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Comparison Forecasting with Double Exponential Smoothing and Artificial Neural Network to Predict the Price of Sugar

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***Abstract* - Forecasting is a method to predict the future using data and the last information as a tool assist planning to be effective and efficient. Research aim to compare forecasting model for double exponential smoothing method and artificial using secondary data price of sugar in weekly by calculating the average price of sugar in seven traditional markets in Depok 2014 to 2016. The program statistics used zaitun time series. The result is using double exponential smoothing Brown Method the value a=0.6 Best model for artificial neural network using 12-8-1. The value of MSE produced by double exponential smoothing method of Brown is 403282 while the Artificial of Neural Network method 15341.2 The value of MAPE using double exponential smoothing method 1.12 while Artificial Neural Network is 0.74. The Conclusion that Artificial Neural Network method is more appropriate the predict forecasting average price of sugar in Depok.**

Keywords - double exponential smoothing brown, artificial neural networks, MSE, MAPE, forecasting

I. INTRODUCTION

Forecasting is an attempt to predict the future based on scientific method (science and technology) systematical. So it can determine when an event occurs can be the right decision. Forecasting is necessary if there is a long time and the future condition or events are influenced by controlled factors [1]. Some researchs are researched time series forecasting using statistical methods neural network, wavelet and fuzzy system. Forecasting models based on statistical mathematical models such as moving average, exponential smoothing, regression (parametric and non parametric). The most frequently is ARIMA (Box Jenkins). Forecasting models based on artificial intelligent neural network, genetic algorithms, simulated annealing, genetic programming classification and hybrid. These methods have distinct disadvantages and advantages. The problem in the real are often complex problems one problem may not be able to solve it well [2] for that has been done to compare the accuracy of forecasting results which influence the selection of for casting models are the identification and understanding of historical data horizon of time [7].

A good forecasting method is a method that produces accurately, timely, understandable, so the forecast produces a better prediction, not a forecasting method with advanced methodology [8]. Research using last data indicating a trend pattern and non stationary, would be appropriate when using the method of double exponential smoothing method is to use relatively little data, fewer parameters are used double exponential smoothing consists of two methods namely holt and Brown method. Both of these can be used on trend patterned data the difference in smoothing parameters used calculation equation of two parameters (Smoothing and trend) Brown forecasting using exponential smoothing.

Hot method is obtained more precisely than Brown, because the value of MSE produced smaller [10] than Brown. Artificial Neural Network method is based on Artificial intelligence, the advantages of Artificial Neural Networks that can be need to solve the of forecasting in a long period of time and high degree of accuracy [11]. Artificial neural network provide better result when compared with conventional methods in monthly forecasts as well as in certain quarter of time [12]. In predicting demand for healthy drink with Neural Network method is more precise than time series method, because it produces smaller MSE [13].

Based on this, research will be compared of double forecasting model exponential smoothing and artificial neural network forecasting. The data is used in this research is the average data of sugar price in weekly period in Depok from January 2014 to December 2016 (156 data).

II. RESEARCH METHOD

Data collection methods is used in this study in non participant observer, researchers only observe data that is available without participating into part of data system. The data needed is the average data of price of sugar is taken from 7 markets in Depok in weekly period. Based on the available data, the forecasting will be done by double exponential smoothing method and ANN (Artificial Neural Network) The existing data is divided into two parts are the model period (in-sample) of 156 data, in the period (out sample) of 52 data in 2017.

Model formation is done using the data in the model period after having the best result the method, then do each. Forecasting with the model to determine the performance of forecasting. It is made the comparison of the result of the data in period of forming the model (in sample) in testing period (out sample) by using MSE (Mean Square Error) the value of MSE and MAPE (Mean Absolut Percentage Error) the value of MSE and MAPE from the method is used to be compared to get smaller error than other method. Frame work above is presented in figure 1 below

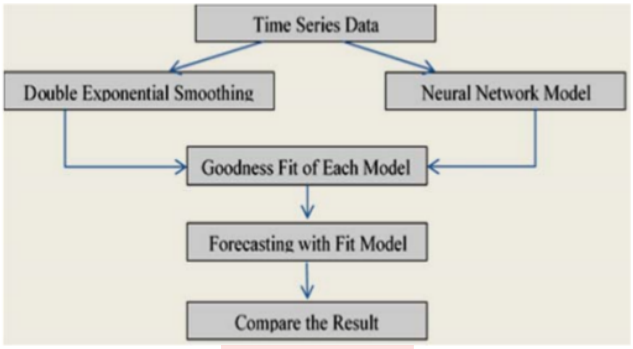

Figure1. Forecasting model

Based on the framework in figure 1, general outline of this study is to prepare time series data, analyzing data using double exponential smoothing method and artificial neural network to determine the suitable model for existing data and test each model by looking at the value of MSE and MAPE, then do the forecasting by using suitable model. For data processing and data analysis use Zaitun time series Software version 0.21 which is a special software which developed for time series analysis.

