

Prediksi Inflasi Indonesia Memakai Model ARIMA dan Artificial Neural Network

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Abstract— Inflation is a macroeconomic indicator that is very important. Various kinds of Indonesian inflation prediction methods have been published. However, the search for more accurate inflation prediction methods is still an interesting topic. This writing is proposed a new method for predicting inflation using the ARIMA and Artificial Neural Network (ANN) models. The inflation data used is monthly inflation data year-on-year from 2010 to 2018 issued by the Central Statistics Agency (BPS). The first two ARIMA models are made, the ARIMA model without annual cycles and with annual cycles. Standard procedures and diagnostics tests have been carried out including: summary of statistics, analysis of variance (ANOVA), significance of coefficients tests, residuals of normality, heteroscedasticity, and stability. From the results of the performance comparison using the Root Mean Squared Error (RMSE), it was found that the ARIMA model with an annual cycle was better. Those models were an ARIMA model (2,1,0) (2,0,0) [12]. Then, to improve the performance of inflation predictions, ANN has been made based on the ARIMA model. The ANN model used one hidden layer and two neurons. The test resulted show that the ANN model produced RMSE which was smaller than the ARIMA model (2,1,0) (2,0,0) [12]. This is probably due to the ability to process nonlinear relationships between target variables and explanatory variables.

Index Terms— Prediction, Artificial Neural Network, Arima, Anova, R programming.

I. INTRODUCTION

Macro-economic indicators, inflation is very important in the world of business and economics. For the economists and entrepreneurs it is becoming a major concern because it is closely related to the value of the currency. By observing the various indicators of the impact of rising inflation, by looking at the data of the previous prediction of inflation can be done with various methods. A variety of methods of prediction of Indonesia's inflation has been published. However the search method more accurate inflation prediction is still a topic of interest. A variety of methods to study the data in a time series prediction. With time series data prediction methods, can study the patterns of data that has been sorted by time. After it built a model predictions based on the patterns of the data. To find the best prediction model can be done by looking at the error level generated, where if a smaller error value is the best model [1][2].

In previous studies said that the results of the forecasting method using ARIMA is able to follow the movement of the actual data of the rate of inflation in journal articles [3]. In other research concluded that getting the length frequency of forecasting the forecasting results will be more accurate and less likely to be a constant visible from upper and lower the value of getting away from the line of the forecast [4]. Basically, good software R or minitab both can be used for forecasting ARIMA. However, it is noted that the level of R software accuracy better than software minitab in terms of test stasioneritas [5].

Artificial Neural Network algorithm will produce optimal results when using the data attribute that is more [6] Previous researchers did predictions of inflation in Indonesia using ANN with 4 variables include interest rates, the money supply, the value of the exchange rate and stock price [7].

This will be used on the research method of prediction models of ARIMA (Autoregresif Integrated Moving Average) and ANN (Artificial Neural Network). ARIMA was the model predictions by studying one of the independent variable to see the value of the past in the predictions. While ANN is a model that can learn a lot of variables in a prediction. So the merger of ARIMA and ANN, give better results compared to the models individually. This is apparent in the pseudo test in January 2010 to December 2017 with the membandingan result of ARIMA, ANN and ARIMA-ANN with the actual data of the year 2018. The data used are the data of inflation year on year from January to December 2010 year 2018 of Bank Indonesia and the Central Bureau of statistics.

II. RESEARCH METODOLOGY

The first pengimputan data from Indonesia year Inflation February 2010 to December 2018, (time series data). The process of merging the motede outline can be seen in Figure 2.1.

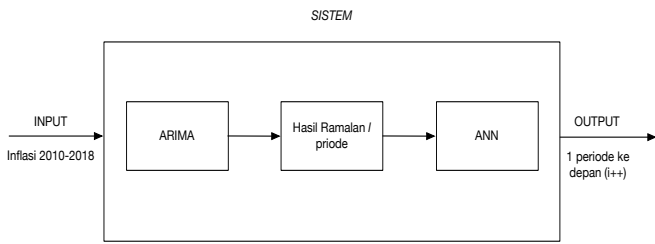


Figure 2.1 system architecture prediction of ARIMA-ANN [8]

System architecture the prediction of ARIMA-ANN is the incorporation of methods ARIMA and ANN [8]. Data entered in ARIMA for 8 years that means 96 months (input value) data from the year January 2010 to December 2018. Of the process of pengimputan the data, then do the predictions using the data which is the result of a process of ARIMA[9], first data prediction uses ARIMA analysis in advance using the ANOVA (Analysis of Variance) that serves to test the difference more than two groups so that the output of the process is the best model ANN by looking at the value of the error is generated. The value of a smaller error value is the best model. Step-step flowchart process ARIMA-ANN can be seen in Figure 2.2.

