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Original Article

Ethereum Value Forecasting Model using Autoregressive Integrated Moving Average (ARIMA)

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Abstract: The purpose of this study is to test the ability of the ARIMA model to predict the value of Ethereum, especially during economic shocks such as the current COVID-19 pandemic. The population in this study is Ethereum value weekly data for the period January 2017 to December 2020, so there are 208 samples in this study. The results showed that the use of the ARIMA method in predicting the value of Ethereum got poor results, where the forecast value was very much different from the actual value. This is evidenced from the results of the accuracy test using MAPE which got a result of 51.94%. On the other hand, the economic conditions that are experiencing uncertainty due to the COVID-19 pandemic and the emergence of deficit (decentralized finance) in early 2021 have pushed up a very significant increase in the value of Ethereum so that the error standard is higher and reduces the ability of the ARIMA model to predict the value of Ethereum. Further research is recommended to use a more advanced model such as the Autoregressive Fractionally Integrated Moving Average (AFRIMA) in order to obtain a better forecast value.

Keywords: ARIMA; Cryptocurrency; Ethereum; Blockchain; Forecasting.

1. Introduction

The current payment transaction instrument has faced many developments, such as when buying an item online, it is now possible to pay for it using digital currency. Cryptocurrency is one of the digital currency assets used for online transactions today (Arviana, 2023). Another function of cryptocurrency is for investment instruments. This cryptocurrency can be used as an investment instrument because there is a lot of demand for this currency. As a result of many who want to invest, the price of crypto currency assets will experience a significant increase. On the other hand, there is a new demand that causes the price of the cryptocurrency to rise. This is because people need a safer investment media that is not affected by the COVID-19 pandemic and currently cryptocurrency is considered a haven asset because it is one of the escape destinations for investors during this uncertain global economic condition. This is evidenced by the price increase in various crypto assets. Because of this, crypto assets have increased in popularity during the COVID-19 pandemic and have resulted in investors flocking to invest mainly due to the price of crypto assets that continues to rise up to 1000 percent, be it Bitcoin, Ethereum or other crypto assets and this also makes investors just interested in investing in the crypto market (Utami, 2021).

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As one type of cryptocurrency asset that is currently popular and widely known, Ethereum is a peer-to-peer network or blockchain with a digital currency called ether. Ethereum was created by Vitalik Buterin in 2013 with the aim of being a medium through which smart contracts can be executed and used. Basically, the purpose of Ethereum is as a world computer. The Ethereum blockchain is created as a place to store various types of data, this data can be reached and used by computer programs running on the Ethereum blockchain. These programs are decentralized applications or daps (Kim et al., 2021).

Currently there are many forecasting methods with various advantages of each. One of them is the ARIMA (Autoregressive Integrated Moving Average) method, a technique that produces forecasts that depend on the unification of historical data patterns. Arima model is a combination of AR (Autoregressive) model is a model that describes the development of a variable through previous actual variables and MA (Moving Average) model is a model that sees the development of variables through previous residuals (Lilipaly et al., 2014). The ARIMA model is often referred to as the Box-Jenkins model since it was first launched by Box and Jenkins. ARIMA models (Autoregressive Integrated Moving Average) is a model that completely ignores independent factors in making forecasts. ARIMA uses a wide range of dependable variable values to produce accurate short-term forecasts (Susanti & Adji, 2020).

Many previous researchers have used the ARIMA method in forecasting for their research, such as the results of research conducted by Salwa et al. (2018) forecasting results using the ARIMA method are (0.2,1), meaning that the value of bitcoin in the next 30 periods will face a gradual decline and the forecasting results are close to the actual data. Research conducted by Hartati (2017) shows that the results of the ARIMA method (1,1,1), which means that the forecasting method that is suitable for use in forecasting the inflation rate is the ARIMA method. Further research Chowdhury et al. (2020) which predicts the value of various crypto assets using ARIMA, research (Tandon et al., 2021) also concluded that the ARIMA method (1, 1, 2) is able to predict the value of bitcoin.

