Novel Adaptive Neuro Fuzzy Inference Modeling Algorithms for Predicting Equity Prices and Indices

Vinod K[1], Nasira GM[2], Haresh M Pandya[3]

[1] *Research Scholar, Department of Computer Science,Chikkanna Government Arts College, Tiruppur, Tamilnadu, India*
[2] *Head of Department, Department of Computer Applications, Chikkanna Government Arts College, Tiruppur, Tamilnadu, India*
[3] *Head of the Department, Department of Physics, Chikkanna Government Arts College, Tiruppur, Tamilnadu, India*

ABSTRACT

Equity markets are considered as dynamic entities behaving in complex manner posing a challenging problem to equity forecasters. Traditional equity market forecasting is based on fundamental and technical analysis. Adoption of neural networks to forecast equity prices have been applied by many, however with shortcomings Recent studies focus on the use of artificial intelligence and machine learning; deploying methods such as artificial neural networks or genetic algorithms. Deployment of ensemble models, which combine the outputs of different machine learning algorithms, is also a common approach in machine learning. Adaptive Neuro fuzzy inference system (ANFIS) is a hybrid technique that integrates the advantage of learning in an Artificial Neural Network (ANN) and using a set of fuzzy if-then rules with appropriate membership functions to generate input-output pairs with a high degree of accuracy which is built on top of Fuzzy Sets and Fuzzy Modelling. ANFIS is a powerful tool for prediction, and this method has applications in prediction of stock prices. The study was done between ***4/2017 to 5/2022****.ANFIS model is used to predict closing prices of a few stocks and NIFTY index.*

Keywords: ***Closing Price Prediction, ANFIS, Grid Partitioning, Subtractive Clustering, Fuzzy C Means***

1. INTRODUCTION AND PROBLEM DISCUSSION

Traditional equity market forecasting is based on fundamental and technical analysis. Fundamental analysis is suitable for long term investors with a buy and hold strategy, which examines the current and future health of the economy by analysing data like money supply, interest rate, inflation, financial data of the company like Price/Earnings ratio, dividend yield. Technical analysis is based on the premise that patterns repeat regularly and makes use of past patterns to predict future prices. Technical analysis tools are employed by traders with short time horizon; few hours or few weeks. Many traditional time series models have been proposed and applied to equity price forecasting. The prediction of stock prices has always been an attractive studying area that many people are interested in as it has the ability to generate profits and reduce losses to retail traders and institutional investors by better prediction of closing prices. So an ANFIS model for prediction for closing prices of equity indices and individual equity is developed.

1.1 ANFIS ARCHITECTURE

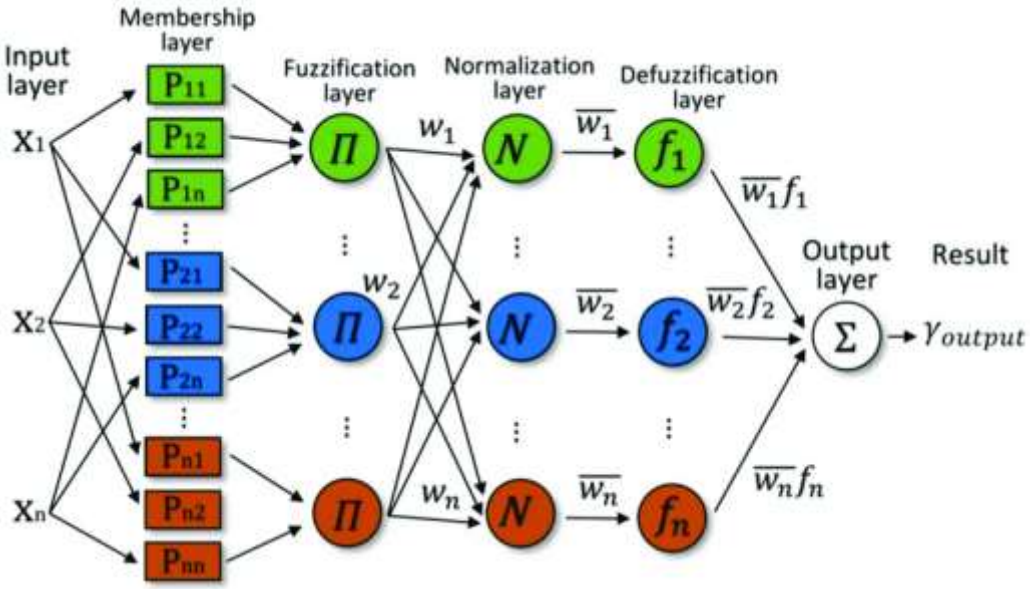

Fig-1 ANFIS ARCHITECTURE

1.2 ARCHITECTURE AND BASIC LEARNING RULE

An adaptive network is a multilayer feed forward network in which each node performs a particular function on incoming signals as well as a set of parameters pertaining to this node. The links in an adaptive network only indicate the flow direction of signals between nodes; no weights are associated with the links the parameter set of an adaptive network is the union of the parameter sets of each adaptive node. In order to achieve a desired input-output mapping, these parameters are updated according to given training data and a gradient-based learning procedure

