# Neural Network Based Forecasting Of The Monthly Closing Returns Of Nifty

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**Abstract**

Stock price prediction is one of the hot areas in neural network application. One critical step in neural network application is network training. In this paper, we showed a method to forecast the stock index value using neural networks. Predicting the stock market is very difficult since it depends on several known and unknown factors. In recent years, one of the techniques that have been used popularly in this area is artificial neural network. The power of neural network is its ability to model a nonlinear process without a priori knowledge about the nature of the process. The objective of this study is to find out the effect on Closing Return of NIFTY of Industrial Production, Wholesale Price Index, Exchange Rate, and Net Investment by FIIs, Export, Import, and Money Supply by using Neural Network. The data for the study comprises the monthly stock returns of NIFTY, Industrial Production, Wholesale Price Index, Exchange Rate, Net Investment by FIIs, Export, Import, Money Supply. The accuracy measure of prediction is defined in terms of the forecasting error, which is the difference between the actual and predicted value. Experiments illustrate a varying degree of pridictability of the monthly stock returns.

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**Keywords**: Mean Square Error, Sum of Square Error, Mean Absolute Error, Root Mean Squared Error, and Mean Absolute Percentage Error, Wholesale Price Index, Industrial Production.

## 1. Introduction

A Neural Network is a group of primitive interconnected decision making units that recognizes patterns and is designed to take a pattern of data and generalize from it. An essential feature of this technology is that it improves its performance on a particular task by gradually learning a mapping between inputs and outputs. There are no set rules or sequence of steps to follow in generalizing patterns of data. The network is designed to learn a nonlinear mapping between the input and output data. Generalization is used to predict the possible outcome for a particular task. This process involves two phases known as the training phase (learning) and the testing phase (prediction).

Regression models have been traditionally used to model the changes in the stock markets. Multiple regression analysis is the process of finding the least squares prediction equation, testing the adequacy of the model, and conducting tests about estimating the values of the model parameters, Mendenhall et al. [1]. However, these models can predict linear patterns only. The stock market returns change in a nonlinear pattern such that neural networks are more appropriate to model these changes.

If stock market return fluctuations are affected by their recent historic behavior, Tang [2] neural networks which can model such temporal stock market changes can prove to be better predictors, The changes in a stock market can then be learned better using networks which employ a feedback mechanism to cause sequence learning.

## 2 . Objective Of Study

The objective of this study is to find out that how much the Closing Return of NIFTY are effected by Industrial Production, Wholesale Price Index, Exchange Rate, Net Investment by FIIs, Export, Import, Money Supply by using Neural Network.

## 3. Modeling & Forecasting Of Stock Prices Using Neural Network

In general, the approaches to predict stock market could be classified into two classes, fundamental analysis and technical analysis. Fundamental analysis is based on macroeconomic data and the basic financial status of companies like money supply, interest rate, inflationary rates, dividend yields, earnings yield, cash flow yield, book to market ratio, price-earnings ratio, lagged returns (Fama and French, 1988; Lakonishok, 1994). Technical analysis is based on the rationale that history will repeat itself and that and the correlation between price and volume reveals market behavior. Prediction is made by exploiting implications hidden in past trading activities and by analyzing patterns and trends shown in price and volume charts (Smirlock and Starks, 1985; Brush 1986).

Using neural networks to predict financial markets has been an active research area in both methods, since the late 1980's (White, 1988; Fishman, Barr and Loick, 1991; Shih, 1991; Stein, 1991; Utans and Moody, 1991; Katz, 1992;Kean, 1992; Swales and Yoon, 1992; Wong, 1992; Azoff,1994; Rogers and Vemuri, 1994; Ruggerio, 1994; Baestaens,Van Den Breg and Vaudrey, 1995; Ward and Sherald, 1995; Gately, 1996; Refenes, Abu-Mostafa and Moody, 1996; Murphy, 1999; Qi, 1999; Virili and Reisleben, 2000; Yao and Tan,2001; Pan, 2003a; Pan 2003b). Most of these published works are targeted at US stock markets and other international financial markets. In this article our Prediction is made by exploiting implications hidden in past trading activities and by analyzing patterns and trends shown in monthly stock price and Industrial Production, Wholesale Price Index, Exchange Rate, Net Investment by FIIs, Export, Import, Money Supply Narrow Money, and Money Supply Broad Money.