A. Double Exponential Smoothing (Brown) Method

This method is commonly used for data containing linear trend. This method is often called also a one parameter linear method from Brown. The similar is used in this method are:

$$Sn'' = \alpha Sn' + (1-\alpha)\, Sn-1'' \quad (1)$$

B. Double Exponential Smoothing (Holt) Method

This method is in principal similar to Brown's method only, in Holt Method to smooth the trend value using different parameters from the original series.The predict of the exponential smoothing (between 0 and 1). The following three equations:

$$S_n = \alpha Y_n + (1-\alpha)(S_{n-1} + T_{n-1}) \quad (2)$$

$$T_n = \gamma(S_n - S_{n-1}) + (1-\gamma)T_{n-1} \quad (3)$$

$$Y_{n+m} = S_n + T_n.m \quad (4)$$

C. Artificial Neural Network Method

Artificial Neural Network is process of information system has characteristics similar to biological nerves. The artificial neural network is formed as a generalization of the mathematical model of biological neural network, assuming that information processing in many simple elements (neurons):

a. The signals are sent between the neurons through the connectors.

b. The connection between neurons have contain (weight) that will strength then or weaken the signal.

c. To determine the output, each neuron uses an activation function (usually not a linear function) the sum of inputs received the member of outputs are compared to the quantity.

Threshold of the artificial neural network (threshold) determined by three things:

a. Pattern relationship between neurons (architecture network)

b. Method for determining linking weight (training method / Learning algorithm).

c. The activation function the artificial neural network model is used as in figure 2.

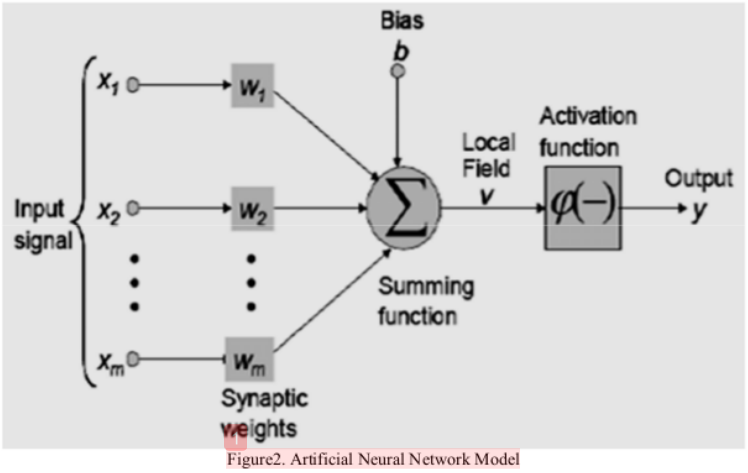

Figure2. Artificial Neural Network Model

In figure 2, X_1 to X_m is the 1st to m. In the hidden layer or synaptic weights, there are 5 hidden units. W1 to Wm where as in (output neuron), there is Y. The modeling procedure with ANN (Artificial Neural Network) generally consists of four steps are data preparation, selections and testing. Back propagation Neural Networks of supervised learning algorithms is commonly used by perception with multiple layer two convert neuron related weight to hidden layers [14, 15].

On network algorithms back propagation artificial neural is used binary sigmoid activation function of binary between up to 1, but the sigmoid function never reaches 0 or 1. The binary sigmoid activation is formulated in (5) below: [16-18]

$$f(x) = \frac{1}{1+e^{-ax}} \quad (5)$$

In the feed forward, network (advanced) training is done in order calculate the weight so that at the end of the training will be obtained good weights training process, weight are arrange iteratively to minimize errors. The error is calculated based on the squared error (MSE) the average squared error is also used as the basis for calculating the work of the activation function (MSE) is calculated using equation (6) :.

$$MSE = \frac{\sum_{i=1}^{n} e_i^2}{n} \quad (6)$$

With:

e_i^2 = the difference between the target value with the value of the output prediction

n= trainings data.

