2nd ICST 2017

THE EMERGENCE OF SCIENCE FOR HUMAN PROSPERITY AND HEALTH

Joint International Conference on Science and Technology in The Tropic

Organized by:
University of Mataram, Indonesia and University of Malaya, Malaysia

PROCEEDINGS

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PREFACE

Bismillaahirrahmaanirrahiim
Assalaamu'alaikumwarahmatullaahwabarakaatuh.
Peace be upon us.

Praise always we pray to God Almighty for giving us the abundance of grace, guidance and inayah, so that we all can meet here in the "2nd International Conference on Science and Technology (ICST) 2017". The theme of this conference is "The Emergence of Science for Human Prosperity and Health" where this conference is joint international conference between Mataram and Malaya University.

First of all, I would like to welcome you all to West Nusa Tenggara Province specially Lombok Island, "the Island of Thousand Mosques", which is famous to its many natural resource and beautiful tourism destinations where you can enjoy them while attending the conference. This conference will be held for two days, from 23rd to 24th August 2017, and took place in campus of the University of Mataram.

So far, we received one hundred fifty papers from various universities and research institutions in Indonesia and from overseas. The paper have been selected and grouped based on the similarity of the research field, which then are presented and discussed. Presentation of the papers will be held in seven parallel classes and poster presentation. The Selected papers will be published in Malaysian Journal of Science (Special Issue) which index by Scopus, and the rest will be published in the Conference Proceedings. Additionally, selected paper in aquaculture have the opportunity to be published in Jurnal Akuakultur Indonesia.

At this moment, the organizing committee would like to express our gratitude to all of you for your participation on this conference, especially to the all keynote speakers, presenters who have submitted for both oral and posters presentations and also to all participants. Our special gratitude also goes to the Rector of the University of Mataram and Vice Chancellor of Malaya University, who have been highly supporting this conference. Critics and suggestions on the implementation of this conference will be appreciated and as much as possible we will improve the next ICST. Last but not least, the organizing committee would like to thank to all of you who have supported this conference.

Have an enjoyable conference.
Wassalamu'alaikum warohmatullahi wabarakatuh.

Chairman of 2nd ICST 2017

Dr.rer.nat. Lalu Rudyat Telly Savalas, M.Si.

OPENING SPEECH - RECTOR THE UNIVERSITY OF MATARAM
The 2nd International Conference on Science and Technology 2017

Joint International Conference on Science and Technology in The Tropic Beetwen Mataram and Malaya Universiti

Respected Guests,
Keynote speakers,
Conference participants,
and all other participants.

On Behalf of all staffs of the University of Mataram, I welcome you all to Lombok, a beautiful island in West Nusa Tenggara Province, where the University of Mataram is located. Lombok is known for its natural and cultural diversity where you can enjoy traditional cuisines, beaches, waterfalls, mountain, traditional villages and handicraft of many ethnics including Sasak, Samawa, Mbojo, Balinese, Chinese, Arabic, and many others.

As the Rector of the University of Mataram, it is a great honour for me to address the opening of "The 2nd International Conference on Science and Technology" here at the University of Mataram, which will be held from 23rd to 24th August 2017, with a theme "The Emergence of Science for Human Prosperity and Health". The main aim of this seminar is to gather scientist from all over the world to share their ideas, knowledge and experiences and to build network for possible future collaboration.

As we are aware that sharing knowledge and experiences from speakers are extremely valuable in a conference, therefore I would like to express my high appreciation, first, to the keynote speakers from overseas and from Indonesia for their willingness to come to Lombok to share their acknowledged works. Your effort and contribution to this conference are absolutely valuable. Second, my high appreciation also goes to the national speakers and all other participants, including the speakers from University of Mataram and local universities in West Nusa Tenggara Province, your participation in this conference not only will give incredible share of ideas, skills and knowledge that you have, but also will improve the academic environment that we are developing in this university. I hope this conference will be a good forum, not only for communicating and sharing ideas, knowledge and experiences, but also for building networking for future collaboration.

I would also like to take this opportunity to express my appreciation to the sponsors which have given some contribution to this conference. Last but not least, I would like to thank the organizing committee as well as all other supporters and participants, without their effort, commitment and hard work, this conference will not run well.

