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The Best Forecasting Model For Cassava Price

Rahmi Yuristia[1)], Dodi Apriyanto[2)], Ketut Sukiono[3)]
[1]Dept. of Social Economics of Agriculture, Faculty of Agriculture, University of Bengkulu
[2]Postgraduate Program in Agribusiness, Faculty of Agriculture, University of Bengkulu
[3]Dept. of Social Economics of Agriculture, Faculty of Agriculture, University of Bengkulu
Corresponding Author: rahmiyuristia@unib.ac.id

ABSTRACT :This study aims to analyze and select the most accurate forecasting for predicting cassava prices in Indonesia. The data used is monthly data during the period of 2009 to 2017. This predicting uses the forecasting model, such as Moving Average, Exponential Smoothing, and Decomposition. Selecting the models found by comparing the smallest values of MAPE, MAD, and MSD. Therefore, it concluded that the Moving Average model is the most appropriate to Forecasting the price of cassava.

Keywords : Selection, Forecasting model, cassava, prices

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INTRODUCTION

Indonesia is a country that has various natural resources compared to other countries in the world. Abundant natural remedies can improve the economy to sustain food security in a region. Cassava is one food that can use as a substitute for rice or corn.

In Indonesia, Cassava has a significant economic value than other types of the tuber. In the arid regions in Indonesia, the function of cassava as a staple food because it is rich in carbohydrates. Humans can use almost all parts of the cassava plant, for example, as a vegetable and old leaves used as fodder, the stem is used as firewood. Products processed from cassava, among others: noodles, crackers, pluntiran, tiwul instant, bidaran, stick, tiwul gatot, and layer cake,

Demand for cassava throughout the entire region of Indonesia has growth of about 3.16% and productivity of 228.16 KU / Ha over the past five years (Pusat Data dan Sistem Informasi Pertanian, 2016). Cassava requests in a region so vary that it affects the difference in the price of cassava in each area. We can see cassava price development in Table 1.

Based on Table 1 shows that the volume of the price of cassava has increased from 2009 to 2017. The development of the cassava price at rural consumers not only increases every year but also every month and It rose to the highest rate in December 2017 about Rp. 276,160/100 Kg. Price stability in the future happens through a price forecasting approach. The purpose of this study was to find the best method of forecasting of the cassava price.

Table 1. Development of Cassava Rural Consumer Price in Indonesia (Rp 100/kg)

Month year	2009	2010	2011	2012	2013	2014	2015	2016	2017
January	*170 176*	*186 450*	*197 912*	*206 663*	*217 386*	*225 011*	*245 824*	*262 116*	*268 286*
February	*174 212*	*188 407*	*198 762*	*207 525*	*217 192*	*226 022*	*245 401*	*261 314*	*268 667*
March	*174 045*	*189 835*	*199 004*	*209 392*	*217 649*	*226 617*	*249 558*	*263 296*	*268 480*
April	*177 395*	*189 697*	*199 247*	*210 689*	*217 987*	*226 566*	*253 062*	*263 042*	*268 006*
May	*177 215*	*191 122*	*198 755*	*210 980*	*217 925*	*228 039*	*253 175*	*264 263*	*269 640*
June	*179 078*	*191 963*	*198 915*	*212 372*	*218 398*	*231 184*	*256 186*	*264 764*	*270 046*
July	*180 282*	*193 123*	*201 623*	*212 949*	*221 174*	*233 396*	*257 375*	*265 390*	*269 746*
August	*180 484*	*194 943*	*202 979*	*215 736*	*222 306*	*233 243*	*257 446*	*265 453*	*269 161*
September	*183 641*	*198 262*	*203 278*	*215 619*	*221 970*	*234 256*	*259 099*	*265 561*	*271 043*
October	*183 029*	*197 282*	*203 448*	*216 554*	*221 834*	*238 364*	*261 349*	*263 774*	*271 200*
November	*187 222*	*195 668*	*204 322*	*216 345*	*221 848*	*239 617*	*262 551*	*263 429*	*273 975*
December	*195 036*	*196 657*	*204 990*	*216 648*	*222 207*	*243 510*	*261 978*	*264 099*	*276 160*

MATERIALS AND METHODS

This study using the data of rural consumer price of cassava development in Indonesia from 2009 to 2017. Total 98 observation model used in this study.