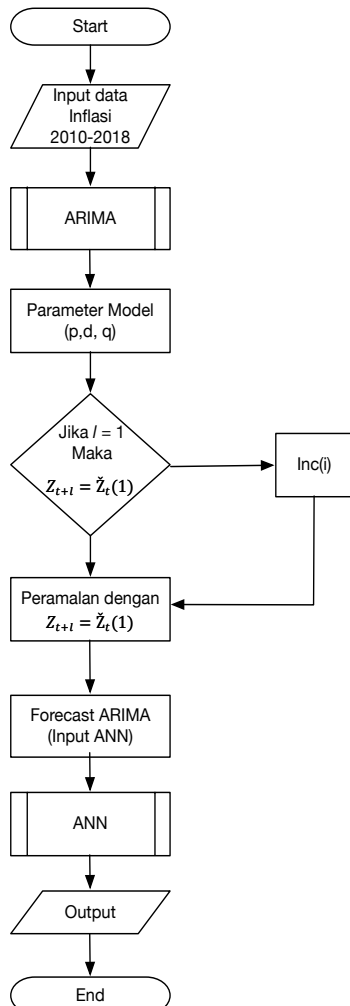


Figure 2.2 Flow Diagram Process of Arima-ANN [8]

Figure 2.2 measures as follows:

- Data input inflation than in January 2010 to December 2018, 108 months or Years using software R Studio.
- The selection of the best models using the autoarima function on R which software obtained models ARIMA (2, 1, 0) (2, 0,0) [12].
- The results of the forecasting process of ARIMA in the ANN through ANOVA function first.
- If the level of significance value P-Value = 0.05 then arguably < qualify. 5% shows the data on normal distribution.
- The output of the merger of ARIMA-ANN.

III. RESULTS AND DISCUSSION

Data obtained from this research as much as 96 record inflation data from January 2010 to December 2018, some data on the use of data for training and testing data.

A. The data used

The data used for the input on this research consists of: 1. The interest rate 2. The unemployment rate of 3. Gross Regional domestic product of South Sulawesi, 4. Indonesia gross domestic product 5. South Sulawesi Regional Minimum wage 6. The selling exchange rate of 7. Buy rate, whereas the data for Inflation data is output in Indonesia than in 2010-2018. The software used to do forecasting RStudio is Software Version 1.1.463.

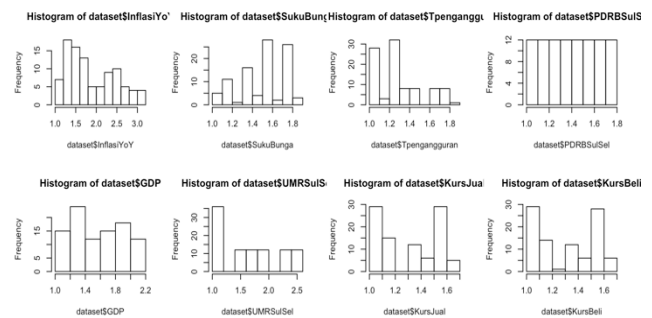


Figure 3.1 Plot hist dataset

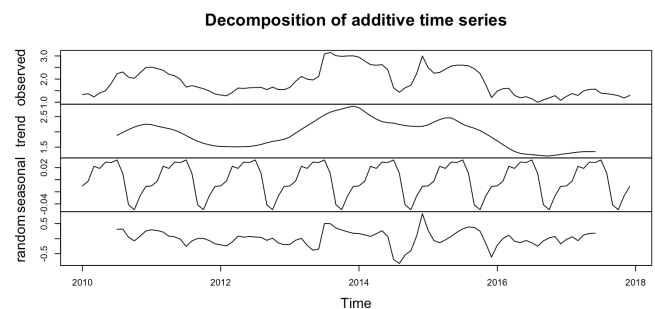


Figure 3.2 Plot decompose Inflasi year on year

B. Arima Model

The results of modelling of Arima in the show in Figure 3.3 and 3.4. Figure 3.3 shows the ACF and PACF of inflation from January 2010 to December 2018 2017. Figure 3.4 (a) shows the actual Inflation (January 2010 until December 2017) and inflation Estimation (January 2010 until December 2017). Figure 3.4 (b) shows the actual Inflation (January to December 2018 2018) and Pseudo Inflation Predictions (January to December 2018 2018) using ARIMA (2, 1, 0) (2, 0, 0) [12], [10] [11].

