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# Forecasting Of Chili Prices In The Special Region Of Yogyakarta, Indonesia Based On *Harga Pangan* Applications (Arima Approach)

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## Abstract.

The price of chili has characteristics that are unstable and fluctuating, this causes stakeholders difficulty in making decisions about the price of chili. The scarcity of chili production causes demand to increase so that the price of chili also rises. Information is needed regarding the predicted fluctuations in chili price trends so that market demand for chili can be known. The purpose of this research is to create a model and predicted the price of large red chili and curly red chili. This research was conducted using the time series data price of large red chili and curly red chili during 40 periods starting from July 2016 up to October 2019 to predict price red chili and curly red chili for 12 the next periods began November 2019 and ended on October 2020. The data was obtained from *Harga Pangan* (*Pusat Informasi Harga Pangan Strategis*) *Bank Indonesia* application using the price of chili in the Special Region of Yogyakarta. The results of the forecasting model using ARIMA shows that the price of large red chili and curly red chili for 12 periods has increased gradually and forecasting results close to the actual data.

**Keywords:** ARIMA, chili price, forecasting, *harga pangan* application

## 1. Introduction

A red chili is a group of vegetable commodities that are commonly cultivated in paddy fields by farmers with traditionally and intensively methods. Compared to other vegetable commodities, red chili has a high economic value but also has a high production risk (Saptana, Daryanto, Daryanto, & Kuntjoro, 2010). High production risk is one of the causes of chili prices to fluctuate. Red chili commodity prices that fluctuate and have high levels of margins lead to inefficient pricing and contribute to inflation (Sativa, Harianto, & Suryana, 2017).

Commonly, the amount of supply and demand for chili become one of the factors affecting the price of chili. If the supply of chili is less than demand so the price increases, otherwise when supply is greater than demand, the price becomes low (the price of chili is elastic to the supply). On religious holidays, for example, nearing Ramadan and *Idul Fitri* 2019, the price of chili rose to 50% because the demand for chili increased by around 10-20%, while supply was seasonal (Makki, 2019). The development of chili prices in the domestic market nationally tends to fluctuate, the price of red chili has a sharper price trend and is more expensive than the price of large and curly red chili. The increase in chili prices the head of the *Idul Fitri* 2019 is

expected to occur in some areas but not significant. The increase in chili prices at intervals of 10 days before and after *Idul Fitri* 2019 is caused by farmers not harvesting related to *Idul Fitri* 2019 homecoming (Yanuarti & Afsari, 2016).

The price of chili is influenced by the demand for the amount of chili, while the demand for the amount of chili is influenced by the price of a substitute item (green chili), the price of shallots and one's income (Gusvita & Budaraga, 2015). Demand for red chili will continue to increase along with the increase in population. Producer prices and wholesale prices of red chili commodities contribute greatly to price formation at the consumer level. The maximum profit is obtained by the retail trader when the retail trader applies to collude price as the dominant strategy (Suwarsinah, Harwanti, Hastuti, & Firdaus, 2018).

There are many sources to find out the price of national chili, for example, from the website of the Ministry of Trade, Central Statistics Agency and others. In the era of the industrial revolution 4.0, the use of Android applications makes it easy for people to access various information. There are several android applications that make it easy to access price information on basic commodities in Indonesia, one of which is the food price application. Food prices are the official mobile application of the Bank Indonesia's National Strategic Food Price Information Center which provides official information on the latest national food prices. This application food price data comes from a direct survey in 82 cities/districts of the Consumer Price Index inflation sample that includes price data in traditional markets for 10 food commodities with 21 variants that are quite dominantly consumed by the public and are a commodity that is a source of food inflation. Strategic food commodity prices contained in the National Food Price are rice, granulated sugar, cooking oil, beef, chicken meat, eggs, flour, soybeans, chilies, onions and garlic (Pusat Informasi Harga Pangan, 2019).

