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FB Prophet Algorithm Based on Clustering for Stock Price Prediction

Meti Despasari[1]* & Rizka Pitri[2]

[1]*Prodi Sistem Informasi, Fakultas Sains Dan Teknologi, Universitas Islam Negeri Raden Intan Lampung, Indonesia*
[2]*Prodi Sains Data, Fakultas Sains Dan Teknologi, Universitas Islam Negeri Raden Intan Lampung, Indonesia*

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Abstract:

Extreme volatility in banking stocks like PT Bank Central Asia Tbk (BBCA) decreases single forecasting model accuracy due to high data heterogeneity. This study aims to analyze BBCA stock price prediction accuracy using the FB Prophet algorithm mediated by K-Means Clustering preprocessing. A quantitative time-series method was applied to monthly data from 2014–2025. Results show that K-Means integration (k=3) effectively resolves data heterogeneity. Globally, the FB-Prophet model yielded a Mean Absolute Percentage Error (MAPE) of 20.34%. However, cluster-based evaluation demonstrated superior accuracy during transition phases (MAPE 9.83%) and low-price phases (MAPE 10.13%), dropping the average cluster error to 16.22%. Accuracy decreased only during highly volatile peak price phases (MAPE 28.70%). The 12-month projection for 2026 indicates a stable, conservative linear growth trend, closing at Rp8,532.34. Conclusively, this hybrid Clustering-Forecasting approach provides a more comprehensive and accurate prediction mapping based on distinct market phases.

1. Introduction

The Indonesian capital market, particularly the banking sector, has shown a fluctuating level of stock price volatility in recent years. The movement of blue-chip banking stocks such as PT Bank Central Asia Tbk (BBCA) is highly vulnerable to market dynamics influenced by various factors, including the flow of foreign investor funds that can trigger rapid price changes (Gultom, 2023). The simulation of BBCA's stock price movement empirically shows an increasingly widening path of fluctuations over time, thereby directly increasing the risk for investors (Amalia et al., 2025). The high level of volatility demands a precise stock price forecasting system so that investors can minimize the risk of losses and optimize their investment decision-making strategies.

In the study of time-series forecasting, the FB Prophet algorithm has been recognized for its reliability in modeling historical data with strong seasonal patterns, as well as its robustness in handling missing data and sudden trend shifts (Rauf, 2023). Recent research has proven that the Prophet model is capable of producing promising accuracy in predicting stock prices by analyzing the effects of public sentiment additively (Taofiqurrohman et al., 2025). However, despite the fact that this algorithm is highly flexible and easy to configure, its predictive performance tends to experience a significant decline when faced with stock data sets that have extreme outlier values or overly heterogeneous movement variances without prior segmentation (Santoso & Dewi, 2024).

The limitation of a single forecasting model in accommodating such extreme data spikes has become a major gap in previous research. To address the issue of data heterogeneity, several recent studies have begun implementing clustering methods before entering the forecasting stage. The use of the K-Means Clustering algorithm has proven to

* Corresponding author.
E-mail address: metidespasari5@gmail.com

be very effective in breaking down and grouping stock data characteristics into more specific and homogeneous intervals (Nasution, 2023). The integration of K-Means as a preprocessing stage can reduce noise in data variance, allowing subsequent prediction models to extract patterns more optimally and provide much more precise results (Rafi et al., 2024; Sihombing, 2024). Although this clustering approach has been successfully combined with various models such as LSTM or Fuzzy Time Series, its specific integration with the FB Prophet algorithm for forecasting the stock prices of large-cap banks has still been rarely explored.

Based on this gap, this research proposes a hybrid approach by applying K-Means clustering as an intermediary before the data series is processed by the FB Prophet algorithm. Therefore, the main objective of this research is to analyze the accuracy level of BBCA stock price predictions using the FB Prophet algorithm, which is run thru the intermediary of K-Means clustering. The novelty in this research lies in the two-stage integration architecture of the algorithm (Clustering-Forecasting) to reduce the prediction error that often arises due to extreme market volatility, thereby expected to produce a forecasting model that is much more stable, robust, and accurate compared to single algorithm testing.