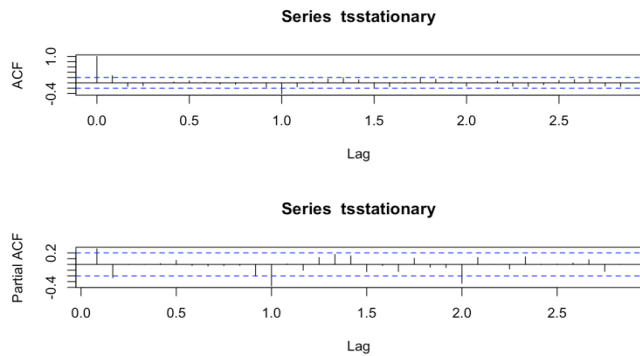


Figure 3.3 Plot ACF dan PACF

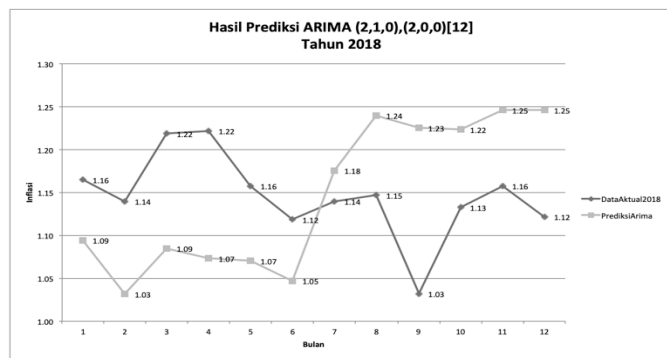


Figure 3.4 Plot Results Prediction of ARIMA 2018

TABLE I
A COMPARISON OF THE VALUE ERROR ARIMA

Peri od	Aktual 2018	ARI MA	Error	Abloute Value of Error	Square of Error	AbsoluteValues of Error Divided by Actual Values
t	At	Ft	At-Ft	At - Ft	(At-Ft)^2	(At - Ft) / At
1	1,16	1,09	0,07	0,07	0,00	0,06
2	1,14	1,03	0,11	0,11	0,01	0,10
3	1,22	1,09	0,13	0,13	0,02	0,11
4	1,22	1,07	0,15	0,15	0,02	0,12
5	1,16	1,07	0,09	0,09	0,01	0,08
6	1,12	1,05	0,07	0,07	0,01	0,06
7	1,14	1,18	-0,04	0,04	0,00	0,03
8	1,15	1,24	-0,09	0,09	0,01	0,08
9	1,03	1,23	-0,19	0,19	0,04	0,19
10	1,13	1,22	-0,09	0,09	0,01	0,08
11	1,16	1,25	-0,09	0,09	0,01	0,08
12	1,12	1,25	-0,12	0,12	0,02	0,11
Total			-0,01	1,25	0,15	1,09

The results of a prediction model using Arima (2, 1, 0), (2, 0, 0) [12] shows the value of the MAPE of 9.12%, MAD 0.10, MSE 0.11 and RMSE 0.01.

C. ANN Model

The results of modeling of ANN in show on Figure 3.5 and 3.6. Figure 3.5 shows a Plot of the Data With ANN Hidden Layer Neurons 1, 3 from the Inflation data (January 2010 to December 2018 2017). Figure 3.6 (a) shows the actual Inflation (January 2010 until December 2017) and inflation Estimation (January 2010 until December 2017 Demesber) Figure 3.6 (b) shows the actual Inflation (January to December 2018 2018) and Pseudo Inflation Predictions (January 2018 to December 2018) using model 1 hidden layer neurons 3 [12][13].

