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Methodological Evaluation of Regional Monitoring Networks in South Africa: Panel Data Estimation for System Reliability Assessment

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Abstract

This study focuses on the methodological evaluation of regional monitoring networks in South Africa, with a particular emphasis on evaluating system reliability. A quasi-experimental design will be employed, utilising panel data from multiple regions in South Africa. Linear Mixed Models (LMM) with random effects will be used to estimate system reliability. Uncertainty quantification will employ robust standard errors to account for within-network variability and region differences. Initial analysis suggests that regional monitoring networks are generally effective, but there is significant variation in performance across different regions, particularly in terms of sensor accuracy and data transmission reliability. The evaluation highlights the need for targeted interventions to address specific weaknesses identified within the various network structures. Specific recommendations include upgrading sensors in less reliable areas, implementing standardised calibration protocols, and enhancing cybersecurity measures to protect sensitive monitoring data. The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Sub-Saharan, panel-data, econometrics, system-analyses, reliability, spatial-statistics, stochastic-models*

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