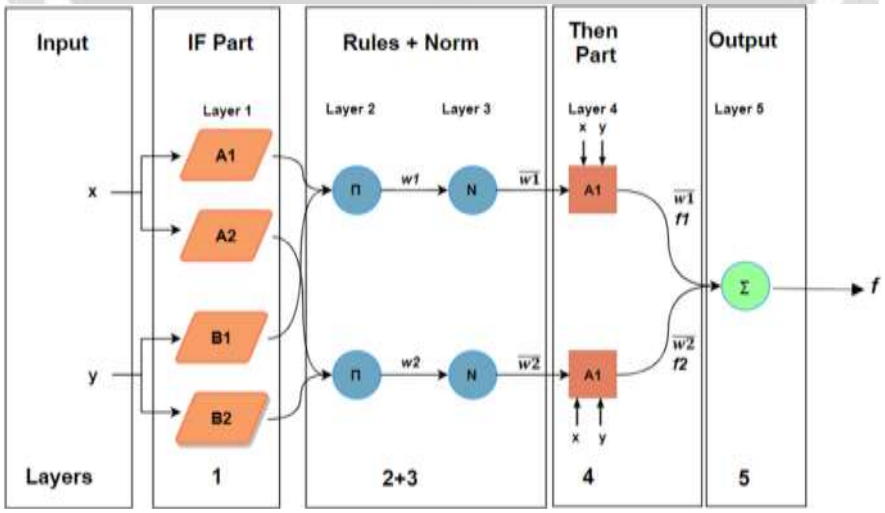

Fig 2 Architecture and Basic learning Rule

2. METHODOLOGY

The dataset is taken from National Stock Exchange; we chose the closing price variable in per day frequency. As the dataset consists of time series data, the training and test sets are generated by splitting the data into two parts without shuffling, based on the occurrence of the observations. The dataset is not shuffled. No sampling method was used.The data is created in the following order for training in ANFIS model.

- The training variable is generated by creating day delay (1, 2, 3, 4, and 5) for five days.
- The target variable is the sixth day (T+1) of the dataset.
- Then a range of data is split into training and testing(80% and 20%).

Three different rule generating algorithms used

1. Grid Partitioning
2. Subtractive Clustering
3. Fuzzy C Means

Grid partitioning divides the whole input space into several fuzzy subspaces and specifies each value represented by them via a corresponding membership function. Subtractive Clustering is focused on the calculation of the probability that a data point can be a cluster centroid by examining the distance metrics of relative data points. This method is used when there is not a precise idea about the number of centroids in the data set. It is less complicated than grid partitioning method and gives better results. Fuzzy C-Means clustering method is quite similar to k-means algorithm and the number of clusters is set in the beginning, then the weights are randomly assigned to each data point. Centroids of the clusters are determined by running the algorithm iteratively. It is a method of clustering that one data point can be placed into two or more clusters.

2.1 MODEL BUILDING

All the development is based on MATLAB and FIS Toolbox. After rules are generated the model gets training with

● Epoch – 50, 100

● No of data points - 1260

● Training data points - 1050

● Market date range - 4/2017 to 5/2022

● Membership function - Trapmf and Gaussmf

The model gets hyper parameter tuning and the final model will get built using the ensemble model. The model performance will be evaluated using MSE and RMSE.