Finally, I wish you most successful conference, enjoy Lombok Island and hope to see you again in other forum here at the University of Mataram.

Rector of the University of Mataram

Prof. Ir. Sunarpi, Ph.D

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A Neural Network Model for Indonesia's Foreign Reserves Model

Syamsul Bahri

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Abstract

Foreign exchange reserves is one of the important indicator of the macro of the country's economy, including the State of Indonesia. Based on the results of previous research, the foreign exchange reserves is influenced by several factors such as exports, imports, exchange rates, inflation rate, and foreign debt. In this research, the amount of Indonesia's foreign exchange reserves is modelled based on some variables which are exports, imports, exchange rates, and external debt using the neural network model. The performance of neural network model was developed is guaranteed by two indicators are mean of squarer error (MSE) of trainning process and the coefficient of determination. The results of the performance of neural network model are 0.00288 for MSE of trainning indicator and 99.70 % for the coefficient of determination forecasting model indicator.

Keywords: neural network model, foreign exchange reserves, export, import, exchange rate, foreign debt

1. Introduction

Indonesia is one of the countries that are being actively doing development. At this time, Indonesia has been able to become one of the developed countries in the G-20. The success is determined by the success of the nation and state of Indonesia in the development and application of appropriate technology to improve the welfare of the community. In the implementation of development, a very determining factor whether or not a development program is a funding factor. One indicator of the ability of the government in terms of funding is determined by the size of the foreign exchange owned by the state.

In macro economics terms, the country's foreign exchange reserves are one of the important indicators related to the country's ability to conduct international trade. In addition, the country's foreign exchange reserves are also a strong indicator or weak fundamentals of the country's economy, specifically related to the ability to pay imports and state debts, as well as to determine the strength of the exchange rate. In fact, several factors that determine the country's foreign exchange reserves include exports, imports, exchange rates, inflation, foreign debt.

Some researchers have produced a mathematical or statistical model that illustrates the relationship between factors affecting the country's foreign exchange with the country's foreign exchange reserves, especially in Indonesia (Agustina and Reny, 2014; Febriyenti, Aimon, and Azhar, 2013; Sulastini, 2017). However, in the three researchs, the resulting model is a model that considers dependent factors to give a linear influence to the country's foreign reserves, namely Agustina and Reny (2014) using multiple linear regression, and Sulastini (2017) using partial least square method.

On the other hand, the neural network is one of the soft computing techniques that began to be developed around the year 1994 which is a computational technique. Neural network (NN) is a form of deliberately created network that is motivated by the workings of the human brain. This model was originally developed by Warren McCulloch and Walter Pitts in 1943 (Kriesel, 2005: 8; Fausett, 1994: 22). In practice, the NN method is also used in time series analysis for reasons of simple calculation, high interconnection rates, and interaction between adaptive elements (Smith, 1996).

The issue of foreign exchange reserves can be viewed as praying for a problem related to time series data. Therefore, in this study the relationship between predictor factors with the country's foreign exchange reserves is modeled using neural network model.

2. Concept of Neural Network Model

Neural network (NN) is a form of network that deliberately created and motivated by the workings of the human brain (Arbib, 2003:4-6). Information from a number of neurons (inputs) will be sent to a particular neuron. Then by the receiving neuron, the information will be added proportionally based on the value of the connection weights. The sum result will compare with a certain threshold value through the activation function. The Neural network model can be described as in Figure 1.

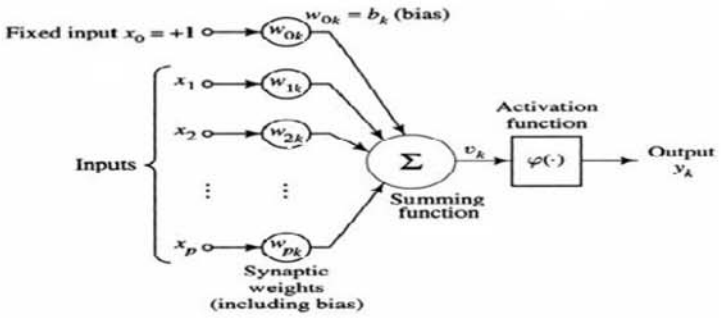

Figure 1. Simple Neural Network Model

The output of the NN model is given by

$$y_k = f(x_1, x_2, \cdots, x_p) = \varphi(g(x_1, x_2, \cdots, x_p)) \tag{1}$$

with $g : R^n \to R$ which is defined as

$$g(x_1, x_2, \cdots, x_p) = v_k = \sum_{j=1}^{n} w_{jk} x_j \tag{2}$$

if $\beta = w_{0k} x_0$ represents the network bias then Equation (2) becomes

$$v_k = g(x_0, x_1, x_2, \cdots, x_p) = \sum_{j=1}^{n} w_{jk} x_j + \beta = \sum_{j=0}^{n} w_{jk} x_j \tag{3}$$

