



## Stock Market Prediction Using Artificial Neural Network

**Prakash Ramani**

Department of Computer Science & Engineering  
Global Institute of Technology, Jaipur.  
Rajasthan Technical University, Kota, India.

**Dr. P.D. Murarka**

Department of Computer Science & Engineering  
Arya College of Engineering and IT  
Rajasthan Technical University, Kota, India.

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**Abstract**—Predicting anything is very hard specially if the relationship between the inputs and outputs are non-linear in nature and stock price prediction is one of such item. In this paper we have proposed a stock price prediction model using multi-layer feed forward Artificial Neural Network (ANN). In this model we have used backpropagation algorithm. As the closing price of any stock already covers other attributes of the company, we have used historical stock prices (closing) for training the network.

**Keywords**— Artificial Neural Network, Neurons, backpropagation Algorithm, Transfer Function , Network Performance, Mean Square Error

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### I. INTRODUCTION

Forecasting has long been in the domain of linear statistics. Linear models have the advantage that they can be easily understood and analysed in great detail and they are easy to explain and implement. However, they may be totally inappropriate if the underlying system is nonlinear as is the case with most of the natural real world systems and stock market is one of them. Hence, I have chosen Artificial Neural Network (ANN), a machine learning approach which can handle nonlinear data, to forecast the price of a stock [1]. A network can be defined as a set of interconnected nodes. A node can be viewed as a computational unit which receives inputs and after processing produces output. The connections between the nodes determine the flow of information between them. The nodes can be unidirectional or bidirectional. Unidirectional means that the information can flow only in one direction and bidirectional means that the information can flow in both the directions. So a neural network means a network consisting of neurons and a neuron can be artificial or natural. If the neurons are artificial the network is termed as Artificial Neural Network. Artificial Neural Network is inspired by the way a biological nervous system such as the brain processes information. A biological system works to solve a problem by the process of learning and so is ANN. Learning in biological system involves adjustments to the synaptic connections that exist between the neurons and learning in ANN involves adjustments in the weights of the connections that exist between neurons [2].

A Multilayer Feedforward Neural Network consists of input layer, one or more hidden layers and an output layer. Inputs correspond to the attributes measured for each training sample. Inputs are fed simultaneously to a layer of units called input layer. The weighted outputs of these units are, in turn, fed simultaneously to the next layer of units making up the hidden layer. The hidden layers weighted outputs act as an input to another hidden layer and so on. The number of hidden layers is a design issue and is arbitrary. The weighted output of the last hidden layer acts as inputs to the units in the last layer called output layer, which emits the networks prediction for given samples [3][4].

Backpropagation is a neural network learning algorithm. Backpropagation learns by repeatedly processing the set of samples and comparing the networks prediction for each with the actual output. If the error between the actual output and the predicted value exceeds a threshold value then the weights of the connections (between the neurons or nodes) are modified so as to reduce the mean square error between the predicted and actual value. The modifications in the weights are done in the opposite direction i.e. from the output layer through each hidden layer down to the first hidden layer. Because the modifications in the weights of the connections are done in the backwards direction so the name given to the algorithm is Backpropagation[5].

### II. METHODOLOGY

We have used Multilayer Feedforward Neural Network and such types of networks consist of input layer , one or more hidden layers and an output layer. This paper uses one input layer, one hidden layer and one output layer for stock price prediction. The model was generated in five steps :

- a) Data Collection
- b) Data pre-processing
- c) Neural Network Creation and Training
- d) Network Validation
- e) Using the Network [9]

#### *A. Data Collection*

In order to train, validate and test the neural network, data is required and we collected five years' historical data of various companies (IT and non-IT) from yahoo finance [7].

#### *B. Data pre-processing*

The data must be prepared such that it covers the range of inputs for which the network is going to be used. Since the performance and reliability of the output from the neural network mainly depends on the quality of the data, therefore, the data must be pre-processed before it is fed to a neural network. First of all, we applied attribute relevance analysis on data so as to remove unwanted attributes from data and then the data was normalized in the range -1 to 1 using min-max normalization technique. Since the input is in the normalized form, the output we get is also in the normalized form and hence, it must be denormalized so as to have actual value. In order to train the network, we divided the data into three subsets [6] :

**Training Data Set:** This data set was used to train the network. The gradient was computed and biases and the weights of the connections between the neurons were adjusted accordingly.

