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Indofood CBP Sukses Makmur Tbk Stock Price Prediction Using Long Short-Term Memory (LSTM)

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Abstract

Fluctuating stock price movements are a challenge in the investment world, so an accurate prediction model is needed to assist decision making. This study aims to evaluate the ability of the LSTM model to predict ICBP stock prices based on historical data and will compare the results of the LSTM model predictions with actual stock price movements to determine the extent to which this model is able to capture trends and patterns of ICBP stock prices. The results show a comparison of the original price and the predicted price indicating that the model can follow market trends, although there are still deviations at some points, especially when volatility is high. Residual analysis shows a distribution of prediction errors that is close to normal, indicating that the model does not experience significant bias. In addition, evaluation of the loss function on the training and validation data confirms that the model has converged well. In the performance evaluation, the model is able to capture stock movement patterns quite well, indicated by the Mean Absolute Error (MAE) value of 0.0231, Root Mean Squared Error (RMSE) of 0.0305, and Mean Absolute Percentage Error (MAPE) of 19.21%.

Keywords: Stock prediction, LSTM, Indofood CBP sukses makmur Tbk, model performance.

1. Introduction

Investment in Indonesia in Q1-2024 showed strong growth, reaching IDR401.5 trillion, with foreign direct investment (PMA) contributing more than half of the total investment (OJK, 2024). This growth reflects investor confidence in the stability of the Indonesian economy and the positive prospects in various sectors, including the food and beverage industry which continues to grow.

The stock market is one of the investment instruments that has high volatility, where stock prices can change in a short time due to various factors, such as economic conditions, government policies, and market sentiment (Naidoo et al., 2025). Therefore, stock price prediction is an interesting field of research, especially with the development of artificial intelligence technology and increasingly sophisticated machine learning methods. One of the models widely used in stock prediction analysis is Long Short-Term Memory (LSTM), which is part of a recurrent neural network (RNN) and has advantages in handling time series data (Malashin et al., 2024).

PT Indofood CBP Sukses Makmur Tbk (ICBP) is one of the leading companies in Indonesia engaged in the food and beverage industry sector (Muis et al., 2023). ICBP is an attractive and potential stock in the consumer goods industry sector because the level of public consumption is very high (Ardyanfitri and Pertiwi, 2021). With market exposure, the ability to predict ICBP stock price movements is important for investors and financial analysts in making more appropriate investment decisions.

Many researchers have used the LSTM model to predict stocks. One of the only studies conducted by Jeenanunta et al., (2018) LSTM provides the best performance with CPALL, SCB, and KTB with errors less than 2%. DBN provides the best performance with PTT and SCC with errors less than 2%. Another study conducted by Nandakumar et al., (2018) found that LSTM had better prediction accuracy than Artificial Neural Network (ANN) with an RMSE value of 0.04.

This study aims to interpret the ability of the LSTM model to predict ICBP stock prices based on available historical data. This study will also compare the prediction results of the LSTM model with actual stock price movements to determine the extent to which this model is able to capture ICBP stock price trends and patterns. Thus, the results of this study are expected to provide more insight into the effectiveness of LSTM in stock prediction analysis and its potential use in investment strategies.

2. Methodology

2.1. Data Collection and Preparation

The data used in this study were obtained from Yahoo Finance with a time span covering the period from January 1, 2020 to January 1, 2025. The main feature used is the Close Price or daily closing price of the stock. Before the data is used in the prediction model, several preprocessing stages are carried out such as converting the date into a time series index, as well as handling missing data (imputation using the forward fill method). The data is normalized using MinMaxScaler to make the range of values more stable, then divided into 80% for training and 20% for testing. Furthermore, the data is converted into sequence format with (look-back = 30) to capture previous price movement patterns. After that, the dataset is reshaped to match the input format required by the LSTM model. The closing stock prices from 2020 to 2025 will be shown in figure 1.

Figure 1: Closing price

At the beginning of the period, the stock price showed a fairly sharp downward trend until it reached its lowest point around 2020. Entering 2021, the ICBP stock price began to show recovery with a gradual increase. In 2025, the stock price again showed an upward pattern, although it was still accompanied by fluctuations.

