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Combination of Regression and ARIMA Methods (Reg – ARIMA) Stock Price Prediction Model

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ABSTRACT

This research is motivated by the limitations of the ARIMA method, which is only suitable for short-term forecasting and specific periods. Therefore, a combination of Regression and ARIMA methods (Reg- ARIMA) is introduced to predict stock prices over a longer period. The purpose of this study is to implement a combination of Regression and ARIMA methods to build a stock price prediction model. The research methodology involves using Mean Absolute Percentage Error (MAPE) and Root Mean Square Error (RMSE) to measure the accuracy of the generated prediction model. The study results indicate significant variations in MAPE and RMSE values among different stocks, reflecting the performance and liquidity of those stock markets. For example, stocks such as ITMG and UNTR show strong performance, while stocks with low closing values may carry higher risks or slower growth. In conclusion, the Reg-ARIMA combination method is effective in extending the range of stock price forecasting, providing a more accurate alternative compared to using only the ARIMA method. This suggests that this hybrid approach can be used to enhance investment decision-making strategies in the stock market.

Keywords: Reg-ARIMA; Stock Price Prediction; MAPE; RMSE; Hybrid Prediction Model.

INTRODUCTION

Stock market changes are often regarded as a “barometer” of the global economy, making stock price prediction an essential topic in financial research. With an increasingly rapid dynamic, especially under the pressures of global economic shifts and international situations, the ability to predict stock prices becomes crucial for achieving financial goals and stable economic development. Accurate predictions not only aid in investment decision-making but also help respond more adaptively to changes in the economic environment. However, traditional analytical methods such as ARIMA have limitations, particularly for long-term forecasting.

To address the limitations of the ARIMA method in long-term forecasting, this study proposes a combination of the ARIMA method with Regression, known as Reg-ARIMA. This combination is expected to enhance prediction accuracy by leveraging ARIMA’s time series analysis strengths alongside the ability of regression to handle broader data variations.

The objective of this study is to develop a more accurate stock price prediction model by combining Regression and ARIMA methods. The main contribution of this research is to provide a hybrid prediction approach that can address the weaknesses of traditional ARIMA models in long- term forecasting and offer a more reliable predictive tool for investors and decision-makers in the stock market.

Previous studies have shown the effectiveness of the ARIMA method for short-term stock price prediction, but it is limited in scope and duration. Research by Yushu and Haihui demonstrates that ARIMA

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requires large datasets and is better suited for short-term rather than long-term predictions. (Shao, 2023)Minhaj combined ARIMA with data from the S&P 500, highlighting this approach's potential for short-term forecasting but not explicitly addressing long-term forecasting issues. (Minhaj, Ahmed, Khalique, & Imran, 2022)This study aims to fill the gap in the literature by providing a more comprehensive solution through a combined methodology.

A stock is a financial instrument that represents an individual's ownership in a company and grants the holder the right to receive dividends. The value of a stock fluctuates based on demand and supply in the capital market.

These fluctuations are often influenced by both internal company factors and external factors, such as global economic conditions and political situations.

The moving average method is one of the approaches commonly used in technical analysis to predict stock prices. This technique calculates the average stock price over a specific period, such as 30 or 60 days, and is used to identify market trends. However, research by Chaddha indicates that the effectiveness of this method is limited, especially in unstable market conditions. (Chaddha & Yadav, 2022)

The Autoregressive Integrated Moving Average (ARIMA) model is a statistical method commonly used for time series analysis and stock price prediction. This model combines autoregressive (AR) and moving average (MA) components, as well as differencing integration to address non-stationary trends in data. Some studies have shown that ARIMA is more effective for short-term predictions but has limitations for long-term forecasting.

The Reg-ARIMA model combines regression with ARIMA to address the limitations of ARIMA in long-term forecasting. Regression is used to capture seasonal patterns or calendar effects, while ARIMA handles the time series components. This model is expected to improve prediction accuracy compared to using a single model.

Research conducted by Suryawati developed a stock prediction model using the moving average method, but it only focused on portfolio recommendations for specific sectors without analyzing individual stocks in depth. (Suryawati , Wardani, Sarmo, Kusmayadi, & Muttaqillah, 2020) Minhaj also applied the ARIMA model to predict the short-term stock prices of Johnson & Johnson, demonstrating that ARIMA has potential in this context, although it is not effective for long-term forecasting. (Minhaj, Ahmed, Khalique, & Imran, 2022)

Previous studies, such as those by Yushu, indicate that ARIMA is effective for short-term predictions but lacks accuracy in the long term, primarily due to its inability to handle external factors such as economic policies. (Shao, 2023) This study aims to address these shortcomings by integrating regression, which accounts for seasonal or calendar variations, to extend the forecasting scope.

