SNS COLLEGE OF TECHNOLOGY

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

Department of Computer Science and Engineering

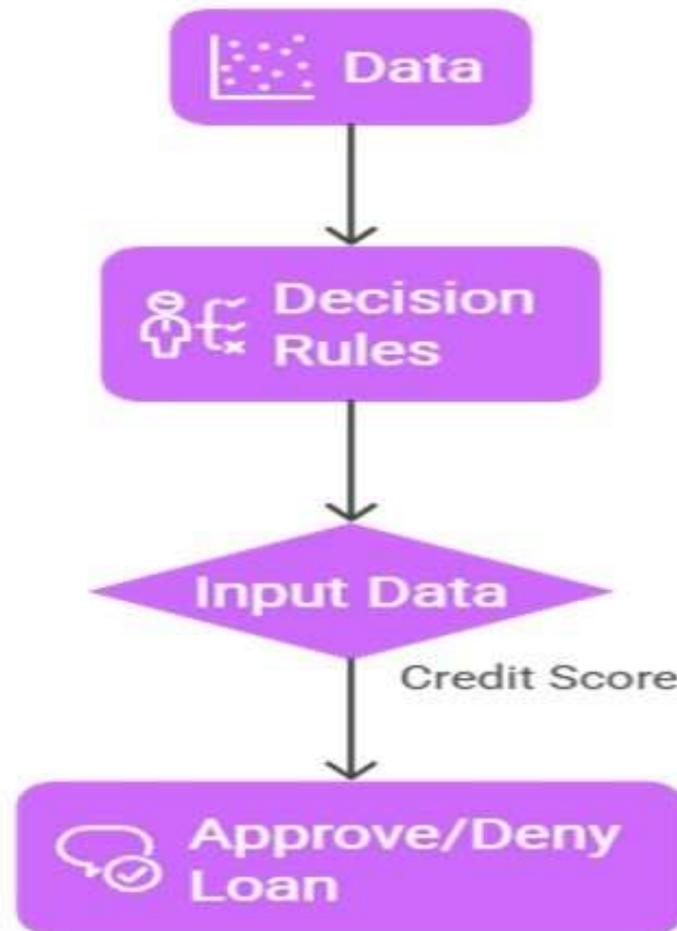# Course Code & Title : 23ADO201 - Data Science Fundamentals

III YEAR / VI SEMESTER - ECE
Unit 3 - INFERENTIAL STATISTICS
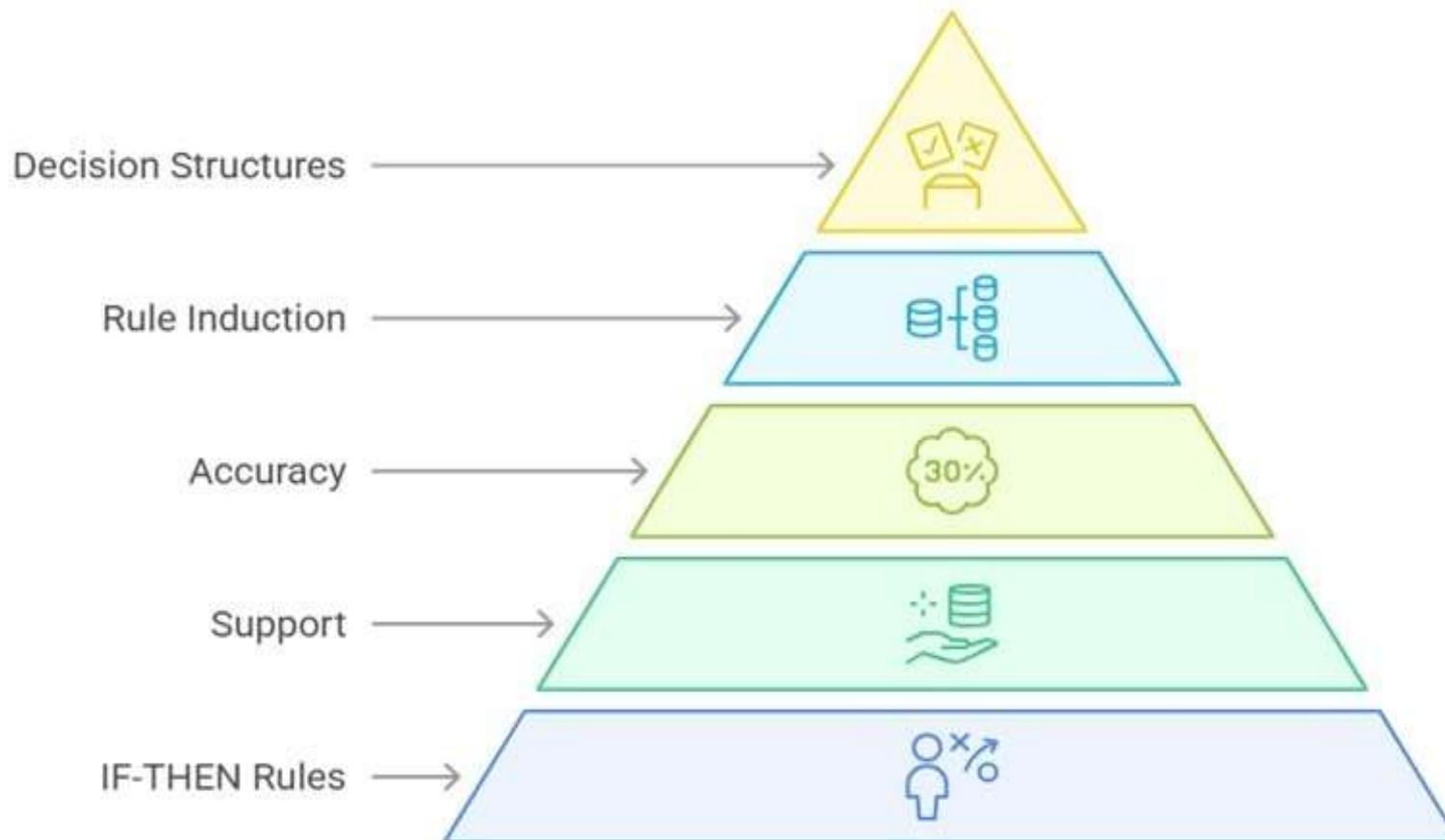## Topic : Decision rule, Calculations and Decisions
K.KARTHIKEYAN AP /CSE

