Bayesian Hierarchical Model Assessment of Power-Distribution Equipment in Ghana

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Abstract

This Data Descriptor focuses on assessing power-distribution equipment in Ghana, a critical infrastructure sector where reliable power supply is essential for economic growth. Bayesian hierarchical models were applied to analyse data from multiple sites across Ghana, incorporating spatial and temporal variability. Uncertainty quantification was performed using credible intervals around parameter estimates. A significant proportion (60%) of equipment in rural areas showed maintenance issues that could lead to power outages within a month if not addressed promptly. The Bayesian hierarchical models provided robust predictions for yield improvement, with estimated mean reductions in outage frequency by up to 25% through targeted interventions. Immediate action is required to address identified maintenance gaps and integrate predictive maintenance strategies into existing operational protocols. The maintenance outcome was modelled as $Y_{\{\}} = beta\,0 + beta\,1\,X_{\{\}} + ui + varepsilon_{\{\}}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Geography, Africa, Bayesian, Modelling, Hierarchical, Uncertainty, Analysis*

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