Tests For Differences Between Mean: Large Sample Sizes:

1. An investigation of the relative merits of two kinds of flashlight batteries showed that a random sample of 100 batteries of brand A lasted on the average 36.5 hours with a standard deviation of 1.8 hours, while a random sample of 80 batteries of brand B lasted on the average 36.8 hours with a standard deviation of 1.5 hours. Use $\alpha = 0.05$ to test whether the observed difference between the average life time is significant.

Sol:- Given that $n_1 = 100$ and $n_2 = 80$

if $n \geq 30$ (large sample mean test)

$\bar{x}_1 = 36.5$, $\sigma_1 = 1.8$ Sample $n_1 = 100$

$\bar{x}_2 = 36.8$, $\sigma_2 = 1.5$ Sample $n_2 = 80$

I NULL HYPOTHESIS (H_0)

H_0: The observed difference between the average life time is not significant.

$H_0: \mu_1 = \mu_2$

ALTERNATIVE HYPOTHESIS (H_1):

H_1: There is significant difference between the average life time.

$H_1: \mu_1 \neq \mu_2$

→ It is two tailed Z-test.

II Computation Test Statistic (C.T.S)

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} \quad \text{(or)} \quad \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}.$$

If σ_1 & σ_2 are not known calculate S_1 & S_2

(2) III Level of Significance

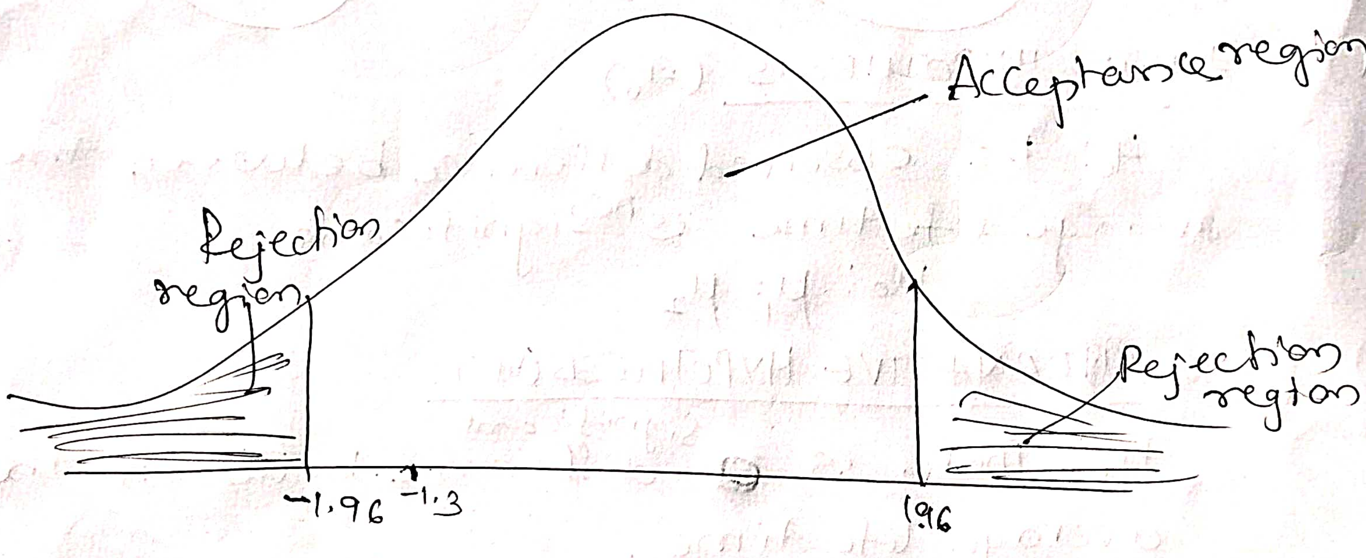
$\alpha = 0.05$ or 5%.

IV Critical value:-

Test \ α%	1%	5%	10%
Two tail	± 2.58	± 1.96	± 1.645
Right tail	2.33	1.645	1.28
left tail	-2.33	-1.645	-1.28

At $\alpha = 5\%$, two tailed test $|Z_{(tab)}| = \pm 1.96$

V Conclusion



$$Z_{(cal)} = \frac{36.5 - 36.8}{\sqrt{\frac{3.24}{100} + \frac{2.25}{80}}} = \frac{-0.3}{\sqrt{0.032 + 0.021}} = \frac{-0.3}{\sqrt{0.053}}$$