Yogyakarta Special Region (DIY) is one of the largest cities in Indonesia which has the highest number of traditional markets, which is ranked thirteenth (13) (Badan Pusat Statistik, 2019). A large number of traditional markets indicate that there are large numbers of consumers who shop at traditional markets to buy food needs. Food needs, one of which is chili, has fluctuating prices and makes it difficult for consumers to predict the price of chili to be purchased. One of the characteristics of chili that has been described is that it has an unstable price and high fluctuations. The instability of the price of chili causes a bad impact on the community so that the chili price forecasting is needed to reduce the adverse effects of chili price fluctuations (Puspatika & Kusumawati, 2018). Based on the background and the problem, the research objective was compiled, which is to find out the forecasting of chili prices in the ARIMA single moving average method. The ARIMA single moving average method is used by utilizing actual past data to get predictive results in the future. (Statistik, 2017)

## 2. Methods

This research was conducted using time series data on the price of large red chili and curly red chili for 40 periods starting from July 2016 to October 2019. Data for 40 month periods is used to predict the price of big red chili and curly red chili for the next 12 periods starting November 2019 and ending in October 2020. The data source used was obtained from an application owned by Bank Indonesia, namely Harga Pangan (Pusat Informasi Harga Pangan Strategis) Bank Indonesia. The research area

is Yogyakarta Special Region which is one of the largest cities in Indonesia which has the highest number of traditional markets, which is ranked thirteenth. Data analysis method to forecast the price of large red chili and curly chili is used ARIMA Single Moving Average analysis.

## 3. Results and Discussion

Forecasting prices of large red chili and curly chili are used ARIMA Single Moving Average analysis in which the best ARIMA models are compared. Prior to the ARIMA analysis, the normality of the data presented in table 1 is analyzed first.

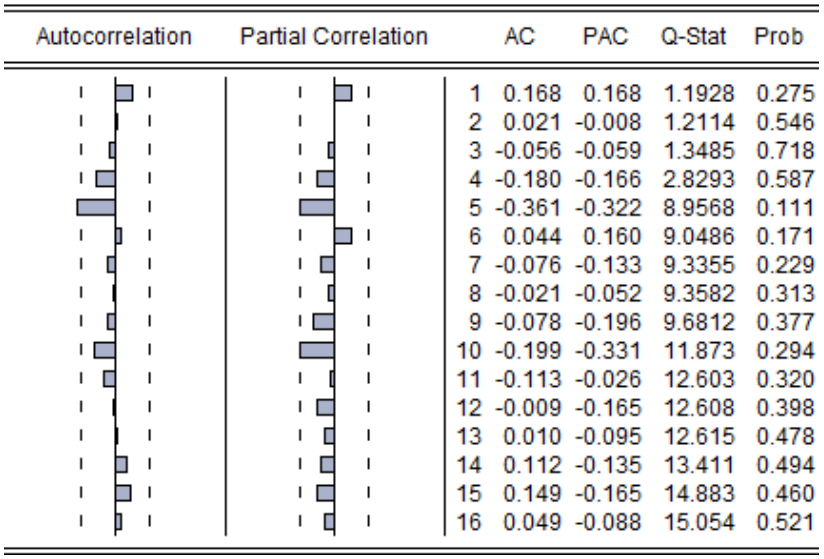
*Table 1. Normality Test*

| | | *t-Statistic* | *Prob.** |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -5.054363 | 0.0002 |
| Test critical values: | 1% level | -4.297073 | |
| | 5% level | -3.212696 | |
| | 10% level | -2.747676 | |

