African Geotechnical Engineering

Bayesian Hierarchical Model for Measuring System Reliability in Process-Control Systems in Uganda

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Published: 18 April 2008 | **Received:** 14 February 2008 | **Accepted:** 17 March 2008

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DOI: 10.5281/zenodo.18870899

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Abstract

In Uganda, process-control systems are critical for ensuring safety and efficiency in industrial operations. However, their reliability often needs to be quantified to optimise performance. A Bayesian hierarchical model was developed using data from multiple sites across Uganda. The model accounts for heterogeneity among different industrial sectors and incorporates prior knowledge about system parameters. The analysis revealed that the reliability estimates vary significantly by sector, with manufacturing systems having a higher estimated mean reliability compared to mining operations (75% vs. 60%). This study demonstrates the utility of Bayesian hierarchical modelling in assessing process-control system reliability across diverse industrial contexts. Future research should explore the model's performance under different operational conditions and integrate real-time data for more accurate predictions. Process-Control Systems, Reliability Assessment, Bayesian Hierarchical Model, Ugandan Industries The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *African Geography, Hierarchical Models, Bayesian Statistics, Process Control Systems, Reliability Analysis, Methodological Evaluation, Quantitative Methods*

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