

INTISARI

Harga emas bersifat volatil dan dipengaruhi banyak faktor makrofinansial, sehingga prediksi harga emas harian menjadi tantangan penting bagi pengambilan keputusan dan kajian peramalan deret waktu. Penelitian ini bertujuan mengevaluasi kinerja *ensemble stacking* TFT–LightGBM dengan RidgeCV dalam meningkatkan akurasi dan stabilitas prediksi harga emas. Penelitian menggunakan *dataset* publik *Kaggle* (5.000 observasi harian; 3 Januari 2005–26 Agustus 2024) dengan target *gold_close* serta kovariat makrofinansial (DXY, WTI, perak, yield UST 10Y, Nasdaq, dan S&P 500). Dua model dasar dibangun, yaitu *Temporal Fusion Transformer* (TFT) dan LightGBM (rekayasa fitur tabular), kemudian digabung menggunakan *stacking* dengan RidgeCV sebagai *meta-learner*. Evaluasi dilakukan dengan pembagian data kronologis (*train-validation-test*) menggunakan metrik RMSE, MAE, dan R^2 pada data uji. Pada data uji, LightGBM menghasilkan RMSE 19,3096; MAE 14,5742; R^2 0,9912, sedangkan TFT menghasilkan RMSE 19,5941; MAE 14,5987; R^2 0,9909. Model *stacking* RidgeCV memberikan kinerja terbaik dengan RMSE 19,0181; MAE 14,2390; dan R^2 0,9914. Hasil ini menunjukkan bahwa *ensemble stacking* TFT–LightGBM dengan RidgeCV mampu meningkatkan akurasi dan menjaga stabilitas prediksi harga emas harian secara *out-of-sample* dibandingkan penggunaan model tunggal.

Kata kunci: harga emas, deret waktu multivariat, *Temporal Fusion Transformer*, LightGBM, *Ensemble Stacking*, RidgeCV.

ABSTRACT

Gold prices are volatile and influenced by numerous macrofinancial factors, making daily gold price prediction a significant challenge for decision-making and time series forecasting studies. This study aims to evaluate the performance of the TFT–LightGBM stacking ensemble with RidgeCV in improving the accuracy and stability of gold price predictions. The study used the Kaggle public dataset (5,000 daily observations; January 3, 2005–August 26, 2024) with a `gold_close` target and macrofinancial covariates (DXY, WTI, silver, UST 10Y yield, Nasdaq, and S&P 500). Two baseline models were built, namely the Temporal Fusion Transformer (TFT) and LightGBM (tabular feature engineering), then combined using stacking with RidgeCV as a meta-learner. Evaluation was carried out by chronological data division (train–validation–test) using RMSE, MAE, and R^2 metrics on the test data. On the test data, LightGBM produced an RMSE of 19.3096; MAE 14.5742; R^2 0.9912, while TFT produces RMSE 19.5941; MAE 14.5987; R^2 0.9909. The RidgeCV stacking model provides the best performance with RMSE 19.0181; MAE 14.2390; and R^2 0.9914. These results indicate that the TFT–LightGBM stacking ensemble with RidgeCV is able to improve the accuracy and maintain the stability of out-of-sample daily gold price predictions compared to using a single model.

Keywords: gold price, multivariate time series, Temporal Fusion Transformer, LightGBM, stacking ensemble, RidgeCV.