

Comparative Analysis of ARIMA and SARIMA Models in Electrical Load Forecasting: Insights for Long and Short-Term Projections

MOHAMMAD AWAD MOMANI, RAFED KHALDOON ABWAINI,
BARAA MOHAMMAD ABABNEH, MOHAMMAD AYMAN NASSER

Department of Electrical Power Engineering, Hajjawi Faculty for Engineering Technology
Yarmouk University, 21163, Irbid, JORDAN

Abstract: — An accurate load forecast model is very important aspect in power system planning. It helps the decision makers to cut the expenses, enhance the operational performance and avoid unnecessary investments in power generation, transmission lines and distribution. This paper examines two popular time series forecasting models; the Autoregressive Integrated Moving Average (ARIMA) and the Seasonal Autoregressive Integrated Moving Average (SARIMA) on two different time series data. The US annual net generation data from 1949 to 2007 as well as the daily peak load of 11 kV distribution feeder between 2019 to 2023 was used in the analysis. The effectiveness of each model for long-term load forecasting was examined through error metrics, offering insights into their advantages and practical consequences. The findings show that the use of ARIMA or SARIMA is strongly depend on the nature of data. It is shown that while SARIMA is suitable for the daily peak load data obtained from 11kV distribution feeder as the consumption pattern repeats itself and the seasonality is obvious in the data, ARIMA was better for US net generation data where the seasonality is not obvious.

Keywords: —Load Forecast, ARIMA, SARIMA, Time Series Analysis, 11KV feeder, Irbid District Electricity Company.

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1 Introduction

Accurate electrical load forecasting is imperative for the efficient utilization of resources, optimizing cost management, and enhancing operational efficiency within the energy sector. The growing complexity of energy systems, influenced by varying consumption patterns and the integration of renewable energy sources, necessitates advanced forecasting models capable of addressing these dynamics. Among the various forecasting methodologies, the Autoregressive Integrated Moving Average (ARIMA) and Seasonal ARIMA (SARIMA) models stand out for their robustness in handling time series data characterized by non-stationarity and seasonality. These models have been extensively applied in predicting short-term and long-term load patterns, offering valuable insights for energy system planning and management [1] [2].

Recent studies have stressed on the effectiveness of ARIMA and SARIMA models in various environments. For instance, Goswami and Kandali [1] demonstrated the application of these models in

forecasting the electrical load in Assam, highlighting SARIMA's superior performance in capturing seasonal fluctuations in load data [1]. Similarly, Nguyen and Hansen [2] explored the use of these models for short-term electricity load forecasting in Texas, emphasizing their utility in managing power system operations [2]. The adaptability of these models to different forecasting horizons and data characteristics makes them indispensable tools in the field of energy forecasting.

Moreover, innovative approaches to enhancing the predictive accuracy of these models have been developed. For example, Mushah and El-Hawary [3] did improvement on SARIMA model forecasting by using Fast Fourier Transform for seasonal component detection, demonstrating the potential for improved forecast accuracy through methodological advancements [3]. Additionally, the integration of ARIMA and SARIMA models with machine learning techniques, as explored by Pooniwala and Sutar [4], indicates a promising direction for hybrid forecasting models that leverage

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