- Experiment and Data Set

The data of this research are primary data of sugar price/kg in seven traditional markets in Depok 1st week of 2014 until last week of December 2016 (156 data) as training data (in-sample),data of the first week of January 2017 to December 2017 (52 data) data forecasting (out-sample). The data is processed with Zaitun Time Series version 0.2.1 to obtain the form of forecasting model and double exponential smoothing and artificial neural network which is suitable to predict the average price of sugar in Depok 2017.

III. RESULTS AND ANALYSIS

In this research comparasion forecasting with Double Exponential Smoothing And Artificial Neural Networkto predict price of sugar with visualization Data Plot cycle the average of sugar price, Result of Data Analysis, Forecasting Model with the best Double Exponential Smoothing Brown and Holt Method, *Forecasting Model With* Neural Network Method With the Following Summary of Neural Network Model Result of Various forms of Network Architecture, Comparison Double Exponential Smoothing Holt Method and Artificial Neural Network Method, and Forecasting Result With The Best Forecasting Model.

A. Data Plot Cycle the Average of Sugar Price

To know visually the pattern of the average sugar price data 2014-2016, can be seen from the time series plot in figure 3 below:

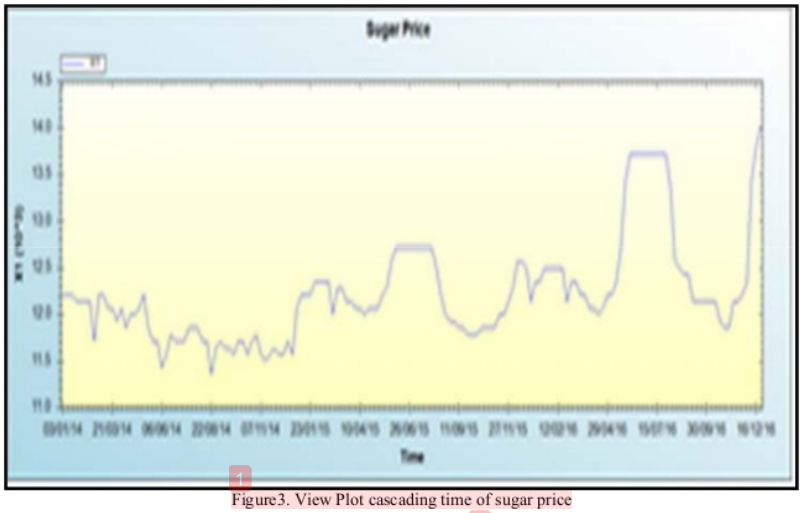

Figure3. View Plot cascading time of sugar price

From the figure 3 the data fluctuate and not stationary.

B. Result of Data Analysis

With double exponential smoothing brown method, brown double exponential smoothing method uses only one parameter α and MSE on Double Exponential Smoothing Brown method based on computer calculation simulation to get the most suitable model.

Figure4. Comparison of parameter α.

Based on figure 4, it can be calculated that the simulation result determines the best smallest MSE value is α =0,6 that the result of parameter α is summed that the value of α and γ the parameter can be value of image comparison of figure 4

C. Data Analysis with Double Exponential Smoothing Holt Method

Double method exponential smoothing Holt uses the double exponential smoothing. This method passes the original values and trend using different parameters. Forecasting uses value and sugar value, comparison

parameters α and γ (with value 0 and 1). There are comparison parameters α, γ and MSE on Double Exponential Smoothing Holt Method based on computer calculation simulation to get the most suitable mode.