and

$$y_k = \varphi(v_k) \tag{4}$$

Activation function $\varphi : R \to R$ is a function that determines an activated neuron or not, through a process comparing with a certain threshold value. There are basically three basic types of activation functions:

a) The function of the threshold (step function), defined as follows:

$$\varphi(u) = \begin{cases} 1, & \text{jika } u \geq 0 \\ 0, & \text{jika } u < 0 \end{cases} \tag{5}$$

b) *Piecewise-linier function* defined as follows :

$$\varphi(u) = \begin{cases} 1, & \text{if } u \geq \frac{1}{2} \\ u, & \text{if } -\frac{1}{2} < u < \frac{1}{2} \\ 0, & \text{if } u < -\frac{1}{2} \end{cases} \tag{6}$$

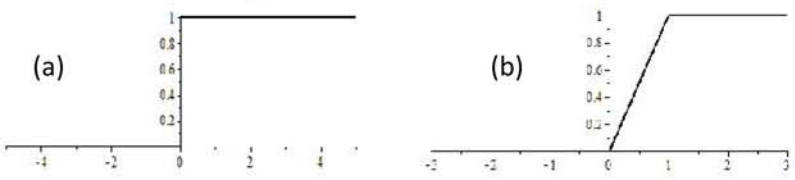

Figure 2. (a) Step Function (b) Piecewise-Linier Function

c) S*igmoid Function*. Function $f : \mathbb{R} \to [0,1]$ is the sigmoid function if it satisfies the following properties: $f \in C^{\infty}(\mathbb{R})$

(i) $\lim_{x\to\infty} f(x) = 1$ dan $\lim_{x\to-\infty} f(x) = 0$

(ii) f is strictly increasing function on $\mathbb{R}$

(iii) f has one inflexion point c with

a. f 'is a strictly increasing function on intervals $(-\infty, c)$

b. $2f(c) - f(x) = f(2c - x)$

Some examples of sigmoid function are logsin, tagsin and purelin. The graph of the three sigmoid functions is given by Figure 3.

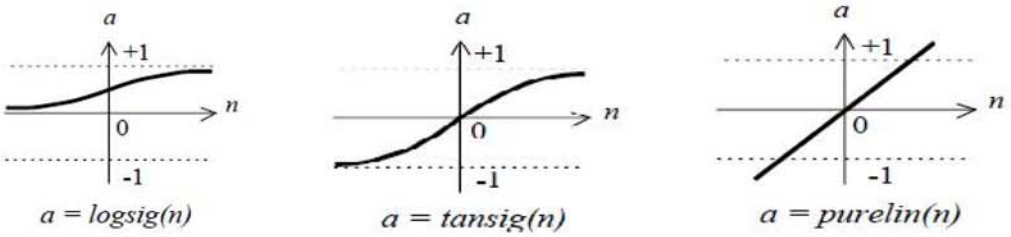

Figure 3. Graph of sigmoid function that serves as an activation function

The architecture of NN model is a graph or chart that represents a learning procedure performed by an NN model. The development of the model of NN architecture illustrates the feed forward process of learning the NN model from the input until the output value is obtained. This architecture shows the structure of the NN model of how many hidden layers, and the number of neurons on each layer of the input, output, and layer layers. In addition, this architecture also shows the process and type of activation function on each layer. The type of architecture of the NN model was developed based on the researcher's interest, ranging from simple to complicated architectures form.

3. Materials and Methods

The Indonesian foreign exchange reserve model shows the relationship between predictor factors (independent variables) and Indonesian national reserves (dependent variable) using neural network model. Data on dependent and independent variables were obtained from Bank Indonesia, the Central Bureau of Statistics, and the World Bank for the period 1975-2016.

