Hypothesis Testing 16 June

10 January 2025 07:04

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. → Reject NH

Null Hyp. contains → =, <=, >=

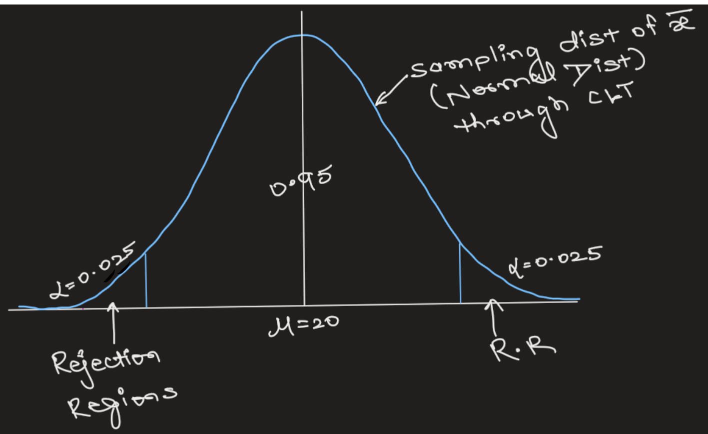
Alternate Hypothesis: Average life > 30 months

Alternate Hyp. contains: ≠, >, <

Hypothesis Testing can consist of 2-sided hypothesis 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

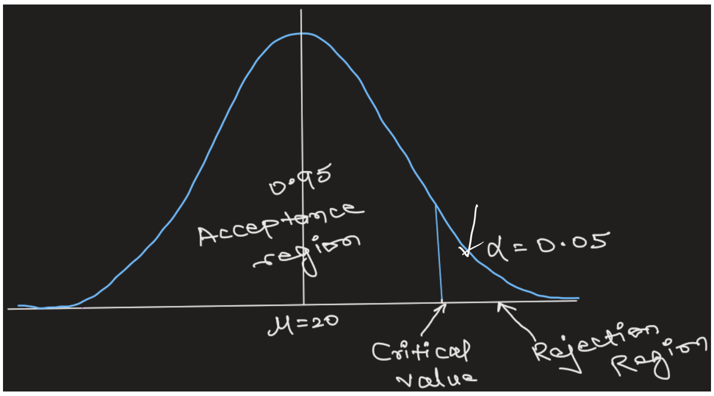


Note: Here the significance level is taken $\alpha = 0.05$, but since it is a two sided hypothesis and rejection region has to be on both sides equally so,

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

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)

<u>Note</u>: 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 form of 'p-value'

⑤ To reject the Null Hypothesis

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

<u>Various Tests that we perform</u> →

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

<u>Assumptions</u> →

(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 expected count.

... to investigate if there is a relationship

Ex → We want to investigate [illegible]
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

Inferential Statistics:

We want to find Pop Mean because it is not known/given.

Sample Mean

Hypothesis Testing:

We know the Pop Mean somehow but before we trust it to be true, we prefer to test it.

Significance Level →

Z-value of sig
↓
Z-statistic
critical-value

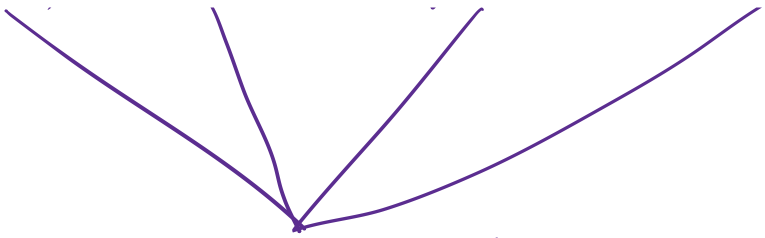
Sample Data
↓
Run some Test on it
↓
We get the proof from the test to be able to decide whether to reject the Null Hypothesis or not.

① PS
→ ② Null AH
③ SD
④ Test on SD

RR

p-value

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



Rejection Region Approach
(critical value)

or

p-value Approach
(p-value)

Test
Data
Proof

Significance Level →

16 June

Person

court → Policemen

Reject this

NH : Person is innocent

AH : Person is guilty

No

60% → Against NH

40% → Favour NH

Reject the NH

> 95% → Against NH

< (5%) → Favour : NH

SL = 5%

There is still 5% chance that we reject the NH when it should have been actually accepted.

significance Level (Possibility of making error while rejecting NH)

Z-test T-test chi-squared ANOVA

Sample Data

↓

p-value (0-1) or critical value

0 → 1

The p-value is the probability that the Null Hypothesis is True.

or

The p-value is the evidence from the data in favour of Null Hypothesis.

Note: To reject the Null Hypothesis

Test
↓
SD
↓
value = 0.03 (3%)

$$\boxed{\text{p-value} < \text{Significance Level } (\alpha) \ (0.05)\ 5\%}$$

p-va

0.03 (3%) < 0.05

Favour of NH

97% > 95%

Against the Null

Ex →

Rs10 → 50 gms (pre)

~~z-test~~

↓

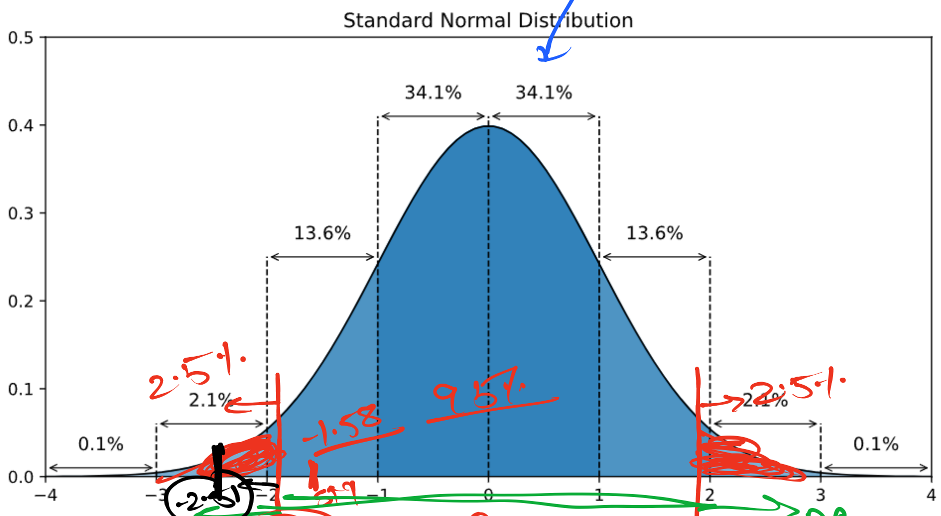
t-test

The organization which manufactures lays packets want to investigate whether the actual weight of lays packets differ from the claimed 50 grams or not.

PM = 50 gms, PSD = 4 gms, SS = 40 packets

① ② ③ ⋮ → SM = 49 gm

CLT



5%

NH

critical value

z-test → z-values

$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} = \frac{49 - 50}{4/\sqrt{40}} = -1.58$$

SM

z-statistic of sample

of sample
mean

significance level → 5%