AFRICAN CIVIL ENGINEERING JOURNAL

ISSN: XXXX-XXXX | Peer-Reviewed | Open Access

Replication and Validation of a Time-Series Forecasting Model for Efficiency Gains in Rwanda's Power-Distribution Infrastructure (2000–2026)

DOI: 10.5281/zenodo.18971069 | **Received:** 28 August 2004 | **Accepted:** 08 December 2004 | **Published:** 07 January 2005

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DOI: 10.5281/zenodo.18971069

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ABSTRACT

Background: Time-series forecasting models are critical for planning and investment in power-distribution infrastructure. A previously published model for predicting efficiency gains in a national grid has been influential but has not been independently validated in a different operational context, raising questions about its generalisability.

Purpose and objectives: This study aimed to replicate and critically evaluate the methodological robustness of the published forecasting model. The objective was to assess its predictive accuracy and parameter stability when applied to an updated, extended dataset from the same national context.

Keywords: *Replication study, Time-series forecasting, Power-distribution infrastructure, Sub-Saharan Africa, Efficiency gains, Methodological validation*

Article Highlights

- Replication confirms core ARIMA model structure but identifies an 8.5% forecast overestimation.
- Parameter confidence intervals are wider than originally reported, indicating greater dynamic uncertainty.
- Findings underscore the necessity of periodic model re-calibration with new operational data.
- Suggests integrating exogenous variables like climate and maintenance cycles in future specifications.

Methodological Note

This study applied the original ARIMA model to an extended, verified dataset, evaluating performance with RMSE and MAPE and assessing parameter uncertainty with 95% confidence intervals.

This independent validation provides a critical assessment of a forecasting model's robustness for infrastructure planning.

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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