2.2. Building the Model

The LSTM model built has four main layers. The first layer is LSTM with 100 units and return_sequences=True so that information can be forwarded to the next layer. The second layer consists of LSTM with 50 units, followed by the third layer in the form of Dense with 25 neurons and ReLU activation, and the last layer in the form of Dense with 1 neuron and linear activation to produce stock price predictions. The model is optimized using the Adam algorithm with a learning rate of 0.0001, and Huber Loss is used as a loss function to increase training stability. In addition, an Early Stopping callback is applied with a stopping criterion if MAE <0.015 to prevent overfitting. The model training process was carried out for 2000 epochs with a batch size of 128, and without shuffling to maintain the order of time series data. With this architecture and training strategy, the model is expected to be able to produce accurate predictions of stock price movements in the time span studied.

Model evaluation is done by analyzing performance during the training and testing process using relevant evaluation metrics. Visualization of loss and Mean Absolute Error (MAE) during training is used to understand model convergence and detect possible overfitting or underfitting. To assess the accuracy of model prediction, three main metrics are used, namely Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and Mean Absolute Percentage Error (MAPE) (Osman and Taman, 2022; Fahad et al., 2023). MAE measures the average absolute error between the actual value (y_i) and the predicted value ($\tilde{y}_i$) with the formula (Roberts, 2023):

$$MAE = \frac{1}{n}\sum_{i=1}^{n}|y_i - \tilde{y}_i| \tag{1}$$

Meanwhile, RMSE gives greater weight to larger errors by calculating the root of the mean square of the differences between the actual and predicted values in equation (2):

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(y_i - \tilde{y}_i)^2} \tag{2}$$

MAPE measures the prediction error as a percentage relative to the actual value, with the formula:

$$MAPE = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{y_i - \tilde{y}_i}{y_i}\right| \times 100\% \tag{3}$$

Using these metrics, the model can be quantitatively evaluated to determine how well it performs in predicting stock prices based on historical data.

3. Results and Discussion

3.1. Stock Price Prediction Visualization

The predictive ability of the analyzed model will be shown in Figure 2.

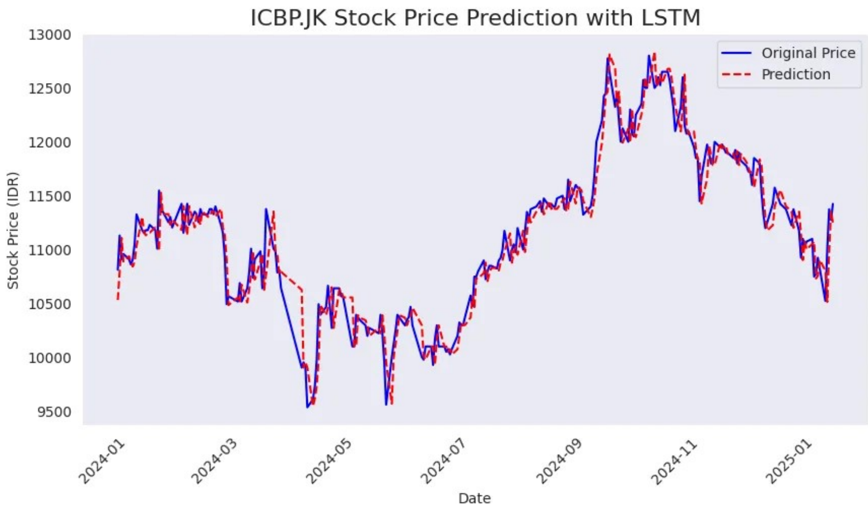

Figure 2: Stock price prediction

The stock price prediction chart of ICBP.JK with the LSTM model shows that the prediction line (red dotted line) follows the original price pattern (blue line) quite well. The model is able to capture the uptrend and downtrend of the stock price, although there are some deviations in sharp price fluctuations. This shows that the model has good generalization ability, but there is still a slight difference between the actual price and the predicted price, especially at some points of trend change.

3.2. Model Performance Evaluation

The model performance is evaluated using several error metrics which are shown in Table 1.

Table 1: Model Performance Evaluation Results

Evaluation Metrics	Value
Mean Absolute Error (MAE)	0.0231
Root Mean Squared Error (RMSE)	0.0305
Mean Absolute Percentage Error (MAPE)	19.21%

In Table 1, the MAE value of 0.0231 indicates that the average difference between the prediction and the actual value is quite small. The relatively low RMSE also indicates that the model's prediction error is not too large in absolute terms. However, the MAPE value of 19.21% indicates that the error relative to the actual value is still quite high, which means that the model still has a significant error rate in some cases.

