ABSTRACT

Daily gold price data in Indonesia exhibits non-linear, non-stationary characteristics, high volatility, and strong temporal dependencies. These characteristics make it difficult for conventional models to generate accurate predictions due to their limitations in capturing temporal patterns. The Gated Recurrent Unit (GRU) architecture is a deep learning model specifically designed to handle temporal data patterns through a simple structure. The performance of the GRU model is highly dependent on the selection of appropriate hyperparameters, thus requiring optimization to determine the optimal configuration. This limitation is addressed by applying Particle Swarm Optimization (PSO) to find the optimal hyperparameter configuration within a continuous search space. This study compares the performance of a standard GRU model and a PSO optimized by GRU (GRU-PSO) in forecasting daily gold prices in Indonesia. The results show that PSO identifies the optimal configuration consisting of 106 units, a batch size of 128, a dropout rate of 0.5, and a learning rate of 0.01. Model evaluation indicates that the standard GRU achieves a Mean Absolute Percentage Error (MAPE) of 1.852%, while the GRU-PSO model achieves a lower MAPE of 0.944%. The integration of PSO reduces the prediction error by approximately 49%. Furthermore, forecasting results for the next five periods show a gradual and relatively stable upward trend. The findings demonstrate that PSO integration effectively improves the accuracy of the GRU architecture in capturing temporal patterns in highly volatile gold price time series data.

Keywords: Daily Gold Prices Forecast, Gated Recurrent Unit (GRU), hyperparameter optimization, Particle Swarm Optimization (PSO).