International Journal of Research in Engineering, Science and Management
Volume-2, Issue-5, May-2019
www.ijresm.com | ISSN (Online): 2581-5792

Stock Market Prediction Using Artificial Neural Network (ANN)

Rakesh Prabhu[1], Viraj Vanatwala[2], Swapnil Mungi[3], Amaan Nawab[4]
[1,2,3,4]*Student, Department of Computer Engineering, Sinhgad Academy of Engineering, Pune, India*

***Abstract*: Stock market prediction has been one of the popular topics in financial domain. Prior to the advancement in machine learning and artificial intelligence, many statistical models were employed. Even though these models gave almost accurate results but using these models was not efficient and time consuming because of the market's rapidly changing behavior. Due to the advancement in machine learning and artificial intelligence it has become possible to employ different models like neural networks, regression, decision tree, bayesian networks etc. which gives us results as accurate results as statistical models if not better in a very short amount of time. In this paper, we are going to make use of artificial neural network (ANN) model with backpropagation to forecast stock prices. Technical indicators that we are going to use in the project to forecast stock values are - trading data viz. open, close, high, low, oil rates, bank interest rates, foreign exchange rates and gold rates.**

***Keywords*: Stock market, Artificial Neural Network(ANN), backpropagation**

1. Introduction

Stock markets are institutions where people can buy(invest) and sell stocks of a company i.e. giving them a fractional part of ownership of that particular company with the help of stock brokers who help investors in buying and selling the stocks. Stock market plays a crucial role in economic development of a developing country like India. Stock market and a country's economic development are tight bounded with the way stock market performs. Stock market is highly dynamic in nature i.e the stock market prices vary within minutes or even seconds which has discouraged people in stock market investment which directly affects the country's growth. Due to this very reason to create confidence among the population and increase the number of investors stock market prediction can play an important role.

Different data mining techniques are used these days to predict future trends and behaviors. These data mining techniques find useful patterns in the database or data set which is difficult for humans to comprehend in a very efficient way. These patterns are then processed further to make predictions. Artificial Neural Network(ANN) is one such data mining technique that can be employed to make predictions over stock market data. As we know, stock market data is highly unpredictive and nonlinear in nature, ANN is the best model that has the capability to process the nonlinear data. Due to this reason in this paper we are going to use ANN with backpropagation. Backpropagation is a machine learning algorithm which was developed in 1960s. It is used to calculate the error generated in ANN while mapping set of inputs to their correct output and backpropagating the error generated to make appropriate changes in weights of ANN used.

2. Literature survey

In [1] Hulbert White used feed forward neural network to forecast closing values of IBM. He used the model with one input layer, one hidden layer, one output layer. 5000 days of data was used of which 1000 were used to train the model and 4000 to test the model.

In [2] Manna Majumdar and MD Anwar Hussain attempted to find optimal ANN model to forecast the trend in the indices of CNX SP Nifty 50. They found out that an ANN model with 10 neurons at input layer, 5 neurons at hidden layer and one neuron at output layer was the optimal combinations of neurons in 3 different layers. Also a tan sigmoid and linear activation function was used for the neurons at hidden and o/p layer. The input data used for the model is the closing values of the index from 1st January 2000 to 31st December 2009. Out of 10 years of data 4 years of data was used for training and remaining 6 years for testing. They achieved best accuracy of 89.65 percent.

In [3] they used a method to predict the closing price of the next day using Hidden Markov Model. Stocks of TATA Steel, Apple Inc., IBM Corporation and Dell Inc. were considered. Open, close, high and low were the parameters they used. The model was first trained for a period of 7 months. The model was tested using MAPE values.

