The Business Problem

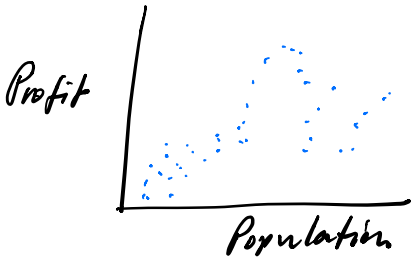
- CEO of a restaurant chain
- Thinking about how to expand the business
- Have data on current restaurants
  - population of town in which restaurant is located
  - profit from restaurant per quarter
- Where should the next 5 restaurants be opened to maximize profit growth?

The Data

Population (10,000)	Profit ($100,000)
6.11	17.59
5.53	9.13
8.52	13.67
⋮	⋮
12.68	15.34

Structure of the data

- food-truck-profits.txt
- 97 rows
- numerical information (not categorical)
- No missing information



Step 1

Scatterplot of the dataset to visualize it

STEP 2 Define the task

(w.r.t. the dataset)

Input → the population size

Output → the profit

Task → Given a population size, predict the profit.

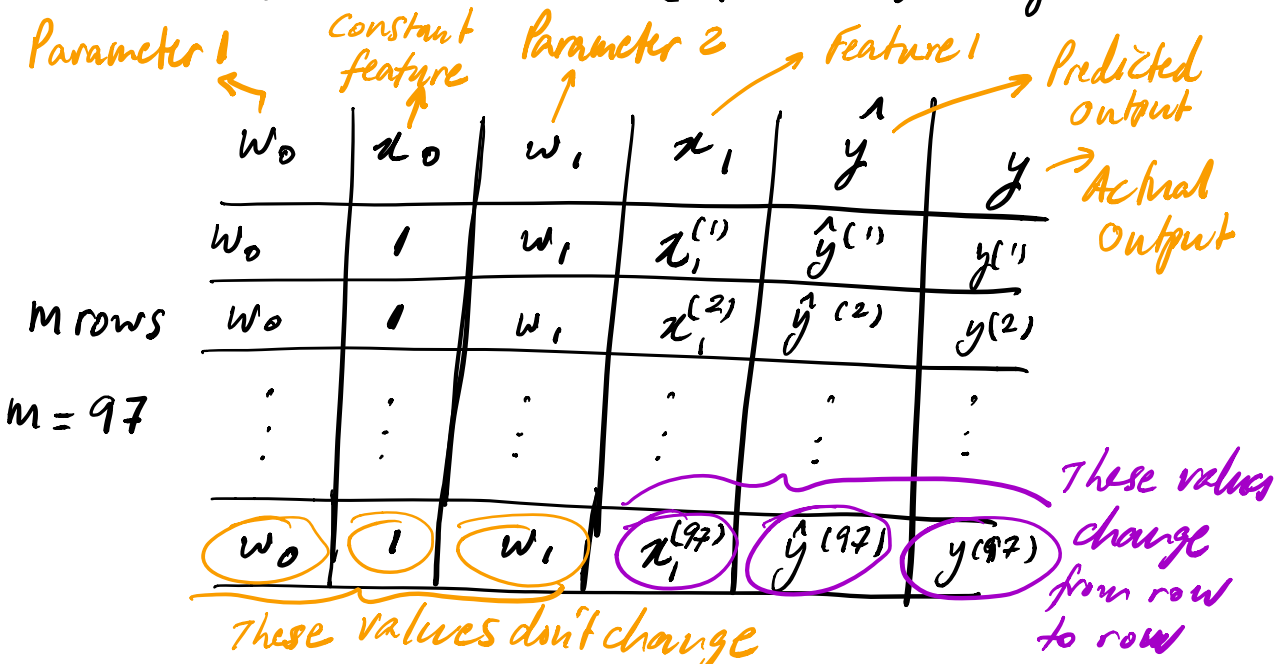
STEP 3 Define the Model

Feature = input = population size

(later we'll see how features can differ from inputs)

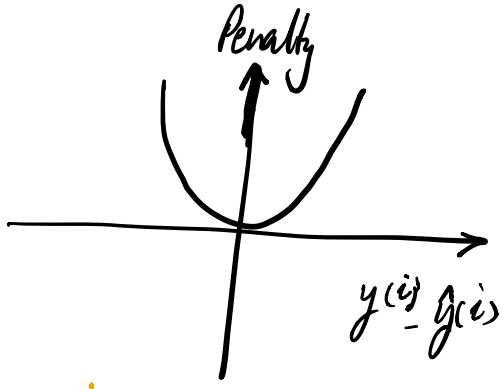
Transform the feature into an output

$$(w_0 \times x_0^{(1)}) + (w_1 \times x_1^{(1)}) = \hat{y}^{(1)}$$



STEP 4 Define the penalty for getting it wrong.

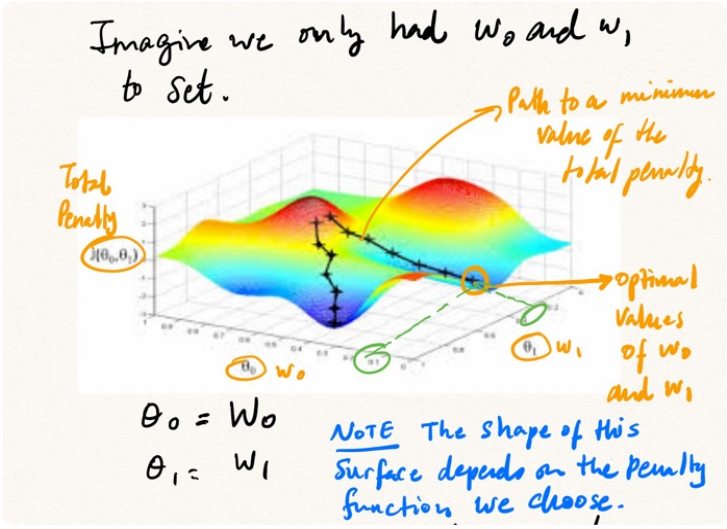
Penalty for each row $= \left(y^{(i)} - \hat{y}^{(i)}\right)^2$



The more we get it wrong, the more we're penalized.

Total Penalty for the entire data set = Sum of penalty of each row.

QUESTION What values of w_0 and w_1 will minimize the total penalty?



Use gradient descent to solve the numerical optimization problem.

- start at an arbitrary point on the surface — pick arbitrary values for w_0 and w_1
- From this point, take a step in the direction where the slope is descending most steeply.
- Do this again and again until you reach a minimum (the "valley floor")

Recap

Model - transforms the input(s) into the output.

Parameters - these are the fixed values (e.g., w_0, w_1) of the model.

Penalty - for each row of the dataset, what's the penalty/cost/price for being wrong?

Recap (Contd.)

Total Penalty - Sum of the penalty of each row of the dataset.

Problem - Find the parameter values of the model (w_0 and w_1 values) that minimize the total penalty.

Approach to Solve the Problem - Gradient Descent.

Hyper-Parameters

Gradient descent can produce different results based on how you set the values of the following parameters.

- Learning Rate. The size of the jump taken at each step.
- The total number of jumps taken.

Every machine learning problem has hyperparameters.

Why? Because every machine learning problem is a giant optimization problem — find the optimal values of the model parameters that minimizes the total penalty.

To find these optimal values of w_0 and w_1 (for example), we use a learning algorithm like gradient descent.

Finding the right hyperparameters is a separate quest — one that must be solved every time you apply machine learning to solve a problem.

In a few sessions we'll see how this problem is tackled.