From several previous studies, this study identified that the ARIMA method is an appropriate and accurate method for determining time series data forecasting. However, from several previous studies, it is still rare for researchers to predict the value of Ethereum using the ARIMA method compared to bitcoin, even though according to (Antonopoulos & Wood, 2018) Ethereum has four basic advantages when compared to bitcoin and is designed to contain a lot of information, besides that Ethereum is also a second generation blockchain system so it is more sophisticated when compared to bitcoin. One of the studies that predicts the value of Ethereum is Kim et al. (2021) which reveals that the information contained in blockchain and other crypto assets can be used to predict the value of Ethereum, research by David et al. (2021) shows that the ARIMA method is less able to predict the value of all crypto assets. The purpose of this study is to test the ability of the ARIMA model to predict the value of Ethereum, especially during economic shocks such as the current COVID 19 pandemic. It is hoped that the results of this research can be a barometer for investors in making decisions in the crypto market.

2. Literature Review

2.1. Blockchain

According to Nugraha & Sutopo (2018), blockchain is a computer programming that contains a database so that it functions as a world bookkeeping record with a computer system that is distributed to all computer network users on a peer-to-peer basis following agreed rules..

2.2. Cryptocurrency

According to Huda & Hambali (2020), cryptocurrency is the name given to a system that uses cryptography. The word "cryptocurrency" comes from a combination of 2 words, namely "cryptography" which means secret code, and "currency" which means currency. Cryptocurrency is a virtual currency system that functions like a standard currency that allows users to make payments virtually for business transactions that occur without service fees but still have a centralized trust authority.

2.3. Ethereum

Ether is the Ethereum cryptographic currency whose blockchain is produced by the Ethereum platform. Like other digital currencies, ether can be traded on cryptocurrency exchanges. Ethereum offers a decentralized touring virtual machine, which is an Ethereum virtual machine that can execute content using an open hub system around the world. The system is more or less closed and a secret exchange system is used to moderate spam and assign assets to the system (Poongodi et al., 2020).

3. Materials and Methods

The population in this study is Ethereum value weekly data for the period January 2017 to December 2020, so the population of this study amounted to 208 time series data. The sample of this study consists of weekly data on the value of Ethereum from January 2017 to December 2020 for 4 years, where in one year it consists of 52 weeks, so there are 208 samples in this study. The data used in this study is quantitative data in the form of numbers and obtained from secondary data sources in the form of Ethereum value data from January 2017 to December 2020. This secondary data was obtained from publications on the website www.investing.com.

4. Results and Discussion

The first step is to identify whether the data is stationary or not, this can be seen from the graph of the following data pattern:

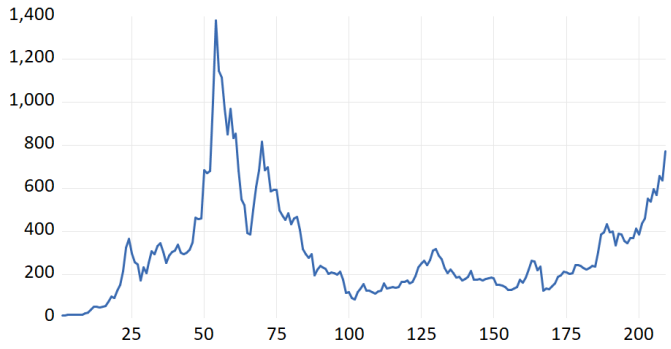

Figure 1. Ethereum Value - Price

Figure 1 displays the plot of data obtained shows that the movement of the Ethereum value has decreased and the balance is not focused on the middle value and the shape of the graph shows a trend data pattern which indicates that the Ethereum price data is not stationary. Besides being able to be seen from the data plot, the ADF test statistics can also be done to see the stationary of the data. The results of the ADF test are as follows:

Table 1. Unit Root Test (ADF) Results

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1,618	0.4714
Test critical values:	1% level	-3,461	
	5% level	-2,875	
	10% level	-2,574	

Table 1 shows the results of the ADF test support the graphical test that the Ethereum value data is not stationary. In addition, looking at the statistical results with the unit root test (ADF), the t-statistic value is -1.618, which is still higher than the value in the table of confidence levels of 1%, 5%, or 10%. For the probability value generated is 0.4714. This value is still greater than the value of α= 0.05 (0.4714 > 0.05) then the data is not stationary. The next step is to stationary the data by doing the first differencing. The following are the results of the plot and unit root test (ADF) after the first differencing.

