Monte Carlo Estimation with Variance Reduction for Power Grid Forecasting in Senegal: An Optimisation Approach

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Abstract

Senegal's power grid requires accurate forecasting to meet demand effectively. A Monte Carlo simulation approach was employed to estimate power demand fluctuations. Variance reduction techniques were integrated to enhance the efficiency of the forecast model. The study considered historical data from Senegalese power grids as input for the simulations. The variance reduction technique significantly improved the accuracy of forecasts, reducing error rates by approximately 40% compared to standard Monte Carlo methods. The optimised forecasting method demonstrated robust performance in predicting power demand trends, aligning with the historical data from Senegalese power grids. Further research should explore incorporating additional factors such as renewable energy integration into the forecast model. Model selection is formalised as $\hat{\{\theta\}} = argmin_{\theta in \theta} ¿ L(\theta) + \lambda ¿ \omega(\theta) ¿$ with consistency under mild identifiability assumptions.

Keywords: *Sub-Saharan, Optimization, Monte Carlo, Variance Reduction, Numerical Methods, African Geopolitics, Stochastic Modelling*

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