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Performance Analysis of Stock Market Using Artificial Neural Network

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Abstract

Stock market is one of the most vital components of a free-market economy, as it provides companies with access to capital in exchange for giving investors a slice of ownership in the company. The successful prediction of a stock's future price could yield significant profit. Many methods like technical analysis, fundamental analysis, time series analysis and statistical analysis etc are all used to predict the price in the share market but none of these methods are proved as an efficient tool. Artificial Neural Network (ANN), a field of Artificial Intelligence (AI), is a popular way to identify unknown and hidden patterns in data which is suitable for share market prediction[2]. In this paper we present a very brief description of Back propagation algorithm and Least Mean Square algorithm to predict share market prices. Model comparison is performed on the basis of the results observed during these experiments. Here we have used data set of Microsoft Corporation from January 1, 2011 to December 31, 2011 [7] for training and prediction. Considered input parameters for prediction are open, high, low, adj. close and volume. Back propagation algorithm is used for training and for learning we used different functions that are named in later section. Comparison represents the effect on performance while altering number of levels and number of neurons in given layer.

Keywords: Stock Market, Back propagation, Least Mean Square, Artificial Neural Network.

1.Introduction

A stock market or equity market is the aggregation of buyers and sellers where shares are bought and sold at prices governed by the forces of demand and supply. Stock market also known as stock exchange is a particular market place where authorized

brokers come together daily (i.e. on working days) on the floor of market and conduct trading activities. London Stock Exchange(LSE) is the oldest one in the world. Stock market prediction is a process of predicting the future value of a stock which is based on past values .According to efficient-market hypothesis (EMH) asserts that financial markets are "information ally efficient". EMH states that stock prices follow a random walk process[1].

1.1. Prediction Methods

Prediction methodologies fall into three broad categories such as fundamental analysis, technical analysis and technological methods.

Fundamental Analysis

Fundamental analysis uses financial and economic analysis to forecast the movement of share prices. Fundamental Analysts are concerned with the company profits. They evaluate a company's past performance as well as the credibility of its accounts. To a fundamentalist, the market price of a stock tends to move towards it's intrinsic value. If the intrinsic value of a stock is above the current market price, the investor would buy the stock. Otherwise would sell the stock

Technical Analysis:

Technical analysts are concerned with determinining the future price of a stock based solely on the trends of the past price in form of a time series . Numerous patterns are used such as the head and shoulders or cup and saucer. Statistical techniques are also used such as the exponential moving average (EMA). Candle stick patterns are believed to be first developed by Japanese rice merchants, and nowadays widely used by technical analysts.

Technological Methods

Stock market prediction has moved into the technological realm. The most prominent technique involves the use of artificial neural networks (ANNs) and Genetic Algorithms. ANNs can be thought of as mathematical function approximations. The use of ANN simulates how human brain functions, by feeding computers with massive data to mimic human thinking. The most common form of ANN in use for stock market prediction is the feed forward network utilizing the backward propagation of errors algorithm.

2.Artificial Neural Network

2.1.Artificial Neural Network In Prediction

A neural network is a processing device which resembles the human brain.ANN has the ability to learn by example which are very much suited for real-time systems because of their fast response and computation speed. An ANN is composed of a large number of highly interconnected processing elements called neurons .A number of inputs are feed into the system and the activation function is applied over the net

input. There exists four basic types of neuron architectures such as single layer and multilayer neural network ,single node with its own feedback and recurrent network.

