# CORRELATION

## DESCRIPTIVE STATISTICS

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# TOPIC OUTLINE

## Covariance

## Correlation Coefficient

# COVARIANCE

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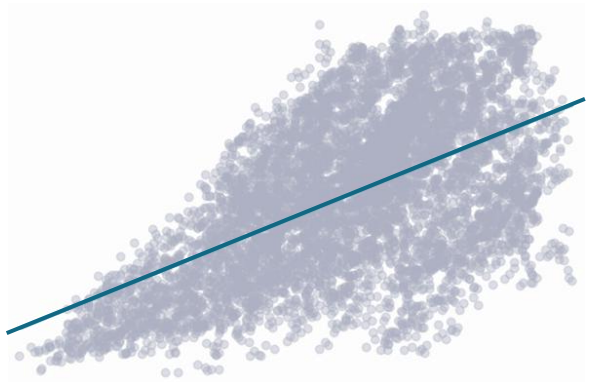
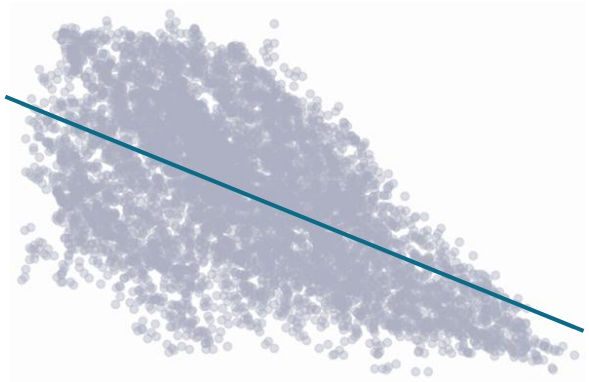
**Covariance** is a statistical measure that quantifies the **relationship** between two random variables $(\boldsymbol{X}, \boldsymbol{Y})$.

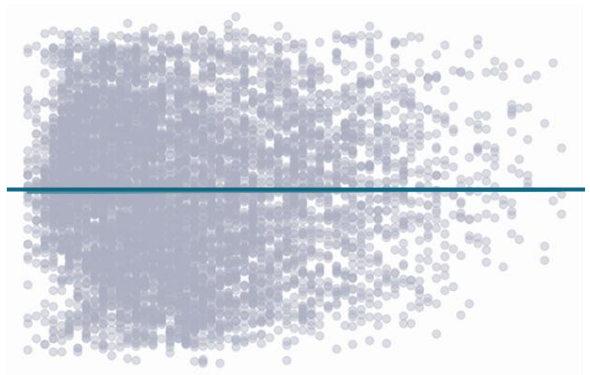
Scatter Plot



**Covariance > 0**



**Covariance < 0**



**Covariance = 0**

# COVARIANCE

**Covariance** is a statistical measure that quantifies the **relationship** between two random variables $(\boldsymbol{X}, \boldsymbol{Y})$.

Population Covariance

$$\sigma_{xy} = \frac{\sum_{i=1}^{N}(x_i - \mu_x)(y_i - \mu_y)}{N}$$

Sample Covariance

$$s_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{n-1}$$

# COVARIANCE

**Covariance** is a statistical measure that quantifies the **relationship** between two random variables ($\boldsymbol{X}, \boldsymbol{Y}$).

The `df.cov()` method is used to compute the covariance matrix of a DataFrame.

# EXERCISE

The given dataset contains five observations of current (A) and corresponding power (W) measurements. Does **current** and **power** consumption have a positive, negative, or no **linear relationship**?

Solution

Device

| Current | Power |
|---|---|
| 2 | 100 |
| 3.5 | 200 |
| 1.8 | 90 |
| 4.2 | 210 |
| 2.7 | 110 |

# CORRELATION COEFFICIENT

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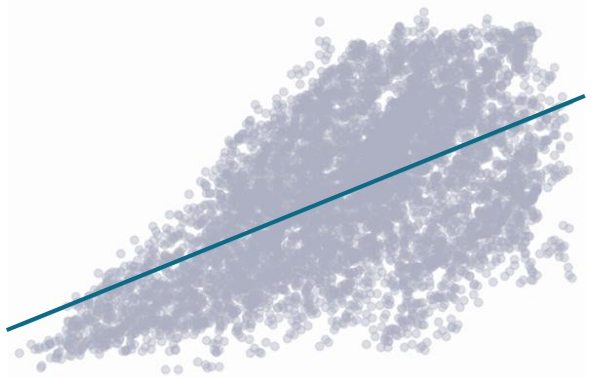
Scatter Plot

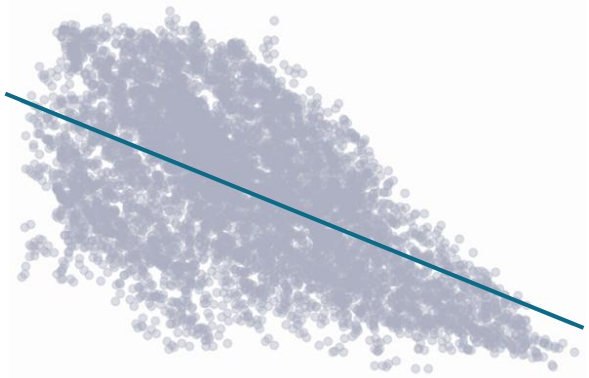
**Correlation coefficient** adjusts covariance, so that the relationship between the two variables becomes easy and intuitive to interpret.