Method of Moving Averages (moving average)

Methods Moving Average (MA) is an indicator often used in technical analysis that shows the average value of the data during the period specified. Data averaged time-dependent data (time series). Moving averages are used widely in stock/forex technical analysis, prices to measure momentum, and determine areas of support and resistance that are possible. Simple Moving Average (SMA) used to create a smooth or smooth Stock/forex price curve and filter noise data so that it is easier to see the trend data (Irfan Abbas, 2016). The Formulas For Moving Averages Are :

$$A_t = (D_t + D_{t-1} + D_{t-2} + \cdots . + D_{t-N+1}) / N$$

Where:
Dt = data series
N = Total number of average periods
At = Prediction in period t + 1

Decomposition Model

In the decomposition method, there are additive and multiplicative decomposition models. Additive and multiplicative decomposition models can be used to predict a trend, seasonal, and cycle factors. The simple average decomposition method assumes the additive model, while the ratio decomposition method on the moving average (classical decomposition) and the Census II method assume a multiplicative model.The formulas are:

$Y_x = T_x + S_x + C_x + I_x$ ....(additive model)

$Y_x = T_xX\ S_xX\ C_xX$

I_x ……………………………(multiplicative model)

Where :
Yx = periodic data period x
Tx = period x trend data
Sx = seasonal period (index) x period
Cx = period x cyclical factor
Ex = error factor x

Exponential Smoothing Model

Exponential smoothing is a method that describes repetition procedures in continuous calculations using new data. The weighting system can be symbolized by a. A symbol can be freely determined to reduce forecast error. Smoothing constant values, a value of 0 can be chosen because it applies: 0 < a < 1 (Garspersz, 2004).

$$S_t = \alpha * X_t + (1 - \alpha) * S_{t-1}$$

St = forecasting for period t.
Xt + (1-α) = Actual time series value
St-1= forecasting at time t-1 (previous time)
α = leveling constant between 0 and 1

Size of forecasting results

According to Wardah and Iskandar (2017), Measurement of forecasting is a measure of error about the slight difference between the results of predicting and actual demand. To calculate forecast errors are usually used Mean Absolute Percentage Error (MAPE), Mean Absolute Deviation (MAD), and Mean Square Deviation (MSD) (Sidik, 2010).

RESULTS AND DISCUSSION

The article on national price data throughout the territory of Indonesia is used to analyze data. This price data uses the last nine years period from January 2009 to December 2017. The cassava commodity price data is obtained from the secondary data of the Ministry of Agriculture Price Information System. The data collected is then analyzed with the following results:

Table 2. Descriptive data Analysis of Cassava Prices

	Mean	Standard deviation	Maximum	Minimum
Cassava prices	225347,7	1917,63	276160	170176

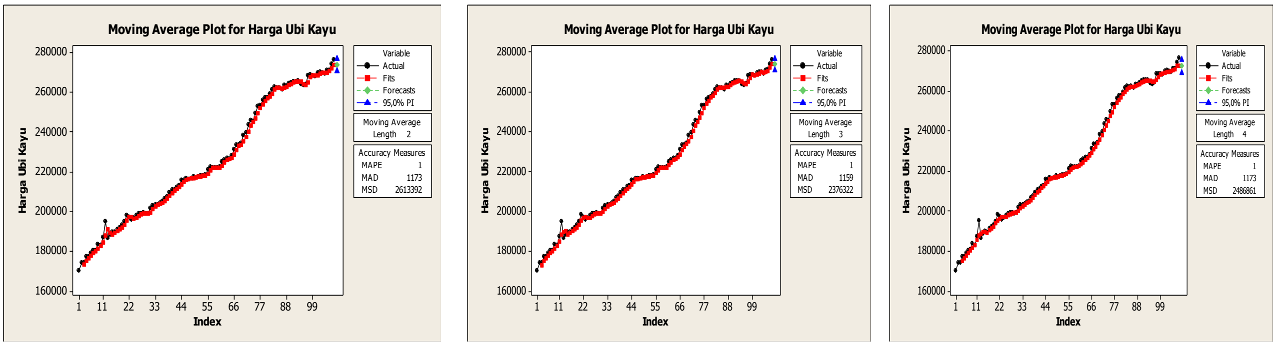
Based on the table. 2, it can be seen that the development of cassava prices has always increased over the past nine years. The highest price occurred in December 2018, while the lowest price occurred in January 2017. To forecast the cost of cassava in the future period, the forecasting model used in writing this article is by using the Moving Average Model, Exponential Smoothing, Decomposition Models, Quadratic Trend Models, and ARIMA Models.

