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Performance Comparison of SARIMA and Prophet Models for Forecasting Indonesian Banking Stock Prices

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ABSTRACT

This study compared the performance of SARIMA and Prophet models in forecasting daily close prices of three major Indonesian banking stocks: BBCA, BBRI, and BMRI, using data from January 2020 to March 2026. Data were retrieved via the yfinance library, preprocessed, and split into 80% training and 20% testing sets. SARIMA modeling followed the Box-Jenkins procedure, while Prophet was configured with a Lag-1 regressor, weekly and monthly seasonality, Indonesian public holidays, and log transformation. Model performance was evaluated using MAPE, MSE, and Dstat metrics. Results showed that SARIMA outperformed Prophet in MAPE and MSE across all six stock-variable combinations, with MAPE values ranging from 1.3368% to 1.9386% for SARIMA and 1.5992% to 2.2300% for Prophet. However, Prophet demonstrated marginally higher Dstat values in several series. Both models achieved "Very Good" forecasting accuracy. A web-based forecasting system was also developed using Streamlit to make the models accessible to investors.
Keywords: SARIMA, Prophet, stock price forecasting, time series, Indonesian banking stocks

1. Introduction

The rapid advancement of information technology has significantly transformed the financial investment industry. In Indonesia, the number of capital market investors grew from 3.88 million in 2020 to 14.87 million by end of 2024, representing a CAGR of 30.82%. This growth is driven by increasing accessibility of digital trading applications and growing financial literacy among younger generations. Despite this expansion, the stock market remains subject to high volatility, making price prediction a critical yet challenging task.[1–3]

The banking sector has attracted considerable investor attention, particularly blue-chip stocks such as BBRI, BMRI, and BBCA, which rank consistently among the highest-traded equities on the Indonesia Stock Exchange (IDX). Their strong fundamentals do not shield them from volatility

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caused by fluctuations in interest rates, fiscal policy, and global market sentiment. Accurate forecasting of these stocks is, therefore, both practically valuable and academically important.[4,5] Among the established forecasting approaches, the Seasonal Autoregressive Integrated Moving Average (SARIMA) model has been widely recognized for capturing recurring seasonal patterns in time series data . Studies on Indonesian stocks have shown that SARIMA outperforms other models in level accuracy . Meanwhile, Prophet, developed by Meta's research team, offers an additive decomposition approach capable of automatically handling trend shifts, multiple seasonality, and holiday effects . Several studies report that Prophet achieves comparable or superior MAPE values compared to classical methods like ARIMA .[6–10]

Prior comparative studies between SARIMA and Prophet yielded mixed conclusions, with performance being highly data-dependent. A notable gap remains in research focusing simultaneously on multiple Indonesian state-owned banking stocks using MAPE, MSE, and Dstat as complementary evaluation metrics. This study addresses that gap by comparing SARIMA and Prophet on BBCA, BBRI, and BMRI close price data from 2020 to 2026, and developing a practical web-based forecasting system for investors.[11–14]

2. Research Method

This research is a quantitative study with a comparative approach. The data consist of daily historical close prices of BBCA, BBRI, and BMRI from January 1, 2020 to March 31, 2026, retrieved via the yfinance library connected to Yahoo Finance. All processing was conducted on Google Colab using Python. The research workflow comprised: (1) data collection, (2) data preprocessing, (3) SARIMA modeling, (4) Prophet modeling, (5) model evaluation using MAPE, MSE, and Dstat, and (6) web-based system development.

2.1 Data Preprocessing

Time series decomposition was applied to each stock to identify trend, seasonality, and residual components. The dataset was split into 80% training (1,200 observations) and 20% testing (301 observations)[15]. No normalization was applied, as both models operate directly on raw price values.

2.2 SARIMA Modeling

SARIMA modeling followed the Box-Jenkins procedure: (1) stationarity testing via the Augmented Dickey-Fuller (ADF) test, (2) model identification via ACF and PACF plots reinforced by *auto_arima* minimizing AIC, (3) residual diagnostics via Ljung-Box test, and (4) forecasting. All six price series were confirmed non-stationary in their original form (p-value > 0.05), achieving stationarity after first-order differencing (d = 1).