2.2 PREDICTION OF NIFTY 50

Epoch = 100,
MF = Trapmf
No of MF = 2
Data points for training = 1260

2.3 **PREDICTION OF HDFCBANK**

Epochs - 100

Membership - Trapmf

Data points - 1260

4. RESULTS

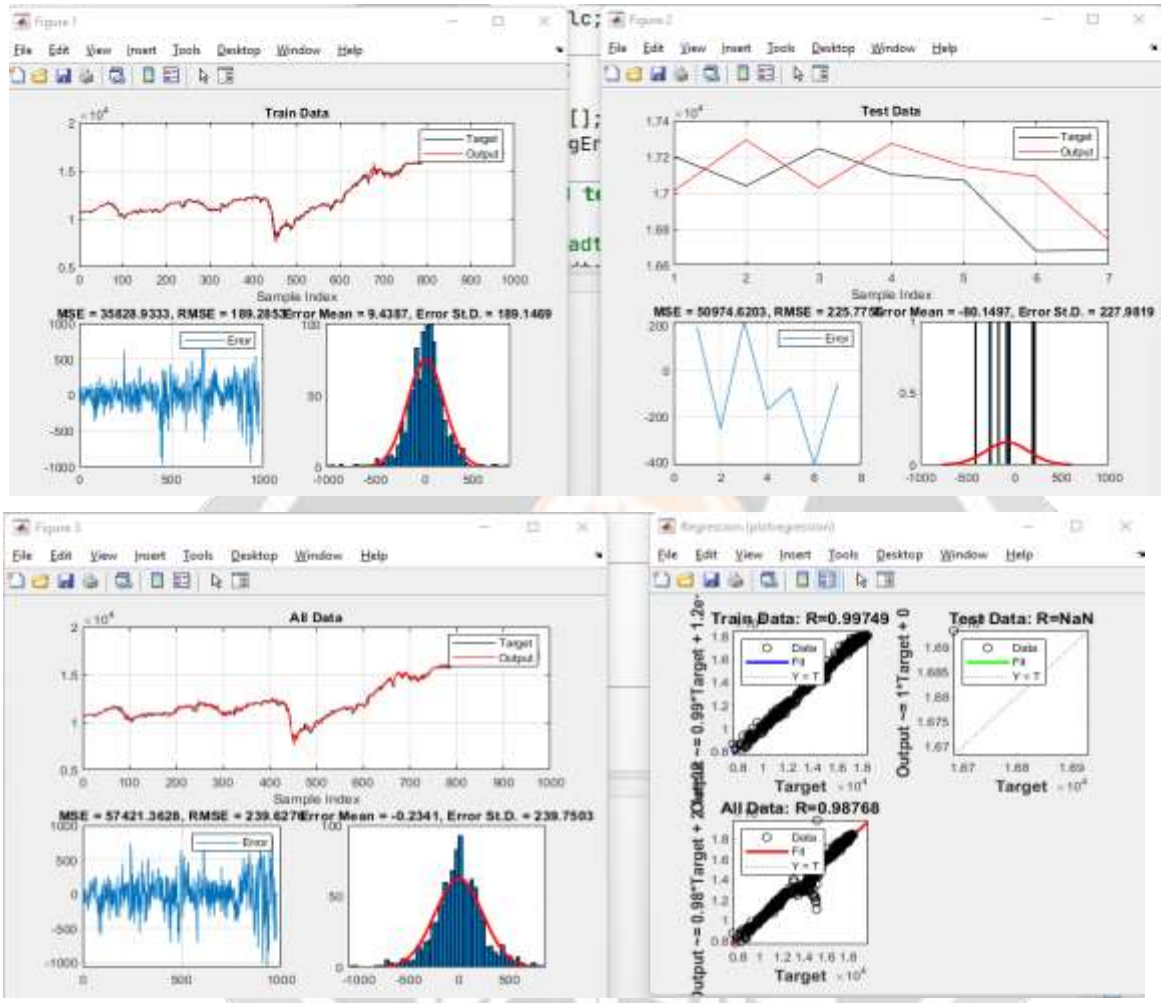

Fig -3 NIFTY 50 Results

Train Data	MSE 3012.85	RMSE 54.88	MEAN 0.009	ERROR STD 54.917
Test Data	MSE 914.7	RMSE 30.23	MEAN 11.044	ERROR STD 30.4012

Table 1 Result for HDFC BANK

Grid Partition 1384.4	Grid Partition tuned 1384.2
FCM 1342.7	FCM Tuned 1342.7

Table 2 Results Comparison

Subtractive Clustering - 1346.3

Actual - 1384.6

Loss between predicted and actual

Grid Partition - 0.2 Grid Partition tuned -0.4

FCM - 41.9 FCM Tuned - 63.5

4. CONCLUSIONS

We have used different data sets with different membership functions, epochs, tuning methods and evaluation metrics. From the empirical study, we have observed that grid partitioning rule generation algorithm predicts better under certain conditions. When the data is similar to Gaussian distribution the Trapmf function prediction is good. For highly skewed data then RMSE is bad. When the recent close data is trained then the grid partition algorithm performs better. Overall the Fuzzy C Means performance is better than other algorithms.

5. REFERENCES

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