

# Electricity Usage IAM Challenge Report

## — A Warm Advertising Video for Blackwood

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### **Background**

With the increasing trend of an aging society, a big concern raises on how to balance convenience and safety when using electrical appliances among the elderly. Strong personal characteristics could be reflected by old people's using habits and preferences for electrical appliances. Combining their physical conditions with the usage of electrical appliances, can we infer their usage patterns to have social organizations provide more targeted services for them? Moreover, by tracking the use of electrical appliances, can the potential dangers of electricity use among elderly people be captured for the first time? Theoretically, it is achievable.

### **Introduction**

We intend to produce an advertising video for Blackwood. Our audiences mainly are families of the occupants and people who are interested in the life in Blackwood. Our video aims to make families get brief knowledge and promote staff to provide better services so as to improve life standard and attract potential occupants. We divide the video into the following parts:

- Part 1 - A narrative diary to show daily life in Blackwood
- Part 2 - How do we use data to improve the services in Blackwood:
  - improve customized services: find habits and patterns of electrical appliances usage
  - make purchase decision
  - maintain appliances
  - detect abnormality

### **Dataset: Problems, Bias, Underrepresentation, Missing data**

We have got 15 occupants' electricity files in the nursing home, and 7 people's brief identity information including gender and health condition. In those files, each CSV file records one electrical appliance's 2 columns of timestamp and instantaneous power value. Duplicate lines are found in the process of data cleaning. After data cleaning, there are still some problems in the data.

- Unstable sensor connection  
It may wrongly show that an appliance has been used for too long or lead to missing data, which in turn causes data analysis errors.
- Lack more electrical appliances data  
We are not given various parameters of each appliance, like expected life span, to offer repair and replacement. Not all occupants have the same electric-appliances, which may lead to underrepresentation.
- Lack more personal information data  
The amount of people is too small to do a meaningful statistical analysis on gender, health conditions and patterns to offer targeted service or accident prevention.

## Program: How to acquire data we need in our advertising video?

### Habits and patterns:

We want to find the habits or patterns of one home of using all the appliances for all time ranges. So we simplify this question to how many times do one home use one appliance in each hour.

