

## A Comparative Analysis of ARIMA Models Based on Data Period and Frequency at PT Midi Utama Indonesia Tbk

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### Abstract

Uncertainty in short-term investment decision-making. This study aims to analyze the daily stock price movement of PT Midi Utama Indonesia Tbk and to determine the feasibility of the ARIMA model for forecasting stock prices. The study employed a quantitative time series approach using daily closing price data over a 3-year period with daily frequency observations. The analysis was conducted using RStudio through descriptive statistics, stationarity testing, first-order differencing, ACF and PACF identification, ARIMA model selection, diagnostic testing, and forecast accuracy evaluation. The results indicate that the data were non-stationary at the level because the Augmented Dickey-Fuller test produced a p-value of 0.4372. After first differencing, the p-value decreased to 0.0100, indicating that the data had become stationary. The best model identified was ARIMA (1,1,1) because it had the lowest AIC value among the compared models. The Ljung-Box test yielded a p-value of 0.7116, indicating that there was no residual autocorrelation. The model produced an MAE of 6.10853, an RMSE of 8.97241, and a MAPE of 2.43817%, indicating that the model is highly accurate with an error rate below 8%. These findings demonstrate that the ARIMA (1,1,1) model is suitable for short-term forecasting of PT Midi Utama Indonesia Tbk stock prices.

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## INTRODUCTION

The development of the capital market in Indonesia has experienced rapid growth in recent years. This trend is marked by an increase in the number of investors, stock trading activity, and high public interest in investing in companies listed on the Indonesia Stock Exchange. In investment activities, stock price movements are a key indicator closely monitored by investors as they reflect a company's condition and market sentiment. The volatile nature of stock prices means that investors need analytical methods capable of helping to predict the direction of future price movements. Therefore, forecasting has become a crucial approach in capital market analysis. According to Rusminto et al. (2024), forecasting methods greatly assist investors in understanding stock price movement patterns based on historical data, thereby serving as a basis for investment decision-making. One of the most widely used methods in time series analysis is the ARIMA (*AutoRegressive Integrated Moving Average*) method, as it can model historical data patterns and generate fairly accurate predictions for financial and stock data. (Gazali & Setiawan, 2025) explain that the ARIMA model remains a relevant statistical method in stock forecasting because it has a strong ability to predict short-term patterns based on historical data.

The ARIMA method is widely used in stock forecasting research because it is considered effective at capturing linear patterns in historical data. This model works by identifying relationships between past data to form predictions for future periods. In practice, the accuracy of the ARIMA model is influenced by the characteristics of the data used, such as the observation

period and data frequency. Khoirayanti & Sulistiyo (2020) ,explain that high-frequency data such as daily data, can provide a more complete picture of market movements compared to weekly or monthly data. Research by Rusminto et al. (2024) indicates that the ARIMA model demonstrates a reasonably high level of accuracy in forecasting short-term stock price movements with relatively small error values, making it widely used in modern forecasting research.

PT Midi Utama Indonesia Tbk was selected as the research subject because it is one of the largest modern retail companies in Indonesia, operating through the Alfamidi minimarket chain. The company's business activities are closely tied to economic conditions, consumer purchasing power, inflation rates, and national retail industry competition; thus, the price movements of MIDI stock are of interest for analysis using forecasting methods. According to Sudipa et al. (2023), retail sector stocks tend to be influenced by changes in economic conditions and consumer behavior, resulting in movement patterns that are of interest for analysis using time series methods.

Previous research indicates that the ARIMA method has been widely applied in forecasting stocks, inflation, transportation, and the macroeconomy (Murdani & Nanlohy, 2022; Qalbi et al., 2021; Saluza et al., 2021). However, most previous studies have focused on the banking sector and stock indices, and have used only a specific type of data frequency without evaluating the data structure employed. Furthermore, research on modern retail sector stocks, particularly PT Midi Utama Indonesia Tbk, remains relatively limited. These conditions indicate a research gap regarding the selection of the optimal data structure for stock forecasting using the ARIMA method.

Based on these issues, this study offers a novel approach by selecting the best ARIMA model based on an evaluation of the data period and frequency to achieve optimal forecasting accuracy. The study focuses on three years of daily data, which yielded the best model with the lowest error rate. The best model obtained was ARIMA (1,1,1) with a MAPE of 2.44%, placing it in the "highly accurate" category. This study aims to analyze the suitability of the ARIMA model in forecasting the stock price of PT Midi Utama Indonesia Tbk through tests of stationarity, residual autocorrelation, and evaluation of the forecasting model's accuracy.

