

CHAPTER - IV

**ANALYSIS AND
INTERPRETATION OF DATA**

A) ANALYSIS & INTERPRETATION

B) TESTING OF HYPOTHESIS

ANALYSIS & INTERPRETATION OF DATA

A) Analysis of data

The responses of students for pre-test and post-test for experimental and controlled group were taken.

In experimental and controlled group 10 girls and 20 boys were considered. Total 30 students in each group were considered.

For constructing the records of the mean and standard deviation the following groups were constructed.

- 1) Experimental group - pre-test, post-test - Girls
- 2) Experimental group - pre-test, post-test - Boys
- 3) Experimental group - pre-test, post-test - Paired group
- 4) Controlled group - pre-test, post-test - Girls
- 5) Controlled group - pre-test, post-test - Boys
- 6) Controlled group - pre-test, post-test - Paired group

For calculating mean and standard deviation of discrete data of these groups following formulae were used.

$$\text{Mean} = \bar{X} = \frac{\sum X_i}{N}$$

$$\text{Standard deviation} = \sigma = \sqrt{\frac{\sum (X_i - \bar{X})^2}{N}}$$

TABLE NO. 1
EXPERIMENTAL GROUP GIRLS : MARKS OF PRE-TEST & POST-TEST

Sr.No.	Pre-test	Post-test
1	10	14
2	17	25
3	11	18
4	20	26
5	10	14
6	22	27
7	15	18
8	22	30
9	23	32
10	20	26

TABLE NO. 2
EXPERIMENTAL GROUP - BOYS : MARKS OF PRE-TEST AND POST-TEST

Sr.No.	Pre-test	Post-test
11	15	20
12	10	15
13	13	22
14	15	24
15	15	19
16	16	19
17	23	28
18	23	28
19	23	30
20	20	29
21	11	15
22	19	23
23	16	22
24	18	22
25	17	24
26	25	34
27	18	28
28	17	24
29	9	16
30	12	16

TABLE NO. 3
CONTROLLED GROUP GIRLS : MARKS OF PRE-TEST & POST-TEST

Sr.No.	Pre-test	Post-test
1	16	21
2	17	18
3	15	18
4	20	22
5	18	20
6	19	23
7	16	20
8	19	22
9	14	15
10	14	18

TABLE NO. 4
CONTROLLED GROUP BOYS : MARKS OF PRE-TEST & POST TEST

Sr.No.	Pre-test	Post-test
11	21	23
12	19	22
13	11	12
14	10	14
15	18	20
16	18	21
17	20	24
18	16	20
19	18	22
20	14	17
21	17	20
22	15	20
23	30	32
24	13	15
25	17	20
26	16	20
27	17	21
28	20	21
29	11	16
30	15	20

**MEANS OF PRE-TEST OF EXPERIMENTAL
AND CONTROLLED GROUP**

	Controlled group	Experimental group
Girls	17.0	16.9
Boys	16.75	16.6
Total	16.83	16.7

From the above table it can be conclude that the two groups selected for experimentation are similar with respect to their previous knowledge regarding VIII and IX chapters of eighth standard Algebra.

Other factors like economical standard, I.Q., Social background are not taken into consideration.

MEANS OF POST-TESTS OF TWO GROUPS

	Controlled group	Experimental group
Girls	19.7	23.00
Boys	20.0	22.9
Total	19.9	22.93

We have taken two similar groups for experimentation.

From the above table following conclusions can be drawn

- 1) In case of girls as mean of Experimental group is greater than mean of controlled group. C.A.I. method is effective to girls.
- 2) In case of boys as mean of experimental group is greater than mean of controlled group C. A. I. method is effective to boys.
- 3) Considering total group also as mean of experimental group is greater than mean of controlled group C.A.I. method is effective to boys & girls both.

