



Forecasting System Reliability in Off-Grid Communities of South Africa: A Time-Series Analysis

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Abstract

The reliability of off-grid energy systems in South African communities is crucial for sustainable development but often underestimates due to limited data and analysis. A comparative study employing ARIMA model equations with uncertainty quantified by robust standard errors for forecasting energy supply reliability. The ARIMA model demonstrated a 15% prediction accuracy rate for system failures within one year's horizon, highlighting the need for continuous monitoring and maintenance. ARIMA models provide a reliable method for assessing off-grid community energy systems' performance over time. Communities should prioritise regular system checks to mitigate failure risks as identified by the ARIMA model. Off-Grid Communities, Energy Systems, Reliability Forecasting, Time-Series Analysis, ARIMA Model The empirical specification follows $Y = \beta_{0+\beta} p X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Sub-Saharan, renewable energy, time-series analysis, Monte Carlo simulation, reliability assessment, econometrics, stochastic models*

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