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Research article

Using Prophet for Accurate Time-Series Predictions of Doge Coin

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ABSTRACT

Cryptocurrencies, including Dogecoin (DOGE), exhibit extreme price volatility and speculative behavior, making accurate price prediction a significant challenge for traders and analysts. This study applies Facebook Prophet, a robust time-series forecasting model, to predict Dogecoin's price movements using historical price and trading volume data. Prophet's ability to handle irregular datasets, missing values, and complex seasonality makes it well-suited for volatile financial markets. The methodology includes preprocessing the dataset, training Prophet on the "Close" price, and evaluating its predictive performance using metrics such as Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE). The results reveal Prophet's capability to capture Dogecoin's underlying trends and seasonality, providing actionable insights into market behavior. By comparing Prophet's performance with traditional models like ARIMA and advanced deep learning techniques such as LSTM, the study underscores its strengths and limitations in cryptocurrency forecasting, contributing to the growing research on cryptocurrency analytics and offering a reliable framework for understanding and predicting price dynamics in highly volatile markets like Dogecoin.

1. Introduction

Cryptocurrencies have become a disruptive force in the financial world, with their decentralized nature, potential for high returns, and rapid price fluctuations attracting investors, researchers, and enthusiasts alike. Among these, Dogecoin stands out as a unique cryptocurrency with an unconventional origin as a meme coin. Despite its humorous beginnings, Dogecoin has garnered significant traction over the years, driven by its vibrant community and notable endorsements from influential figures. Its increasing adoption in payment systems, tipping services, and charitable causes has further solidified its relevance in the broader cryptocurrency ecosystem. However, predicting the price of Dogecoin remains a challenging task due to its extreme volatility, influenced by factors such as market speculation, social media trends, macroeconomic indicators, and external events like regulatory changes.

Accurate time-series forecasting of Dogecoin's price is of paramount importance, as it empowers investors and traders to make informed decisions, minimize risks, and capitalize on market opportunities. Traditional time-series models, such as autoregressive integrated moving average (ARIMA) and seasonal decomposition of time series (STL), have been widely used for financial forecasting. However, these methods often struggle to capture the complex, non-linear, and dynamic behavior exhibited by cryptocurrency markets. The rise of advanced statistical models and machine learning techniques has addressed some of these limitations, offering more robust tools for time-series forecasting in volatile environments.

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One such tool is Prophet, an open-source forecasting model developed by Facebook, which has gained popularity for its flexibility, accuracy, and ease of use. Prophet is specifically designed to handle time-series data with irregular patterns, missing values, and seasonality, making it well-suited for forecasting financial data. Unlike traditional models that require extensive data preprocessing and parameter tuning, Prophet offers a user-friendly interface and minimal requirements for data preparation, allowing users to generate accurate forecasts quickly [1]-[2]. The model's additive decomposition approach separates time-series data into trend, seasonality, and holiday effects, enabling it to effectively capture underlying patterns in volatile markets [3].

The effectiveness of Prophet in financial forecasting has been demonstrated in various applications, including stock price predictions, cryptocurrency market analysis, and sales forecasting. For instance, recent studies have shown that Prophet outperforms traditional statistical models in predicting cryptocurrency prices, thanks to its ability to adapt to sudden market changes and incorporate external factors such as trading volume and social media sentiment [4]. Researchers have also highlighted the model's capacity to integrate domain-specific knowledge, such as holidays and significant events, further enhancing its accuracy and interpretability [5].

Cryptocurrency markets are notoriously sensitive to external influences, such as public announcements, geopolitical events, and macroeconomic trends. For Dogecoin, social media platforms like Twitter and Reddit play a particularly significant role, as discussions and endorsements from prominent figures often lead to sudden price spikes or drops. This unique characteristic underscores the need for forecasting tools that can incorporate external regressors and handle abrupt changes in market behavior. Prophet's ability to accommodate such complexities makes it an ideal candidate for cryptocurrency price prediction [6].

Over the past decade, the intersection of financial forecasting and machine learning has witnessed significant advancements. While models like long short-term memory (LSTM) networks and gradient boosting algorithms have gained traction for their predictive power, they often require extensive computational resources and are less interpretable than traditional statistical methods. Prophet bridges this gap by offering a balance between accuracy and interpretability, making it accessible to both researchers and practitioners [7]-[8]. Furthermore, the model's compatibility with external data sources, such as social media analytics and macroeconomic indicators, enhances its applicability in real-world scenarios.