Therefore C. A. I. method is more effective than traditional method.

$$\begin{aligned}\bar{x} &= \sum x_i / N = 230 / 10 = 23 \\ \bar{y} &= \sum y_i / N = 197 / 10 = 19.7 \\ \bar{D} &= \text{Difference of mean} \\ &= 23 - 19.7 \\ &= 3.3\end{aligned}$$

Check -

$$\begin{aligned}\bar{x} &= \sum x / N + 50 \\ &= -270 / 10 + 50 \\ &= -27 + 50 = +23\end{aligned}$$

Check -

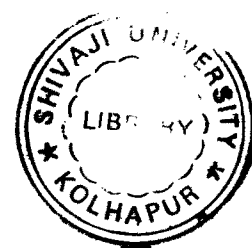
$$\begin{aligned}\bar{y} &= \sum y / N + 50 \\ &= -303 / 10 + 50 = 19.7\end{aligned}$$

Check -

$$\begin{aligned}\bar{D} &= \text{Check } \bar{x} - \text{Check } \bar{y} \\ &= 23 - 19.7 \\ &= 3.3\end{aligned}$$

σ Mean Differences =

$$\begin{aligned}&= \sqrt{\frac{N (\sum D^2) - (\sum D)^2}{N^2 (N-1)}} \\ &= \sqrt{\frac{10 (587) - (33)^2}{10^2 (10-1)}} \\ &= \sqrt{(5870 - 1089) / 900} \\ &= \sqrt{4781 / 900} \\ &= \sqrt{5.312} \\ &= 2.305\end{aligned}$$



$$\text{Calculated } t = \frac{\bar{D}}{s\bar{D}} = \frac{2.3}{2.305} = \frac{0.998}{1.432}$$

90

From the table of t entering the row corresponding to $n = N-1 = 9$ d.f.

We find that the chance of getting a value of t greater than or equal to $\pm t$, i.e.

Table Value of t = 3.250

As calculated t < table t

The null hypothesis is rejected.

Hence we conclude that - "There is significant difference in case of girls in performance of Algebra by two methods."

**USE OF t TEST IN CASE OF BOYS OF EXPERIMENTAL
AND CONTROLLED GROUP**

Ho - There is no significant difference in case of Boys in performance of Algebra by two methods.

Pair No.	Achievement Scores		Differences		(2)-50	3-(50)			
	Experimental Group	Controlled Group	D	D ²	X	Y	XY	X ²	Y ²
1	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	20	23	-3	9	-30	-27	810	900	729
2	15	22	-7	49	-35	-28	980	1225	784
3	22	12	10	100	-28	-38	1064	784	1444
4	24	14	10	100	-26	-36	936	676	1296
5	19	20	-1	1	-31	-30	930	961	900
6	19	21	-2	4	-31	-29	899	961	841
7	28	24	40	16	-22	-26	352	484	256
8	28	20	8	64	-22	-30	660	484	900
9	30	22	8	64	-20	-28	560	400	784
10	29	17	12	144	-21	-33	693	441	1089
11	15	20	-5	25	-35	-30	1050	1225	900
12	23	20	3	9	-27	-30	810	729	900
13	22	32	-10	100	-28	-18	504	784	324
14	22	15	7	49	-28	-35	980	784	1225
15	24	20	4	16	-26	-30	780	676	900
16	34	20	14	196	-16	-30	480	256	900
17	28	21	7	49	-22	-29	638	484	841
18	24	21	3	9	-26	-29	754	676	841
19	16	16	0	0	-34	-34	1156	1156	1156
20	16	20	-4	16	-34	-30	1020	1156	900
	458	400	58	1020	-542	-600	16056	15242	17910

$$\bar{x} = \sum x_i/N = 458/20 = 22.9$$

$$\bar{y} = \sum y_i/N = 400/20 = 20$$

$$\begin{aligned}\bar{D} &= \text{Difference of mean} = \sum D/N \\ &= 58/20 \\ &= 2.9\end{aligned}$$

Check -

$$\begin{aligned}\tilde{x} &= \sum x/N + 50 \\ &= -542/20 + 50 \\ &= -27.1 + 50 = +22.9\end{aligned}$$

Check -

$$\begin{aligned}\tilde{y} &= \sum y/N + 50 \\ &= -600/20 + 50 = 20\end{aligned}$$

Check -

$$\begin{aligned}\bar{D} &= \text{Check } \bar{x} - \text{Check } \bar{y} \\ &= 22.9 - 20 \\ &= 2.9\end{aligned}$$

σ Mean Differences =

$$\begin{aligned}&= \sqrt{\frac{N \sum D^2 - (\sum D)^2}{N^2 (N-1)}} \\ &= \sqrt{\frac{20 (1020) - (58)^2}{20^2 (20-1)}} \\ &= \sqrt{(20400 - 3364) / 400 \times 19} \\ &= \sqrt{17036 / 7600} \\ &= \sqrt{2.242} \\ &= 1.497\end{aligned}$$

From the table of t entering the row corresponding to $n = N - 1 = 19$

d.f. We find the chance of getting a value of t greater than or equal to

$\pm t_0$ i.e.

