

Covariance: Discover How Data Variables Connect

Data Science and A.I. Lecture Series

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Problem Statement

- Calculate the covariance between X and Y .

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- Given pairs of observations (x_i, y_i) :

$(2, 4), (10, 15), (20, 12), (10, 16), (17, 17), (12, 10), (15, 11), (16, 8)$

Table of Values

- The data is summarized as follows:

x_i	y_i	$x_i y_i$
2	4	8
10	15	150
20	12	240
10	16	160
17	17	289
12	10	120
15	11	165
16	8	128
$\sum x_i = 102$	$\sum y_i = 93$	$\sum x_i y_i = 1260$

Formula for Covariance

- The formula for covariance is:

$$\text{Cov}(X, Y) = \frac{1}{n} \sum x_i y_i - \left(\frac{1}{n} \sum x_i \right) \left(\frac{1}{n} \sum y_i \right)$$

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- Given values:

$$n = 8, \quad \sum x_i = 102, \quad \sum y_i = 93, \quad \sum x_i y_i = 1260$$

- Substituting the values into the formula:

$$\text{Cov}(X, Y) = \frac{1}{8}(1260) - \left(\frac{102}{8}\right) \left(\frac{93}{8}\right)$$

Solution and Interpretation

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$$\text{Cov}(X, Y) = \frac{1}{8}(1260) - \left(\frac{102}{8}\right) \left(\frac{93}{8}\right)$$

- Simplify:

$$\text{Cov}(X, Y) = 157.5 - (12.75 \times 11.625)$$

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- Final answer:

$$\text{Cov}(X, Y) = 157.5 - 148.21 = 9.29$$

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- **Interpretation:** A positive covariance (9.29) indicates that X and Y tend to increase together. However, the magnitude of covariance does not indicate the strength of the relationship.

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