Forecasting Of Indian Stock Market Index Using Artificial Neural Network

Proposal
ABSTRACT

The objective of the study is to present the use of artificial neural network as a forecasting tool for predicting the direction of the stock market. The neural network is employed to use the homogeneous input data set which in this case is the daily returns of S&P CNX Nifty 50 Index. The data set encompassed the trading days from 6th November, 1991 to 31st March, 2007. The Daily return of the index is calculated from the daily closing prices of Nifty 50 Index. The data is collected from the historical data available on the website of National Stock Market. The study also seeks to document the self similarity characteristic of the stock market. Accuracy of the performance of the neural network is compared using various out of sample performance measures. Modeling techniques and the architecture of the ANN will also reported in the paper.


**Introduction**

Recently forecasting stock market return is gaining more attention, maybe because of the fact that if the direction of the market is successfully predicted the investors may be better guided and also monetary rewards will be substantial. If any system which can consistently predict the trends of the dynamic stock market be developed, would make the owner of the system wealthy. Another motivation for research in this field is that it possesses many theoretical and experimental challenges. The most important of these is the efficient market hypothesis which proposes that profit from price movement is very difficult and unlikely. In an efficient market, stock market prices fully reflect available information about the market and its constituents and thus any opportunity of earning excess profit ceases to exist any longer. So it is ascertain that no system is expected to outperform the market predictably and consistently. There has been a lot of debate about the validity of the EMH and many researchers have attempted to use neural networks to give a contradictory view to the Efficient Market Hypothesis.

Moreover, many researchers claim that the stock market is a chaos system. Chaos is a non linear deterministic process which only appears random because it is not easily expressed. These systems are dynamic, aperiodic, complicated and difficult to deal with normal analytical methods but with neural network’s ability to deal with non linear, chaotic system, it may be possible to forecast the trends of the market. This may eventually question the traditional financial theory of efficient market.

There is not much evidence that the stock market returns are perfectly linear for the very reason that the residual variance between the predicted return and the actual is quite high. The existence of the nonlinearity of the financial market is propounded by many researchers and financial analyst. (Abhyankar et al., 1997). Some parametric nonlinear model such as Autoregressive Conditional Heteroskedasticity (Engle, 1982) and General Autoregressive Conditional Heteroskedasticity have been in use for financial forecasting. But most of the non
linear statistical techniques require that the non linear model must be specified before the estimation of the parameters is done.

During last few years there has been much advancement in the application of neural network in stock market indices forecasting with a hope that market patterns can be extracted. The novelty of the ANN lies in their ability to discover nonlinear relationship in the input data set without a priori assumption of the knowledge of relation between the input and the output. (Hagen et al., 1996). They independently learn the relationship inherent in the variables. From statistical point of view neural networks are analogous to nonparametric, nonlinear, regression model. So, neural network suits better than other models in predicting the stock market returns.

This paper presents the use of artificial neural network as a forecasting tool for predicting the direction of the market. Accuracy is compared against a traditional forecasting method, ARIMA model using the same data set. The feedforward neural network with back propagation algorithm is used to forecast the daily returns of S&P CNX Nifty 50 Index. Accuracy of the performance of the neural network is compared using various out of sample performance measures.

The study also seeks to document the self similarity characteristic of the stock market. A phenomenon that is self similar, or invariance against changes in scale or size, looks the same or behaves the same when viewed at different degrees of magnification of different scales on a dimension. The dimension can be space, length, width or time. In case of a stock market the dimension is time. If a stock market possesses self similarity characteristics then the long term and the short term characteristics will be same. The rise and the falls in the market index over a year will reassemble the rise and the fall trend in a monthly scale and the same pattern can also be seen on an intraday scale. So, it can be assumed that the trend of the index price on a day is likely to be followed in a monthly trend, yearly trend and over a period of years. So, this study can help the regulators to design the market checks in advance to avoid steep fluctuation in the market.