2. Literature Review

2.1 Stock Price

Stock prices are defined as the market value formed thru the mechanism of supply and demand on the stock exchange, which represents the value of an individual's or party's capital investment in a company (Fitriani & Suhartono, 2018). In the capital market ecosystem, stock price movements are often considered the main indicator reflecting the fundamental condition of the issuer as well as investor expectations regarding the company's future performance (Sharma et al., 2025). The banking sector, in particular, plays a crucial role as the driving force of the stock market index due to its large capitalization, but on the other hand, it has a very high sensitivity to economic fluctuations and monetary policy.

The fundamental nature of stock prices is dynamic, unstable, and highly fluctuating or volatile. This level of volatility reflects the magnitude of risk faced by investors; the greater the price fluctuations in a short period, the greater the uncertainty of the returns that will be received (Alamsyah, 2021). The movement of these prices is influenced by a combination of internal factors, such as financial reports and corporate actions, as well as external factors that include macroeconomic conditions, global market sentiment, and extraordinary events (shocks) like pandemics that can cause drastic upheavals in the price structure on the exchange.

Technically, stock price movements tend to form certain trend patterns, namely uptrends, downtrends, or sideways (Taofiqurrohman et al., 2025). Understanding these historical patterns becomes an important foundation in technical analysis to predict future price directions. Given the complexity and non-linear nature of stock data, the development of accurate forecasting models becomes a crucial necessity for investors and fund managers to mitigate the risk of losses and optimize decision-making strategies in the uncertain capital market.

2.2 Time-Series

Time-series data is defined as a collection of observations or data points recorded sequentially based on specific time intervals, such as daily, weekly, or monthly (Hate et al., 2025). In the context of financial markets, time-series analysis becomes a crucial instrument because it can capture the dynamic patterns of historical price movements, such as opening prices and closing prices that interact within the same time system. The use of historical data aims to identify the internal structure of the data to build forecasting models capable of predicting future trends or values (Rusminto et al., 2024).

The main characteristic that distinguishes financial time series data from other types of data is its high level of complexity. This data often exhibits non-stationary behavior, contains seasonal elements, fluctuating volatility, and long-term trends (Hate et al., 2025). Furthermore, stock price fluctuations in the capital market are greatly influenced by changes in the macroeconomic and microeconomic environment, which are often unpredictable, making the data tend to be non-linear and non-parametric (Marjuni, 2022). These characteristics are what make forecasting financial data a technical challenge that requires an adaptive algorithmic approach.

In conducting time series analysis, systematic steps are required starting from initial data processing, model parameter selection, to performance evaluation (Rusminto et al., 2024). The accurate recognition of patterns, trends, and price

fluctuations is key to generating predictions with a high level of accuracy. A deep understanding of the components of this time series is crucial for researchers to determine whether a dataset requires additional preprocessing steps, such as clustering, to reduce noise and enhance the stability of the prediction model.

2.3 K-Means Algorithm

The K-Means algorithm is a non-hierarchical data clustering method that iteratively divides a set of data into K groups or clusters (Fathurachman & Saepudin, 2025). The main objective of this algorithm is to partition objects into clusters based on the similarity of their characteristics, so that the variation within a single cluster is minimized (Gubu et al., 2023). This technique relies on determining the cluster center (centroid) and allocating data to the nearest center using a specific distance metric, where Euclidean distance is one of the most commonly used measures.

Operationally, K-Means works thru several systematic stages, starting with the determination of the number of clusters K and the random initialization of initial cluster centers (Lee et al., 2010). Next, the distance of each data object to all cluster centers is calculated, and it is assigned to the cluster with the nearest center. After all the data has been allocated, the new cluster center will be recalculated based on the average position value of all the data points within the group. This process is repeated continuously until it reaches a convergent condition, which is when the cluster center no longer experiences significant changes or there are no more movements of cluster members (Fathurachman & Saepudin, 2025; Gubu et al., 2023).

$$J = \sum_{k=1}^{K} \quad \sum_{Xi \in C_k} \|X_i - \mu_k\|_2^2 \tag{1}$$

In the implementation of stock market prediction, the clustering approach plays a crucial role in grouping historical data that has similar volatility or price movement patterns. By dividing heterogeneous financial time series data into more homogeneous sub-clusters, forecasting algorithms can work with more consistent and focused data (Lee et al., 2010). This strategically simplifies the model learning process because more similar patterns are grouped within one cluster, which ultimately can improve accuracy and reduce the error rate in stock price predictions.

