

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:
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A diagram illustrating the components of a linear regression equation. The equation $Y = b_0 + b_1X$ is centered at the top. A curved arrow originates from the text "Numerical data (continuous data)" on the left and points to the variable Y . Another curved arrow originates from the text "Can be either numerical data or categorical data." on the right and points to the variable X .

$$Y = b_0 + b_1X$$

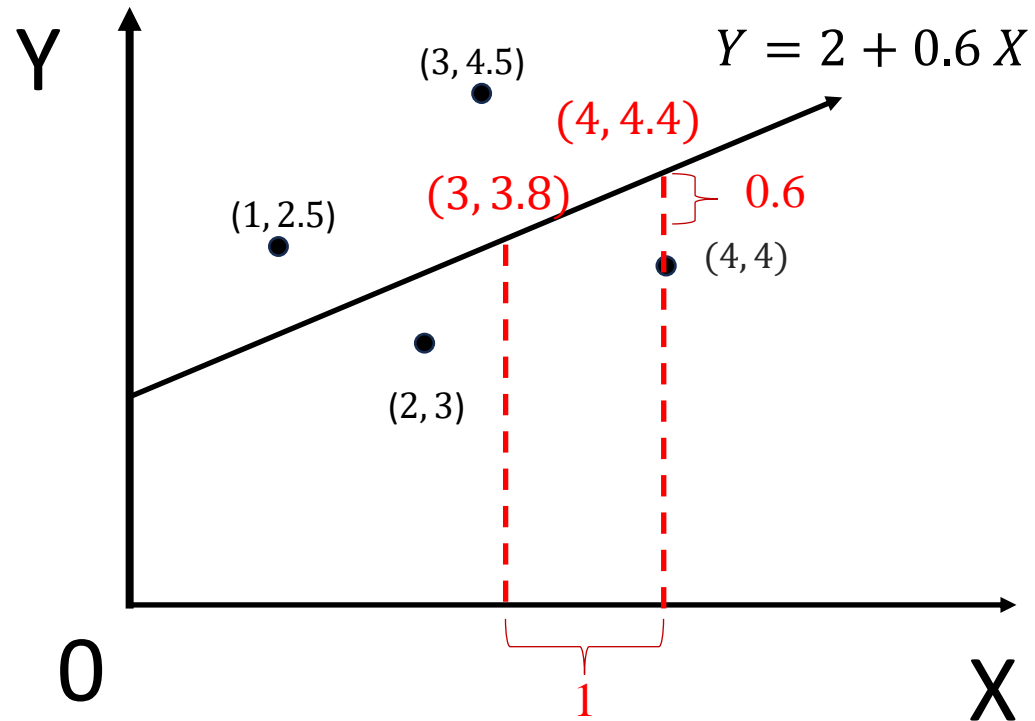
Numerical data
(continuous data)