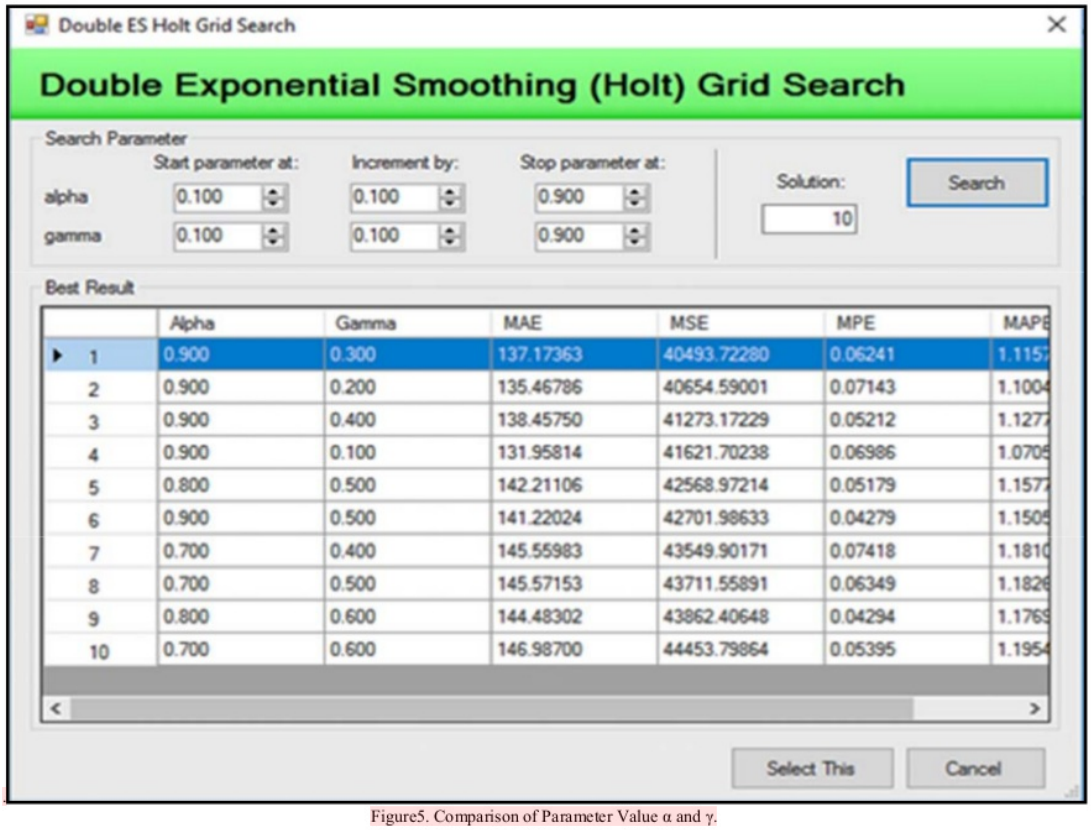

Figure5. Comparison of Parameter Value α and γ.

Based on figure 5, it can be conclude that the simulation result gives the best parameter value for Double Exponential Smoothing Holt method is α=0,9 and γ=0,3 with the smallest MSE value that is 137,47.

D. Forecasting Model with the best Double Exponential Smoothing Brown and Holt Method

After knowing the value of parameter value that is will be made forecasting model based on result of parameter. The following summarize the results of the forecasting model of ethics with the most Double Exponential Smoothing method

FORECAST MODELLING WITH DOUBLE EXPONENTIAL SMOOTHING		
Variable : X1 (Average of Sugar Price)		
Included Observation : 156		
MODEL	DOUBLE ES (BROWN)	DOUBLE ES (HOLT)
Smoothing Constant		
Alpha (for data)	0.6	0.9
Gamma (for trend)	-	0.3
Accuracy Measures		
Mean Absolute Error (MAE)	137.843041	137.173828
Sum Square Error (SSE)	6250869.878	6317020.757
Mean Squared Error (MSE)	40328.19276	40493.7228
Mean Percentage Error (MPE)	0.03	0.062406
Mean Absolute Percentage Error (MAPE)	1.12	1.115712

Figure6. Forecasting Model Double Exponential Smoothing the best parameter value

Based on figure 6, it can be concluded that the form of suitable forecasting model to predict the average price of sugar is double Exponential smoothing Brown forecasting has a smaller MSE value than the Double Exponential Smoothing Holt model which amounted to 40328,19 and MAPE of 1.12.

E. Forecasting Model with Neural Network Method with the Following Summary of Neural Network Model Result of Various forms of Network Architecture.

