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# Stock Price Forecasting using Arima Model

Leo Willyanto Santoso, Renaldi

Associate Professor, Department of Informatics, Petra Christian University, Surabaya, Indonesia

Student, Department of Informatics, Petra Christian University, Surabaya, Indonesia

**ABSTRACT:** This research aims to study the use of the Autoregressive Integrated Moving Average (ARIMA) model to predict stock prices by comparing 20 energy sector companies on the Indonesian Stock Exchange. Historical stock price data was taken from Yahoo Finance for the period January to April 2024. The ARIMA model was selected based on the lowest Akaike Information Criterion (AIC) value. Evaluation is carried out using three error value metrics: Mean Squared Error (MSE), Mean Absolute Error (MAE), and Root Mean Squared Error (RMSE). The results show that ELSA shares (1,0,0) have an MSE error value of 27.7526, MAE of 4.8832, and RMSE of 5.2681 for a prediction period of 7 days and for the best prediction performance in 30 days with an MSE value of 168.7569, MAE of 11.1394, and RMSE of 12.9906. This research suggests parameter optimization and the use of longer historical data to improve the accuracy of prediction models. It is hoped that this research can provide guidance for investors in choosing an accurate prediction model for making better investment decisions.

**KEYWORDS:** Forecasting, Stock Price, Arima, RMSE, MAE.

## I. INTRODUCTION

As time goes by, the need to understand and analyze the relationship between stock price movements has become important. In the era of globalization and integration financial markets, investments in various financial instruments such as shares are becoming increasingly complex and interrelated. Stocks remain the primary investment option in traditional financial markets. The stock market instrument is a place where investors gather to hold sales and purchases of shares in public companies or IPO (Initial Public Offering) companies. A public company or IPO company is a company that sells its shares on the stock market to anyone who wants to buy shares in the company. Shares are a sign of investor or trader ownership of an amount of funds invested in a company. However, it is quite difficult to invest in a good investment instrument and also divest. A technique that can be linked to statistics is Technical Analysis, where this technique focuses on analyzing charts and candle charts to make investments and divestments at the right time in order to get maximum profits and also reduce risks to the maximum. Technical Analysis is not an easy technique for predicting prices even for people who work professionally in the field of Technical Analysis. Apart from that, there are many external factors that influence price movements, starting from many beginner investors who fall for Influencer invitations, which can pose risks that are not known to novice investors, therefore investors must be able to carry out analysis independently to suit their risk profile.

Statistics can carry out its function, namely to make good predictions on stock instruments. Even though there are many statistical methods and computational methods, this is still considered a problem of financial variables and especially index prices [1]. Predicting price movements is critical in making good investment decisions. The Autoregressive Integrated Moving Average (ARIMA) method is used as an analytical tool to evaluate the relationship between stock price movements. Autoregressive Integrated Moving Average (ARIMA) has the main advantage, namely the ability to handle trends and seasonal patterns in stock price movement data.

The aim of this research is to identify the extent to which patterns are studied that are suitable for making price predictions by comparing several stocks using the Autoregressive Integrated Moving Average (ARIMA) method for making time series predictions. Benefits of this research are to help lay people to know which instrument suits them best, to simplify analysis in choosing investment instruments and provide a broader perspective on the use of statistics to analyze financial assets.

Paper is organized as follows. Section II describes stock price forecasting. The design of the proposed system is given in Section III. Section IV presents experimental results showing results of the prediction of stock price. Finally, Section V presents conclusion.

## II. RELATED WORK

Prediction or forecasting is an attempt to predict or estimate something that will happen in the future by utilizing various relevant information at previous times (historical) through a scientific method. A prediction is a statement or calculation that cannot be tested over time which is expected to occur in the future [2]. The purpose of prediction is to obtain information about what will happen in the future with the greatest probability of occurrence. Prediction methods can be carried out qualitatively through expert opinions or quantitatively using mathematical calculations. One quantitative prediction method is to use time series analysis. Stock price forecasting is a critical area in financial research, attracting significant attention due to its potential impact on investment strategies and financial planning. Accurate predictions can lead to substantial financial gains, making this area a focal point for both academics and practitioners. Various methodologies have been explored to enhance the accuracy and reliability of stock price predictions. Among these methodologies, the ARIMA (Auto Regressive Integrated Moving Average) model has been widely used and studied for its effectiveness in time series forecasting.