Decision Rules in Data Science

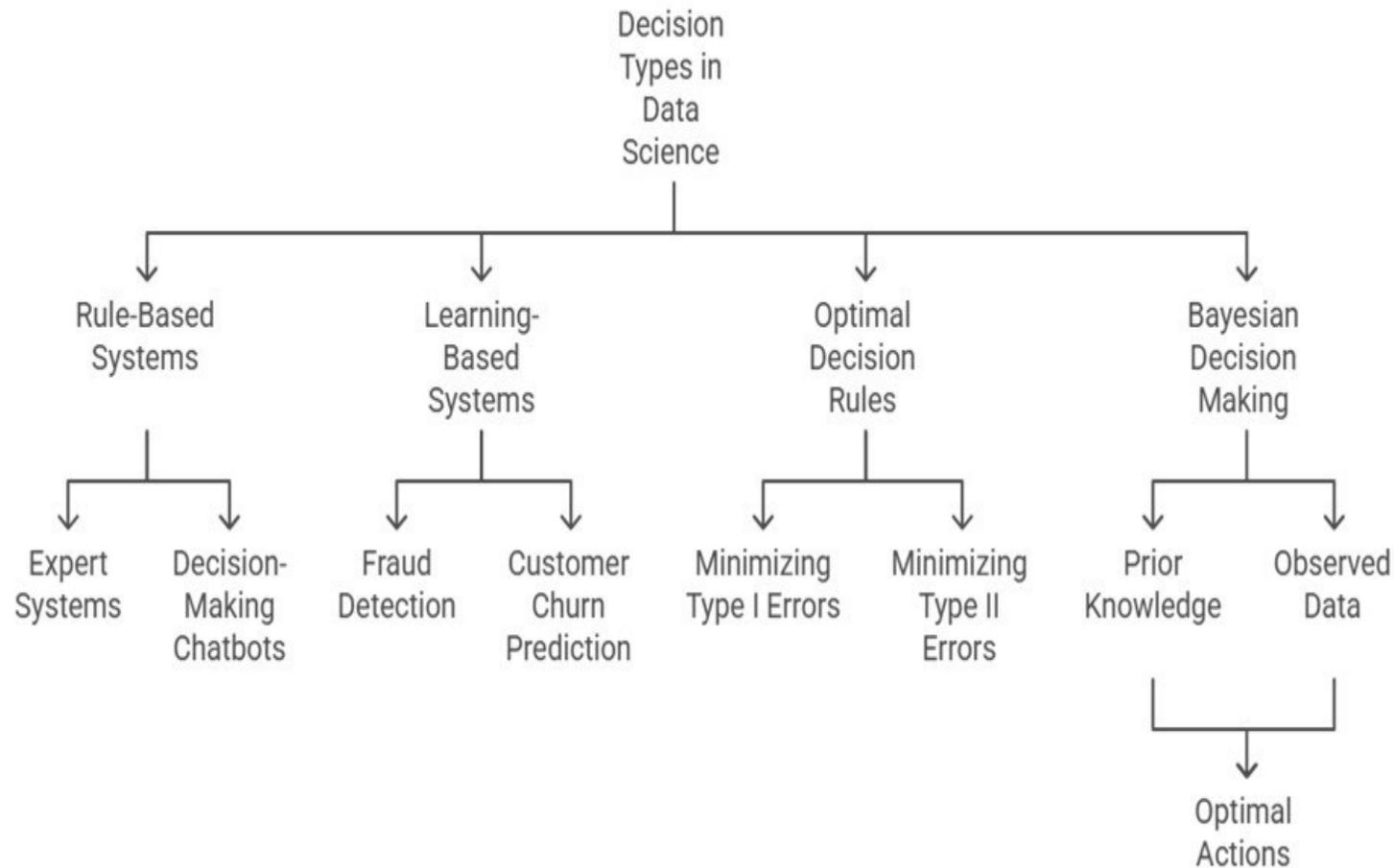# Descision Rule Hierarchy

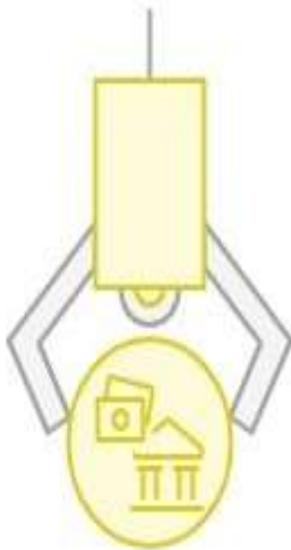**Decision Rule Hierarchy**

- Decision Structures
- Rule Induction
- Accuracy — 30%
- Support
- IF-THEN Rules

DECISION RULE, CALCULATIONS AND DECISIONS / 23ADO201 - DATA SCIENCE FUNDAMENTALS / K.KARTHIKEYAN/AP/CSE/SNSCT

Decision Types in Data Science

Decision Types in Data Science
- Rule-Based Systems
  - Expert Systems
  - Decision-Making Chatbots