In [4] the authors predicted stock price using feed forward Neural Network. They considered stocks of Microsoft Corp. of the year 2011. Open, close, high, low, adjacent close, volume were the parameters that they used in their project. Close value of next day was predicted using backpropagation with multilayer feed forward NN. Mean squared error(MSE) was used to check the accuracy of the proposed system. In [5], the authors employed Artificial Neural Network using back propagation strategy to predict Stock Exchange of Thailand indices. Parameters used were SET index, Dow Jones index (NY), Strait Times index (Singapore), Nikkei Index (Japan), Hang Seng Index (HK), MLR, gold prices. Data used for the experiment had the duration from 2 July 2004 to 30 December

2004. Among 152 days, 124 days of data was used for training and 71 days of data was used for testing. They used mean squared error (MSE) and mean absolute percentage error (MAPE) for measuring error in prediction. The authors compared Adaptive evolutionary strategies with ANN having back-propagation using MSE and MAPE. The MSE and MAPE values for ANN were 243.68 and 1.96 percent respectively. The MAPE value for Adoptive ES was 2.46 percent.

In [6] The authors of the paper presented a neural network model for technical analysis of stock market, and its application to buying and selling timing prediction system for stock index. They considered Tokyo stock exchange data for forecast buying and selling signals with an overall forecasting rate of 63 percent by using ANN.

In [7], the authors employed artificial neural network using back-propagation strategy to adjust weights in the Neural Networks. The main objective of the project was to forecast the trends in 100 indices of Istanbul Stock Exchange. In the model, they used 50 input nodes, one hidden layer and one output layer. Activation for hidden layer and output layer nodes used was linear activation function. Calculation of error in prediction of closing value was done using mean squared error. Accuracy of 74.51 percent was achieved by the model.

3. Artificial neural network

The development of neural network is inspired from human nervous system. A human nervous system is composed of billions of neurons connected to one another. A neuron has a tree like structure which consists of dendrites, soma, axon, nucleus. The dendrites are situated at the top of the neuron/cell body near nucleus and also at the bottom of the neuron/cell body as shown in fig. 1. These dendrites are responsible for the communication between neurons. These neurons carry electrical impulses triggered by some events in the external environment. These electrical impulses can be thought of as some kind of information from the surrounding. The neurons communicate with the other neurons in contact and transmit these impulses through synapses present at the tip of dendrites as shown in fig.1. When the electrical impulses are transmitted at the synapse of the receiving neuron, the receiving neuron will activate and transmit the impulses/signals to other neurons in contact only if it receives signal greater than the threshold for its activation. Threshold for each neuron is different. The moment a neuron activates is when we say the neuron has fired. In technical terms, each neuron is called nodes and the connection between two neurons through dendrites is called as a link. This was the basic idea behind the development of artificial neural network.

In [8] the authors enhanced k- means clustering with genetic algorithm. Historical trading data of Egypt Stock Exchange (EGX 30) was utilized in the paper for prediction of the stock indices. In this paper authors attempted to predict the amount of sellers, holders and buyers of the stock. They also compared the individual performances of genetic algorithm and k- means clustering. It is observed that the prediction accuracy of k-means clustering with genetic algorithm is more than the individual algorithms. The prediction accuracy of genetic algorithm was found out to be 82.3 percent, accuracy of k-means was 83.5 percent and that of k-means with genetic algorithm was 89 percent.

In [9], the authors employed artificial neural network with back-propagation strategy. The aim of their project was to compare the performances of two trading strategies buy and hold, buy and sell. The data was taken from Shanghai Composite Index from June 1995 to June 2003. Study showed that buy and sell strategy was better than buy and hold strategy. Average accuracy of 56.3 percent over 30 days was achieved

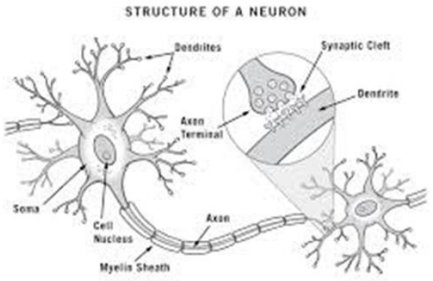

Fig. 1. Biological neuron [10]