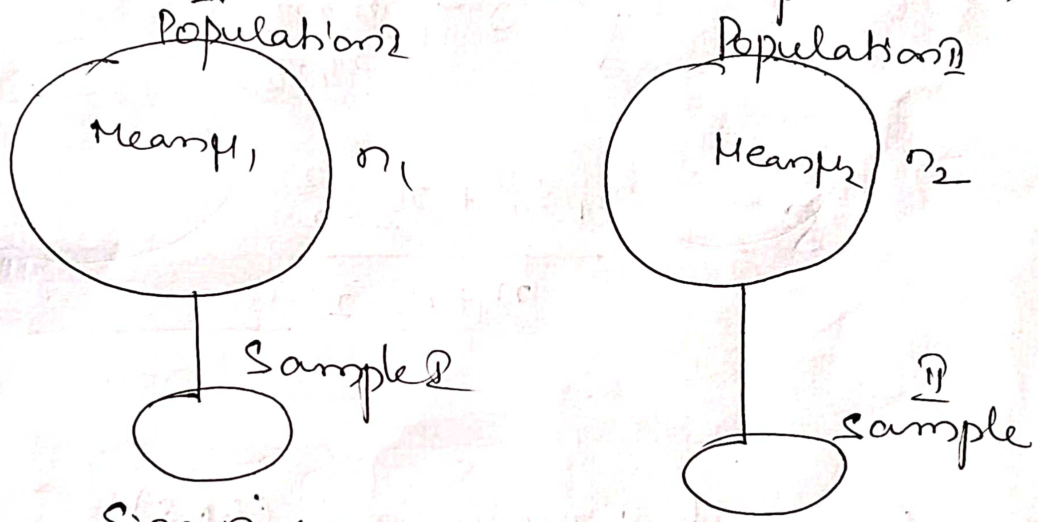
$$Z_{(cal)} = \frac{-0.3}{0.2302} = -1.304$$

$\therefore Z_{(cal)}$ value lies in Acceptance region. We accept H_0 (otherwise reject H_0) i.e., there is no difference between the averages.

1. A Sample of 5 patients treated with medicine 'A' weigh 42, 39, 48, 60 and 41 kgs: Second Sample of 7 patients from the sample hospital treated with medicine 'B' increases the weight ~~significantly~~ 38, 42, 56, 64, 68, 69 and 62 kgs. Do you agree with the claim that medicine 'B' increases the weight significantly?

Sol:- Given $n_1 = 5$, $n_2 = 7$

if $n \leq 30$ (Small sample 't'-test)



Size $n_1 < 30$

$n_1 = 5$

mean $\bar{x}_1 =$

$$\bar{x}_1 = \frac{42+39+48+60+41}{5}$$

$\bar{x}_1 = 46$

Size $n_2 < 30$

$n_2 = 7$

mean $x_2 =$

$$\bar{x}_2 = \frac{38+42+56+64+68+69}{7}$$

$\bar{x}_2 = 277.85$

Standard deviation is not known, it is required find S_1 & S_2

$$S_1^2 = \frac{\Sigma x_1^2 - n_1(\bar{x}_1)^2}{n_1 - 1}$$

$$S_2^2 = \frac{\Sigma x_2^2 - n_2(\bar{x}_1)^2}{n_2 - 1}$$

(4) After we calculate $S_1 =$ $S_2 =$

I Null Hypothesis(H_0): There is no significant difference between two sample means (medicines)

$H_0: \mu_1 = \mu_2$

I Alternative Hypothesis(H_1): There is an increase from medicine A to medicine B. $H_1: \mu_1 < \mu_2$

→ It is ~~LT~~-tailed t-test

II Computation of test statistic

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{S^2\left(\frac{n_1+n_2}{n_1 n_2}\right)}}$$

$$S^2 = \frac{n_1 S_1^2 + n_2 S_2^2}{n_1+n_2-2}$$

III Level of Significance (LOS):-

∴ (not given) $\alpha = 5\%$ (Consider)

IV Critical Value

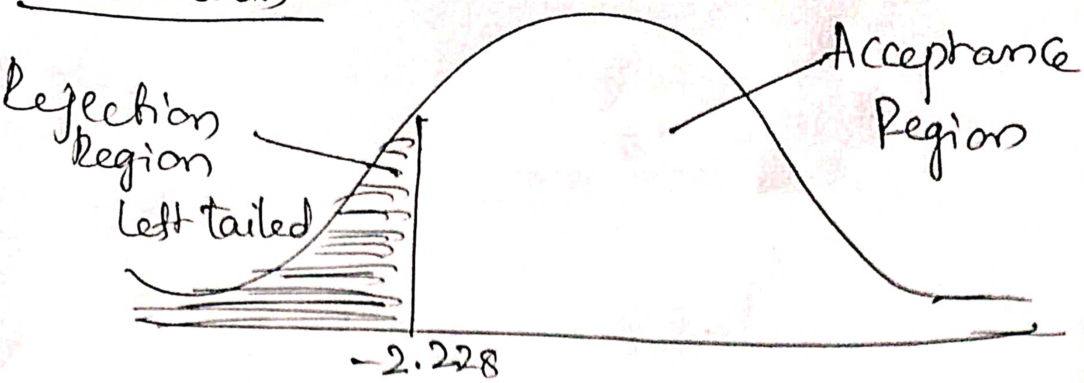
$df = n_1+n_2-2 = 5+7-2 = 10$

t_α value from tables at $df = 10$ is

$t_\alpha = 3.169$

~~Acceptance~~

V Conclusion



If $t_{(cal)} =$ lies in Acceptance region, then acceptance H_0 (or otherwise reject H_0).

Tests For Difference Between proportions: large samples

1. A machine puts out 16 imperfect articles in a sample of 500. After machine is over hauled, it puts out 3 imperfect articles in a batch of 100. Has the improved? Test at $\alpha = 0.05$ or 5%

Sol:- Given $n_1 = 500$, $n_2 = 100$

large samples.

$H_0 : P_1 = P_2$

$H_1 : P_1 > P_2$.