Vol.5.Issue.3.2017 (July-Sept)

http://www.bomsr.com
Email:editorbomsr@gmail.com

RESEARCH ARTICLE

BULLETIN OF MATHEMATICS AND STATISTICS RESEARCH

A Peer Reviewed International Research Journal

INTERNATIONAL STANDARD SERIAL NUMBER 2348-0580

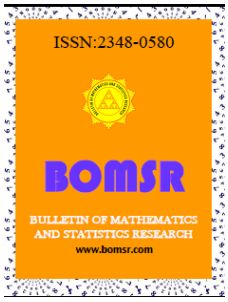
PREDICTION OF GOLD PRICES BY USING ARTIFICIAL NEURAL NETWORKS

R. B. DESHMUKH[1], D. D. PAWAR[2]

[1]School of Mathematical Sciences, Swami Ramanand Teerth Marathwada University, Nanded (M.S.), India.

[2]Professor & Head, Department of Statistics, N. E. S. Science College, Nanded (M.S.), India.

E-mail: rbdeshmukh1@gmail.com



ABSTRACT

This study gives an application of an Artificial Neural Network (ANN) to forecast the future gold prices. An artificial neural network model is used to forecast the future average monthly gold prices per 10 grams in Indian currency by using the Fleletcher-Powell Conjugate Gradient, Quasi-Newton, One Step Secent, Lenvenberg-Marquardt and Scaled Conjugate Gradient Algorithms'. The data analysis is done by MATLAB R2011b software. The best algorithm is chosen by the least value of MSE (Mean Square Error) and RMSE (Root Mean Square Error).

Keywords: ANN, MSE, RMSE, Gold Price, Forecast.

1. Introduction

Gold is a major commodity in the economic and monetary market. India is the major importers of gold among the world. This yellow metal has grabbed a lot of attention for every class of people as investment purpose. Every day, the value of gold is changes and It is beyond regular phenomina. Now a day's people investing in gold owing to huge profit in future, Investors have mainly primary objective that one being it is a hedge against inflation as over a period of time, the return on gold investment is in line with the rate of inflation. Investing in gold has changed over a period of time for traditional ways by buying jewelries to the modern ways to purchasing gold coins and bars or by investing the gold exchange traded fund (Gold ETF). Gold ETF is a financial instrument of mutual funds in nature which is turn invests in gold and these are listed in stock index. From the past onwards, gold has a received the considerable amount of attention in the markets. This attention has made researchers, investors, and activist in the capital market to look for invest and

use new forecasting method in order to achieve better results. Hence an accurate gold price forecasting is required for the business trend in future.

Soft computing techniques like Neural Network, Fuzzy Logic, Genetic Algorithms, can be used to forecast the gold price.

Many researchers have used artificial neural network for forecasting the time series data. Gray Grudnitski and Larry Osburn [1] used Neural Networks for forecasting S&P and future gold prices using the statistical techniques of R^2 and SE (Standard Error). T. W. S. Chow and S. Y. Cho[2] used neural networks for the study of rainfall forecasting system in Hong Kong city, results evaluated by the percentage of RE (Relative Error) based on RSLI (Rain Storm Likelihood Index). Shang-Wu Yu[3] used back propagation networks for forecasting the Nikkei Stock Index futures and compare it with the Auto-regressive Intrgrated moving average (ARIMA) Model using the statistical tools RMSE and gives results based on least value of RMSE. Yan Wang et al.[4] forecast the gold prices based on Improved Particale Swarm Optimization (PSO)-Back Propogation (BP) neural networks by comparing the RE (Relative Error). Hamideh Moradi et al.[5] used the Group Method of Data Hamdling (GMDH) Neural Network for modeling and forecasting price and gives the results comparing the least values of MSE and RMSE.

Definition1.1: A Neural network is a massively parallel distributed processor that has a natural propensity for storing experimental knowledge and making it available for use. It resembles the brain processor in two respects:

(i) Knowledge is acquired by the network through a learning process.

(ii) Interneuron connection strengths known as synaptic weights are used to store the knowledge.