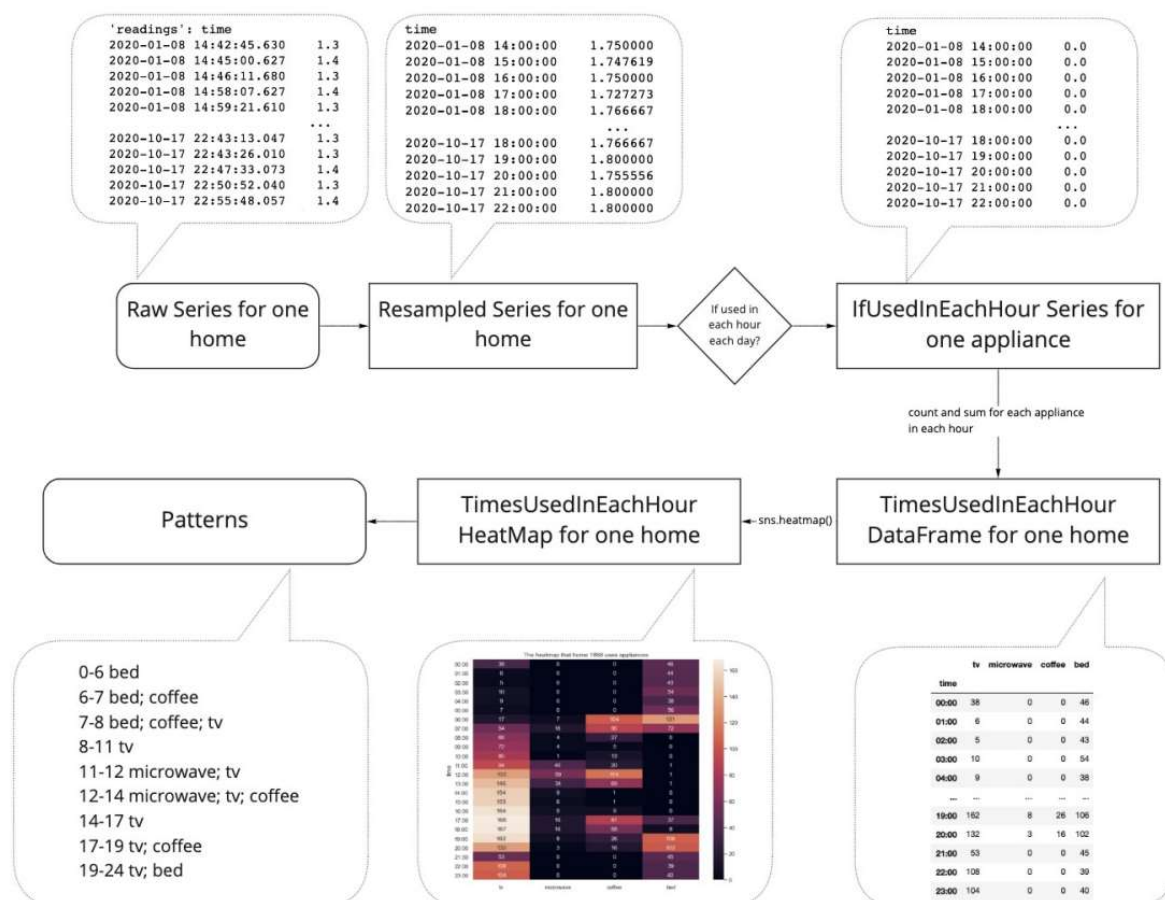


Figure 1 Habits and patterns flowchart

The numbers and colors in the heatmap will show the times that the home used this appliance in that hour so we can find some habits and patterns.

### Frequencies of using different electrical appliances:

Knowing frequencies of one home using different electrical appliances can help care home staff not only plan appliances procurement more accurately, but also monitor any abnormality in time to prevent potential dangers.

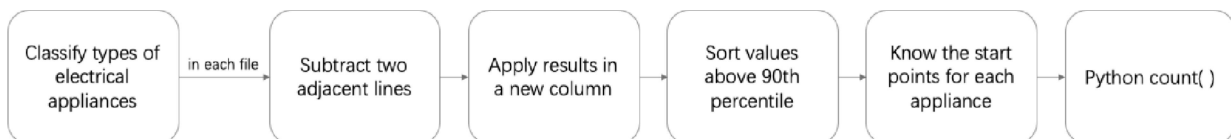


Figure 2 Frequency flowchart

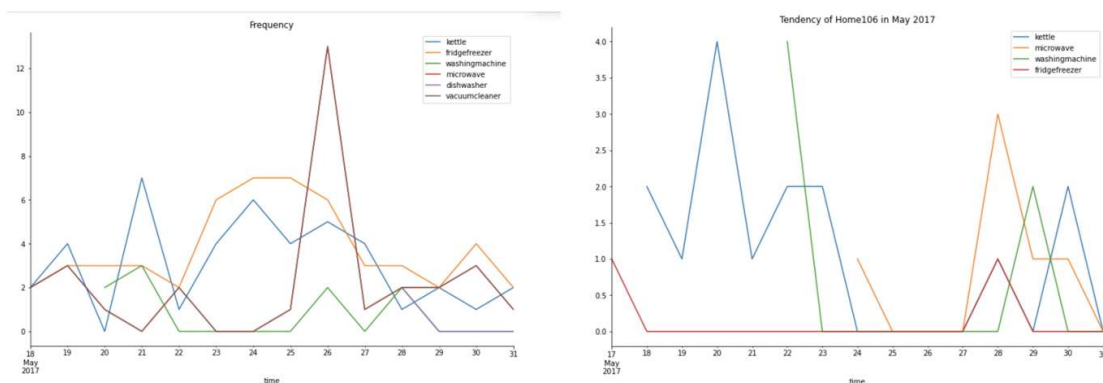


Figure 3 Abnormal tendency

Despite directly counting numbers, we also use python libraries like seaborn and matplotlib to show the tendency, from which we find some abnormal images like peak and trough. This reminds us that something unusual happened, and we make some hypotheses for the condition.

### Total usage time of electrical appliances :

This section focuses on the total usage time of each appliance in the dataset. After obtaining this information, we can correlate this with the average service life of different appliances, and finally determine whether a specific appliance has reached the established Life, so as better to provide Blackwood staff with electrical maintenance and testing information.

