Artificial Neural Network for Forecasting Series Data using Multi-Layer Perceptron

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Abstract— **Dollar rate prediction is a classification problem, which helps to forecast the next day dollar rate based on the history of dollar rate. The result of the work is the prediction of dollar rate which helps the untrained traders to make decisions. The proposed work is to forecast the dollar rate series data for various applications by using neural network. The advantage of using neural network is that it will predict the future even in the presence of hidden data. The dollar rate prediction using Multi-Layer Perceptron (MLP) model is proposed. The dollar rate prediction problem is built by using the mathematical operations, so that this project is implemented in R language.**

Keywords— **Data mining, Artificial neural network, Neural Network Training, Neural Network Testing, Multi-Layer Perceptron (MLP) model**

I. INTRODUCTION

Predicting the dollar exchange rate is a complex task, due to consequences of unsystematic changes in behaviour of a dollar rate time series. In order to predict the dollar rate we need to have the knowledge of marketing and data mining techniques. Predicting the dollar exchange rate is a complex task, due to consequences of unsystematic changes in behaviour of a dollar rate time series. In recent years, the concept of neural networks has been an emerging technology among them. The Artificial Neural Network (ANN)[1] is built based on association of human brain biological neuron system. Neuron systems are formed from trillions of neurons these will exchange succinct electrical pulses called action potentials. These biological structures are adopted to the computer algorithm formally called Artificial Neural Networks. The challenges of prediction are addressed by implementing this work in R language. It is a software environment and programming language for statistical computing and graphics widely used among statisticians and data miners for data analysis and developing statistical software . In this process, we are using the Neural Networks for prediction.

II. OBJECTIVE

The main objective of the project is to gain knowledge about variations in the exchange rate and better support for marketing people to make the decision. In predictive modelling, data is collected from ECB and it is pre-processed according to the requirements of prediction methods. A statistical model is formulated, predictions are made and accuracy is detected by the plot of observed and predicted data. The model can be validated as additional data becomes available. In this project, the pre-processed data is input to fit MLP using Back propagation algorithm.

A Artificial Neural Networks

These are mathematical models stimulated by central nervous system of the human that are able to perform machine learning and pattern recognition. ANNs are implemented similar to biological neural network model. Programs that can be written using flowcharts are the problems for which neural networks are not suitable. ANNs are useful for finding solutions for problems that cannot be expressed as a sequence of steps, such as recognizing patterns, prediction, data mining and classification.

1) Neural Network Training

Supervised training [3] is the most common type of neural network training. In this training a set of experimental data along with the expected outputs from each of these samples are input to neural network. In training process the neural network is processed through a number of iterations called Epoches. This process continues until the neural network predicted output matches the expected output and error is less than the specified error rate. Training is the process by which the connection weights are assigned. In most of the training algorithms weights as are assigned by random numbers between some specified intervals.

2) Neural Network Testing

Testing is the final step after training neural network. The weights are adjusted based on the validity of the results. This procedure is recurring until the error is equal or less than the acceptable limit. Testing is extremely important since it help us to determine further training of network required or not. To test the correctness of generated model by trained neural network, testing dataset must be selected in such a way that it is completely different from the training dataset [2].

III. PROBLEM STATEMENT

To design a Predictive Model for dollar exchange rate by using multilayer perceptron Neural Network model (MLP) and build using the mathematical operations, so that this project is implemented in R language.

IV. RELATED WORK

Sharda, R. and Patil, R[3] proposed autoregressive and autoregressive moving average for forecasting and trading the USD rates of one year as input in-sample-data and next one year data set as an out-of-sample data set. In this AR and ARMA model is benchmarked with Naive strategy prediction model. This study concludes that, the ARMA model is the best for in-sample data set where as ARMA and AR is best in out-of-sample data set.

Kalyani Dacha[1] proposed analysing and comparing the ability in forecasting the daily rates US dollar using ANNs and GARCH and ARCH models. In this proposed system he failed to work with different kinds of neural networks instead of single NN.

Bishop, C.M [5] explains about Markov model implementation for exchange rate forecasting. He proposed Markov-switching method is lit for I8 rates in the basis of quarter frequencies instead of single day. He worked with in-sample data sets of many exchange rates. He proved that the forecasts of the Markov model are greater at predicting if change in the exchange rates

Tang, Almeida and Fishwick[4] proposed six nonlinear architectures to forecasting the dollar rate. The results conclude that GMDH and GP will provide more accurate predictions as compared to other over all the currencies. GMDH is the best predictor because it will be combination of the many forecasting techniques.

V. PROPOSED WORK

This method is type of feed forward ANN model that takes sets of time series data as input and produces suitable outputs. In feed forward neural network the data processing take place only in forward direction which is used in predicting the various time series data. A MLP is a directed graph with multiple layers of nodes: input layer nodes, hidden layer nodes and output layer nodes with each layer nodes are linked to the every node of next layer. Except for the input nodes, each node in the neural network contains a nonlinear activation function. MLP is trained by a supervised learning method called back propagation algorithm. Errors will be back propagated until the mean square error is minimized.
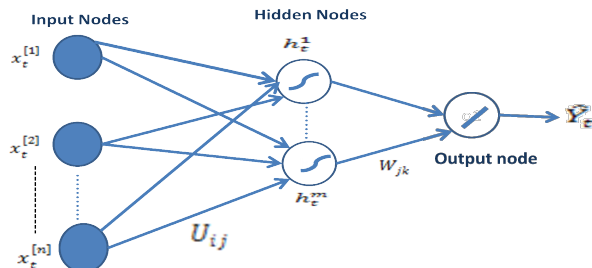

Figure 1   MLP neural network structure

A typical training example of the MLP is shown in figure 3.2

Where

- $x_t^{[1]}, x_t^{[2]}, \ldots x_t^{[n]}$: the inputs at time t

- $h_t^1, h_t^2, \ldots h_t^m$: outputs of hidden node

- $\hat{Y}_t$ is MLP output at time t

- U_{ij} is network weights of input to hidden nodes

- W_{jk} are network weights from hidden nodes to output node

- is the sigmoid function, given as

- $S(y) = \dfrac{1}{1-e^{-x}}$

- is the linear function, given as

  $f(x) = \sum_i x_i$

- The linear function is minimizes is

- $E(c, w_j) = \dfrac{1}{T} \sum_{t=1}^{T} (y_t - \hat{y}_t(w_k, c))^2$

  y_t target value.

