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Topic: 1.3 – Large sample test -difference of means

Test of Significance - Difference of two means

Sample sizes $\Rightarrow n_1, n_2$
Population means $\Rightarrow \mu_1, \mu_2$
Sample means $\Rightarrow \bar{x}_1, \bar{x}_2$
S.D's $\Rightarrow \sigma_1, \sigma_2$

Note:-
In particular, if S.D is not given directly and need to be taken from samples then use s_1 and s_2 as S.D in place of σ_1 and σ_2 .
 \therefore The test statistic becomes

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \quad (\text{or})$$

(ie)
$$\sigma^2 = \frac{n_1 s_1^2 + n_2 s_2^2}{n_1 + n_2}$$



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Problems.

1) The means of 2 large samples 1000 and 2000 members are 67.5 inches and 68.0 inches respectively. Can the samples be regarded as drawn from the same population of S.D 2.5 inches.

$n_1 = 1000$ $n_2 = 2000$
 $\bar{x}_1 = 67.5$ inches $\bar{x}_2 = 68$ inches

Population S.D $\sigma = 2.5$ inches
 $\sigma_1 = \sigma_2 = \sigma$.

$H_0 : \mu_1 = \mu_2$
 $H_1 : \mu_1 \neq \mu_2$

LOS: $\alpha = 5\%$

Test Statistics

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma^2}{n_1} + \frac{\sigma^2}{n_2}}}$$
$$= \frac{67.5 - 68}{\sqrt{(2.5)^2 \left(\frac{1}{1000} + \frac{1}{2000}\right)}}$$



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$$= \frac{-0.5}{0.0968} = -5.16$$

 $|z| = 5.16$: Critical value $|z_{\alpha}| = 1.96$
Conclusion.
C.V TV
5.16 > 1.96
 $\therefore H_0$ is rejected.

2. Sample of students were drawn from two universities and from the weight is kilogram. The mean and SD are calculated. Test the significance of the difference between the means of two samples.

	Mean	S.D	Sample size
University A	55	10	400
University B	57	15	100.

Soln:- $\bar{x}_1 = 55$ $\bar{x}_2 = 57.$
 $S_1 = 10$ $S_2 = 15$
 $n_1 = 400$ $n_2 = 100.$



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LOS : 5%

Test Statistic: $Z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$

$$Z = \frac{55 - 57}{\sqrt{\frac{10^2}{400} + \frac{15^2}{100}}} = -1.265.$$

$|Z| = 1.265.$ Critical Value at 5%
 $|Z_{\alpha/2}| = 1.96$

Conclusion: 13

C.V T.V
 $1.265 < 1.96.$
 $\therefore H_0$ is accepted.

3. The average hourly wage of sample of 150 workers in plant A was Re 2.56 with S.D of Re 1.08. The average wage of a sample of 200 workers in plant B was Re 2.87. with a S.D of Re 1.28. Can an applicant safely assume that the hourly wages paid by plant B are greater than those paid by plant A.?



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	Mean	S.D	Sample
Plant A	2.56	1.08	150
Plant B	2.87	1.28	200

$\therefore \bar{x}_1 = 2.56$ $S_1 = 1.08$ $n_1 = 150$
 $\bar{x}_2 = 2.87$ $S_2 = 1.28$ $n_2 = 200$

$H_0 : \mu_1 \geq \mu_2$
 $H_1 : \mu_1 < \mu_2$ (One tailed left)

L.O.S :- $\alpha = 5\%$

Test statistics

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$
$$= \frac{2.56 - 2.87}{\sqrt{\frac{(1.08)^2}{150} + \frac{(1.28)^2}{200}}} = -2.543$$

$\therefore |Z| = 2.543$

Critical value at $\alpha = 5\%$
One tailed left $Z_{\alpha} = 1.645$



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Conclusion:
C.V > T.V
2.543 > 1.645
∴ H_0 rejected.