FORECAST MODELLING WITH NEURAL NETWORK									
Variable : X1 (Average of Sugar Price)									
Included Observation : 144 (After Adjusting Endpoints)									
Network	I	II	III	IV	V	VI	VII	VIII	IX
Input Layer	12	12	12	12	12	12	12	12	12
Hidden Layer	4	5	6	7	8	9	10	11	12
Output Layer	1	1	1	1	1	1	1	1	1
Activation Function	Bipolar Sigmoid	Bipolar Sigmoid	Bipolar Sigmoid	Bipolar Sigmoid	Bipolar Sigmoid	Bipolar Sigmoid	Bipolar Sigmoid	Bipolar Sigmoid	Bipolar Sigmoid
Back Propagation									
Learning Rate	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Momentum	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Criteria									
Error	0.745759	0.534998	0.693469	0.757631	0.471372	0.516671	0.509641	0.456346	0.454444
MSE	23902.2104	20298.303	22456.6997	23757.8769	15341.159	16740.921	16617.6169	16205.4632	15632.3059
MAE	112.189758	109.68242	107.020084	111.861204	90.309517	95.480796	92.140536	92.939854	91.571824

Figure7. Forecast modeling with Neural Network of Varous forms of Network Architecture

Based on figure 7, it can be concluded that the most suitable and good forecasting model is the artificial neural network model with 12-8-1 architecture, the number of 12 layer of 12 neurons, the hidden layer of 8 neurons and the output layer of 1 neuron. The activation function used is Bipolar Sigmoid, learning rate of 0.05 and momentum of 0,5. Calculation of the weight is done as much as 10000 iterations. MSE obtained from the forecasting model is 15341.16 and MAPE is 0.74. The result is quite well and can be used to predict to value of variable X1 is the average price of sugar in Depok 2017.

F. Comparison Double Exponential Smoothing Holt Method and Artificial Neural Network Method

A comparison between the Brown method and artificial neural network method is used to find the best method. Comparison of method based on MSE and MAPE value with actual values generated by both methods.

The Value of MSE produced by Brown method is 151376.63, while the artificial neural network method is 14010.27, so it can be concluded that the smallest MSE value obtained artificial neural network method.

Average absolute percentage error (MAPE) of 1.12, in the double exponential smoothing model. While the average presentation of absolute error model of artificial neural network is 0.74. Based on MSE value and the absolute percentage of error rate (MAPE) it can conclude that the artificial neural network method is better than double exponential smoothing Brown method.

G. Forecasting Result with the Best Forecasting Model

Based on the best forecasting model the artificial neural network will calculated the prediction value or average forecasting of the average model of sugar in Depok 2017

FORECAST VALUE WITH THE BEST MODEL

NO.	PERIODE	FORECAST	NO.	PERIODE	FORECAST
1	31/12/16	13835.1816	27	1/7/2017	12875.6891
2	7/1/2017	13892.0661	28	8/7/2017	13800.794
3	14/01/17	13824.7881	29	15/07/17	13904.8908
4	21/01/17	13730.2385	30	22/07/17	13804.313
5	28/01/17	13736.5343	31	29/07/17	13783.113
6	4/2/2017	13788.3352	32	5/8/2017	13858.1405
7	11/2/2017	13770.8767	33	12/8/2017	13752.4935
8	18/02/17	13515.7958	34	19/08/17	13765.4968
9	25/02/17	12703.1949	35	26/08/17	13790.0909
10	4/3/2017	12434.0852	36	2/9/2017	13824.6898
11	11/3/2017	12476.8349	37	9/9/2017	13706.2976
12	18/03/17	12477.1083	38	16/09/17	13041.3283
13	25/03/17	12257.9646	39	23/09/17	12459.051
14	1/4/2017	12169.2869	40	30/09/17	12438.9152
15	8/4/2017	12229.2788	41	7/10/2017	12486.0614
16	15/04/17	12392.8552	42	14/10/17	12325.0156
17	22/04/17	12421.0666	43	21/10/17	12193.414
18	29/04/17	12226.8954	44	28/10/17	12158.6892
19	6/5/2017	11878.4108	45	4/11/2017	12331.1005
20	13/05/17	11667.7756	46	11/11/2017	12507.778
21	20/05/17	11762.3693	47	18/11/17	12491.5514
22	27/05/17	11819.0741	48	25/11/17	12202.7538
23	3/6/2017	11844.188	49	2/12/2017	11879.698
24	10/6/2017	11812.4318	50	9/12/2017	11860.1915
25	17/06/17	11886.0306	51	16/12/17	11963.9837
26	24/06/17	12208.9163	52	23/12/17	12081.7241

Figure8. Using the best Model

Based on the figure 8 above it can be calculated that the average network price of sugar/kg in Depok 2017 the layer is 12770.17 in Rupiah.