The NN model developed is an NN feed forward model consisting of five layers, with three hidden layers. In the first hidden layer (second layer), the activation process uses sigmoid tangent hyperbolic (**tansig**) function. In the second hidden (third layer) use the logarithm sigmoid (**logsig**) function, and on the third hidden layer (fourth layer) using the linear (**purelin**) activation function (Default MATLAB).

4. Results and Discussion

4.1. Architecture of Neural Network Model Proposed

The neural network model architecture for modeling the country's foreign exchange reserves is designed to be five layers, one for each input and output model, and three layers for the hidden layer as shown in Figure 4.

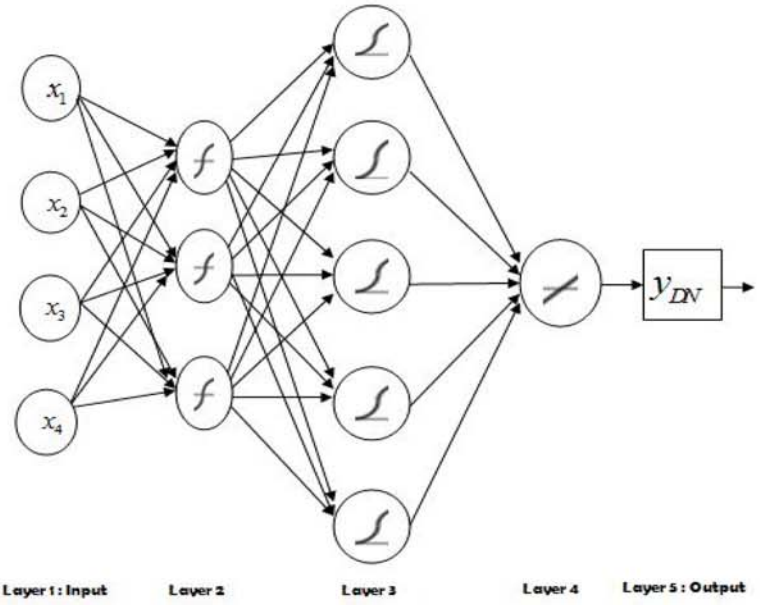

Figure 4. Neural network model architecture for modeling the country's foreign exchange reserves

In Figure 4, it is seen that the NN model architecture for modeling the country's foreign exchange reserves is arranged in five layers:

Layer 1: consists of four neurons representing the number of model inputs, which are export variables, imports, exchange rates, and foreign debt.

Layer 2: consists of three neurons representing the number of clusters of data determined by using substractive clustering method. In this layer, the result of the weighted input value values associated with the first cluster is activated using the sigmoid tangent hyperbolic (tansig) function is:

$$TS(x) = \frac{\exp(x) - \exp(-x)}{\exp(x) + \exp(-x)}. \tag{7}$$

Layer 3: consists of five neurons that are the weighted sum of the second output layer and then activated using the logarithm sigmoid (logsig) function is:

$$LS(x) = \frac{1}{1 + \exp(-x)} \ . \tag{8}$$

Layer 4: consists of a layer which is the weighted sum of the third layer output and then activated using the linear (purelin) function is:

$$PL(x) = ax \ , \tag{9}$$

for some a constant $a \in \mathbf{R}$.

Layer 5: is the value of the foreign exchange reserves of the country which is the ouput model of neural network,

$$y_{DN} = PL\left(LS_j\left(TS_k\left(WX\right)\right)\right), \ j = 1,2,..,5 \text{ and } k = 1,2,3. \tag{10}$$

4.2 Learning Parameters of Neural Network Model

The model of NN proposed is trained by using the type of supervised training. Training NN is done to minimize the cost function (Bahri, Widodo, and Subanar, 2013) :

$$E = \frac{1}{2}\left(y_i - y_i^t\right)^2, \tag{11}$$

with y_i indicates output of the NN model and y_i^t indicates output targets. By using the gradient descent algorithm with momentum, the weight parameters w_{ij}, u_{ij}, and v_j will be updated using equation (12) - (14).