**Validation Data Set:** This data was used to save the weights and biases at the minimum error and to avoid network over fitting data.

**Testing Data Set :** This data set was used to test the performance of the network.

#### *C. Neural Network Creation and Training*

In this step neural network was created with two layers one hidden layer and one output layer .Of course, input layer is essential. Artificial Neural Networks depend on the following parameters [8]:

- Number of layers
- Number of neurons in input layer
- Number of neurons in hidden layer
- Momentum
- Learning rate
- Number of training iterations that are required to obtain the best result
- Transfer function used for hidden and output layer
- Training algorithm used
- Learning function used.

The network was created with some initial values of above mentioned network parameters. Then, these parameters were varied and the results were observed. The network was trained using backpropagation algorithm with the aim to improve the network performance i.e. to reduce mean square error (mse). In this algorithm , the network is trained by repeatedly processing the training data set and comparing the network output with the actual output and reducing the error to the minimum possible. If the error between network output and the actual falls below the threshold value, then the training stops otherwise weights of the connections between various neurons are modified so as to reduce 'mse'. The modifications are done in the opposite direction i.e. from output layer through each hidden layer down to the first hidden layer. Since the modifications in the weights of the connections are done in the backward direction so the name given is backpropagation [6].

Transfer functions calculate layer's output from its net input. Hyperbolic tangent sigmoid transfer function and Log-sigmoid transfer function can be used for hidden layer and output layer. We have used Log-sigmoid transfer function for hidden layer as well as output layer.

#### *D. Network Validation*

After training the network, it was validated using validation data so as to improve the network performance.

#### *E. Using the Network*

After validating the network, it was tested using the test data set. The testing was performed on ten different companies (IT and non IT) and 100 tests were performed for each company.

### **III. EXPERIMENTAL RESULTS**

The testing was performed on ten different companies and results obtained were quite satisfactory. We are showing the chart depicting the 100 days actual versus predicted stock price of five companies. It can be seen from the chart that the prediction accuracy is quite good and that too in diversified categories of companies.