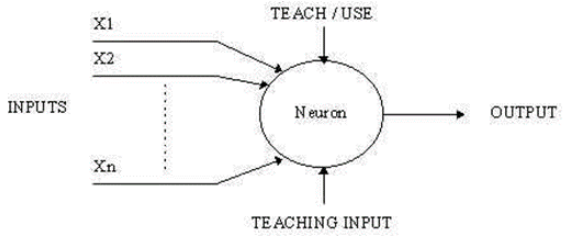

Fig. 2. Artificial neuron model

An Artificial Neural Network(ANN) is a layered network of several computational nodes interconnected to every other node present in the neighbouring layers as shown in Fig. 3. Basically, it is a model which helps to process highly nonlinear data and find patterns which is impossible for a human mind to comprehend. An artificial neural network has at least three layers input layer, hidden layer, output layer. A model can have more than one hidden layer. Each layer can have as many computational nodes as required for the model. A node in an ANN looks like as depicted in fig. 2 which contains an activation/transfer function which is responsible for the nodes to fire up. It also has many incoming connection links as shown in fig. 2 which have some weights associated with each link. The weighted sum of the inputs from previous nodes serve as input to the current node. This input is processed by the activation function present at the current node and activates the node if output of the function is greater than the threshold. Once the current node fires up or activates it sends the output to all the nodes connected to it in the next adjacent layer as input.

Each node does computation except for the nodes present at input layer. The only responsibility of the nodes present at input layer is to get the observed data and pass it on to the nodes present in the first hidden layer. The no. of nodes in input layer is equal to the no. of parameters used for data analysis or prediction.

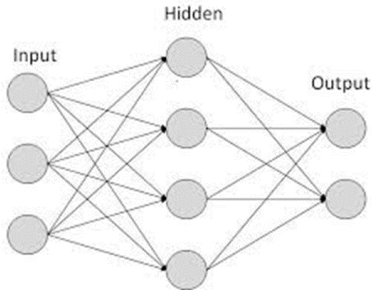

Fig. 3. Multilayer feedforward artificial neural network

4. Implementation

Firstly, we take the input data that is the stock indicators namely high, low, open, close prices for a particular company. We have also considered some additional parameters such as OBV, VPT, Gold prices and Foreign Exchange Rates for the high accuracy of the prediction. The data of almost 20 years of history of a particular organization has been considered for training, validation and testing. Secondly, the data is given as an input to the artificial neural network to train the model so that it can predict the closing value of stock prices of the future for a particular organization. Weighted linear combination of all inputs is given to each and every node to its successive layer. Then the weighted sum is calculated for each and every node. It is formulated as:

$$W=w1x1+w2x2+w3x3+\ldots+wnxn$$

Where,
W=Weighted sum
w=weight of each node
x=input on the particular node
n=no. of nodes

Then the weighted sum goes to the Activation Function which activates the node that is it sees whether the value is to be passed on to the next layer or not. In our case we have used ReLu as an Activation function. Then, the activation function decides whether a particular node is to be fired or not. Similarly, the data is processed on each and every node of the hidden layer as well and it is propagated to the next layer to give us some output on the output layer. Then the predicted output is compared by the desired output and then the error is calculated and is backpropogated by using backpropagation algorithm. Then the back propagating algorithm updates the weights connected to each node in such a way that the error is minimized and the predicted output is very close to the desired output. So for the backpropagation, Adams Algorithm is used in this case.

Table 1
Close price

	MAE	MAPE
Training score	1.181	1.648
Testing score	3.08	1.18

Table 2
High price

	MAE	MAPE
Training score	0.92	1.41
Testing score	2.49	0.93

Table
Low price

	MAE	MAPE
Training score	1.03	1.52
Testing score	2.53	0.98

1) Initialize no. of epochs(n),batch size(b), M = 0,V=0. 2) Sample d from D such that the size of d = b.

3) Compute the gradient descent for d by calculative partial derivative of the loss function with respect to weight and bias using backpropagation algorithm.