$$w_{ij}(t+1) = w_{ij}(t) + \eta_w \frac{\partial E}{\partial w_{ij}} \tag{12}$$

$$u_{ij}(t+1) = u_{ij}(t) + \eta_u \frac{\partial E}{\partial u_{ij}} \tag{13}$$

$$v_j(t+1) = v_j(t) + \eta_v \frac{\partial E}{\partial v_j} \tag{14}$$

with η_w, η_u, and η_v indicates learning rate parameter for the weight parameters w_{ij}, u_{ij}, and v_j. The value of partial derivatives in equation (15) - (17) are given by the following equations.

$$\frac{\partial E}{\partial w_{jk}} = \frac{\partial E}{\partial y_{DN}} \frac{\partial y_{DN}}{\partial LS_i} \frac{\partial LS_i}{\partial TS_k} \frac{\partial TS_k}{\partial w_{jk}} \tag{15}$$

$$\frac{\partial E}{\partial u_{ij}} = \frac{\partial E}{\partial y_{DN}} \frac{\partial y_{DN}}{\partial LS_i} \frac{\partial LS_i}{\partial u_{ij}} \tag{16}$$

$$\frac{\partial E}{\partial v_i} = \frac{\partial E}{\partial y_{DN}} \frac{\partial y_{DN}}{\partial v_i} \tag{17}$$

Selection value of learning rate parameters to ensure convergence of WNN model are determined by Banakar et al (2008) that is the value of learning rate parameter in equation (12) - (14) which ensures convergence WNN model is

$$0 \le \eta_\rho < \frac{2}{\max_t \left(\frac{\partial y(t)}{\partial \rho(t)} \right)^2}, \quad \rho = w, u, \text{ and } v. \tag{18}$$

4.3. Results and Discussion

The training of NN model with gradient descent with momentum of 20000 epoh gives model performance based on indicator mean squarer error equal to 0,0028815 as in Figure 5.

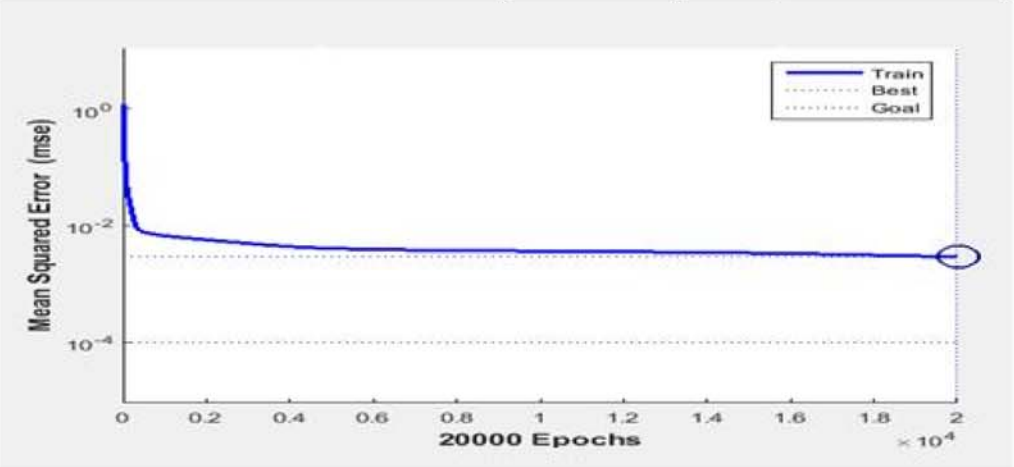

Figure 5. Performance of Model NN is 0.0028815 at epoch 20000.

Figure 6 shows the output regression of the NN model to the actual data of Indonesia's foreign exchange reserves. Based on Figure 6, the coefficient regression of this model is 0.99852, or the coefficient of determination forecasting model is 0.997042.