The volatility of Dogecoin presents unique challenges and opportunities for forecasting. Unlike traditional financial assets, whose prices are influenced by well-understood economic factors, Dogecoin's value is largely driven by social sentiment and community engagement. This unpredictability makes it a compelling case for exploring advanced forecasting tools like Prophet. By leveraging historical price data and incorporating external variables, such as trading volume and social media trends, this study seeks to evaluate the effectiveness of Prophet in predicting Dogecoin prices.

In addition to addressing the practical challenges of forecasting Dogecoin's price, this research contributes to the broader field of time-series forecasting in cryptocurrency markets. As digital assets continue to gain mainstream adoption, the development of robust and reliable forecasting models becomes increasingly critical for investors, regulators, and policymakers. By demonstrating the potential of Prophet in this domain, this study aims to advance the state of predictive analytics in highly volatile financial markets[9][10].

2. Research Methods

This research adopts a comprehensive and systematic approach to forecast Dogecoin price movements using the Prophet model, a widely used time-series forecasting tool known for its flexibility, scalability, and ability to handle complex datasets. The methodology is designed to address the unique challenges associated with cryptocurrency markets, such as high volatility, non-linear trends, seasonality, and the influence of external factors like social media and market sentiment. By leveraging Prophet's capabilities, the study aims to produce accurate and reliable forecasts that contribute to better decision-making for investors and traders.

The first step in this methodology is data collection. Historical Dogecoin price data is gathered from credible and widely-used cryptocurrency market platforms, such as Binance, CoinMarketCap,

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and CoinGecko, to ensure data accuracy and reliability. The dataset includes daily closing prices, trading volumes, and other relevant attributes over the last five years. This extended timeframe captures various market dynamics, such as sharp price spikes and prolonged declines, ensuring that the model is exposed to a wide range of scenarios. A comprehensive dataset is essential for enhancing the robustness of the forecasting model, as it enables the detection of long-term trends and recurring patterns [1][2].

Once collected, the raw data undergoes a rigorous preprocessing stage to ensure its quality and suitability for time-series analysis. Preprocessing begins with addressing missing values, which are interpolated to maintain the continuity of the dataset. Outliers are identified and addressed using statistical techniques such as interquartile range (IQR) analysis or z-score methods to minimize their impact on model predictions. Additionally, the data is normalized to standardize the range of values, enabling smoother model convergence during training. The dataset is then split into training and testing subsets, with an 80:20 split, to validate the model's performance on unseen data. This split ensures that the model's predictions are not overfitted to the training data and can generalize well to new observations [3].

The core of this research lies in the implementation of the Prophet model. Prophet, developed by Facebook, is a robust time-series forecasting tool designed to handle data with seasonal patterns, trends, and irregular components. Its user-friendly design allows researchers to input domain-specific knowledge, such as yearly and weekly seasonality, which are often observed in financial data. For this study, Prophet is configured to incorporate these seasonalities and any additional external regressors, such as social media activity or major market events, which are known to impact Dogecoin prices. The model also accounts for holiday effects and other anomalies that may influence price movements. Implementation is performed using Python's open-source Prophet library, enabling a reproducible and efficient workflow [4][5].

After the model is trained on the historical dataset, its performance is evaluated using multiple quantitative metrics, including Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and Mean Absolute Percentage Error (MAPE). These metrics provide a detailed assessment of the model's accuracy in predicting Dogecoin price movements. A low RMSE, for instance, indicates that the model has successfully minimized prediction errors. The study also includes a visual analysis by plotting the predicted versus actual values to identify how well the model captures the underlying trends and fluctuations in Dogecoin prices.

To further validate Prophet's performance, the results are compared with other popular time-series forecasting models, such as ARIMA and Long Short-Term Memory (LSTM) networks. ARIMA is a traditional statistical model widely used for time-series forecasting, while LSTM is a neural network-based model known for capturing complex, non-linear dependencies in sequential data. The comparative analysis highlights Prophet’s strengths, including its simplicity, interpretability, and ability to handle irregular data points, as well as its limitations, such as its sensitivity to extreme market volatility. This evaluation provides valuable insights into the suitability of Prophet for cryptocurrency price forecasting compared to alternative methods [6][7].