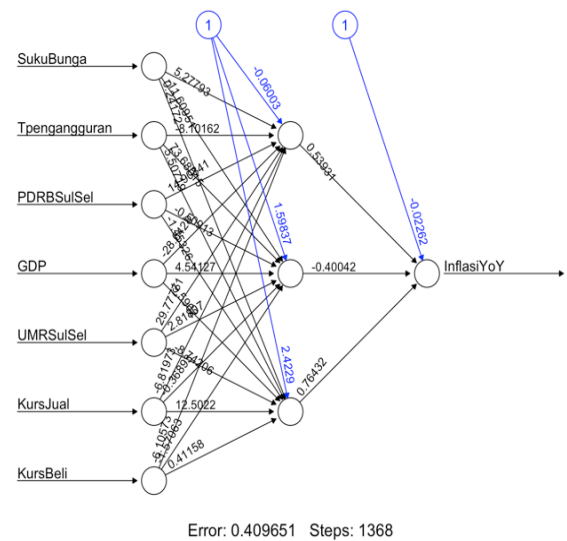


Figure 3.5 Plot Neural Model 1 Hidden Layer 3 Neuron

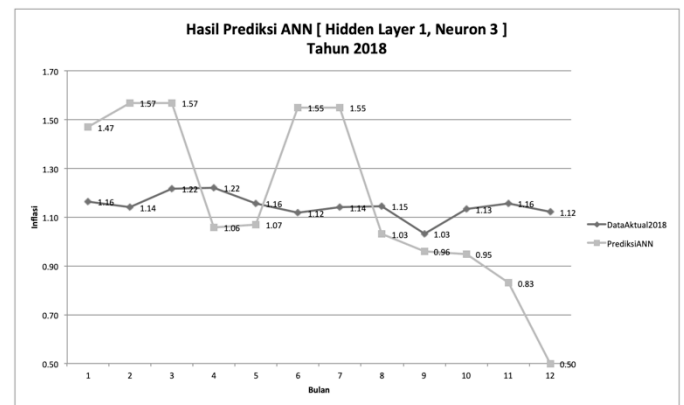


Figure 3.6 Plot Results Prediction of ANN 2018

TABLE I
A COMPARISON OF MODEL ANN

No	Model	MSE
1	1 Hidden layer 1 Neuron	2,81
2	1 Hidden layer 2 Neuron	2,56
3	1 Hidden layer 3 Neuron	1,88
4	2 Hidden layer 1 Neuron	2,70
5	3 Hidden layer 2 Neuron	3,16
6	3 Hidden layer 1 Neuron	2,19
7	4 Hidden layer 1 Neuron	1,96
8	5 Hidden layer 3 Neuron	1,89

Comparison of model ANN in the table I shows that the model ANN with one Hidden layer and 3 Neurons is the best model, it is proved with lower MSE values with values of MSE amounted to 1.88.

TABLE II
A COMPARISON OF THE VALUE ERROR ANN

Peri od	Aktual 2018	ANN	Error	Ablolute Value of Error	Square of Error	Absolute Values of Error Divided by Actual Values
t	At	Ft	At-Ft	At - Ft	(At-Ft)^2	(At - Ft) / At
1	1,16	1,47	-0,31	0,31	0,09	0,26
2	1,14	1,57	-0,43	0,43	0,19	0,38
3	1,22	1,57	-0,35	0,35	0,12	0,29
4	1,22	1,06	0,16	0,16	0,03	0,13
5	1,16	1,07	0,09	0,09	0,01	0,08
6	1,12	1,55	-0,43	0,43	0,19	0,39
7	1,14	1,55	0,41	0,41	0,17	0,36
8	1,15	1,03	0,12	0,12	0,01	0,10
9	1,03	0,96	0,07	0,07	0,01	0,07
10	1,13	0,95	0,18	0,18	0,03	0,16
11	1,16	0,83	0,33	0,33	0,11	0,28
12	1,12	0,50	0,62	0,62	0,39	0,55
Total			-0,36	3,50	1,34	3,05

A comparison of the value of the error in the table II model using ANN, 1 hidden layer and 3 Neurons showed the value MAD = 0,29, MSE = 0,11, RMSE = 0,33, MAPE = 25,44.

D. Results Prediction

The results of Modeling the merger Model ANN-ARIMA at the show in Figure 3.7 and 3.8. Figure 3.7 shows the Plot Data ANN With the input 2 pieces Hidden Layer Neurons 1, 2/1 from the inflation data (January 2010 to December 2018 2017). Figure 3.8 (a) shows the actual Inflation (January 2010 until December 2017) and inflation Estimation (January 2010 until December 2017) 3.8 (b) shows the actual Inflation (January to December 2018 2018) and Pseudo Inflation Predictions (January 2018 to December 2018) using model 1 hidden layer 2 neurons [14] [15].

