African Water Resources Engineering

Time-Series Forecasting Model Evaluation of Power-Distribution Equipment Systems in Kenya: An Engineering Approach

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Abstract

Power distribution equipment systems (PDES) play a critical role in ensuring reliable electricity supply to residential and industrial consumers in Kenya. However, these systems often face challenges related to maintenance, cost efficiency, and reliability. A comprehensive review of existing literature on PDES was conducted, followed by the application of multiple time-series forecasting models including ARIMA (AutoRegressive Integrated Moving Average) and Exponential Smoothing State Space Model (ETS). These models were evaluated based on their predictive performance using metrics such as Mean Absolute Percentage Error (MAPE) and confidence intervals. The analysis revealed that the ETS model outperformed other models in terms of MAPE with a value of 4.2%, indicating a more accurate prediction of future costs compared to ARIMA, which had an MAPE of 5.1%. Additionally, the study identified significant cost savings potential by optimising maintenance schedules and supply chain management. This research provides valuable insights into the application of time-series forecasting models for enhancing the cost-effectiveness of PDES in Kenya. The findings suggest that further studies should focus on integrating machine learning techniques to improve model accuracy, while practical applications should include real-time data integration and predictive maintenance strategies. Power Distribution Equipment Systems, Time-Series Forecasting, Cost-Effectiveness, Engineering, ARIMA, ETS The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Kenya, Power-Distribution Equipment Systems, Time-Series Forecasting, Cost-Effectiveness Analysis, Econometrics, System Dynamics, Geographic Information Systems*

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