



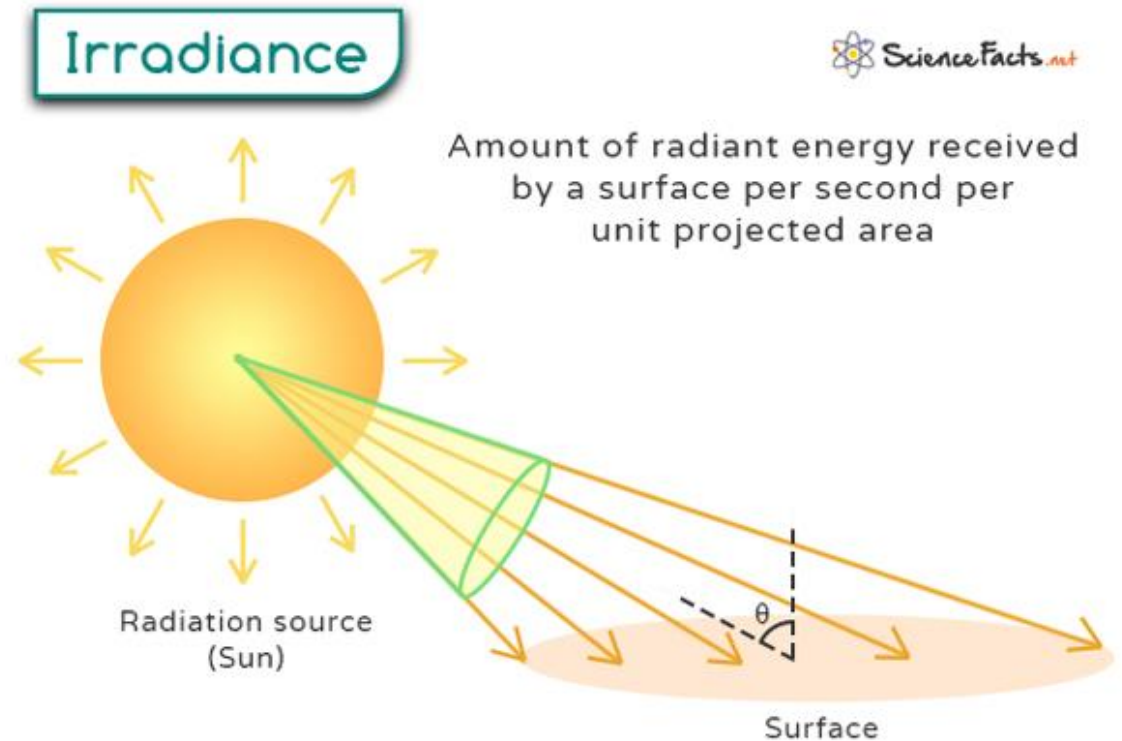
Forecast Direct Normal Irradiance of Solar Energy

Erdos Data Science Bootcamp Summer 2024

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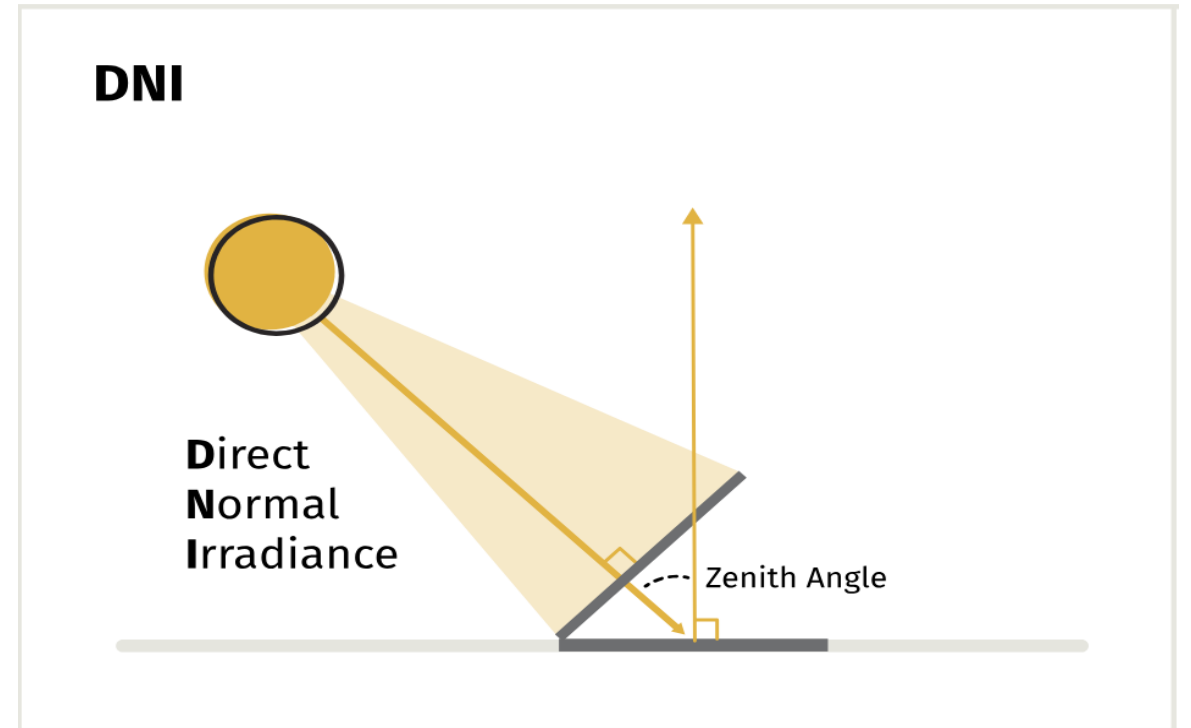
Overview

Solar energy, a renewable source of power, plays an important role in reducing greenhouse gases, mitigating climate change, and protecting ecosystems. Nowadays, the adoption of solar energy into the power grid has increased, and Direct Normal Irradiance (DNI) is particularly important in forecasting the performance of concentrating solar power (CSP) systems. Photovoltaic panels track the sun to receive more DNI, which accounts for a large portion of solar energy from PV.