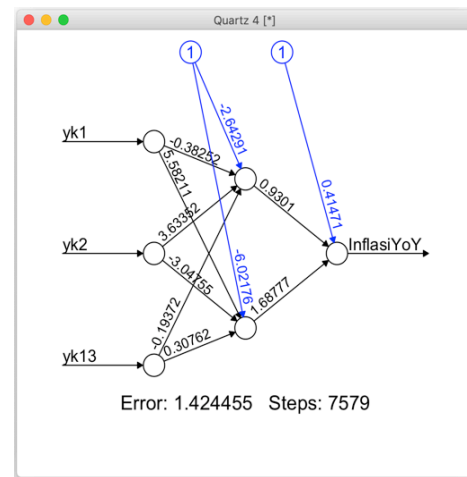


Figure 3.7 Plot ANN Model 1 Hidden Layer 2 Neuron

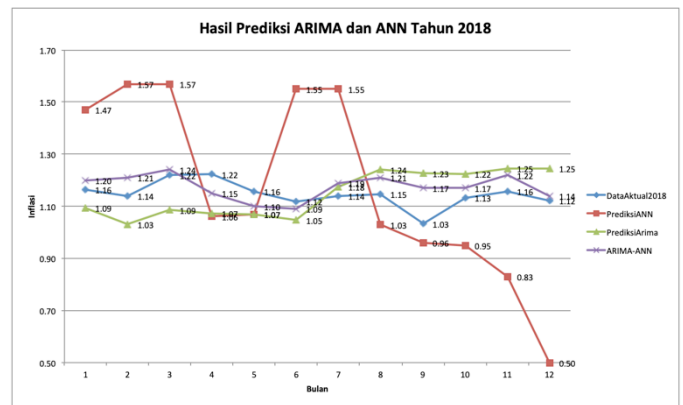


Figure 3.8 Plot Results Prediction of ARIMA-ANN

TABLE III
A COMPARISON OF THE VALUE ERROR ARIMA-ANN

Peri od	Aktual 2018	ARI MA-ANN	Error	Ablolute Value of Error	Square of Error	Absolute Values of Error Divided by Actual Values
t	At	Ft	At-Ft	At - Ft	(At-Ft)^2	(At - Ft) / At
1	1,16	1,20	-0,04	0,04	0,00	0,03
2	1,14	1,21	-0,07	0,07	0,00	0,06
3	1,22	1,24	-0,02	0,02	0,00	0,02
4	1,22	1,15	0,07	0,07	0,01	0,06
5	1,16	1,10	0,06	0,06	0,00	0,05
6	1,12	1,09	-0,05	0,03	0,00	0,03
7	1,14	1,19	-0,06	-0,05	0,00	0,04
8	1,15	1,21	-0,14	-0,06	0,00	0,05
9	1,03	1,17	-0,04	-0,14	0,02	0,13
10	1,13	1,17	-0,06	-0,04	0,00	0,03
11	1,16	1,22	-0,02	-0,06	0,00	0,05
12	1,12	1,14	-0,02	-0,02	0,00	0,02
Total			-0,34	0,65	0,05	0,58

A comparison of the value of the error from the merger of ARIMA-ANN on Table III by using the model of ANN, a hidden layer 1 and 2 show the value of Neurons MAD = 0,05, MSE = 0,00, RMSE = 0,06, MAPE = 4,82. Error value from the merger of the ARIMA-ANN shows the value of the lowest error in compare with ARIMA and ANN.

E. Software R

R-Studio software is open source software that can be downloaded for free. Some software that is often used among other things, SPSS, Eviews, SAS, Minitab. R Studio in his last version IE v 1.1.463 April 2019 for both windows as well as linux. In the use of the R-Studio a variety of methods that you want to apply the data to analyze all use different package fits function and purpose, the package can be downloaded for free and applied R Studio [16].

IV. CONCLUSION

The results predicted inflation in 2018 by using actual data (January 2010 sd December 2017) shows MAPE ARIMA-ANN 4,82%, ARIMA 9,12%, ANN 25,44 %. Combination model of ARIMA-ANN is the best model for the prediction of value to inflation in 2018 by the number of hidden layer 1, the number of neurons and the smallest error has a value of MAPE 4,82%. In the process of training, it is known that the number of neurons in the hidden layer greatly affects the results of prediction, both MSE or computational time.

THANK YOU

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