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Replication and Bayesian Hierarchical Modelling of Power-Distribution Equipment Adoption in Rwanda, 2000–2026

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ABSTRACT

Background: The adoption of power-distribution equipment is a critical infrastructural process in developing economies. Prior studies have modelled adoption rates using deterministic frameworks, which often fail to account for regional heterogeneity and uncertainty inherent in long-term infrastructure planning.

Purpose and objectives: This study aims to replicate and critically evaluate a previous national adoption model using a Bayesian hierarchical framework. The objective is to produce more robust probabilistic forecasts and quantify the uncertainty in the adoption rates of key equipment types across different regions.

Keywords: Replication study, Bayesian hierarchical modelling, Power-distribution equipment, Sub-Saharan Africa, Infrastructure adoption, Developing economies, Rwanda

Article Highlights

- Replication study applies Bayesian hierarchical modelling to national adoption data.
- Model quantifies significant regional variation in equipment adoption rates.
- Probabilistic forecasts produce wider, more conservative credible intervals.
- Findings advocate for uncertainty-aware infrastructure planning frameworks.

Methodological Note

Core model: $y_{ij} \sim \text{Normal}(\alpha_j + \beta x_{ij}, \sigma^2)$, with $\alpha_j \sim \text{Normal}(\mu_{\alpha}, \tau^2)$, estimating posteriors via MCMC.

This replication underscores the value of probabilistic forecasts for infrastructure planning in developing economies.

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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