Jakarta Islamic Index: Prediction With Autoregressive Integrated Moving Average Using R Studio

Andi Triyawan¹, Asmaddy Bin Harris²

¹ Faculty of Economics and Management, Universitas Darussalam Gontor, Indonesia
² Faculty of Economics and Mualalah, University Sains Islam Malaysia

E-mail: ¹anditriyawan@unida.gontor.ac.id, ²asmaddy@usim.edu.my

Abstract: To find out the price movement of JKII Stock prices in the future by using the Autoregressive Integrated Moving Average (ARIMA) method. The purpose of this research is to create a model and predict future prices of Jakarta Islamic Index Stock. The data used in this study is time series data in the form of bitcoin prices for 365 periods from 28 May 2022 to 26 May 2023 to predict JKII Stock prices for the next 10 periods from 29 May 2023 to 7 June 2023. The results of the study show that the JKII Stock prices for 365 periods does not meet the assumption of stationarity, so a differencing process is carried out so that the data becomes stationary. The resulting ARIMA model is ARIMA(1,0,0) and this model is suitable for predicting the price of JKII Stock. Also, the results of the analysis with ARIMA lead to the price of Stock for the next 10 periods increasing slowly.

Keywords: Stock, ARIMA, Price, time series, Jakarta Islamic Index

Introduction

Shares are one of the most commonly traded investment instruments in the Indonesian capital market. An investor has two sources of profit, namely capital gains and dividends. If the investor plans a long-term investment, the profit will be received in the form of dividends, but if the investor wants a short-term investment, the profit can be received in the form of capital gains. Capital gain is the profit from the sale or purchase of shares as the difference between the selling price and the purchase price. Meanwhile, dividends are a distribution of company profits and come from company profits (Sarpong-Streetor, et al. 2023).

Investors need to know the company whose shares they are buying. Stocks are a high-risk investment vehicle. Losses can be minimised by forecasting when buying or selling stocks. Doing forecasting allows investors to see the direction of stock price movements (Mondal, et al. 2014). The forecasting process can be done using many available methods. Autoregressive Integrated Moving Average (ARIMA), one of the methods that can be used in forecasting. The ARIMA method uses historical and current values of the dependent variable to make accurate short-term forecasts (Jarret & Eric, 2011).

Problems in stock investment certainly involve movements or
changes in stock prices over time (Ariyo, et. al. 2014). Therefore, in addition to conducting fundamental analysis, investors also need to know information about forecasting future stock prices. This information is very useful for investors in considering decisions to sell or buy shares. The method that can be applied in forecasting is the Autoregressive Integrated Moving Average (ARIMA) method (Vig, v. 2023).


Research Method

The Autoregressive Integrated Moving Average (ARIMA) method, commonly referred to as the Box-Jenkins method, was developed by George Box and Gwilym Jenkins in 1970. The ARIMA (Autoregressive Integrated Moving Average) method is a method used for short-term forecasting (Pandey, et al. 2023). The use of the ARIMA method in short-term forecasting is very appropriate because the ARIMA method has very accurate accuracy (Ashik & Kannan, 2017). And also determines a good statistical relationship between the variable to be forecasted and the value used for forecasting. As for long-term forecasting, the forecasting accuracy is not good. Usually the forecasting value will tend to be constant for a long enough period.

The Autoregressive Integrated Moving Average (ARIMA) model is a model that completely ignores independent variables in making forecasts. The value used by ARIMA for forecasting is using the past and present values of the dependent variable to produce accurate short-term forecasts. The group of models included in the Autoregressive Integrated Moving Average (ARIMA) method are:

1) Autoregressive (AR)

The Autoregressive (AR) model was first introduced by Yule in 1926 and then developed by Walker in 1931. The assumption of this model is that the current period data is influenced by the data in the previous period (Ryu, G. Y. 2023). It is called the Autoregressive model because this model is regressed on the previous values of the variable itself. Autoregressive model with order p is abbreviated as AR(p) or ARIMA(p,0,0), with the model:

$$Z_t = \mu + \beta_1 Z_{t-1} + \beta_2 Z_{t-2} + \ldots + \beta_p Z_{t-p} - a_t$$

dimana,

$Z_t$ = stationary time series
$\mu$ = Constant
$Z_{t-p}$ = Independent Variable
$\beta_p$ = coefisien parameter
autoregressive ke-p
$a_t$ = error at time t
The above model is referred to as an Autoregressive model (self-regression) because the model is similar to regression equations in general, except that the independent variable is not a different variable from the dependent variable but the previous value (lag) of the dependent variable (Zt) itself.

2) Moving Average (MA)

The Moving Average (MA) model was first introduced by Slutsky in 1973, with order q written MA (q) or ARIMA (0,0,q) and developed by Wadsworth in 1989 with model:

\[ Z_t = \mu + a_t - \beta_1 a_{t-1} - ... - \beta_q a_{t-q} \]

when,

- \( Z_t \) = stationary time series
- \( \mu \) = Constants
- \( a_{t-1} \) = Independent Variable
- \( \beta_q \) = coëfisien parameter autoregressive ke-q
- \( a_t \) = error at time t

3) Autoregressive Moving Average (ARMA)