The aim is to compare and find out the best forecasting model for data on cassava prices for the future. The basis used to compare the best models is by looking at the value of MAPE (Mean Absolute Percentage Error), MAD (Mean Absolute Deviation), and MSD (Mean Square Deviation). If MAPE, MAD, and

MSD have the smallest value, then the model is the best forecasting model.

Moving Average (MA) Method

Moving Average model estimation is presented to see the forecasting of cassava prices in the next period is order two movements in the -110 period. The model estimation results are shown in Figure 1. Visually the model estimation results are done five times from the three images. It can be seen that the line shows the forecasting value almost coincident or closest to the line representing the actual value is the forecasting value produced by MA (3). While for the forecasting value produced by MA (2) and MA (4), it is not too coincide with the line that represents the actual value. Thus MA (3) has a better value together based on the results of the comparison of MAPE, MAD and MSE values which can present in the following picture:



Picture 1

Estimation of the forecasting model results with Moving Average Models

Comparing all results between MA (2), MA (3), and MA (4) presented that MA results (3) have a better value because it found the smallest amount in MSE, MAD, and MPE. Thus the MA value (3) can be used as forecasting the price of Cassava at the level of rural producers in Indonesia with the Moving Average model. The forecast value for the 110th period in February 2018 is Rp 273,778.00. The forecasting results inform the comparison of cassava prices in December 2017 is Rp 276,160.00. It means the price decrease about Rp 2, 382.00 in February 2018.

Table 4. Comparison of forecasting models with moving average models

	MA2	MA3	MA4
Forecastingvalue (Rp/100 kg)	273828	273778	272220
Forecasting Period	110	110	110
Error criteria in the Moving Average Model Forecasting			
MAPE	1	1	1
MAD	1173	1159	1173
MSE	2613392	2376322	2486861

Exponential Smoothing Method

Exponential smoothing forecasting in this article uses a single exponential smoothing method. The exponential way is a weighting forecasting technique where data is weighting by an exponential function (Render and Heizer, 2005). Exponential smoothing has a more accurately level of accuracy compared to the moving average forecasting method even though it has similarities. The estimation results of the model using various levels of α (0.1 - 0.9) presented in Table 5.