*Source: Harga Pangan (modified) (2019)*

*Figure 1. Big Red Chili Correlogram Table*

Date: 10/18/19 Time: 18:42
Sample: 2016M07 2019M10
Included observations: 39



| Autocorrelation | Partial Correlation | | AC | PAC | Q-Stat | Prob |
|---|---|---|---|---|---|---|
| | | 1 | 0.168 | 0.168 | 1.1928 | 0.275 |
| | | 2 | 0.021 | -0.008 | 1.2114 | 0.546 |
| | | 3 | -0.056 | -0.059 | 1.3485 | 0.718 |
| | | 4 | -0.180 | -0.166 | 2.8293 | 0.587 |
| | | 5 | -0.361 | -0.322 | 8.9568 | 0.111 |
| | | 6 | 0.044 | 0.160 | 9.0486 | 0.171 |
| | | 7 | -0.076 | -0.133 | 9.3355 | 0.229 |
| | | 8 | -0.021 | -0.052 | 9.3582 | 0.313 |
| | | 9 | -0.078 | -0.196 | 9.6812 | 0.377 |
| | | 10 | -0.199 | -0.331 | 11.873 | 0.294 |
| | | 11 | -0.113 | -0.026 | 12.603 | 0.320 |
| | | 12 | -0.009 | -0.165 | 12.608 | 0.398 |
| | | 13 | 0.010 | -0.095 | 12.615 | 0.478 |
| | | 14 | 0.112 | -0.135 | 13.411 | 0.494 |
| | | 15 | 0.149 | -0.165 | 14.883 | 0.460 |
| | | 16 | 0.049 | -0.088 | 15.054 | 0.521 |

Possible models that can be used to choose the best model. The ARIMA model can be formed in combination as follows:

a. ARIMA c(5,1,4)
b. ARIMA c(8,1,8)
c. ARIMA c(16,1,16)

The predetermined model will be used for the next stage *diagnostic checking* to ensure that the model to be used is free from autocorrelation, homoscedasticity, and normal distribution, *Diagnostic checking* can be seen in the table below.

*Table 2. ARIMA Diagnostic Checking Model Price of Big Red Chili*

| Model | Normality Residual | No Autocorrelation | Homoskedastic |
|---|---|---|---|
| ARIMA c(5,1,4) | - | √ | √ |
| ARIMA c(8,1,8) | √ | √ | √ |
| ARIMA c(16,1,16) | √ | √ | √ |

*Source: Harga Pangan (modified) (2019)*
*Information :*
*√: Assumption accepted*

Based on the results of diagnostic checking, it is known that all the selected models are the best models where all models are homoscedastic, free from autocorrelation, and normally distributed. Therefore to choose the best model, consideration of value is needed Adj.$R^2$, $R^2$, SE, SIC, and AIC at the table 3.

*Tabel 3. Criteria for Choosing the ARIMA Model for Big Red Chili Prices*

| Model | Adj.$R^2$ | $R^2$ | SIC | AIC | SE |
|---|---|---|---|---|---|
| ARIMA c(8,1,8) | -0,01 | 0,06 | 0,03 | -0,11 | 0,21 |
| ARIMA c(16,1,16) | 0,13 | 0,20 | 0,05 | -0,14 | 0,19 |

*Source: Harga Pangan (modified) (2019)*

Based on table 3 then the best model among the existing models will be obtained by selecting the highest value of Adj.R2 and R2, and the lowest Akaike Info Criterion (AIC), Schwarz Criterion (SIC), and SE scores. Can be seen in table 3 ARIMA model c (16,1,16) is the best model among the existing models, it is based on the highest Adj.R2 value of 0.13 and the highest R2 of 0.20, and the lowest Akaike Info Criterion (AIC) value is -0.14, the lowest Schwarz Criterion (SIC) is -0.14, and the lowest SE is 0.19, therefore the ARIMA model c(16,1,16) then it used as a model for the forecasting process or prediction prices for curly red chili.

