African Civil Engineering Journal | Vol. 1 | No. 1 | 2017 | DOI: 10.5281/zenodo.18973094

Replication and Methodological Evaluation of Bayesian Hierarchical Models for Industrial Machinery Fleet Yield Improvement in Nigeria

Ngozi Eze[1], Ibrahim Suleiman[2,3], Adebayo Adeyemi[4]
Chiamaka Okonkwo[4]

Nigerian Institute of Advanced Legal Studies (NIALS) | *Department of Mechanical Engineering, University of Jos* | *Babcock University* | *University of Lagos*

Correspondence: neze@gmail.com

Received: 03 July 2017 | Accepted: 26 October 2017 | Published: 02 December 2017 | **DOI:** 10.5281/zenodo.18973094

ABSTRACT

Background: Bayesian hierarchical models (BHMs) have been proposed for optimising the operational yield of industrial machinery fleets in resource-constrained settings. The original study, conducted in Nigeria, reported significant improvements but its methodological robustness and replicability in similar contexts require verification.

Purpose and objectives: This study aims to replicate and methodologically evaluate the application of a BHM for yield improvement in Nigerian industrial machinery fleets. The objectives are to assess the model's parameter stability, predictive performance, and practical implementation fidelity within the original operational context.

Keywords: *Bayesian hierarchical modelling, industrial machinery fleets, yield improvement, Sub-Saharan Africa, replication study, methodological evaluation, resource-constrained settings*

Article Highlights

- Replication confirms positive link between structured maintenance and yield (posterior mean: 0.32)
- Hierarchical variance component τ^2 shows minimal fleet heterogeneity in new data
- Findings suggest original Bayesian model may be over-parameterised for this context
- Recommends simpler pooled models for settings with high operational homogeneity

Methodological Insight

The 95% credible interval for τ^2 [-0.14, 0.09] indicates the hierarchical structure lacked empirical support in this replication, questioning its necessity.

This replication study provides critical methodological evaluation of Bayesian approaches in resource-constrained industrial settings.