The ARIMA model, introduced by Box and Jenkins has been a staple in time series analysis due to its flexibility and robustness in handling various types of data patterns [3]. ARIMA is a powerful statistical tool used for analyzing and forecasting time series data. The model combines three components: autoregression (AR), differencing (I), and moving average (MA) to capture various temporal structures in data, which is crucial for accurate forecasting. Numerous studies have applied the ARIMA model to financial time series data, demonstrating its effectiveness in capturing the underlying trends and seasonality of stock prices.

Numerous recent studies have applied ARIMA models to stock price forecasting with promising results. For instance, Patel et al. (2015) employed ARIMA along with other models such as artificial neural networks (ANN) and support vector machines (SVM) to forecast stock prices [4]. Their findings indicated that ARIMA could provide competitive forecasts, especially when the stock prices exhibit linear patterns. A valuable application of ARIMA-GARCH models for estimating market risk using Value at Risk (VaR) for the WIG20 index was proposed by Makiel [5]. The combination of ARIMA for modeling the mean and GARCH for modeling the volatility offers a robust framework for capturing the complexities of financial time series data. Valuable insights into modeling and forecasting inflation in Kenya using ARIMA and GARCH analysis proposed by Nyoni [6]. The application of these models helps in understanding both the trends (ARIMA) and the volatility (GARCH) of inflation rates, providing a comprehensive approach. Moreover, a thorough analysis of inflation rates in Nigeria by applying ARMA, ARIMA, and GARCH models was presented [7]. It effectively demonstrates the strengths of these models in capturing both the trends and volatility of inflation

Similarly, Kumar and Thenmozhi (2012) compared the performance of ARIMA with other sophisticated models like EGARCH (Exponential Generalized Autoregressive Conditional Heteroskedasticity) for predicting stock market volatility [8]. They found that ARIMA models could effectively capture the underlying patterns in stock prices and offer reliable short-term forecasts. In a more recent study, Mashadihasanli, (2022) utilized ARIMA models to forecast the stock prices of the Tehran Stock Exchange [9]. Their research highlighted the model's efficacy in capturing the trend and seasonality components of stock prices, leading to accurate predictions.

## III. METHODOLOGY

The approach employed in this research for constructing the ARIMA model for stock price forecasting is thoroughly detailed in the following subsections. The software used for this implementation is HTML and python. The historical daily stock prices from the stock exchanges of Indonesia serve as the data source for this research. This data includes four components: opening price, lowest price, highest price, and closing price. Dataset taken from Yahoo Finance. The company data taken is based on 20 companies included in the energy sector on the Indonesia Stock Exchange (BEI), namely companies with share codes ABMM, ADMR, ADRO, AKRA, BSSR, DOID, ELSA, HRUM, INDY, ITMG, MBAP, MBSS, MCOL, MEDC, PSSI, PTBA, PTRO, PGAS, RAJA, and SGER. Figure 1 depicts the flowchart of ARIMA.