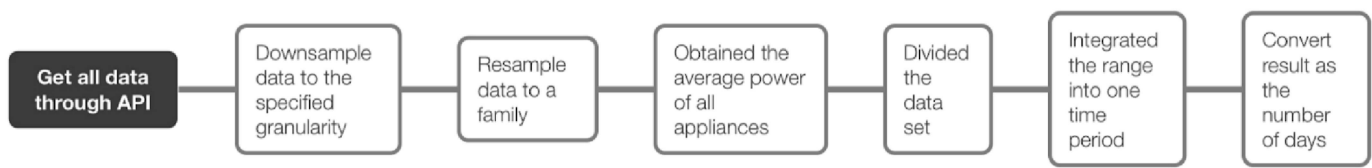


Figure 4 Total usage time flowchart

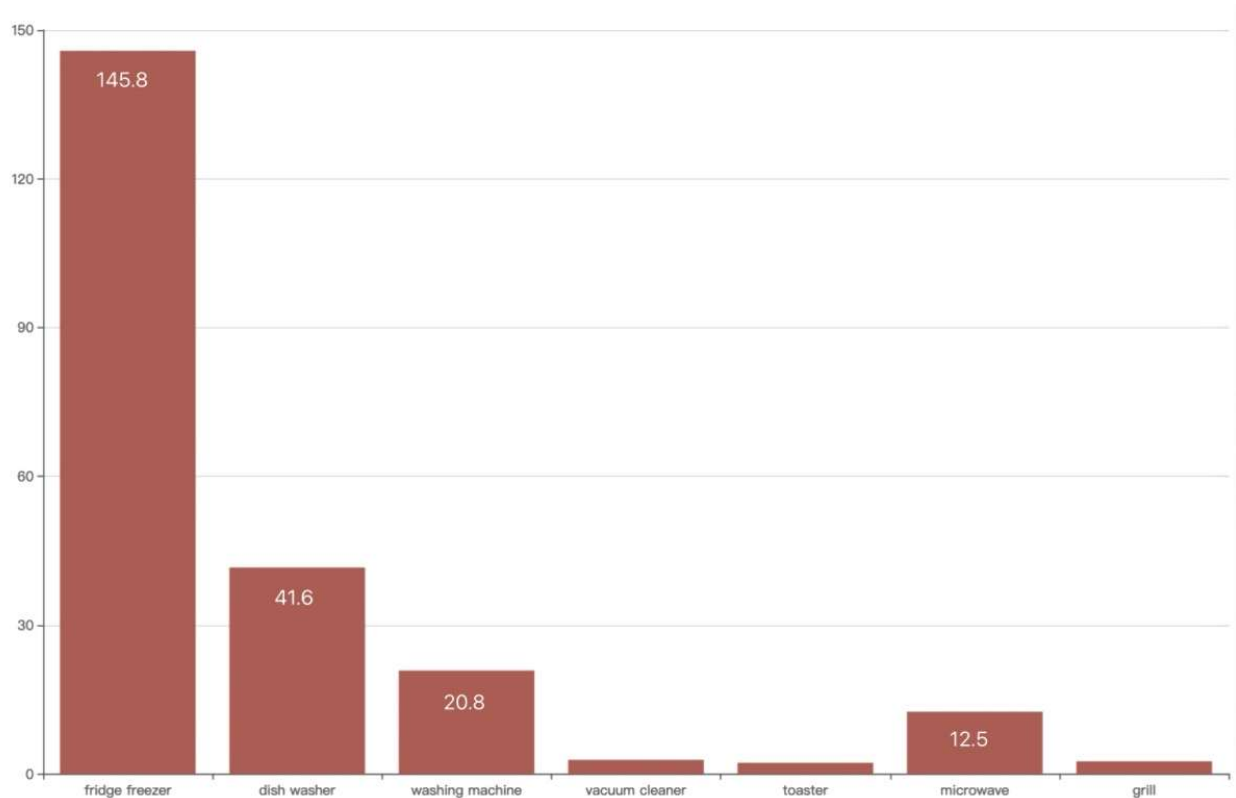


Figure 5 The total duration of each appliance

In the subsequent analysis, we will also convert the result in seconds as the number of days, and finally, get the proportional relationship with service life and visualize.

## Communicate

We make our video by using Final Cut Pro and Motion, based on the game – *Animal Crossing*. Since the game can imitate scenarios of an elderly's life vividly and the player can add various electrical appliances in the protagonist's home, the audience can understand the elder's life intuitively. The method that we use is *Machinima*<sup>1</sup>.

The video is divided into 2 sections. In the first section, we show the life track of an elderly occupant in the form of a diary(Figure 6) from the first perspective to shorten the

<sup>1</sup> **Machinima** is the use of real-time computer graphics engines to create a cinematic production. Most often, video games are used to generate the computer animation.

distance with the audience. There are rolling small videos in the bottom to highlight the usage of the appliances.



Figure 6 The grandma's diary

In the second section, we present how we use data to improve the nursing home's services through 4 parts.