3.3. Loss Function Analysis

The loss function graph aims to describe how good or bad the model is in making predictions during the training process, which will be shown in Figure 3.

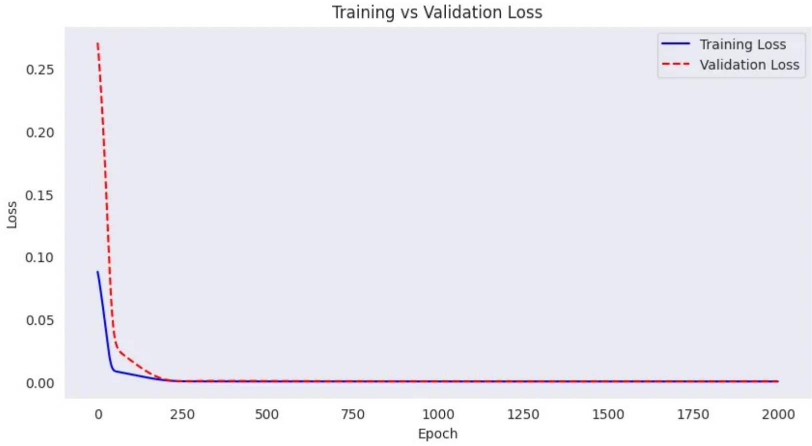

Figure 3: Loss comparison

The loss function graph shows that both the training loss (blue line) and validation loss (red dashed line) experience a rapid decrease at the beginning of the training process and reach a plateau after about 250 epochs. This indicates that the model has achieved good convergence, with no significant signs of overfitting. The very small difference between the training loss and validation loss also indicates that the model has good generalization ability to new data.

3.4. Residual Distribution Analysis

Residual distribution aims to show the distribution of residuals or the difference between the values predicted by the model and the actual values. The results of the residual distribution will be displayed in Figure 4.

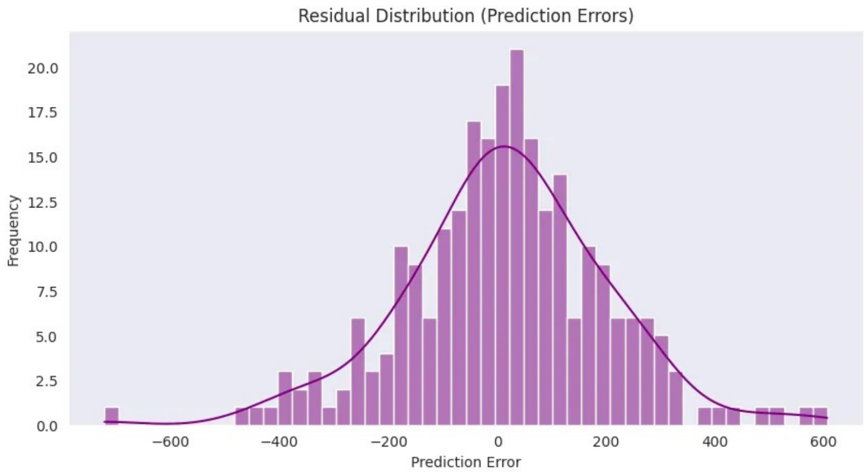

Figure 4: Residual distribution

In Figure 4, it shows that the model does not have significant bias in predicting stock prices, although there are some outliers with larger errors. Most errors are within the range of ±200, but there are some extreme errors outside this range, indicating that the model still has difficulty in capturing very sharp changes in stock prices.

4. Conclussion

Based on the research results, it can be concluded that the Long Short-Term Memory (LSTM) model has a fairly good performance in predicting the stock price of ICBP.JK. The model successfully captures the price movement pattern with a relatively small error rate, as indicated by the MAE value of 0.0231, RMSE of 0.0305, and MAPE of 19.21%.

The comparison graph between the original price and the predicted price shows that the model is able to follow the stock price trend well, although there are some deviations, especially during periods of high volatility. In addition, the evaluation of the loss function shows that the model has converged well, where the loss values on the training and validation data decrease as the number of epochs increases, indicating that the model has successfully learned from historical data effectively.

The residual distribution shows that the prediction errors are normally distributed with an average close to zero, indicating no significant bias in the model. However, there are still variations in errors that can be reduced by further optimization, such as hyperparameter tuning or the use of hybrid models to improve prediction accuracy.

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