

A Study on Forecasting Mutual Fund Net Asset Value Using Neural Network Approach

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Abstract-The theoretical focus brings an outlook in the Indian mutual fund Net Asset Value (NAV) using corresponding countries macro-economic variables as an input. The study uses Neural Network toolbox simulation to perform the feedforward-back propagation network model to forecast the NAV from other economic variables. Mutual Fund is working as a pool of money from the multiple investors and invests it in diversified market. This is to directly focus on forecasting the NAV of the selected mutual fund using Neural Network Approach. The performance tested for the collected historical data of economic variable in this network model were using Mat Lab NNTool simulation. The input data has been collected for monthly basis from 2011 to 2017 and the similar period of target output of two selected mutual fund's NAV. From the analysis it implies that the best and fastest performance evaluation function is Levenberg-Marquardt (LM) because the mere perfect value of R represents the exact matching of network output and the target output.

Keywords: Mutual Fund, Net Asset Value, Levenberg-marquardt, Back Propagation Network, Neural Network ToolboX.

I. Introduction

Mutual Fund is the investment vehicle[1][2] to enter into the investment avenues like stock market, money market and debt securities. It is working as a pool of fund[3] from which multiple investors invest themselves in the diversified market. The profit or loss from the investment will be shared to the investors proportionately. Investment objective of the fund differs from the type of the fund. For example equity growth

fund's objective is to invest in stocks. On the other hand, Debt income scheme fund invest itself in fixed income securities. A balanced fund's main objective is to balance the return and the risk where the fund invests partly in stocks and partly in debt securities. The collected funds are managed by professional investment manager[3] who has the knowledge to predict the expected return. So that investors invest their money with the expectation that this scheme would yield forecasted return.

Mutual fund gives investors the total number of units as per the current NAV of the fund. NAV is the total asset value divided by the unit of the fund. It is determined by AMC on every working day. Investors are ready to invest in mutual fund to achieve their financial goal with less risk. The pool of money from which the investors invests is managed by professional funding manager. So the individual who does not have much knowledge about investment decision would be investing their savings to this fund to get return without any risk. The study directly focuses on forecasting the NAV of the selected mutual fund using Neural Network Approach.

Neural network approach is the mathematical model to forecast the mutual fund NAV using multiple other economic input layers. In this study selected economic variables are CPI inflation, treasury rate and exchange rate. Reason for selecting these variables as an input is the neural network model related to one domain as to another domain (NAV) by using algorithmic techniques. The study uses Neural Network toolbox simulation to perform the feedforward-back propagation network model to forecast the NAV from other economic variables.

II. Data collection

This is to assess the efficiency of neural network model to forecast the NAV of the selected mutual fund using the nntool simulation in MATLAB. From this study we analyze the performance of the feedforward backpropagation model by training the network. The network simulation requires giving input as well as targeting output. The other economic variables collected were Input layer. These economic variables are mentioned in Table 1.

Output layer is the target output which is the NAV of the selected mutual fund. For this testing of neural network model, the data have been collected for 7 years (2011-2017) monthly NAV of CRISIL ranked mutual funds such as HDFC Small Cap fund and Reliance Vision Fund.

Input	Economic variable	Definition	Units
Neuron 1	Inflation Rate	Percentage change of rise in price of goods and services over the period.	%
Neuron 2	CPI	This index measures the average price on the expenditure of consumers on goods and services.	Index
Neuron 3	Treasury Rate	This is the rate at which the return on investment on US government obligation as a percentage.	%
Neuron 4	Exchange Rate	Value of Indian Rupee against the Dollar	US Dollar
Neuron 5	Unemployment Rate	The percentage of the population who are not employed.	%
Neuron 6	Money supply M1	This is the measurement of money circulation in central banks and checking deposits	Trillion US Dollar
Neuron 7	Money supply M2	Money supply M2 includes M1 as well as money circulation in money market	Trillion US Dollar

There are reasons for using this data for the simulation,

1. The model analyzes the data by interlinking input variables as well as target output data. For this purpose, input should not be directly related to the output.
2. As per the base research model, there were very less research base analyzed using small number of samples. But this study uses simulation which can be performed with small number of data sample. This serves the purpose of collecting seven input neurons and two mutual funds.
3. As per the review, the regression analysis could be used as the coding method to forecast the NAV but the method seems outdated. The neural network approach is the most viable technique for the study. Because the NNtool has been implemented as the automatic simulation of the neural network model. In these algorithms, functions were inbuilt in the NNtool.