- Learning-Based Systems
  - Fraud Detection
  - Customer Churn Prediction
- Optimal Decision Rules
  - Minimizing Type I Errors
  - Minimizing Type II Errors
- Bayesian Decision Making
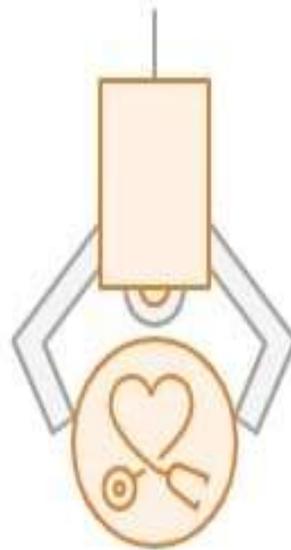 - Prior Knowledge
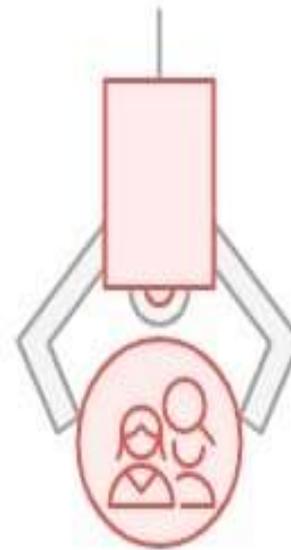 - Observed Data
    - Optimal Actions

Common Applications

Banking
Credit scoring to determine loan approval.

Healthcare
Disease diagnosis based on symptoms.

Marketing
Identifying customer segments likely to churn.

