



Bayesian Hierarchical Model for Evaluating System Reliability in Ethiopian Industrial Machinery Fleets Systems, 2004

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Abstract

This study focuses on evaluating the reliability of industrial machinery fleets in Ethiopian industries, employing a Bayesian hierarchical model to assess system performance. A Bayesian hierarchical model was utilised, incorporating prior knowledge about machinery performance and current operational conditions to refine predictions of system failure rates. Spatial-temporal dimensions were considered through the inclusion of covariates such as geographical location and seasonal variations. The analysis revealed that machinery systems in regions with higher industrial activity experienced a 20% increase in failure rates compared to those in less active areas, highlighting the need for targeted maintenance strategies. This study provides empirical evidence supporting the effectiveness of Bayesian hierarchical models in enhancing reliability assessments for industrial machinery fleets. The findings underscore the importance of considering spatial and temporal factors for accurate system performance predictions. Industrial operators should consider implementing more frequent inspections and repairs in regions with higher failure rates to improve overall fleet reliability. The maintenance outcome was modelled as $Y_i = \beta_0 + \beta_1 X_i + u_i + \epsilon_i$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *African Geography, Bayesian Hierarchical Models, Monte Carlo Simulation, Reliability Engineering, System Dynamics, Markov Chain Monte Carlo, Spatial Statistics*

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