2.4 FB Prophet Algorithm

The FB Prophet algorithm is an open-source time-series forecasting software developed by the Facebook Data Science team. This algorithm is designed to simplify the process of accurate forecasting modeling without requiring deep statistical skills in its implementation (Santoso & Dewi, 2024). In various studies, this model has proven to be very flexible for predicting stock prices due to its ability to automatically adjust to the dynamic characteristics of financial data. Mathematically, Prophet is based on an additive regression model that combines several key components to produce optimal predictions (Rauf, 2023). The basic formulation of this algorithm is expressed in the equation:

$$y(t) = g(t)\big(1 + s(t) + h(t)\big) + \varepsilon_t \tag{2}$$

In this model, g(t) represents the trend function to model non-periodic trend changes, s(t) represents periodic or seasonal changes such as daily, weekly, or yearly patterns, h(t) functions to handle the effects of holidays or specific events that impact the data, and ϵt is the error term that captures random fluctuations that cannot be explained by the model.

One of the main advantages of FB Prophet is its robustness against missing values and the presence of extreme outliers in historical data. This algorithm also has the capability to automatically handle trend shifts thru changepoint identification and is very effective in extracting complex seasonal patterns from stock market data (Taofiqurrohman et al., 2025). This flexibility makes Prophet a highly reliable method for producing stable, robust, and highly accurate short-term and long-term forecasts.

2.5 Evaluation of Prediction Model Performance

Performance evaluation is a crucial stage in the forecasting system to measure the level of accuracy and effectiveness of the model in providing future price estimates based on historical data (Sadewa et al., 2025). Evaluation metrics help researchers assess how close the model's predictions are to the actual values occurring in the market. In financial time series analysis, there are several key indicators commonly used to test the reliability of a model, namely Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), and Mean Absolute Percentage Error (MAPE) (Tshamaroh et al., 2025).

Root Mean Squared Error (RMSE) is used to measure the magnitude of the difference between a model's predicted values by calculating the square root of the mean squared error (Siregar & Santoso, 2025). This metric is very effective in reflecting the predictive accuracy of the model because it imposes a greater penalty on significant prediction errors (Tshamaroh et al., 2025). Next, the Mean Absolute Error (MAE) calculates the average of the absolute differences between the predicted values and the actual observed values without considering the direction of the error. The smaller the RMSE and MAE values obtained (approaching zero), the more accurate the model's performance in handling data fluctuations.

Another indicator that provides an intuitive interpretation of relative error is the Mean Absolute Percentage Error (MAPE), which measures the average error in percentage form. The advantage of MAPE lies in its ability to show model accuracy on a percentage scale, where a MAPE value below 10% is categorized as a highly accurate forecasting result (Siregar & Santoso, 2025). By comparing the evaluation results from these various metrics, researchers can make the necessary parameter adjustments to minimize uncertainty risk and improve forecasting precision on volatile investment instruments.

3. Research Method

This research was conducted from August to July 2025 at Raden Intan Lampung State Islamic University using a quantitative approach thru time-series analysis method. This approach was chosen due to the dynamic, non-stationary nature of stock price data, which also contains complex trend and seasonal elements. The main focus of this research is to implement the FB Prophet algorithm integrated with K-Means Clustering as a preprocessing method to produce stock price forecasts with a high level of precision.

The population in this study includes all historical data on the stock price movements of PT Bank Central Asia Tbk (BBCA) listed on the Indonesia Stock Exchange. The sampling technique was conducted using purposive sampling by setting criteria in the form of complete monthly closing price data available on the Yahoo Finance platform. The observation period is set for 11 years, from January 1, 2014, to December 1, 2025, to represent various market conditions in both uptrend, downtrend, and sideways phases. All data were collected thru documentation methods in Comma Separated Values (CSV) format to be processed computationally using the Python 3 programming language in the Google Colab environment.