E-commerce

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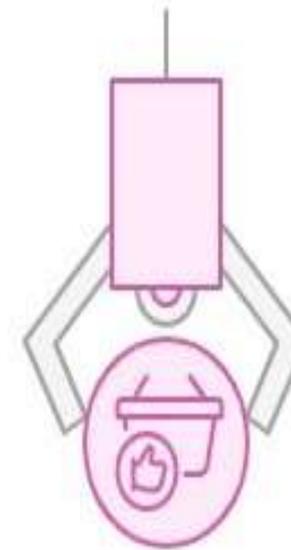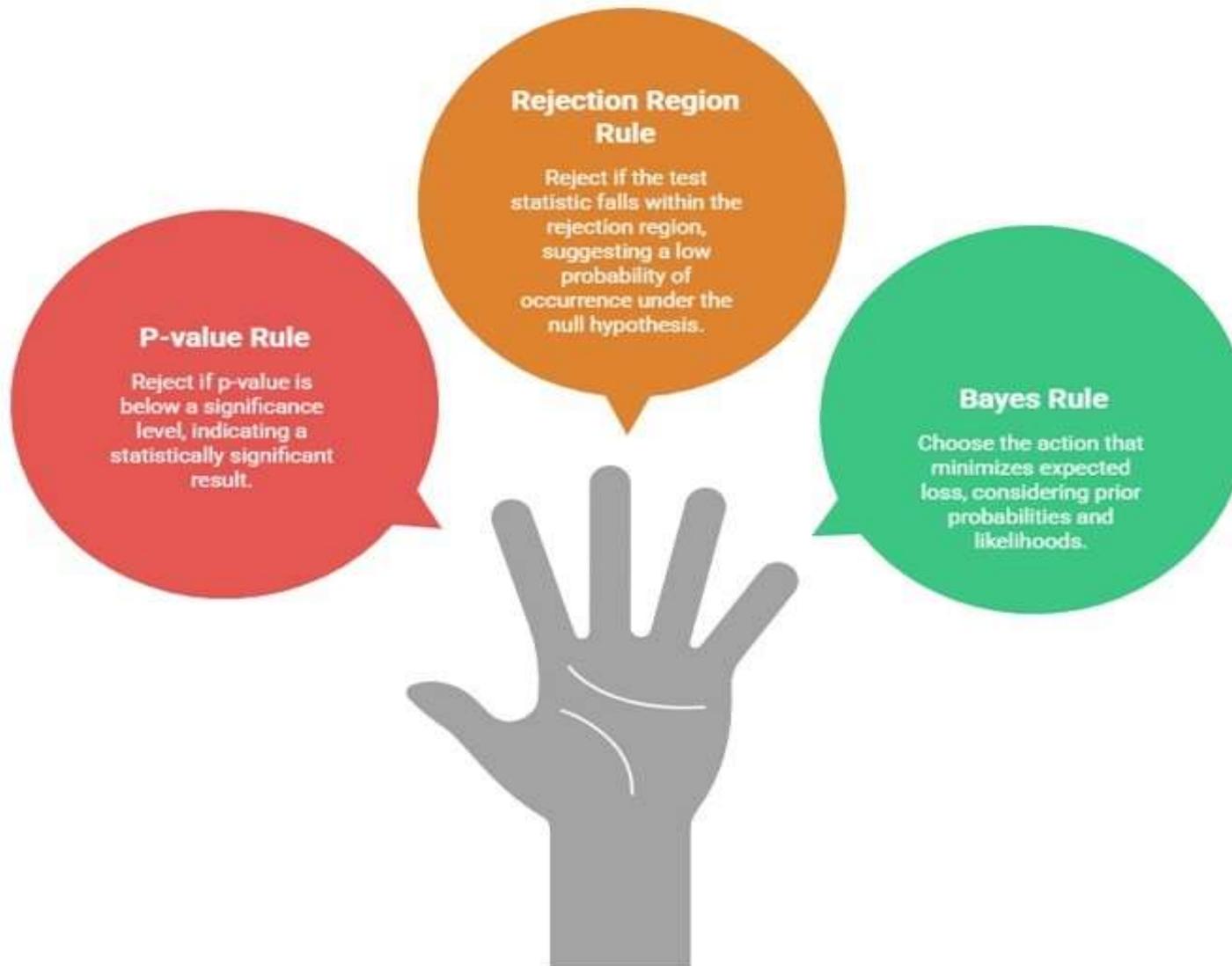
Example Decision Rule