## METHODS

This study employs a quantitative approach using time series methods to analyze and forecast the stock price of PT Midi Utama Indonesia Tbk using the ARIMA (*AutoRegressive Integrated Moving Average*) model. The research subject is the stock of PT Midi Utama Indonesia Tbk, with the ticker symbol MIDI, which operates in the modern retail sector through the Alfamidi minimarket chain. The data used consists of secondary data on *closing stock prices* obtained from the Investing.com website. The study focuses on daily data over a 3-year period because it yields the best forecasting model with the lowest error rate compared to other data combinations. Next, a stationarity test is conducted using *the Augmented Dickey-Fuller Test (ADF Test)*. If the data is not stationary, first-order differencing is applied using the " " method until the data meets the stationarity assumption. Once the data is stationary, model identification is performed using *Autocorrelation Function (ACF)* and *Partial Autocorrelation Function (PACF)* plots to determine the *autoregressive (p)*, *differencing (d)*, and *moving average (q)* parameters. The next step is to estimate several ARIMA models and select the best model based on the smallest Akaike Information Criterion (AIC) value. The best model obtained in this study is ARIMA (1,1,1). Next, diagnostic tests were conducted using the Ljung-Box Test to ensure the model's residuals are white noise and do not contain autocorrelation. According to Amri et al. (2024), residuals without autocorrelation indicate

that the ARIMA model meets the assumptions for forecasting validity. Once the model meets these assumptions, stock price forecasting is performed for future periods. The model's accuracy was measured using the *Mean Absolute Error (MAE)*, *Root Mean Squared Error (RMSE)*, and *Mean Absolute Percentage Error (MAPE)*. The model is considered good if it has low error values, particularly a MAPE below 8%, making it suitable for short-term stock price forecasting.

## RESULTS AND DISCUSSION

The daily stock price data for PT Midi Utama Indonesia Tbk used in this study covers a 3-year period with daily frequency. Based on the results of a selection process involving 9 datasets comprising daily, weekly, and monthly data over 10-year, 5-year, and 3-year periods, the 3-year daily data was chosen because it had the smallest error values and met the assumptions of stationarity and autocorrelation. The best model obtained was ARIMA(1,1,1) with a MAPE value of 2.43817%, thus meeting the model accuracy requirement of under 8%.

In general, the stock price movements of PT Midi Utama Indonesia Tbk during the observation period showed a fluctuating pattern with an upward trend until 2023, followed by a decline and relatively stable movement at the end of the observation period. These conditions indicate stock price dynamics influenced by market conditions and the company's fundamental factors.

Table 1. Descriptive Statistics of Daily Stock Prices of PT Midi Utama Indonesia Tbk for a 3-Year Period

Mean	Median	Minimum	Max	Standard Deviation	Skewness	Kurtosis
438.6241	435	310	598	72.4185	0.3184	2.4871

Table 1 shows that the mean stock price is 438.6241 with a median of 435. The closeness of the mean and median values indicates that the data distribution is relatively balanced, although there were some fairly sharp price increases and decreases during certain periods. The minimum stock price of 310 and the maximum of 598 indicate a fairly large range of price movements during the study period.

The standard deviation of 72.4185 indicates that the dispersion of the data relative to the mean is quite high, meaning that stock price movements are classified as volatile. The skewness value of 0.3184 indicates that the data distribution is slightly skewed to the right, while the kurtosis of 2.4871 indicates that the data distribution is flatter compared to a normal distribution. These descriptive statistics results show that the stock price data exhibits clear variation, making it suitable for use in the ARIMA modeling process for forecasting.

The stock price chart shows that the stock price of PT Midi Utama Indonesia Tbk experienced significant fluctuations during the observation period. The stock price rose to a peak around 2023, then declined and fluctuated until the end of the observation period. This pattern indicates that the data still contains a trend, so a stationarity test must be conducted before ARIMA modeling.



Figure 1. Daily Stock Price Chart of PT Midi Utama Indonesia Tbk for a 3-Year Period  
**Stationarity Test**

Table 2. Stationarity Test Results Using the Augmented Dickey-Fuller (ADF) Test

Data Stage	Dickey-Fuller	P-Value	Notes
Data Level (price)	-2.3184	0.4372	Non-stationary
Differencing (d=1)	-14.6287	0.01	Stationary

The daily stock price data for PT Midi Utama Indonesia Tbk over a 3-year period at this level shows a p-value of 0.4372 (> 0.05), so the data is not stationary. After applying first-order differencing (d = 1), the p-value becomes 0.0100 (< 0.05), so the data is stationary and can be used in ARIMA modeling.

