Hypothesis Testing

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Ex → Person is claimed to have commited a crime.

① Define Null and Alternate Hypothesis.

Null Hyp: Person is innocent.] Reject this

Alternate Hyp: Person is guilty.

Aim: To collect evidence statistically to be able to say that we accept the null hypothesis or reject it.

Note: Never say that we accept Null Hypothesis, we say that we failed to reject Null Hypothesis;

100
- 60% → Guilty
- 40% → Not guilty

100
- 95% → says that person is guilty
- 5% → say that person is innocent.

Significance level →

95% → Guilty

↓

5% → Not Guilty

Punish the person
↓
innocent

Favour of the person

Probability that we are rejected the null hypothesis when it should have been accepted.

To collect the evidence from the data, we have to run some statistical tests →

Z-test, T-test, Chi-squared Test, ANOVA Test

These tests will give us the evidence in the form of 'p-value'.

p-value (The probability that Null Hypothesis is True)
(0 – 1)

Note: To reject the Null Hypothesis

$$\boxed{\text{p-value} < \text{significance level } (\alpha)}$$

P-value < significance level (α)

$0.03 < 0.05$

$3\% < 5\%$

Defining Null and Alternate Hypotheses →

Claim → Apollo Tyres claims that the average life of their tyres is more than 30 months.

Null Hypothesis: Average life <= 30 months.

Null Hyp. contains → =, <=, >=

Alternate Hypothesis: Average life > 30 months

Alternate Hyp. contains: ≠, >, <

Hypothesis Testing can consist of 2-sided hypo-thesis or 1-sided hypothesis

Ex → Suppose if a company claims that the life of its product is exactly 20 months.

$H_0 = 20$ months , $H_A \neq 20$ months

sample

>30

→ 17.4

17.5

22.5

22.8

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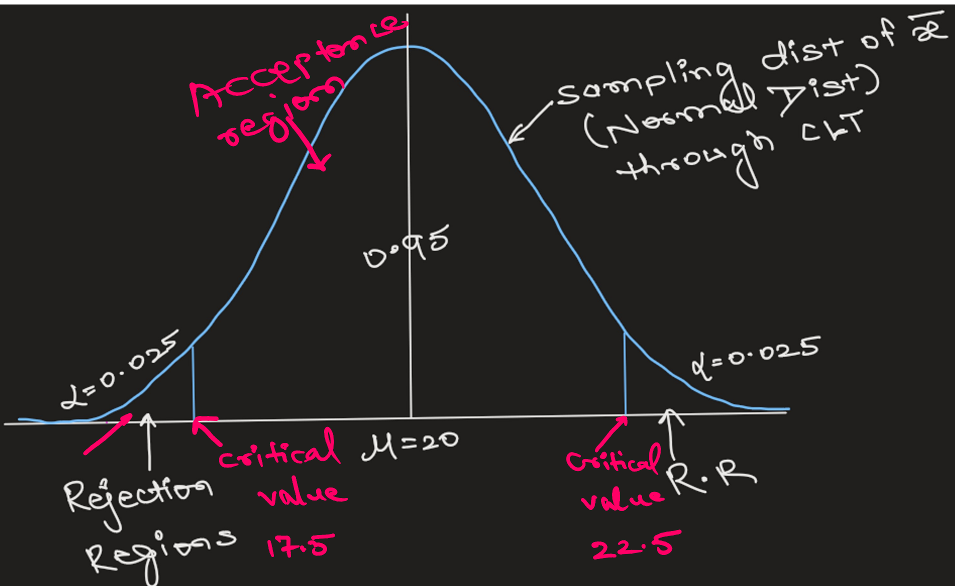
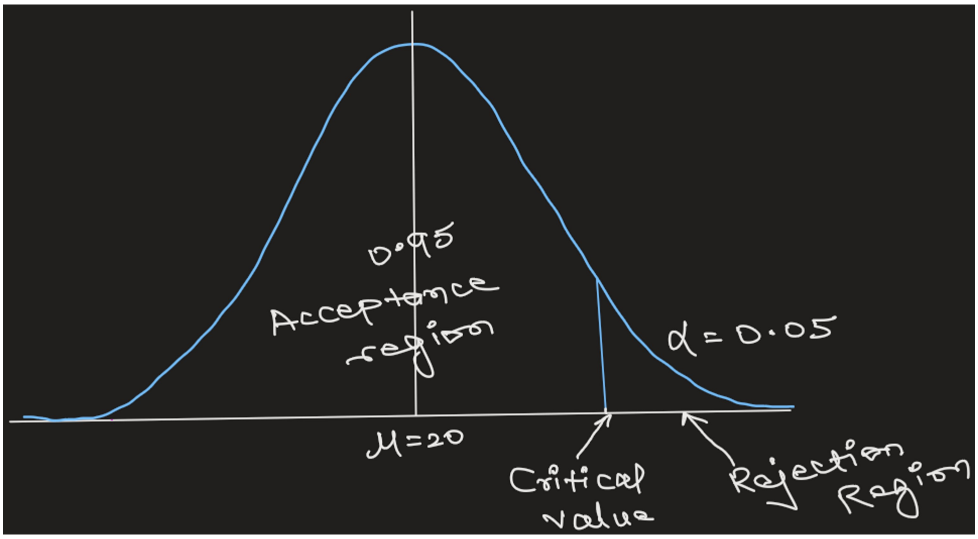