**Literature Review**
In the last two decades forecasting of stock returns has become an important field of research. In most of the cases the researchers had attempted to establish a linear relationship between the input macroeconomic variables and the stock returns. But with the discovery of nonlinearity in the stock market index returns (A. Abhyankar et al. 1997), there has been a great shift in the focus of the researchers towards the nonlinear prediction of the stock returns. Although, there after many literatures have come up in nonlinear statistical modeling of the stock returns, most of them required that the nonlinear model be specified before the estimation is done. But for the reason that the stock market return being noisy, uncertain, chaotic and nonlinear in nature, ANN has evolved out to be better technique in capturing the structural relationship between a stock’s performance and its determinant factors more accurately than many other statistical techniques (Refenes et al., S.I. Wu et al., Schoeneburg, E.,)

Many literatures are available on application of ANN in modeling the stock market returns. Researchers have tested the accuracy of ANN in predicting the stock market index return of most developed economies across the globe. Literatures are available for forecasting index returns of U.S markets like NYSE [5], FTSE [6], DJIA [7], S&P500 [8, 9]. Studies in European context are available for markets like Euronext Paris Stock Exchange [2], German Stock Exchange [11], and Madrid Stock Exchange (Spain) [12]. Few papers are also available in context to Asian stock markets like Hang Seng Stock Exchange, Korea Stock Exchange Tokyo Stock Exchange and Taiwan Stock Exchange.

Kim and Han (2000) used neural network modified by Genetic Algorithm. The genetic algorithm was used to reduce the complexity of the feature space. Kim and Chun (1998) used refined probabilistic NN (PNN) to predict a stock market index. Pantazopoulos et al. (1998) presented a neurofuzzy approach for predicting the prices of IBM stock. Siekmann et al. (2001) implemented a network structure that contains the adaptable fuzzy parameters in the weights of the connections between the first and second hidden layers. In another paper by Rong-Jun Li; Zhi-Bin Xiong developed a fuzzy neural network that is a class of adaptive networks and functionally equivalent to a fuzzy inference system. The experiment results based on the comprehensive index of Shanghai stock market indicate that the suggested fuzzy neural network could be an efficient system to forecast financial time series.
The uniqueness of the research comes from the fact that the research employs a neural network based forecasting approach on National Stock Exchange index (CNX S&P Nifty 50). Furthermore, as not much work has been done on the forecasting of Indian stock market indices using neural network, this paper will actually help to develop neural network as another forecasting tool for highly volatile Indian market. The self similarity study of the market will help to understand the microstructure of Indian market.

Data and methodology

The neural network is employed to use the homogeneous input data set which in this case is the daily returns of S&P CNX Nifty 50 Index. The data set encompassed the trading days from 6th November, 1991 to 31st March, 2007. The Daily return of the index is calculated from the daily closing prices of Nifty 50 Index. The data is collected from the historical data available on the website of National Stock Market. The whole data set is divided in two parts. The daily return for the period from 6th Nov, 1991 to 31st March 2006 is used for training the neural network. The other set containing 249 data points is going to be used for validation of the model and is not presented to the network as training data set.

Here, different network structure will be designed having different numbers of Neurons in the input and the hidden layer. The output layer has only one neuron which gives the forecasted index value. The input to the 1st node will be today’s daily return value, the 2nd node will have yesterday’s return value as the input and like wise. Where as the output will be tomorrow’s forecasted daily return.

A back propagation neural network learning methodology will be used to obtain the output. A subset of available daily stock return data will be used to construct the neural network. The network so constructed will be trained using the training data set. Training of a back propagation network involves obtaining optimal values for the learning rate, the momentum of learning, estimating the number of hidden layers and the number of nodes in each layer. The training of the network will be done using different combinations of learning algorithm and transfer functions. The overall error is tracked until a minima is obtained by
altering the fore mentioned parameters. The net so obtained with minimum error is saved and this trained network can then be used in predicting future stock market returns. Accuracy of the performance of the neural network is compared against a traditional forecasting method.

References