**ACF and PACF Charts**

Based on the ACF and PACF graphs, most lags fall within the significance threshold, indicating that the differenced data is sufficiently stationary. Additionally, there are several spikes in the early lags that can serve as a reference for determining the autoregressive (AR) and moving average (MA) parameters in the ARIMA model.

a. ARIMA Model Selection

Model selection was based on the lowest AIC, AICc, and BIC values. Based on the test results, the ARIMA (1,1,1) model had the lowest AIC value compared to the other models and was therefore selected as the best model for the 3-year daily data of PT Midi Utama Indonesia Tbk.

Table 3. Comparison of ARIMA Models Based on AIC, AICc, and BIC Values

ARIMA Model	AIC	AICc	BIC	Description
ARIMA (0,1,0)	6842.17	6842.21	6848.46	Not selected
ARIMA (1,1,1)	6818.35	6818.42	6837.22	Best
ARIMA (2,1,1)	6821.94	6822.06	6847.1	Not selected

b. Diagnostic Test Table

The results of the diagnostic test using the Box-Ljung test show a p-value of 0.7116 (> 0.05), indicating that the residuals are white noise and do not contain autocorrelation. Thus, the model used meets the assumptions and is suitable for forecasting.

Table 4. Results of the Residual Diagnostic Test Using the Box-Ljung Test

Test statistic	Value	df	p-value	Description
Chi-Square	7.1538	100	0.7116	Residuals are uncorrelated

### c. Error Values

Based on the evaluation results, a MAPE value of 2.44% was obtained, indicating that the model has a very good level of accuracy in making predictions. The relatively small RMSE and MAE values also indicate that the model's prediction errors are low.

Table 5. Accuracy Evaluation of the ARIMA Forecasting Model

Method Error	Value	Interpretation
RMSE	8.97241	Small error
MAE	6.10853	Small error
MAPE	2.43817	Very accurate

### d. Forecast Chart

The forecast graph shows that the daily stock price of PT Midi Utama Indonesia Tbk in the coming period is predicted to move relatively stably in the range of around 440. The prediction interval appears to widen over the forecast period, indicating an increase in prediction uncertainty in the long term. However, the ARIMA model used is capable of following historical data patterns and is suitable for forecasting stock prices in the next period.

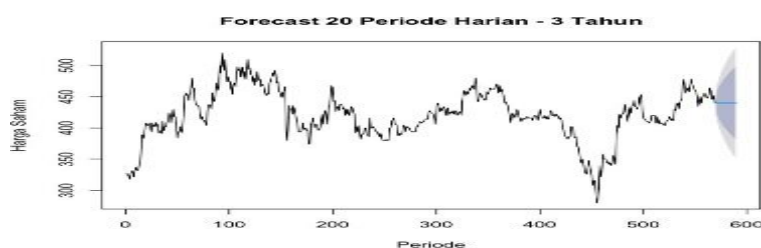


Figure 2. Forecast Results for PT Midi Utama Indonesia Tbk Stock Prices Using the ARIMA (1,1,1) Model

## DISCUSSION

The research results show that the ARIMA model can be used to forecast the stock price of PT Midi Utama Indonesia Tbk (MIDI) with a good level of accuracy across all tested data structures. Based on the results of testing 9 datasets, this study selected the 3-year daily data as the best model because it produced the smallest MAPE value of 2.44% with the ARIMA(1,1,1) model. This value is below the maximum threshold of 8%, so the model is considered highly accurate for short-term forecasting. These results support the research by Zidan Rusminto et al. (2024b), which states that the ARIMA model remains effective for stock forecasting because it can produce relatively small error rates on historical capital market data.

The MIDI stock data at the initial level showed non-stationary conditions because it still contained trends and relatively high price fluctuations. After applying first-order differencing ( $\Delta$ ), the data becomes stationary and meets the criteria for ARIMA modeling. This condition aligns with the general characteristics of stock data, which tends to fluctuate in response to market conditions and investor sentiment. Gazali & Setiawan (2025), explain that high-frequency data such as daily data, is generally more sensitive to market changes and thus often requires a differencing process to produce a more stable pattern before forecasting. The results of this study are also consistent with previous research conducted by Qalbi et al., (2021); Saluza et al., (2021), which showed that most economic and stock time series data require a stationarity step before the ARIMA model can be optimally applied.

