



Bayesian Hierarchical Model Assessment for Yield Improvement in Rwanda's Process-Control Systems

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Abstract

Rwanda's manufacturing sector is leveraging process-control systems to enhance product quality and efficiency. A Bayesian hierarchical model was applied to analyse data from multiple factories, accounting for variability at both factory and process levels. Model parameters were estimated using Markov Chain Monte Carlo methods. The analysis revealed a significant variation in yield improvement rates across different factories (e.g., 15% to 28%), indicating the need for tailored interventions rather than uniform strategies. Bayesian hierarchical models provided nuanced insights into yield performance variability, facilitating more targeted process-control system improvements. Facilities showing lower improvement rates should focus on specific areas of their processes that have shown significant potential for enhancement based on model outputs. 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: *Bayesian statistics, Hierarchical modelling, Quality control, Manufacturing processes, Rwanda, Geographic information systems, Statistical process control*

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