CHAPTER 5
CONCLUSION

This section presents the conclusions and suggestions derived from the results and disc ussion of the study on Indonesia's inflation forecasting using the hybrid ARIMAX-LightGBM model with Optuna-based hyperparameter optimization and macroeconomic indicators.

5.1 Conclusion

Based on the results of the study on Indonesia's inflation prediction through an ARIMAX-LightGBM construct underpinned by Optuna-enabled hyperparameter refinement based on macroeconomic indicators, several conclusions were obtained as follows:

1. This research succeeded in building Indonesia's inflation prediction system with the ARIMAX-LightGBM-Optuna hybrid approach. The model was built through several stages, namely data preprocessing, transformation and stationarity test, the formation of the ARIMAX model using macroeconomic variables as exogenous variables, residual modeling using LightGBM, and optimization of LightGBM hyperparameters using Optuna. The last expectation was obtained from combining the results of the ARIMAX prediction with the residual LightGBM prediction. The best configuration was obtained at 80:10:10 data split, the use of residual lags 1, 2, and 3, and the LightGBM hyperparameters as a result of Optuna's optimization. These findings show that the hybrid approach is able to integrate the the intrinsic merits of statistical models in capturing linear patterns and the influence of macroeconomic indicators with the ability of machine learning to study nonlinear patterns that remain in residuals.
2. Empirical evaluation revealed that the ARIMAX-LightGBM-Optuna model achieved the most favorable predictive performance performance compared to the ARIMAX, LightGBM, and ARIMAX-LightGBM models without optimization. In the test data, the ARIMAX-LightGBM-Optuna model produced an RMSE value of 0.055973, MAE of 0.042383, MBE of 0.008892, and R^2 of 0.989878. This value shows that the model furnished to explain about 98.99% of an exceptionally restrained magnitude error rate and small prediction bias. In addition, optimization using Optuna has exhibited considerable potential for

elevating the overall effectiveness of hybrid models, which is shown by the decrease in RMSE values from 0.094603 to 0.055973 and the decrease in MAE values from 0.077751 to 0.042383 compared to the ARIMAX-LightGBM model without optimization. Thus, the use of Optuna contributes to finding more suitable hyperparameter combinations so that LightGBM's ability to study ARIMAX residuals is more optimal.

5.2 Suggestions

Guided by the empirical findings of this study, the following recommendations are offered considered for further research, namely:

1. Further research can add other macroeconomic underlying determinants that may contribute to inflationary pressures, such as worldwide commodity pricesenergy prices, world food price indexes, or other international economic indicators, so that the information used by the model has a wider scope of analysis in predicting.
2. Longer historical data spans allow models to learn about a variety of economic conditions, such as crisis periods, economic recovery, and changes in monetary policy. With a wider range of data, the model is expected to be able to produce better learning patterns so as to improve the model's generalization ability in predicting inflation in the coming period.
3. The development of hybrid models can be done by combining ARIMAX with other algorithmic prediction models, such as XGBoost, CatBoost, or LSTM, to compare the capabilities of each method in modeling nonlinear components on inflation data.
4. Optuna served as the optimization framework for hyperparameter calibration in this study. Further research can compare other optimization methods, such as Bayesian Optimization, Genetic Algorithm, or Particle Swarm Optimization to find out the most effective optimization methods in improving the performance of inflation prediction models.