Table value of t = 2.861

As calculated t < table t

The null hypothesis is rejected.

Hence we can conclude that : "There is significant difference in case of Boys in performance of Algebra by two methods."

**Calculations for tests of significance of difference
in paired groups by two methods**

Pair No.	Achievement Scores		Differences		(2)-50	3-(50)	XY	X ²	Y ²
	Experimental Group	Controlled Group	D	D ²	X	Y			
1	X _i (2)	Y _i (3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	14	21	-7	49	-36	-29	1044	1296	841
2	25	18	7	49	-25	-32	800	625	625
3	18	18	0	0	-32	-32	1024	1024	1024
4	26	22	4	16	-24	-28	672	576	576
5	14	20	-6	36	-36	-30	1080	1296	900
6	27	23	4	16	-23	-27	851	529	1369
7	18	20	-2	4	-32	-30	960	1024	900
8	30	22	8	64	-20	-28	560	400	784
9	32	15	17	289	-18	-35	630	324	1225
10	26	18	8	64	-24	-32	768	576	1024
11	20	23	-3	9	-30	-27	810	900	729
12	15	22	-7	49	-35	-28	980	1225	784
13	22	12	10	100	-28	-38	1064	784	1444
14	24	14	10	100	-26	-36	936	676	1296
15	19	20	-1	1	-31	-30	930	961	900
16	19	21	-2	4	-31	-29	899	961	841
17	28	24	4	16	-22	-26	352	484	256
18	28	20	8	64	-22	-30	660	484	900
19	30	22	8	64	-20	-28	560	400	784
20	29	17	12	144	-21	-33	693	441	1089
21	15	20	-5	25	-35	-30	1050	1225	900
22	23	20	3	9	-27	-30	810	729	900
23	22	32	-10	100	-28	-18	504	784	324
24	22	15	7	49	-28	-35	980	784	1225
25	24	20	4	16	-26	-30	780	676	900
26	34	20	14	196	-16	-30	480	256	900
27	28	21	7	49	-22	-29	638	484	841
28	24	21	3	9	-26	-29	754	676	841
29	16	16	0	0	-34	-34	1156	1156	1156
30	16	20	-4	16	-34	-30	1020	1156	900
Total	688	597	91	1607	-812	-903	24445	22912	27178
Mean	22.93	19.9							

$$\bar{x} = \sum xi/N = 688/30 = 22.93$$

$$\bar{y} = \sum yi/N = 597/30 = 19.9$$

$$\begin{aligned}\bar{D} &= \text{mean difference} = \sum D/N \\ &= 91/30 \\ &= 3.03\end{aligned}$$

Check -

$$\begin{aligned}\bar{x} &= \sum x/N + 50 \\ &= -812/30 + 50 \\ &= -27.07 + 50 = +22.93\end{aligned}$$

Check -

$$\begin{aligned}\bar{y} &= \sum y/N + 50 \\ &= -903/30 + 50 = 19.9\end{aligned}$$

Check -

$$\begin{aligned}\bar{D} &= \text{Check } \bar{x} - \text{Check } \bar{y} \\ &= 22.93 - 19.9 \\ &= 3.03\end{aligned}$$

Variance of Differences :

$$\begin{aligned}S_D^2 &= \frac{N(\sum D^2) - (\sum D)^2}{N(N-1)} \\ &= \frac{30 \times 1607 - (91)^2}{30(29)} \\ &= 39929/870 = 45.89.\end{aligned}$$

$$\text{Variance of mean} = S_D^2/N = 45.89/30 = 1.53$$

$$\text{Standard error of mean} = \sqrt{S_D^2/N} = S_D/\sqrt{N} = \sqrt{1.53} = 1.24$$

$$\begin{aligned}
 &= \sqrt{\frac{N \sum D^2 - (\sum D)^2}{N^2 (N-1)}} \\
 &= \sqrt{\frac{30 (1607) - (91)^2}{30^2 \times 29}} \\
 &= \sqrt{(48210 - 8281) / 26100} \\
 &= \sqrt{39929 / 26100} \\
 &= \sqrt{1.5298} \\
 &= 1.24
 \end{aligned}$$

$$\begin{aligned}
 t_0 &= \bar{D} / D \\
 &= 3.03 / 1.24 \\
 &= 2.444
 \end{aligned}$$