2.3 Prophet Modeling

The Prophet model was configured with a Lag-1 external regressor, weekly seasonality, monthly seasonality (period = 30.5, Fourier order = 3), Indonesian public holidays, and custom *cuti bersama* dates. A log(1+x) transformation was applied before training to stabilize price variance and reversed post-prediction. The rolling one-step-ahead (Walk-Forward Validation) approach with a sliding training window of 120 observations was used to prevent data leakage.

2.4 Evaluation Metrics

Three metrics were used. MAPE measures the mean absolute percentage error:

$$MAPE = \frac{1}{n}\sum_{t=1}^{n} \left| \frac{A_t - F_t}{A_t} \right| \times 100\%$$

MSE measures average squared error, penalizing large deviations:

$$MSE = \frac{1}{N}\sum_{t=1}^{N}(A_t - F_t)^2$$

Dstat measures directional accuracy — the proportion of periods where the predicted direction of price change matches the actual direction:

$$Dstat = \frac{1}{N}\sum_{t=1}^{N} a_t \times 100\%$$

where $a_t = 1$if $(x_{t+1} - x_t)(\hat{x}_{t+1} - \hat{x}_t) \geq 0$, and 0 otherwise. MAPE categories follow: <10% = Very Good, 10–20% = Good, 20–50% = Fair, >50% = Poor.

3. Results and Analysis

3.1. SARIMA Forecasting Results

All six SARIMA models achieved MAPE values below 2%, classified as "Very Good." A consistent pattern was observed: Close price MAPE is lower than Open price MAPE within the same stock across all three issuers, indicating that closing prices are more predictable as they reflect full-session market consensus. Dstat values ranged from 39.67% to 47.67%, all below the 50% random-guessing threshold, revealing a structural limitation of linear models in capturing short-term directional dynamics.

3.2. Prophet Forecasting Results

Prophet also achieved "Very Good" MAPE values across all six series, with results ranging from 1.5992% (BBCA Close) to 2.2300% (BMRI Open). Dstat values for Prophet were generally higher than SARIMA equivalents for example, BMRI Close improved from 47.67% (SARIMA) to 49.00% (Prophet), and BBRI Open from 46.67% to 49.00% suggesting the Lag-1 regressor and holiday effects provide a modest improvement in directional prediction. The anomalously high MSE for BMRI Close (608,888.71) is attributed to a small number of extreme prediction errors rather than systematic inaccuracy, as confirmed by its low MAPE of 1.9430%.

3.3 Model Evaluation and Comparison

The complete evaluation results for all models are presented in Table 1

Table 1 Model Evaluation Results: SARIMA vs. Prophet

Stock	Price Type	Model	MAPE (%)	MSE	Dstat (%)	Category
BBCA	Open	SARIMA	1.4684	27,798.12	39.67	Very Good
BBCA	Open	Prophet	1.8223	40,138.66	42.67	Very Good
BBCA	Close	SARIMA	1.3368	19,943.58	39.67	Very Good
BBCA	Close	Prophet	1.5992	28,102.11	39.67	Very Good
BBRI	Open	SARIMA	1.6217	6,262.70	46.67	Very Good
BBRI	Open	Prophet	1.9978	8,290.11	49.00	Very Good
BBRI	Close	SARIMA	1.5643	5,610.59	42.33	Very Good
BBRI	Close	Prophet	1.8999	7,491.79	46.33	Very Good
BMRI	Open	SARIMA	1.9386	13,402.40	45.33	Very Good
BMRI	Open	Prophet	2.2300	16,923.86	46.33	Very Good
BMRI	Close	SARIMA	1.6488	9,411.73	47.67	Very Good
BMRI	Close	Prophet	1.9430	608,888.71	49.00	Very Good

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SARIMA outperformed Prophet in MAPE across all six stock-variable combinations, with advantages ranging from ~0.22 to ~0.29 percentage points. SARIMA also showed lower MSE in five of six series. These findings showing that SARIMA better captures the seasonal structure of Indonesian stock data. In contrast, Prophet demonstrated higher Dstat in most series, suggesting its trend-decomposition and holiday-modeling components offer a slight edge in directional prediction consistent with findings from Kumar & Sikari on blue-chip Indian stocks. This reveals a trade-off: SARIMA excels at level accuracy, while Prophet provides marginally better directional prediction.

