African Nanotechnology Applications (Technology)

Multilevel Regression Analysis for Measuring System Reliability in Ghanaian Industrial Machinery Fleets Systems

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Abstract

Industrial machinery fleets in Ghana face challenges related to system reliability due to varying conditions across different locations and operational environments. A multilevel logistic regression model was employed to analyse the dataset collected from various industrial sites. The model accounts for both fixed effects (such as equipment type and site characteristics) and random effects (site-specific variability). Uncertainty in parameter estimates is accounted for using robust standard errors. The analysis reveals that environmental factors significantly influence system reliability, with a 20% higher likelihood of failure in areas with extreme weather conditions compared to moderate environments. This finding underscores the need for adaptive maintenance strategies. Multilevel regression provides a nuanced understanding of system reliability by distinguishing between site-specific and common effects, enhancing the robustness of reliability assessments across diverse industrial settings. Adopting multilevel regression analysis can improve the accuracy of reliability predictions in Ghanaian industrial machinery fleets, facilitating more effective maintenance planning and resource allocation. Industrial Machinery Reliability Multilevel Regression Logistic Model Environment The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Sub-Saharan, multilevel, logistic, reliability, validation, econometrics, stratified*

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