It ranges from $-1$ to $+1$:

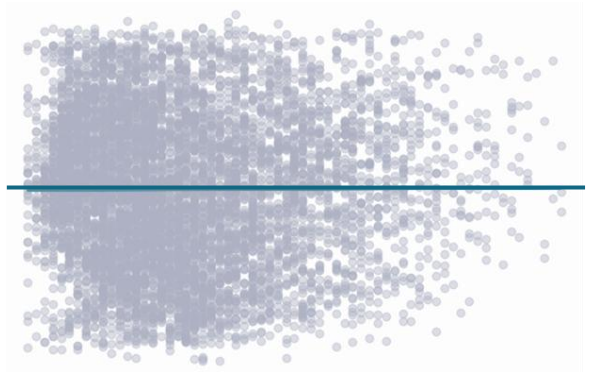
- $+1$ indicates perfect positive correlation
- $-1$ indicates perfect negative correlation
- $0$ indicates no linear relationship



Correlation > 0



Correlation < 0



Correlation = 0

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Population Correlation Coefficient

$$r = \frac{\sigma_{xy}}{\sigma_x \sigma_y}$$

Sample Correlation Coefficient

$$r = \frac{s_{xy}}{s_x s_y}$$

# CORRELATION COEFFICIENT

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The `df.corr()` method is used to compute the correlation matrix of a DataFrame.

# EXERCISE

Determine if each scenario suggests a positive, negative, or no correlation:

1. Ice cream sales and umbrella sales in a city.
2. Hours spent studying and exam scores.
3. A person's shoe size and their IQ.
4. Age of a used car and its resale value.

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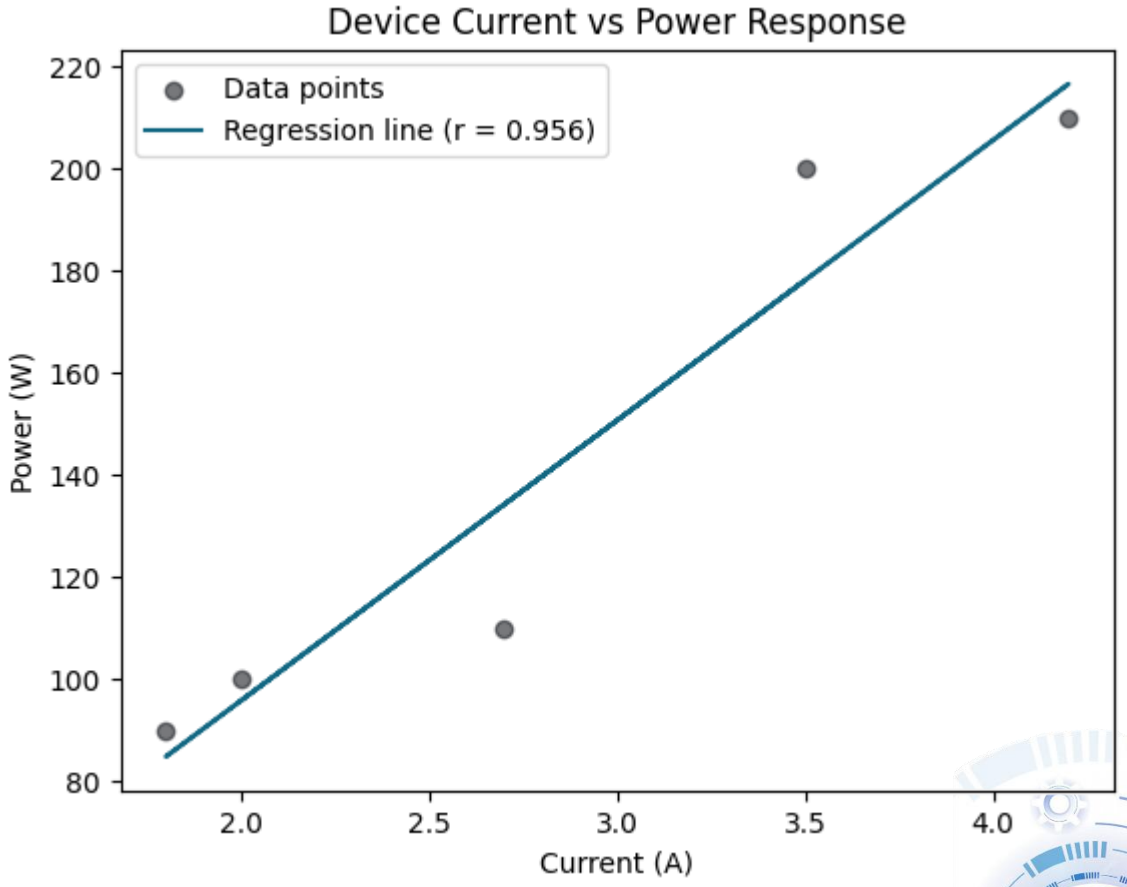
$\bar{x} = 2.84$ $\bar{y} = 142$ $s_{xy} = 56.15$

$s_x = 1.011$ $s_y = 58.05$

Solution



# LABORATORY