### Training a Neural Network

To experiment with neural networks, we used NeuralWare, NeuralWorks Predict, (http://www.neuralware.com)which provides the tools to implement and test various configurations of neural networks and learning algorithms.

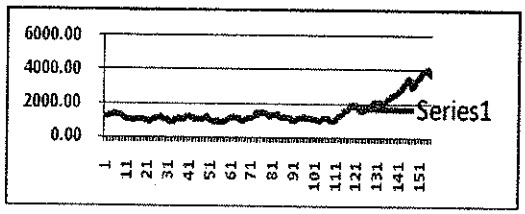
## 4. Data And Methodology

### 4.1 Data Set Used

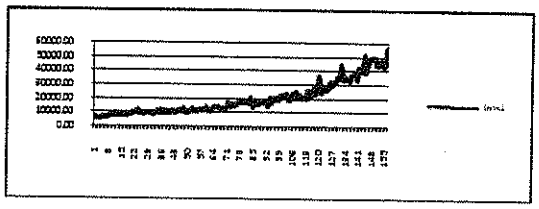
The data is obtained from the RBI site(www.rbi.org.in), NSE site(www.nseindia.com), SEBI site(www.sebi.gov.in). The NIFTY data (closing Nifty Index), Industrial Production, Wholesale Price Index, Exchange Rate, Net Investment by FIIs, Export, Import, Money Supply Narrow Money, Money Supply Broad Money is from April, 1994 to March , 2007. All above data taken monthly basis. The stock market can display varying characteristics for Industrial Production, Wholesale Price Index, Exchange Rate, Net Investment by FIIs, Export, Import, Money Supply. So it is necessary to develop model for predicting monthly stock return of NIFTY. The data for the study comprises the monthly stock returns of NIFTY, monthly Industrial Production, monthly Wholesale Price Index, monthly Exchange Rate, monthly Net Investment by FIIs, monthly Export & Import, monthly Money Supply from April, 1994 to March , 2007 creating a series of 156 observations which were collected from the Reserve Bank of India website (www.rbi.org.in) , NSE site(www.nseindia.com), SEBI site (www.sebi.gov.in).

To build the Neural Network forecasting models monthly data (156 observations) is used to for the measurement of forecasting accuracy. An important first step in the analysis

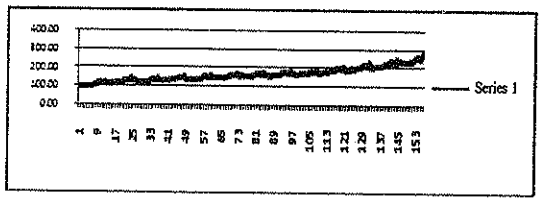
of the data is to determine if the series is stationary, as all other calculations of invariants presume stationary in both linear and nonlinear. A time series is said to be stationary if there is no systematic change in mean (no trend), in variance, and, if so, periodic variations have to be removed. To detect non stationary, the study uses a stationary test, called the unit root test (Augmented Dickey Fuller Test and Philip Perron Test). The null hypothesis tested here is "the series is non-stationary". If the absolute value of the statistic is greater than the critical Value, then the null hypothesis is rejected and hence the series is stationary.



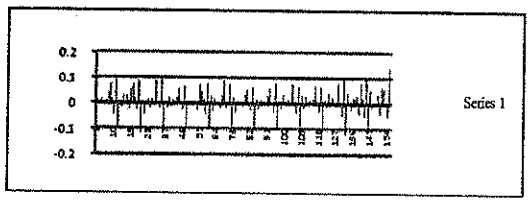

**Monthly stock closing for period April 1994 to March 2007**



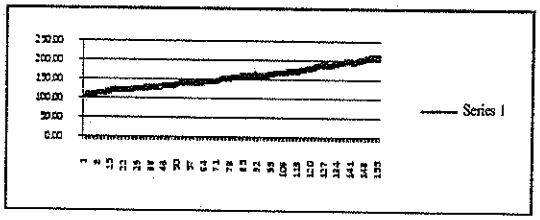
**Monthly Export for period April 1994 to March 2007**