In this study, data has been analyzed by training, validating and testing the created network using the NNtool simulation.

III. Nntool

Neural Network Toolbox provides algorithms, pre-trained models, and apps to create, train, visualize and simulate both shallow and deep neural networks. You can perform

classification, regression, clustering, dimensionality reduction, time series forecasting and dynamic system modeling and control[4].

Levenberg-Marquardt Algorithm LM was designed to approach second order training speed without having to compute the hessian matrix similar to newton method which is utilized for training[5]. And also this is consider as a best approach to the multilayer network training[6].

TRAINLM is the training function in the NNtool simulation. At the time of creating the network TRAINLM is selected as a training function. This will update weights and bias values accordingly. This function is the fastest backpropagation algorithm in the NNtool. Training function forecast the performance using mean square error. So, the MSE is used as a performance function.

Adaption learning function LEARNNGDM is used to define weight change (dw)of the layer from neuron’s input (p) and error (e), weight (w), Learning Rate (LR) and momentum constant (MC)[7].

$$dw = mc * DW_{prev} + (1 - mc) * lr * gw \quad (1)$$

MSE is the performance function which measures the network’s performance as per mean squared error[8].

$$perf = mse(net, t, y, ew) \quad (2)$$

Where,

Net – Neural Network

T - Cell Array of targets

Y - Cell array of outputs

EW – Error Weights

TANSIG is the sigmoid transfer function which derive the layer's output from the network input layer[9].

$$A = Tan(N, FP) \quad (3)$$

Where,

N – Cell array of net input

FP – Function Parameter

IV. Simulation Process

There are seven steps to perform the simulation

Step 1: Collecting data

The data has been collected from the corresponding websites such as Money control, Government data bank, Bureau of Labor statistics and inflation.eu etc.

Step 2: Creating the Network

While creating the network, the input data, target data, network type, training function, adaption function, performance function and number of layers were selected as per the theoretical model.

Step 3: Configure the Network

The Network has been configured by the use of NNtool simulation.

Step 4: Initialize the weights and bias

The selected LM algorithm automatically initialized the weights and bias in the neural network model.

Step 5: Train the Network

The training is initialized after the above mentioned steps through the selection.

Step 6: Validate the Network

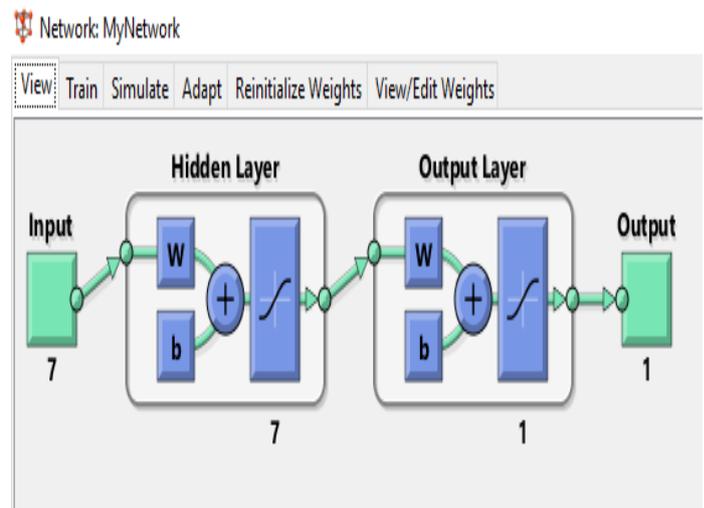
The network will be simultaneously validated and the results are produced as a graph.

Step 7: Use the Network

The final analysis is made through the training, validation and testing of the network.

V. Feedforward – Backpropagation Network Model

Fig1. Created Network



From the above given figure, the network has three layers. Input layer, hidden layer and an output layer. Input layer has been imported by selected input data of the economic variables and the output layer is the collected NAV of the mutual fund for 7 years period (2011- 2017). In this network model it is been represented as weights (w) and bias (b). Weights are automatically assigned to the input. This transfer function will be calculated by Sum of weighted inputs and bias. And the linear transfer function will generate the output in backpropagation model[4].

After initializing the weights and bias, the levenberg-marquardt algorithm is used for training the network due to its fastest and efficient performance of the algorithm. In the training stage, the data has been approximated to solve the regression problem. Weights and biases iteratively adjusted while training the network to minimize the network error. In the current study, the training stopped after 16th iteration because of the error that was initiated.