The analysis procedure begins with the data preprocessing stage, which includes data cleaning, handling missing values, and converting daily data into monthly data using the month-end method to minimize noise in the time series. Next, the data is partitioned using the K-Means Clustering algorithm to group the data based on the similarity of price volatility patterns into several more homogeneous clusters. Thru this clustering process, the heterogeneity of financial data can be reduced, making it easier for the model to learn the specific features of each cluster before entering the core forecasting stage.

The forecasting model is built using the FB Prophet algorithm, which adopts an additive model structure to automatically capture trend, seasonal, and holiday effect components. The dataset is divided with an 80% ratio as training data and 20% as testing data thru the hold-out validation technique. The model's performance is statistically evaluated using the metrics Mean Absolute Error (MAE), Mean Squared Error (MSE), Root Mean Squared Error (RMSE), and Mean Absolute Percentage Error (MAPE) to ensure the reliability of the prediction results. As a final stage, the validated model is used to forecast the stock price of BBCA for the next 12 months, presented visually in the form of a future trend graph.

4. Results and Discussion

4.1. Descriptive Analysis of BBCA Stock Historical Data

Descriptive analysis was conducted on the monthly closing price data of BBCA shares for the period from January 2014 to December 2025, with a total of 143 observations. Based on the statistical summary, BBCA's stock price has an average (mean) value of Rp5,861.53 with a median value of Rp5,982.50, indicating that the price data distribution is not heavily skewed to one side. This data includes a wide range of price movements, with the lowest recorded price being Rp1,985.00 in January 2014 and the highest price reaching Rp10,325.00 in the period of August or September

2024. The standard deviation value of Rp2,570.61 reflects significant volatility and price changes over time, influenced by economic dynamics and market sentiment during the 11 years of observation.

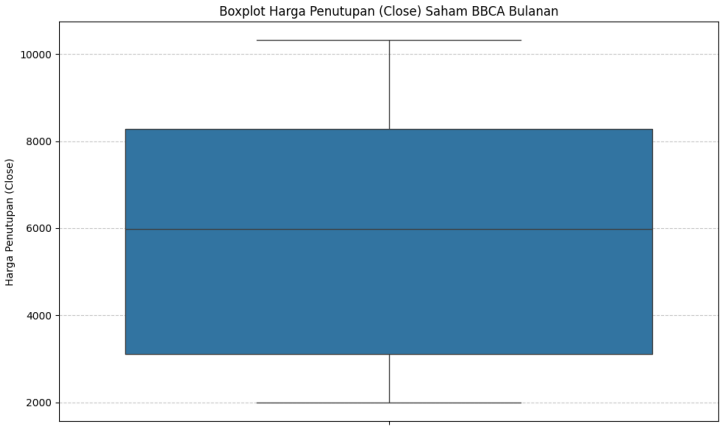

Figure 1. Boxplot of BBCA Stock Monthly Closing Prices.

The examination of data distribution thru a skewness value of 0.08 and kurtosis of -1.33 indicates that the price distribution is nearly symmetric and flatter compared to a normal distribution, thus not dominated by extreme and unusual spikes. The results of the outlier test using the Interquartile Range (IQR) method and visualization thru a boxplot confirm that there are no outliers in the dataset, allowing all observations to be validly used for the next stage of analysis. Visually, the trend of BBCA's stock price shows a pattern of movement that tends to increase (uptrend) in the long term, although it is still accompanied by fluctuations and price corrections during certain periods.

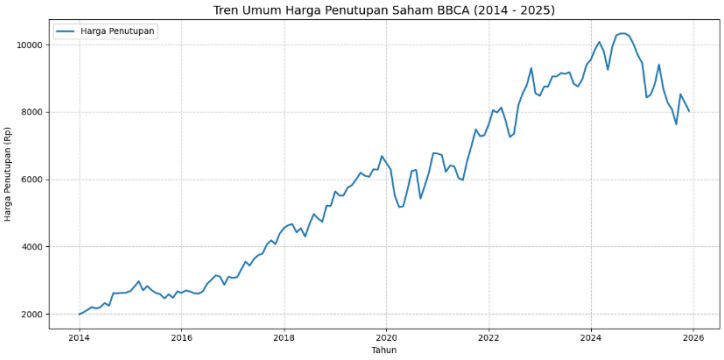

Figure 2. General Trend of Monthly Closing Prices of BBCA Stocks (2014–2025).

