Forecasting the Price of Curly Red Chilies in Malang Regency With Using the ARIMA Method

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Article Info

Abstract

Chile is one of the hultikura plants that grows abundantly in Indonesia. In Indonesia, chilies are widely used as a cooking spice, making them a household staple. The increasing need for chilies (during the holidays) causes the demand for chilies to also increase. The increase in chile prices which is not directly proportional to chile production causes price changes. To maintain optimal availability of chilies, forecasting is needed to help make decisions and develop policies. One method that can be used for forecasting is the Autoregressive Integrated Moving Average (ARIMA) method. Based on the analysis results obtained, the best ARIMA model used in this research is the ARIMA model (0, 1, 0) which produces the smallest AIC value and MAPE of 2.664656%, the accuracy value is less than 10% which means that the forecasting ability with the ARIMA (0, 1, 0) model is very good.

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INTRODUCTION

Indonesia is an agricultural country, where majority its population Work as farmers. This is supported with condition climate of Indonesia that is climate tropical so that Indonesia has fertile soil which causes plant can grow optimall, one of the plants developed in Indonesia that is commodities horticulture (Indra Utama et al., 2021) Commodity horticulture This is commodities potential that has mark economy tall and have potential that can Keep going developed. Types of plants cultivated in commodities horticulture covering fruits, vegetables, flowers and plants ornamental. The area of Indonesia with diversity agroclimate allows development various type plant horticulture which includes 80 types commodities vegetables (Indarti, 2015). One of product horticulture that is of interest to the Indonesian people is chilli cayenne pepper and chili red big Because chili which is one of the need everyday inside consumption House ladder like used For cooking, spices cooking and others (Amalia Yunia Rahmawati, 2020) .

Chilli red curly contain substance required nutrition man such as vitamin A, vitamin C, carotene, substances iron, potassium, calcium, phosphorus and also contains alkaloids such as kapaicin, flavenoids, and oils essential . In addition to having lots substance nutrition, chili red have benefit or role in spice cuisine or material mixture of various industry processing food and drink, and also use for medicines and cosmetics (Zamili et al., 2020)

Based on results Survey National Socio- Economic Survey (Susenas) September 202, average consumption chilli red rice production in Indonesia reached 0.15 kg/capita/month. In 2021, Indonesia produced chilli red big amounting to 1.36 million tons, an increase of 7.62% compared to year previously. Based on average production data chilli big 2016 – 2020, there were province center with contribution cumulative reached 85.84% of total production chilli largest in Indonesia. East Java Province is manufacturer the biggest with percentage contribution reached 21.05% of total production chilli large part of Indonesia. The provinces of West Java and Central Java are in the top second and third with contributions of 15.33% and 13.15% respectively (Agriculture, 2021) .

Demand level will chili also increased when days big like day highway Eid al-Fitr Fitri, because lots used as spice cuisine (Wulandari, 2020) . The increase request chilli cause price chilli fluctuating high. This is can cause the more size risk loss for farmers . Farmers need certainty about price chilli before decide For plant and sell it on the market, so that it doesn't experience loss (Siregar et al., 2022) . If price chilli soaring, then will impact on power buy society and also give rise to anxiety (Dahlia Nauly, 2017). Farid and Subekti (2012), stated that fluctuations price chilli happen Because production chilli nature seasonal factors rain, costs production, and length channel distribution. One of the solutions that can done For minimize occurrence loss, then need he did forecasting to price chilli.

Forecasting is One means that can used for help something installation in do effective planning, in order to can used as base determination policy in taking decisions that will affect the future come. To do forecasting can done with method in a way qualitative and quantitative. Qualitative methods applied with use opinion or opinion and analysis descriptive, whereas method quantitative applied with there is a calculation process mathematical with historical data and time series data. Many methods forecasting quantitative that can used For do forecasting, one of them that is ARIMA (*Autoregressive Integrated Moving Average*) method (Aprilia et al., 2021) .

The ARIMA forecasting method is one of the methods that can produce forecasting based on data patterns in historical or time series. This ARIMA method combine between AR (Autoregressive Integrated), namely a model that explains movement something variables through variables the in the future then and the MA (Moving Average) model, namely the model for see residual movement in the past. This method Enough heavy compared to with method other due to this ARIMA method capable give accuracy sufficient forecasting accurate For forecasting term short.