Definitions1.2: Sigmoid Logistic function, $\psi(x)=\frac{1}{1+e^{-ax}}$ which shows linear and nonlinear behavior.

Definitions1.3: To measure the performance of artificial neural network different type of error functions used. Using this error functions we can find out how much training algorithms is useful for prediction.

Mean Squared Error: MSE = $\frac{1}{n}\sum_{i=1}^{n}(x_i-\overline{x})^2$

2 . Research Data

The gold prices are normally related with other commodities like crude oil, USD (United States dollers) foreign exchange rate. In this study the future gold prices are forecated from three commodities like historical data of gold prices, Cruid oil prices and foreign exachange rate. The period of study is from average monthly gold price data from April 2007 to March 2016 are used for analysis. The data taken from the website of Reserve Bank of India (RBI). The Inputs have to be normalized by proper behavior of the network. Input values normalized between -1 to +1. This can be done by normalization techniques, one of the popular techniques we used maximum and minimum of the data set. All values are normalized using following equation.

$$Y=\frac{2*X-(x_{max}+x_{min})}{(x_{max}-X_{min})}$$

Y : Normalized values.

X : Present value of the data set.

X_{max} : Maximum value of the data set.

X_{min} : Minimum value of the data set.

The average monthly normalized gold price data represented graphically in figure 2.1 below

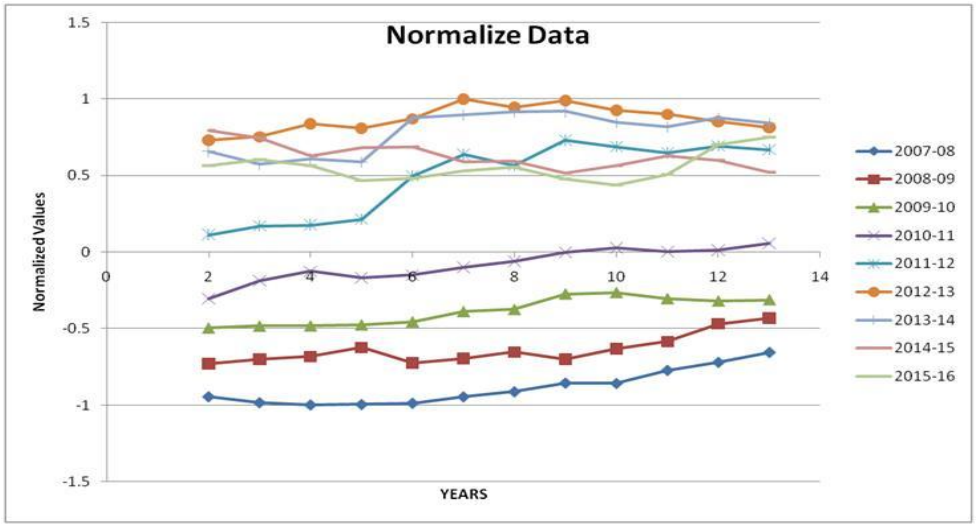


Figure 2.1 : Average Monthly Gold Price Normalized Data

3. Data Analysis

The following combinations were chosen for modeling the artificial neural network for predicting the average monthly gold prices.

(i) Input layers: 3 input layers with tan sigmoid transfer function .

(ii) Hidden layers: Three linear layers

(iii) Output layer: One linear layer with 1 neurons.

The following algorithms were used for the average monthly gold price values of the data set.

(i) Feletcher-powell Conjugate Gradient

(ii) Quasi Newton's

(iii) One Step Secent

(iv) Lenvenberg-Marquardt

(v) Scaled Conjugate Gradient.

The Input data for ANN is average monthly gold price for the past 108 months. The training of the network takes place in the following fashion. The weight update is epoch based, weight remains unchanged till training data set fed into network, compared with desired output and their respective error stored. The cost function for training process are the Mean Square error (MSE) and Root Mean Square Error (RMSE). It is suitable at the end of the training network when minimum level of cost function is observed. If it is observed that there is no significant decrease in the MSE then training experiment is stopped. The following is the Neural Network in figure 3.1.