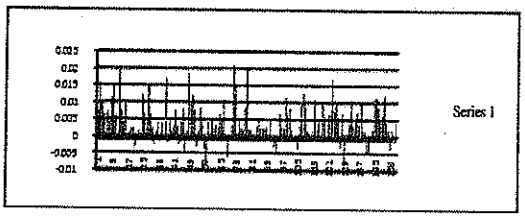

**Monthly Industrial production for period April 1994 to March 2007**



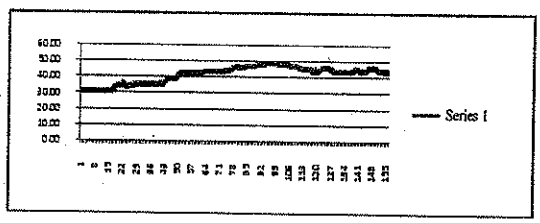

**Monthly Closing alternate series**



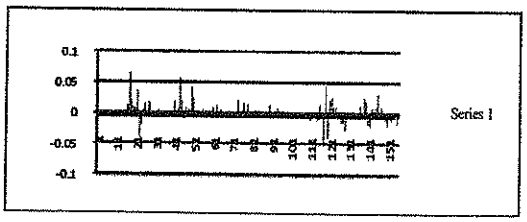

**Monthly Wholesale Price Index for period April 1994 to March 2007**



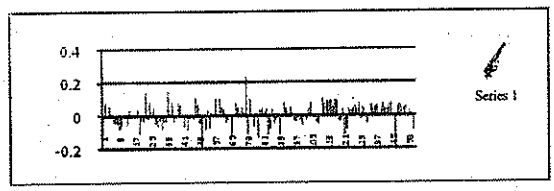

**Monthly Industrial Production alternate series**



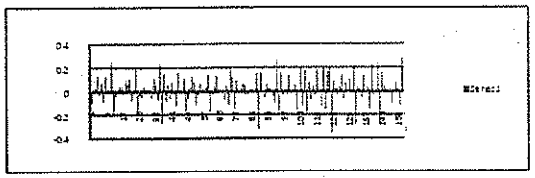

**Monthly Exchange Rate for period April 1994 to March 2007**



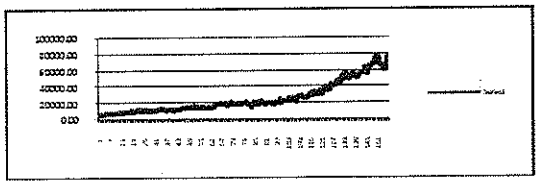

**Wholesale Price Index alternate series**



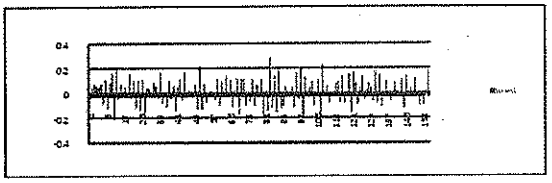

**Monthly import for period April 1994 to March 2007**



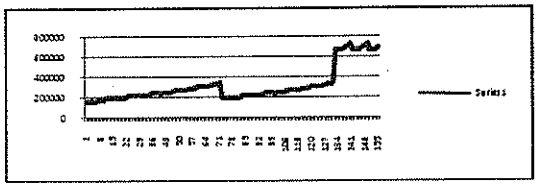
**Exchange rate alternative series**



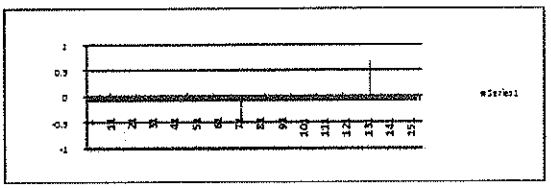
**Export alternate series**



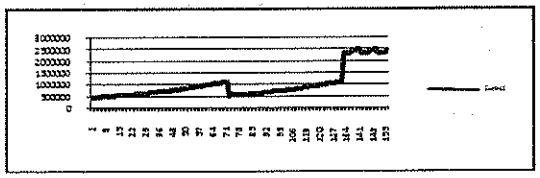
**Monthly Money Supply Broad Money for period April 1994 to March 2007**



