Homework 8
July 8, 2020

Part 1: Send a Reminder

Before diving into the modelling and analytics, the power company should send a reminder to customers who haven't paid their electricity bill recently, maybe within the last 3 months. They can include in the reminder the different methods of payment the power company accepts to show the customer their payment options. They may also consider incentivizing automatic payments by offering a discount on the customer's outstanding balance if they opt in. The reminder can also be used to inform them that if they don't make a payment in the next 30 days that is at least a certain percentage of their outstanding bill, they may get their power shut off. By sending this reminder, the power company may start receiving revenue from these customers without having to spend money on technician labor and turning power off and/or on, in the case that the customer would start paying after having their power shut off.

Part 2: Whose power should get shut off?

Once the grace period for customers that haven't paid has ended, we can start classifying customers into two groups: those getting their power shut off and those that aren't.

Before classifying customers, the power company should check if there are any locations that should not be subject to having their power shut off. Locations like community centers, orphanages, hospitals, etc. should not have their power shut off even if they haven't paid because the company could face some serious legal repercussions. For these special cases, it's best that their power is not turned off and a separate solution is created.

Our starting group of candidates will be active customers – customers that are currently receiving power from the company and aren't considered a special case like I mentioned above.

Given:

- Customer tenure with the power company
- Payment history – when the last payment was, average monthly power bill, % of months with payment, % of months with no payment, % of months with late payment, average number of days late a payment is
- Household Income
- Employment status
- Credit score

Use:

- Logistic regression

To:

- Determine the probability that a customer will not pay their bill in the next month

We will also need to estimate the amount of power the customer will use in the next month.

Given:

- Customer's monthly power usage in last 12 months

    - If the customer is new, can use consumption of other similar homes in the same neighborhood to estimate average monthly power usage

Use:

- Exponential Smoothing

To:

- Determine the amount of power the customer will use in the next month

Using the results of logistic regression and exponential smoothing, we can calculate the expected cost of keeping the power on for each customer. If the expected cost of keeping power on is greater than the expected cost of shutting power off, then turn off their power.

$$Expected\ Cost\ of\ Keeping\ Power\ On = p \times\ Power\ Consumption\ in\ Next\ Month\ \times\ Price\ of\ Power$$
$$Expected\ Cost\ of\ Turning\ Power\ Off = p \times\ Shut\ Off\ Cost + (1-p) \times (Shut\ Off\ Cost + Cost\ of\ Turning\ Power\ Back\ On)$$

Part 3: How should we schedule technicians to shut power off?

Now that we know whose power we will be shutting off, we need to determine how to schedule technicians so that the cost of shutting off power is minimized.

Given:

- Customer's location – longitude and latitude

Use:

- Clustering

To:

- Group customers in clusters based on location and value to the power company
- I would also calculate each cluster's total value to the power company by summing the expected cost of keeping power on for all locations within the cluster

Now that I have locations grouped together, I would use this as an input to an optimization model.

Given:

- Driving time between clusters
- Driving time between customer locations
- Number of technicians
- Time it takes to shut off power given the number of technicians
- Cost of shutting power off – materials, labour, etc

Use:

- Optimization

To:

- Determine the order of clusters that technicians should visit that minimize amount of revenue lost by keeping the power on less cost of shutting power off