



# Bayesian Hierarchical Model for Measuring Adoption Rates in Process-Control Systems in Uganda

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## Abstract

Process-control systems are essential for improving efficiency in manufacturing processes, especially in developing countries like Uganda. A Bayesian hierarchical model was developed to estimate the adoption rates across different sectors and regions in Uganda, accounting for variability within and between groups. The analysis revealed that adoption rates varied significantly by sector (manufacturing: 42%, services: 30%), with a robust uncertainty interval around the estimates. The Bayesian hierarchical model provided more precise estimates of adoption rates compared to traditional methods, highlighting regional disparities in technology uptake. Further research should focus on understanding factors influencing adoption and developing targeted strategies for underperforming sectors. 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 inference, Hierarchical modelling, Process control, Adoption rates, Statistical methods, Quantitative analysis*

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