In the first part, we choose 3 homes with special occupants — a cerebral palsy patient, a wheelchair user, and a person who likes cleaning — to show their one day life. Each small video is surrounded by 2 dynamic circles which represent 24 hours in real-time(Figure 7). The clock within circles aims to give the audience a sense of time passing. Rotating icons with corresponding colourful traces show which appliance is being used in each hour.

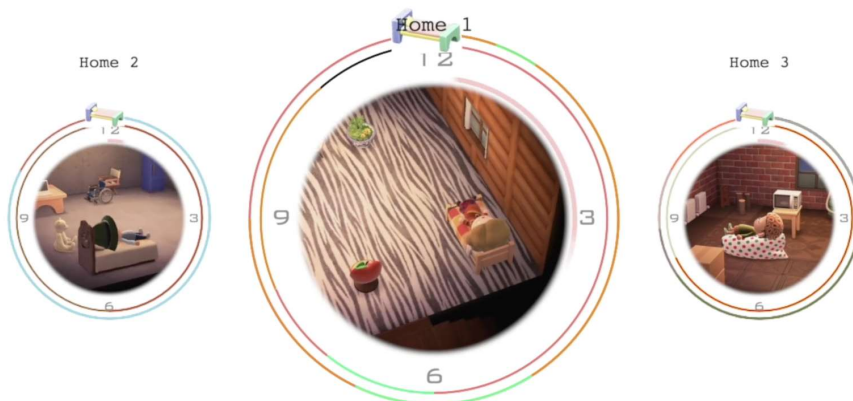


Figure 7 Habits and patterns of three homes

In the second part, we display a bar chart(Figure 8) to show total using times for different appliances and present a scenario of staff selecting appliances(Figure 9) to demonstrate how the staff makes purchase decision according to the popularity of appliances among occupants.

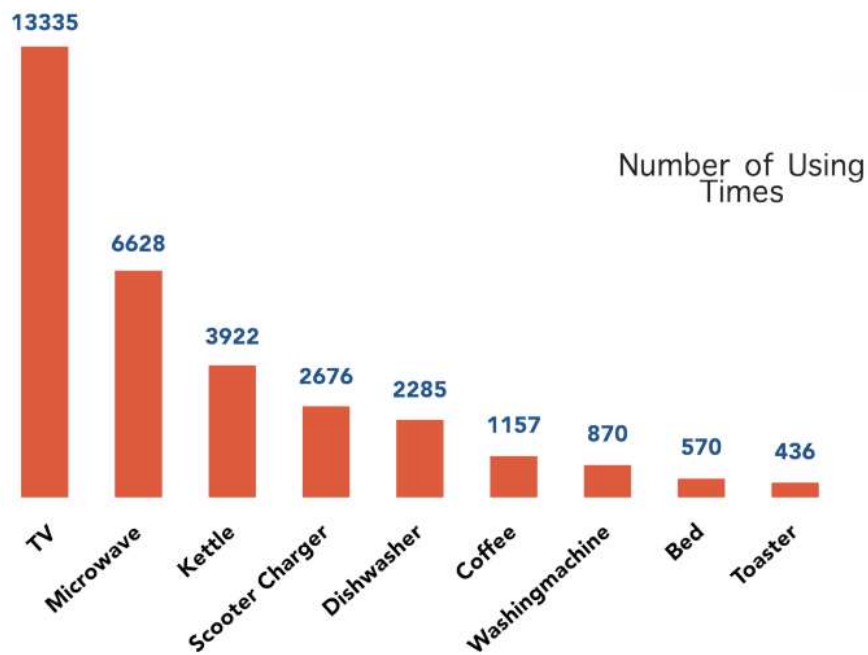


Figure 8 Total using times of different appliances



Figure 9 A staff is purchasing appliances for occupants

In the third part, besides the bar chart of usage time in days for appliances(Figure 10), we use progress bars(Figure 11) to indicate the depletion process and color the bar with red when it is approaching 80% of the life expectation to give a sense of warning. The elderly on the left side shows various facial expressions when it comes to different use conditions of appliances.