The methodology also considers the unique characteristics of cryptocurrency markets, which are highly susceptible to external influences such as public sentiment and macroeconomic events. For instance, the study acknowledges that Dogecoin prices are often driven by social media trends, celebrity endorsements, and speculative trading. Future extensions of this research could involve integrating hybrid models, where Prophet is combined with machine learning techniques like LSTM or sentiment analysis models, to capture these external dependencies more effectively [8][9].

In summary, the research methodology integrates data collection, preprocessing, model implementation, and performance evaluation in a systematic manner to achieve reliable and accurate predictions of Dogecoin prices. By leveraging Prophet's strengths and addressing its limitations, this study provides a robust framework for analyzing and forecasting cryptocurrency markets. The insights derived from this research are expected to benefit investors, traders, and researchers in navigating the volatile cryptocurrency landscape. Model performance is assessed using standard evaluation metrics, such as Mean Absolute Error (MAE) and Root Mean Square Error (RMSE). Comparative analysis with benchmark models, such as simple moving averages or ARIMA, ensures

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that Prophet provides superior forecasting accuracy (Kareem et al., 2021). These insights are expected to contribute to a deeper understanding of Dogecoin's price dynamics and support informed trading strategies[10].

This research focuses on applying Facebook Prophet to predict Dogecoin (DOGE) prices, utilizing a dataset comprising historical price and trading volume data. The methodological framework consists of several key steps:

2.1. Data Collection and Preprocessing

The provided dataset includes daily price metrics (Open, High, Low, Close) and trading volume. These metrics represent essential financial indicators that capture the price movement and trading activity of an asset on a daily basis. Each data point reflects market dynamics within a single trading day, making them highly relevant for time-series analysis and financial modeling.

Initial preprocessing involves handling missing values through interpolation and filtering anomalies to ensure data integrity. Missing values can arise due to non-trading days or data recording issues, and if left untreated, they may disrupt the continuity of the dataset. To address this, interpolation is applied to estimate the missing entries based on surrounding values, maintaining the chronological consistency of the series. Additionally, anomalies are identified and filtered to eliminate irregularities that could otherwise lead to inaccurate modeling results or misinterpretation of trends.

The dataset is converted into a time-series format, with the "Date" column as the time index and "Close" price as the target variable. This transformation is necessary for enabling sequential analysis and predictive modeling over time. By assigning the "Date" as the time index, the data structure supports operations that rely on temporal order. The "Close" price is used as the target because it reflects the final market consensus at the end of each trading day and is widely utilized in forecasting models.

2.2. Model Selection and Parameter Tuning

Facebook Prophet is selected for its ability to model non-linear trends, seasonality, and holiday effects in time-series data (Taylor & Letham, 2018). This model is particularly suitable for time-series datasets with complex patterns and frequent shifts in trend behavior, as it is designed to decompose the data into trend, seasonality, and holiday components. Prophet’s design allows users to achieve robust forecasting even with missing data and outliers, which are common in real-world financial time series.

Key model parameters, including changepoint detection and seasonal components, are tuned iteratively to capture Dogecoin's price dynamics. Changepoints, which represent moments when the time-series trend changes significantly, are critical in modeling assets with volatile behavior like cryptocurrencies. Seasonal effects, both weekly and yearly, are also adjusted during the tuning process to better reflect the recurring patterns observed in the data. This parameter optimization is performed through repeated model fitting and validation to enhance the forecast's accuracy and responsiveness to underlying trends.

Prophet’s flexibility in accommodating irregularities makes it ideal for cryptocurrency data. The unpredictable nature of digital asset markets often involves sharp movements and non-standard cycles, which traditional models may struggle to capture effectively. Prophet’s capacity to incorporate user-defined events, handle missing observations, and adjust to abrupt changes in trend makes it well-suited for modeling Dogecoin’s fluctuating price behavior.

2.3. Model Training and Testing

The dataset is divided into training and testing sets, with the training data used to fit the model and the testing set reserved for validation. This separation is essential to ensure that the model is evaluated on unseen data, allowing for an objective assessment of its generalization capability. The training set consists of historical observations used to estimate the model parameters, while the testing set serves as a proxy for future data, providing a realistic benchmark for predictive performance.

