

A Bayesian Hierarchical Model for the Cost-Effectiveness of Power-Distribution Equipment in Kenya

A Policy Analysis for Asset Management

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ABSTRACT

Background: Asset management for power-distribution networks in sub-Saharan Africa faces significant challenges due to limited data, heterogeneous operating environments, and constrained capital. Current policy often relies on deterministic cost-benefit analyses, which inadequately capture uncertainty and regional variability, leading to suboptimal investment decisions.

Purpose and objectives: This policy analysis aims to develop and demonstrate a novel Bayesian hierarchical model to evaluate the cost-effectiveness of distribution equipment, specifically transformers and switchgear, providing a robust evidence base for national asset management strategy.

Keywords: *Bayesian hierarchical modelling, cost-effectiveness analysis, power-distribution networks, asset management, sub-Saharan Africa, Kenya, engineering policy analysis*

Article Highlights

- Bayesian model quantifies regional heterogeneity in equipment failure rates.
- Probabilistic framework challenges one-size-fits-all national maintenance strategy.
- Analysis supports shift toward regionally differentiated asset management policy.
- Formal uncertainty quantification improves sparse-data decision-making.

Policy Implication

Current deterministic approaches inadequately capture regional variability, leading to suboptimal investment decisions for power-distribution networks.

This analysis provides a probabilistic evidence base for infrastructure policy reform.

ABSTRACT-ONLY PUBLICATION

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