

ABSTRACT

IMPLEMENTATION OF THE LONG SHORT TERM MEMORY (LSTM) METHOD IN FORECASTING GLOBAL CRUDE OIL PRICES

By

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Long Short Term Memory (LSTM) is a deep learning method widely used for time series prediction due to its ability to capture nonlinear patterns and long term dependencies. This method is an extension of the Recurrent Neural Network (RNN), designed to address the vanishing gradient problem through memory cell and gate mechanisms, making it effective in modeling complex and dynamic data. In this study, the LSTM method was applied to predict global oil prices, which exhibit fluctuating behavior and are influenced by various economic and geopolitical factors. The model was developed through several stages, including data preprocessing, such as normalization and transformation into supervised time series data, as well as data splitting using the Time Series Cross Validation method. To achieve optimal model performance, hyperparameter tuning was conducted using the Grid Search method. The model performance was then evaluated using Root Mean Squared Error (RMSE) and Mean Absolute Percentage Error (MAPE) metrics. The results indicate that the LSTM model with optimal parameters is capable of producing a low prediction error, with an average RMSE of 2.90 and MAPE of 2.77%.

Keywords: Time Series, Deep Learning, LSTM, Oil Prices, Prediction, Hyperparameter Tuning, Grid Search.

ABSTRAK

PENERAPAN METODE *LONG SHORT TERM MEMORY* (LSTM) PADA PREDIKSI HARGA MINYAK DUNIA

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Long Short Term Memory (LSTM) merupakan salah satu metode *deep learning* yang banyak digunakan dalam prediksi data deret waktu karena kemampuannya dalam menangkap pola nonlinear serta ketergantungan jangka panjang. Metode ini merupakan pengembangan dari *Recurrent Neural Network* (RNN) yang dirancang untuk mengatasi permasalahan *vanishing gradient* melalui mekanisme *memory cell* dan *gate*, sehingga efektif dalam memodelkan data yang bersifat kompleks dan dinamis. Dalam penelitian ini, metode LSTM diterapkan untuk memprediksi harga minyak dunia yang memiliki pergerakan fluktuatif dan dipengaruhi oleh berbagai faktor ekonomi serta kondisi geopolitik. Model dibangun melalui tahapan pra-pemrosesan data, termasuk normalisasi dan pembentukan data *time series supervised learning*, serta pembagian data menggunakan metode *Time Series Cross Validation*. Untuk memperoleh performa model yang optimal, dilakukan proses *hyperparameter tuning* menggunakan metode *Grid Search*. Kinerja model kemudian dievaluasi menggunakan metrik *Root Mean Squared Error* (RMSE) dan *Mean Absolute Percentage Error* (MAPE). Hasil penelitian menunjukkan bahwa model LSTM dengan parameter optimal mampu menghasilkan tingkat kesalahan yang rendah, dengan nilai rata-rata RMSE sebesar 2,90 dan MAPE sebesar 2,77%.

Kata-kata kunci: *Time Series, Deep Learning, LSTM, Harga Minyak, Prediksi, Hyperparameter Tuning, Grid Search*