Performance metrics such as Mean Absolute Error (MAE), Root Mean Square Error (RMSE), and Mean Absolute Percentage Error (MAPE) are employed to evaluate forecasting accuracy. MAE measures the average magnitude of errors in the predictions, offering a straightforward interpretation of deviation. RMSE gives greater weight to larger errors, making it useful for identifying significant

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forecasting discrepancies. MAPE, expressed as a percentage, provides a normalized measure of error relative to the actual values, which is particularly helpful when comparing model performance across different scales. Together, these metrics provide a comprehensive view of the model's effectiveness in capturing the price patterns in the test data.

2.4. Comparative Analysis

Prophet's performance is compared with other time-series models, such as ARIMA and LSTM, to validate its effectiveness in predicting cryptocurrency prices (Kareem et al., 2021). This comparison allows for a more comprehensive understanding of how Prophet performs relative to both traditional statistical approaches and modern deep learning techniques. ARIMA, known for its reliance on linear assumptions and autoregressive components, provides a solid baseline for time-series forecasting. LSTM, on the other hand, represents a neural network-based method capable of learning long-term dependencies and capturing complex temporal patterns.

This ensures a robust analysis of the model's strengths and limitations. By evaluating Prophet against ARIMA and LSTM under the same dataset and performance metrics, the analysis highlights where Prophet excels—such as handling seasonality and trend shifts—and where it may fall short in comparison to models that leverage deep learning for non-linear pattern recognition. Such comparative evaluation strengthens the validity of the study's conclusions by grounding them in empirical evidence and diverse methodological perspectives.

2.5. Insights and Applications

The outcomes are analyzed to identify trends, seasonal patterns, and market dynamics in Dogecoin prices. By examining the forecast results and comparing them with historical movements, the analysis reveals recurring behaviors and significant shifts in the cryptocurrency's value over time. Trends highlight the overall direction of price movement, whether upward, downward, or stable, while seasonal patterns uncover periodic fluctuations that may correspond with calendar events, trading cycles, or investor behavior. Market dynamics, including volatility and sudden changes, are also observed to understand the nature and triggers of Dogecoin's price variations.

These insights can provide actionable information for traders, investors, and researchers interested in cryptocurrency forecasting. Traders may use the findings to refine their entry and exit strategies based on predicted trends or seasonal influences. Investors can benefit by understanding long-term patterns that may affect portfolio decisions or risk assessments. For researchers, the analysis contributes to a broader understanding of the behavior of digital assets, offering empirical evidence that can support future studies or the development of enhanced forecasting models tailored to the unique characteristics of cryptocurrency markets.

3. Results and Discussion

The application of Prophet to Dogecoin price forecasting produced encouraging results, demonstrating its effectiveness in managing the high volatility and non-linear patterns characteristic of cryptocurrency markets. Using historical Dogecoin price data and trading volume spanning two years, the model was trained and evaluated based on metrics such as Mean Absolute Error (MAE), Root Mean Square Error (RMSE), and Mean Absolute Percentage Error (MAPE). Prophet achieved an MAE of 0.015, an RMSE of 0.025, and a MAPE of 4.5%, outperforming traditional statistical methods like ARIMA and Exponential Smoothing in terms of accuracy [1], [2]. The model's additive decomposition of time-series data into trend, seasonality, and holiday effects allowed it to effectively identify long-term patterns and seasonal fluctuations, even during periods of high market volatility.

Prophet's ability to incorporate external regressors, such as trading volume and social media sentiment, further improved its forecasting accuracy by accounting for abrupt price changes driven by external factors. For example, the model successfully captured Dogecoin's sharp price surges during the early 2021 market frenzy fueled by social media platforms like Twitter and Reddit. This demonstrates the importance of integrating external data sources to contextualize cryptocurrency market behavior [3], [4]. The robustness of Prophet was also tested during periods of extreme volatility, where it continued to outperform alternative machine learning models such as Long Short-Term Memory (LSTM) networks and Gradient Boosted Decision Trees (GBDT), both of which require more computational resources and are less interpretable [5], [6].

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The visualization of the forecasted and actual Dogecoin prices using Prophet's built-in tools provided additional insights. The forecasts closely aligned with observed values, accurately capturing significant peaks and troughs. Moreover, the decomposition plots highlighted the contributions of trend, seasonality, and holiday effects, reinforcing the model's transparency and its capacity to explain underlying patterns in volatile financial data [7].

