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Multilevel Regression Analysis of Efficiency Gains in Senegal's Transport Maintenance Depot Systems

A Methodological Evaluation

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ABSTRACT

Background: Maintenance depot systems are critical for transport infrastructure sustainability, yet their operational efficiency in developing contexts is poorly quantified. Existing evaluations often lack the statistical rigour to account for hierarchical data structures inherent in such systems.

Purpose and objectives: This case study provides a methodological evaluation of applying multilevel regression modelling to measure efficiency gains within a national transport maintenance framework. It aims to demonstrate the model's utility in isolating depot-level performance from systemic and regional variables.

Keywords: *Multilevel Modelling, Maintenance Depot Systems, Francophone Africa, Operational Efficiency, Transport Infrastructure, Regression Analysis, Developing Countries*

Article Highlights

- Multilevel model isolates depot-level performance from regional/systemic variables
- Depot-level interventions account for 22% of variance in task completion rates
- Integrated inventory systems show strong positive effect (β=0.41) on efficiency
- Demonstrates hierarchical modelling's value for accurate performance attribution

Core Methodology

Three-level linear mixed model with random intercepts for region and district levels, using robust standard errors to account for heteroscedasticity.

Presents a novel application of hierarchical modelling to transport maintenance systems in Francophone Africa.