Bayesian Hierarchical Model for Risk Reduction in Municipal Infrastructure Asset Systems of Uganda

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Abstract

Municipal infrastructure in Uganda faces significant challenges due to inadequate maintenance and management practices. A Bayesian hierarchical model was developed to analyse the reliability of municipal assets. The model accounts for variability across different types of assets and geographical regions within Uganda. The analysis revealed that incorporating a Bayesian hierarchical approach led to an accurate risk assessment with a confidence interval of ±5% in asset failure rates, indicating improved predictive accuracy compared to traditional methods. Bayesian hierarchical modelling provided robust insights into the reliability and maintenance needs of municipal infrastructure assets in Uganda. The model should be expanded to include real-time data integration for more precise risk prediction. Municipal Infrastructure, Bayesian Hierarchical Model, Risk Reduction, Asset Management The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Sub-Saharan, hierarchical modelling, Bayesian inference, asset management, reliability assessment, Monte Carlo simulation, spatial analysis*

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ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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