Bayesian Hierarchical Model Evaluation for System Reliability in Ghanaian Manufacturing Plants

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Abstract

Manufacturing plants in Ghana often face challenges related to system reliability, impacting productivity and operational costs. A Bayesian hierarchical model was applied to analyse data from manufacturing plants across Ghana. The model accounts for variability at different levels (e.g., plant level, equipment level) by incorporating prior knowledge and observed data. The analysis revealed a significant proportion ($p = 0.45$) of system failures attributed to maintenance inefficiencies, suggesting targeted interventions can improve reliability. Bayesian hierarchical models offer a robust framework for assessing system reliability in Ghanaian manufacturing environments, providing actionable insights into maintenance strategies. Manufacturing plants should prioritise regular equipment inspections and preventive maintenance programmes based on the findings of this study. manufacturing plant reliability, Bayesian hierarchical model, maintenance inefficiencies, system failure analysis

Keywords: *Ghana, Hierarchical Modelling, Bayesian Statistics, Reliability Engineering, Monte Carlo Simulation, Markov Chain Monte Carlo, Spatial Analysis*

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