African Safety Engineering

Bayesian Hierarchical Model for Measuring Adoption Rates in Municipal Infrastructure Assets Systems, South Africa

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Abstract

This study focuses on evaluating municipal infrastructure assets systems in South Africa by applying a Bayesian hierarchical model to measure adoption rates. A Bayesian hierarchical model was employed to analyse adoption rates across different municipal districts. This approach allows for the incorporation of spatial and temporal dependencies in the data. The analysis revealed significant variations in adoption rates among municipalities, with some regions showing adoption rates as high as 85% in certain infrastructure projects. This study provides insights into the effectiveness of municipal investments through a robust statistical framework that accounts for complex spatial and temporal dynamics. The findings suggest that targeted interventions could be more effective if tailored to areas with lower adoption rates, based on this model's predictive power. The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Bayesian statistics, hierarchical modelling, spatial analysis, asset management, econometrics, stochastic processes, South Africa*

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