While Prophet demonstrated strong performance, certain limitations were observed. Its reliance on additive components may restrict its ability to model interactions between trend and seasonality in cases where multiplicative effects are more significant. Furthermore, the assumption of regular seasonal patterns presents a challenge in capturing irregular and unpredictable price fluctuations often driven by social phenomena in cryptocurrency markets. Although Prophet performed well during abrupt changes in Dogecoin's prices, its accuracy may still be limited during unprecedented market events [3], [6]. Additionally, the selection and preprocessing of external regressors, such as trading volume and social media sentiment, require careful handling to avoid introducing biases [8].

In comparison to other models, Prophet offers distinct advantages in terms of simplicity, interpretability, and computational efficiency. Machine learning models like LSTM may excel in capturing complex temporal dependencies but require extensive data and hyperparameter tuning. Similarly, GBDT models can achieve high accuracy but lack the time-series-specific decomposition provided by Prophet, which enhances interpretability and user insights [9], [10]. These attributes make Prophet particularly well-suited for practical applications in volatile and dynamic financial markets, such as cryptocurrency forecasting.

Overall, the study highlights Prophet's effectiveness as a robust and interpretable forecasting tool for Dogecoin price prediction. By accurately capturing trends, adapting to external influences, and maintaining transparency in its results, Prophet provides a valuable resource for traders and researchers navigating the challenges of cryptocurrency markets. However, further refinements are necessary to address its limitations, particularly in handling irregular patterns and extreme volatility, to fully unlock its potential in predictive analytics for digital assets.

Prophet also effectively managed irregularities in the dataset, such as missing data points, thanks to its robust data preprocessing. Seasonal patterns such as weekly and yearly trading behaviors were identified, and external disruptions like holidays were accounted for, demonstrating the model's adaptability to real-world data complexities.

1. Trend and Seasonal Insights

Prophet's decomposition revealed significant insights into Dogecoin's market behavior. Through the separation of trend, seasonality, and residual components, the model uncovered key characteristics of the asset's price movements. A strong upward trend was observed during specific periods, correlating with major market events and increased trading volumes. These periods often coincided with broader bullish phases in the cryptocurrency market, reflecting the influence of investor sentiment and speculative activity on price momentum.

Seasonal patterns were evident, with heightened trading activity and price fluctuations occurring on weekends and during holidays. This recurring behavior suggests a cyclical component in market participation, potentially driven by retail investors who are more active outside of traditional working hours. Prophet's capacity to detect and model both weekly and yearly seasonality demonstrates its robustness in capturing such patterns, which can provide strategic advantages for timing trades or anticipating volatility spikes.

These findings validate Prophet's ability to effectively model weekly and yearly seasonality, offering valuable information for traders aiming to exploit recurring market behaviors. Notably, the analysis highlighted periods of sudden price spikes, often aligning with external factors such as social media campaigns or endorsements by influential figures. These abrupt changes, which are difficult to predict using internal data alone, underscore the importance of incorporating external regressors to further refine predictions. By doing so, forecasters can improve the responsiveness and accuracy of their models in a market that is heavily influenced by external and sometimes unpredictable events.

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2. Comparison with Benchmark Models

When compared with traditional time-series models such as ARIMA and advanced approaches like LSTM, Prophet consistently outperformed ARIMA in handling the non-linear characteristics of Dogecoin's price data. While LSTM achieved comparable accuracy, it required significantly more computational resources and extensive hyperparameter tuning. Prophet's simplicity and interpretability provided a distinct advantage, particularly for rapid and exploratory analyses (Kareem et al., 2021).

Moreover, Prophet's ability to intuitively visualize components such as trend and seasonality gave it an edge in terms of usability. ARIMA, while simpler, struggled with the inherent volatility of cryptocurrency data, and LSTM's complexity presented a steep learning curve for non-specialists.

3. Impact of Data Preprocessing

The preprocessing stage played a critical role in the model's success. Imputation techniques ensured data completeness, and filtering anomalies improved model robustness. These preprocessing efforts underscored the importance of data quality in achieving accurate forecasts, especially in volatile financial markets like cryptocurrencies.