3.4 Web-Based System

The developed Streamlit application enables investors to select a stock (BBCA/BBRI/BMRI), choose a forecasting model (SARIMA, Prophet, or both), and view interactive Plotly charts alongside forecasted values and evaluation metrics. The system was successfully deployed on Streamlit Community Cloud, making it publicly accessible without requiring technical expertise from end users.

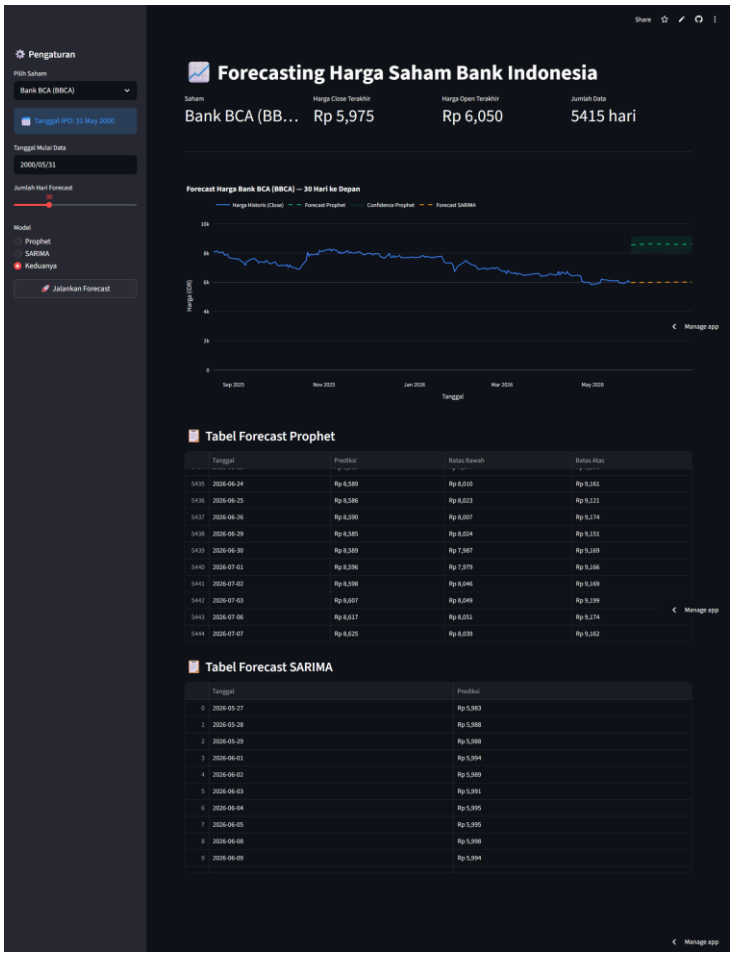

Figure 1 Web Base Implementation

4. Conclusion

Both SARIMA and Prophet models achieved "Very Good" forecasting accuracy for BBCA, BBRI, and BMRI daily close prices, with all MAPE values below 3%. SARIMA consistently outperformed Prophet in MAPE and MSE across all stock-variable pairs, confirming its superiority

for price level estimation on Indonesian banking stock data with stable seasonal structure. However, Prophet achieved marginally higher Dstat values in most series, indicating a modest advantage in directional prediction attributable to its Lag-1 regressor and holiday components. Future research may explore hybrid SARIMA-Prophet models or incorporate deep learning approaches to improve directional accuracy beyond the 50% threshold. The web-based forecasting system developed in this study provides a practical tool for data-driven investment decision-making.

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