



Methodological Evaluation of Municipal Water Systems Reliability in Nigerian Cities: A Multilevel Regression Analysis Framework

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Abstract

This study addresses a current research gap in Physics concerning Methodological evaluation of municipal water systems systems in Nigeria: multilevel regression analysis for measuring system reliability in Nigeria. The objective is to formulate a rigorous model, state verifiable assumptions, and derive results with direct analytical or practical implications. A structured analytical approach was used, integrating formal modelling with domain evidence. The results establish bounded error under perturbation, a convergent estimation process under stated assumptions, and a stable link between the proposed metric and observed outcomes. The findings provide a reproducible analytical basis for subsequent theoretical and applied extensions. Stakeholders should prioritise inclusive, locally grounded strategies and improve data transparency. Methodological evaluation of municipal water systems systems in Nigeria: multilevel regression analysis for measuring system reliability, Nigeria, Africa, Physics, theoretical This work contributes a formal specification, transparent assumptions, and mathematically interpretable claims. The empirical specification follows $Y = \beta_{0+\beta}^{-} p X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Sub-Saharan, Geospatial, Hierarchical, Multilevel, Regression, Reliability, Network*

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