Meaning of Slope in Linear Regression

Notes

- 1. The author accepts no responsibility for the topicality, correctness, completeness, or quality of the information provided.

- 2. This pdf is part of a YouTube tutorial:

https://youtu.be/Yyryi2ddNSo

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$$Y = b_0 + b_1 X$$

Numerical data
(continuous data)

Can be either numerical data or categorical data.

Question: What does the slope (b_1) mean?

Situation 1: X is Numerical

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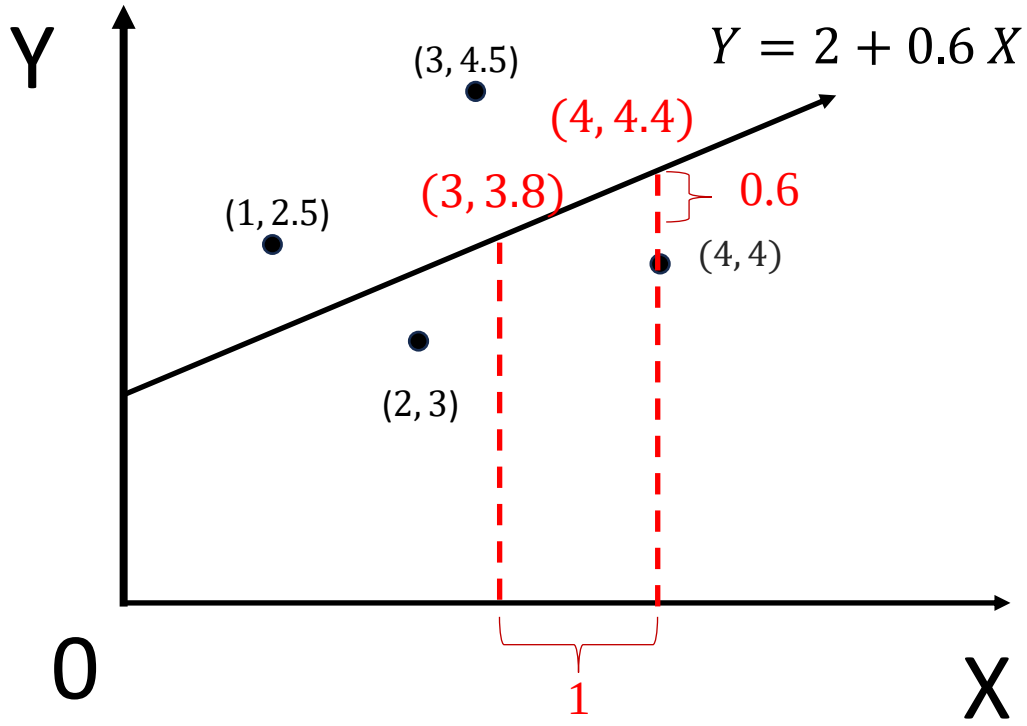

x	y
3	4.5
4	4
1	2.5
2	3

Slope (b_1=0.6) is the change in Y when X changes 1 unit.

Situation 2: X is Categorical

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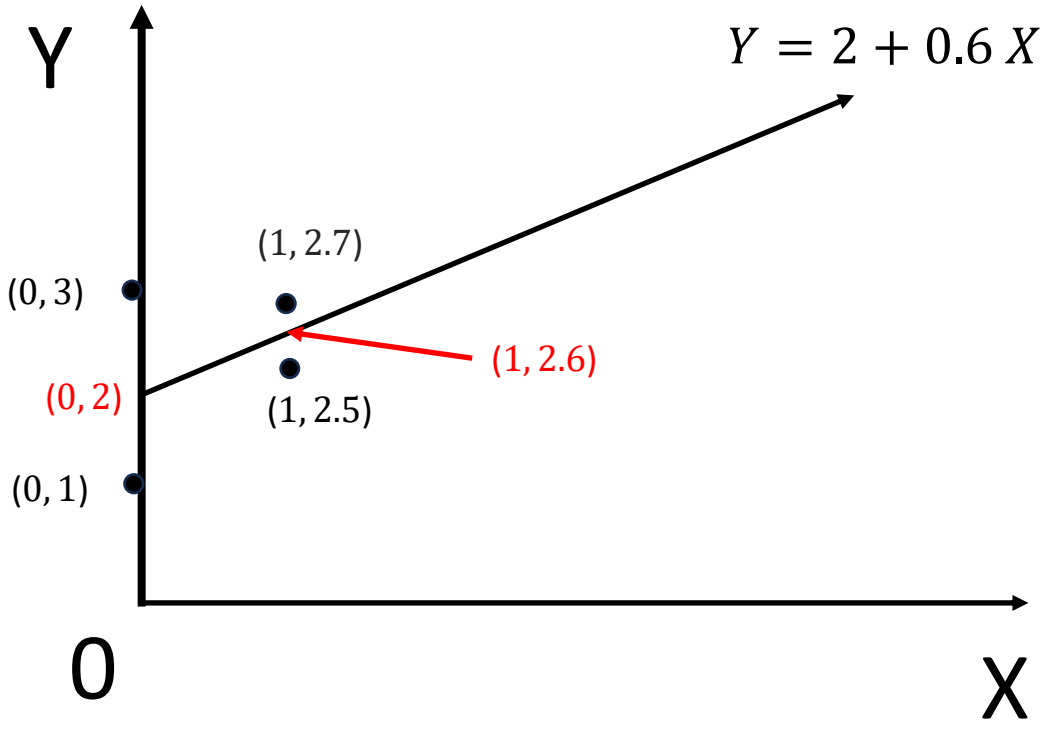