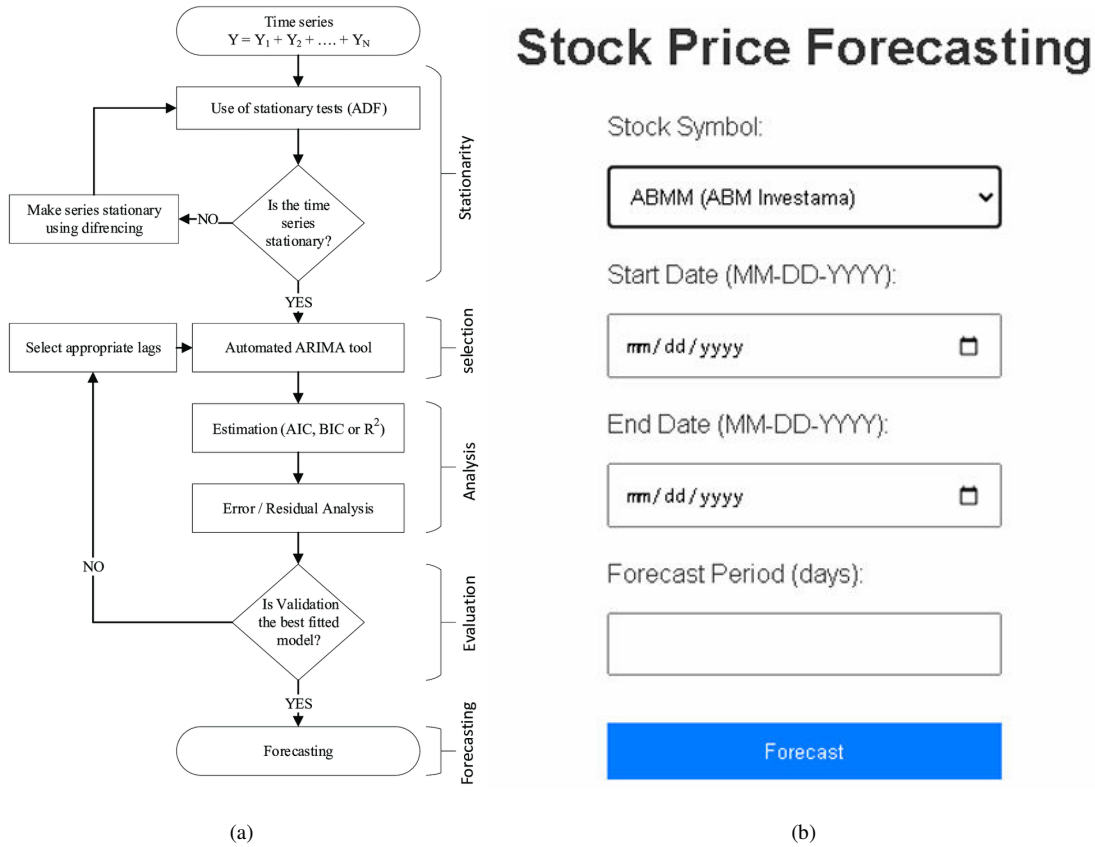


Fig. 1. Design of the proposed system. (a) The flowchart of ARIMA Model (b) The UI design of the proposed system

Users can use stock data that is already available from the website. In addition, users can choose the time period that will be predicted and also the training time that will be used. After filling in the parameters, the user can click a button to start the prediction process, which will then display data and graphs of prediction results directly on the dashboard page as in Figure 2.

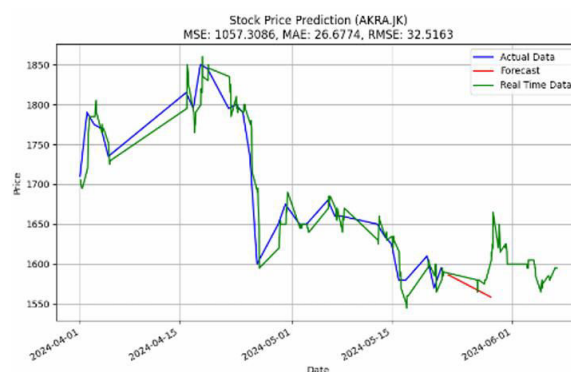


Fig. 2. The output of the proposed system

#### IV. EXPERIMENTAL RESULTS

ARIMA testing can be done by comparing the MSE, MAE and RMSE values from the prediction results. The smallest value of the prediction will show the accuracy of the prediction. Data was taken from 20 selected companies. This

research uses start data which was taken on April 1, 2023 and final data which was taken up to March 31 2024. Then, testing will be carried out for the number of forecast periods for short-term prediction periods (7 days) and medium-term predictions (30 days). Each company was tested one by one in forecasting, the results were as follows (Table 1).