*Figure 2. Big Red Chili Price Graph*

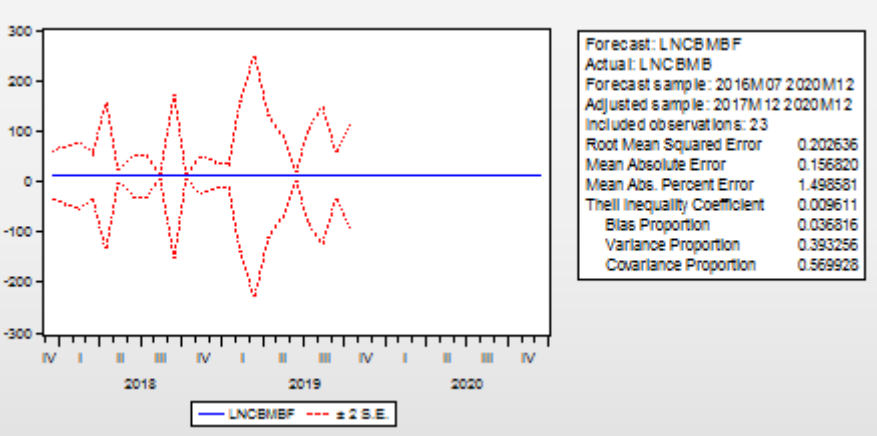



*Table 4. Prediction Results of Big Red Chili with ARIMA c (16,1,16) Dynamic Method*

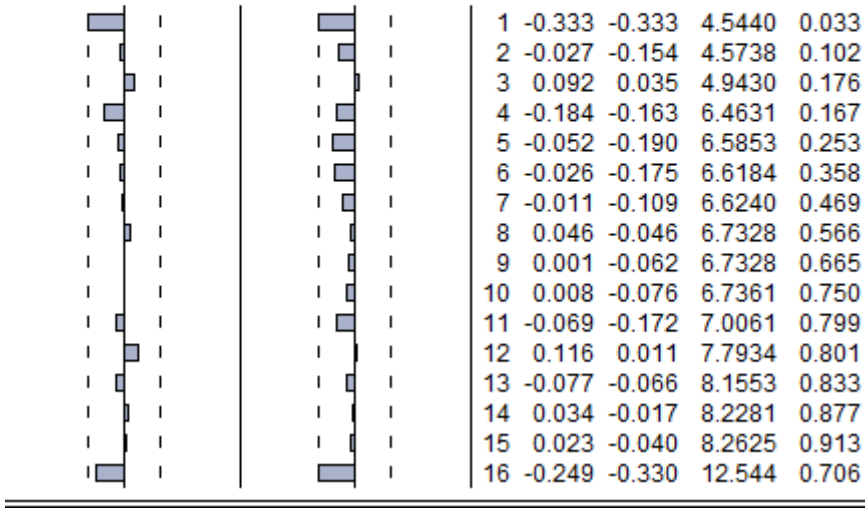
| Month | Price of Big Red Chili |
|---|---|
| Jan-18 | 40.550,00 |
| Feb-18 | 43.900,00 |
| Mar-18 | 43.900,00 |
| Apr-18 | 52.050,00 |
| May-18 | 38.450,00 |
| Jun-18 | 34.500,00 |

| Month | Price of Big Red Chili |
|---|---|
| Jul-18 | 32.150,00 |
| Aug-18 | 34.200,00 |
| Sep-18 | 26.050,00 |
| Oct-18 | 35.250,00 |
| Nov-18 | 32.100,00 |
| Dec-18 | 36.450,00 |
| Jan-19 | 33.250,00 |
| Feb-19 | 26.000,00 |
| Mar-19 | 22.950,00 |
| Apr-19 | 30.750,00 |
| May-19 | 36.100,00 |
| Jun-19 | 44.750,00 |
| Jul-19 | 58.750,00 |
| Aug-19 | 61.350,00 |
| Sep-19 | 40.950,00 |
| Oct-19 | 36.550,00 |
| Nov-19 | 42.141,00 |
| Dec-19 | 41.543,00 |
| Jan-20 | 44.136,00 |
| Feb-20 | 42.165,00 |
| Mar-20 | 41.609,00 |
| Apr-20 | 41.368,00 |
| May-20 | 41.964,00 |
| Jun-20 | 42.988,00 |
| Jul-20 | 46.231,00 |
| Aug-20 | 47.889,00 |
| Sep-20 | 51.530,00 |
| Oct-20 | 54.834,00 |
| Nov-20 | 57.712,00 |
| Dec-20 | 55.063,00 |

