**ENEC490.003.SP24 Spring 2024: Assignment 3**

**Due: 4/18/2024 by 11:59pm**

**Summary:** For this assignment, we will examine how the different predictive models we’ve been building can help us answer tricky questions by simulating outcomes where data science can impact energy decisions. In this case, we are going to simulate what’s called a demand response event, which is when a utility asks enrolled facilities to curtail (or reduce) their electric load during times of peak demand.

You will assume the role of the owner of a retail facility (let’s say it’s a boutique clothing store) in California. Your electric utility, PG&E, is notifying you there will be a demand response event January 16th to 19th 2024 due to high demand and several power plants being offline. They are offering you an incentive of $100 per kWh for any load you reduce during the peak hours of 9-11am and 3-6pm on those dates only. To participate, you would need to modify your store’s hours and will lose $500 per hour for any hours you choose to keep the store closed when it would normally be open.

**Objective:** The objective of this assignment is to build a model using the facility’s smart meter data that allows you to predict and evaluate different outcomes during the demand response event using the provided forecasted weather data.

First, you need to build a model of the smart meter kW demand data using one of the ML methods we’ve been studying and via feature engineering and hyperparameter tuning your model should have a MAPE under 10%. Next, you need to determine the hours when your store is normally open and add a variable to the model that reflects the open/closed hours. This will allow you to create a predicted kW demand estimate for the days during the demand response event under normal circumstances (when hours aren’t modified) and also with adjustments to your hours.

Then, you need to use the weather forecast data to simulate the demand response event. You should forecast a base or business-as-usual case, where your store hours would be normal, and a modified case where you reduce hours to close the store during the peak hours of the event. The base case forecast will tell you what your predicted demand is based on the weather forecast and normal hours, and your modified case will show your predicted demand with fewer open hours. You can estimate the kWh reduction by subtracting your modified case from your base case (the data is hourly and measured in kW, so effectively we’re already looking at kWh and don’t need to convert from kW to kWh).

Your estimated revenue from participating in the demand response event is the kWh difference from your base case and modified case times the $100 per kWh incentive.

Your estimated revenue loss from closing the store to participate is the number of hours your store is closed when it would have been open times $500 per hour in lost revenue.

In addition to building the models, your objective is to answer whether it’s a good financial decision to participate in the demand response event (i.e. do you make more by closing the store vs operating as normal) and why or why not.

**Data Files:** There are two data files for this part:

1. **Reference Materials/facility smart meter kw data.xlsx**: this is your facility’s hourly kW demand and weather time series data (temperature, humidity, and pressure) for almost a full year before the event.
2. **facility weather forecast for DR event.xlsx**: this is hourly weather forecast data for the week of the demand response event.

**Python Files:** You can use the *Assignment 3 - Predicting smart meter kw for demand response event.ipynb* file as a starting point. It is located in the file folder on Canvas for this assignment and just has a few blocks of code to load the facility kw data file and a function to calculate MAPE since sklearn.metrics doesn’t have a native function for MAPE.

**Steps to include in your analysis:**

1. Load the facility smart meter data and come up with a way to estimate which days and hours the store is open based on the kW demand (hint: visualizing the kw data for the weeks before the demand response event might help. Your store is not open every day but has fairly regular hours when it’s open).
2. Make sure you have a feature added to your dataframe to represent when the store is open vs closed.
3. Add any other time series features as needed and build ML models of the facility smart meter kw demand data using a train/test split where test\_size=0.2. Show the standard metrics from your model’s including MAE, MSE, RMSE, and MAPE. You should be able to get MAPE under 10%.
4. Load the forecasted weather data for the week of the demand response event.
5. Add the same features (time series and your open/closed feature) to the forecasted weather data and run your selected ML model on this data to create your base case kw forecast.
6. Modify your open/closed feature values to have the store closed only for the days and hours of the demand response event. Run your selected ML model on this modified data to create your modified case kw forecast.
7. Subtract your modified case kw forecast from your base case kw forecast to calculate the kWh reduction during the event and estimate how much you’d earn from closing the store.
8. Calculate the number of hours the store would be closed if you participated in the event and calculate the estimated lost revenue.
9. Summarize your findings and whether you think it makes sense to participate in the event or not and why.

**Deliverable:** submit a jupyter notebook with your python code and comments showing your approach to the assignment, how you added a feature to represent when the store is open/closed, how you created your base and modified kw demand forecasts, and your results including whether it makes sense financially to close the store for the demand response event hours or not.

Add features in hours of day day of week and open to original data

Then add same feature to forcast data to predict

Kwu = difference between the original and open and

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