4) M = B1*M + (1-B1)*gradient. 5) V = V*B2 + (1-B2)*gradient2 6) Update weights and biases:

w = w + learning_rate * M * (V1/2 + e)-1/2 b = b + learning_rate * M * (V1/2 + e)-1/2

7) Repeat from step 3 to 6 b no. of times. 8) Repeat from step 3 to 7 n no. of times.

Adam's Algorithm:

1) Initialize no. of epochs(n),batch size(b), M = 0,V=0.
2) Sample d from D such that the size of d = b.
3) Compute the gradient descent for d by calculative partial derivative of the loss function with respect to weight and bias using backpropagation algorithm.
4) M = B1*M + (1-B1)*gradient.
5) V = V*B2 + (1-B2)*gradient2
6) Update weights and biases:
   $w = w + learning\_rate * M * (V^{1/2} + e)^{-1/2}$
   $b = b + learning\_rate * M * (V^{1/2} + e)^{-1/2}$
7) Repeat from step 3 to 6 b no. of times. 8) Repeat from step 3 to 7 n no. of times.

B1, B2,e,n,b,learning_rate are all hyper parameters.

So this is how the error is minimized and the model is trained. Now the testing is done by taking in account the unknown values of the input parameters and the predicted output is calculated which will be more accurate and efficient.

5. Results

After training the model and validating it the accuracy of the

model is calculated by Mean-Absolute-Error (MAE) and Mean-Absolute-Percentage-Error (MAPE). It is observed that the predicted close price value is 98.32 percent on training data and 98.82 percent on testing data.

The training and testing scores for High, Low, Close are observed as shown in Tables.

6. Conclusion

Stock Market Prediction is a very tedious process due to the uncertainties of some parameters that affect the stock market directly or indirectly. Here, we have considered various different parameters which affect the stock market directly which has immensely helped us in predicting the stock market trend for various organizations. The method that we have used gives a very high accuracy, that is, it predicts the value very close to what the actual value is supposed to be.

As it can be seen by the observations that the accuracy of the model is very high which shows that there is a huge scope for using Artificial Neural Network for predicting the future stock market trends in the future.

Lastly and most importantly, the progress of this approach opens a way for the creation of better suited market indicators.

References

[1] H. White, “Economic prediction using neural network: The case of IBM daily stock returns”, IEEE International Conference on Neural Network.
[2] M. Majumdar and A. Hussain, “Forecasting Indian Stock Market Index using Artificial neural network.”
[3] Aditya Gupta and Bhuwan Dhingra, “Stock market prediction using Hidden Markov Model.”, IEEE 2012.
[4] Kumar Abhishek and Anshul Khairwa, Tej Pratap and Surya Prakash, “A stock market prediction model using artificial neural network,” ICCCNT12, 26th 28th July 2012, Coimbatore, India.
[5] P. Sutheebanjard, and W. Premchaiswadi, “Stock Exchange of Thailand Index Prediction Using Back Propagation Neural Networks,” AAMJAF, Vol. 6, No. 2, 85114, 2010.
[6] H. Mizono, M. Kosaka, H. Yajma, and N. Komoda, “Application of Neural Network to Technical Anaysis of Stock Market Prediction”, Studies in Informatics and Control, 1998, Vol.7, No.3, pp.1l1-120.
[7] B. Yildiz, A. Yalama, and M. Coskum, “Forecasting the Istanbul stock exchange national 100 index using an artificial neural network,” Proc. World Academy of Science, Engineering and Technology, vol. 36, 2008.
[8] Eslam Nader Desokey, Amr Badr, Abdel Fatah Hegazy, “Enhancing Stock Market Prediction using k-means clustering with genetic algorithm,” IEEE 2017.
[9] D. Zhang, Q. Jiang, “Application of neural networks in financial data mining,” Proceedings of International Conference on Computational Intelligence, pp. 392-395, 2004.
[10] browardschools.instructure.com/courses/58892/assignments/295231
[11] www.doc.ic.ac.uk/nd/surprise96=journal=vol4=cs11:htm
[12] www.tutorialspoint.com/artificialintelligence