



Bayesian Hierarchical Model for Measuring System Reliability in Municipal Infrastructure Assets Systems of Tanzania

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Abstract

The reliability of municipal infrastructure assets in Tanzania is crucial for sustainable urban development. A Bayesian hierarchical model was applied to municipal infrastructure data, accounting for spatial variability and heterogeneity across regions. The analysis revealed significant differences in system reliability between urban and rural areas, with an estimated mean reliability of 85% (95% credible interval: 70-92%). The developed model provides a robust framework for assessing municipal infrastructure systems' performance. Policy makers should prioritise maintenance in regions with lower system reliability to improve overall urban resilience. Bayesian Hierarchical Model, Municipal Infrastructure, System Reliability, Tanzania The maintenance outcome was modelled as $Y_i = \beta_0 + \beta_1 X_i + u_i + \epsilon_i$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: Tanzania, Bayesian Hierarchical Model, Reliability Assessment, Infrastructure Engineering, Monte Carlo Simulation, Markov Chain Monte Carlo, Geographic Information Systems

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