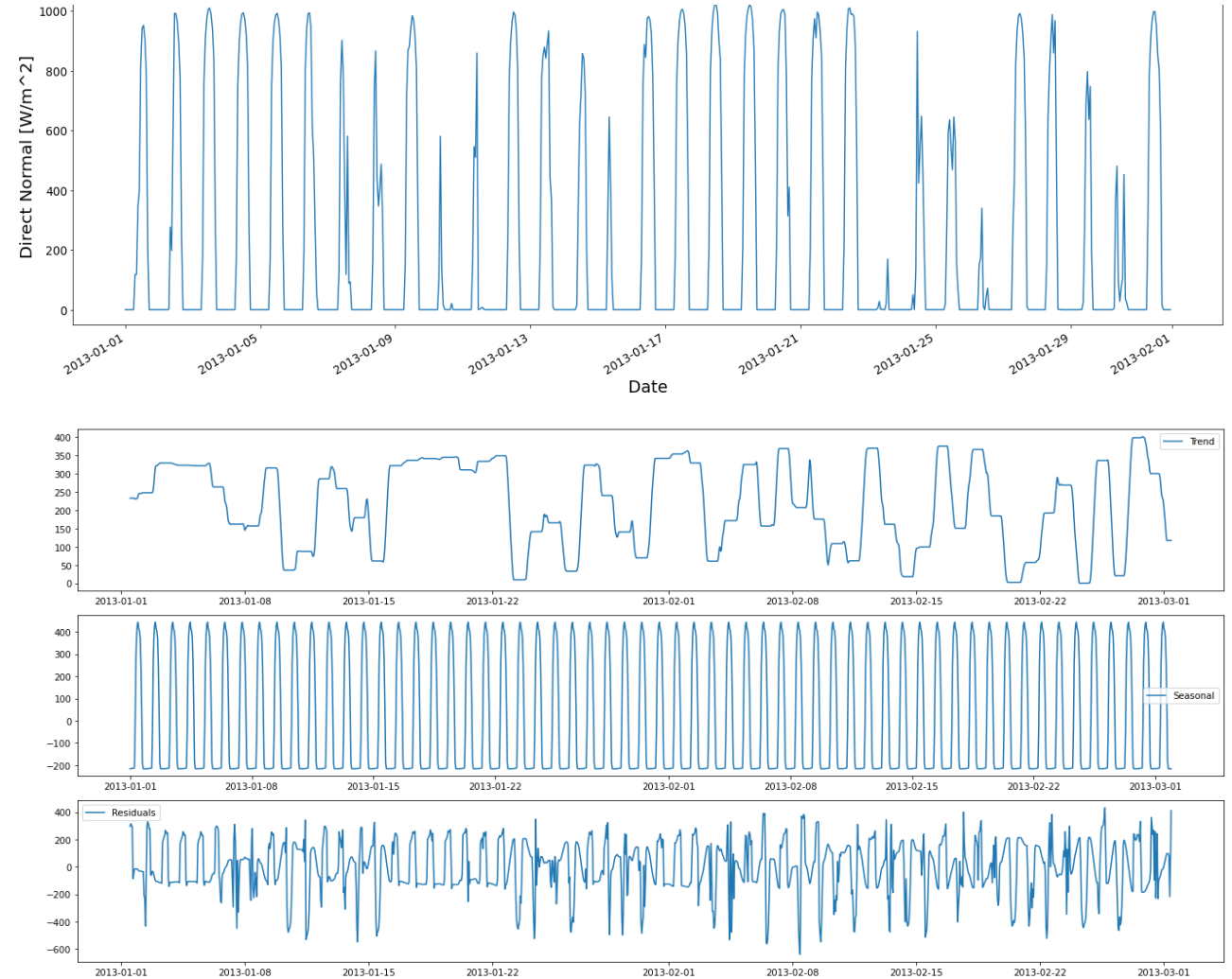
Goal

Choose an effective time series model that can forecast a week ahead of Direct Normal Irradiance from solar power. This is crucial for the effective operation and maintenance of power systems, ensuring their ability to harness solar energy effectively