VI. Graphs and Results

Output State

Performance State

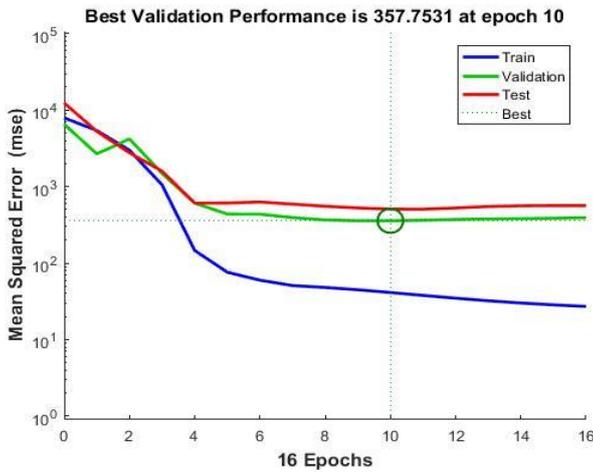


Fig2. Performance of the network

The graph represents the training, validation, testing and progress the best performance of the network. In this graph, epochs means the iteration of the train network. An epoch is indicated as X axis and Mean Square Error (MSE) is indicated as Y axis. Best validation performance reached at 10th iteration and 6 more iteration processed before ending.

Training state

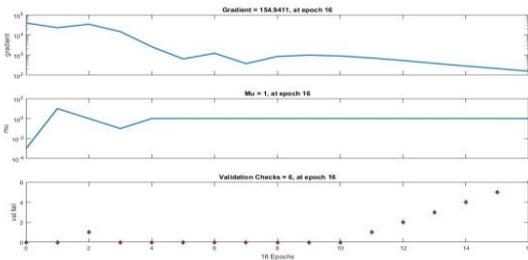


Fig3. Training state of the network

The graph represents the training state value of the network. In this figure, gradient error is 154.9411 at epoch 16 and the number of validation check is 6. From this graph, the result implies that the LM algorithm is at its best when it is giving least gradient error.

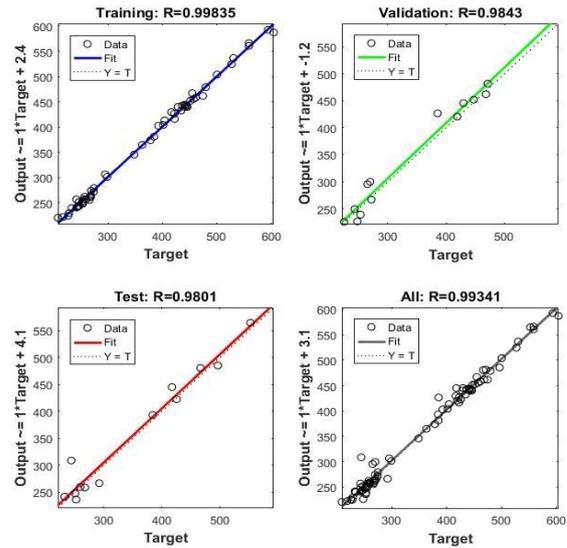


Fig4. Graphical Output

After the performance evaluation, next step is to validate the network by plotting the regression graph. The graph shows the target output and the network output in the exact line represented in the network that has performed well. There are four graphs which are represented as training, validation, testing and all combined. In this analysis, it shows that the target output is exactly matching with the network output. The dashed line represents the best result and the solid line represents the regression between target and output which is been plotted in the same place. R represents the correlation coefficient between the output and the targets. In this study, R=0.99835 for the training, R= 0.9843 for the validation and R= 0.9801 for the testing. The overall value of R=0.99341 is for the feedforward backpropagation network model. From the analysis, it is implied that LM algorithm is at its best and the fastest function gives a mere perfect linear relationship between target and the output. Highest R value shows a good fit between the network output and target output.

VII. Conclusion

This research focuses mainly on evaluating performance of the neural network model using NNtool simulation. In this model Feedforward Backpropagation network was used to train the network and LM algorithm is used as the transfer function. Using LM algorithm the study gives a big impact to the mutual fund industry to forecast the NAV of the mutual fund for the unlimited data. The main limitation of this study was the input data was not direct relevant to the output but the network gives interconnection between input and output using the neural network approach. And also in this study involves two mutual funds NAV which was collected for the analysis. The result shows that the performance of the LM algorithm in feedforward backpropagation network used NNTool to generate perfect correlation between network output and the target output. It could be extended using other algorithms.

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