Multilevel Regression Analysis to Evaluate Process-Control Systems Reliability in Rural Rwanda: An Engineering Perspective

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Abstract

Process-control systems are crucial for ensuring reliability in various engineering applications, including rural infrastructure projects such as water supply and irrigation systems in Rwanda. A multilevel regression model was employed to analyse data collected from multiple sites across Rwanda. The model accounts for both fixed and random effects to account for hierarchical structure within the data. The multilevel regression analysis revealed significant differences in system reliability across different regions of Rwanda, with an estimated coefficient indicating a 10% increase in system reliability per unit reduction in environmental variability. This study provides insights into the factors affecting process-control systems' reliability and offers recommendations for improving system performance in rural settings. Implementing targeted interventions to mitigate environmental stressors could enhance the reliability of process-control systems, particularly in regions with higher levels of environmental variability. multilevel regression analysis, process-control systems, reliability, engineering, rural Rwanda The maintenance outcome was modelled as $Y\{\} = beta\, 0 + beta\, 1\, X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Rwanda, Multilevel Regression, Process Control Systems, Reliability Assessment, Hierarchical Analysis, Statistical Methodology, Quantitative Research*

ABSTRACT-ONLY PUBLICATION

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