*Source : Harga Pangan (modified) (2019)*

*Figure 3. Curly Chili Price Correlogram Table*

Date: 10/19/19 Time: 19:42
Sample: 2016M07 2019M10
Included observations: 38



| Autocorrelation | Partial Correlation | | AC | PAC | Q-Stat | Prob |
|---|---|---|---|---|---|---|
| | | 1 | -0.333 | -0.333 | 4.5440 | 0.033 |
| | | 2 | -0.027 | -0.154 | 4.5738 | 0.102 |
| | | 3 | 0.092 | 0.035 | 4.9430 | 0.176 |
| | | 4 | -0.184 | -0.163 | 6.4631 | 0.167 |
| | | 5 | -0.052 | -0.190 | 6.5853 | 0.253 |
| | | 6 | -0.026 | -0.175 | 6.6184 | 0.358 |
| | | 7 | -0.011 | -0.109 | 6.6240 | 0.469 |
| | | 8 | 0.046 | -0.046 | 6.7328 | 0.566 |
| | | 9 | 0.001 | -0.062 | 6.7328 | 0.665 |
| | | 10 | 0.008 | -0.076 | 6.7361 | 0.750 |
| | | 11 | -0.069 | -0.172 | 7.0061 | 0.799 |
| | | 12 | 0.116 | 0.011 | 7.7934 | 0.801 |
| | | 13 | -0.077 | -0.066 | 8.1553 | 0.833 |
| | | 14 | 0.034 | -0.017 | 8.2281 | 0.877 |
| | | 15 | 0.023 | -0.040 | 8.2625 | 0.913 |
| | | 16 | -0.249 | -0.330 | 12.544 | 0.706 |

*Table 5. Normality Test*

| | | *t-Statistic* | *Prob.** |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -8.434686 | 0.0000 |
| Test critical values: | 1% level | -4.297073 | |
| | 5% level | -3.212696 | |
| | 10% level | -2.747676 | |

*Source : Harga Pangan (modified) (2019)*

Possible models that can be used to choose the best model. The ARIMA model can be formed in combination as follows:

a. ARIMA c(4,2,1)
b. ARIMA c(5,2,5)
c. ARIMA c(5,2,12)
d. ARIMA c(10,2,10)
e. ARIMA c(15,2,15)
f. ARIMA c(16,2,16)

The predetermined model will be used for the next step which is diagnostic checking to ensure that the model to be used is free from autocorrelation, homoscedasticity, and normal distribution. Diagnostic checking can be found in the table.

*Table 6. Diagnostic Checking ARIMA Model For Curly Chili Price*

| Model | Normalitas Residual | No Autocorrelation | Homoskedastic |
|---|---|---|---|
| ARIMA c(4,2,1) | √ | √ | √ |
| ARIMA c(5,2,5) | √ | - | √ |
| ARIMA c(10,2,10) | √ | - | √ |
| ARIMA c(15,2,15) | √ | - | √ |
| ARIMA c(16,2,16) | √ | √ | √ |

*Source : Harga Pangan (modified) (2019)*
*Information :*
*√: Assumption accepted*

Based on the results of diagnostic checking, it is known that all the selected models are the best models where all models are homoscedastic, free from autocorrelation, and normally distributed. Therefore to choose the best model, consideration is needed from the values of Adj.R2, R2, SE, SIC, and AIC as shown in table 7.

*Table 7. Criteria for Selection of ARIMA Curly Chili Prices*

| Model | Adj.$R^2$ | $R^2$ | SIC | AIC | SE |
|---|---|---|---|---|---|
| ARIMA c(4,2,1) | 0,16 | 0,23 | -4,47 | -4,64 | 0,02 |
| ARIMA c(16,2,16) | 0,53 | 0,57 | -4,64 | -4,63 | 0,01 |

*Source: Harga Pangan (modified) (2019)*

Based on table 5.6. then the best model among the existing models will be obtained by selecting the highest Adj.R2 and R2 values, and the lowest Akaike Info Criterion (AIC), Schwarz Criterion (SIC), and SE values. Can be seen in table 5.6. ARIMA c model (16,2,16) is the best model among the existing models, it is based on the highest Adj.R2 value of 0.53 and the highest R2 of 0.57, and Akaike Info Criterion value ( The lowest AIC) is -4.63, the lowest Schwarz Criterion (SIC) is -4.64, and the lowest SE is 0.1, therefore the ARIMA c (16.2,16) model is then used as a model for the forecasting or prediction process of curly red chili prices.