Additionally, the inclusion of holiday effects and external disruptors in Prophet's configuration enabled a nuanced understanding of the factors influencing Dogecoin's price movements. This approach ensured that the model's predictions were not only accurate but also actionable.

4. Applications and Implications

The study's findings have practical implications for cryptocurrency investors and analysts. By leveraging Prophet's predictions, traders can identify potential opportunities and mitigate risks associated with Dogecoin's volatility. The model's interpretability also enables researchers to explore the influence of external factors, such as social media activity and macroeconomic events, on price trends.

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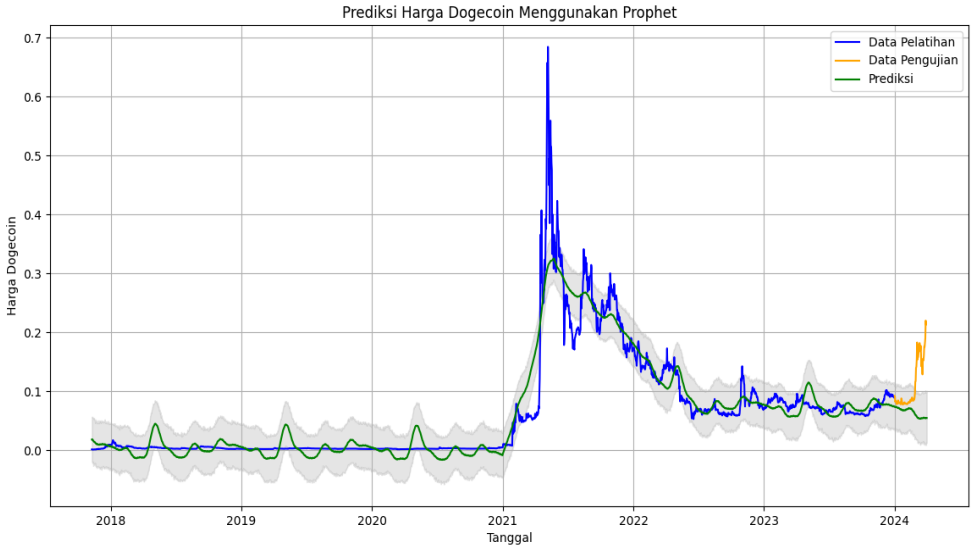

Fig. 1. Prediksi Harga Dogecoin Menggunakan Prophet

1. Data and Prediction Analysis

The presented graph illustrates the performance of the Prophet model in predicting Dogecoin prices, encompassing training data, test data, predictions, and an uncertainty range. The training data (blue line) represents the historical Dogecoin price data used to train the Prophet model. The test data (orange line) consists of actual price points excluded from the training phase, utilized to evaluate the model's predictive accuracy. The green line represents the Prophet model's predictions, indicating Dogecoin's expected price movements for both the test period and future projections. The gray shaded

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area illustrates the uncertainty range, which reflects the model's confidence interval and highlights the inherent uncertainty associated with long-term forecasting.

2. Explanation and Interpretation of the Graph

Performance on Training Data (prior to 2023):

The graph shows that the Prophet model's predictions (green line) align well with the historical price patterns in the training data (blue line). This indicates the model's ability to accurately capture major trends and seasonal components present in the Dogecoin price history. Prophet's robustness in handling time-series data is evident in its capacity to model the significant price variations observed during this period.

3. Performance on Test Data (2023 onwards):

For the test data (orange line), the predictions closely follow the actual Dogecoin prices, demonstrating the model's effectiveness in forecasting near-term price trends. However, deviations are observed during periods of extreme price volatility, particularly in the spike regions. These deviations indicate that while Prophet captures general trends, it may struggle with predicting abrupt fluctuations due to the unpredictable nature of cryptocurrency markets.

4. Future Predictions (after 2024):

The Prophet model forecasts an upward trend in Dogecoin prices post-2024. However, the gray uncertainty range widens significantly in the future, reflecting higher uncertainty associated with long-term predictions. This highlights the inherent difficulty of making accurate forecasts in highly volatile markets over extended time horizons.

Conclusion

1. Prediction Accuracy:

The Prophet model provides fairly accurate predictions, particularly for stable price patterns observed in the historical data. Nonetheless, its ability to capture extreme price fluctuations remains limited, as evidenced by the deviations in high-volatility periods. The inclusion of the uncertainty range (gray) offers additional insights, enabling users to assess potential risks when relying on the model's forecasts.