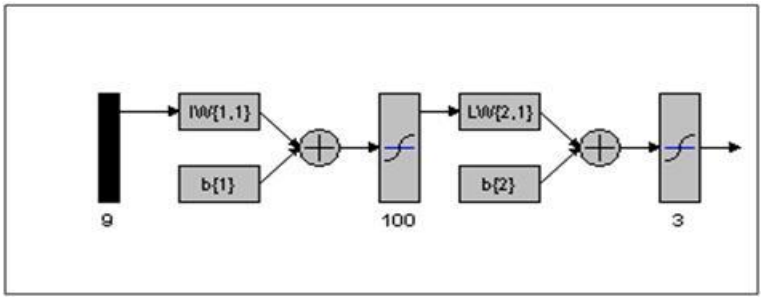


Figure 3.1 : Neural Network View

In training process by using the different algorithms, one of the epoch based training performance shown in following figure 3.2

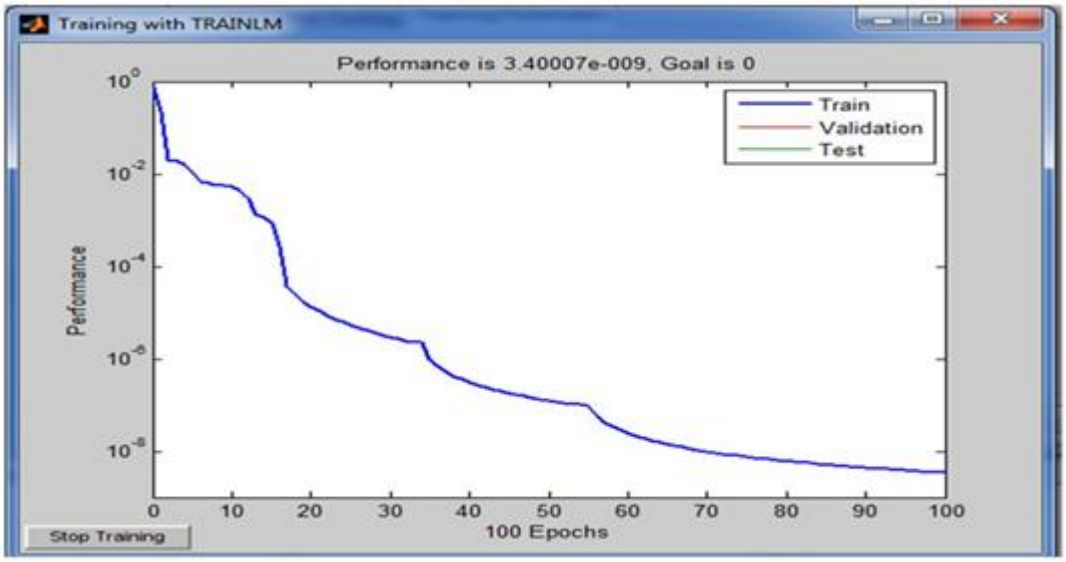


Figure 3.2 : Lavenberg-Marquardt Algorithm Training Process

At the end of training process the weights are frozen for testing the network on input that are set apart from the training set. The predicted average gold price is compared with desired output or actual values of average monthly gold price. The Mean Square Error (MSE) and Root Mean Square Error (RMSE) recorded at each data set.

4. Results and Discussion

According to the Felecher-powell Conjugate Gradient Algorithm the value of Mean Square Error (MSE) is 0.0400399, and the valule of Root Mean Square Error (RMSE) is 0.200099725. According to Quasi Newton's Algorithm the value of Mean Square Error (MSE) is 0.0135256, and value of the Root Mean Square Error (RMSE) is 0.116299613. Simmillarly according to One Step Secent Algorithm value of the Mean Square Error (MSE) is 0.00514037 and value of the Root Mean Square Error(RMSE) is 0.22672384. According to the Lenvenberg-Marquardt Algorithm, value of the Mean Square Error (MSE) is 4.46418E-009, and value of the Root Mean Square Error (RMSE) is 6.68145E-05. According to Scaled Conjugate Gradient Algorithm gives value of the Mean Square Error (MSE) is 0.0541617, and value of the Root Mean Square Error (RMSE) is 0.232726664. Results are found as following table.

