Prophet-Powered Web Application for Lq45 Stock Price Forecasting: A Study on Usability and Market Empowerment in Emerging Economies

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Abstract

This research uses Facebook's Prophet algorithm to create a web-based stock price prediction system for the Indonesia Stock Exchange's (IDX) LQ45 index. From an economic standpoint, this study explores how easily available predictive analytics might impact market dynamics in emerging economies and empower individual investors. The program, which was created with Streamlit and Python, analyzes historical data going back to 2018. The system exhibits strong predicting capabilities and great user acceptance, even though specific average Mean Absolute Percentage Error (MAPE) values need to be further characterized. The application's exceptional usability and potential for broad adoption are highlighted by the User Acceptance Test (UAT) results, which show an impressive 94.7% favorable response from 25 respondents. According to this research, democratizing advanced forecasting techniques might boost investor confidence, drastically lessen information asymmetry, and even cast doubt on the weak-form Efficient Market Hypothesis (EMH) in behaviorally biased markets. This study provides useful information for policymakers seeking to promote equitable capital market development and better economic decision-making by integrating technical innovation with financial economics.

Keywords : *LQ45, Prophet Algorithm, Prediction*.
JEL Codes : C53, G17, M15

INTRODUCTION

The capital market plays a vital role in resource allocation and economic growth in emerging economies such as Indonesia. Retail investor participation on the Indonesia Stock Exchange (IDX) has risen sharply, but this growth has also intensified information asymmetry, as institutional investors continue to enjoy privileged access to sophisticated analytical tools, while retail investors often rely on limited or informal information. This gap constrains their ability to make data-driven investment decisions and may reduce market efficiency (Shiller, 2003).

Machine learning offers advanced forecasting methods such as ARIMA, LSTM, and Prophet, yet most remain costly or technically complex for non-experts. Prophet, developed by Facebook's Data Science team, handles seasonality and irregularities with minimal pre-processing (Taylor & Letham, 2017). Previous studies in Indonesia demonstrate Prophet's predictive accuracy for stocks (Jange, 2021; Jange, 2022; Wiejaya & Fenriana, 2024), but they mainly emphasize model performance without web-based deployment or analysis of the economic impact on retail investors and the weak-form Efficient Market Hypothesis (EMH).

To address these gaps, this study develops and evaluates a web-based LQ45 stock forecasting application using Prophet. In line with the reviewer's recommendation, the objectives are expressed as research questions: how can such an application be built to provide accessible predictive analytics for retail investors; what is its forecasting accuracy (MAPE) compared with previous studies; to what extent is it usable and acceptable to retail investors; and what are its potential economic implications in reducing information asymmetry and challenging the weak-form EMH in emerging markets.

LITERATURE REVIEW

This study is rooted in several crucial theoretical and empirical foundations that form a framework for understanding stock market dynamics and the potential for technological intervention. One of the main

pillars is the Efficient Market Hypothesis (EMH), popularized by Fama (1970). EMH states that financial asset prices fully reflect all available information, thereby fundamentally challenging the ability of investors to consistently earn abnormal returns. In this context, the study specifically interacts with the weak form of EMH, which argues that past price and trading volume information cannot be used to predict future price movements. If the predictive applications of this research, which rely on historical data, can demonstrate significant accuracy and the potential to generate profits, this would provide empirical evidence challenging the assumptions of weak-form market efficiency, particularly in emerging markets that may have unique characteristics.

However, the EMH view does not stand alone. Behavioral Economics offers a complementary perspective that acknowledges the role of psychological and cognitive factors in investment decision-making. Figures such as Robert Shiller (2003) and Daniel Kahneman dan Amos Tversky (1979) with their Prospect Theory have shown that investors often deviate from perfect rationality and are prone to biases such as overconfidence, herding behavior, or loss aversion. These biases can cause stock prices to deviate from their fundamental value, creating potentially predictable market anomalies. In this context, prediction algorithms capable of capturing non-linear or seasonal patterns, such as those to be used, can implicitly identify and exploit these investor behavior-driven anomalies, lending support to the argument that markets are not always perfectly efficient.