Table 1. Company Stock Code, Model, MSE, MAE and RMSE for Short Term Prediction Testing (7 days)

Stock Price	Model (P, D, Q)	MSE	MAE	RMSE
ABMM	(0, 0, 0)	23818.3177	151.5199	154.3318
ADMR	(0, 0, 0)	3120.6888	44.2509	55.8631
ADRO	(0, 0, 0)	15593.2966	120.0061	124.8731
AKRA	(0, 0, 0)	61263.6101	245.2037	247.5149
BSSR	(0, 0, 0)	6720.9856	75.5562	81.9816
DOID	(1, 0, 3)	118.7257	9.6110	10.8961
ELSA	(1, 0, 0)	27.7526	4.8832	5.2681
HRUM	(0, 0, 0)	10603.2363	101.2432	102.9720
INDY	(0, 0, 0)	112760.2899	335.4468	335.7980
ITMG	(1, 1, 2)	1667148.1027	1201.3824	1291.1808
MBAP	(2, 0, 1)	567896.9447	695.2259	753.5894
MBSS	(2, 0, 2)	104.4249	8.6169	10.2189
MCOL	(1, 0, 1)	9746.1850	93.1117	98.7228
MEDC	(1, 0, 0)	806.9291	20.9582	28.4065
PSSI	(2, 0, 2)	45.7009	5.8070	6.7602
PTBA	(1, 0, 0)	1386.8512	29.9022	37.2405
PTRO	(0, 0, 1)	23635.7761	100.5100	153.7393
PGAS	(0, 0, 0)	3109.8731	50.3830	55.7662
RAJA	(1, 0, 0)	1991.4010	38.3018	44.6251
SGER	(1, 0, 1)	132.4751	10.2348	11.5098

Based on the results of Table 1., it can be seen that the results of prediction tests using ARIMA for 20 companies have different results. In general, the MSE, MAE, and RMSE values give an idea of how well the model is at predicting a company's share price. Small values indicate more accurate predictions. The most suitable stock for the prediction test is the ELSA stock (1,0,0) because it has an MSE value of 27.7526, MAE of 4.8832, and RMSE of 5.2681, this stock shows the most accurate prediction results (Figure 3).

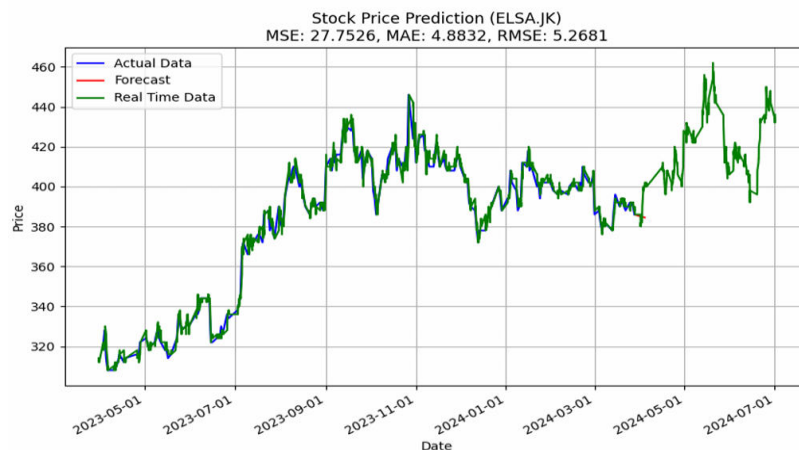


Fig. 3 Chart/Graph of short-term ARIMA prediction results for ELSA shares

Table 2. Company Stock Code, Model, MSE, MAE and RMSE for Medium Term Prediction Testing (30 days)

