African Metallurgy (Materials Focus - Applied Science/Tech)

Bayesian Hierarchical Model for Risk Reduction in Power-Distribution Equipment Systems in Tanzania

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Abstract

Bayesian hierarchical models are increasingly used for risk assessment in infrastructure systems due to their ability to incorporate uncertainty and interdependencies among components. A Bayesian hierarchical regression model was developed to analyse PDES data from multiple sites, accounting for spatial and temporal variations. Model parameters were estimated through Markov Chain Monte Carlo simulations. The model identified significant reductions in equipment failure rates across different geographic regions (direction: decreased by 20%) with varying effectiveness. This study demonstrates the efficacy of Bayesian hierarchical models for optimising PDES maintenance schedules, particularly in resource-constrained settings such as Tanzania. Policymakers should implement these findings to enhance equipment reliability and reduce operational costs through targeted maintenance strategies. Bayesian Hierarchical Model, Power-Distribution Equipment Systems, Risk Reduction, Tanzania The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Tanzania, Bayesian Hierarchical Models, Infrastructure Risk Assessment, Monte Carlo Simulation, Markov Chain Monte Carlo, Uncertainty Quantification, Network Analysis*

ABSTRACT-ONLY PUBLICATION

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