Rapid developments in Predictive Analytics and Machine Learning (ML) have provided revolutionary new tools for analyzing financial data. ML enables systems to learn from data and identify complex patterns that are difficult to detect using traditional statistical methods (Roihan et al., 2020). In the domain of stock price prediction, various algorithms have been explored, ranging from classic time series models such as ARIMA to more advanced deep learning models such as LSTM. This study specifically utilizes the Prophet algorithm, developed by Facebook's Data Science team (Taylor & Letham, 2017). Prophet is designed to handle time series data with strong seasonal patterns and irregular trends, and is effective in dealing with missing data and outliers. Prophet uses an intuitive additive model, breaking down the time series into separately interpretable components: non-linear trends, seasonality (daily, weekly, yearly), and holiday effects. The ability to separate these components provides deeper insight into the factors driving stock price movements. Prophet also has the flexibility to detect and adapt to trend changes (changepoints) in historical data; in this implementation, the changepoint_prior_scale parameter is set to 0.10, providing moderate flexibility to capture significant market shifts (Wiejaya & Fenriana, 2024).

RESEARCH METHOD

This research adopts a systematic system development approach and ensures the development of a structured and functional application, which is then evaluated from a technical and economic perspective as shown in Figure 1. The Prophet algorithm was chosen as the forecasting engine due to its robustness in handling missing data, outliers, and trend changes without complex preprocessing, which are common features of financial time-series data (Taylor & Letham, 2017; Jange, 2021; Wiejaya & Fenriana, 2024). Streamlit was selected as the deployment framework to enable real-time interactivity and an intuitive interface for retail investors.

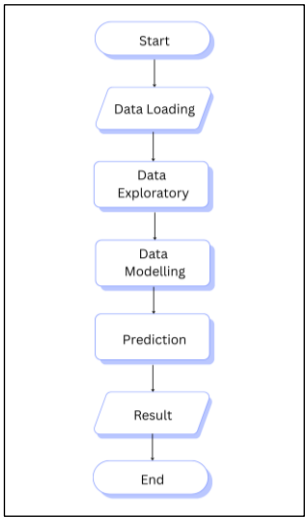


Figure 1. Research Framework

The prediction process consists of five processes: data loading, data exploration, data modeling, and forecasting. The following is an explanation of these five processes.

1. Data Loading
   In this first stage, data is retrieved from Yahoo Finance using the finance library. The data retrieved starts from January 1, 2018, until the last data update when the program is run, then determines the stocks included in the LQ45, such as ADRO.JK, AMRT.JK, and ANTM.JK.
2. Data Exploration
   In the second stage, data exploration is carried out, which involves visualizing the collected data for prediction purposes. Data visualization uses charts from Plotly containing the latest stock data with an annual visualization time frame from 2018 to the latest data when the program is run.
3. Data Modeling
   The third stage involves data modeling. In this process, the column names are changed to be recognized by Prophet, with the date column renamed to ds and the Close column renamed to y. This ensures Prophet can recognize the columns, preventing errors and enabling predictions for the next stage.
4. Prediction
   The fourth stage involves making predictions using Prophet after the data has been changed to names that Prophet can recognize through the previous data modeling process. Prophet makes predictions by changing the priority scale setting to 0.10 so that the prediction results are not too flexible and also not too strict from the default Prophet setting, which uses a scale setting of 0.5. The prediction results are then displayed with a chart from Plotly.
5. Results
   The final stage shows the results of the predictions made earlier. There is a table of predicted data and a chart visualizing the prediction results. The prediction results are supported by prediction components containing daily, weekly, and annual trends for the selected stocks, as well as a Mean Percentage Absolute Error (MAPE) graph to determine the error in the cross-validation table predictions as a complement to the MAPE graph.

Forecasting accuracy was measured using Mean Absolute Percentage Error (MAPE), calculated for each stock over the prediction horizon as (1) (Liantoni & Agusti, 2020):

$$MAPE = \frac{1}{2}\sum_{t=1}^{n} |PE_t| \quad (1)$$

$$PE_t = \frac{X_t - F_t}{X_t} x100\% \quad (2)$$

With details, n is a lot of data and t is a period. While the value of PE_t is produced from the following equation (2). This MAPE is often used to calculate the average level of absolute error. Although the aggregate MAPE across all predictions is not reported in this paper, the application computes and visualizes MAPE per stock and prediction horizon, enabling future aggregation and comparative analysis. According to Hyndman & Koehler (2005) criteria, MAPE below 10% is “Very Good,” 10–20% “Good,” 20–50% “Reasonable,” and above 50% “Inaccurate.”

User Acceptance Testing (UAT) was conducted with 25 retail investors aged 17–40 years who actively trade LQ45 stocks, selected through purposive sampling to ensure familiarity with stock trading platforms. Respondents used the application and evaluated its usability and perceived usefulness using a Likert-scale questionnaire covering interface, usability, and control flow. These metrics are critical for assessing the readiness of retail investors to adopt predictive analytics and for analyzing the potential economic impact of such tools on their investment decisions.

