Visualizing Slope: Study Hours vs. Exam Scores

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Real-World Dataset

We'll use student study hours (X) and exam scores (Y) to demonstrate slope:

Student	1	2	3	4	5
Hours (X)	2	4	6	8	10
Score (Y)	50	70	80	85	95

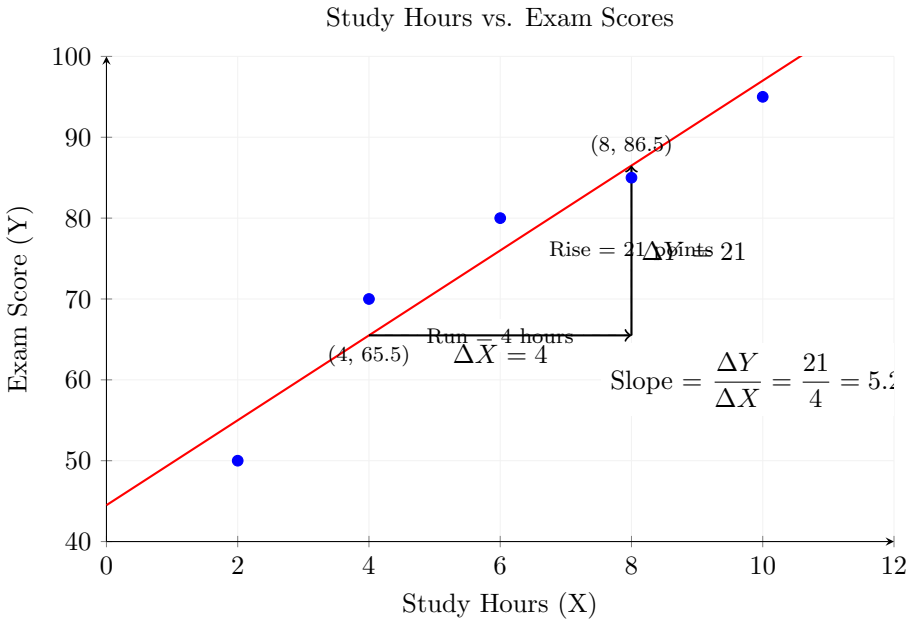
Regression Line Equation

From previous calculations:

$$\hat{Y} = 44.5 + 5.25X$$

- **Slope ($b_1 = 5.25$)**: For every additional hour studied, scores increase by 5.25 points
- **Intercept ($b_0 = 44.5$)**: Expected score with 0 hours studied

Visualizing the Slope



Interpreting the Slope

The slope ($b_1 = 5.25$) represents:

- **Direction**: Positive relationship (line slopes upward)
- **Magnitude**: Each hour of studying adds 5.25 points
- **Practical meaning**:
  - Student studying 4 hours: Predicted score $= 44.5 + 5.25 \times 4 = 65.5$
  - Student studying 8 hours: Predicted score $= 44.5 + 5.25 \times 8 = 86.5$
  - Difference: $86.5 - 65.5 = 21$ points over 4 hours

Mathematical Foundation

The slope is derived from covariance and variance:

$$b_1 = \frac{\text{Cov}(X, Y)}{\text{Var}(X)} = \frac{52.5}{10} = 5.25$$

Where:

- Covariance (52.5): Joint variability of hours and scores
- Variance of X (10): Spread of study hours

Teaching Activity: Predict Scores

Study Hours	**Predicted Score**	**Calculation**
0	44.5	$44.5 + 5.25 \times 0$
yellow!20 4	65.5	$44.5 + 5.25 \times 4$
8	86.5	$44.5 + 5.25 \times 8$
12	107.5	$44.5 + 5.25 \times 12$

- **Note**: Highlighted row shows the starting point in the diagram
- **Question**: What score would a student studying 5 hours get? (Answer: $44.5 + 5.25 \times 5 = 70$)