Chapter 4

Stock Price Prediction: Effect of Exchange Rate, FII Purchase, FII sales on daily return of Nifty Index

4.1-Introduction

A Neural Network is a group of interconnected decision making units that recognizes patterns and is designed to take a pattern of data and deduce generalization out of from it. An essential feature of this technique 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 traditionally been 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[1]. However, these models can predict linear patterns only. Since the stock market returns change in a
nonlinear pattern, therefore, neural networks are more appropriate to model these changes.

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

4.2-Modeling & Forecasting of Stock Prices using Neural Network

In general, the approaches to predict stock market could be classified in two ways, 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 [13-15]. Technical analysis is based on the rationale that history will repeat itself and that and the correlation between price and volume reveals market behaviour. Prediction is made by exploiting implications hidden in past trading activities and by analyzing patterns and trends shown in price and volume charts.

Using neural networks to predict financial markets has been an active research area since the late 1980's [3-7,16-27]. Most of these published works are targeted at US stock markets and other international financial markets. The prediction is made by exploiting implications hidden in past trading activities and by analyzing patterns and trends shown in daily stock price and daily exchange rate return, FII Purchase and FII Sales factors.
4.3-Training a Neural Network

To experiment with neural networks, we used NeuralWare, NeuralWorks Predict, [8] which provides the tools to implement and test various configurations of neural networks and learning algorithms.

4.4-Data and Methodology

4.4.1 Data Set Used

The data is obtained from the NSE site, RBI site, SEBI site [9-11]. The NIFTY data is taken from Sept 2, 2002 to Aug 25, 2004 on a day to day basis. The stock market can display varying characteristics for various stock. So it is necessary to develop model for predicting daily stock return of NIFTY. The data for the analysis comprises the daily stock returns of NIFTY, Exchange Rate Rupee/US Dollar, FII Purchase, FII Sales (on a day to day basis), creating a series of 500 observations which were collected from the Reserve Bank of India website, NSE site, SEBI site [9-12].

To build the Neural Network forecasting model daily data (500 observations from Sept 2, 2002 to Aug 25, 2004) is used 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 stationarity 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 nonstationarity, the analysis uses a stationary test, called the unit root test (Augmented Dickey Fuller and Philip Perron). 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. The time series plots are given in Fig 4.1 and 4.3, which shows numerous changing turning points in the series. This analysis has used the first difference of logarithm of daily closing nifty and daily exchange rate as the primary time series, which can be calculated as follows:

\[ Y_t = \log_e \left( \frac{T_t}{T_{t-1}} \right) \]  

[12]

Where \( T_t \) and \( T_{t-1} \) are today’s and yesterday’s daily closing nifty or daily exchange rate. Fig 4.2 and Fig 4.4 represent a typical data set after transformation.

Figure 4.1 Daily closing nifty original series
Figure 4.2 Daily closing Nifty converted series

Figure 4.3 Daily exchange rate original series
4.4.2 Design Methodology

It is difficult to design a Neural Network Model for a particular forecasting problem. Modelling 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 analysis to determine the input nodes and output nodes, selecting the performance metrics etc.

4.4.2.1 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.

Closing NIFTY is taken as dependent variable and exchange rate, FII purchase, FII sales are taken as independent variable. For the present study the output is the forecasted daily stock return.

4.4.2.2 Performance Metrics

The performance of neural network can be measured by numerous metrics as discussed in the previous chapter. 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).

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.[12]

4.5-Results
4.5.1 Stationarity Test:

The input and output series have been tested for Stationarity. The Augmented Dickey Fuller test statistics as given in following table. The table indicate that the first difference of the logarithmic of the daily exchange rate and daily closing nifty are stationary as the absolute value of statistics is greater then the critical value.

<table>
<thead>
<tr>
<th>Series</th>
<th>Augmented Dickey Fuller Test</th>
<th>Critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Exchange  Rate</td>
<td>-13.79892</td>
<td>-3.4389</td>
</tr>
<tr>
<td>Daily Closing   Nifty</td>
<td>-14.47719</td>
<td>-3.4389</td>
</tr>
</tbody>
</table>

Table 4.1 Unit Root Test of Two Series

4.5.2 Forecasting performance results

This section is focused on forecasting ability of the ANN. The total observations are 500 data. The forecasting has been made from Neural Network model and we have obtained the following results:

<table>
<thead>
<tr>
<th>Closin g Nifty Return</th>
<th>R</th>
<th>Net-R</th>
<th>Avg. Abs.</th>
<th>Max. Abs.</th>
<th>RMS</th>
<th>Accuracy (20%)</th>
<th>Conf. Interval (95%)</th>
<th>Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>0.38649</td>
<td>0.37373</td>
<td>0.010419</td>
<td>0.10119</td>
<td>0.014413</td>
<td>0.98996</td>
<td>0.028099</td>
<td>498</td>
</tr>
<tr>
<td>Test</td>
<td>0.26228</td>
<td>0.24847</td>
<td>0.010619</td>
<td>0.06938</td>
<td>0.014372</td>
<td>0.993333</td>
<td>0.028212</td>
<td>150</td>
</tr>
</tbody>
</table>

Table 4.2 Forecasting performance results
The experiments illustrate a varying degree of predictability of the daily stock returns. For example, based on the values of RMS and other statistics it can be observed that the movement of daily stock return is predictable. The RMS of 500 test record and all records show very similar patterns. RMS are obviously smaller. The correlation $r$ between daily actual closing nifty result and daily closing nifty Neural Network result is $-0.00284278$.

Following figure depicts the NN, Actual closing nifty daily prices.

![Figure 4.5 Neural Network based Forecasting and Actual result](image)

4.6 Conclusion

In this chapter attempt has been made to develop a neural network model for daily stock return prediction of NIFTY and the effect of Exchange Rate, FII Purchase, FII Sales on daily return of Nifty stock return has been studied. The
Neural Networks appear to be the best modelling method currently available as they capture nonlinearities in the system.
References:


[9] Reserve Bank of India (RBI), www.rbi.org.in