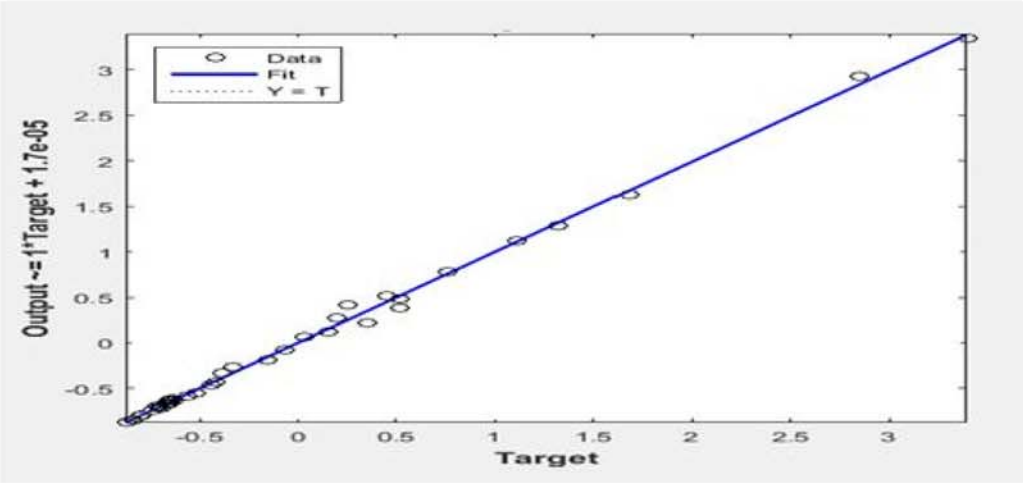

Figure 6. Plot of output regression of NN model with actual data of foreign exchange reserves of state

Compared with result of Sulastini (2017) which produce model forecasting of foreign exchange of state using technique of Partial Linear Square (PLS) with model:

$$CDN=41.218 + 0.528\times X_1 - 2.021\times X_2 - 0.00448\times X_3 + 0.313\times X_4 \ , \qquad (19)$$

with CDN indicates foreign exchange reserves of the country, and X1, X2, X3 and X4 respectively states exports, imports, exchange rates, and foreign debt.

Comparing the result of this research with the Sulastini model shown by the Graph of Figure 7.

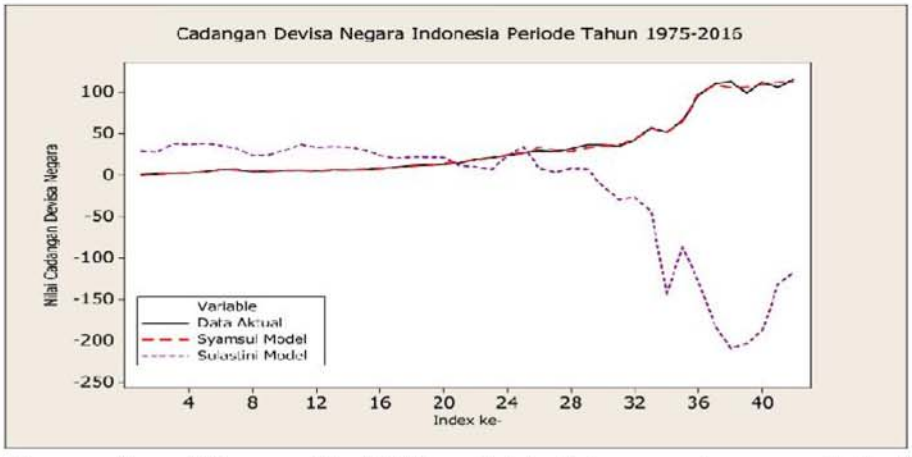

Figure 7. Comparing of the result of NN model in this researh versus Sulastini model.

Based on Figure 7, the forecasting model generated in this study is more accurate than that of Sulastini (2017) using the PLS technique. The performance of the NN model developed in this study is given by Table 1.

Tabel 1 Performance of Neural Network Model Proposed

Characteristic of Model	In-Sample Data					Out-Sample Data			
	Min	Max	MSE	RMSE		Min	Max	MSE	RMSE
	-0.6438	110.12	1.8977	1.3776		99.39	116.36	30.2197	5.4972

Based on Table 1, the NN model performance developed in this study provides accuracy based on the indicator of MSE is 1.8977 or RMSE = 1.3776 for in-sample data, and MSE for out-sample data is 30.2197 or RMSE = 5.4972.

5. Conclusion

The model of forecasting of foreign exchange reserves using the exports, imports, exchange rates, and foreign debt variables generated in this study provides a fairly good accuracy, which is shown by the coefficient of determination forecasting model is 0.997042. Numerically, the performance of the developed model provides accuracy based on the indicator of MSE is 1.8977 for in-sample data and MSE of out-sample data is 30.2197. Graphically, the NN model output developed is quite accurate as shown in Figure 7.

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