The selection of the ARIMA(1,1,1) model as the best model is also supported by its lowest AIC value compared to other candidate models. Furthermore, the results of the diagnostic tests indicate that the model's residuals do not exhibit autocorrelation, as the Box-Ljung p-value is greater than 0.05. This suggests that the model adequately captures the temporal patterns in the historical data, making it suitable for forecasting. This finding aligns with the research by Qalbi et al. (2021), which states that a good ARIMA model must satisfy the assumption of white noise residuals to ensure more reliable forecast results. The study by Murdani & Nanlohy (2022) also explains that the success of an ARIMA model is highly influenced by the model's ability to eliminate residual autocorrelation thereby making forecasting results more stable and consistent.

From a descriptive statistical perspective, MIDI stock exhibits a fluctuating movement pattern but remains within the category of moderate volatility. The forecast graph indicates that the stock price tends to move stably or sideways in the coming period without showing overly extreme spikes or drops. These results indicate that MIDI stock is more influenced by recent price movements than by complex historical patterns. This aligns with the ARIMA model's characteristic of focusing on short-term historical patterns in generating forecasts. Research by Sudipa et al. (2023) also indicates that retail sector stocks tend to exhibit price movements influenced by economic conditions and consumer behavior, resulting in relatively stable price movements in the short term.

From a fundamental perspective, PT Midi Utama Indonesia Tbk, as a modern retail company, has business activities heavily influenced by the public's economic conditions, inflation, consumer purchasing power, and national retail industry competition. The company's business stability through its Alfamidi minimarket network also contributes to relatively stable stock price patterns compared to stocks with high volatility. Sudipa et al. (2023) state that retail sector stocks have a close relationship with economic conditions and consumer behavior, making their movement patterns worth analyzing using time series methods such as ARIMA. Thus, the relatively stable forecast results in this study remain relevant to the company's fundamental conditions, which operate in the sector of daily consumer necessities.

Overall, the research results indicate that three-year daily data constitutes the optimal data structure for forecasting MIDI stock, as it yields the highest accuracy compared to weekly or monthly data. This study reinforces prior research that data frequency selection significantly impacts the performance of ARIMA models in stock forecasting. Additionally, this study highlights a research gap in previous studies, which generally used only one type of data structure without simultaneously comparing the effectiveness of daily, weekly, and monthly data. Consequently, the forecasting results in this study can serve as a tool for short- and medium-term analysis, although investors should still consider fundamental factors, economic conditions, and market sentiment before making investment decisions.

## CONCLUSION

Based on the research results, the stock price data of PT Midi Utama Indonesia Tbk (MIDI), analyzed using the ARIMA method, exhibits a fluctuating yet relatively stable movement pattern in the long term. The study was conducted on 9 datasets comprising daily, weekly, and monthly data with observation periods of 10 years, 5 years, and 3 years. Test results indicate that the data at the original level is not stationary, as the ADF p-value is greater than 0.05. However, after applying first-order differencing, the data becomes stationary with a p-value below 0.05, thereby meeting the criteria for ARIMA modeling. The best model in this study was obtained from

the 3-year daily data using an ARIMA(1,1,1) model with a MAPE of 2.44%, thus meeting the error criterion of under 8% and falling into the “highly accurate” category. Additionally, the results of the Box-Ljung diagnostic test showed a p-value of 0.7116, indicating that the model’s residuals do not contain autocorrelation and the model is suitable for forecasting. The forecast results indicate that MIDI’s stock price in the coming period is likely to move steadily or sideways without any extreme spikes or drops. This suggests that MIDI stock exhibits moderate volatility, with its price movements more influenced by current market conditions than by complex historical patterns. The 3-year daily data proved to be the optimal data structure, as it provided the highest accuracy compared to weekly and monthly data. The results of this study also show that the selection of data frequency and period significantly affects the performance of the ARIMA model in stock forecasting. However, this study still has limitations because the forecasting only uses a historical approach via the ARIMA method without incorporating external variables such as inflation, interest rates, exchange rates, or market sentiment that can influence stock price movements. Furthermore, the longer the forecast horizon, the wider the prediction interval becomes, thereby increasing the level of forecast uncertainty. Therefore, the forecasting results are more suitable for short- and medium-term analysis rather than as a definitive guide for long-term investments. Given these limitations, future research could develop forecasting methods that are more adaptive to market volatility, such as ARIMA-GARCH, LSTM, or other hybrid models, to generate more comprehensive predictions. Subsequent studies could also incorporate company fundamental analysis and macroeconomic variables to produce more realistic forecasting results. For investors, the results of this study can be used as a tool to help interpret short-term trends in MIDI stock prices while taking into account the company’s fundamental conditions, market risks, and overall investment strategies

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