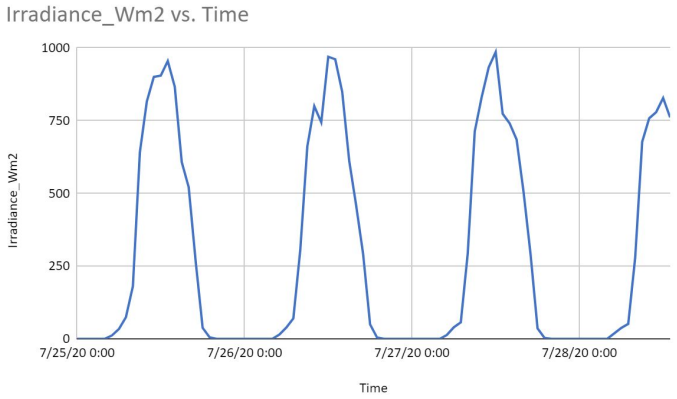
Project Exercise #1: Solar Irradiance Forecasting

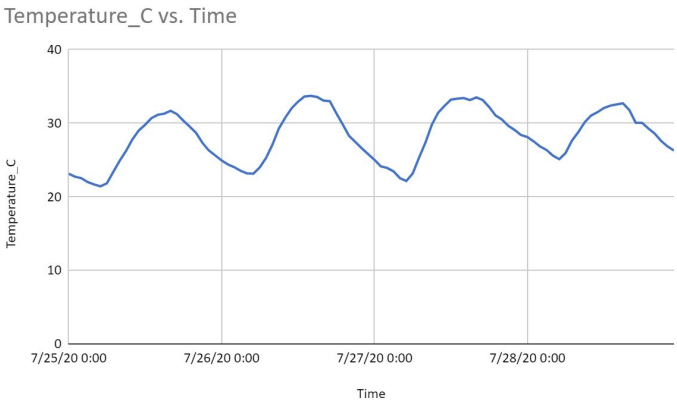
Team Blue:

Name	**Contribution**
Albert Joseph	Computing errors and graphs
Jonathan Shechter	Preliminary analysis
Jake Miller	Final forecast
Niki Kapasouris	Final forecast
Marc Yarkony	Models and methods

Preliminary Analysis:

This project involves forecasting solar irradiance using three variables; time, irradiance historical data, and associated temperature. To understand what type of forecasting method is best, it is crucial to understand the relationship between these variables graphically.



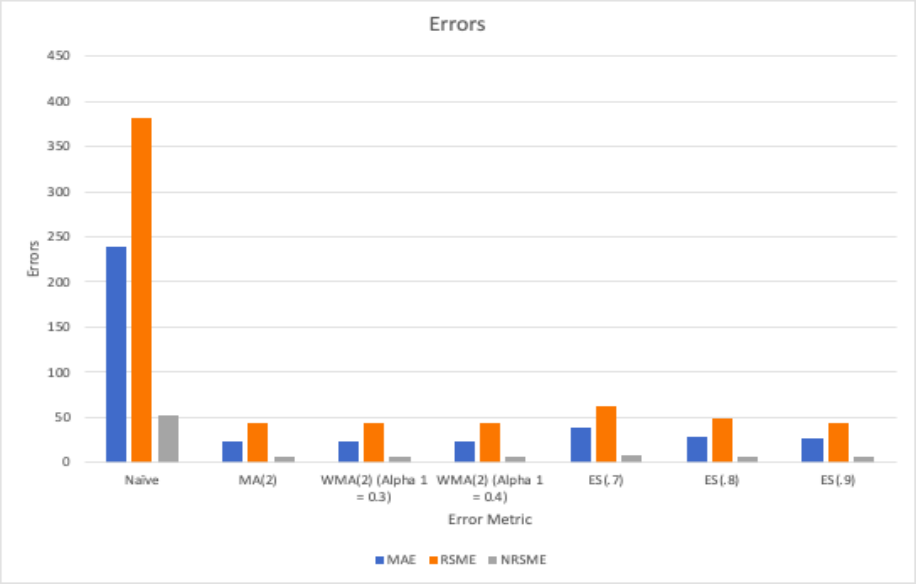


As can be seen by the above graphs, there seems to be a cyclical trend for irradiance with respect to time and temperature. This emphasizes the fact that there are peak hours for irradiance and little to no linear relationship with the other two variables. Making this observation rules out forecasting methods like linear regression. Trend adjusted exponential smoothing is tempting here to capture any trend, but there are too many assumed parameters. As a result, the methods of choice to train became moving average, weighted moving average, and exponential smoothing

using various weights for alpha. The forecasted data will use data from the same time slots of previous days, as irradiance and temperature seem very time dependent according to the above graphs.

Models and Methods:

Our final forecasting method was the MA(2) Method. After analyzing many methods such as WMA methods and Exponential Smoothing methods, the MA(2) gave us the most accurate results based on our forecasts. Instead of basing forecasts on immediate previous results, we based it off the results from the previous matching time interval. In our testing data, we tested times 14:00-23:00 by the previous 14:00-23:00 time intervals. Based on the graph below, another candidate that gives close results to the MA(2) is the WMA(2)(Alpha 1 = 0.3) method. Our WMA(2)(Alpha 1 = 0.3) method was able to compare to the MA(2) method because of its accurate arbitrarily chosen alpha values. The WMA(2)(Alpha 1 = 0.3) and the MA(2) gave us the best error results for MAE, RSME, and NRMSE, but ultimately the MA(2) method gave us a slightly better result because of its low error accuracy across all training error forecasts.



Final Forecast:

The training errors showed that MA(2) was the best method using a specialized grouping of data based on a pattern seen from the general graphing of the data. Additionally, the percent improvement for the MA(2) over the Naive was 90.48%.

The graph below depicts the irradiance in relation to time and the final curve represents the forecasts. The forecasted curve follows the cyclical trend from the data points which indicates that the forecasts are accurate. The fall in irradiance after 17:00 has a similar slope to the drops in the previous curves. The peak in the forecasted curve does reach as large values as the peaks in the previous curves which is an indication of error in forecasting.