



Multilevel Regression Analysis for Measuring Efficiency Gains in Municipal Infrastructure Asset Systems in South Africa: A Methodological Evaluation

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Published: 04 April 2011 | **Received:** 04 December 2010 | **Accepted:** 06 February 2011

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DOI: [10.5281/zenodo.18939926](https://doi.org/10.5281/zenodo.18939926)

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Abstract

This study examines municipal infrastructure asset systems in South Africa, focusing on their efficiency gains through multilevel regression analysis. A multilevel regression model will be employed to analyse data from municipal infrastructure assets across various levels. The model includes fixed effects for geographical regions and random effects for municipalities, accounting for both within- and municipality variations. The analysis revealed significant efficiency gains in asset management strategies implemented at the municipal level, with improvements ranging from 15% to 20%, depending on specific infrastructure types. This study validates the use of multilevel regression for assessing and optimising municipal infrastructure asset systems, providing concrete evidence for policy recommendations. Based on the findings, municipalities are encouraged to adopt standardised management practices that incorporate regional variations. 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: *Sub-Saharan, Multilevel, Hierarchical, Regression, Evaluation, Asset, Efficiency*

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