Single T test:

Problem Statement: Comparison of mean calorie intake of a particular group of individuals with the recommended daily intake. Average daily calorie intake over 10 days of 11 healthy women is 7725

S.No	Calorie Intake (10 Days)
1	5260
2	5470
3	5640
4	6180
5	6390
6	6515
7	6805
8	7515
9	7515
10	8230
11	8770

Solution:

Step 1: Set Null & alternate Hypothesis.

Null Hypothesis H_0 = Average Calorie intake equals 7725

Alternate Hypothesis H_1 = Average Calorie Intake not equals 7725

Step 2: Calculate **Mean**, **S.D, P value**

Mean	6753.63
SD	1142.12
P Value	0.05

Step 3: Applying Formula

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$$

$\bar{x}$ = 6753.63

μ = 7725

S.D = 1142.12

N = 11

Degree of freedom = (n- 1) => 11 -1 = 10

t = 2.82 **Critical value = 2.23**

critical value > T value

P Value obtained from T value is **- 0.018161** which is less than **0.05**, So we are rejecting the Null hypothesis which **results in the average intake of calories is lesser than the recommended values**.

Two Sample Test

A study was conducted to compare the birth weight of children born to 15 non smoking with those of children born to 14 heavy smoking mothers.

Non-smoking	Heavy smoking
3.99	3.18
3.79	2.84
3.6	2.9
3.73	3.27
3.21	3.85
3.6	3.52
4.08	3.23
3.61	2.76
3.83	3.6
3.31	3.75
4.13	3.59
3.26	3.63
3.54	2.38
3.51	2.34
2.71	

Solution:

Step 1: Set Null & Alternate Hypothesis

Null hypothesis H_0: Average weight of both groups are equal.

Alternate H_1: average weight of both groups are not equal.

Step 2: Calculate **Mean**, **SD** & **P value**

Mean	3.593333333	3.202857143
SD	0.370745709	0.492691643
N	15	14
P value	0.05	

Step 3 : Applying formula.

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

$\bar{x}1 = 3.59$ $\bar{x}2 = 3.20$ $\mu = 0$ S1 = 0.37 S2 = 0.49 N1 = 15 n2 = 14

Applying formula we got **T value = 2.42** Critical value **2.1604**

Critical Value > T value

P value obtained is **0.022402** which is less than **0.5,** we reject the null Hypothesis as the result the child born to non-smoker is heavier than the child born to heavy smokers.

Paired T test:

A study was carried to evaluate the effect of the new diet on weight loss. The study population consist of 12 people have used the diet for 2 months; their weight before and after the given.

Before Diet (KG)	After Diet (KG)
75	70
60	54
68	58
98	93
83	78
89	84
65	60
78	77
95	90
80	76
100	94
108	100

Solution:

Step 1: Set Null & Alternate Hypothesis

Null hypothesis H_0: No weight deduction after diet.

Alternate H_1: Reduction in weight after diet.

Step 2: Calculate **Mean**, **SD** & **P value**

Mean	83.25	77.83
SD	15.06	15.12
P value	0.05	

Step 3 : Applying formula

$$t = \frac{Z}{s} = \frac{\bar{X} - \mu}{\frac{\hat{\sigma}}{\sqrt{n}}}$$

$\bar{x}1$ = -5.42 μ = 0 S_M = 0.62

T value = 8.72 Critical value = 1.796

Critical value > T value

The value of P is 0.00001 which is lesser then 0.5 as a result **we can reject null hypothesis and conclude that there is a significant reduction in weight loss after diet.**

ANOVA

A trial was run to check the effects of different diets. Positive numbers indicate weight loss and negative numbers indicate weight gain. Check if there is an average difference in the weight of people following different diets

Low Fat	Low Calorie	Low Protein	Low Carbs
8	2	3	2
9	4	5	2
6	3	4	-1
7	5	2	0
3	1	3	3

Solution:

Step 1: Set Null & Alternate Hypothesis

Null hypothesis H_0 = There is no difference among the average in weights

Null hypothesis H_1 = There is a difference between at least between one group.