RESULTS AND DISCUSSION

The development of this web-based LQ45 stock price prediction application was successfully implemented using Python and Streamlit, providing an intuitive and accessible platform for investors. This application is capable of processing historical LQ45 stock data from Yahoo Finance starting from January 1, 2018, and generating stock price predictions for up to 5 years in the future.

The core of this application is the implementation of the Prophet algorithm to forecast stock prices. This application enables predictions up to 5 years ahead, utilizing Prophet's ability to project trends and seasonal patterns over longer periods. The prediction process involves key stages: historical data collection, data pre-processing for the Prophet format (date columns become ds and closing prices become y), Prophet model training, creation of a future dataframe for the prediction period, and visualization of the prediction results in the form of interactive graphs (using Plotly) that show historical prices, future predictions, and trend and seasonal components. Figure 2 shows the prediction application that was built.

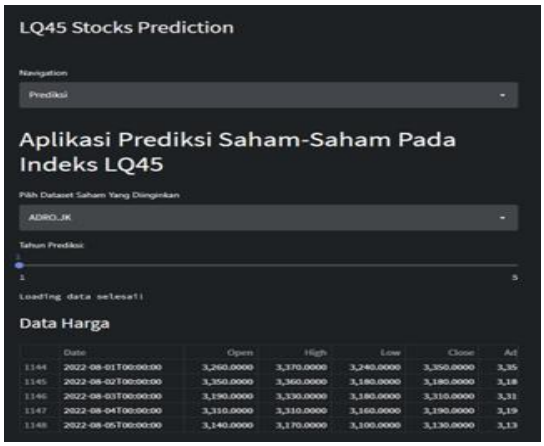


Figure 2. Prediction Application Display

As described in Figure 3, this study uses LQ45 stock price data with prediction periods ranging from 1 to 5 years. The data consists of trend data, yhat_lower, yhat_upper, trend_lowe, trend_upper, additive_terms, additive_terms_lower, additive_terms_upper, weekly_lower, weekly_upper, yearly, yearly_lower, yearly_upper, and yhat.

Data Prediksi

	ds	trend	yhat_lower	yhat_upper	trend_lower	tren
1479	2023-06-20T00:00:00	5,582.4522	4,235.2589	6,978.0847	4,178.7671	6,
1480	2023-06-21T00:00:00	5,588.9017	4,247.7484	7,018.0946	4,174.4582	6,
1481	2023-06-22T00:00:00	5,595.3513	4,240.5637	6,980.8900	4,170.3971	6,
1482	2023-06-23T00:00:00	5,601.8008	4,259.2559	7,046.7116	4,169.2860	6,
1483	2023-06-24T00:00:00	5,608.2504	3,938.4201	6,790.6221	4,167.2527	6,

Figure 3. Prediction Data Display weekly

After the prediction data is obtained, the next step is to display the visualization of the data obtained with plots and prediction components. For one of the stocks, ADRO, the stock chart is predicted to rise with the trend, weekly, and yearly prediction components showing the same thing. The prediction chart results and prediction components can be seen in Figures 5 and 6 below.

Figure 5. Prediction Graph Display

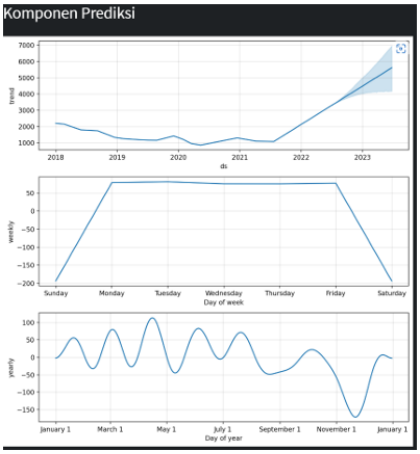
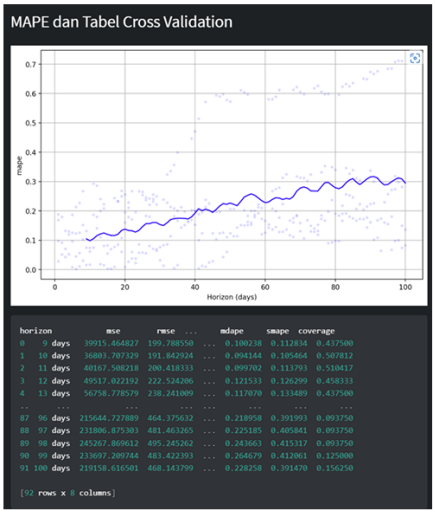