Problem -1

A company claims that the **average lifetime of a bulb is 1000 hours**. A sample of **36 bulbs** is tested and the **sample mean lifetime is 960 hours**. The **population standard deviation is 120 hours**. Test the claim at **5% significance level** using a **Z-test**.
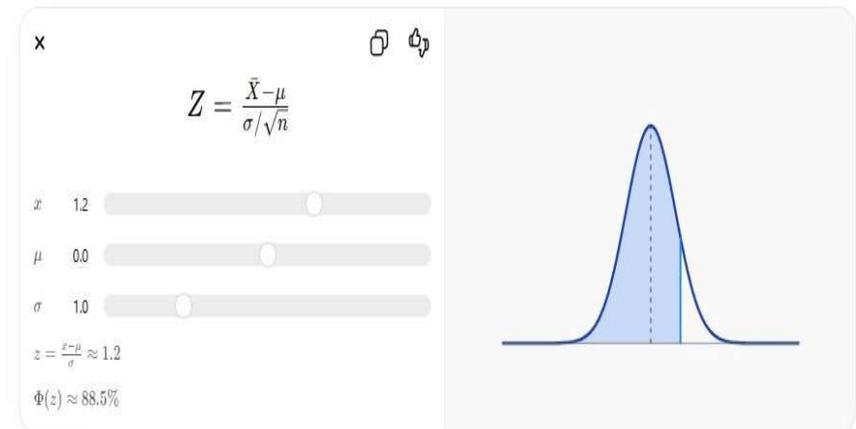
Step 1: State the Hypotheses
- Null Hypothesis (H_0): $\mu = 1000$
- Alternative Hypothesis (H_1): $\mu \neq 1000$

Step 2: Significance Level

$\alpha = 0.05$

Since it is a **two-tailed test**, the critical values are **±1.96**.

Step 3: Test Statistic Formula

$$Z = \frac{\bar{X} - \mu}{\sigma/\sqrt{n}}$$

x 1.2

μ 0.0

σ 1.0

$z = \frac{x - \mu}{\sigma} \approx 1.2$

$\Phi(z) \approx 88.5\%$

Where:

- $\bar{X}$ = Sample mean
- μ = Population mean
- σ = Population standard deviation
- n = Sample size

Step 4: Calculation

$$Z = \frac{960 - 1000}{120/\sqrt{36}}$$

$$Z = \frac{-40}{120/6}$$

$$Z = \frac{-40}{20} = -2$$

Step 5: Decision Rule

- If $Z < -1.96$ or $Z > 1.96$, **Reject H$_0$**
- If $-1.96 \leq Z \leq 1.96$, **Accept H$_0$**

Step 6: Conclusion

Calculated **Z = -2**

Since **-2 < -1.96**, we **Reject the Null Hypothesis.**

✅ **Conclusion:** There is enough evidence at the **5% significance level** to conclude that the **average lifetime of the bulbs is different from 1000 hours.**

Activity

**Activity: Understanding the Decision Rule in Hypothesis Testing**

Objective:

To help students understand how a decision rule is used to accept or reject a null hypothesis in hypothesis testing.

Activity Scenario

A company claims that the average battery life of its product is 10 hours. A sample of 25 batteries is tested, and the sample mean is found to be 9 hours. The population standard deviation is 2 hours. The test is conducted at a 5% significance level.

Test Statistic Formula

$$Z = \frac{\bar{X} - \mu}{\sigma/\sqrt{n}}$$

x	1.2
μ	0.0
σ	1.0

$z = \frac{x-\mu}{\sigma} \approx 1.2$

$\Phi(z) \approx 88.5\%$
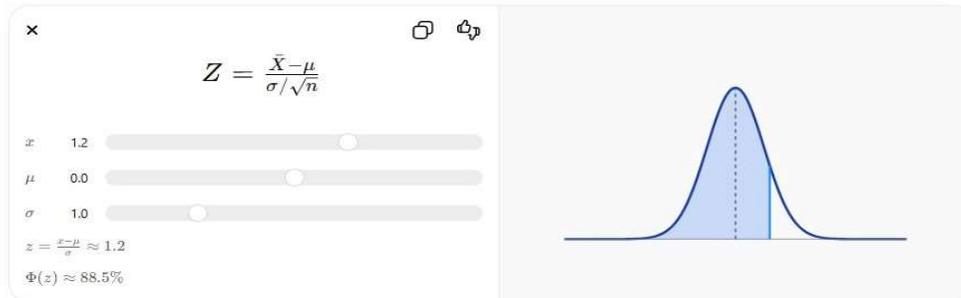
Conclusion of Activity