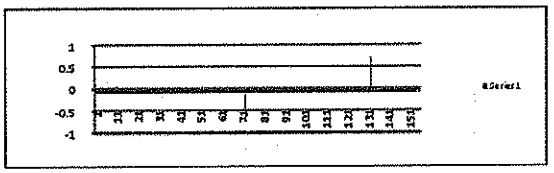
**Import alternate series**



**Money Supply Narrow Money Alternate Series**



**Monthly Money Supply Narrow Money for period April 1994 to March 2007**



**Money Supply Broad Money Alternate Series**

### 4.2 Design Methodology

It is difficult to design a Neural Network Model for a particular forecasting problem. Modeling issues must be considered carefully because it affects the performance of an ANN. One critical factor is to determine the appropriate architecture, that is, the number of layers, number of nodes in each layer. Other network design decisions include the selection of activation functions of the hidden and output nodes, the training algorithm, and performance measures. The design stage involves in this study to determine the input nodes and output nodes, selecting the performance metrics etc.

#### 4.2.1 Input and Output Nodes

The number of input nodes corresponds to the number of variables in the input vector used to forecast future values. The number of input nodes is probably the most critical decision variable for a time series forecasting problem since it contains the important information about the data. However currently there is no suggested systematic way to determine this number. Too few or too many input nodes can affect either the learning or prediction capability of the network. For this study the output is the forecasted monthly stock return. Monthly Closing NIFTY is

taken as dependent variable and Industrial Production, Wholesale Price Index, Exchange Rate, Net Investment by FIIs, Export, Import, Money Supply Narrow Money, Money Supply Broad Money are taken as independent variable.

### 4.2.2 Performance Metrics

The performance of neural network can be measured by numerous metrics. The ultimate and the most important measure of performance is the prediction accuracy it can achieve beyond the training data. An accuracy measure is often defined in terms of the forecasting error, which is the difference between the actual (desired) and predicted value. The study uses five statistics to evaluate and compare the fit and forecasting accuracy of the models of neural network models such as :Mean Square Error(MSE), Sum of Square Error(SSE), Mean Absolute Error(MAE), Root Mean Squared Error(RMSE) , and Mean Absolute Percentage Error(MAPE), The different performance measures used are measured as follows:

1.MAE : The mean absolute error between the actual and the predicted returns.

2.SSE : The sum of square error between the actual and predicted returns.

3.MSE : The mean square error between the actual and predicted returns.

4.RMSE : The root mean square error between the actual and predicted returns is given byRMSE = SQRT(MSE)

5.MAPE: The mean absolute percentage error between the actual and predicted returns.

Traditional measures of forecasting performance based on point forecast error, such as RMSE, MAE and SSE , are not strongly correlated with the profits that may be generated from the forecast using certain trading strategies.

## 5. Results

**Stationarity Test :** The Augmented Dickey Fuller test and Philip Perron Test statistics given in table 1 indicate that the first difference of the logarithmic of the monthly stock closing rates and other dependent variable series are stationary as the absolute value of statistics is greater than the 5% critical value.

**Table 1 : Unit Root Test of Two Series**

| Series | Augmented Dickey Fuller Test | | Philip Perron Test | |
|---|---|---|---|---|
| | Statistic | Critical Value | Statistic | Critical Value |
| Monthly Closing Nifty | -6.003996 | -2.8807 | -10.75355 | -2.8802 |
| Industrial Production | -7.156955 | -2.8807 | -20.88403 | -2.8802 |
| Wholesale Price Index(WIP) | -5.785719 | -2.8807 | -9.353126 | -2.8802 |
| Exchange Rate | -5.787231 | -2.8807 | -11.66870 | -2.8802 |
| FII_Inflow | -3.810648 | -2.8807 | -7.702074 | -2.8801 |
| Export | -8.882446 | -2.8807 | -28.79228 | -2.8802 |
| Import | -7.393810 | -2.8807 | -28.33717 | -2.8802 |
| Money Supply Narrow Broad | -5.379986 | -2.8807 | -12.50017 | -2.8802 |
| Money Supply Broad Money | -5.360614 | -2.8807 | -12.35444 | -2.8802 |

***Forecasting performance results*** This section is focused on forecasting ability of the ANN. The sample period is form April 1994 to March 2007 and the total observations are 156 data. The forecasting have been made from Neural Network model and we have tabulated the result in table 2.

