Bayesian Hierarchical Model for Measuring Cost-Effectiveness of Manufacturing Systems in Ugandan Plants

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Abstract

This study addresses the need for a methodological framework to evaluate the cost-effectiveness of manufacturing systems in Ugandan plants, which can inform policy and investment decisions. A Bayesian hierarchical model was developed to account for heterogeneity across Ugandan manufacturing plants. The model incorporates random effects to reflect variations in system efficiency due to plant type (e.g., assembly vs. processing) and regional factors such as labour costs and technology adoption rates. Uncertainty quantification is achieved through the specification of prior distributions and robust estimation using MCMC methods. The Bayesian hierarchical model revealed significant differences in cost-effectiveness between plant types, with assembly plants generally being more efficient than processing plants. Regional variations also showed substantial impacts on system performance, particularly in regions with higher labour costs. This study demonstrates the efficacy of the proposed Bayesian hierarchical model for evaluating manufacturing systems and highlights the importance of considering both plant type and regional factors when assessing cost-effectiveness. Policy makers should consider implementing this methodological approach to guide investments in Ugandan manufacturing sectors, ensuring a more informed decision-making process based on data-driven insights. Bayesian hierarchical model, manufacturing systems, cost-effectiveness, Ugandan plants, regional variability The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *African, Bayesian, Hierarchical, Markov Chain Monte Carlo, Cost-Effectiveness, Econometrics, Decision Analysis*

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