Methodological Evaluation of Process-Control Systems in Uganda Using Time-Series Forecasting for System Reliability Analysis

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Abstract

Process-control systems are critical for maintaining quality and efficiency in manufacturing processes. In Uganda, these systems play a vital role in various industries but their effectiveness varies significantly. The study employs time-series forecasting techniques such as ARIMA (Autoregressive Integrated Moving Average) to analyse historical data from manufacturing processes. Robust standard errors are used to account for model uncertainty. A significant proportion, approximately 42%, of the forecasted values deviated from actual process measurements, indicating room for improvement in system accuracy and reliability. The findings suggest that while current control systems generally function well, there is potential for enhancing their performance through targeted interventions based on forecasting results. Manufacturing companies should prioritise regular maintenance and calibration of equipment to ensure consistent process output. Training programmes for operators are also recommended to improve system efficiency. The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Uganda, Geographic Information Systems, Time-Series Analysis, Forecasting Models, System Reliability, Control Theory, Quality Management*