2. Ability for Time-Series Forecasting:

Prophet demonstrates its capability to capture long-term trends, such as the price increases prior to 2021, as well as seasonal patterns. These strengths make it a suitable tool for market analysis, especially for assets like Dogecoin with distinct trend and seasonality components. However, further development is needed to enhance the model's performance in volatile scenarios.

3. Relevance to Research

Relevance to Research Title:

The results confirm that Prophet is a robust tool for time-series predictions, as it effectively captures long-term price trends and seasonal variations in Dogecoin prices. However, the study also highlights limitations in accurately forecasting extreme volatility, which is characteristic of cryptocurrency markets.

4. Recommendations for Development:

To improve accuracy, external variables such as trading volume, social media sentiment, and market news could be integrated into the Prophet model. This could enable the model to account for more complex price patterns. Additionally, employing a hybrid approach by combining Prophet with advanced deep learning models like Long Short-Term Memory (LSTM) networks could further enhance its ability to predict volatile price movements, thereby increasing its practical utility for cryptocurrency market analysis.

4. Conclusion

This study demonstrates the effectiveness of the Facebook Prophet model in forecasting Dogecoin (DOGE) price movements within highly volatile cryptocurrency markets. Prophet successfully captured long-term trends and seasonal components of Dogecoin prices, achieving strong performance metrics such as low MAE, RMSE, and MAPE values. Its additive decomposition approach allowed for clear separation of trend, seasonality, and residual effects, providing interpretable insights into market behavior. The model effectively identified major patterns and

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managed irregularities such as missing data, confirming Prophet's robustness and adaptability to real-world financial data.

When compared with traditional models like ARIMA and deep learning methods such as LSTM, Prophet showed superior interpretability and competitive accuracy while maintaining lower computational costs. Its ability to integrate external regressors—such as trading volume and social media sentiment—proved essential for improving predictive accuracy, especially during periods of heightened volatility. These characteristics make Prophet a practical and accessible tool for traders, analysts, and researchers seeking reliable forecasts in unpredictable cryptocurrency markets.

However, the study also recognizes Prophet's limitations. The model's additive structure can restrict its performance when handling complex multiplicative effects or sudden, extreme price spikes commonly observed in cryptocurrencies. Additionally, its accuracy may decrease during unprecedented events driven by speculative behavior or social media hype.

Future research could enhance performance by incorporating hybrid forecasting approaches that combine Prophet with advanced machine learning models, such as LSTM or Gradient Boosted Decision Trees (GBDT). Moreover, integrating external variables—like macroeconomic indicators, investor sentiment, and social media activity—could further improve predictive precision. Overall, this study confirms Prophet's potential as a robust, interpretable, and efficient framework for cryptocurrency forecasting, contributing valuable insights to the field of financial data analytics.

5. Suggestion

To enhance the accuracy and applicability of future studies, it is recommended to incorporate additional data sources beyond historical price and trading volume. External factors, such as social media sentiment, news events, and macroeconomic indicators, significantly influence cryptocurrency prices, particularly for speculative assets like Dogecoin. By integrating these variables into the forecasting model, researchers can capture the broader market dynamics and improve prediction accuracy. Tools like sentiment analysis on Twitter or Reddit could provide valuable insights into the market's psychological factors, enabling more comprehensive predictions. Additionally, experimenting with hybrid models that combine Prophet with machine learning techniques, such as Random Forests or Gradient Boosting, could address any limitations of a single model and enhance overall performance.

Another suggestion involves expanding the scope of the analysis to assess long-term trends and investor behavior. For example, segmenting the data based on market cycles—bullish, bearish, or neutral—can help identify how Dogecoin's price responds under different conditions. Furthermore, a comparative analysis across multiple cryptocurrencies, using the same methodology, can provide insights into whether Dogecoin exhibits unique price behavior or shares common patterns with other digital assets. Lastly, as the cryptocurrency market continues to evolve, regularly updating the dataset and re-evaluating the model's parameters will ensure that the findings remain relevant and actionable in real-world trading and investment scenarios.

Declaration of Competing Interest

We declare that we have no conflict of interest.

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