



Methodological Evaluation of Industrial Machinery Fleets in Ethiopia Using Multilevel Regression Analysis to Measure System Reliability

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Abstract

Industrial machinery fleets in Ethiopia are crucial for various sectors including mining, manufacturing, and construction. However, their reliability is often compromised by factors such as age, maintenance practices, and environmental conditions. A multilevel regression model was employed to analyse data collected from a representative sample of machinery fleets. The model accounts for both fixed effects (e.g., region-specific maintenance practices) and random effects (e.g., variability within regions). The analysis revealed that age-related factors significantly contribute to the probability of system failure, with older machines being more prone to breakdowns. This study provides insights into improving machinery reliability in Ethiopia by targeting maintenance interventions specifically at older equipment. Policy recommendations include prioritising regular maintenance and upgrading older machinery in high-risk regions. multilevel regression, industrial machinery fleets, system reliability, Ethiopia The maintenance outcome was modelled as $Y_i = \beta_0 + \beta_1 X_i + u_i + v_i \epsilon_i$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: Ethiopia, Multilevel Regression Analysis, Reliability Engineering, Maintenance Strategies, Supply Chain Management, Predictive Analytics, Geographic Information Systems (GIS)

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