4.2. Results of Data Clustering Using K-Means Clustering

The application of the K-Means Clustering method in this study aims to address the heterogeneity of long-term time series data over 11 years by dividing price movements into homogeneous segments. The first step in this process is to determine the most optimal number of clusters (K) using the Silhouette Score evaluation. The testing was conducted on variations of the number of clusters from k=2 to k=5, where the calculation results showed that the peak value was reached at k=3 with a silhouette score of 0.66. This value indicates that partitioning the data into three groups is the most stable configuration, where the distance between members within a cluster is quite compact and clearly separated from other clusters. The drastic drop in scores at k=4 and k=5 further confirms that setting k=3 is the most ideal parameter.

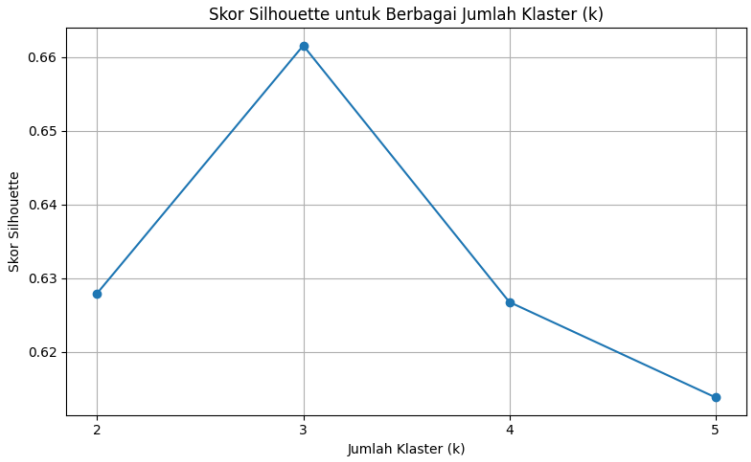

Figure 3. Silhouette Score Evaluation Graph for Determining Optimal K.

After being run on the normalized data, the K-Means algorithm effectively succeeded in dividing the historical data into three characteristics or price phases chronologically. The first group, Cluster 0, dominated the early period (2014–2017) and represented the lowest price phase in the range of Rp1,985.00 to below Rp4,500.00. This phase shows a stable upward trend with minimal fluctuations, indicating an initial accumulation period. Next, Cluster 2 encompasses the mid-period (2018–2021) marking the market transition phase. In this cluster, prices move within the mid-range between Rp4,500.00 and Rp7,500.00 with more dynamic fluctuations as the market attempts to stabilize at a new level. Finally, Cluster 1 covers the period 2022–2025 and represents the peak price phase or All-Time High. Prices in this group move above Rp7,500.00, reaching a maximum value of Rp10,325.00, reflecting the BBCA stock valuation that has settled at a much higher level post-economic recovery.

Overall, preprocessing using K-Means has proven to be very effective in capturing market structure changes (regime switching) in BBCA shares. Mapping the data into three homogeneous segments (Low, Medium, High) becomes a crucial foundation for the subsequent forecasting stage, as the prediction model can be trained to recognize specific patterns from each phase, significantly minimizing forecasting errors.

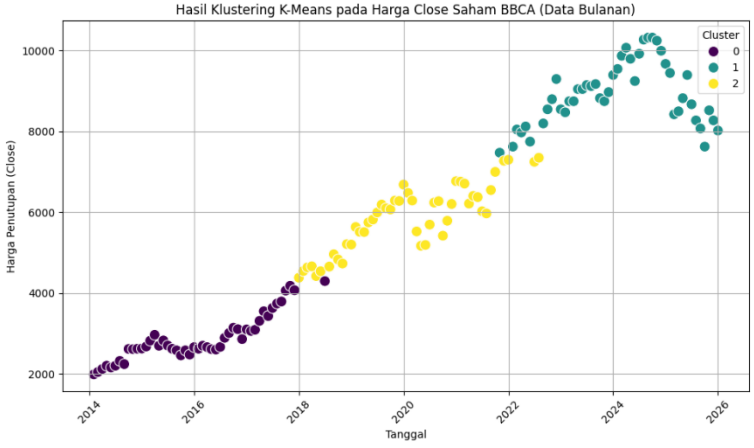

Figure 4. Visualization of the Clustering Results of BBCA Stock Prices.

