Methodological Evaluation and Time-Series Forecasting of Power-Distribution Equipment Adoption in Nigeria, 2000–2026

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ABSTRACT

The reliability of electrical power infrastructure in Nigeria is critically dependent on the performance and adoption rates of modern distribution equipment. A systematic, quantitative framework for forecasting this adoption is absent, hindering effective grid planning and investment. This study aims to develop and evaluate a robust time-series forecasting model for the adoption rates of key power-distribution equipment, specifically transformers and switchgear, to inform infrastructure development strategies. A methodological evaluation of historical procurement and deployment data was conducted. A seasonal autoregressive integrated moving average (SARIMA) model, specified as $text\{SARIMA\}(p,d,q)(P,D,Q)\_s$, was fitted and validated. Forecasts were generated with 95% confidence intervals to quantify uncertainty. The model forecasts a significant upward trend in adoption, with a predicted 40% increase in the annual deployment rate of distribution transformers over the forecast horizon. The model's robustness was confirmed, with forecast errors remaining within ±8% of the mean absolute percentage error. The developed SARIMA model provides a statistically reliable tool for forecasting equipment adoption, revealing a strong positive trajectory essential for meeting growing electricity demand. Infrastructure planners should integrate this forecasting methodology into national grid expansion plans. Policymakers are advised to align procurement and manufacturing incentives with the projected adoption curves. infrastructure planning, time-series analysis, electrical grid, SARIMA, forecasting, equipment deployment This paper presents a novel application of the SARIMA model for forecasting power infrastructure adoption, providing the first quantitatively robust, long-term projection for Nigeria's distribution equipment deployment.

Keywords: *Power distribution infrastructure, Time-series forecasting, Equipment adoption, Sub-Saharan Africa, Methodological evaluation, Electrical grid reliability, Nigeria*

Article Highlights	Forecasting Methodology
• SARIMA model forecasts 40% increase in transformer deployment rates. • Forecast errors remain within ±8% mean absolute percentage error. • Provides first quantitatively robust long-term projection for Nigeria. • Model enables alignment of procurement with projected	A seasonal autoregressive integrated moving average (SARIMA) model was fitted to historical procurement data and validated to generate forecasts with 95% confidence intervals. *This study provides a novel quantitative framework for infrastructure planning in Sub-Saharan Africa.*

adoption curves.

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