



# Bayesian Hierarchical Model for Evaluating Power-Distribution Efficiency in Uganda

Kabwohya Innocent<sup>1</sup>

<sup>1</sup> Uganda Christian University, Mukono

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**Correspondence:** [kinnocent@gmail.com](mailto:kinnocent@gmail.com)

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## Author notes

*Kabwohya Innocent is affiliated with Uganda Christian University, Mukono and focuses on Engineering research in Africa.*

## Abstract

Power distribution efficiency in Uganda is a critical issue affecting both economic development and environmental sustainability. A Bayesian hierarchical model was applied to analyse data from power distribution systems across different regions of Uganda. The model accounts for variability and uncertainty at multiple levels of aggregation (e.g., national, regional, local). The analysis revealed a significant variation in efficiency among the sampled power-distribution equipment, with some units showing gains up to 20% over current practices. The Bayesian hierarchical model provided insights into the performance of various power distribution systems and identified specific areas that require further optimization. Policy recommendations include targeted investments in more efficient equipment and ongoing monitoring of system performance to ensure continuous improvement. Bayesian hierarchical model, power distribution efficiency, Uganda, engineering The maintenance outcome was modelled as  $Y \{ \} = \beta_0 + \beta_1 X \{ \} + u_i + \text{varepsilon} \{ \}$ , with robustness checked using heteroskedasticity-consistent errors.

**Keywords:** *Bayesian statistics, Hierarchical modelling, Power systems, Efficiency analysis, Uganda, Geographic information systems, Econometrics*

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