

Exploring the seasonal variation in electric vehicle charging in New Zealand

Pablo Paulsen

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Data Exploration

Distance traveled and vehicle efficiency (km/kWh) by month, as well as the region of the vehicle was collected from the on-board computers of 1259 vehicles between 2017 and 2021 as part of the ‘Flip the Fleet’ project.

A monthly weighted average was calculated for the whole of New Zealand and then for each region of NZ. The monthly averages were weighted using the distance traveled to give more weighting to vehicles with higher km traveled in that month. this was done using the formula

$$\bar{x} = \frac{\sum_i^n (d_i \times x_i)}{(\sum_i^n d_i) \times n}$$

Power consumption (Wh/km) was calculated using the efficiency (km/kWh). This will be used instead of efficiency in the modeling for reasons that will become apparent later in the analysis.

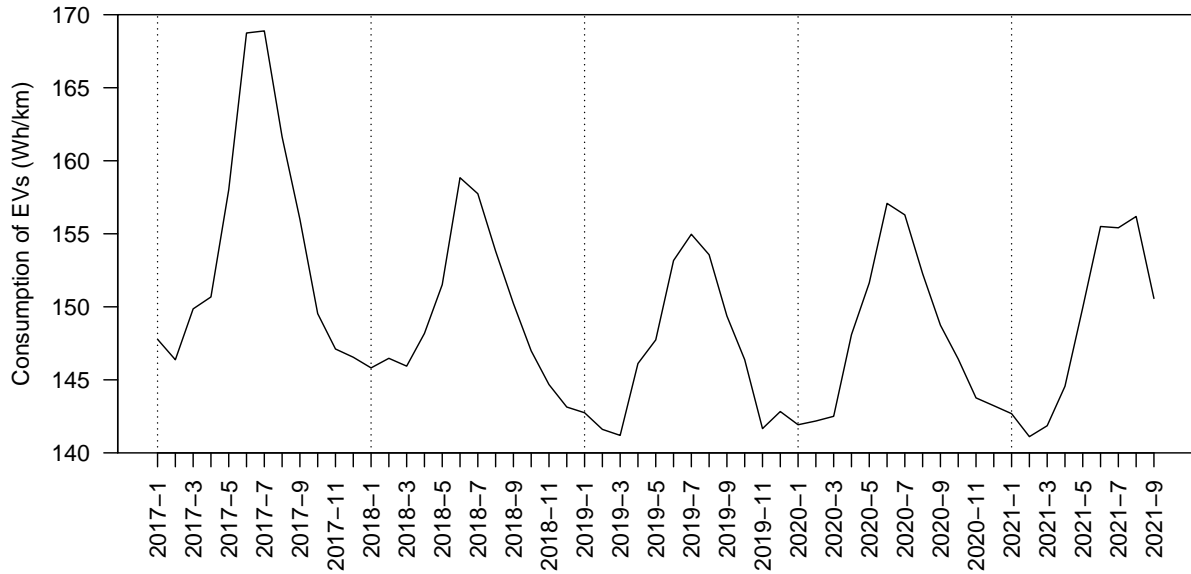


Figure 1: Time series of EVs weighted mean consumption using Flip the Fleet data from all NZ regions

Figure ?? shows there is a clear seasonal trend in the monthly average consumption of Flip the Fleets vehicles from all regions of NZ.

A time series Decomposition is used to isolated the seasonal trend in consumption from the overall trend. This can be done for all regions of NZ combined and also for each region independently.

