

**Linear Regression***(find and work with a partner)*

In the case of *simple* linear regression, for each example we have a single feature  $x$  and associated response (output) variable  $y$ . Our model is:

$$h_{\mathbf{w}}(x) = w_0 + w_1x$$

1. Name one goal of linear regression. Why would we want to fit a linear model?
2. In simple linear regression, how many features does each example have? How many parameters does our linear model have in this case?
  - # features ( $p$ ) =
  - # model params =
3. What cost/loss function are we trying to minimize in simple linear regression?
4. *Small example.* Let  $n = 2$  and  $p = 1$ , with the following data:

$$\mathbf{X} = \begin{bmatrix} 1 \\ 0 \end{bmatrix}, \quad \mathbf{y} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

Plot these two points – what should  $\hat{w}_0$  and  $\hat{w}_1$  be?

5. This week we derived the solution for simple linear regression:

$$\hat{w}_1 = \frac{\text{Cov}(\mathbf{x}, \mathbf{y})}{\text{Var}(\mathbf{x})} = \frac{\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2} \quad \hat{w}_0 = \bar{y} - \hat{w}_1 \bar{x}$$

where  $\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$  and  $\bar{y} = \frac{1}{n} \sum_{i=1}^n y_i$ . Use these equations to compute  $\hat{w}_0$  and  $\hat{w}_1$  and verify your answer to the previous question.