Sr. No.	Algorithms	Values of Mean Square Error (MSE)	Values of Root Mean Square Error (RMSE)
1	Feletcher-powell Conjugate Gradient	0.0400399	0.200099725
2	Quasi Newton's	0.0135256	0.116299613
3	One Step Secent	0.000514237	0.022672384
4	Lenvenberg-Marquardt	4.46418E-09	6.68145E-05
5	Scaled Conjugate Gradient	0.0541617	0.232726664

5. Conclusions

The purpose of this paper is to forecast the future average monthly gold prices. From all the above results, we conclude that, by comparing the values of MSE and RMSE of different ANN algorithms, the performance of Lenvenberg-Marquardt algorithms for predicting monthly average gold price data is better than that all used algorithms with value of the MSE is 4.46418E-009 and value of the RMSE is 6.68145E-05.

Acknowledgment

We are grateful to Dr. N. S. Kapse, Dr. R. K. Dase and Mr. G. S. Phad for their help and support. Mr. R. B. Deshmukh is thankful to Department of Science and Technology (DST) New Delhi, India for providing financial support through INSPIRE Fellowship.

References :

[1]. Gray Grudnitski , Lory Osbum "Forecasting S&P and Gold Future Prices:An Application of Neural Networks,"*The Journal of Future Markets,*Vol.13, No.6,pp.631-643,1993.

[2]. T. W. S. Chow and S. Y. Cho "Development of recurrent Sigma-Pi Neural Network rainfall Forecasting System in Hong Kong," *Neural Computing and Applications,* vol. 5, pp.66-75, 1997.

[3]. Shang-Wu Yu "Forecasting and Arbitrage of the Nikkei Stock Index Future : An Application of Backpropagation Networks," *Asia –Pacific Financial Markets,* Vol. 6, pp.341-354, 1999.

[4]. Yan Wang, Liguo Zhang, Yongfu Liu and Jun Guo "Gold Price Prediction Method Based on Improved PSO-BP," *International Journal of u- and e- service ,Science and Technology,* Vol.8,No.11, pp.253-260, 2015.

[5]. Hamideh Moradi, Iman Joker, Ahmed Forouzantabar "Modelling and Forecasting Gold Price Using GMDH Neural Network," *Indian Journal of Fundamental and Applied Life Sciences,* Vol.5,pp.30-41, 2015

[6]. S. Kumar Chandar, M. Sumathi, S. N. Sivanadam "Forecasting Gold Prices Based on Extreme Learning Machine," *International Journal of Computers communications & Control,* Vol.11(3),pp. 372-380, 2016.

[7]. C. Shivpragasam , S. Vanita, Nitin Muttil, K.suganya, S. Suji, M. Thammaraii Selvi, R. Selvi S. Jeya Sudha "Monthly floe Forecast for Mississippi River basin using Artificial Neural Networks," *Neural Computing and Applications,* vol. 6, pp.13-22, 2013.

[8]. Hanh H. Nguyen , Christien W. Chan "Multiple Neural Networks for a long term Time Series Forecast," *Neural Computing and Applications,* vol. 13, pp.90-98, 2004.

[9]. Ismail Saritas "Prediction of Breast Cancer ," *Journal of Medical Systems,* Vol.36, pp.2901-2907,2012.

[10]. Salvatore Campisi-Pinto, Jan Adamowski, Gideon Oron "Forecasting Urban Water Demand Via Wavelet-Denoising and Neural Network Models, Case Study: City of Syracuse, Italy," *Water Resour Manage ,* Vol.26,pp.3539-3558,2012.

[11]. Giorgio Corani , Giorgio Gnariso "An Application of Pruning in the Design of Neural Networks for Real Time Flood Forecasting," *Neural Computing and Applications,* Vol.14,pp.66-77,2005.