



UNDERGRADUATE THESIS

TEMPORAL FUSION TRANSFORMER WITH OPTUNA OPTIMIZATION FOR MULTI-HORIZON FORECASTING OF CROSS-SECTOR STATE- OWNED ENTERPRISE STOCKS

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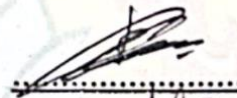
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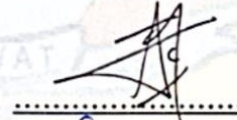
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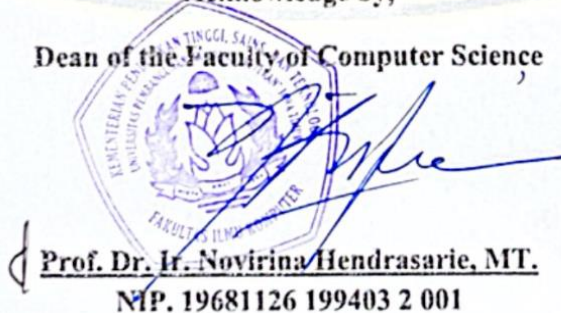
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ABSTRACT

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The stock market is an important component of the financial system that serves as an indicator of a country's economic performance. Increasingly high stock price Volatility due to global financial market integration makes forecasting activities more complex and crucial in supporting investment decisions. This Study applies the Temporal Fusion Transformer (TFT) model optimized using the Optuna framework for multi-horizon stock price forecasting on three Indonesian state-owned enterprises (SOEs) from different sectors, namely Bank Mandiri (BMRI), Perusahaan Gas Negara (PGAS), and Telkom Indonesia (TLKM). Five years of historical data were obtained from Yahoo Finance using the yfinance library. The Preprocessing pipeline includes data Cleaning, technical feature engineering comprising Moving average and Volatility indicators, per-group normalization using GroupNormalizer with softplus transformation, and Time Series dataset construction using PyTorch Forecasting. This Study examines three feature engineering scenarios, three data Splitting scenarios, and twenty Hyperparameter scenarios using Tree-structured Parzen Estimator (TPE)-based optimization.

The results show that the best combination was achieved under Feature engineering 1 (MA5, MA20, VOL10), Split Data 1 (70:15:15), and Hyperparameter configuration O14, yielding MAE of 151.32, RMSE of 220.92, MAPE of 4.89%, and sMAPE of 5.06%. These results significantly outperform the Baseline model with MAE of 397.03 and RMSE of 562.67, proving that Optuna optimization successfully reduced prediction error. Per-stock evaluation demonstrates that the model effectively generalizes across sectors, with best sMAPE values of 4.30% for BMRI, 6.76% for PGAS, and 5.34% for TLKM. Model interpretability analysis confirms that the MA5 feature is the most dominant encoder variable with an importance score of 81%, while the smoother Temporal Attention distribution of the optimized model indicates a better ability to leverage long-term historical patterns compared to the Baseline model.

Keywords : Stock Market, Temporal Fusion Transformer , Optuna Optimization, Time Series Forecasting, Deep Learning

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The author acknowledges that this thesis still has various shortcomings and is far from perfect. Therefore, the author welcomes constructive criticism and suggestions from all parties to improve this academic work in the future.

Surabaya, June 29th 2026

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