Unlike previous studies that only used ARIMA or other technical methods like moving averages, this research adopts a hybrid Reg-ARIMA approach. This approach not only overcomes the long-term limitations of the ARIMA model but also enhances prediction accuracy by incorporating seasonal and calendar variables, which have not been extensively explored in prior research.

METHOD

The research methodology used in this thesis includes several important steps designed to analyze and predict stock prices using the Reg-ARIMA (Regression-ARIMA) model. The following is a detailed explanation of the research methodology taken from the report file.

Research Stages

The stages of this research are as follows.

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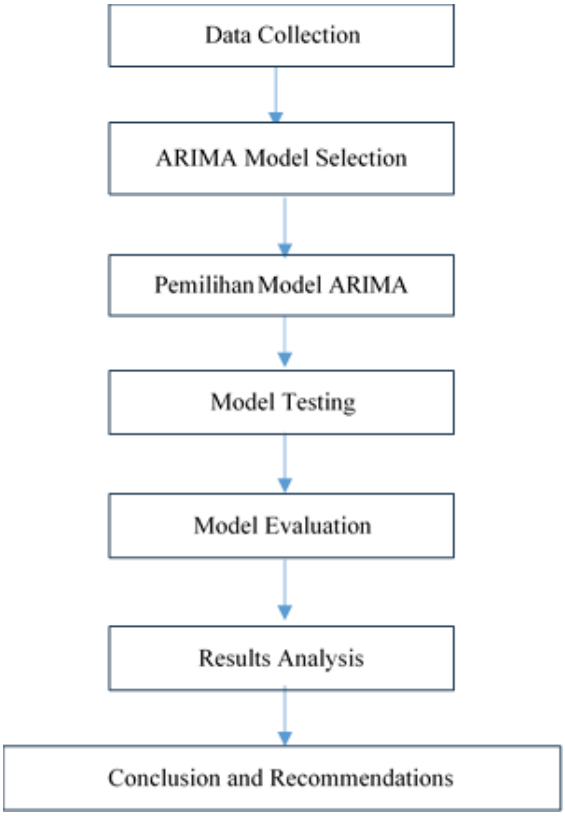

Fig 1. Flowchart of Research Stages

1. Problem Analysis
   The first stage begins by analyzing the problem related to stock price prediction using the Reg-ARIMA model. This analysis aims to understand the challenges faced in predicting stock prices and to determine the appropriate method to address those challenges. This stage also includes identifying relevant data for the analysis.
2. Data Collection
   The data used in this study is secondary data, taken from the stock dataset on the LQ45 index. This data includes daily stock prices from August 2019 to February 2024. The data is obtained from a reliable source, and the data collection process is a crucial step to ensure the quality of the predictions to be made.
3. Model Selection and Research Design
   This study uses a combination of regression methods and ARIMA (Autoregressive Integrated Moving Average) to build the stock price prediction model. In this stage, the appropriate model is selected based on the nature of the collected data. The model selection process includes choosing the correct parameters for the ARIMA model by using the Augmented Dickey-Fuller (ADF) method to test for stationarity, as well as utilizing the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) to determine the values for parameters p, d, and q.
4. Data Preprocessing
   The collected data is then processed to ensure that it is ready for use in the model. This process includes checking and handling missing data, normalizing the data if necessary, and adjusting the data to meet the requirements of the chosen model.

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5. ARIMA Model Parameter Selection
   After data preprocessing, the ARIMA model parameters are selected using ACF and PACF analysis. The values for parameters p, d, and q are determined based on the autocorrelation patterns of the stationary data. This step is important to ensure that the resulting model can capture the data patterns well and provide accurate predictions.
6. Reg-ARIMA Model Implementation
   In this stage, the combination of regression methods and ARIMA is implemented to build the stock price prediction model. The model is then applied to the historical data collected, and the prediction results are compared with actual data to evaluate the model's performance. The evaluation is done using accuracy metrics such as Mean Absolute Percentage Error (MAPE) and Root Mean Square Error (RMSE).
7. Evaluation and Analysis of Results
   The prediction results obtained from the model are then evaluated to determine their accuracy. Analysis is conducted to observe the variation in MAPE and RMSE values across different stocks, indicating differences in the accuracy levels of predictions. This evaluation helps in understanding how well the Reg-ARIMA model performs.
8. Conclusion and Recommendations
   Based on the evaluation results, conclusions are drawn regarding the effectiveness of the Reg-ARIMA model in predicting stock prices. Recommendations for further research are also provided, including suggestions to improve the model's accuracy and address the weaknesses identified during the study.