Stock Price	Model (P, D, Q)	MSE	MAE	RMSE
ABMM	(0, 0, 0)	17472.0735	107.9608	132.1820
ADMR	(0, 0, 0)	55658.1216	220.5604	235.9197
ADRO	(0, 0, 0)	13761.0233	108.8099	117.3074
AKRA	(0, 0, 0)	50827.6409	216.6560	225.4499
BSSR	(0, 0, 0)	21925.2689	140.7944	148.0718
DOID	(1, 0, 3)	2487.2669	46.4102	49.8725
ELSA	(1, 0, 0)	168.7569	11.1394	12.9906
HRUM	(0, 0, 0)	41049.2740	182.7908	202.6062
INDY	(0, 0, 0)	1777704.3811	415.4468	421.5500
ITMG	(1, 1, 2)	637391.4119	666.9869	798.3680
MBAP	(2, 0, 1)	472141.9736	614.1544	687.1259
MBSS	(2, 0, 2)	1030.7025	28.7658	32.1046
MCOL	(1, 0, 1)	23424.5111	140.4298	153.0508
MEDC	(1, 0, 0)	17845.9956	114.6556	133.5889
PSSI	(2, 0, 2)	642.8960	24.8509	25.3554
PTBA	(1, 0, 0)	58647.1645	196.3318	242.1718
PTRO	(0, 0, 1)	183603	370.5674	428.4902
PGAS	(0, 0, 0)	14549.7837	108.4624	120.6225
RAJA	(1, 0, 0)	12477.2169	98.9551	111.7015
SGER	(1, 0, 1)	2031.2338	41.9607	45.0692

Based on the results of Table 2., it can also be seen that the results of prediction tests using ARIMA on 20 companies have different results. In general, the MSE, MAE, and RMSE values give an idea of how well the model is at predicting a company's share price. Small values indicate more accurate predictions. From the table above, the most suitable stock for the prediction test is ELSA stock (1,0,0) because it has an MSE value of 168.7569, MAE of 11.1394, and RMSE of 12.9906, this stock shows the most accurate prediction results (Figure 4). Meanwhile, stocks like ITMG show very high error values, which shows that the ARIMA model is less effective for predicting the price of this stock. For these stocks, further model optimization or consideration of the use of alternative prediction models is required.

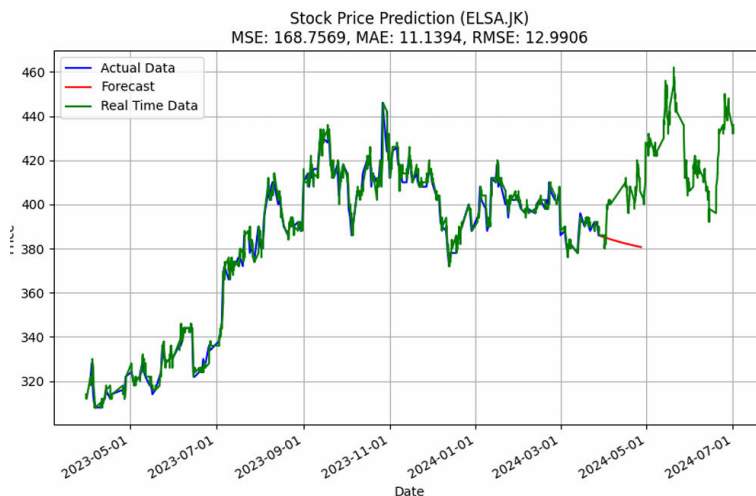


Fig. 4 Chart/Graph of medium-term ARIMA prediction results for ELSA shares

## V. CONCLUSION

The ARIMA model remains a valuable tool in the domain of stock price forecasting due to its simplicity and proven effectiveness. However, ongoing research continues to explore ways to enhance its performance, particularly through hybrid approaches and integration with machine learning techniques. As the financial markets evolve, so too will the methodologies used to predict stock prices, with the ARIMA model likely to remain a foundational component in this field. Choosing the right ARIMA model parameters (P, D, Q) greatly influences prediction accuracy. Stocks with optimized parameters show lower errors. Stocks that have high error values may be influenced by external variables such as extreme prices, so alternative prediction models are needed to increase accuracy. Taking historical stock price data that is used effectively in the ARIMA model can provide accurate predictions. However, the quality and length of historical data taken by the user also affects the prediction results.

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