**Table 2 : Forecent made by Neural Network**

| Monthly Closing Nifty Index | R | Net - R | Avg. Abs. | Max. Abs. | RMS | Accuracy (20%) | Conf. Interval (95%) | Records |
|---|---|---|---|---|---|---|---|---|
| Train | 0.524014 | 0.528463 | 0.044496 | 0.150827 | 0.055627 | 0.833333 | 0.109612 | 108 |
| Test | 0.272651 | 0.27123 | 0.049027 | 0.146381 | 0.061476 | 0.808511 | 0.12331 | 47 |
| Valid | 0.430171 | 0.432351 | 0.04587 | 0.150827 | 0.057464 | 0.825807 | 0.112763 | 155 |

The experiments illustrate a varying degree of pridictability of the daily stock returns. For Example based on the values of RMS and other statistics. It can be observed that , the movement of monthly stock return is predictable. The RMS of 156 test record and all records shows very similar patterns.RMS are ovbiously smaller. The correlation r between monthly actual closing nifty result and monthly closing nifty Neural Network result is 0.428392714

## Conclusion

This study attempted to develop a neural network model for monthly stock return prediction of NIFTY and also shows the effect of Industrial Production, Wholesale Price Index, Exchange Rate, Net Investment by FIIs, Export, Import, Money Supply Narrow Money, Money Supply Broad Money.

The scope for future research is as follows:

1.The performance of Neural networks in forecasting can further be evaluated using other input factors such as daily/ monthly exchange rate of US stock market or a mixture of technical and fundamental factors, particularly for long term forecasting. This model can also include domestic and international economic factors.

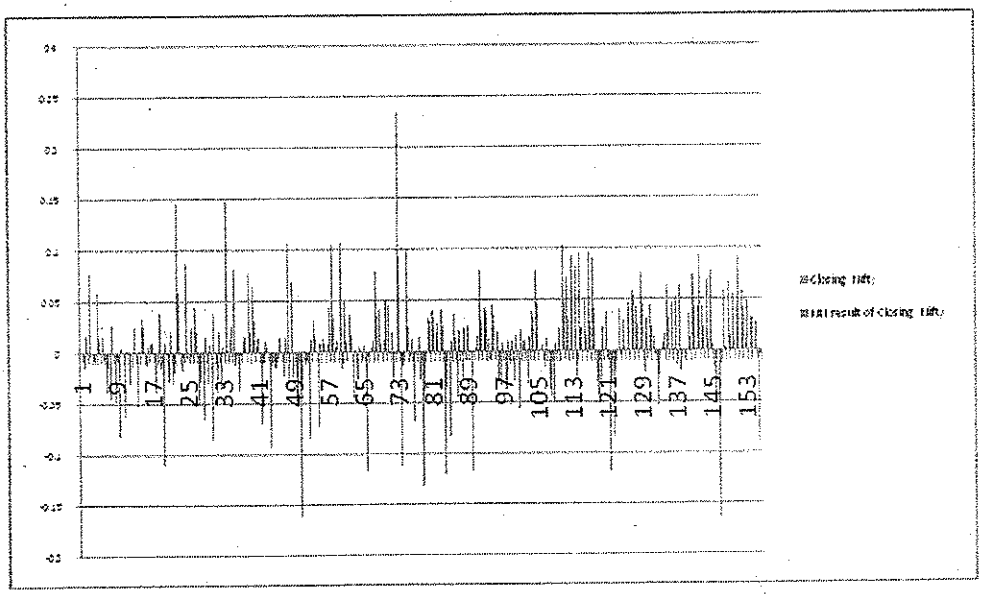



**Figure 1 : Dipicts the NN, Actual closing nifty monthly prices.**

2.The effectiveness of neural network can be measured using the hit rate, which may be a better standard for determining the quality of forecast instead of the traditional measures like RMSE, SSE, and MAE. The effectiveness can also be empirically examined by comparing models developed using Random Walk, ARIMA, etc.

3.The field of neural networks is very diverse and opportunities for future research exist in many aspects, including data preprocessing and representation, architecture selection, and application. The logical next step for the research is to improve further the performance of NNs , for this application, perhaps through better training methods, better architecture selection , or better input. The future of neural network time series forecasting seems to be in more complex network types that merge other technologies with neural networks like fuzzy logic, genetic algorithm and other stochastic process.

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