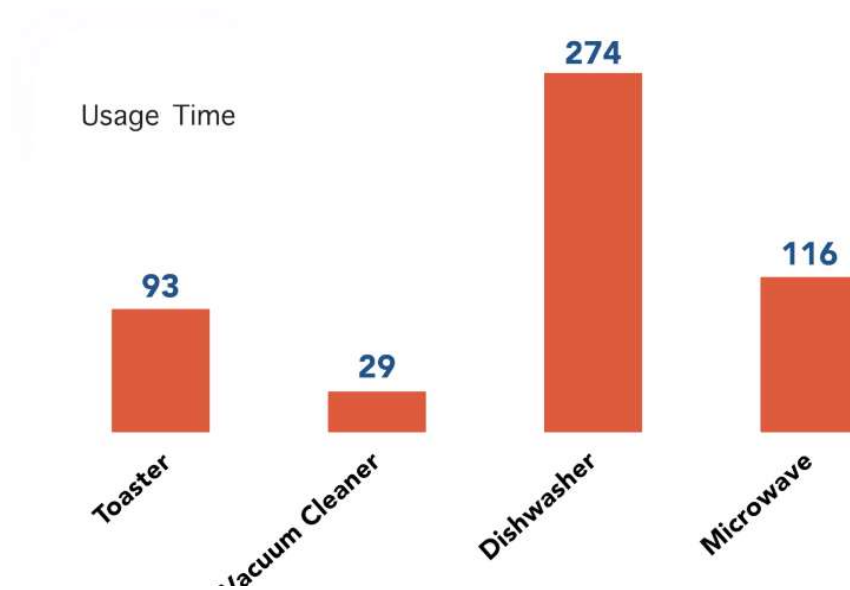


Figure 10 Usage time of different appliances

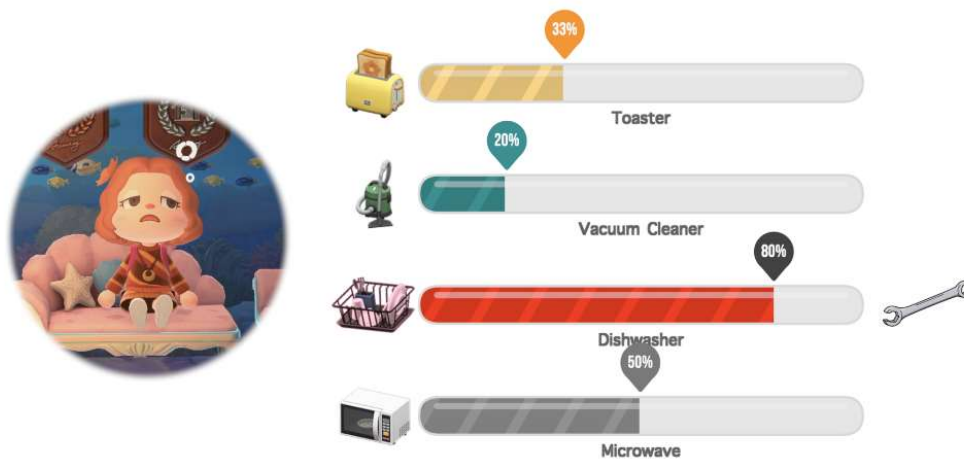


Figure 11 Progress bars of depletion of appliances

In the final part, we display a line diagram of abnormal usage frequency of the vacuum cleaner in a home(Figure 12). We color the anomalous interval in red to indicate abnormality of the vacuum cleaner to show a possible abnormality of the occupant. When this case occurs, a staff will visit the corresponding occupant to see if he or she has an emergency, as is shown in Figure 13.

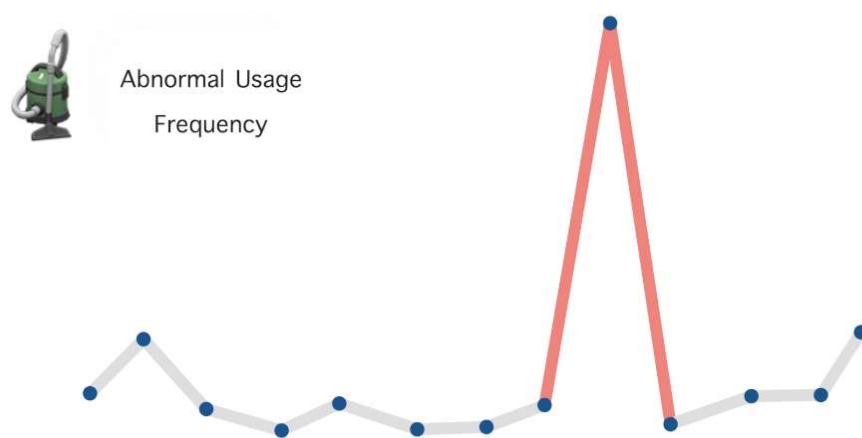


Figure 12 Abnormal usage frequency of a vacuum cleaner



Figure 13 A staff visits an occupant

Video link: <https://www.youtube.com/watch?v=ido80cEYUJM>