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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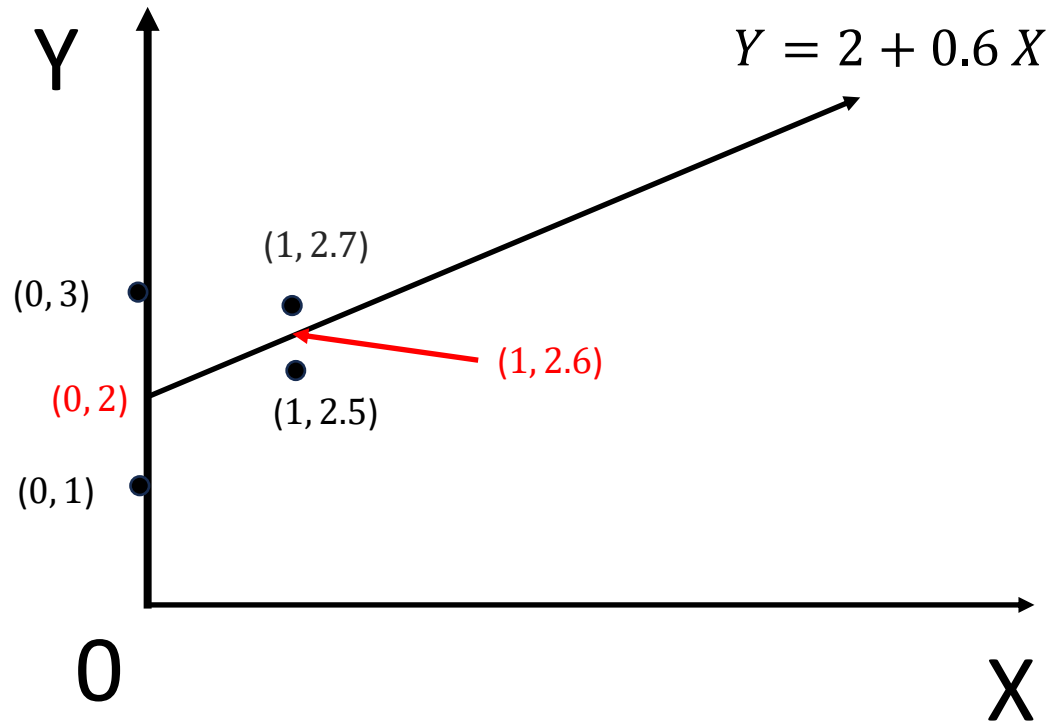


x	y
3	4.5
4	4
1	2.5
2	3

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

Situation 2: X is Categorical

Situation 2: X is Categorical



x	y
0	3
0	1
1	2.5
1	2.7

Red curly braces on the right side of the table indicate the mean y-values for each group: a brace for the first two rows (y=3 and y=1) is labeled '2', and a brace for the last two rows (y=2.5 and y=2.7) is labeled '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:

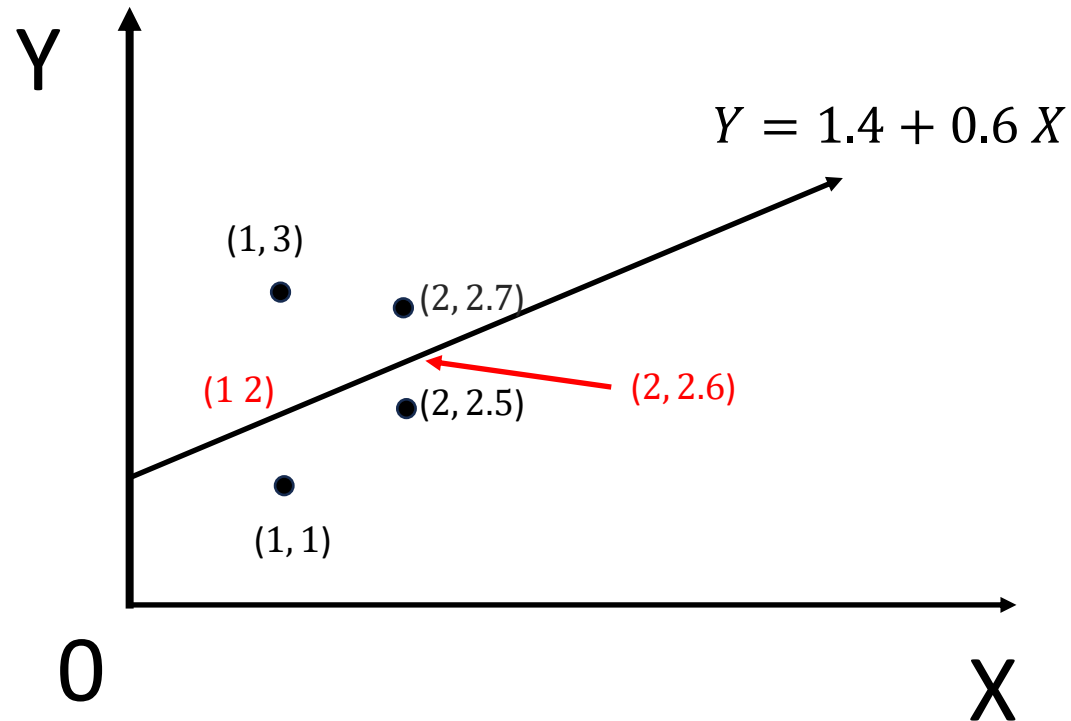
Slope is the change in Y when X changes 1 unit.