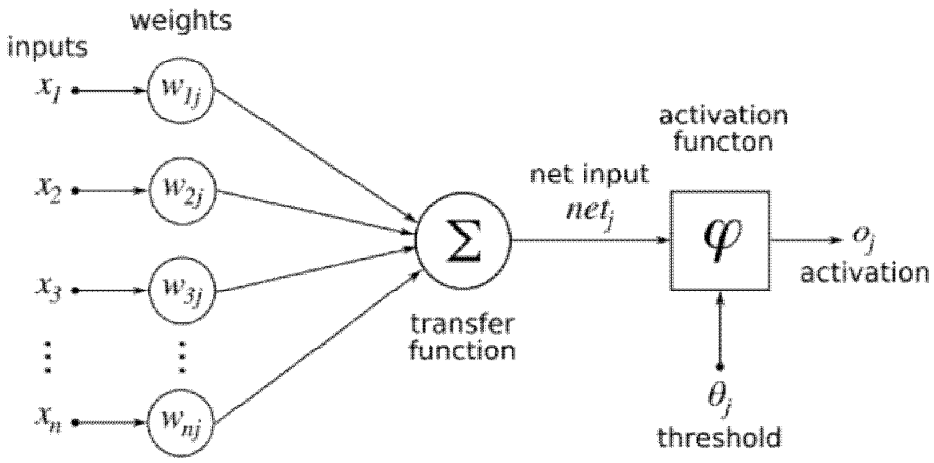

Figure 1: Artificial Neuron Structure

3.Working Model-1

3.1Back Propagation Model

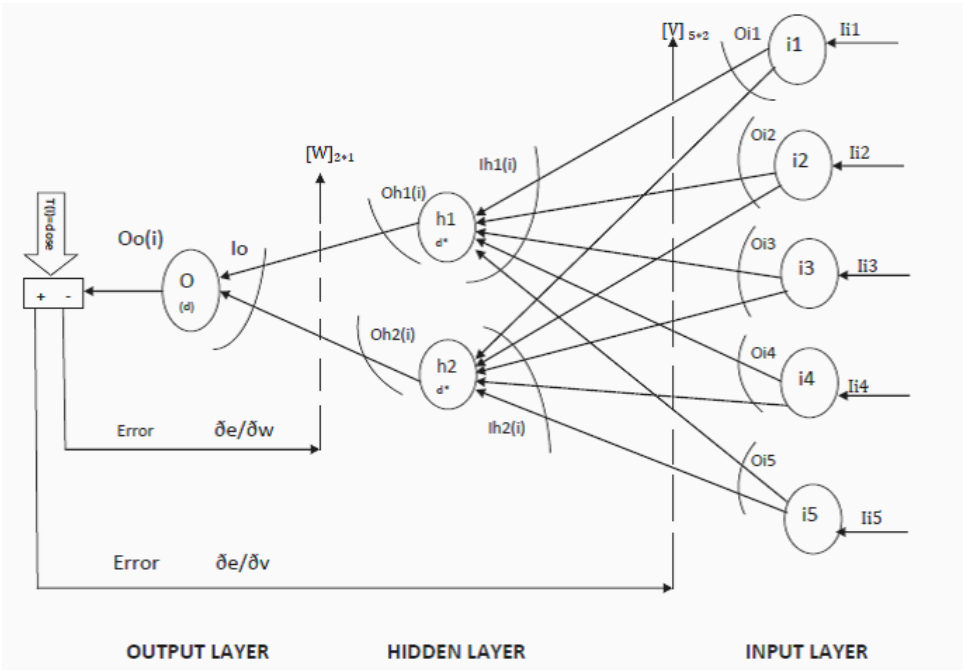

Figure 2: Back propagation structure

Input Layer I(i)=[Open(i),Low(i),High(i),Vol(i),WAP(i)]

Back-propagation algorithm is basically the process of back-propagating the errors from the output layers towards the input layer during training sessions [3][4]. Back-propagation is necessary because the hidden units have no target values which can be used, so these units must be trained based on errors from the previous layers. The output layer has a target value which is used to compare with calculated value. As the errors are back propagated through the nodes, the connection weights are continuously updated. Training will occur until the errors in the weights are adequately small to be accepted. On the other hand the computational complexity of Back propagation Algorithm is only O(n)[5][6][7]. These features of the algorithm are the main criteria for predicting share prices accurately. The main steps using the Back propagation algorithm as follows:

Step 1: Feed the input data set and find the desired output;

Step 2: Find the error between the desired output and the actual target;

Step 3: Accordingly the connection weights are adjusted;

Step 4: IF error > tolerance THEN go to Step 1 ELSE stop.

4.Working Model-2

4.1Least Mean Square Model

Artificial neural networks is that technology which initially grew from the full understanding of some ideas and aspects about how biological systems work, especially the human brain. A multi-layered network consists of numerous neurons, which are arranged into levels. Each level is interconnected with the one above and below it. The first layer receives external inputs and is aptly named the input layer .The last layer provides the classification solution, and is called the output layer. Sandwiched between the input and output layers are any number of hidden layers[8][9][10].

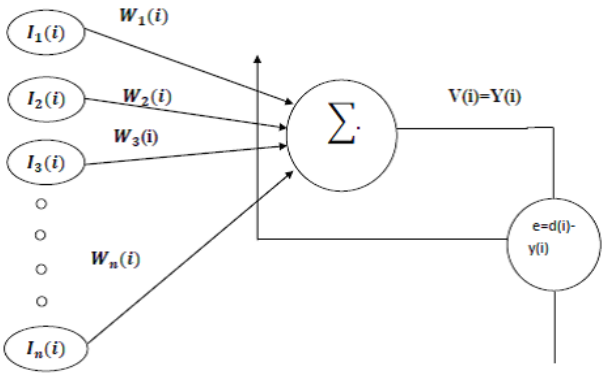

Figure 3: Least Mean Square structure

As it is a linear model the summation of inputs to the neurons is the output. After getting the output we compare it with the desired output and the error is calculated using the formula error=desired output-predicted output and the network is trained using the weight updating formula i.e. delw=eta*e(i)*I(i).

