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Bayesian Hierarchical Model for Risk Reduction in Manufacturing Plants of Senegal

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Abstract

Manufacturing plants in Senegal are critical for the country's economic growth but often face operational risks that can jeopardize productivity and safety. A Bayesian hierarchical model was employed to analyse plant data, incorporating prior knowledge about operational systems and uncertainties in environmental conditions. The model accounts for variability across different types of manufacturing environments. The analysis revealed that implementing robust maintenance protocols reduced equipment failure rates by approximately 20% compared to baseline scenarios, with a 95% confidence interval indicating significant improvement in reliability. This study provides evidence-based insights into risk reduction strategies for Senegalese manufacturing plants and highlights the effectiveness of Bayesian hierarchical models in quantifying these risks. Manufacturing plant managers should prioritise regular maintenance checks and consider adopting more resilient design standards to enhance overall system reliability. The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *African geography, Hierarchical modelling, Bayesian statistics, Risk assessment, Manufacturing systems, Quality control, Economic impact*