



Bayesian Hierarchical Model for Evaluating Cost-Effectiveness of Transport Maintenance Depots in South Africa: A Methodological Assessment

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Abstract

Transport maintenance depots play a crucial role in ensuring the reliability and efficiency of road transport systems in South Africa. A Bayesian hierarchical model was employed to assess the cost-effectiveness of transport maintenance depots in South Africa. The model accounts for variability across different depots and incorporates uncertainty through robust standard errors. The analysis revealed that depots located closer to major highways showed a 15% reduction in average repair times, indicating their strategic importance. This study provides evidence supporting the effectiveness of deploying depots strategically based on proximity to high traffic areas. Future deployments should prioritise locations with significant traffic volumes for optimal cost-effectiveness and service delivery. The maintenance outcome was modelled as $Y_i = \beta_0 + \beta_1 X_i + u_i + \text{var}_{\epsilon}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Geographic, Transport Infrastructure, Hierarchical Modelling, Bayesian Statistics, Cost-Benefit Analysis, Reliability Engineering, System Dynamics*

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