

Model Evaluation and Refinement Report

1. Models Evaluated

- **ARIMA Model**
 - **MAE:** 1.0548
 - **RMSE:** 1.5550
 - **R-squared:** -0.0763
- **LSTM Model**
 - **MAE:** 0.0445 (initial) / 0.4833 (after tuning)
 - **RMSE:** 0.0796 (initial) / 0.6267 (after tuning)
 - **R-squared:** 0.9729 (initial) / -25733.6644 (after tuning)
- **Gradient Boosting Model**
 - **MAE:** 0.0375
 - **RMSE:** 0.1123
 - **R-squared:** 0.9461

2. Evaluation Metrics Analysis

- **ARIMA Model**
 - Performance was suboptimal, indicated by a negative R-squared value, which suggests poor fit to the data.
- **LSTM Model**
 - Initial performance was excellent with low MAE, RMSE, and high R-squared.
 - After hyperparameter tuning, performance degraded significantly, with an extremely negative R-squared, suggesting overfitting or issues with model configuration.
- **Gradient Boosting Model**
 - Demonstrated good performance with low MAE and RMSE and a high R-squared value. It provided a robust balance of accuracy and interpretability.

3. Model Performance Visualization

- **Residuals Plot for LSTM**
 - An error occurred when plotting residuals due to memory issues. The correct calculation of residuals was needed to ensure accurate residual plots.

4. Hyperparameter Tuning

- **LSTM Model Tuning**
 - Initial tuning provided promising results, but further tuning led to drastic performance degradation. This could indicate that the model might have been overfitted or other hyperparameters were not appropriately tuned.