Table 2. Test Results Unit Root Test (ADF) After First Differencing

			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-12,847	0.0000
Test critical values:	1% level		-3,461	
	5% level		-2,875	
	10% level		-2,574	

Table 2 captures the results of the ADF test with the first difference, the value generated from the t-statistic is -12.847. The resulting value is already smaller than the value in the 1%, 5%, or 10% confidence level table. For the

resulting probability value of 0.0000, the probability value is already smaller than the value of = 0.05 (0.0000 < 0.05). From the results obtained, it supports that the Ethereum value data is stationary at the first level of differentiation. The next step is to identify the ARIMA model (p,d,q) by plotting ACDF (correlogram autocorrelation) and PACF (partial autocorrelation) from the plot results, which will determine how many p and q are in the ARIMA model (p,d,q). The results of the correlogram with the first differentiation will show the ACF and PACF graphs as shown in the following table.

Table 3. Results of ACF and PACF Correlograms

Date: 10/01/21 Time: 11:20
Sample: 1 209
Included observations: 208

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.094	0.094	1.8672	0.172
		2	0.068	0.060	2.8576	0.240
		3	0.067	0.056	3.8215	0.281
		4	-0.077	-0.093	5.0749	0.280
		5	-0.038	-0.031	5.3782	0.371
		6	0.009	0.022	5.3943	0.494
		7	0.011	0.025	5.4207	0.609
		8	-0.053	-0.062	6.0255	0.644
		9	-0.065	-0.068	6.9602	0.641
		10	-0.123	-0.109	10.280	0.416
		11	-0.048	-0.008	10.789	0.461
		12	-0.126	-0.110	14.342	0.279
		13	-0.003	0.020	14.345	0.350
		14	0.082	0.078	15.840	0.323
		15	0.063	0.060	16.739	0.335
		16	0.146	0.115	21.614	0.156
		17	-0.072	-0.125	22.788	0.156
		18	0.044	0.043	23.231	0.182
		19	-0.028	-0.040	23.408	0.220
		20	0.059	0.077	24.229	0.233

Table 3 describes the result of ACF and PACF correlograms, then based on the table obtained ARIMA(p,d,q) models, namely ARIMA(10,1,17) and ARIMA (17,1,12). The next step is to calculate the AIC and HQC values for each model.

Table 4. Comparison of AIC and HQC Values ARIMA Model

Value	ARIMA (10,1,17)	ARIMA (17,1,12)
AIC	1,109	1,108
HQC	1,112	1,111

Table 4 indicates from two ARIMA models, the one with the smallest AIC and HQC values is the model (17,1,12). Furthermore, the residual white noise examination is carried out to determine whether the variance value is constant or not. This test uses the Ljung-Box test statistics as follows:

Table 5. Ljung-Box ACF and PAC data patterns

Date: 10/01/21 Time: 11:58
Sample: 1 209
Included observations: 208
Q-statistic probabilities adjusted for 2 ARMA terms

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.107	0.107	2.4252	
		2	0.066	0.055	3.3557	
		3	0.084	0.072	4.8415	0.028
		4	-0.061	-0.082	5.6499	0.059
		5	-0.050	-0.045	6.1806	0.103
		6	0.013	0.025	6.2169	0.184
		7	-0.013	0.001	6.2518	0.282
		8	-0.060	-0.060	7.0331	0.318
		9	-0.058	-0.057	7.7598	0.354
		10	-0.118	-0.101	10.808	0.213
		11	-0.029	0.010	10.994	0.276
		12	-0.003	0.013	10.995	0.358
		13	0.014	0.020	11.039	0.440
		14	0.081	0.062	12.506	0.406
		15	0.083	0.059	14.048	0.371
		16	0.149	0.134	19.078	0.162
		17	-0.014	-0.063	19.122	0.208
		18	0.057	0.036	19.862	0.227
		19	-0.021	-0.049	19.963	0.276
		20	0.058	0.082	20.749	0.292

Table 5 shows the residual is white noise. This is shown by a bar graph that is all on a Bartlett line. After carrying out this diagnostic step, it can be concluded that this estimate can be continued to the forecasting stage.