x	y
0	3
0	1
1	2.5
1	2.7

2

2.6

Meaning 1: Slope (b_1=0.6) is the change in Y when X changes 1 unit.

Meaning 2: Slope (b_1=0.6) is the mean difference between two groups.

Observation: The line passes the points of (0, 2) and (1, 2.6).

Quick Summary

X is either numerical or categorical:

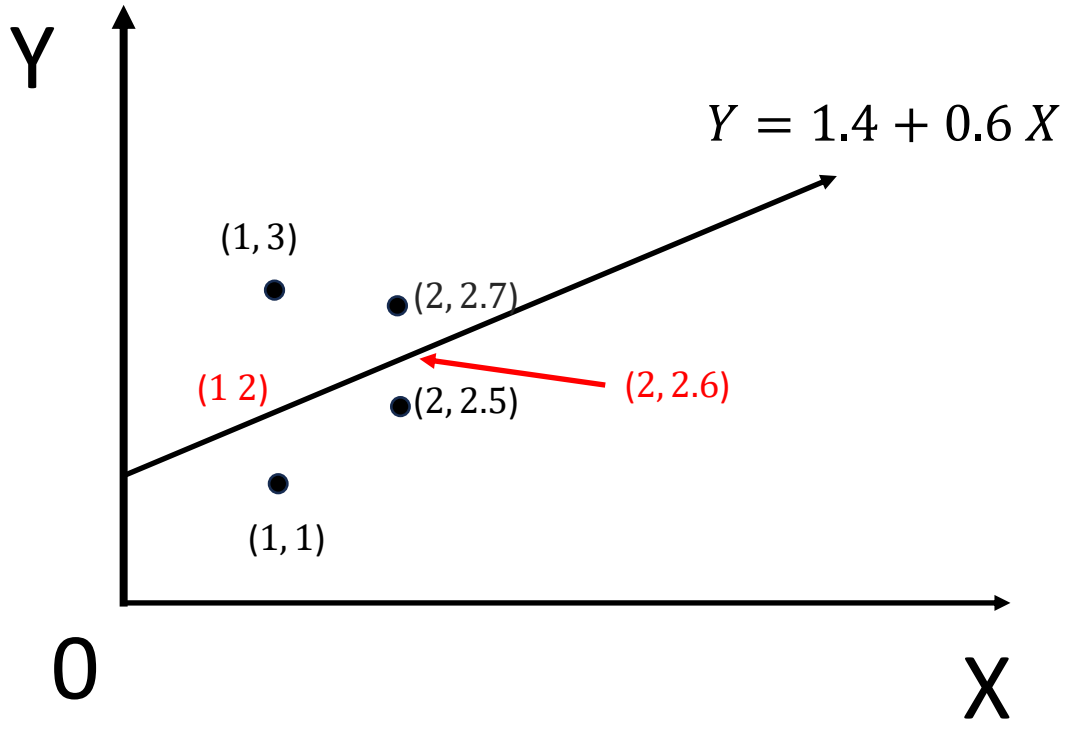
Slope is the change in Y when X changes 1 unit.

X is categorical:

When X is dummy coded (i.e., 0, 1), slope is the mean difference between two groups.

