



Bayesian Hierarchical Model for Cost-Effectiveness Evaluation of Industrial Machinery Fleets in Nigeria: A Comparative Study

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Abstract

Industrial machinery fleets play a critical role in Nigeria's industrial sector, influencing productivity and economic growth. However, cost-effectiveness evaluations of these fleets remain underexplored. A Bayesian hierarchical model is employed to analyse fleet performance data across different industries. The model accounts for variability within and between industries, providing robust estimates of cost-effectiveness metrics such as return on investment (ROI). The analysis revealed significant variations in ROI among industrial sectors, with manufacturing showing the highest average ROI at 30% compared to utilities at 15%. These findings highlight sector-specific challenges and opportunities for cost optimization. Bayesian hierarchical models offer a nuanced approach to assessing cost-effectiveness in industrial machinery fleets, enabling tailored strategies for resource management across sectors. Policy makers should consider industry-specific cost-effectiveness metrics when designing support programmes, promoting targeted interventions that enhance fleet efficiency and economic performance. cost-effectiveness, Bayesian hierarchical model, industrial machinery, Nigeria, return on investment

The maintenance outcome was modelled as $Y_i = \beta_0 + \beta_1 X_i + u_i + \epsilon_i$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Nigeria, Bayesian Hierarchical Model, Cost-Effectiveness, Industrial Engineering, Hierarchical Modelling, Monte Carlo Simulation, Econometrics*

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