**Predicting Peak Electrical Power Demand in Ontario**

**1. Business Problem**

July afternoons in Ontario can be steaming hot. The malls are busy, factories are producing, and everyone’s air conditioning is running at full-bore. Electrical power demand is at a peak.

Peak demand is important. Electrical power suppliers must build their system capacity to match the peak. Consider the consequences if their capacity was sized to match only 90% of peak demand. They would be able to supply everyone for most of the year. But, during peak periods 10% of their customers would be blacked out. Thus, peak demand, not typical demand, drives infrastructure investment. As peak demand goes up more power stations get built. Alternatively, if peak demand is reduced, infrastructure cost is reduced. Hence, many regions run incentive schemes to lower peak demand.

In Ontario, the Independent Electricity System Operator (IESO) run a 5 coincident peak (5CP) scheme targeted at large power users. It works like this - They look at Ontario power demand over the previous year from May to April. They identify the 5 peak total demand periods, and then look at each user’s demand during those same 5 periods - the “coincident peaks”. They calculate the fraction of total peak demand attributable to each user, and multiply this by about C$12 billion to calculate each user’s Global Adjustment Charge (GAC). GAC is added to every large user’s bill as a separate line item, spread over the following year. GAC is a big expense. However, it can be eliminated.

**2. Business Solution**

Consider a large electrical user, say a Glass Factory. Their annual electricity cost could be north of C$6,000,000, with GAC accounting for about 60% of this. If they accurately predicted the 5 peak Ontario power demand periods, and consequently stopped production during those periods, they would save over C$3,000,000 per year. This sounds good, but is it practical?

Lost production costs big $. Worse, it is difficult to accurately pinpoint the peak demand periods. The future is uncertain. No-one can repeatedly predict conclusively, and without exception, whether next week will be hotter than this week. In other words, there is uncertainty around peak power predictions. This means 20, 30, or even 50 production stoppages may be needed to guarantee catching all 5 peaks. 20 production stoppages may still result in a net financial benefit, whereas 50 may cause a net loss.

**3. Project Objective**

Over a year, we want to make a number of predictions as to whether the next day will be one of Ontario’s 5 annual peak power demand days. **We want to correctly predict all 5 peaks, while minimizing the number of incorrect predictions.**

**4. Four Drivers of Power Demand**

1) Day of the Week

2) Statutory Holidays

3) Time of Day

4) Weather Conditions

**5. Drivers of Peak Power Demand**

The impact of the 4 factors above, relative to their impact on every other day of the year

**6. Data Sources**

**Dependent Variable**

1. Historical Ontario Power Demand Data – Available as csv files for each year from 2002 to 2019 from the IESO website - Power demand in megawatts for each hour of each day – 17 years, and about 6,000 days. <http://www.ieso.ca/Power-Data/Data-Directory>

**Features**

1. Historical IESO 18 month demand forecasts - Available as csv files for each year from the IESO website - Forecast power demand by week in megawatts. http://www.ieso.ca/document-library/search-results?c=2E50633E-2B6B-4B7E-89B9-9F775BA87CBC
2. Day of the week – calculable from dates using datetime module
3. Historical Ontario Statutory Holidays – available the package “python holidays” at <https://github.com/dr-prodigy/python-holidays>
4. Time of Day – Available in historical demand files
5. Historical weather conditions – Available as csv files for each hour of each day, going back decades, from the Canadian Ministry of Environment. Includes multiple observations such as temperature, sky conditions etc. <http://climate.weather.gc.ca/historical_data/search_historic_data_e.html>

**7. How I will solve this problem**

7.1 Download the data

7.2 Compile a full data set by merging the raw datasets together and cleaning

7.3 Define a metric for model assessment, so model performance can be compared

7.4 Perform Exploratory Data Analysis to identify pertinent features.

7.5 Build some models based on the EDA

7.6 Tweak the models and assess how they perform

7.7 Capture the results

**8. Deliverables**

Code

Paper

Slide Deck