What if X is categorical, but not dummy coded?

X is categorical, but not dummy coded



x	y
1	3
1	1
2	2.5
2	2.7

2

2.6

Meaning 1: Slope (b_1=0.6) is the change in Y when X changes 1 unit.

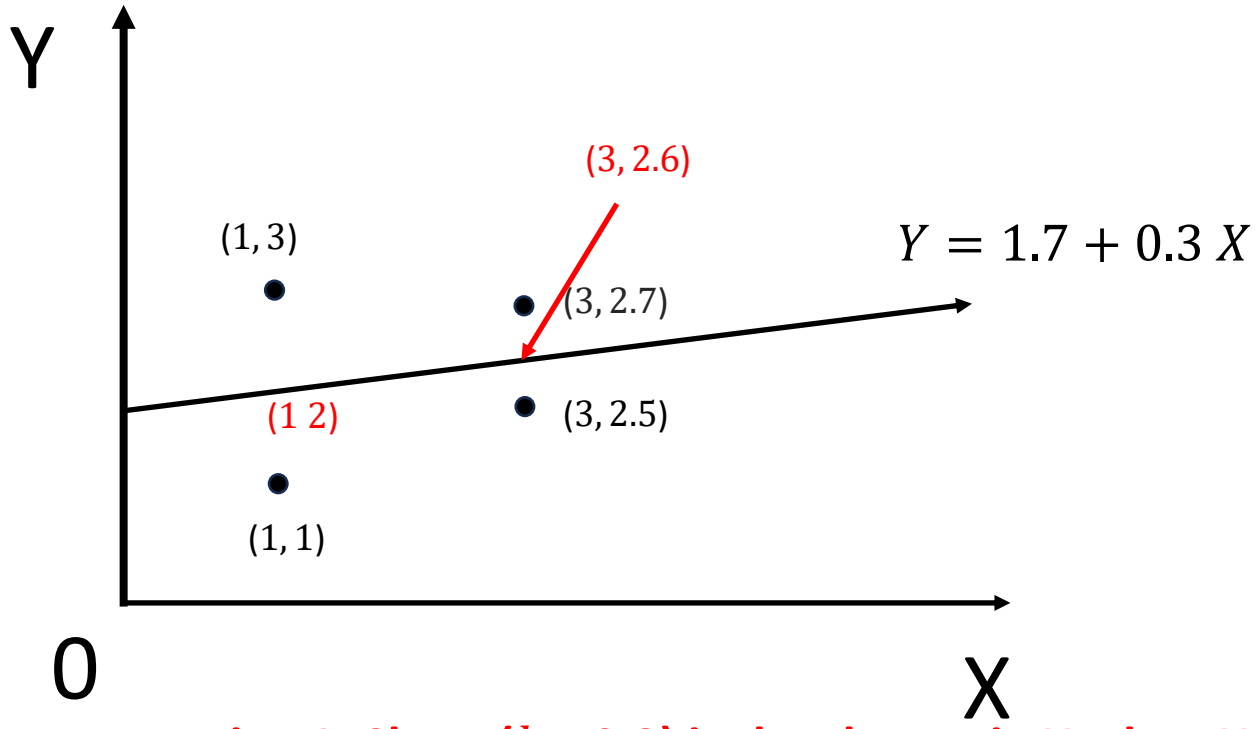
Meaning 2: Slope (b_1=0.6) is the mean difference between two groups.

Observation 1: The line passes the points of (1, 2) and (2, 2.6).

Observation 2: changing from (0, 1) to (1, 2), it only changes the intercept, but not the slope.

What if X is coded as 1 and 3?

X is categorical, and coded as 1 & 3



x	y
1	3
1	1
3	2.5
3	2.7

2

2.6

Meaning 1: Slope (b_1=0.3) is the change in Y when X changes 1 unit.

Meaning 2: Slope (b_1=0.3) is: $\frac{\text{mean difference between two groups}}{\text{difference between two coding numbers}} = \frac{0.6}{3-1=2}$

Observation 1: The line passes the points of (1, 2) and (3, 2.6).

Observation 2: changing from (0, 1) to (1, 3), it changes both intercept and slope.

Final Summary

X is either numerical or categorical:

Slope is the change in Y when X changes 1 unit.

X is categorical:

Slope is: $\dfrac{\text{mean difference between two groups}}{\text{difference between two coding numbers}}$