Study about this ARIMA method has Lots done, where a number of study such as, Bitcoin Price Forecasting Using the ARIMA (Autoregressive Integrated Moving Average) Method carried out by Nany Salwa, et al. with the best model produced namely the ARIMA (0, 2,1) model, with results forecasting price bitcoin highest that is worth Rp. 126,778,629 and the lowest worth Rp94,488,991

with size error using a MAPE of 4.753% (Salwa et al., 2018). Likewise, the forecasts made by Ari Cynthia, Sugiman, and Zaenuri Mastur with title study Analysis Comparison Using ARIMA and Bootstrap in Forecasting Value Indonesia's exports with results study ARIMA method is method suitable forecast in the case This with the ARIMA (1, 1, 2) model (Cynthia et al., 2016)and so on namely forecasting conducted by Reni Yulianti and Elly Arliani with title study Forecasting Amount Resident Using the ARIMA Model with results study estimated that amount resident will Keep going increase in year, the best ARIMA model used namely (0, 2, 1) with MAPE of 3.62% (Yuliyanti et al., 2022).

Urgency and purpose study this for analyze and examine for get the best model possible used For predict price chili in Malang City with use ARIMA method for a number of time in the future. There is research this can beneficial for government/institutions/farmers in set policies and decision making decision, with hope forecast generated own size small error (MAPE).

METHOD

2.1. Curly Red Chilies

Plant chilli is plants that are included in one of the type plant annual, which is classified as in Solanaceae family or eggplants in the form of shrubs. The stems of the plants chilli red curly there are two parts that is primary (secondary) colored chocolate green and more (primary) branching small from stem mainly. According to Prajnanta plant chilli classified as following: Kingdom: Plantae, Division: Spermatophyta, Subdividi: Angiospermae, Class: Dicotyledoneane, Subclass: Sympetale, Order: Tubiflorae, (Solanales), Family: Solanaceae, Genus: Capsicum, and Species: Capsicum annuum L. Not only as spice cuisine just chili is also useful for health such as, can launch circulation blood to the heart, can used as material manufacturing rub antirheumatic, as an anti- allergy, and still lots benefit other (Amalia Yunia Rahmawati, 2020)

2.2. *Autoregressive Integrated Moving Average* (ARIMA)

Study This use ARIMA (Autogressive Integrated Moving Average) method. The ARIMA method is also often called method sequence Box-Jenkins time. This method in a way intensive developed by George Box and Gwilym Jenkins in 1970 (Djami & Nanlohy, 2022) . ARIMA is very suitable in predict forecasting term short, whereas for forecasting term long its accuracy not enough good. Usually will shaped horizontal or constant over a sufficient period length. The ARIMA model is generally symbolized with ARIMA(p,d,q) where p is sequence (number pause time) of the autoregressive model, d is degrees from differencing (how many times the data has past values minus), and q is sequence of moving-average models. The group of time series models that includes in method This include: Autoregressive (AR), Moving Average (MA), Autoregressive-Moving Average (ARMA), and Autoregressive Integrated Moving Average (ARIMA) (Suyitno, 2011) .

In a way general ARIMA model (p,d ,q) is as following :

$$Y_t = \phi_1 Y_{t-1} + . . . + \phi_p Y_{t-p} + e_t + \theta_1 e_{t-1} - ... - \theta_q e_{t-q}$$

$\phi_1, \phi_2, \phi_3, \ldots, \phi_p$ is coefficient order p

$\theta_1, \theta_2, \theta_3, . . . , \theta_q$ is coefficient order q

Y_t = data in period t

e_t = error in period t

2.3. Forecasting

Forecasting is arts and sciences for estimate future events. This is can done with involving Retrieving past data and placing it into the future come with something mathematical model form. Forecasting classified based on the future time it covers that is term short, long term medium and long term long. Forecasting term short predict incident in period time up to 1 year but generally not enough from 3 months. Forecasting term medium predict incident in period time monthly up to 3 years. Forecasting term long predict incident in period 3 years or more (Muhammad Rizal et al., 2021)

2.4. Data Collection Techniques

Type of data used in study This is secondary data sourced from from the National Food Price Information Center website (https://www.bi.go.id/hargapangan) namely the index data price Curly Red Chilies in traditional markets in Malang Regency per day, namely data starting from from month January 2022 to December 2022 .

2.5. Stages Data Analysis

Stages data analysis conducted For Forecasting the Price of Curly Red Chilies in Malang City with use ARIMA method as following :

1. Describes the price data for curly red chilies in Malang City
2. Cleaning data, namely cleaning data with a value of 0
3. Do inspection data stationarity
4. In step This inspection done with using the ADF test, when mark p-value $> \alpha(0.05)$, then the data is not stationary and it is necessary to differencing the data until the p-value $< \alpha(0.05)$ then the data can be said to be stationary.
5. Model identification in ARIMA
   Model identification in ARIMA is carried out with using Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots.
6. Perform parameter estimation tests
   The ARIMA model that has been formed will be tested by looking at the AIC value of the model. The ARIMA model with the smallest AIC and MAPE values is the best ARIMA model.
7. Diagnostic tests
   In this test, two residual assumption tests were carried out, namely the residual normality test using the Jarque Bera test and white noise (residual freedom) using the Ljung-Box test.
8. Do prediction for 6 periods on the Price of Curly Red Chilies in Malang City.