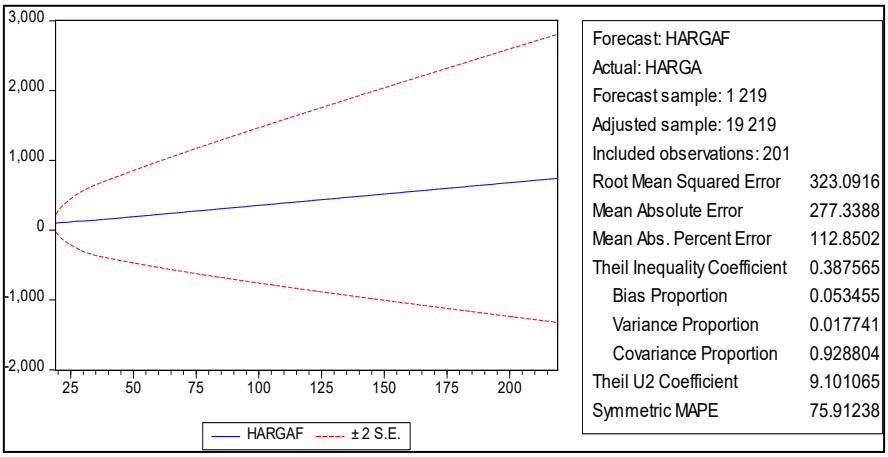

Figure 2. Results of Ethereum price forecasting with ARIMA model (17,1,12)

Figure 2 displays the forecasting results obtained from the ARIMA model (17,1,1), for the MSE value of 323.0916, the MAE value of 277.3388, and the MAPE value of 112.8502. So, from these three criteria, the chosen one is MAPE because it has the smallest criterion value.

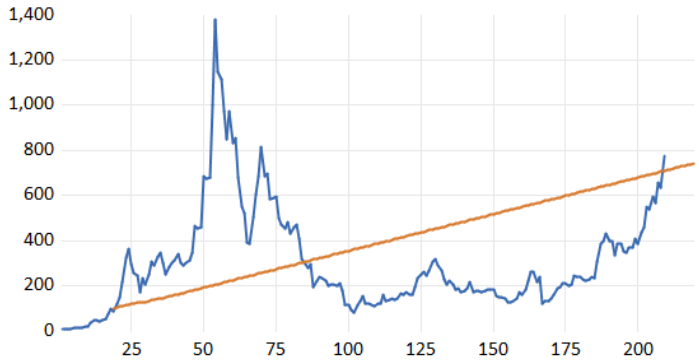

Figure 3. Ethereum Value Forecast and Actual Data (Price).

Figure 3 shows that forecasting estimates for the next 10 periods tend to increase. This can be due to the high expectations of investors for the increase in the price of crypto assets. The last step is to check how accurate the ARIMA method is in predicting the value of Ethereum using Mean Absolute Percentage Error (MAPE), the forecasting results for 10 periods will be compared to the original data value.

Table 5. Mean Absolute Percentage Error (MAPE)

Date	Original	Forecast	Percentage of Absolute Error
3-Jan-21	1,275.58	712.8916	44.11
10-Jan-21	1,228.27	716.1437	41.69
17-Jan-21	1,233.40	719.3959	41.67
24-Jan-21	1,376.96	722.648	47.52
31-Jan-21	1,676.63	725.9002	56.70
7-Feb-21	1,815.49	729.1523	59.84
14-Feb-21	1,913.88	732.4045	61.73
21-Feb-21	1,458.93	735.6566	49.58
28-Feb-21	1,649.19	738.9088	55.20
7-Mar-21	1,921.13	742.1609	61.37
MAPE			51.94

Table 5 captures the ARIMA model verification is carried out by looking at the forecasting MAPE value generated using Microsoft excel. Forecasting the value of Ethereum has a MAPE of 51.94%. In accordance with the significance of the MAPE value shown in Table 5, this study concluded that forecasting for the value of Ethereum using the ARIMA method is in the bad category.

5. Conclusion

The results showed that the use of the ARIMA method in predicting the value of Ethereum got poor results, where the forecast value was very much different from the actual value. This is evidenced from the results of the accuracy test using MAPE which got a result of 51.94%. The results of this study are in line with David et al. (2021) which states that the ARIMA model is less suitable in predicting the value of cryptocurrencies. On the other hand, the economic conditions that are experiencing uncertainty due to the COVID-19 pandemic and the emergence of decentralized finance in early 2021 have pushed up a very significant increase in the value of Ethereum so that the error standard is higher and reduces the ability of the ARIMA model to predict the value of Ethereum. Further research is recommended to use a more advanced model such as the Autoregressive Fractionally Integrated Moving Average (AFRIMA) in order to obtain a better forecast value.

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