Table 5. Error values in the Single Exponential Smoothing Method

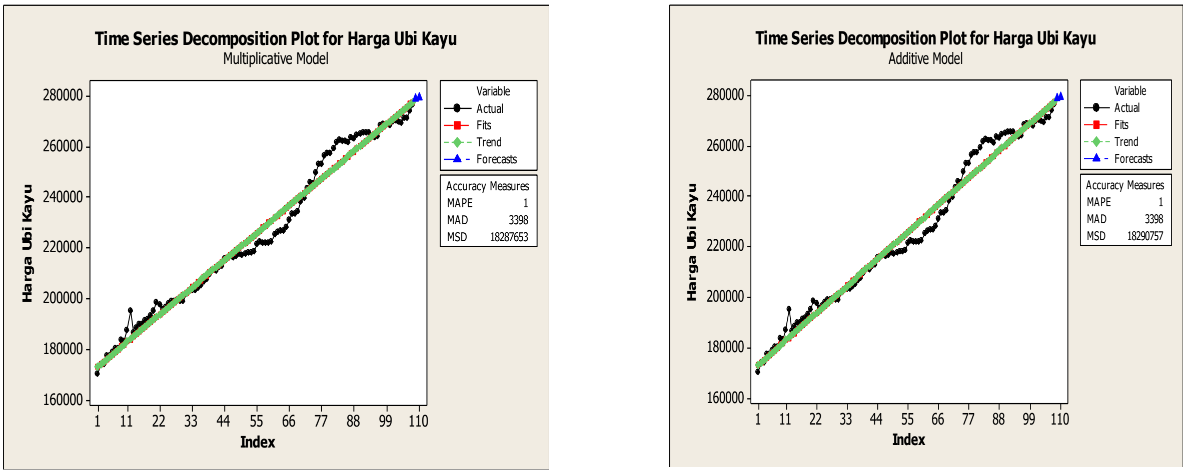
A	MAPE	MAD	MSE
0,1	4	8697	89599771
0,2	2	4555	27510683
0,3	1	3140	14265189
0,4	1	2465	9339467
0,5	1	2077	7004366
0,6	1	1824	5743450
0,7	1	1643	5013520
0,8	1	1517	4584614
0,9	1	1438	4344500

Based on Table 5, it is known that the best criteria are the modelwith the smallest error value that value of α = 0.9, the MSE value 4344500, MAD value 1438, and MAPE value 1. Based on this method, the price of cassava forecasts for the period of February 2018 is Rp 275,913. From this forecasting method, it can be seen that there is a decrease in the price of cassava by Rp 247 in February 2018.

The decomposition method tries to identify ways that are separate from basic patterns that tend to characterize data series, especially economic and business data, to see stationary data. The following are the results of an analysis of cassava data using the Decomposition Method, either the Additive Decomposition Method or the Multiplicative Decomposition Method.

Decomposition Method

Multiplicative and additive decomposition models are methods that are often used to generate predictions by regarding various factors such as trends (cycles), cycles, and seasonally. In figure (a) is a multiplicative decomposition model while in figure (b) additive decomposition. Multiplicative and additive decomposition models have different patterns; both approaches show the same slope trend. It has similar accuracy as a method of forecasting cassava prices.



Picture 2. Comparison of Additive and Multiplicative Decomposition Methods

Table 6. Comparison of Additive and Multiplicative Decomposition Methods

Decomposition Methods	MAPE	MAD	MSE
Multiplicative	1	3398	18287653
Additive	1	3398	18290757

From table 6 above, it can be seen that both methods give resultstend as same as the price of cassava forecast in February 2018 forMultiplicative and Additive Decomposition Methods, respectively, which is Rp 279379 and 279405. Decomposition models show that they have multiplicative and additive types. In world price, the most appropriateness method used in multiplicative price forecasting done because the value of MSE is smaller than other methods that meet the criteria of goodness.

Accurate Model Selection

Forecasting the price of cassava to predicting cassava prices has not yet occurred to forecast the cost of cassava in the future by using data on cassava prices from the past. Forecasting the price of cassava in this article uses the forecasting Moving Average method, the Exponential Smoothing model, and the Decomposition model. Of the three models, the most accurate model will be chosen to determine the best forecasting of cassava prices. Model selection is made by comparing the MAPE (Mean Absolute Percentage Error), MAD (Mean Absolute Deviation), and MSD (Mean Square Deviation) values of each model have done before. The results of the three models show in Table 7 as follows:

Table 7. Forecasting Accuracy rates on cassava prices

Model Forecasting	Accuracy Measure			Conclusion
	MAD	MSD	MAPE (%)	
World Price				
Moving Average	1	1159	2376322	The Moving Average is the most appropriateness model
Exponential Smoothing	1	1438	4344500	
Decomposition				
multiplicative	1	3398	18287653	
additive	1	3398	18290757	

CONCLUSION

In this article, for forecasting the price of cassava using a forecasting model. Moving Average, Exponential Smoothing, and Decomposition have a different model and selecting the model by comparing the smallest MAPE, MAD, and MSD values among the three models. Moving Average model is the most appropriate method used for forecasting the price of cassava.

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