From the table of t entering the row corresponding to $n = N - 1 = 30 - 1 = 29$. We find the chance of getting a value of t greater than or equal to $\pm t_0$ that i.e. ± 2.444 is slightly greater than 1 in 100 ($t = 2.756$). Therefore the null hypothesis is rejected. Hence we can conclude that the two methods of teaching produced significantly different results.

**Summary Table of Standard Deviations
of Two Groups**

	Pre-Test		Post-Test	
	Experimental	Controlled	Experimental	Controlled
	Group	Group	Group	Group
Girls	4.96	2.04	6.16	2.33
Boys	4.36	4.23	5.26	3.99
Total	4.57	3.65	5.58	3.59

In case of Girls of experimental group

Ho - There is no significant difference in case of girls between marks obtained in pre-test & Post-test of experimental group.

$F = \frac{\sigma_1^2}{\sigma_2^2}$ By placing greater variance in the numerator and smaller variance in denominator. $\sigma_1 = 6.16$ $\sigma_2 = 4.96$

$$F = \frac{\sigma_1^2}{\sigma_2^2} = (6.16)^2 / (4.96)^2 = 37.95 / 24.60 = 1.54$$

As calculated F (i.e. 1.54) is less than table F at 0.01 level of significance (Table F = 5.47) We reject the null hypothesis and we conclude that. There is significant difference in case of girls between marks obtained in pre-test & post-test of experimental group.

In case of Boys of experimental group.

Ho - There is no significant difference in case of boys between marks obtained in pre-test and post-test of experimental group.

$$\sigma_1 = 5.26, \sigma_2 = 4.36$$

$$F = \frac{\sigma_1^2}{\sigma_2^2} = (5.26)^2 / (4.36)^2 = 27.67 / 19.03 = 1.43$$

Table F for d.f. 19-19 = 2.15 at 0.01 level of significance. As calculated

$F < \text{table F}$ We reject null hypothesis.

We conclude that there is significant difference in case of boys between marks obtained in pre-test and post-test of experimental group.

In case of paired groups of experimental group.

H_0 - There is no significant difference between marks obtained in pre-test and post-test of experimental group.

$$\sigma_1 = 5.58, \sigma_2 = 4.57$$

$$F = \frac{\sigma_1^2}{\sigma_2^2} = 31.14/20.58 = 1.49$$

Table F value for d.f. 29-29 at 0.01 level of significance = 2.41

We reject the null hypothesis and conclude that there is significant difference between the marks obtained in pre-test and post-test of experimental group.

TABLE NO. 11
Summary Table of Calculated F and
Table F in case of Experimental Group

F Group	Calculated F	Table F at 0.01 level	Table F at 0.05 level
Girls	1.54	5.47 (at 9-9 d.f.)	3.18 (at 9-9 d.f.)
Boys	1.43	2.15 (at 19-19 d.f.)	3.00 (at 19-19 d.f.)
Paired groups	1.49	2.41 (at 29-29 d.f.)	1.85 (at 29-29 d.f.)

TABLE NO. 12
Summary Table of calculated F and
Table F in case of Controlled Group

F Group	Calculated F F	Table F at 0.01 level	Table F at 0.05 level
Girls	1.30	5.47 (at 9-9 d.f.)	3.18 (at 9-9 d.f.)
Boys	1.12	2.15 (at 19-19 d.f.)	3.00 (at 19-19 d.f.)
Paired groups	1.03	2.41 (at 29-29 d.f.)	1.85 (at 29-29 d.f.)

As in each case calculated F < Table F From above table we can draw following conclusions.

- 1) There is significant difference between the marks obtained in pre-test and post-test in case of girls of controlled group.
- 2) There is significant difference between the marks obtained in pre-test and post-test in case of boys of controlled group.
- 3) There is significant difference between the marks obtained in pre-test and post-test in case of paired groups of controlled group.