Universal Framework for Hypothesis Testing

First Principles Method

Step 1: Formulate Null Hypothesis (H_0)

The Principle: H_0 is the stated standard or claim. It represents "no change."

- **Look for:** Values linked to words like: *intended, produces, claims, set to, mean of.*
- **Formula:**

$$H_0 : \mu = \text{stated value}$$

Step 2: Formulate Alternative Hypothesis (H_1)

The Principle: H_1 is the suspicion or the goal of the test.

Look for keywords in the "Test" sentence:

1. "Differ / Proper / Accurate / Significant difference"

$$H_1 : \mu \neq \text{stated value}$$

2. "Successful / Increased / Superior"

$$H_1 : \mu > \text{stated value}$$

3. "Inferior / Decreased / Reduced"

$$H_1 : \mu < \text{stated value}$$

Step 3: Find Calculated Value (t_calc)

The Principle: Use sample data ($|(x), s, n$) to see how far the result is from the standard.

The Formula:

$$t_{\text{calc}} = \frac{|(x) - \mu}{\frac{s}{\sqrt{n}}}$$

(Note: Use $\sqrt{n-1}$ only if the question specifically follows the formula in Q7. Most 3-mark questions use n.)

Step 4: The Final Decision

The Principle: Compare your result to the critical value (t_α) given in the brackets.

Condition 1:

$$|t_{\text{calc}}| > t_{\alpha}$$

Reject H_0
(Difference is significant)

Condition 2:

$$|t_{\text{calc}}| \leq t_{\alpha}$$

Accept H_0
(Difference is due to chance)

Application Examples

Question 27 (Net weight of cartons)

1. **Anchor:** "Intended mean of 12 kg" $\rightarrow H_0 : \mu = 12$
2. **Direction:** "Does the mean **differ**?" $\rightarrow H_1 : \mu \neq 12$
3. **Calc:** $|(x) = 11.8, \mu = 12, s = 0.15, n = 10.$
4. **Verdict:** If $|t_{\text{calc}}| > 2.26$ (given), **Reject** $\boldsymbol{H_0}$.

Question 25 (Advertising campaign)

1. **Anchor:** "Mean sales was 50 units" $\rightarrow H_0 : \mu = 50$
2. **Direction:** "Was campaign **successful**?" $\rightarrow H_1 : \mu > 50$
3. **Calc:** $|(x) = 55, \mu = 50, s = 10, n = 20.$
4. **Verdict:** If $|t_{\text{calc}}| > 1.729$ (given), **Reject** $\boldsymbol{H_0}$.

Scenario	Lighthouse Keywords	Math H_1
Two-Tailed	Differ, Accurate, Proper, Validity	$\mu \neq$
Right-Tailed	Successful, Increased, Superior	$\mu >$
Left-Tailed	Inferior, Reduced, Less than	$\mu <$