5.Simulation and Performance Analysis

By using the past historical data of company ITC LTD. We have included 5 inputs to both the working models.

The input historical data is from 1-01-2012 to 30-11-2012 .At first step we have normalized the input data .We has tried to predict the closing price of share market using both the models. Table 1 shows the comparison between the two working models. At first the Mean Square Error (MSE) was 0.00020 when we have used 2 hidden neurons in case of back propagation but the increase in hidden neuron shows a decrement in the MSE value. The Mean Square Error in case of LMS is found to be 0.000184.

Table1: Comparison between the two models in terms of MSE

MODEL	EPOCH	MSE	TOLERANCE
BBP(5,2,1)	5000	0.00020	0.0001
BBP(5,3,1)	5000	0.000198	0.0001
LMS	1000	0.000184	0.0001

Figure4 shows the actual versus predicted graph of stock prices using BPP (5,3,1) model after simulation and Figure 5 shows the actual versus predicted graph of stock prices using LMS algorithm after simulation.

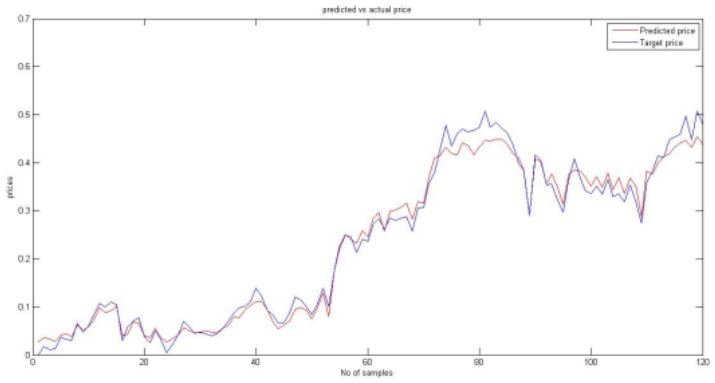

Figure 4: Graphical representation of predicted vs. actual price using BPP model

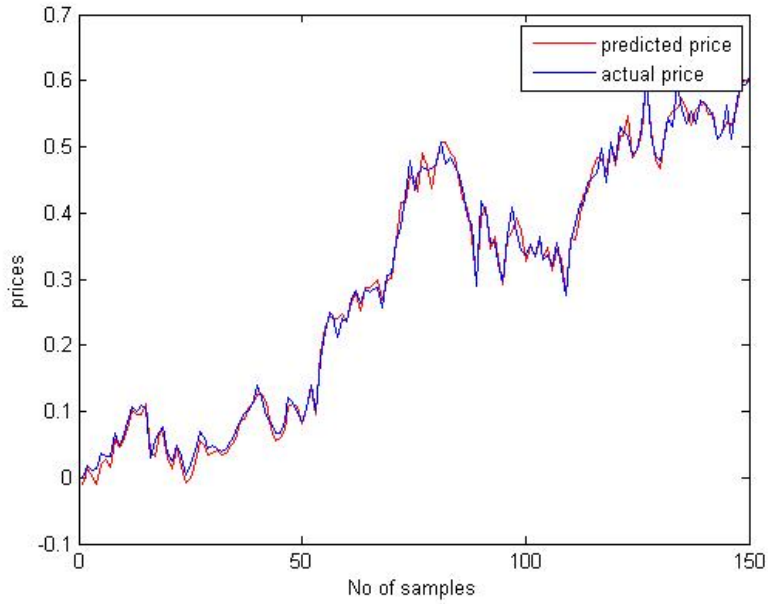

Figure 5: Graphical representation of predicted vs. actual price using LMS model

6.Observation

1. We observed that while using 2 hidden neurons in hidden layer for prediction in case of BPP model the mean square error is more but by increasing the number hidden neurons the mean square error converges more quickly.
2. We have taken the data of share market in sequential date so that we can predict the price nearer to the actual price. Discontinuous dates don't help to predict prices more efficiently.
3. We have increased the epoch from 100 to 1000 in case of LMS to converge the error and from 100 to 5000 in case of BPP. Increase of no. of iterations helps to find out a better graph.

7.Conclusion

From the above experimental results we conclude that Least Mean Square Method for stock prediction is considered to be most accurate for the data sets we have used in comparison to BPP. For future work we will use these data sets and put them in FLANN model to see if the prediction is more efficient because LMS and FLANN both uses linear neuronal model. In this model, each component of the input vector is subjected to a functional expansion to yield the enhanced representation of the original pattern.

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