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Bayesian Hierarchical Modelling for Yield Improvement in Ghana's Power-Distribution Equipment Systems

A Methodological Evaluation

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ABSTRACT

Background: Power-distribution systems in Ghana face persistent challenges with equipment reliability and yield losses. Existing analytical methods often fail to adequately account for the hierarchical structure of network data and inherent uncertainties in performance measurement.

Purpose and objectives: This study presents a methodological evaluation of a Bayesian hierarchical model designed to measure and improve yield within the nation's power-distribution equipment systems. The objective is to assess the model's efficacy in quantifying performance gains and identifying influential factors.

Keywords: Bayesian hierarchical modelling, power-distribution reliability, yield improvement, sub-Saharan Africa, equipment failure analysis, probabilistic forecasting, grid resilience

Article Highlights

- Bayesian hierarchical model isolates regional effects from equipment-level covariates
- Quantifies yield improvements with full probabilistic uncertainty intervals
- Robust performance with sparse data at sub-station level
- Provides framework for ongoing performance monitoring and resource allocation

Methodological Contribution

Introduces a statistically rigorous Bayesian hierarchical framework for power-system yield analysis, offering superior handling of uncertainty and data structure compared to conventional methods.

This methodological evaluation demonstrates practical application of Bayesian inference for infrastructure reliability.

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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