

INTISARI

DETEKSI ANOMALI HARGA BITCOIN MENGGUNAKAN PENDEKATAN *HYBRID LONG SHORT-TERM MEMORY* DAN METODE DETEKSI *OUTLIER*

Oleh

Dilla Meylia

21/477322/PA/20649

Pasar *cryptocurrency*, khususnya Bitcoin, dikenal memiliki volatilitas harga yang sangat tinggi sehingga sering kali memunculkan pergerakan harga ekstrem yang dapat dianggap sebagai anomali. Deteksi terhadap anomali penting untuk mendukung pengambilan keputusan investasi dan manajemen risiko. Penelitian ini bertujuan mengembangkan pendekatan teknikal untuk mendeteksi dan memprediksi anomali harga Bitcoin secara *unsupervised* dengan menggabungkan model prediksi *Long Short-Term Memory* (LSTM) dan berbagai metode deteksi anomali, yaitu *Z-score*, *One-Class Support Vector Machine* (SVM), *Isolation Forest*, serta *LSTM Autoencoder*. Hasil penelitian menunjukkan bahwa model prediktif LSTM terbaik diperoleh pada konfigurasi *rolling window* 60 hari, yang berhasil menangkap dinamika harga Bitcoin dengan baik, dibuktikan nilai MAPE sebesar 2,15%. Dari segi deteksi anomali, *Isolation Forest* terbukti paling stabil dan konsisten tanpa asumsi distribusi khusus. Sementara itu, *LSTM Autoencoder* dengan *Rolling Z-score* menunjukkan sensitivitas yang tinggi terhadap perilaku ekstrem pasar, dengan distribusi *error* yang mengikuti pola *power-law* berekor tebal. Sebaliknya, metode *Z-score* kurang sesuai karena bergantung pada asumsi distribusi normal, dan *One-Class SVM* menunjukkan ketidakstabilan hasil. Temuan ini menegaskan bahwa pemilihan metode deteksi anomali harus disesuaikan dengan tujuan sistem yang dibangun, baik untuk kestabilan deteksi maupun kepekaan terhadap anomali ekstrem pasar *cryptocurrency*.

ABSTRACT

ANOMALY DETECTION OF BITCOIN PRICE USING HYBRID LONG SHORT-TERM MEMORY AND OUTLIER DETECTION METHODS

By

Dilla Meylia

21/477322/PA/20649

The cryptocurrency market, particularly Bitcoin, is known for its extreme price volatility, often exhibiting sharp movements that may be classified as anomalies. Detecting such anomalies is crucial to support investment decision-making and risk management. This study aims to develop a technical approach for unsupervised anomaly detection and prediction of Bitcoin price movements by combining a Long Short-Term Memory (LSTM) prediction model with several anomaly detection methods, including Z-score, One-Class Support Vector Machine (SVM), Isolation Forest, and LSTM Autoencoder. The best-performing LSTM model was configured with a 60-day rolling window, effectively capturing Bitcoin's price dynamics with a MAPE of 2.15%. Among the detection methods, Isolation Forest proved to be the most stable and consistent, requiring no assumptions about data distribution. Meanwhile, the LSTM Autoencoder combined with Rolling Z-score showed high sensitivity to extreme market behavior, with reconstruction error distributions following a heavy-tailed power-law pattern. In contrast, the Z-score method was less suitable due to its reliance on the normality assumption, and One-Class SVM results were unstable. These findings emphasize that the choice of anomaly detection method should align with the system's purpose, whether prioritizing detection stability or responsiveness to extreme anomalies in the highly dynamic cryptocurrency market.