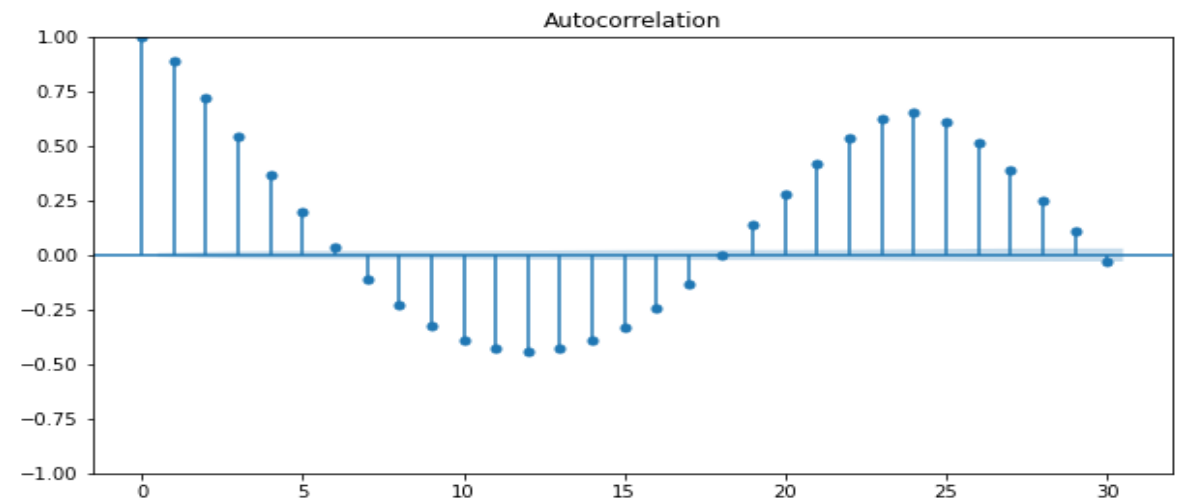
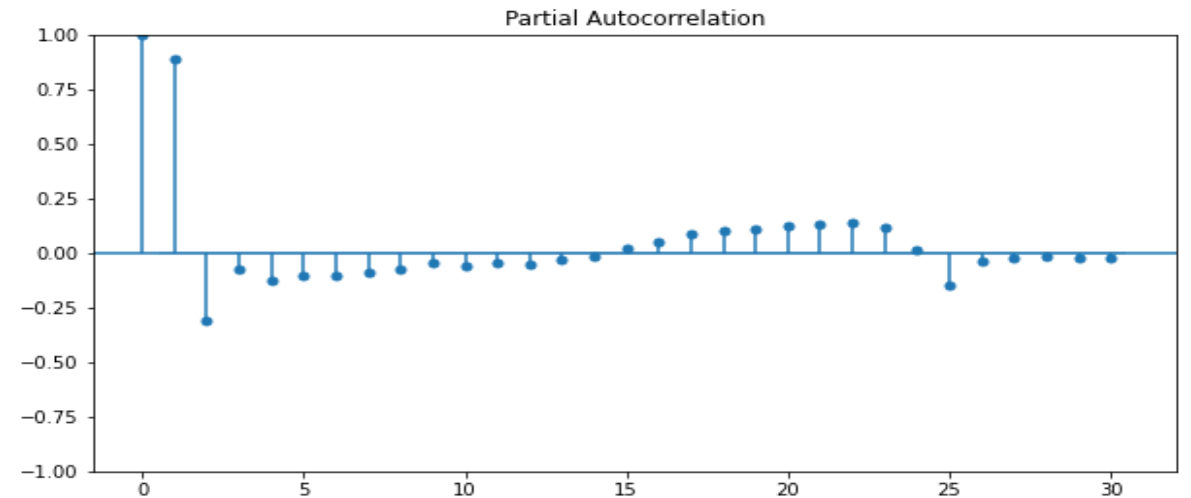
Data Processing

We collected the from the Lowery power station and conducted a thorough data cleaning process, fixing anomalies, filling in missing values, and converting it to an hourly dataset. Also, check the seasonality and trend of the data



ACF and PACF

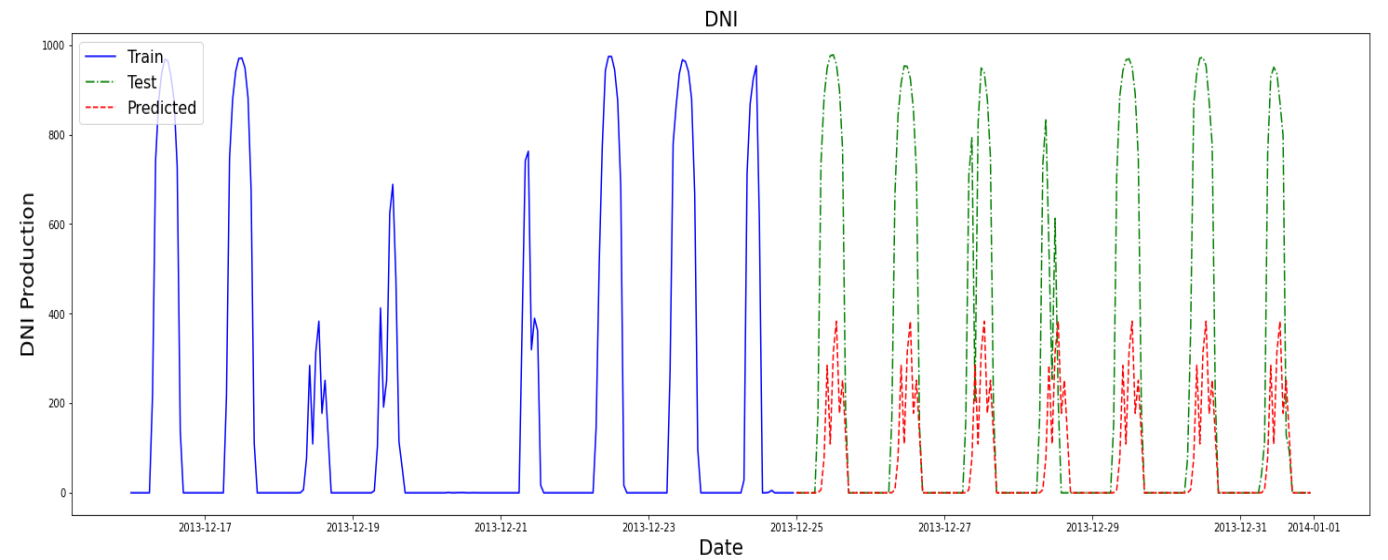
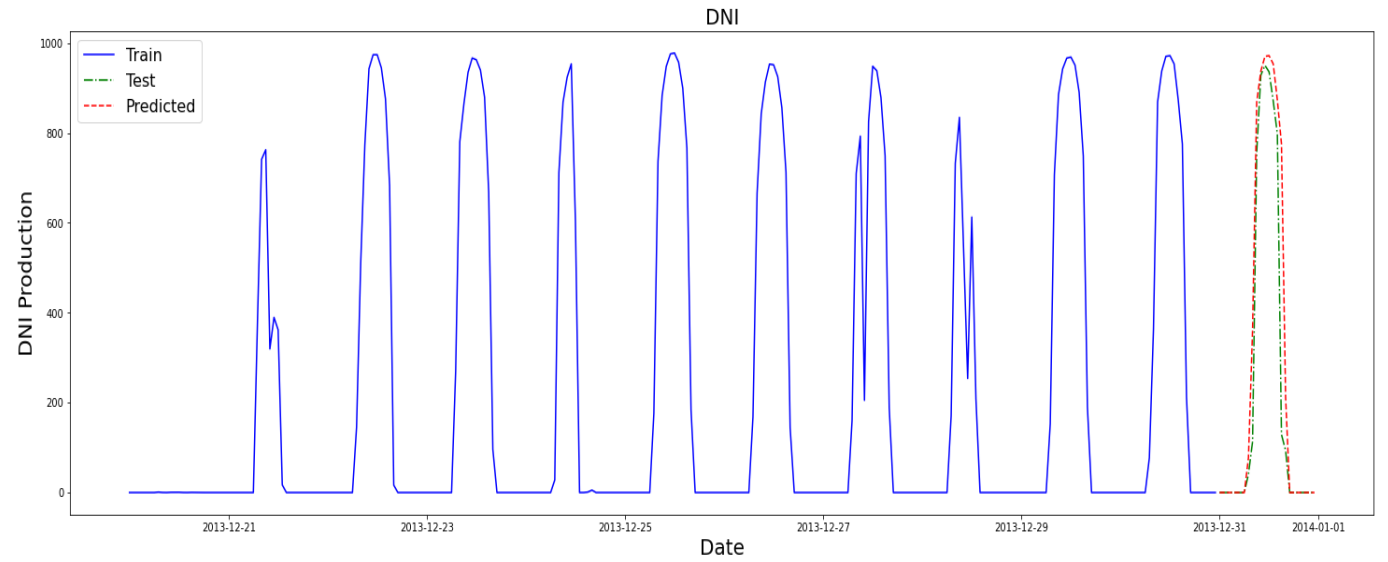
- From autocorrelation and partial autocorrelation plots, identify the seasonal pattern of direct normal irradiance



