Test whether there is any significant difference between the two diets with respect to increase in weight.

Null hypothesis: $\mu_1 = \mu_2$

TABLE 10.3

X_1	X_2	X_1^2	X_2^2
4	5	16	25
3	4	9	16
2	4	4	16
2	2	4	4
1	3	1	9
0	2	0	4
5	6	25	36
6	1	36	1
3		9	
26	27	104	111

$\bar{X}_1 = 2.89$, $\bar{X}_2 = 3.38$

$$s_c^2 = \frac{\left[104 - \frac{(26)^2}{9}\right] + \left[111 - \frac{(27)^2}{8}\right]}{9+8-2} = 3.25$$

$$t = \frac{|\,2.89 - 3.38\,|}{\sqrt{3.25\,(1/9+1/8)}} = 0.56$$

CONCLUSION: t (calculated) $<$ t (tabulated), (2.131) with 15 d.f. at 5 per cent level of significance. Therefore, the null hypothesis is accepted. That is, there is no significant difference between the two diets with respect to increases in weight.

10.7. Paired t-test

When the two small samples of equal size are drawn from two populations and the samples are dependent on each other then the paired t-test is used in preference to independent t-test. The same patients for the comparison of two drugs with some time interval; the neighbouring plots of a field for comparison of two fertilizers with respect to yield assuming that the neighbouring plots will have the same soil composition; rats from the same litter for comparison of two diets; branches of same plant for comparison of the nitrogen uptake, etc., are some of the situations where paired t-test can be used.

In the paired t-test the testing of the difference between two treatments means was made more efficient by keeping all the other experimental conditions same.

Assumptions: 1. Populations are normal.
2. Samples are drawn independently and at random.

Conditions: 1. Samples are related with each other.
2. Sizes of the samples are small and equal.
3. S.D.'s in the populations are equal and not known.

Null hypothesis: $\mu_1 = \mu_2$

$$t = \frac{|\bar{d} - 0|}{\sqrt{s_d^2/n}} \qquad d_i = (X_{1i} - X_{2i})$$

$\bar{d} = \Sigma d_i/n$

n = Size of the sample.

$$s_d^2 = \frac{1}{n-1}\left[\Sigma d_i^2 - \frac{(\Sigma d_i)^2}{n}\right]$$

CONCLUSION: If t (calculated) $<$ t (tabulated) with (n—1) d.f. at 5 per cent level of significance, the null hypothesis is accepted. That is, there is no significant difference between the means of the two samples. In other words, the two samples may belong to the same population. Otherwise, the null hypothesis is rejected.

EXAMPLE: The following is the experiment conducted on Agronomy farm in the year 1969-70 at S.K.N. College of Agriculture, Jobner (Rajasthan) for comparing two types of grasses on neighbouring plots of size 5×2 meters in each replication. The weights of grasses per plot (in kgs) at the harvesting time were recorded on 7 replicates:

	1	2	3	4	5	6	7
Cenchrus cilioris (Grass I)	1.96	2.10	1.64	1.78	1.95	1.70	2.00
Losirus sindicus Grass (II)	2.13	2.10	2.14	2.08	2.20	2.12	2.05

Test the significant difference between the two grasses with respect to their yield.

Null hypothesis: $\mu_1 = \mu_2$

TABLE 10.4

X_{1i}	X_{2i}	d_i	d_i^2
1.96	2.13	−0.17	0.0289
2.10	2.10	0	0
1.64	2.14	−0.50	0.2500
1.78	2.08	−0.30	0.0900
1.95	2.20	−0.25	0.0625
1.70	2.12	−0.42	0.1764
2.00	2.05	−0.05	0.0025
		−1.69	0.6103

$$\bar{d}=-0.24$$

$$s_d^2=\frac{1}{(7-1)}\left[0.6103-\frac{(-1.69)^2}{7}\right]=0.0337$$

$$t=\frac{|\,0.24\,|}{\sqrt{0.0337/7}}=3.46$$

CONCLUSION: t (calculated) > t (tabulated), (2.447) with 6 d.f. at 5 per cent level of significance. The null hypothesis is rejected. There is significant difference between the two grasses with respect to yield.

10.8. S.N.D. Test for Proportions

Sometimes there is need to have the tests of hypothesis for proportion of individuals (or objects) having a particular attribute. For example, to know whether the proportion of disease infected plants in the sample is in confirmity with the proportion in the whole field (or population).

Here the number of plants in the sample is identically equal to the n independent trials with constant probability of success, p. The probabilities of 0, 1, 2,... successes are the successive terms of the binomial expansion $(q+p)^n$ where $q=(1-p)$. For the Binomial distribution the first and second moment of the number of successes are 'np' and 'npq' respectively.

Mean of proportion of successes $=P$

S.E of the proportion of successes $=\sqrt{PQ/n}$

10.8.1. One Sample Test

Assumptions: 1. Population is normal.