RESULTS AND DISCUSSION

Data used is the price data for curly red chilies in Malang City from period January 1, 2022 to December 30th . Data used this is daily data with 260 observations obtained from the National Strategic Food Price Information Center (PIHPS Nasional) website (https://www.bi.go.id/hargapangan/RataHarga/PasarTradisionalDaerah) which is presented in Figure 1 below.
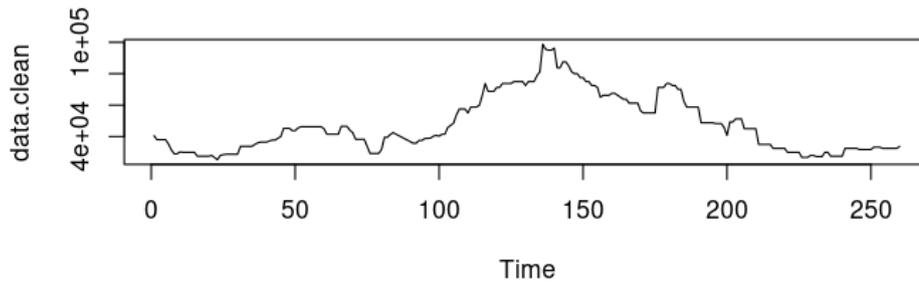
Figure 1. Graph of Curly Red Chili Price Data in Malang City

Price Data for Curly Red Chilies in Malang City from period January 1, 2022 to December 30th experience data fluctuations, which cause the data to no stationary. For do forecasting with use ARIMA method data used must be stationary.

3.1. Data Stationarity

Stationarity of data is defined as when data fluctuations are at the value constant mean and variance at each period. For see what data is used stationary or not on the mean and variance can seen with using the ADF test and seeing mark rounded value. Examination to data stationarity with see p-value > α(0.05), then the data is used no stationary and so on on the contrary. When the data is not stationary so need done differencing. The process of differencing This can you said more from once when the data has been differentiated Not yet stationary. If the data is used No stationary on variance then, can done transformation (Mukron et al., 2021) .

From the results analysis of data on the price of curly red chilies in Malang city was carried out transformation data that is differentiating as much as once due to the data on the price of curly red chilies on average and variance No stationary. For stationarization of data is done differencing, ADF value before differentiating that is of 0.7005 > α(0.05) and after differentiating become of 0.01 < α(0.05). With a p-value of < α (0,05)then the data is stationary or the mean and variance are constant at each point. the period. The following Chili Price Chart in Malang City which has been differentiated and has stationary, which is shown in Figure 2 below .
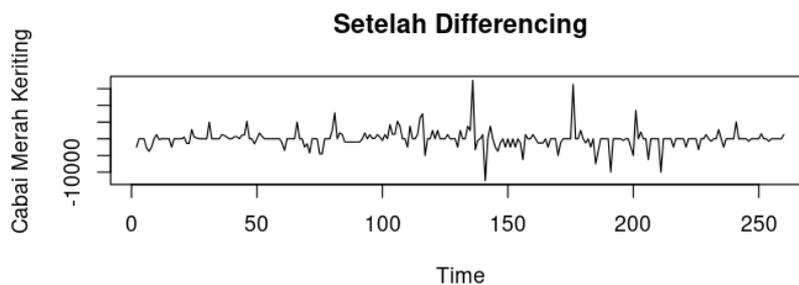