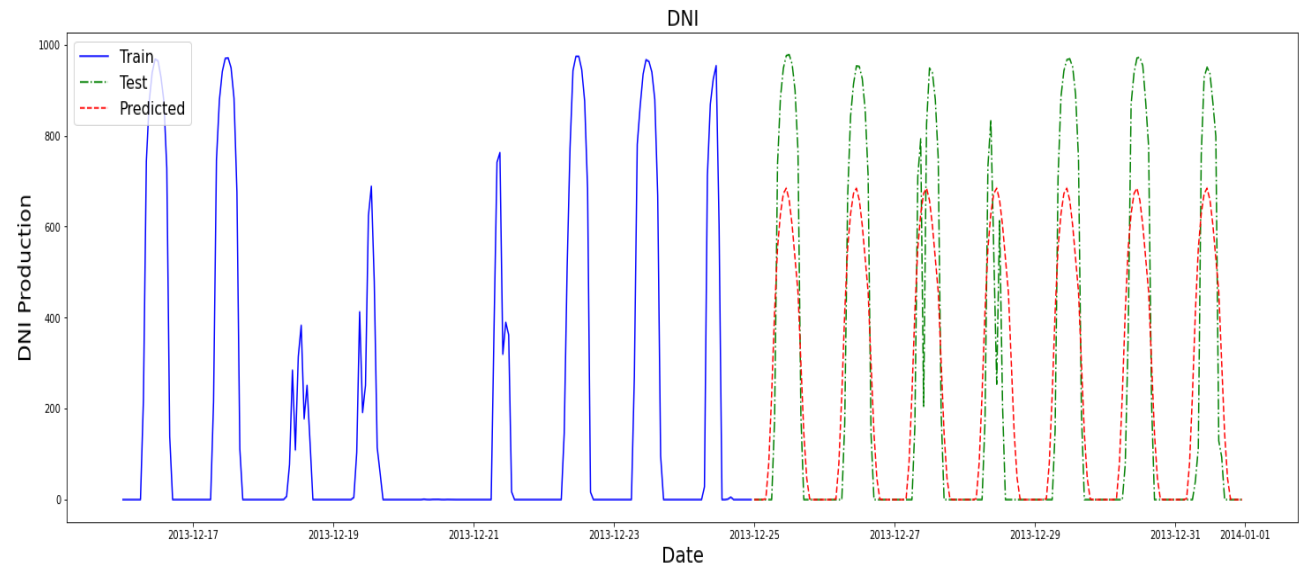
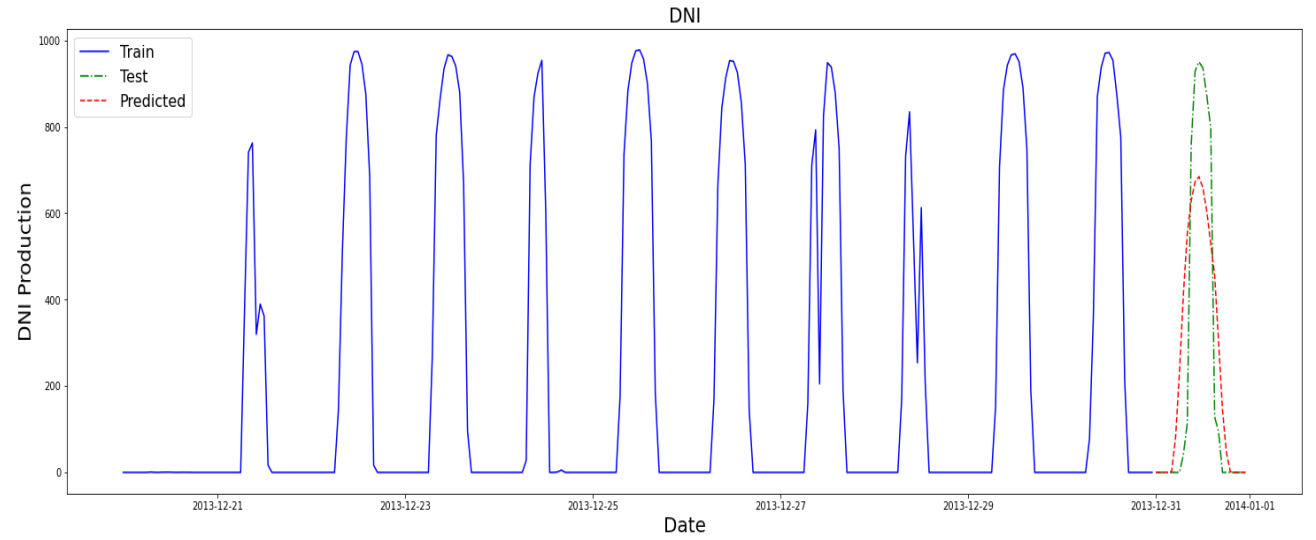
Models

