## 1. Descriptive Statistics

Descriptive statistics summarise and describe the main characteristics of a dataset.

#### Key Measures and Real-World Examples

a. Measures of Central Tendency

1. Mean (Average)  
   Formula:  
   Mean = ΣX / n  
   Example:  
   Monthly sales (in units) for a store: [120, 150, 180, 200, 250]  
   Calculation:  
   Mean = (120 + 150 + 180 + 200 + 250) / 5 = 180  
   Interpretation: The store sells an average of 180 units per month.
2. Median  
   Example:  
   Sales data: [120, 150, 180, 200, 250]  
   Sorted order: [120, 150, 180, 200, 250]  
   The middle value is 180.
3. Mode  
   The most frequent value in the dataset.  
   Example:  
   Customer satisfaction ratings: [4, 4, 5, 3, 4, 3, 5, 4]  
   Mode = 4 (most frequent).

b. Measures of Dispersion

1. Range  
   Formula:  
   Range = Maximum Value - Minimum Value  
   Example:  
   Sales data: [120, 150, 180, 200, 250]  
   Range = 250 - 120 = 130
2. Variance and Standard Deviation  
   Variance Formula:  
   Variance (σ²) = Σ(Xᵢ - 𝑋̄)² / n  
   Standard Deviation Formula:  
   Standard Deviation (σ) = √Variance  
   Example:  
   Daily temperatures: [30, 32, 34, 36, 38]
   * Mean = 34
   * Variance = [(30 - 34)² + (32 - 34)² + (34 - 34)² + (36 - 34)² + (38 - 34)²] / 5 = 8
   * Standard Deviation = √8 = 2.83

## 2. Inferential Statistics

Inferential statistics help draw conclusions about a population based on sample data.

#### Key Concepts and Real-World Examples

a. Hypothesis Testing

* Null Hypothesis (H₀): There is no difference/effect.
* Alternative Hypothesis (Hₐ): There is a difference/effect.

Example:  
Does a new marketing strategy increase sales?

* Sales before strategy: [200, 210, 215, 220, 230]
* Sales after strategy: [250, 260, 270, 280, 300]

Interpretation: If p < 0.05, the difference is statistically significant.

b. Confidence Intervals (CI)  
Formula:  
CI = 𝑋̄ ± Z × (σ / √n)

Example:

* Sample mean = 180, Std Dev = 15, n = 25, Z = 1.96
* CI = 180 ± 1.96 × (15 / √25)
* CI = (174.12, 185.88)

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## 3. Probability

Probability quantifies the likelihood of events.

#### Key Concepts and Real-World Examples

a. Simple Probability

Example:  
A bag contains 5 red, 3 blue, and 2 green balls.

* Total balls = 5 + 3 + 2 = 10
* Probability (P) = Favourable Outcomes / Total Outcomes
* P(Blue) = 3 / 10 = 0.3

b. Conditional Probability  
Formula:  
P(A | B) = P(A ∩ B) / P(B)

Example:  
A factory produces 60% A-grade items and 40% B-grade items. If 5% of A-grade and 10% of B-grade items are defective, what is the probability that a defective item is A-grade?

We are given:

* P(A) = 0.60 (probability that an item is A-grade)
* P(B) = 0.40 (probability that an item is B-grade)
* P(D | A) = 0.05 (probability that an A-grade item is defective)
* P(D | B) = 0.10 (probability that a B-grade item is defective)

We want to find P(A | D), the probability that a defective item is A-grade.

### Bayes' Theorem:

Bayes' Theorem states:

P(A | D) = (P(D | A) \* P(A)) / P(D)

Where:

* P(A | D) is the probability that the item is A-grade given that it is defective.
* P(D | A) is the probability that an A-grade item is defective.
* P(A) is the probability that an item is A-grade.
* P(D) is the total probability that an item is defective.

To calculate P(D) (the total probability of a defective item), we use the law of total probability:

P(D) = P(D | A) \* P(A) + P(D | B) \* P(B)

### Step 1: Calculate P(D)

P(D) = (0.05 \* 0.60) + (0.10 \* 0.40) P(D) = 0.03 + 0.04 P(D) = 0.07

### Step 2: Apply Bayes' Theorem

Now, we can calculate P(A | D):

P(A | D) = (0.05 \* 0.60) / 0.07 P(A | D) = 0.03 / 0.07 P(A | D) ≈ 0.4286

### Conclusion:

The probability that a defective item is A-grade is approximately 0.4286 or 42.86%.

c. Bayes’ Theorem  
Formula:  
P(A | B) = [P(B | A) × P(A)] / P(B)

## 4. Frequency Distribution

Frequency distribution shows how often each value occurs.

Example: Exam scores: [70, 80, 90, 70, 80, 90, 90, 100, 70]

Score Frequency

70 3

80 2

90 3

100 1

Example Graphs : [Example\_Graphs.ipynb](https://colab.research.google.com/drive/1wIgp95JaDj28FGadHLQ_ImhLzTtwQSgZ?usp=sharing)