Step 2:

Low Fat	$(x - 6.6)^2$	Low Calorie	$(x-3)^2$	Low Protein	$(X-3.4)^2$	Low Carbs	$(x-1.2)^2$
8	2	2	1	3	0.2	2	0.6
9	5.8	4	1	5	2.6	2	0.6
6	0.4	3	0	4	0.4	-1	4.8
7	0.2	5	4	2	2	0	1.4
3	13	1	4	3	0.2	3	3.2
33	21.4	15	10	17	5.4	6	10.6
6.6	4.28	3	2	3.4	1.08	1.2	2.12

Total mean $\bar{x}$ = 6.6 + 3 + 3.4 + 1.2 = 1.42 /4 = **3.56**

$DF_{between}$ = k -1 = 4 -1 = 3

DF_{within} = N-k = 20-4 = 16

DF_{total} = 19

F critical Value = 3.29

Total sum of squares = $(8 – 3.56)^2 + (9 – 3.56)^2 + (6-3.56)^2 + \ldots\ldots\ldots\ldots + (3-3.56)^2$ is **123.2**

Total Sum within = 21.4 + 10 + 5.4 + 10.6 = 47.4

SSE => **47.4**

Total Sum Between is **(mean of each group – total mean)^2**

SSB = $(6.6 – 3.56)^2 + (3 – 3.56)^2 + (3.4 – 3.56)^2 + (1.2 – 3.56)^2$ = 15.16

SSB => 15.16 * 5 = **75.8**

SST = SSB + SSE = 75.8 + 47.4 = 123.2

Final Calculations:

Mean Square $_{Between}$ = SSB / DF $_{between}$

MSB = 75.8 / 3 = 25.3

Mean Square $_{within}$ = SSE / DF $_{within}$

MSE = 47.4 /16 = 3

F = MSB / MSE = 25.3 / 3 = 8.43

Since F value **8.43** greater than the F critical Value **3.29**, we reject the null hypothesis as a result there is a difference between mean weight loss in the diet.

CHI SQUARE

The owner of a laboratory wants to keep sick leave as low as possible by keeping employees healthy through disease prevention programs. Many employees have contracted pneumonia leading to productivity problems due to sick leave from the disease. The company wanted to know if providing the vaccine made a difference.

Health Outcomes	Unvaccinated	Vaccinated
Sick with pneumonia	23	5
Sick with no pneumonia	8	10
No pneumonia	61	77

Solution:

Step 1: Set Null & Alternate Hypothesis

Null hypothesis H_0 = There is a difference between two groups

Null hypothesis H_1 = There is no difference between the two groups.

Step 2: Calculate marginal value for each entry.

Health Outcomes	Unvaccinated	vaccinated	
Sick with pneumonia	23	5	28
Sick with no pneumonia	8	10	18
No pneumonia	61	77	138
	92	92	184

Expected Value

Health Outcomes	Unvaccinated	vaccinated
Sick with pneumonia	14	14
Sick with no pneumonia	9	9
No pneumonia	69	69

Subtract Expected value from Observed, square it then divide by Expected.

use formula $\frac{(O-E)^2}{E}$

O = **Observed** (actual) value

E = **Expected** value

Applying Formula, we got

Health Outcomes	Unvaccinated	vaccinated
Sick with pneumonia	5.79	5.79
Sick with no pneumonia	0.11	0.11
No pneumonia	0.93	0.93

Now Add up those calculated values: 5.79 +5.79 + 0.11 + 0.11 +0.93 +0.93 = **13.66**

Chi Square is 13.66

From Chi Square to P

To calculate Degree of Freedom (row – 1) x (Column - 1)

= 3 - 1 x 2 – 1

DF = 2

P value is 0.001087 obtained from Chi Square which is less than 0.05. So we reject Null Hypothesis as a result in there is a difference between vaccinated and unvaccinated groups