Note: Here the significance level is taken $\alpha = 0.05$, but since it is a two sided hypothesis and rejection region has to be on both sides equally so,

$$\alpha = \frac{0.05}{2} = 0.025 \text{ (each side)}$$

Ex 2 → One-sided hypothesis

$H_0: \mu \leq 20$ months , $H_A: \mu > 20$ months



Steps in Hypothesis Testing →

① Defining / Formulating the Null and Alternate Hypothesis.

② Mention the significance level.

$\alpha = 0.05$ (most common)

Note: If we have very small sample size then we can take α to be 0.10.

→ If we have a very large sample size the we can take α to be 0.01 or 0.02 or 0.03.

③ Run the Hypothesis Tests to collect the evidence against the null hypothesis.

Z-test, T-test, Chi-square Test, ANOVA Test.

④ We get the evidence from these tests in the

④ We get the evidence from these tests in the form of 'p-value'

⑤ To reject the Null Hypothesis

$$\boxed{\text{p-value} < \text{significance level } (\alpha)}$$

Various Tests that we perform →

1 → Z-test : We decide if the population mean is equal to a specific value or not.

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Assumptions →

(i) Sample size > 30. ✗
(ii) Data is normally distributed.
(iii) Population standard deviation is given/known. ✗

② T-test : Comparative study of means b/w two groups or checking whether pop. mean is equal to a value or not.

(i) 1-sample T-test
(ii) 2-sample T-test

Ex → Does salary differ for male and female employees.

Mean salary of male employees	Vs	Mean Salary of female employees

Null : Mean salary (male) = Mean salary (female)

Alternate: Mean salary (male) ≠ Mean salary (female)

If p-value comes out to be < 0.05, then the means are significantly different.

③ ANOVA (Analysis of Variance)

Test whether there is a significant difference b/w more than 2 - samples

Null : Mean of three group samples are same

Alternate : Mean of three group samples are not same.

Ex → Examine the effect of three different medicines on diabetic patients.

M1 → Group A

M2 → Group B

M3 → Group C

Assumptions →

→ Distribution of each group should be normal.

→ Each group should have roughly equal variance.

④ Chi- square Test

When dealing with counts and investigating how the observed counts are different from how the observed counts are different from expected count.

Ex → We want to investigate if there is a relationship b/w gender and the preference of beverages: 'Tea' & 'Coffee'.

	Coffee	Tea	Total
Male	30	20	50
Female	40	110	150
Total	70	130	200

Gender	Pre
M	Tea
F	Coffe
F	Tea
M	Tea