A Requirement Specification

1) Hardware Requirements

- Intel CORE i3 processor
- 3 GB RAM
- 120 GB Hard Disk
- CD-ROM
- Mouse and Keyboard

2) Software Requirements

- Operating System : Windows XP / Windows 7
- Programming Tool : R i386 3.1.2
- IDE : R STDIO v0.99

VI. IMPLEMENTATION

A .Selection of the platform

Windows XP is the product of Microsoft, provides best reliable version of Windows, with privacy and security features has ever provided by previous editions. There are two editions of Windows XP those are home edition for domestic purpose, and professional edition for corporate business. The professional edition includes security and other features of home edition, along with different security management features. These security features secure our system from threats, vulnerabilities and online threats.

Windows 7 is an operating system developed by Microsoft to the personal computer, it is a version of Windows NT. Windows 7 was planned to upgrade to the operating system, intending to overcome the disadvantages of its predecessor and the maintenance of compatibility between hardware and software designed for Vista

B. Selection of Language

To implement this project, there is a need to concentrate on some of the practical developments of project work, which is the application, should be ease of development, code security and extensibility of the code. Hence, this project is implemented using R programming language and R Studio IDE.

C. Algorithm Steps of Project

- pre process the data
- split the data into sequence of 20 values
- First 19 values used as input and last one as output
- Train the MLP using Back propagation Algorithm by using train data
- Predict the future values by providing test data as input

VII. EXPERIMENTAL RESULTS OBTAINED

In this step, MLP neural network is trained with pre-processed dollar rate data. In this work supervised learning method is used, this contains set of inputs and desired output. The training sample is shown in Figure 2. MLP neural network consists of twenty inputs, eleven hidden and one output layer. So twenty values indicate inputs and twenty first value is the desired output, this training is done by back propagation algorithm. The below figure represents the iterative error of the MLP training for 1000 iterations.
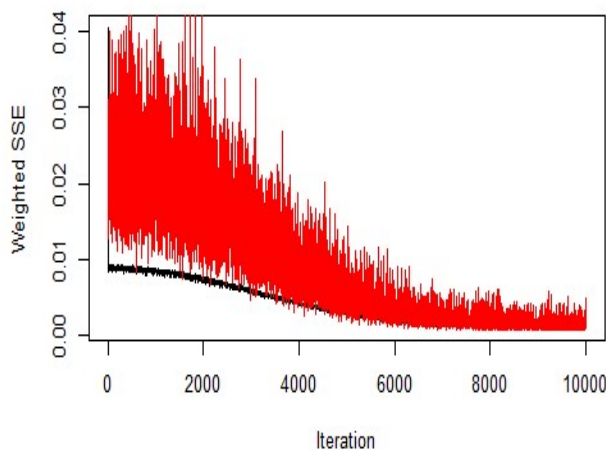

Figure 2: MLP iterative error plot

The predicted values of the MLP is

61.55503 61.48062 61.37702 61.27692 61.17171 61.0730
60.97198 60.85667 60.81067 60.77593 60.77920 60.80453
60.82236 60.83332 60.82547 60.83426 60.86396 60.8423
60.74865 60.66446 60.60117 60.54535 60.49500 60.4797
60.48318 60.47428 60.47354 60.47273 60.47904 60.4765
6 60.48127 60.51545 60.54172 60.54663 60.54433 60.572
50 60.64163 60.69864 60.73290 60.77504 60.81370

The Plot of observed data and predicted data is shown in Figure 3. The red line represents the observed data and blue line represents the predicted data. The predicted plot slightly differs than the observed data. This difference is an error.
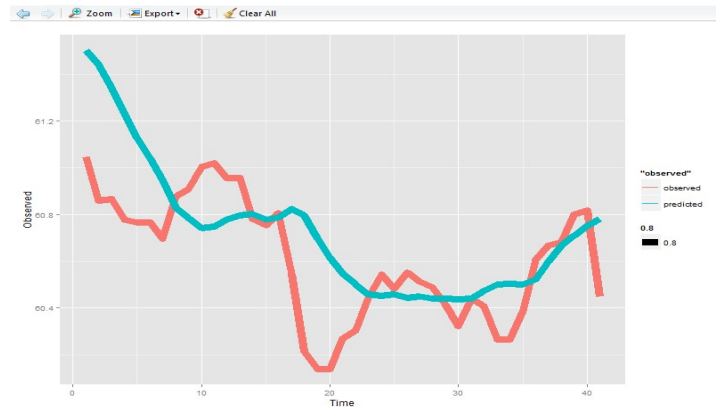

Figure 3. MLP Plot of Predicted and observed data

VIII. CONCLUSION AND FUTURE SCOPE

The proposed work can be further extended for different Neural Networks and performance can be tested. This work is intended to model Artificial Neural Networks like Multi-Layer Perceptron to predict dollar rate, an application of forecasting series data. The prediction is made for the next day using the previous data. We use supervising algorithm called Back Propagation Algorithm to train the MLP model.

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