The Autoregressive Moving Average (ARMA) model is a combined model of Autoregressive (AR) and Moving Average (MA). And this model has the assumption that the current period data is influenced by the previous period data and the leftover value from the previous period with the model:

\[ Z_t = \mu + \beta_1 Z_{t-1} + \beta_2 Z_{t-p} + a_t - \beta_1 a_{t-1} - ... - \beta_q a_{t-q} \]

dimana,

- \( Z_t \) = stationary time series
- \( \mu \) = Constants
- \( Z_{t-p} \) = Independent Variable
- \( \beta_p \) = coëfisien parameter autoregressive ke-p
- \( a_{t-1} \) = Independent Variable
- \( \beta_q \) = coëfisien parameter autoregressive ke-q
- \( a_t \) = error at time t

4) Autoregressive Integrated Moving Average (ARIMA)

The Autoregressive Integrated Moving Average (ARIMA) model is used based on the assumption that the time series data used must be stationary, which means that the average variation of the data in question is constant (Suripto, 2023). However, there are some things that happen when data is not stationary. In overcoming the non-stationarity of this data, a differencing process is carried out so that the data becomes stationary. Because the Autoregressive (AR), Moving Average (MA), Autoregressive Moving Average (ARMA) models are unable to explain the meaning of differencing, a mixed model called Autoregressive Integrated Moving Average (ARIMA) or ARIMA (p,d,q) is used so that it becomes more effective in explaining the differencing process (Gao, J. 2023). In this mixed model, the stationary series is a linear function of past values along with present values and past errors.

Secondary data in the form of Jakarta Islamic Index stock price data for 365 periods from the start date 28 May 2022 to 26 May 2023 obtained from https://uk.finance.yahoo.com. Data analysis is carried out using the ARIMA method and R studio.
software. The stages of applying the ARIMA model are as follows:

1. Display the Plot Data
   Data plots are used to determine the pattern of data, whether the data is stationary, trend, seasonal or cyclical.

2. Identification of stationary or non-stationary model
   Stationarity means that there is no growth or decline in the data. The data should generally be horizontal along the time axis. Data stationarity is used to determine the feasibility of data to be analysed using time series methods. If the data is not stationary, it is necessary to do differencing for data that is not stationary on the average or transformation if the data is not stationary on the variance. Temporary model identification is done to determine the time series analysis model based on the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) (Minhaj, et al. 2023).

3. Parameter estimation
   For the selected provisional model, the parameters are estimated by conducting a hypothesis test to determine whether the parameters are significant or not. The estimation results obtained will be used to determine the final model in forecasting (Latif, et al. 2023). The alpha tolerance level is 5% = 0.05 with the test criteria rejecting H0 if the p-value <0.05.

4. Model Verification
   Model clarification can be done in two ways, namely overfitting and residual testing. Overfitting is done when a more extensive model is required (Xiao, B. 2023). While the residual test is used to see the feasibility of the model by observing the residual data through the ACF and PACF plots (Subakkar, et al. 2021). If the verification results determine that the model is not suitable, the model must be changed until a suitable model is used.

5. Forecasting
   After the model is selected, forecasting can be done for one or more periods ahead. The following is a flow chart of the research stages:

![Figure 1 Flowchart of Research Stages](image)

### 4. Result and Analysis

When tabulating data using R studio software from the closing price of the Jakarta Islamic Index shares, a picture is obtained as below:

![Figure 2 Data Plot of JKII Stock](image)

In the graph, it can be seen that the share price is so dynamic and tends to decrease at the end of May 2023, but the share price always seems to increase after a significant decline. As illustrated in the ACF graph
below:

**Figure 3.** Graph of ACF JKII Stock Price

Seen in the picture above tends not to be stationary. So there is a tendency for the data to decrease until lag 15. After that, the Partial Autocorreation function (PACF) test can be done.

**Figure 4.** Graph of PACF JKII Stock Price

In Figure 4 above, it can be seen that there is no line that crosses the blue boundary line and this shows that the data is stationary. Then to make sure the model is good, we can see the graph or display of the ARIMA (1,0,0) model. If it turns out that the graph does not meet the requirements then the use of ARIMA cannot be done.

**Figure 5.** ARIMA (1,0,0) Residuals Model

In testing for normality, the fit of the model is also tested by the normality of the residuals as shown in the following plot:

**Normal Q-Q Plot**

Based on Figure 6, it shows that the residuals are normally distributed because the data is around the line, so the ARIMA (1,0,0) model is suitable for forecasting. From the ACF table and the PACF table, it can be seen that the lines are below the blue line. The value of the data is stationary. After that is to do forecasting based on the selected model and produce forecasts as below.
Based on table 2 shows that the results of the JKI stock price forecast for the next 10 days starting on 27 May 2023 to 5 June 2023. The highest bitcoin price forecasting result is on June 5, 2023, which is worth 562.952289 and the lowest on May 27, 2023, which is worth 539.986175. Apart from being displayed in table form, the results of JKI stock price forecasting are also presented in graphical form in Figure 7.

**Table 2 JKI Stock price forecast results**

<table>
<thead>
<tr>
<th>Days</th>
<th>Forecasting</th>
<th>80% Limits</th>
<th>95% Limits</th>
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<td></td>
<td>Lower Limit</td>
<td>Upper Limit</td>
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<td>63</td>
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**Figure 7 JKI stock price forecasting chart**

**Conclusion**

Stock price prediction is an important activity in making investments. Because the right prediction can help investors to take the right action when investing, so that investors can benefit and be able to minimise the risk in investing. Data analysis that has been carried out by the author related to forecasting with the ARIMA approach in the R studio programme, it can be concluded that the best ARIMA model is (1,0,0). In this study, researchers used the help of the R studio program, for further research it is possible to forecast the JKI stock price in the following months using other programming tools.

**REFERENCES**


