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A Bayesian Hierarchical Model for Yield Improvement in Nigerian Process-Control Systems

A Methodological Case Study

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ABSTRACT

Background: Process-control systems in the manufacturing sector are critical for operational efficiency and product yield. In the Nigerian context, evaluating the effectiveness of such systems is often hampered by data scarcity, process variability, and the need to integrate information from multiple, heterogeneous production lines.

Purpose and objectives: This case study presents and methodologically evaluates a Bayesian hierarchical model designed to quantify yield improvement attributable to enhanced process-control systems. The objective is to provide a robust analytical framework suitable for environments with limited but structured data.

Keywords: *Bayesian hierarchical modelling, process-control systems, yield improvement, Sub-Saharan Africa, manufacturing efficiency, methodological evaluation*

Article Highlights

- Bayesian hierarchical model quantifies yield improvement from enhanced process-control.
- Stable estimates achieved despite sparse individual plant data in Nigerian context.
- Substantial variation in plant-level intercepts reveals differing baseline efficiencies.
- Framework suitable for environments with limited but structured manufacturing data.

Core Methodology

Bayesian hierarchical linear regression applied to anonymised production data from three Nigerian plants, with posterior distributions estimated via MCMC sampling.

This study provides a methodological framework for data-constrained manufacturing environments.

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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