4.3. Modeling and Evaluation of FB Prophet Algorithm Accuracy

The FB-Prophet algorithm is implemented to predict the closing price of BBCA shares due to its ability to handle time series data with trend patterns and automatically detect trend changes. Before the training process begins, the dataset format is adjusted to meet the algorithm's standards, where the time column (Date) is changed to ds (datestamp) and the price column (Close) is changed to y. The adjustment of the model configuration focused on

trend flexibility thru the Changepoint Prior Scale (CPS) parameter. After undergoing various testing phases on the training data (80%), the model with a CPS value of 0.500 was selected as the final configuration. The CPS parameter of 0.500 proved to be the most optimal and reactive in tracking actual data fluctuations, resulting in a fitting line that accurately captures price change dynamics without overly strict constraints.

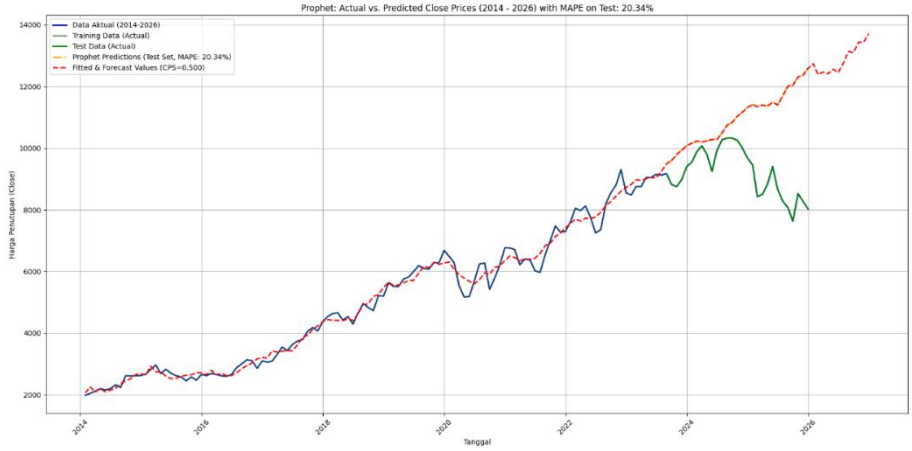

Figure 5. Final FB-Prophet Modeling Results.

The performance of the trained FB-Prophet model was then tested on 20% of the test data using the Mean Absolute Percentage Error (MAPE) and Root Mean Squared Error (RMSE) metrics. In a comprehensive (global) evaluation without considering clusters, the model produced a MAPE value of 20.34% with an RMSE deviation of 2,255.94, placing it in the fair forecasting category. However, the specific evaluation based on K-Means clustering shows a much more detailed and transparent accuracy profile. In Cluster 2 (medium price transition phase), the model shows the most superior performance with an error rate of only 9.83% (very good category) because the trend pattern moves steadily without extreme fluctuations. Reliable results are also observed in Cluster 0 (low-price phase) with a MAPE value of 10.13%.

The sharp decline in accuracy only occurred in Cluster 1 (the very volatile peak price phase), where the MAPE value surged to 28.70%. Overall, the average prediction error from the three clusters was recorded at 16.22%, a figure that is much better compared to the global MAPE value. This proves that the clustering-based approach provides a more representative evaluation understanding, where the FB-Prophet algorithm has proven to be very accurate in predicting prices during the early to mid-movement phases, despite facing challenges when prices enter a high volatility cycle at the All-Time High level.

Table 1. FB Prophet Evaluation Results by Cluster

Type of Evaluation	Cluster	Data Condition	MAE	MSE	RMSE	MAPE	Accuracy Category
Cluster	0	Low Price Trend	412,67	197.875,60	444,83	10,13%	Good
Cluster	2	Medium Price Trend (Transition)	712,10	596.429,14	772,29	9,83%	Very Good
Cluster	1	High Price Trend	2.380,45	6.006.924,02	2.450,90	28,70%	Enough
Average	-	Average MAPE Per Cluster	-	-	-	16,22%	Good
Without a Group	-	Overall Test Data	1.748,84	5.089.249,35	2.255,94	20,34%	Enough

4.4. BBCA Stock Price Projection for the Next 12 Months

As the final stage of the forecasting analysis, the validated FB-Prophet model, which has proven capable of adapting to historical trends, is used to project BBCA's stock price over the next 12 months, specifically for the period from January to December 2026. The forecasting results indicate that the movement of BBCA's stock price in the future is projected to be relatively stable with a moderate growth rate and to fluctuate within a relatively narrow range.

