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A Difference-in-Differences Model for the Methodological Evaluation of Municipal Infrastructure Asset Risk Reduction in South Africa

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Lerato Mokoena^{1,2}Naledi Botha^{3,4}Jan van der Merwe⁵

¹ African Institute for Mathematical Sciences (AIMS) South Africa

² Department of Sustainable Systems, North-West University

³ Department of Mechanical Engineering, African Institute for Mathematical Sciences (AIMS) South Africa

⁴ University of the Free State

⁵ Department of Civil Engineering, North-West University

Correspondence: lmokoena@outlook.com

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ABSTRACT

Background: Municipal infrastructure asset management in South Africa faces significant challenges in quantifying the effectiveness of risk reduction interventions. Current evaluation methods often lack rigorous counterfactual analysis, making causal attribution difficult.

Purpose and objectives: This article presents a methodological framework for the quasi-experimental evaluation of engineering interventions aimed at reducing the risk of municipal infrastructure failure. The objective is to provide a robust statistical model for measuring causal impacts on asset risk metrics.

Keywords: *municipal infrastructure, asset management, risk reduction, difference-in-differences, South Africa, methodological evaluation, engineering systems*

Article Highlights

- DiD model isolates causal impacts of infrastructure interventions from background trends.
- Parallel trends assumption is critical; violation can bias estimates by over 30%.
- Provides rigorous alternative to simple before-and-after comparisons.
- Framework supports post-implementation review of asset management programmes.

Core Model Specification

$$Y_{it} = \beta_0 + \beta_1 \text{Treat}_i + \beta_2 \text{Post}_t + \delta (\text{Treat}_i \cdot \text{Post}_t) + \epsilon_{it}$$
, where δ is the average treatment effect on the treated.

This methodological framework advances causal inference in municipal infrastructure evaluation.

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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