Test for difference of mean.

Null hypothesis : $H_0 : \mu_1 = \mu_2$

Test statistic : $t = \dfrac{\bar{x}_1 - \bar{x}_2}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$

where $s^2 = \dfrac{n_1 s_1^2 + n_2 s_2^2}{n_1 + n_2 - 2}$ (or) $s^2 = \dfrac{\Sigma(x_1 - \bar{x}_1)^2 + \Sigma(x_2 - \bar{x}_2)^2}{n_1 + n_2 - 2}$

Degrees of freedom : $\nu = n_1 + n_2 - 2$

1. In a test examination given to two groups of students the marks obtained are as follows:

Group I :	18	20	36	50	49	36	34	49	41
Group II :	29	28	26	35	30	44	46		

Examine whether the significance of difference between the average marks secured by the students of the above two groups

Given : Group I : $n_1 = 9$

Group II : $n_2 = 7$

$\bar{x}_1 = \dfrac{18+20+36+50+49+36+34+49+41}{9} = 37$

$$\bar{x}_2 = \frac{29+28+26+35+30+44+46}{7} = 34$$

x_1	$x_1-\bar{x}_1$	$(x_1-\bar{x}_1)^2$	x_2	$x_2-\bar{x}_2$	$(x_2-\bar{x}_2)^2$
18	-19	361	29	-5	25
20	-17	289	28	-6	36
36	-1	1	26	-8	64
50	13	169	35	1	1
49	12	144	30	-4	16
36	-1	1	44	10	100
34	-3	9	46	12	144
49	12	144			386
41	4	16			
		1134			

$$s^2 = \frac{\Sigma(x_1-\bar{x}_1)^2 + \Sigma(x_2-\bar{x}_2)^2}{n_1+n_2-2} = \frac{1134+386}{9+7-2} = 108.57$$

$s = 10.42.$

Null hypothesis: $H_0 : \mu_1 = \mu_2$

Alternative hypothesis: $H_1 : \mu_1 \neq \mu_2$

Level of significance: $\alpha = 5\%$ [fixed]

Test statistic: $$t = \frac{\bar{x}_1 - \bar{x}_2}{s\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}} = \frac{37-34}{10.42\sqrt{\frac{1}{9}+\frac{1}{7}}} = 0.5713$$

Critical value: t_α for degrees of freedom $\nu = n_1+n_2-2$
$= 9+7-2 = 14$

$t_\alpha = 2.145$

Conclusion: $t = 0.5713 < 2.145 = t_\alpha$.

$\therefore H_0$ is accepted

Hence there is no significant difference in the average marks of the two groups of students.

2. A sample of two types of electric bulbs were tested for length of life and the following data were obtained

Samples	Size	Mean	S.D
I	8	1134	35
II	7	1024	40

Test at 5%.

$n_1 = 8$, $\bar{x}_1 = 1134$, $s_1 = 35$

$n_2 = 7$, $\bar{x}_2 = 1024$, $s_2 = 40$.

Null hypothesis: $H_0 : \mu_1 = \mu_2$

Alternative hypothesis: $H_1 : \mu_1 \neq \mu_2$ (2-tailed)

Level of significance: $\alpha = 5\%$ is fixed

Test statistic: $t = \dfrac{\bar{x}_1 - \bar{x}_2}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$

$$s^2 = \frac{n_1 s_1^2 + n_2 s_2^2}{n_1 + n_2 - 2} = \frac{8(35)^2 + 7(40)^2}{8+7-2} = 1615.38$$

$\therefore s = 40.19$

$$\therefore t = \frac{1134 - 1024}{40.19\sqrt{\frac{1}{8} + \frac{1}{7}}} = \frac{110}{20.8} = 5.288$$

Critical value: t_α for degrees of freedom $\nu = n_1 + n_2 - 2$
$= 8 + 7 - 2 = 13$

$t_\alpha = 2.160$.

Conclusion: $t = 5.288 > 2.160 = t_\alpha$.

$\therefore H_0$ is rejected at 5% level of significance