Figure 2. Curly Red Chili Price Data Stationary

3.2. ARIMA Model Identification

In determining the ARIMA model, it can be seen from the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots. The ACF and PACF plots of the Price of Curly Red Chilies in Malang City that have been stationarized are in Figures 3 & 4.
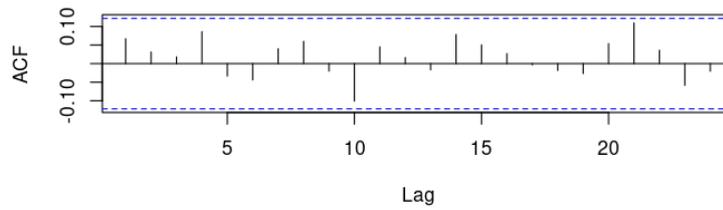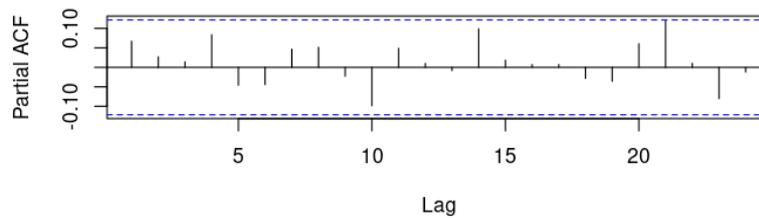
Figure 3. ACF plot

Figure 4. PACF plot

Based on the ACF and PACF plots produced, several ARIMA models are formed, namely ARIMA (2, 1, 2), ARIMA (0, 1, 0), ARIMA (0, 1, 1), ARIMA (1, 1, 1) and ARIMA (1, 1, 0) which can be used for forecasting.

3.3. ARIMA Model Parameter Estimation

Parameter estimation of ARIMA (2, 1, 2), ARIMA (0, 1, 0), ARIMA (0, 1, 1), ARIMA (1, 1, 1) and ARIMA (1, 1, 0) models. The following are the parameter estimation results, which are presented in Table 1.

Table 1. ARIMA Model Parameter Estimation

Model	AIC
ARIMA (2, 1, 2)	4830,061
ARIMA (0, 1, 0)	4820,621
ARIMA (1, 1, 0)	4823.69
ARIMA (0, 1, 1)	4832,577
ARIMA (1, 1, 1)	4825,245

Based on results testing and selecting the best model After looking at the p-value of the ARIMA models formed, the ARIMA (0, 1, 0) model had the smallest AIC value, so the ARIMA (0, 1, 0) model was chosen as the best model.

3.4. Diagnostic Test of the model

ARIMA model diagnostic test is used For inspect what model is selected? the fulfil assumptions remainder . Assumption the remainder being checked There are two, namely normality tests remainder and white noise (freedom remainder). The following The visualization of the ARIMA (0, 1, 0) model is presented in Table 2. Below.

Table 2. Diagnostic Tests

Test	Alpha (α)	*p-value*
Normal Distribution	0.05	2.2e -16
White Noise	0.05	0.8075

From the normality test carried out, in the normality test with using the Jarque test fallow, with obtained The p-value is 2.2e-16 > α (0.05), which indicates that the residuals of the model are normally distributed. In the *white noise test* using the ljung-box test, with obtained mark *p-value* of 0.8075 > α (0,05),which indicates that the residuals of the model are spread evenly random.

3.5 . Forecasting

From the ARIMA (0, 1, 0) model obtained, it was carried out forecasting for the next 6 periods. The results of the forecast for the price of curly red chilies in Malang City are in table 3 below.

Table 3. Red Chili Price Forecast for the Next 6 Periods.

Period	Forecasting	Lower Limit	Upper Limit
261	33750	28389.19	39110.81
262	33750	26168.66	41331.34
263	33750	24464.80	43035.20
264	33750	23028.37	44471.63
265	33750	21762.86	45737.14
266	33750	20618.74	46881.26

Forecasting results of the ARIMA (0, 1, 0) model produce value accuracy error with MAPE indicator of 2.664656%. This value not enough of the 10% that shows that ability forecasting with using the ARIMA (0, 1, 0) model is very good.
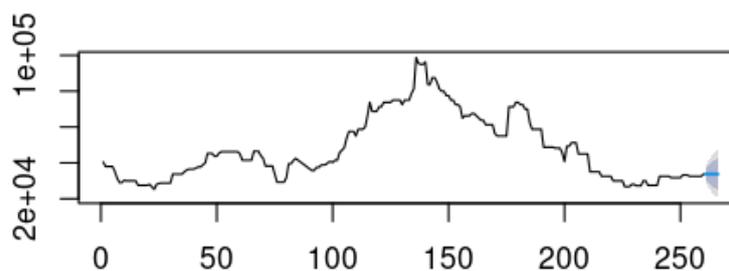

Figure 5. Plot of Curly Red Chili Price Forecast

CONCLUSION

Based on research conducted, it can be concluded that the data on the price of curly red chilies in Malang City on the date January 1, 2022 to December 30 th experience fluctuations in data. Chili prices highest that is around period of the 140s and the lowest in the 20s. The best model used for the forecasting of the price of curly red chilies in Malang City is the ARIMA (0, 1, 0) model because own smallest AIC value and accuracy level less errors from 10%.

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