

Homework 12

Due: Nov. 13, 2025

Question 18.1

Which shutoffs should be done each month, given the capacity constraints? Describe analytics models and data that could be used to make good recommendations to the power company.

Here are some questions to consider:

- Some of the capacity – the workers' time – is taken up by travel, so maybe the shutoffs can be scheduled in a way that increases the number of them that can be done.
 - Not every shutoff is equal. Some shutoffs shouldn't be done at all, because if the power is left on, those people are likely to pay the bill eventually. How can you identify which shutoffs should or shouldn't be done? And among the ones to shut off, how should they be prioritized?
 - What kind of data do you think you realistically have access to and can legally collect/use?
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This problem has several parts to consider

Repayment prediction model

1. Given information about the customer such as
 - a. Occupancy¹,
 - b. Account type (Business, Residential)²,
 - c. Domicile type²,
 - d. Household income,
 - e. Credit score,
 - f. Current and previous employment status,
 - g. Monthly charges,
 - h. Age of account,
 - i. Payment history:
 - i. Previous default behavior,
 - ii. Months since balance fully paid,
 - iii. Partial payment amounts
 - j. History of attempts to contact the customer about missed payments

¹ Factor that I had not considered prior to seeing [Piazza post 2709](#).

² Factor that I had not considered prior to seeing [Piazza post 2674](#).

2. Use a classification model – There are a great deal of unknowns on what type of classifier is appropriate:
 - a. Are there legal requirements for explainability?
 - b. What models produce the required accuracy? - I assume that there is a great deal of non-linearity in this type of prediction, so either a kernel SVM or neural network will probably be best
3. Determine if the household:
 - a. May qualify for assistance,
 - b. Will never repay their bill

Since the power company aims to shut off services only for customers who are unlikely to repay, this step is crucial. Customers identified as eligible for assistance can be redirected to support programs, while those predicted never to pay proceed to the next stage.

Shutoff routing

1. Given:
 - a. a set of customers that have been determined will not pay their bill including
 - i. Service address
 - ii. Monthly charges
 - b. Amount of time to perform shutoff
 - c. Number of hours technician's work
 - d. Home bases of technicians
2. Use a weighted network model
3. To plan technician routes that minimize the company's total operational cost within a work shift.

The purpose of shutting off a customer's power is to stop the cost; however, given that technicians have limited working hours, defaulting customers are spread out over the area the power company supports, and some defaulting customers might be costing the company more than others there will be routes that minimize the cost the company bears.

Shutdown scheduling

1. Given:
 - a. A set of optimal routes that reduces the lost revenue of the power company that a technician can run in a shift
 - b. The costs of running these routes
 - i. Wages of technicians,
 - ii. Material costs: equipment, fuel, etc.
 - c. Constrained by the number of technicians available
2. Use a linear programming model
3. To minimize the power company's cost

Even after identifying optimal routes, it may not be cost-effective to send technicians to every location. For example, shutting off service for a remote customer with a static overdue balance may not justify the expense. The scheduling model ensures that dispatch decisions are financially optimal.