- Naïve
- Seasonal Average
- Tripple Exponential Smoothing
- ARIMA
- SARIMA
- SARIMAX

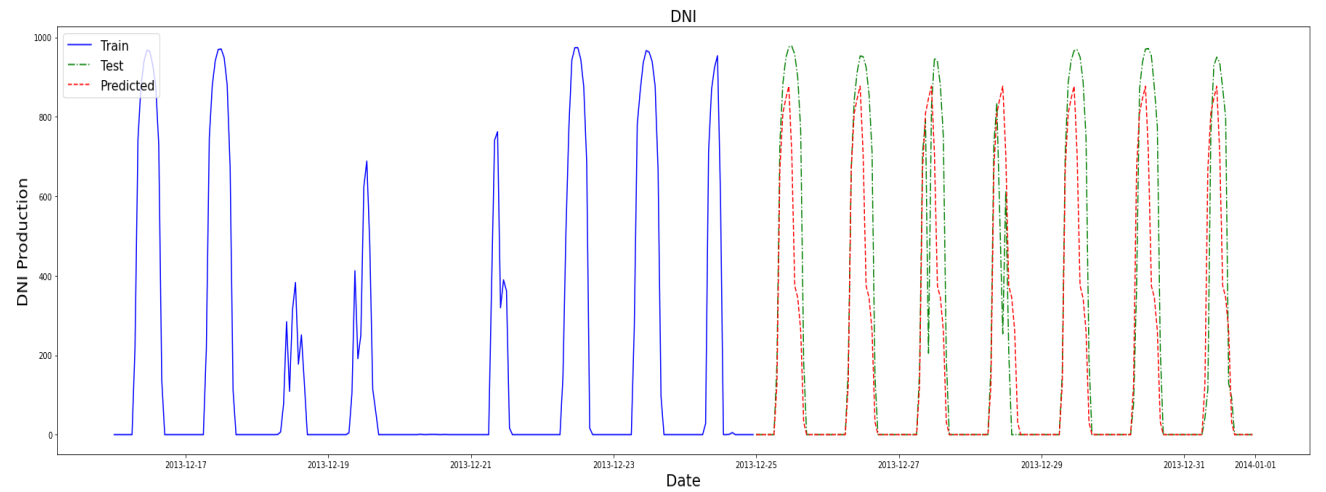
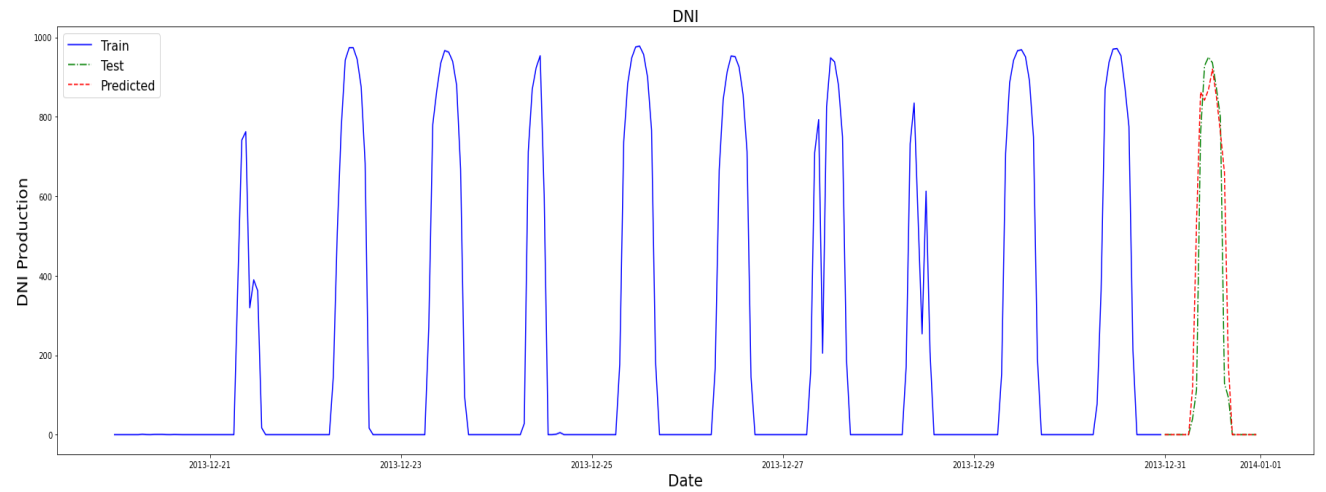
Seasonal Naïve