Table 2. BBCA Stock Price Projection for the Next 12 Months

Period (Month)	FB-Prophet Prediction
2026-01-31	Rp 8,073.18
2026-02-28	Rp 8,076.52
2026-03-31	Rp 8,023.60
2026-04-30	Rp 8,051.52
2026-05-31	Rp 8,033.60
2026-06-30	Rp 8,018.60
2026-07-31	Rp 8,139.03
2026-08-31	Rp 8,274.85
2026-09-30	Rp 8,244.43
2026-10-31	Rp 8,425.26
2026-11-30	Rp 8,463.59
2026-12-31	Rp 8,532.34

Specifically, the algorithm predicts that the stock price will open at Rp8,073.18 in January 2026. Entering mid-year, the model detects a slight downtrend (minor correction), where the price is projected to gradually decline, reaching its lowest point of the year at Rp8,018.60 in June 2026. However, after passing thru the mid-year consolidation phase, the predicted trend line shows a linear and gradual strengthening again. The stock price is projected to continue climbing in the second semester, eventually closing at a new highest level of Rp8,532.34 by the end of December 2026.

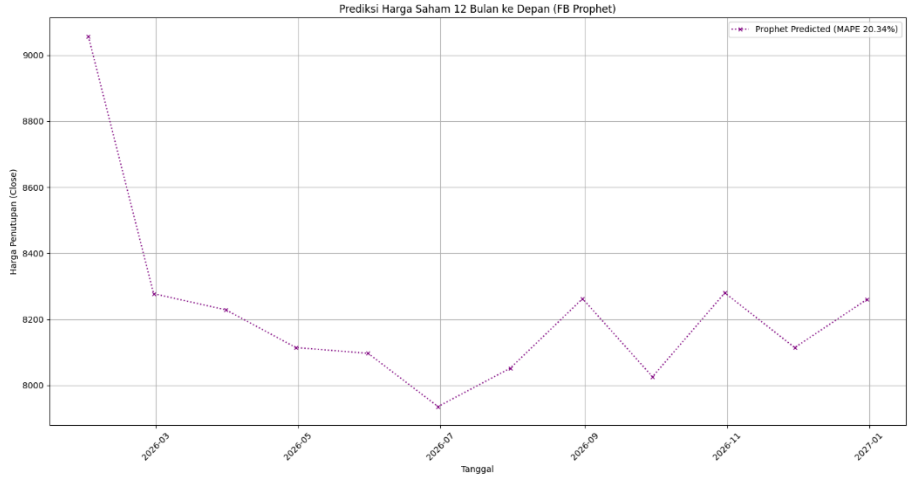

Figure 6. BBCA Stock Price Prediction Chart for the Next 12 Months.

This projection pattern provides a strategic indication that within the next one-year horizon, BBCA shares still offer positive and consistent value prospects. Although the FB-Prophet model predicts the absence of exponential price spikes or sharp declines, this linear movement trajectory reflects solid banking fundamentals and resilience to market turbulence. For investors, this prediction can serve as a basis for taking more conservative long-term investment steps, utilizing the mid-year weakening momentum as an entry point before prices strengthen again toward the end of the year.

4.5. Results

The integration of K-Means Clustering as a preprocessing step has proven to be a crucial contribution in the financial time series analysis in this study. The stock market has characteristics of dynamic volatility, instability, and often undergoes structural changes over time (Alamsyah, 2021). Global testing (without clustering) initially only produced a mean absolute percentage error (MAPE) of 20.34%, which gives the impression that the FB-Prophet model has a performance that is fairly adequate but lacks overall precision. This decline in predictive performance aligns with the findings of Santoso and Dewi (2024) who state that the Prophet algorithm tends to experience a significant decrease in accuracy when faced with a stock data set that has overly heterogeneous movement variance without prior segmentation. However, thru a clustering approach, the heterogeneity of the 11-year data was successfully decomposed into three more specific and homogeneous movement phases (Nasution, 2023). The integration of K-Means has proven capable of reducing noise in data variance, allowing subsequent predictive models to extract patterns more optimally and yield results with much greater precision.

