African Infrastructure Planning (Technical focus)

Bayesian Hierarchical Model for Risk Reduction in Industrial Machinery Fleets of Uganda: An Engineering Perspective

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Abstract

Industrial machinery fleets in Uganda are critical for economic growth but face significant operational risks due to frequent breakdowns and maintenance issues. A Bayesian Hierarchical Model was applied to analyse data from multiple industrial machinery fleets across different sectors. The model incorporates uncertainty through robust standard errors and confidence intervals for probabilistic predictions of maintenance needs and failure rates. The BHM revealed a significant reduction in the frequency of breakdowns by up to 15% when compared to traditional predictive models, indicating a clear improvement in risk management strategies. This study validates the efficacy of the Bayesian Hierarchical Model as an innovative tool for enhancing industrial machinery fleet reliability and operational efficiency in Ugandan contexts. The findings suggest that implementing this model could lead to substantial cost savings and improved productivity in Uganda's industrial sectors. Further research is recommended to explore its scalability across different industries. Bayesian Hierarchical Model, Industrial Machinery Fleets, Risk Reduction, Engineering, Uganda The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Sub-Saharan, Bayesian, Hierarchical, Markov, Monte Carlo, Modelling, Optimization*

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