A COMPARATIVE ANALYSIS OF FIVE TIME SERIES MODELS FOR CO_2 EMISSIONS FORECASTING IN PORT-HARCOURT AND ITS ENVIRONS

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ABSTRACT

Accurate forecasts of greenhouse gas (GHG) emissions are crucial for addressing climate change and guiding effective mitigation strategies. We developed and tested advanced techniques to improve time-series GHG emissions forecasting, addressing the limitations of existing models. Our study explored various algorithms, including ARIMA, SARIMA, ETS, Prophet, and TBATS, to identify the most effective methods for capturing the complex seasonality and non-linear patterns in GHG data particular to the city of Port Harcourt, Rivers State Nigeria. We tested the stationarity of the time series using ADF and KPSS tests. The ETS model, selected for its ability to handle trend and seasonal components, was optimized using grid search and the Akaike Information Criterion (AIC). We then compared its performance with ARIMA, SARIMA, Prophet, and TBATS models. The ETS model outperformed the others, with predicted CO_2 values within the 95% confidence interval of observed data and a mean absolute error (MAE) of 14.82 and a root-mean-square error (MSE) of 18.91. This research marks a significant advancement in GHG emissions forecasting, underscoring the practical value of well-tuned models in environmental science and their relevance to policy decisions. Future work should focus on refining these models for real-time use, ensuring a balance between computational efficiency and predictive accuracy to provide actionable insights for policymakers and environmental scientists.

Keywords: Time Series, Emission, Greenhouse gases, Forecasting, Exponential Smoothing.