

Linear Regression – Intuition – I - II

Dr. Muhammad Wasim

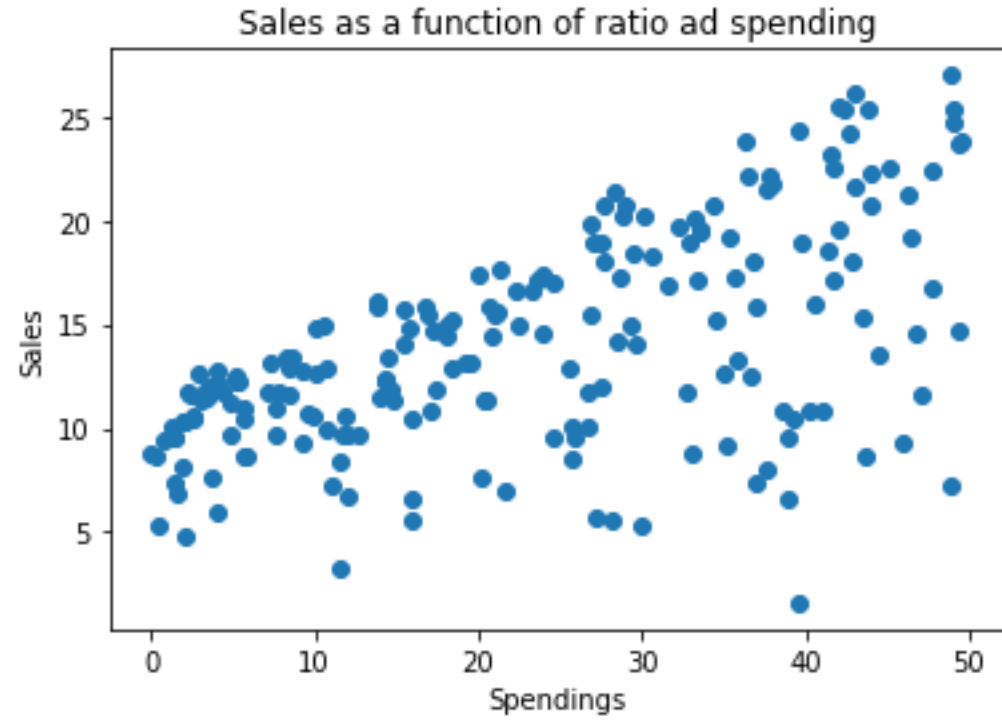
Linear Regression

- In contrast to classification, the predictions of the linear regression are real-valued.
- A model which is a linear combination of the features of input examples.

Spending on advertisement vs sales

Spending on Ads (in millions)	Sales (in millions)
3.7	7.6
4.9	9.7
9.3	12.8
8	13.4
...	...

Spending on Advertisements vs Sales



Linear Regression

$$h_{\theta}(x) = \theta_0 + \theta_1 x_1 + \theta_2 x_2 + \dots + \theta_m x_m = \begin{bmatrix} \theta_0 \\ \theta_1 \\ \cdot \\ \cdot \\ \theta_m \end{bmatrix} \times [x_0 \ x_1 \ \dots \ x_m] = \theta^T x$$