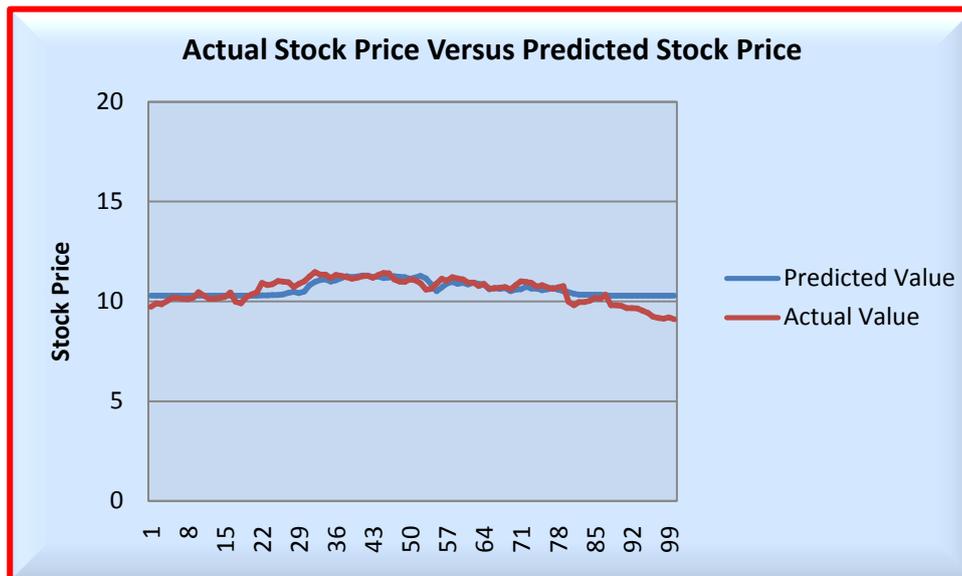


Fig. 1: Chart Showing Actual Stock Price and Predicted Stock Price: IT Company

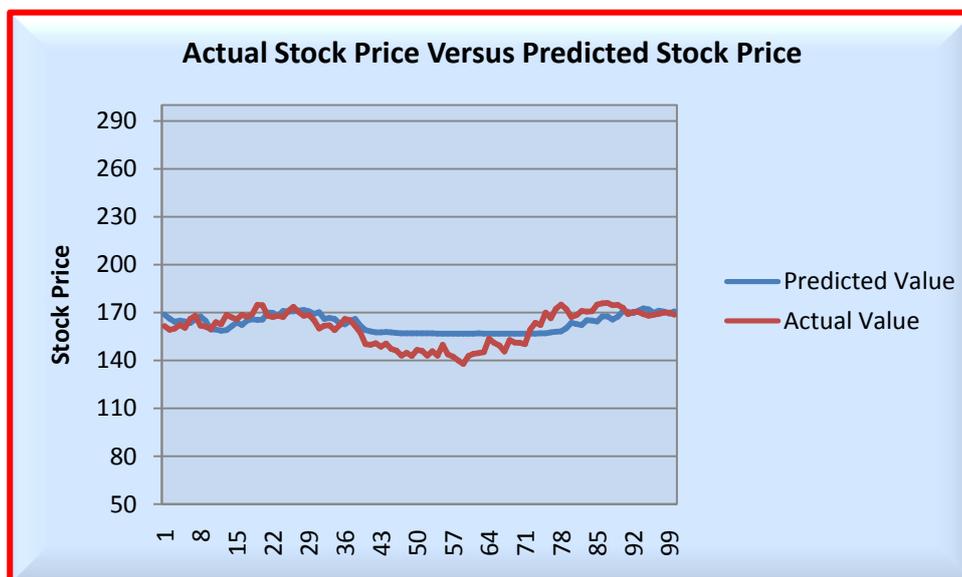


Fig. 2: Chart Showing Actual Stock Price and Predicted Stock Price: Cement Company

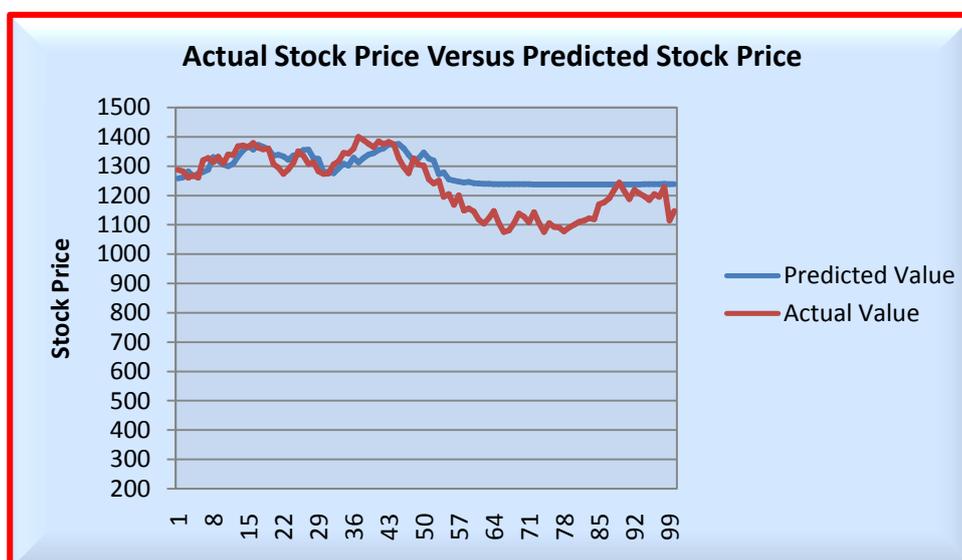


Fig. 3: Chart Showing Actual Stock Price and Predicted Stock Price: Automobile Company