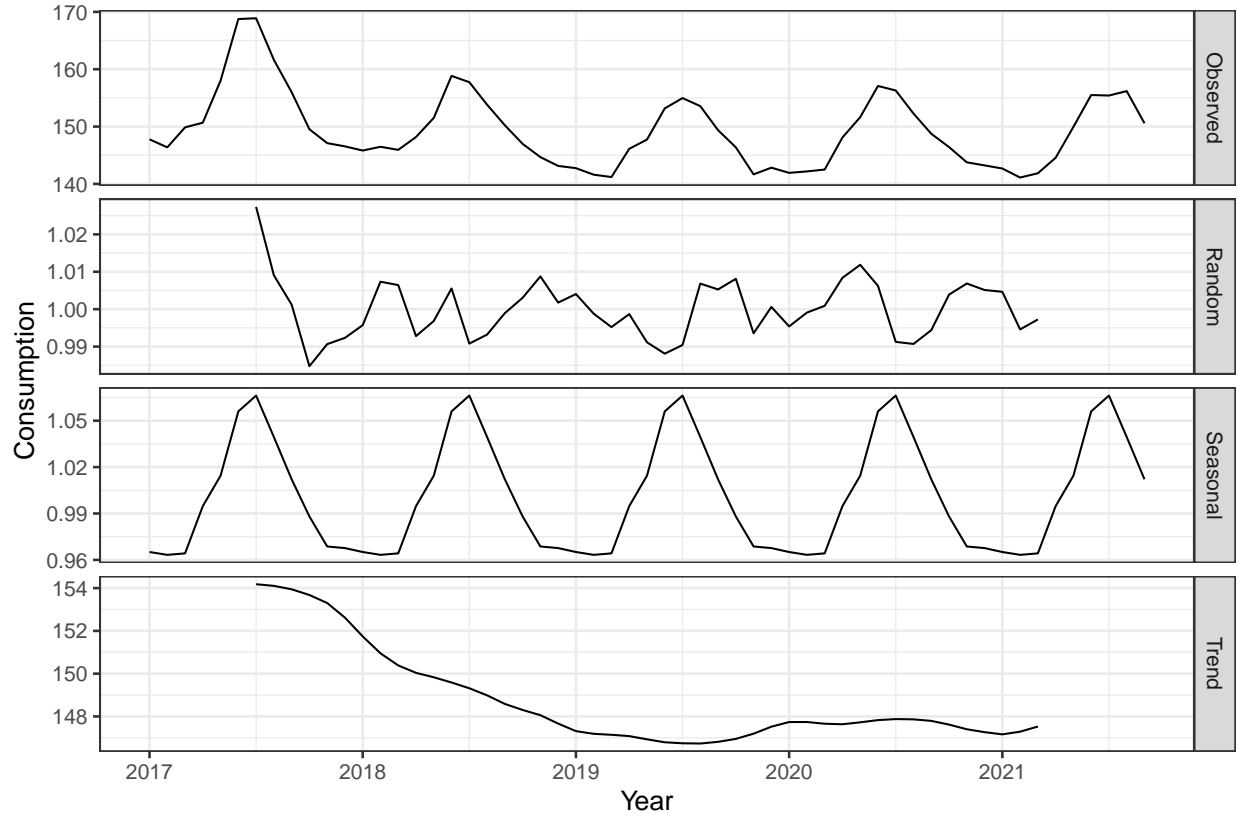


Figure 2: Multiplicative Time Series Decomposition of Flip the Fleet Average Consumption for all of NZ

The time series decomposition (Figure 2) shows a very clear seasonal trend. This seasonal trend going from 0.96 times the mean consumption in February to 1.07 times the mean consumption in February, A peak to peak difference of 10.7%.

As NZ weather differs significantly by region, to test the hypothesis that EV consumption is correlated with heating degree days we must limit the comparison to a single region of Flip the Fleet data and compare it to that regions weather at the same period of time.

In order to do this hourly weather data from 2017 to 2021 was collected from the NIWA national climate Database for 14 regions around New Zealand that best correspond to the regions of the Flip the Fleet vehicles. The base temperatures were selected to represent the range of comfortable temperatures for most people, as research shows that a majority of the seasonal variation in EV efficiency is due to cabin temperature control[?]. Using the regional hourly temperatures, monthly heating degree days (HDD) and cooling degree days (CDD) were imputed using base temperatures of 16°C and 22°C respectively.

The HDD and CDD was then divided by the length of the month so that HDD and CDD corresponds to average heating degrees days per day for the month. This is so that when comparing to other statistics such as efficiency that are averaged out rather than summed so there is less bias.

The calculated monthly weather statistics by region was then added to the monthly EV data based on the regions of vehicle. This assumes that vehicle stays in it's own region for a majority of the time.

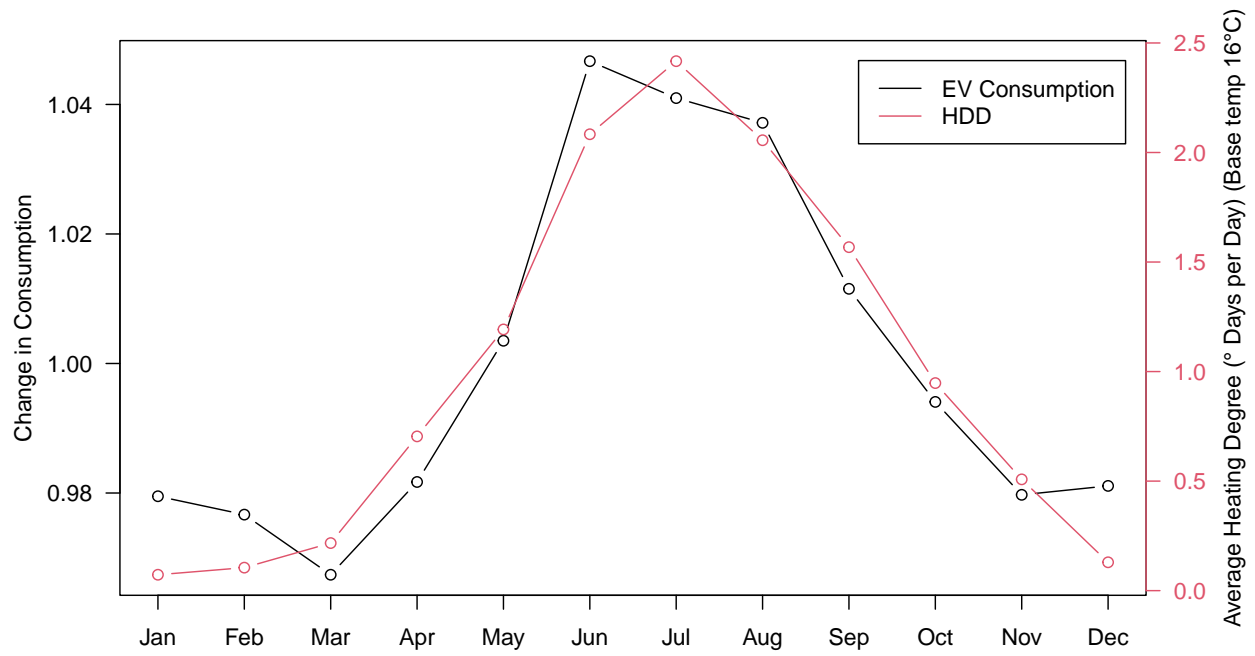


Figure 3: Auckland Seasonal component Decompostions