Methodological Evaluation of Industrial Machinery Fleets Systems in Ghana Using Time-Series Forecasting Models for Cost-Effectiveness Analysis

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Abstract

Industrial machinery fleets in Ghana face challenges related to maintenance costs, operational efficiency, and asset utilization. These factors significantly impact overall cost-effectiveness. A comparative analysis was conducted using two time-series forecasting models: ARIMA (AutoRegressive Integrated Moving Average) and LSTM (Long Short-Term Memory). Data from ten industrial machinery fleets across Ghana were analysed to forecast future maintenance costs with a confidence interval of ±5%. The ARIMA model showed an R² value of 0.85 in predicting maintenance costs, indicating that 85% of the variance is explained by the model. LSTM demonstrated superior performance with an R² value of 0.92 and a confidence interval of ±4%, suggesting higher predictive accuracy. Both ARIMA and LSTM models have been validated for their effectiveness in forecasting maintenance costs, providing insights into potential cost savings through proactive maintenance strategies. Industrial machinery fleet managers should consider implementing the LSTM model due to its superior performance. This recommendation is based on the higher R² value and narrower confidence interval of LSTM compared to ARIMA. maintenance costs, industrial machinery fleets, time-series forecasting, cost-effectiveness analysis The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Sub-Saharan, predictive analytics, econometrics, inventory management, maintenance scheduling, stochastic models, grey systems theory*

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