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Bayesian Hierarchical Model for Evaluating Adoption Rates in Water Treatment Facilities in Ghana: A Methodological Approach

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Abstract

Water treatment facilities play a crucial role in improving water quality for communities in Ghana. However, their adoption rates vary significantly across different regions and socio-economic groups. A Bayesian hierarchical model was constructed using aggregated data from various regions. The model accounts for both fixed effects (e.g., region, socio-economic status) and random effects (e.g., facility-specific variability). Uncertainty is quantified through credible intervals. The analysis revealed significant regional variations in adoption rates, with urban areas showing higher adoption compared to rural areas. Socioeconomic factors significantly influenced adoption decisions. This study provides a robust methodological framework for assessing water treatment facility adoption rates and highlights the importance of considering both fixed and random effects in such models. Future research should explore additional socioeconomic variables that may impact adoption rates, and practical interventions to increase adoption in regions with lower rates. Bayesian hierarchical model, water treatment facilities, adoption rates, Ghana, region-specific analysis The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Geographic, Ghana, Hierarchical, Bayesian, Model, Adoption, Evaluation*

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