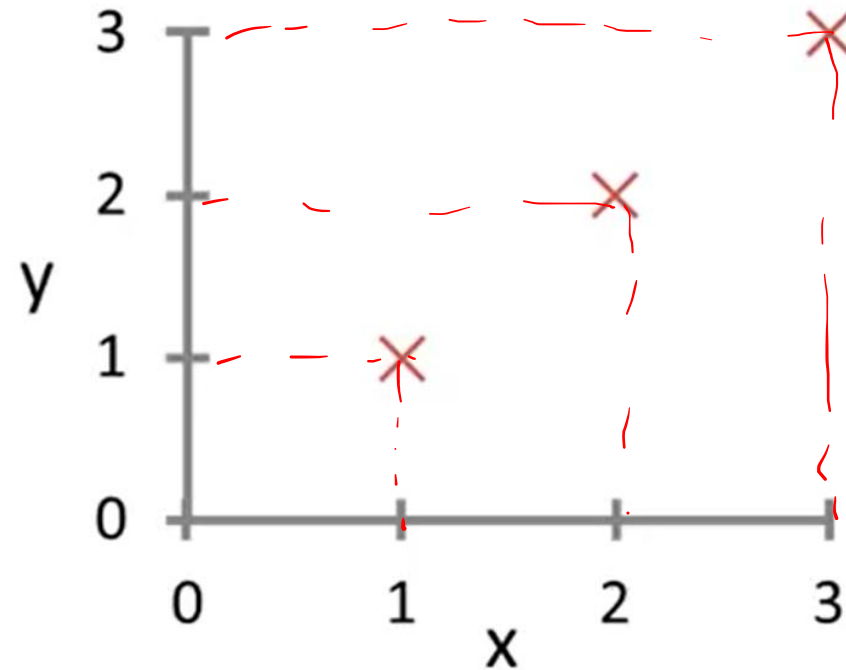
$$\hat{y} = \theta^T x$$

Linear Regression – Intuition – II

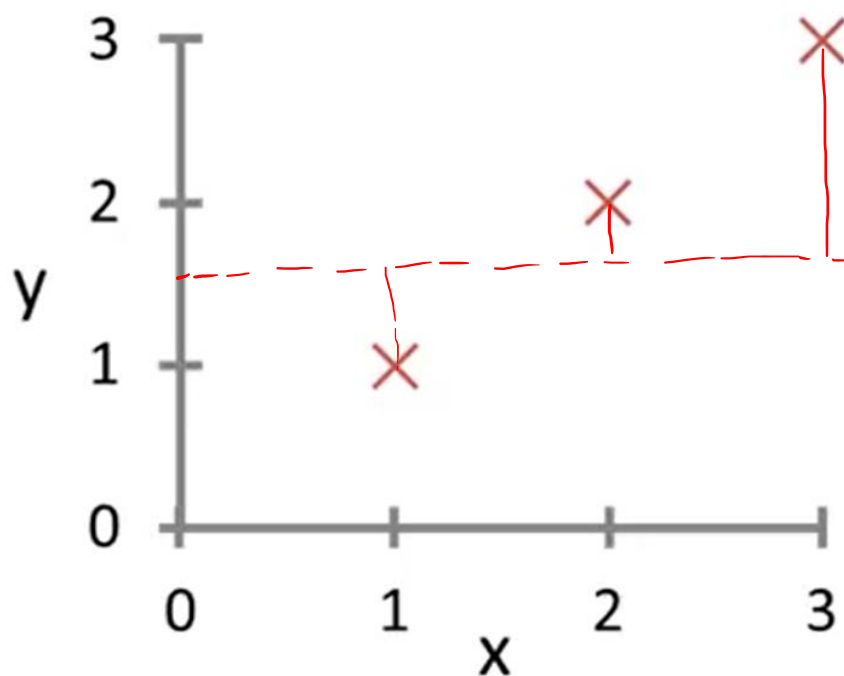
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Linear Regression – An Example Dataset

x	y
1	1
2	2
3	3



What will a good line fit for this dataset?



