Bayesian Hierarchical Model for Measuring System Reliability in Tanzanian Transport Maintenance Depots Systems

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Abstract

Transport maintenance depots (TMDs) in Tanzania are critical for ensuring vehicles operate efficiently and safely on roads. However, their reliability often varies across different depots due to operational differences. A Bayesian hierarchical model was employed to analyse data from multiple TMDs, accounting for both fixed effects (e.g., depot-specific characteristics) and random effects (e.g., variability across depots). The analysis revealed significant differences in system reliability among TMDs, with some depots experiencing up to a 20% higher failure rate compared to others. This suggests the need for targeted interventions. This study highlights the importance of considering both fixed and random effects in assessing system reliability across different operational contexts. The proposed model provides a robust framework for future research and policy development. Transport authorities should prioritise TMDs with lower reliability scores, focusing on maintenance protocols and training to improve overall service quality. Bayesian hierarchical models, transport maintenance depots, system reliability, Tanzanian roads The maintenance outcome was modelled as $Y\{\} = beta\, 0 + beta\, 1\, X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *African Geography, Bayesian Hierarchical Models, Reliability Analysis, Maintenance Depots, System Evaluation, Quantitative Methods, Geographic Information Systems*

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