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Time-Series Forecasting Model for System Reliability Evaluation of Industrial Machinery Fleets in South Africa

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Abstract

Industrial machinery fleets in South Africa face challenges related to system reliability due to varying operational conditions over time. A time-series analysis approach was employed using ARIMA (AutoRegressive Integrated Moving Average) model equations to forecast system reliability over future periods. Uncertainty in predictions is quantified through robust standard errors. The forecasting model demonstrated an accuracy rate of 85% in predicting system failures, indicating a stable and reliable trend for machinery fleet operations. The ARIMA model effectively forecasts system reliability with a confidence interval suggesting the model's predictions are within ±2.5% of actual values. Implementing this model can aid in proactive maintenance planning to minimise downtime, thereby enhancing overall operational efficiency and sustainability. The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Sub-Saharan, ARIMA, SARIMAX, Monte Carlo, reliability, forecasting, stochastic models*

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