IV. CONCLUSION

Based on the result, can be conclude that the best forecasting model to predict the average price of sugar/kg in Depok prediction is model for artificial neural network forecasting with architectural 12-8-1 Bipolar Sigmoid. The value of MSE obtained is 15341.16 and MAPE is 0.74. With the best model it can be predicted the average price of sugar/kg in Depok 2017 is 12770.17 in Rupiah.

REFERENCES

[1] Robert A. Yaffee and Monnie McGee, "Introduction to Time Series Analysis and Forecasting with Applications of SAS and SPSS", Academic Press Inc, New York, 1999.

[2] Faruk DO, "A Hybrid Neural Network and ARIMA Model for Water Quality Time Series Prediction", Eng App Intelligence. 23:586-594, 2010.

[3] Z. Tang, et al (1991), "Time Series Forecasting Using Neural Networks vs Box–Jenkins Methodology", Simulation 57, 303–310, 1991

[4] Atok, R.M. and Suhartono. Comparison between Neural Networks, ARIMA Box-Jenkins and Exponential Smoothing Methods for Time Series Forecasting. Research Report, Lemlit: Sepuluh Nopember Institute of Technology, 2000

[5] Suhartono, et al., "A Comparative Study of Forecasting Models for Trend and Seasonal Time Series: Does complex model always yield better forecast than simple models?", JURNAL TEKNIK INDUSTRI: Jurnal Keilmuan dan Aplikasi Teknik Industri, Vol. 7, No. 1, pp. 27-41, 2005

[6] Ayodele Ariyo Adebiyi, Aderemi Oluyinka Adewumi, and Charles Korede Ayo, "Comparison of ARIMA and Artificial Neural Networks Models for Stock Price Prediction," Journal of Applied Mathematics, vol. 2014, Article ID 614342, 7 pages, 2014. doi:10.1155/2014/614342

[7] Hanke, J.E., Wichern, D.E, "Business Forecasting", Eight Edition. Pearson Education Inc: New Jersey, 2005

[8] Jan G. De Gooijer and Rob J. Hyndman,"25 years of time series forecasting", International Journal of Forecasting 22, 443– 473, 2006.

[9] Makridakis, S., Wheelwright, S. C., & Hyndman, R. J., "Forecasting: Methods and Applications", New York, John Wiley & Sons, 1998.

[10] Nazim A. and Afthanorhan A., "A Comparison Between Single Exponential Smoothing (SES), Double Exponential Smoothing (DES), Holt's (Brown) and Adaptive Response Rate Exponential Smoothing (ARRES) Techniques in Forecasting Malaysia Population", Global Journal of Mathematical Analysis, 2 (4), 276-280, 2014

[11] Khashei, M., Bijari, M., "An Artificial Neural Network (p,d,q) Model For Timeseries Forecasting", Expert System with Application: An International Journal, 2010

[12] Hill, T., O'Connor, M., and Remus, W., "Neural Network Models For Time Series Forecast", Management Science, 1996

[13] Ani Shabri, 2001,"Comparison of Time Series Forecasting Methods Using Neural Network and Box-Jenkins Model", Jurnal Matematika University Teknologi Malaysia, Jilid 17 bil. 1, hlm. 25-32.

[14] Tsung- Lin Lee, " Backpropagation Neural Network for The Prediction of The Short-Term Storm Surge in Taichung Harbor, Taiwan, Engineering Applications of Artificial Intelligence, vol. 21, issues 1, pp. 63-72, 2008.

[15] K.Manikya Kanti, P. Srinivasa Rao, " Prediction of Bead Geometry in Pulsed GMA Welding Using Backpropagation Neural Network", Journal of Materials Processing Technology, vol. 200, issues 1-3, pp. 300-305, 2008.

[16] Mehdi, K. and Mehdi, B.,"A Novel Hybridization of Artificial Neural Networks and ARIMA Models for Time Series Forecasting", Applied Soft Computing 11, 2664–2675, 2011.

[17] G. Zhang and M. Qi, "Neural Network Forecasting for Seasonal and Trend Time Series," European Journal of Operational Research, vol. 160, no. 2, pp. 501–514, 2005.

[18] Stamos T. Karamouzis, Andreas Vrettos,"An Artificial Neural Network for Predicting Student Graduation Outcomes", Proceedings of the World Congress on Engineering and Computer Science, 2008

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