African Maintenance Engineering

Bayesian Hierarchical Model for Cost-Efficiency Evaluation of Industrial Machinery Fleets in Ghana: A Methodological Assessment

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Abstract

Industrial machinery fleets in Ghana are critical to economic development but often suffer from inefficiencies and high maintenance costs. A Bayesian hierarchical model was applied to analyse data on industrial machinery fleets in Ghana. This approach accounts for variability across different types and sizes of machinery within the same fleet. The analysis revealed significant heterogeneity in cost-effectiveness among machine categories, with some machines showing substantial overuse or underutilization. Bayesian hierarchical modelling offers a robust framework to assess and optimise industrial machinery fleets, facilitating more informed decision-making for maintenance and procurement policies. Adopting the Bayesian hierarchical model can help in identifying cost-saving opportunities by focusing on underperforming equipment and optimising usage patterns. The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Geographic, Industrial, Maintenance, Cost-effectiveness, Hierarchical, Bayesian, Evaluation*

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