*Figure 4. Curly Red Chili Price Graph*

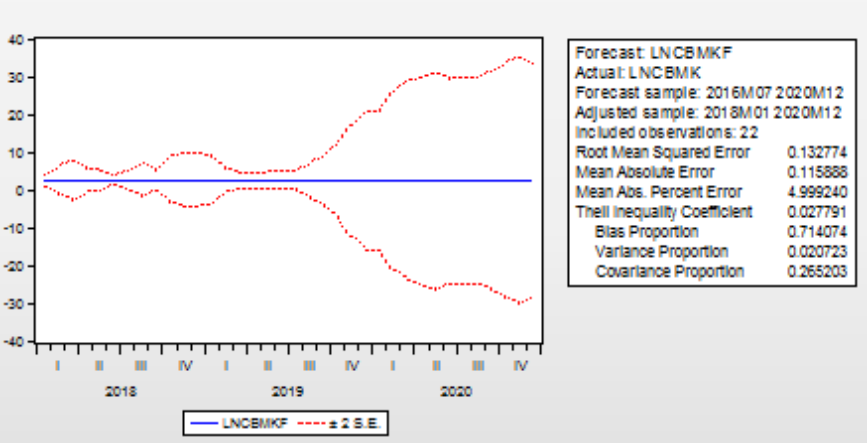


*Table 8. Prediction Results of Curly Red Chili Prices with ARIMA c (16,2,16) Dynamic Method*

| Month | Price of Curly Red Chili (Rupiah) |
|---|---|
| Jan-18 | 39.400,00 |
| Feb-18 | 39.800,00 |
| Mar-18 | 40.150,00 |
| Apr-18 | 33.150,00 |
| May-18 | 27.000,00 |
| Jun-18 | 26.800,00 |
| Jul-18 | 26.950,00 |
| Aug-18 | 25.200,00 |
| Sep-18 | 20.450,00 |
| Oct-18 | 30.200,00 |
| Nov-18 | 25.450,00 |
| Dec-18 | 24.900,00 |
| Jan-19 | 23.100,00 |
| Feb-19 | 18.400,00 |
| Mar-19 | 17.700,00 |
| Apr-19 | 18.550,00 |
| May-19 | 24.850,00 |
| Jun-19 | 41.100,00 |
| Jul-19 | 59.050,00 |
| Aug-19 | 59.850,00 |
| Sep-19 | 44.900,00 |
| Oct-19 | 33.650,00 |
| Nov-19 | 56.507,00 |
| Dec-19 | 42.938,00 |
| Jan-20 | 42.636,00 |
| Feb-20 | 29.169,00 |
| Mar-20 | 23.577,00 |
| Apr-20 | 20.647,00 |
| May-20 | 18.523,00 |
| Jun-20 | 19.399,00 |
| Jul-20 | 18.043,00 |
| Aug-20 | 16.840,00 |
| Sep-20 | 14.090,00 |
| Oct-20 | 11.508,00 |
| Nov-20 | 9.728,00 |
| Dec-20 | 10.076,00 |

*Source: Harga Pangan (modified) (2019)*

## 4. Conclusion

Forecasting models using ARIMA (Single Moving Average) show that the price of big red chili and curly red chili over the 12 periods has gradually increased and forecast results are close to actual data. The demand for chili trends increase and good planning is needed so that the increase in consumption demand is supported by an increase in production which is predicted to increase higher. Then it is expected that a more stable market price will occur.

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