Bayesian Hierarchical Model for Assessing System Reliability in Ugandan Industrial Machinery Fleets

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Abstract

Industrial machinery fleets in Uganda are critical for food processing industries, yet their reliability is often underappreciated due to limited data and analytical tools. A Bayesian hierarchical model was developed to assess the reliability of industrial machinery in Ugandan food processing industries. This approach accounts for variability across different types of machinery and their operational environments. The model identified that machinery failure rates varied significantly by type, with a proportion of 15% attributed to mechanical failures, indicating the need for targeted maintenance strategies. This study provides empirical evidence on system reliability in Ugandan industrial machinery fleets, offering insights into effective maintenance planning and resource allocation. Implementing tailored maintenance programmes based on model findings can improve overall fleet efficiency and reduce downtime costs. The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *African geography, Bayesian statistics, Hierarchical modelling, Reliability engineering, Uncertainty quantification, Markov chain Monte Carlo, Simulation studies*

ABSTRACT-ONLY PUBLICATION

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