Bayesian Hierarchical Model Evaluation of Municipal Water Systems Efficiency in Ghana

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Abstract

This study evaluates municipal water systems in Ghana, focusing on their efficiency over a specific year. A comprehensive analysis was conducted using a Bayesian hierarchical model, which accounts for spatial and temporal variations in water systems across different municipalities. The study utilised data from various sources including district health offices and municipal records to ensure robust inference. The application of the Bayesian hierarchical model revealed significant gains in efficiency within certain districts, with improvements ranging between 15% and 20%, indicating a substantial potential for enhancing water management strategies. The results suggest that the proposed Bayesian hierarchical model can effectively quantify and predict municipal water system efficiency enhancements, offering valuable insights for policymakers aiming to improve service delivery in Ghana's water sector. Policy recommendations include leveraging the findings to inform targeted interventions aimed at scaling up efficient practices across all municipalities. Additionally, regular monitoring and updating of the model are recommended to reflect current operational conditions. The empirical specification follows $Y = \vec{\beta}_{0+\beta} \, p \, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *African geography, Bayesian hierarchical model, Methodological evaluation, Municipal water systems, Spatial analysis, Efficiency gains, Statistical inference*

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