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

Mean values for each group: 2 for x=1, 2.6 for x=2.

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

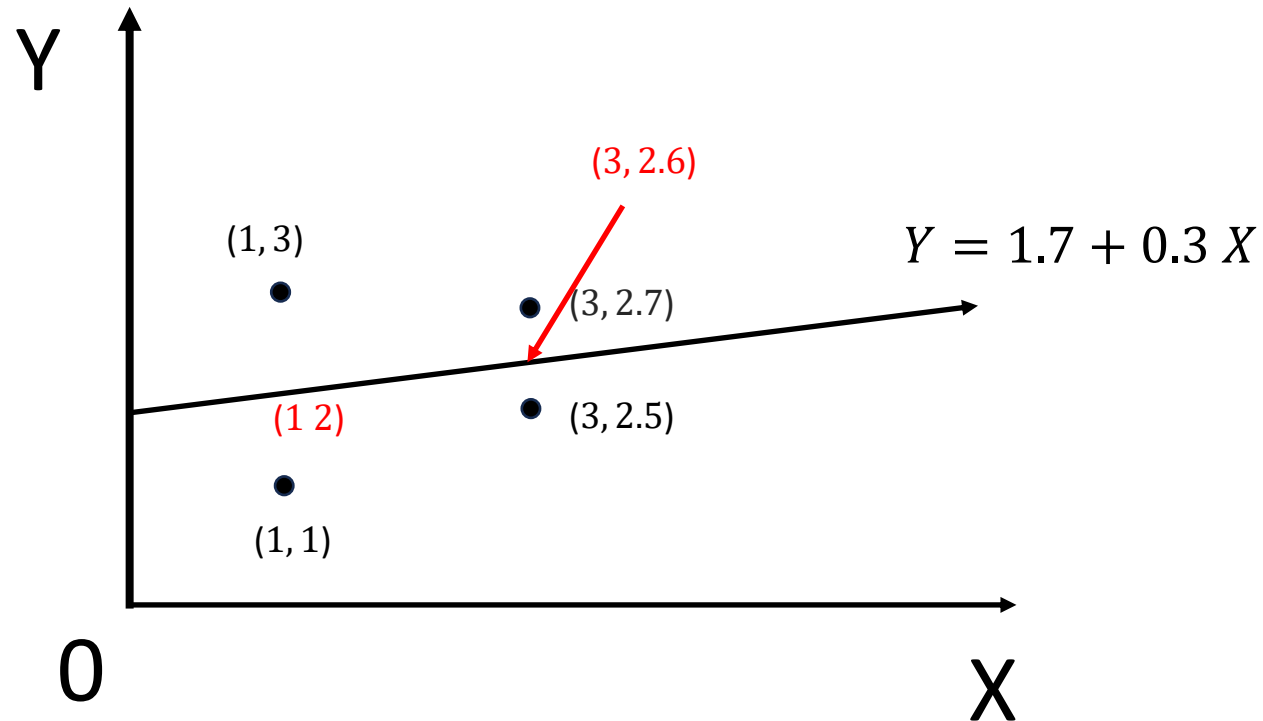
Meaning 2: Slope ($b_1=0.6$) is the mean difference between two groups.

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: $\frac{\text{mean difference between two groups}}{\text{difference between two coding numbers}}$