Cluster-based evaluation results reveal that the FB-Prophet algorithm actually has a very high and reliable accuracy level when applied to consistent and focused data sub-clusters (Lee et al., 2010). The main advantage of this model is clearly seen in the medium price phase (Cluster 2) with a MAPE of 9.83% and the low price phase (Cluster 0) with a MAPE of 10.13%, where the error values around the 10% threshold can be categorized as very accurate forecasting results (Siregar & Santoso, 2025). In both phases, the trend movement occurs gradually without extreme sentiment fluctuations, allowing the trend shift detection or changepoints feature in FB-Prophet to work optimally in tracking the price movement direction (Taofiqurrohman et al., 2025). On the contrary, the weakness of this algorithm is exposed when dealing with data in Cluster 1, which is the phase of very volatile all-time high prices. At this level, the model often produces predictions that are too aggressive in following the momentum (overshoot) when the actual price is undergoing a sharp correction, resulting in an error rate soaring to 28.70%. The drastic shocks in the price structure at this peak level are a real representation of the dynamics of foreign investor fund flows and macroeconomic factors that trigger rapid and unexpected price changes (Gultom, 2023; Marjuni, 2022).

Regarding the projection of BBCA's stock price for the next 12 months (January–December 2026), the FB-Prophet model forecasts conservative and stable growth. This prediction directly reflects the fundamental conditions of the issuer as well as investors' positive expectations regarding future banking performance (Sharma et al., 2025). Although its movement is projected to be slow, the long-term trend consistently forms an uptrend pattern. From a practical standpoint, the results of this research provide strategic implications for investors in their efforts to mitigate the risk of losses due to the empirically widening fluctuation spread (Amalia et al., 2025). Investors are recommended to heavily rely on this hybrid prediction model when the market is in an accumulation phase (low prices) or a stable transition. However, an extra cautious approach is needed when referring to prediction results during times when the market is experiencing euphoria and is at its peak price levels.

5. Conclusion

This research has successfully implemented the FB-Prophet algorithm integrated with the K-Means Clustering preprocessing method to forecast the stock price of PT Bank Central Asia Tbk (BBCA) for the period 2014–2025. The application of K-Means Clustering has proven to be very effective in unraveling the complexity and heterogeneity of long-term financial time series data. This algorithm accurately partitions price movements into three clusters that chronologically represent different market phases: the low-price accumulation phase (Cluster 0), the mid-transition phase (Cluster 2), and the peak price or All-Time High phase (Cluster 1). The mapping of market structure (regime switching) provides a much more transparent and specific basis for model performance evaluation compared to global data testing.

Performance evaluation shows that the reliability of the FB-Prophet algorithm highly depends on the volatility level of the data phase being processed. Overall (global), the model recorded an error rate or Mean Absolute Percentage Error (MAPE) of 20.34%. However, thru a cluster-based review, this model proved to be very accurate and superior when applied to stable trend movements, namely during the transition phase (MAPE 9.83%) and the low-price phase (MAPE 10.13%). A drastic decline in performance only occurred during the peak price phase (MAPE 28.70%), where the model with a Changepoint Prior Scale setting of 0.500 tended to be too aggressive and struggled to adapt to sharp price corrections. The average error per cluster, which stands at 16.22%, confirms that this hybrid method provides a much more comprehensive prediction mapping.

The projected stock price of BBCA for the next 12 months (January to December 2026) indicates a prospect of stable and conservative fundamental growth. The stock price is projected to move linearly within a relatively narrow range, starting at Rp8,073.18, experiencing slight consolidation in the middle of the year, and closing stronger at Rp8,532.34 by the end of 2026. These findings provide a strategic signal for investors to adopt a more measured long-term investment approach. Further research is recommended to explore the integration of the FB-Prophet algorithm with public sentiment analysis or macroeconomic indicators to reduce error rates when the stock market enters a cycle of extreme volatility at the peak price phase.

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