African Construction Management and Engineering
(Engineering focus)

Bayesian Hierarchical Model for Evaluating Cost-Effectiveness of Power-Distribution Equipment Systems in Senegal

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Abstract

In Senegal, power-distribution equipment systems play a critical role in ensuring reliable electricity supply to households and businesses. A Bayesian hierarchical model was developed using data from multiple power-distribution sites in Senegal. This model incorporates uncertainty through robust standard errors to estimate the cost-effectiveness of equipment systems across various conditions. The analysis revealed a significant variation ($p < 0.05$) in the cost-effectiveness metrics, indicating that regional and infrastructure-specific factors influence system performance. This study demonstrates how Bayesian hierarchical modelling can be used to assess power-distribution equipment systems' efficiency across diverse settings in Senegal. Future research could explore additional variables impacting system performance and validate findings through practical applications. The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Bayesian statistics, hierarchical modelling, cost-effectiveness analysis, power distribution, Africa, econometrics, stochastic processes*

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