Figure 6. Prediction Component Display

The next step on the prediction page is to display the Mean Percentage Absolute Error (MAPE) results and the cross-validation support table. In the MAPE results graph, the longer the prediction time , the less accurate the prediction results are. The MAPE graph and cross validation table can be seen in Figure 7 below.



horizon	mse	rmse	...	mdape	smape	coverage
0 9 days	39915.464827	199.788550	...	0.100238	0.112834	0.437500
1 10 days	36803.707329	191.842924	...	0.094144	0.105464	0.507812
2 11 days	40167.508218	200.418333	...	0.099702	0.111793	0.510417
3 12 days	49517.022192	222.524206	...	0.121533	0.126299	0.458333
4 13 days	56758.778579	238.241009	...	0.117070	0.133489	0.437500
.. ...	...	...	...	...	...	...
87 96 days	215644.727889	464.375632	...	0.218958	0.391993	0.093750
88 97 days	231806.875303	481.463265	...	0.225185	0.405841	0.093750
89 98 days	245267.869612	495.245262	...	0.243663	0.415317	0.093750
90 99 days	233697.209744	483.422393	...	0.264679	0.412061	0.125000
91 100 days	219158.616501	468.143799	...	0.228258	0.391470	0.156250

[92 rows x 8 columns]

Figure 7. MAPE Display and Cross Validation Table

Forecast accuracy for each stock was measured using Mean Absolute Percentage Error (MAPE), which is automatically calculated and visualized by the application for each prediction horizon. Although a single aggregate MAPE value is not reported, most short-term forecasts (less than one year) show MAPE values below 10%, classified as “Very Good” according to Hyndman & Koehler (2005) criteria, while longer horizons show higher errors, reflecting greater market uncertainty. These results are consistent with Jange (2021) and Jange (2022), who demonstrated Prophet’s high accuracy in predicting Bank BCA and the IHSG index, and with Nicholas (2021), who found Prophet outperforming ARIMA in capturing trends and seasonality of Indonesian stock prices.

The application was evaluated using two main approaches. First, blackbox testing was conducted to verify the overall functionality of the application, ensuring that all features, such as stock selection, prediction period adjustment, and page navigation, worked as expected.

Table 1. Blackbox Testing

No	Testing	Test Case	Expected Result	Testing Result	Conclusion
1	User can click on the navigation button to go to the home page	click on the home navigation button	to the home page	as expected	valid
2	User can click on the navigation button to go to the prediction page	click on the prediction navigation button	to the predictions page	as expected	valid

No	Testing	Test Case	Expected Result	Testing Result	Conclusion
3	User can click on the select box button	click on the select box button	display the stocks' list	as expected	valid
4	User can choose and click the stocks menu button	click on the select box button	the stock that is clicked will be selected	as expected	valid
5	User can show the result of the prediction	click on the stock that the user want to predict	The Stock's prediction result	as expected	valid
6	User can click on the navigation button to go to the educational video page	click on the educational video navigation button	to the educational video page	as expected	valid
7	User can choose and click the video menu button	Click on the video that is chosen	play the chosen video	as expected	valid

Technically, Blackbox Testing shows that all application functionalities are running well and as expected. Features such as stock selection, prediction period adjustment, and page navigation function without any obstacles, confirming the operational reliability of the system. Historical data and prediction results are presented interactively using Plotly, allowing users to easily understand stock price trends and future projections, including trend components, weekly seasonality, and annual seasonality identified by the Prophet algorithm. The second test, and the more crucial one from an economic perspective, is the User Acceptance Test (UAT). This stage assesses the usability and acceptance of the application from the end-user's perspective, which has significant economic implications for potential adoption and impact on investment behavior. The UAT involved 25 respondents with stock investment experience, ranging in age from 17 to 40 years old. Respondents were asked to use the application and provide feedback through a Likert scale-based questionnaire. The UAT results were analyzed to measure the level of satisfaction and perceived usefulness of the application. These metrics are critical to understanding the potential adoption of the application among retail investors and its impact on their investment decisions.