Since the calculated **Z** value (−2.5) is **less than −1.96**, the **null hypothesis is rejected.**

This means the **average battery life is significantly different from 10 hours.**

Step	Student Task	Answer
1	Identify the Null Hypothesis (H₀)	$\mu = 10$ hours
2	Identify the Alternative Hypothesis (H₁)	$\mu \neq 10$ hours
3	Identify the significance level	$\alpha = 0.05$
4	Determine the critical value	$Z = \pm 1.96$
5	Use the formula to calculate Z	See formula below
6	Substitute the values	$Z = (9 - 10) / (2 / \sqrt{25})$
7	Calculate the Z value	$Z = -2.5$
8	Apply the decision rule	Reject H₀ if $Z < -1.96$ or $Z > 1.96$
9	Final Decision	Reject H₀

MCQ

MCQ questions on Decision Rule in Hypothesis Testing.

1. What is a decision rule in hypothesis testing?

A) A method used to collect data

B) A rule used to decide whether to reject or accept the null hypothesis

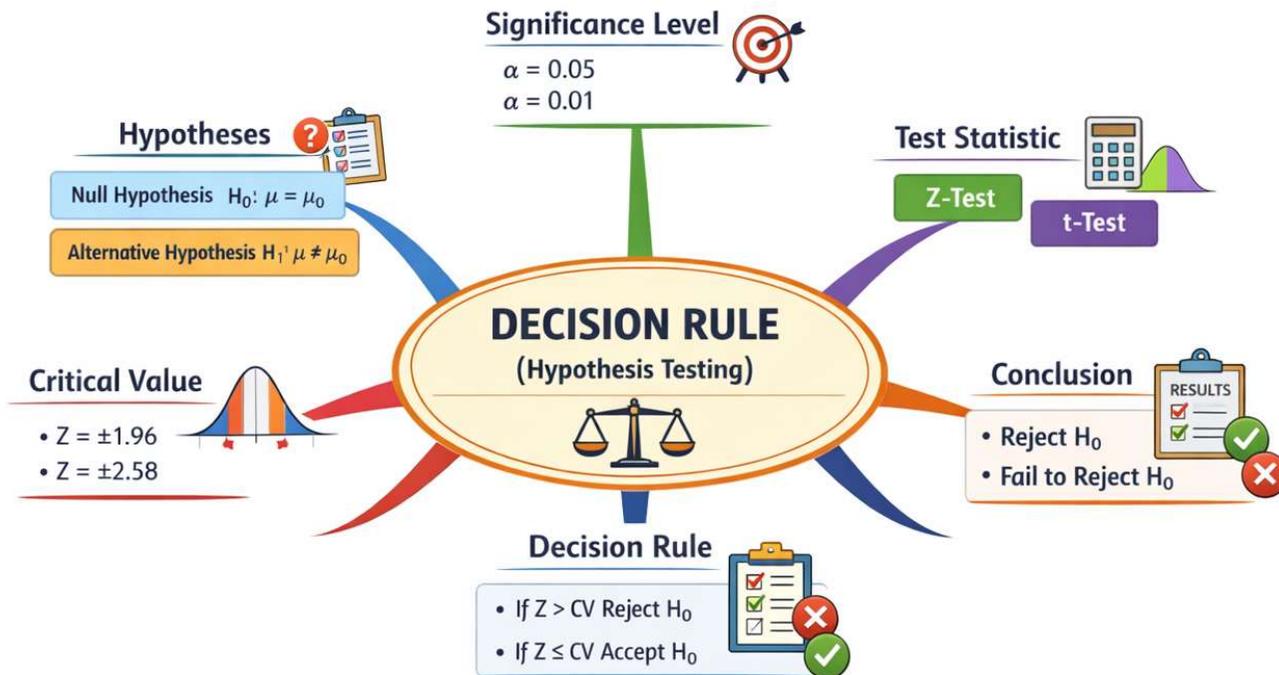C) A formula used to calculate the mean

D) A method used to draw graphs

Answer: B

2. The decision rule is based on which of the following?

A) Sample size only

B) Level of significance and critical value

C) Mean and median

D) Range of the data

Answer: B

MIND MAP

REFERENCE BOOKS

1.Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.
2.Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, "Fundamentals of Data Science", CRC Press, 2022.
3.Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020.
4.Vineet Raina, Srinath Krishnamurthy, "Building an Effective Data Science Practice: A Framework to Bootstrap and Manage a Successful Data Science Practice", A press, 2021.

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