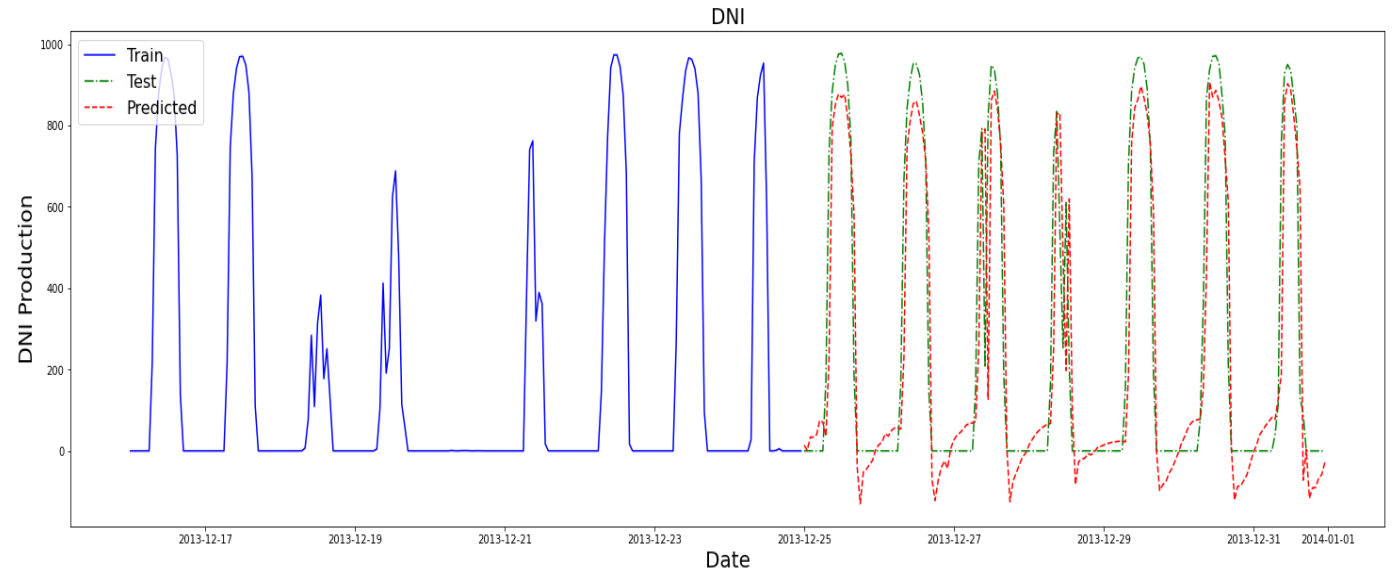
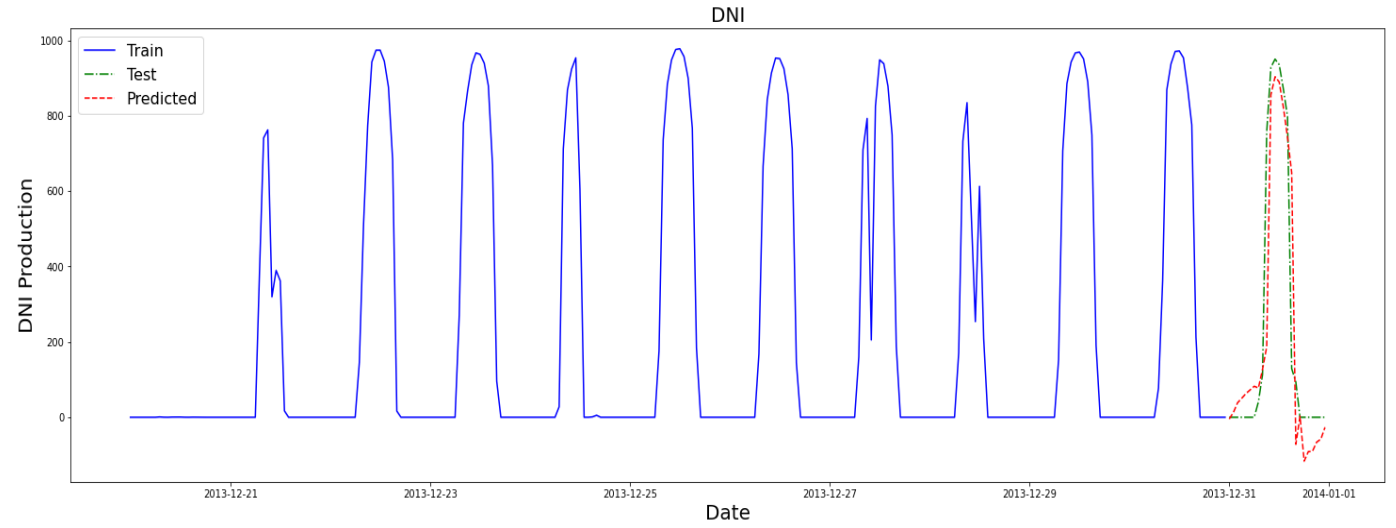
Average Seasonal Forecast