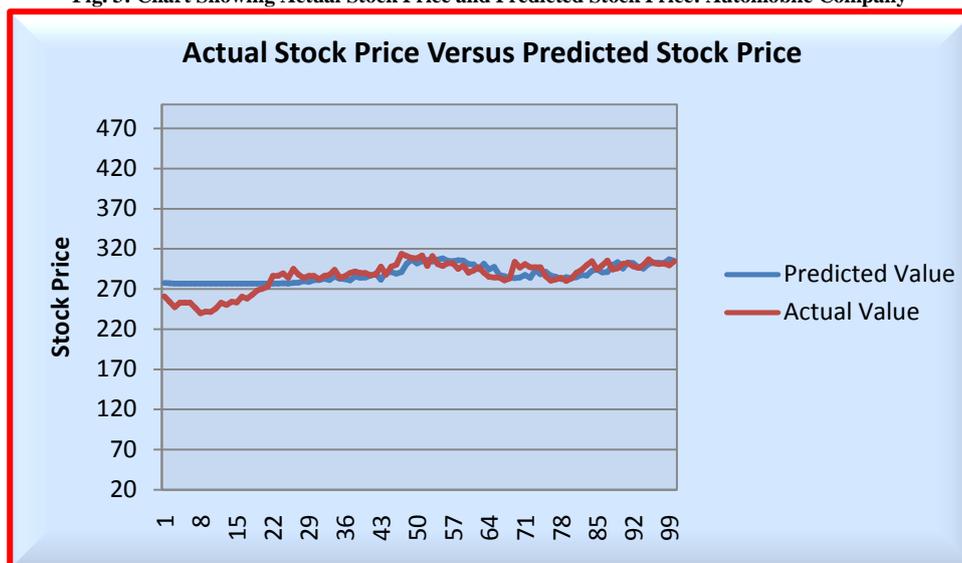


Fig. 4: Chart Showing Actual Stock Price and Predicted Stock Price: Oil Company

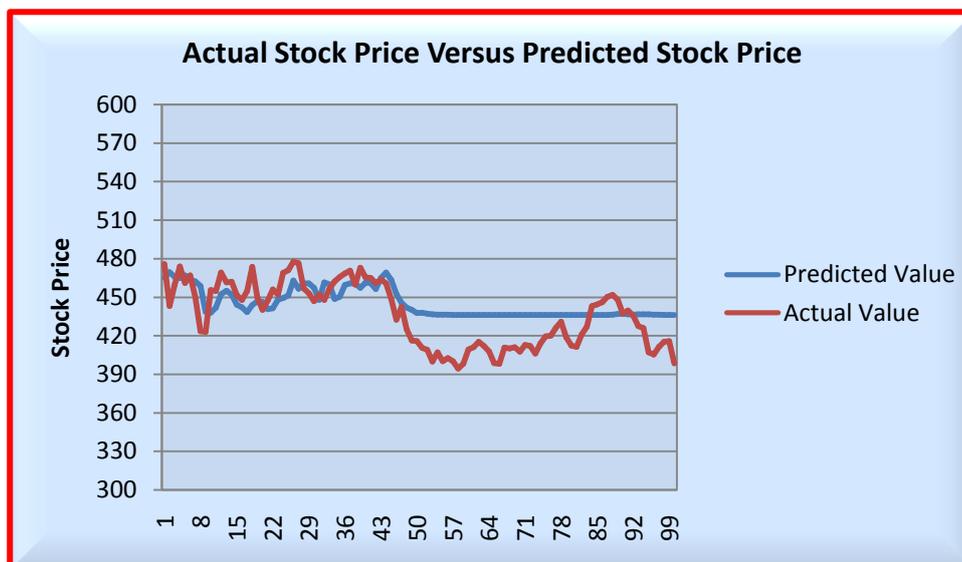


Fig. 5: Chart Showing Actual Stock Price and Predicted Stock Price: Steel Company

#### IV. CONCLUSIONS

On the basis of above charts, we can say that ANN-based systems perform quite well as the prediction accuracy is quite satisfactory. Although, there are possibilities for improvement but we can say that Feed forward network using Back Propagation is quite reasonable for stock price prediction.

This system is still at a preliminary stage and many of the parameters which affect ANN have not been fully explored. However, this simple ANN-based model has provided an insight into the design of a successful ANN-based prediction model.

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