Bayesian Hierarchical Model for Cost-Effectiveness Assessment of Industrial Machinery Fleets in Senegal

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Abstract

This study addresses the need for a robust method to evaluate the cost-effectiveness of industrial machinery fleets in Senegal, considering the economic and operational complexities of such systems. A Bayesian hierarchical model was developed using Markov Chain Monte Carlo methods for analysing data on maintenance costs, operational efficiency, and productivity outcomes from a sample of industrial machinery fleets across Senegal. The BHM accounts for heterogeneity within and between fleets to estimate cost-effectiveness ratios with uncertainty quantification. The analysis revealed that fleet utilization rates significantly impact the overall cost-effectiveness (utilization rate above 70% resulted in an average cost-effectiveness ratio of $15,000 \, per \, year$). *The Bayesian hierarchical model demonstrated its utility for assessing $\wedge$ optimising industrial r* $Y_{it}=\beta_0+\beta_1 X_{it}+u_i+\varepsilon_{it}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Sub-Saharan, Bayesian, Hierarchical, Markov, Monte Carlo, Econometrics, Optimization*

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