African Computational Statistics (Technology/Maths)

Bayesian Hierarchical Model for Risk Reduction in Municipal Infrastructure Assets Systems of Senegal

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Abstract

The municipal infrastructure assets in Senegal are under significant stress due to poor maintenance and aging structures, posing a risk to public safety and economic stability. A Bayesian hierarchical model was constructed using available data on municipal infrastructure assets. The model accounts for spatial heterogeneity and incorporates expert knowledge to quantify risk reduction strategies. The model identified a significant decrease of 20% in structural failure risks when comprehensive maintenance programmes are implemented across Senegal's municipalities. This study validates the effectiveness of Bayesian hierarchical modelling in accurately predicting and mitigating infrastructure asset failures, offering policymakers actionable insights for risk reduction strategies. Policymakers should prioritise investment in preventive maintenance programmes to align with the model's findings. Implementation of these recommendations could lead to substantial savings and improved public safety. Senegal, Municipal Infrastructure, Risk Reduction, Bayesian Hierarchical Model, Structural Failure The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Sub-Saharan, Africa, Bayesian, Monte Carlo, Sensitivity, Simulation, Stochastic, Modelling*

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