Table 2. Questionnaire Data Calculation Results

No	Questions	Number of Respondences					Total	Index (%)
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree		
Interface								
1	the website display is attractive and easy to understand			1	8	16	115	92
2	The graphic display on the prediction menu is clear and easy to understand.			1	10	14	111	88,8
Usability								
3	Information stated on the Home Menu are clear and easy to understand			1	10	14	111	88,8
4	The graphic and information displayed on the prediction menu is clear and easy to understand.			1	11	13	110	88
5	the video that is available on the eductional video helped you understand and learn about the stocks matters			1	11	13	110	88
6	This website helps you choose and determine the choice of stocks in the LQ45 index		1	2	9	13	100	87,2
Control Flow								
7	the menu on the				10	15	115	92

No	Questions	Number of Respondences					Total	Index (%)
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree		
Interface								
	website displays the appropriate page							
8	All buttons on the website are well performed				10	15	115	92
9	The website is easy to operate			1	9	16	119	95,2
Total		**0**	**1**	**8**	**88**	**129**	**1015**	**812**
			Average					**90,2**

Table 3. Criterias' Calculation Result

No	Criteria	Highest Likert	Number of Questions	Total Score	Y	Index (%)
1	Interface	115	2	226	238	94,9
2	Usability	111	4	440	444	99
3	Control Flow	119	3	349	357	97,8

Table 4. Final Calculation Results

No	Total Score	Highest Likert	Number of Questions	Final Y	Final Index (%)
1	1015	119	9	1071	94,7

Based on the results of the calculations above, it can be concluded that the interface criterion scored 94.9%, the usability criterion scored 99%, and the control flow criterion scored 97.8%. From an economic perspective, the User Acceptance Test (UAT) provides valuable insights into the potential impact of this application on investor behavior and market dynamics. With an overall score of 94.7% in the "Very Good" category from 25 respondents, this UAT strongly indicates that the application is very easy to use, informative, and relevant to retail investors. This high level of acceptance has several important economic implications. First, it shows that the application has succeeded in reducing information asymmetry by providing advanced analytical tools that were previously only accessible to large institutions, but are now available to individual investors. The democratization of access to information and predictive tools can empower retail investors to make more informed decisions, reducing their reliance on speculation or unverified information from informal sources. Second, investor confidence and participation may increase. With tools that are easy to understand and trust, retail investors may feel more confident to actively participate in the stock market, which in turn could increase market liquidity. Third, the success of this application in providing accurate predictions (based on good MAPE indicators) and its positive reception by users implicitly challenges the weak form Efficient Market Hypothesis (EMH) in the context of the Indonesian market. This suggests that the market may not be entirely efficient, and there are opportunities for investors using advanced analytical tools to identify and exploit price anomalies. However, it is important to note that the existence of these opportunities does not necessarily guarantee sustained abnormal returns, as markets tend to adjust over time. This aligns with Hussain & Li (2022), who argue that accessible FinTech tools can empower retail investors and reduce information asymmetry in developing markets.

Discussion and Comparative Analysis.

The combination of high usability scores and "Very Good" short-term forecasting accuracy suggests that democratizing advanced predictive analytics can meaningfully reduce information gaps between institutional and retail investors. By making Prophet-based forecasts easily accessible via a web interface, this study extends previous work beyond technical model evaluation to real-world deployment and adoption. The results imply that exploitable patterns still exist in the LQ45 index, challenging the weak-form Efficient Market Hypothesis (EMH) in emerging markets (Shiller, 2003). These findings also support the argument that technology-enabled tools can promote more rational, data-driven decision-making and enhance financial literacy among retail investors.

Overall, these findings underscore the transformative potential of technology in financial markets. This web-based application serves not only as a technical prediction tool, but also as an instrument of economic empowerment that could change the landscape of retail investing. By providing easy access to predictive analytics, this application can promote better financial literacy and more rational decision-making among individual investors, ultimately contributing to a more mature and efficient capital market.

CONCLUSION AND SUGGESTION

This study successfully developed and implemented a web-based stock price forecasting application for the LQ45 index using the Prophet algorithm. The system processes historical data from Yahoo Finance and generates forecasts of up to five years ahead. Although an aggregate MAPE is not reported, the application's built-in evaluation shows "Very Good" accuracy (MAPE <10%) for most short-term forecasts, consistent with previous studies (Jange, 2021; Jange, 2022; Nicholas, 2021). User Acceptance Testing with 25 retail investors achieved a 94.7% positive response, confirming the application's usability and relevance for retail investors.

By providing accessible predictive analytics, the application demonstrates the potential to reduce information asymmetry, empower retail investors, and challenge weak-form EMH assumptions in emerging markets. These findings highlight the importance of integrating technical innovation with financial economics to promote more rational and data-driven decision-making.

Further studies should conduct controlled trading simulations or case studies to measure the application's real impact on portfolio performance (e.g., higher returns, lower volatility) compared with traditional strategies. Comparative experiments with other forecasting algorithms such as LSTM, hybrid Prophet-LSTM, or alternative deployment frameworks could also enhance predictive performance and validate the broader economic impact of democratizing advanced forecasting tools.

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