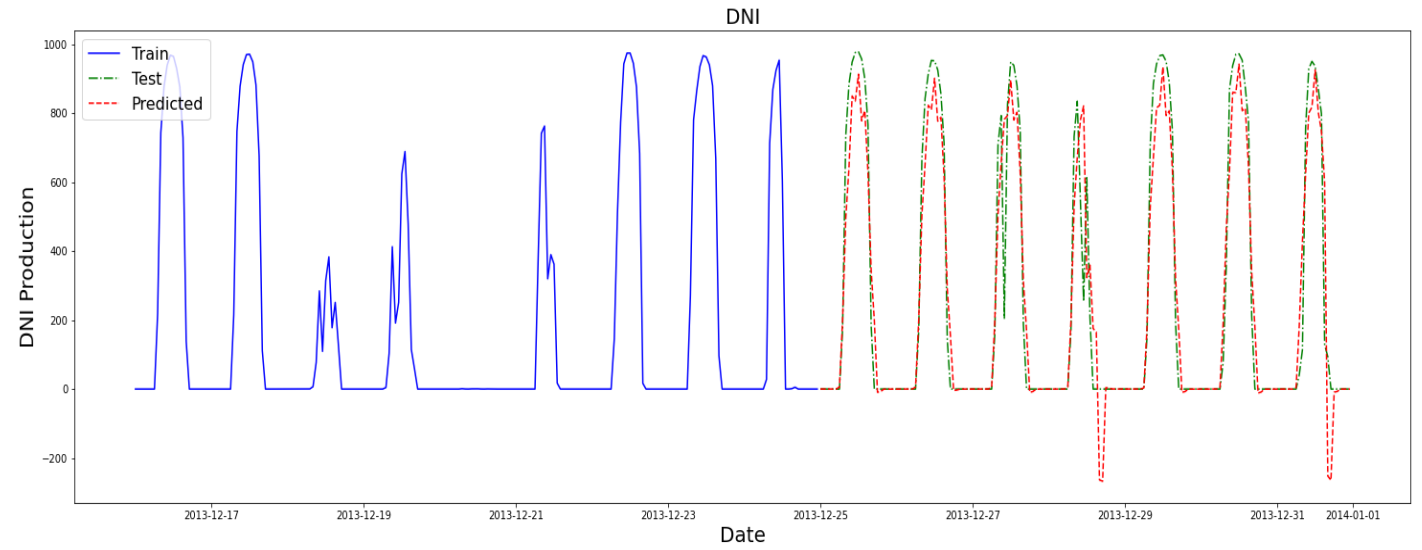
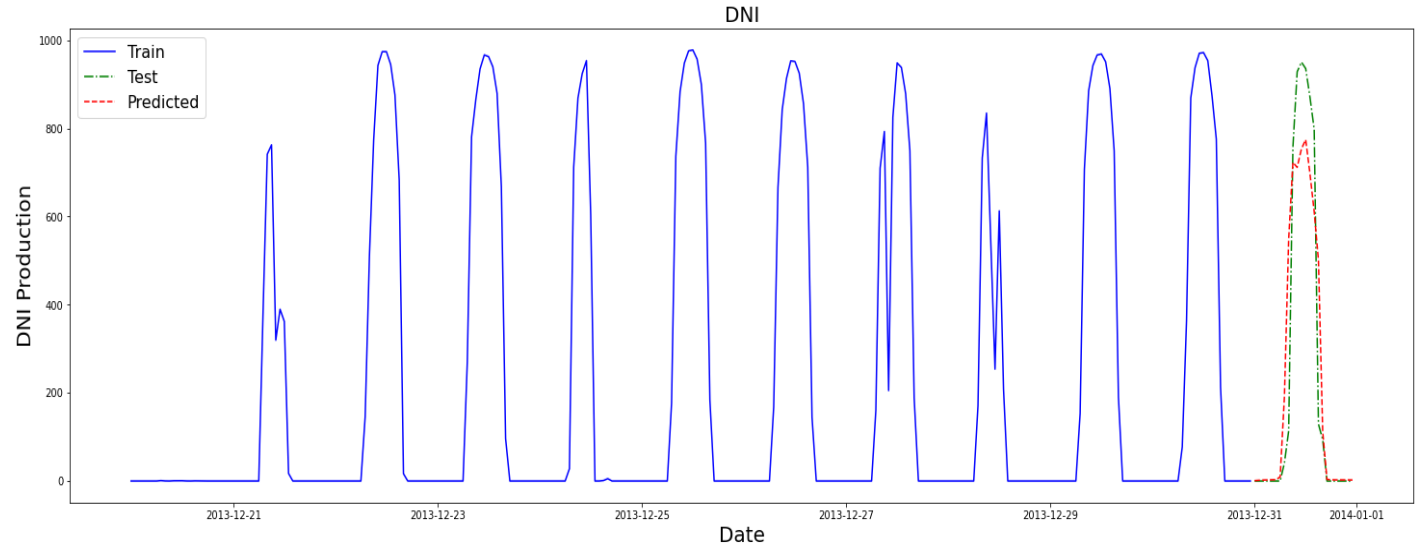
Triple Exponential Smoothing



