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

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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 differecing 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 using the ARIMA forecasting method has been conducted by Paul, et al (2013) on selecting the best ARIMA model for forecasting daily average stock prices in Pharmaceutical companies. Ramos, et al (2015) used the ARIMA method for forecasting consumer retail sales. Fitria, et al (2016) used the ARIMA-Kalman Filter method in stock price forecasting. Based on this background, in this paper, stock price forecasting of the Jakarta Islamic Index (JKII) is carried out. In forecasting stock prices, the authors implement the ARIMA method (Lilipaly, et al. 2014).

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:

$$Z_t = \mu + ß_1 Z_{t-1} + ß_2 Z_{t-2} + \ldots + ß_p Z_{t-p} - a_t$$

dimana,

Z_t = stationary time series
μ = Constant
Z_{t-p} = Independent Variable
$ß_p$ = 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 Slutzky in 1973, with order q written MA (q) or ARIMA (0,0,q) and developed by Wadsworth in 1989 with model:

$$Z_t = \mu + a_t - ß_1 a_{t-1} - \ldots - ß_q a_{t-q}$$

when,

Z_t = stationary time series
μ = Constants
a_{t-1} = Independent Variable
$ß_q$ = coefisien 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:

$$Z_t = \mu + ß_1 Z_{t-1} + ß_2 Z_{t-p} + a_t - ß_1 a_{t-1} - \ldots - ß_q a_{t-q}$$

dimana,

Z_t = stationary time series
μ = Constants
Z_{t-p} = Independent Variable
$ß_p$ = coefisien parameter autoregressive ke-p
a_{t-1} = Independent Variable
$ß_q$ = coefisien 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 defferencing, 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: 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:

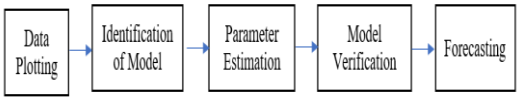

Figure 1 Flowchart of Research Stages

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:

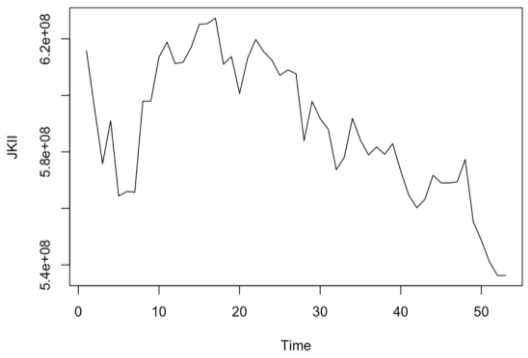

Figure 2 Data Plot of JKII Stock

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:

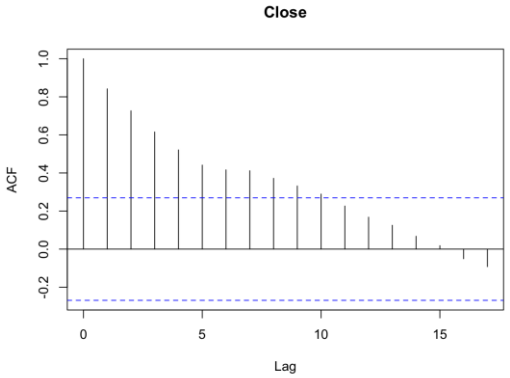

Figure 3. Graph of ACF JKII Stock Price

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.

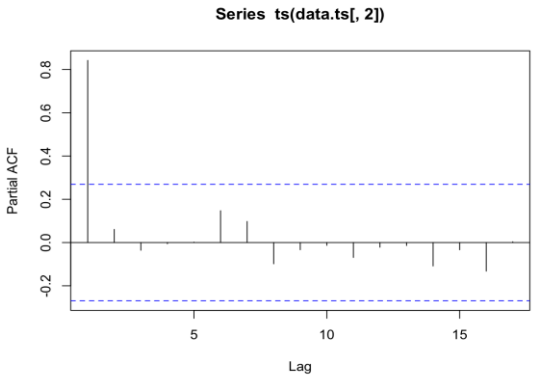

Figure 4. Graph of PACF JKII Stock Price

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.

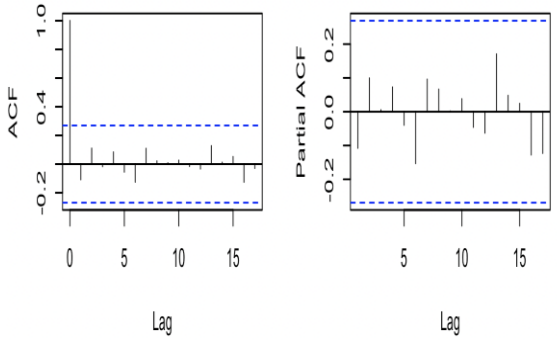

Figure 5. ARIMA (1,0,0) Residuals Model

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

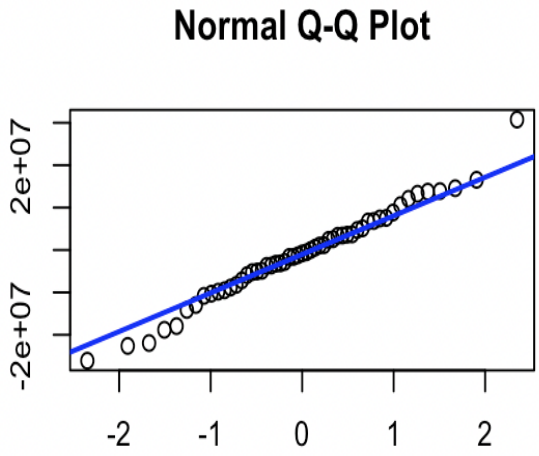

Figure 6. Residual Normalisation Plot

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.

Table 2 JKII Stock price forecast results

Forecasting for the next 10 Days					
Days	Forecasting	80% Limits		95% Limits	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
54	539,986175	526,187755	553,784595	518,883312	561,089038
55	543,433864	524,660463	562,207265	514,722425	572,145303
56	546,614511	524,470562	568,75846	512,748263	580,480758
57	549,548799	524,89659	574,201008	511,846499	587,251099
58	552,25581	525,654503	578,857117	511,572622	592,938998
59	554,753149	526,599078	582,907219	511,695214	597,811084
60	557,057055	527,645951	586,468158	512,076653	602,037456
61	559,18251	528,742423	589,622598	512,628414	605,736607
62	561,143338	529,854139	592,432537	513,290637	608,996039
63	562,952289	530,958167	594,94641	514,021502	611,883075

Based on table 2 shows that the results of the JKII 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 JKII stock price forecasting are also presented in graphical form in Figure 7.

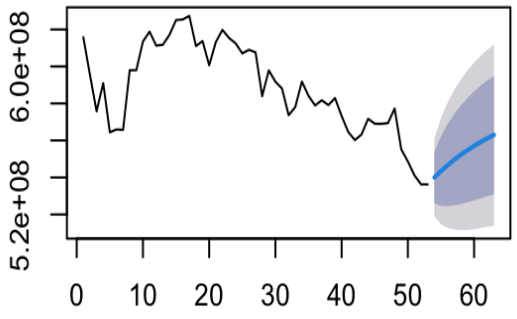

Figure 7 JKII stock price forecasting chart

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 JKII stock price in the following months using other programming tools.

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