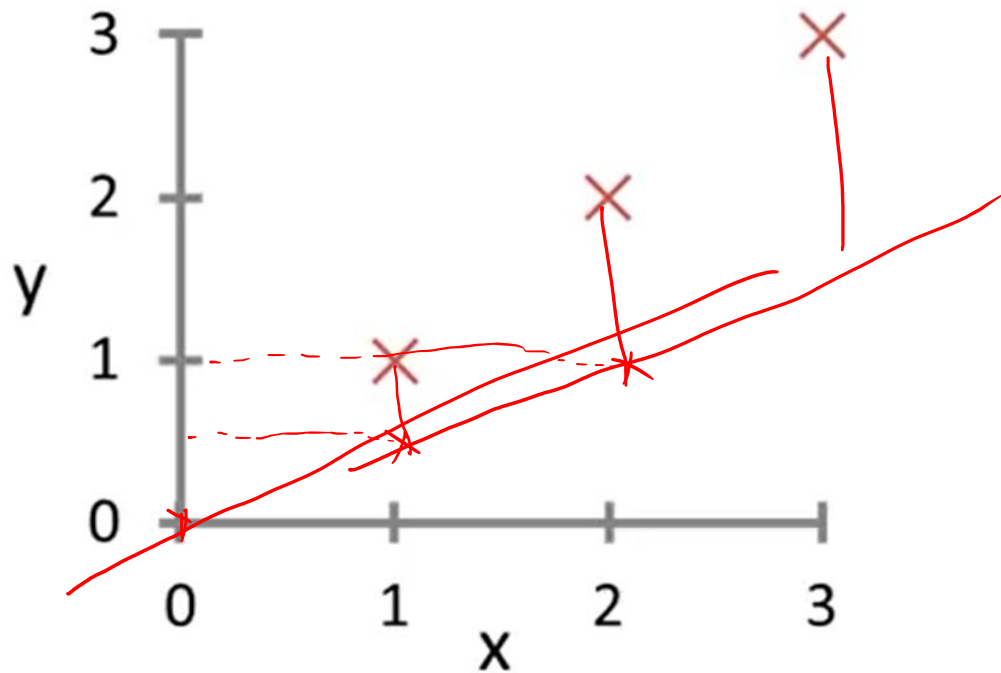
$$\hat{y} = \theta_0 + \theta_1 x_1$$

Cost Function

$\hat{\theta}_0 = 1.5$ $\hat{\theta}_1 = 0$
 $(1 - 1.5)^2 + (2 - 1.5)^2 + (3 - 1.5)^2$
 $0.25 + 0.25 + 2.25 = \frac{2.75}{3} = 0.92$
 $= 0.45$

$\frac{1}{2 \times 3} \sum_{i=1}^3 (y_i - \hat{y}_i)^2 \leftarrow \text{MSE}$

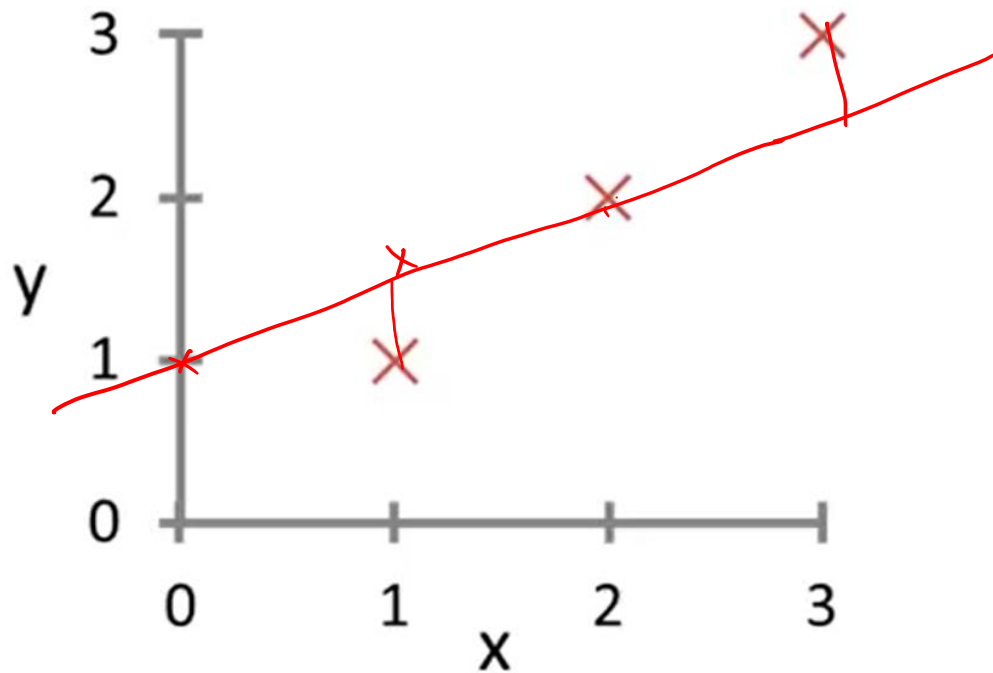
What will a good line fit for this dataset?



$$\hat{y} = \theta_0 + \theta_1 x_1$$

$$\begin{aligned} \theta_0 &= 0 & \theta_1 &= 0.5 \\ \underline{\underline{=}} & & & \\ \frac{1}{2m} \sum_{i=1}^m (y_i - \hat{y}_i)^2 & & & \\ &= \underline{\underline{0.58}} \end{aligned}$$

What will a good line fit for this dataset?



$$\theta_0 = 1 \quad \theta_1 = 0.5$$

$$J(\theta_0, \theta_1) = 0.07$$

$$\hat{y} = \theta_0 + \theta_1 x_1$$

What will a good line fit for this dataset?