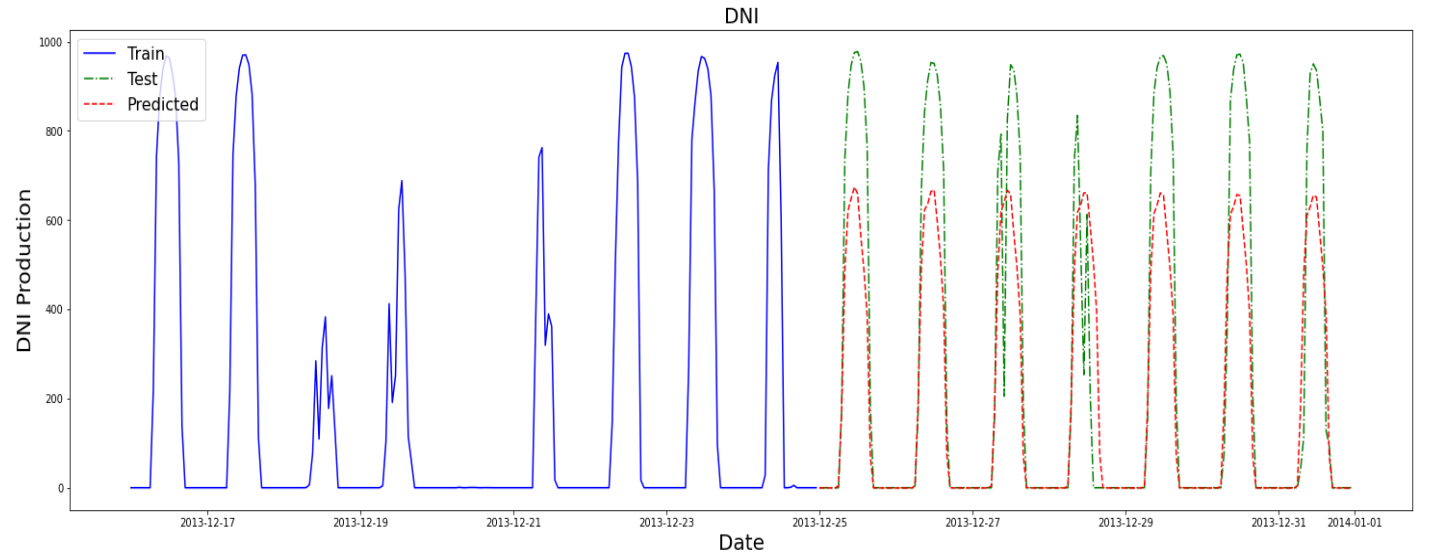
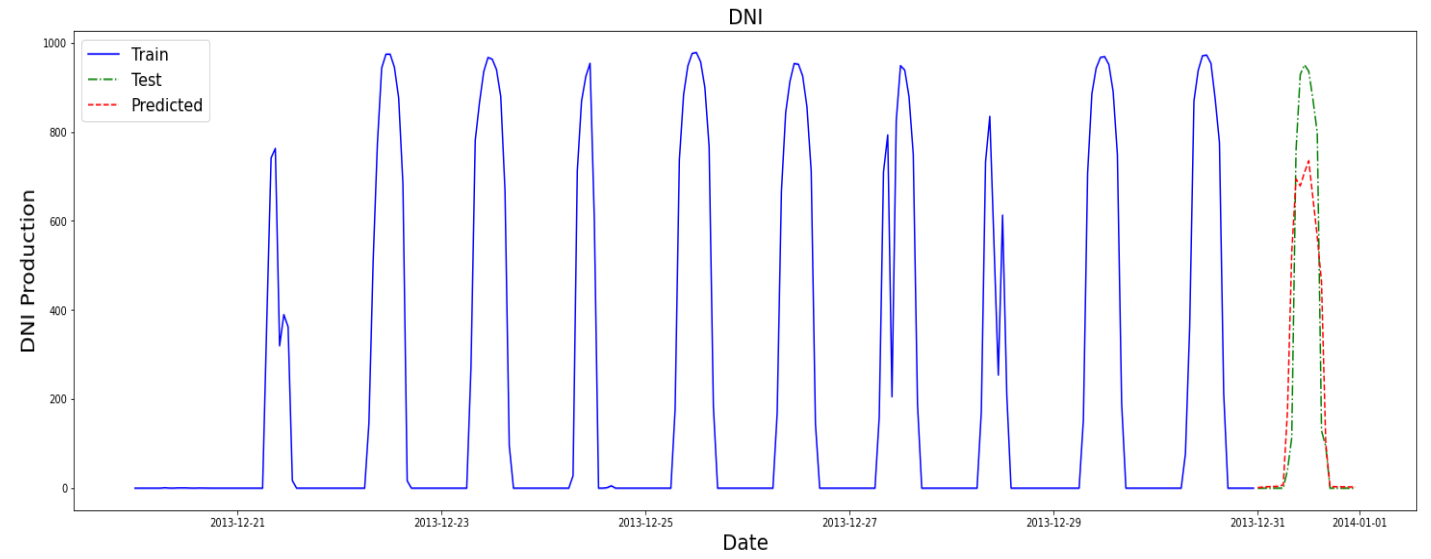
ARIMA



SARIMA



SARIMAX

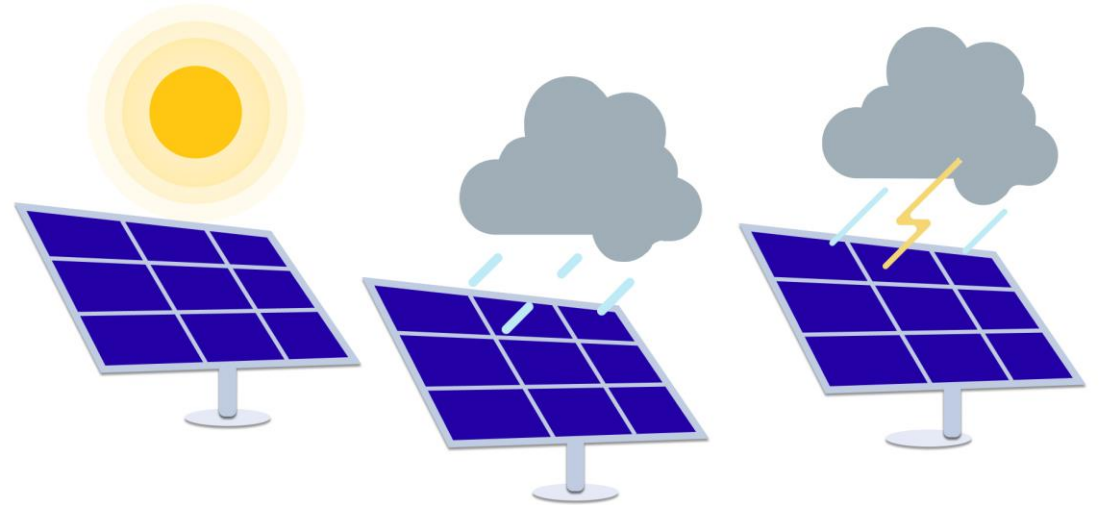


Model Comparison

Model	RMSE of a day ahead forecast	RMSE of a week ahead forecast
Naive	147.53	360.69
Seasonal Average	197.70	193.36
Tripple Exponential Smoothing	144.49	202.26
ARIMA	170.48	167.75
SARIMA	156.63	126.36
SARIMAX	154.13	181.81

Future Work

- Incorporate weather and cloud cover data, which can be important features for forecasting direct normal irradiance.
- Use multivariate deep learning models that can incorporate all important features of solar energy and forecast direct normal irradiance more accurately.



Thank you!



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