RESULT

ARIMA Parameter Recommendation Results

Based on the tests, the ARIMA (p, d, q) parameter values for various stocks in the LQ45 index are obtained. Table 1 below shows the proposed ARIMA parameter values:

Table 1. ARIMA Parameter Values

Stock	Values p	values d	Values q
ACES	2		2
ADRO	2	0	2
AKRA	2	0	2
AMRT	2	0	2
ANTM	2	0	2
ARTO	2	0	2
ASII	2	0	2
BBCA	2	0	2
BBNI	3	0	2
BBRI	16	0	0
BBTN	3	0	3
BMRI	4	0	3
BRIS	2	0	3
BRPT	2	0	2
BUKA	2	0	2
CPIN	2	0	2
EMTK	2	0	2
ESSA	2	0	2

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EXCL	2	0	2
GGRM	2	0	2
GOTO	2	0	2
HRUM	20	0	20
ICBP	2	0	2
INCO	2	0	2
INDF	2	0	2
INKP	2	0	2
INTP	2	0	2
ITMG	2	0	2
KLBF	2	0	2
MAPI	2	0	2
MBMA	2	0	2
MDKA	2	0	2
MEDC	2	0	2
MTEL	2	0	2
PGAS	2	0	2
PGEO	2	0	2
PTBA	2	0	2
PTMP	2	0	2
SIDO	2	0	2
SMGR	2	0	2
SRTG	2	0	2
TLKM	2	0	2
TOWR	2	0	2
TPIA	2	0	2
UNTR	20	0	20

From the results, the majority of stocks show low values for p and q (between 1-3), indicating that the ARIMA model with low parameters is sufficient to predict stock price patterns. However, some stocks, such as HRUM and UNTR, show very high values for p and q, indicating the presence of long-term autocorrelation in the stock price data.

Discussion of Stock Closing Price Predictions

The evaluation of stock closing price predictions for the year 2024 is conducted using the MAPE and RMSE metrics. Table 2 below shows the evaluation results of the ARIMA model for several stocks:

Table 2. ARIMA Model Evaluation Results

Stock	MAPE (%)	RMSE	Final Score
ACES	1.60	1786	8346
ADRO	0.96	3295	243809
AKRA	0.85	1861	163429
AMRT	1.22	2201	18123
ANTM	1.01	2951	25079

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ARTO	2.13	3176	28110
ASII	0.73	3258	188299
BBCA	0.68	2934	392394
BBNI	1.14	3782	22998
BBRI	2.07	4186	64139
BBTN	0.89	2063	1339
BMRI	0.72	2648	176123
BRIS	1.02	2451	1743
BRPT	0.76	2763	939
BUKA	1.58	1873	2924
CPIN	0.85	2943	62013
EMTK	1.48	2825	58294
ESSA	1.27	1972	12573
EXCL	0.98	1742	3139
GGRM	0.72	2438	103224
GOTO	1.32	1987	1789
HRUM	2.13	5242	166282
ICBP	0.79	1984	68221
INCO	0.83	2349	216229
INDF	0.63	4896	131283
INKP	1.04	3184	128394
INTP	0.86	2674	98743
ITMG	1.01	2943	402984
KLBF	0.94	1881	18294
MAPI	1.21	2324	10294
MBMA	1.07	2648	12384
MDKA	1.42	4387	29374
MEDC	0.88	2397	8392
MTEL	1.35	2984	2984
PGAS	0.79	2723	8393
PGEO	1.10	1847	17294
PTBA	0.96	2861	184294
PTMP	1.47	2937	48273
SIDO	1.32	2382	9384
SMGR	1.08	2734	78923
SRTG	1.24	2284	5938
TLKM	0.79	2453	49374
TOWR	1.14	1938	23894
TPIA	7.07	41757	553513
UNTR	10.5	34037	2316246

Stock Price Closing Prediction Graph

The prediction results for UNTR and TPIA stocks are visualized in the following graph:

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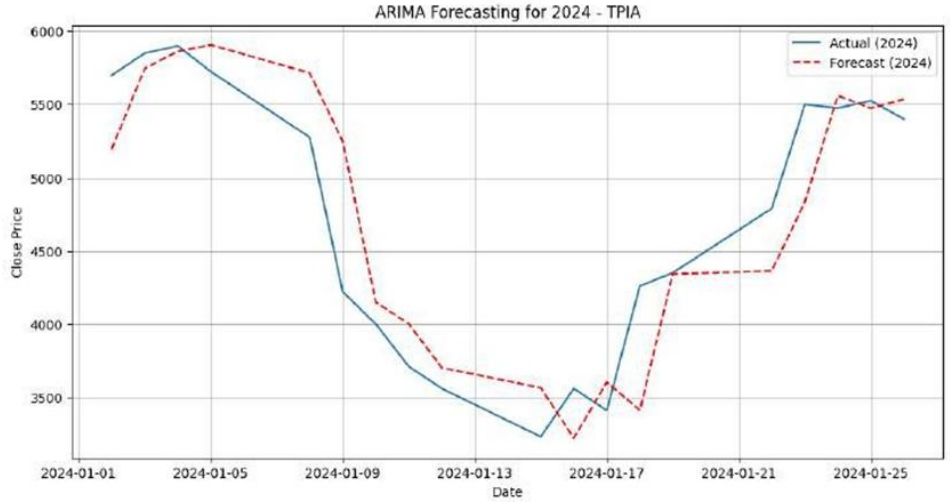

Fig 2. Stock Price Closing Prediction Graph for TPIA in 2024

Figure 2 shows the predicted stock price closing for TPIA in 2024, with a predicted value of 553,513, a MAPE of 70.7%, and an RMSE of 41,757.

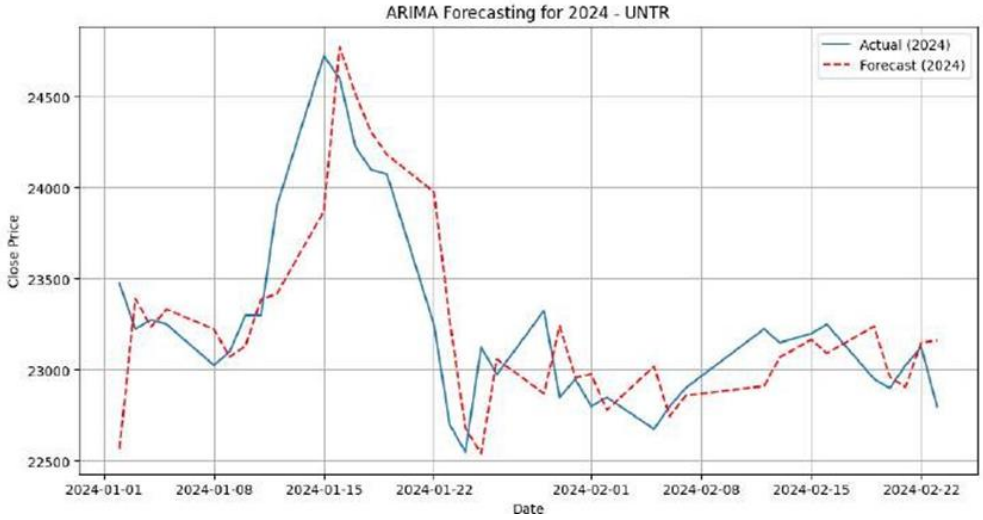

Fig 3. Stock Price Closing Prediction Graph for UNTR in 2024

Figure 3 shows the predicted stock price closing for UNTR in 2024, with a predicted value of 2,316,246, a MAPE of 10.5%, and an RMSE of 34,037.

This graph provides a clearer visualization of the prediction performance, particularly for stocks with significant predicted values and evaluation metrics that indicate considerable variation in model accuracy.

DISCUSSIONS

This discussion focuses on the prediction results of stock closing prices for the year 2024 using the ARIMA model. The recommended ARIMA parameter results are presented in detail, followed by the evaluation of stock price predictions using the MAPE (Mean Absolute Percentage Error) and RMSE (Root Mean Square Error) metrics. The prediction results are visualized in the form of graphs to provide a clear picture of the model's performance.

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CONCLUSION

The conclusion contains a summary of what is learned from the results obtained, what needs to be improved in further study. Other common features of the conclusions are the benefits and applications of the research, limitation, and recommendations based on the results obtained.

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