CHAPTER FIVE

ANALYSIS AND INTERPRETATION OF DATA
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ANALYSIS AND INTERPRETATION OF DATA

This chapter deals with the analysis and interpretation of data. It has two sections. The first section presents the interpretation of results pertaining to pre-test and post-test scores. The second section embodies the analysis and interpretation of main effects and interaction effects of two variables, namely, level of aspiration and socio-economic status.

5.1

ANALYSIS OF PRE-TEST AND POST-TEST SCORES

Pre-test was given to the subjects before conducting the experiment in order to assess subjects' initial learning in the topics which were programmed by the investigator. After completion of the programme, a post-test was also administered to ascertain the amount of learning gained as a result of reading the programmed text.

The pre-test and post-test were scored by the investigator and the data was further processed to find out sums, and means of pre-test and post-test scores in respect of all the nine
treatment combinations. In table-34 the sums and means of pre-test and post-test scores for each experimental group are recorded.

TABLE - 34

SUMS OF PRE-TEST AND POST-TEST SCORES IN RESPECT OF I, II, III, TREATMENT GROUPS

| STATISTICS | Group-I |  | Group-II |  | Group-II |  |
|------------|---------|  |----------|  |----------|  |
|            | Pre-test score | Post-test score | Pre-test score | Post-test score | Pre-test score | Post-test score |
| SUMS       | 72      | 1306 | 68       | 1286 | 70       | 1228 |
| MEANS      | 4.8     | 87.06 | 4.53    | 85.73 | 4.66    | 81.86 |

TABLE-35

SUMS OF PRE-TEST AND POST-TEST SCORES IN RESPECT OF IV, V, VI, TREATMENT GROUPS

| STATISTICS | Group-IV |  | Group-V |  | Group-VI |  |
|------------|----------|  |---------|  |----------|  |
|            | Pre-test score | Post-test score | Pre-test score | Post-test score | Pre-test score | Post-test score |
| SUMS       | 64       | 1165 | 65      | 1071 | 63       | 1046 |
| MEANS      | 4.26     | 77.66 | 4.33    | 71.4 | 4.2      | 69.73 |
TABLE-36
SUMS OF PRE-TEST AND POST-TEST SCORES IN RESPECT OF VII, VIII, IX, TREATMENT GROUPS

<table>
<thead>
<tr>
<th></th>
<th>Group-VII</th>
<th></th>
<th>Group-VIII</th>
<th></th>
<th>Group-IX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-test</td>
<td></td>
<td>Pre-test</td>
<td></td>
<td>Pre-test</td>
</tr>
<tr>
<td></td>
<td>score</td>
<td></td>
<td>score</td>
<td></td>
<td>score</td>
</tr>
<tr>
<td>SUMS</td>
<td>69</td>
<td>929</td>
<td>61</td>
<td>909</td>
<td>61</td>
</tr>
<tr>
<td>MEANS</td>
<td>4.6</td>
<td>61.93</td>
<td>4.06</td>
<td>60.6</td>
<td>4.06</td>
</tr>
</tbody>
</table>

It may be gleaned from the table-34, 35 and 36 that the difference between the means of pre-test and post-test scores is very high. It may also be observed that the difference between means for pre-test scores is very negligible while this difference seems to be fairly large for post-test scores in respect of the nine experimental groups. However, variance of pre-test scores( X ) and post-test scores( Y ) was separately analysed for accurately determining the nature of difference of means of pre-test and post-test scores. Table-37 provides the details of analysis of variance (pre-test scores).
### TABLE-37

**ANALYSIS OF VARIANCE OF PRE-TEST SCORES**

<table>
<thead>
<tr>
<th></th>
<th>HIQA</th>
<th>ALOA</th>
<th>LLOA</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sum x = 72$</td>
<td>$\sum x = 68$</td>
<td>$\sum x = 70$</td>
<td></td>
</tr>
<tr>
<td>$\sum x^2 = 488$</td>
<td>$\sum x^2 = 400$</td>
<td>$\sum x^2 = 424$</td>
<td></td>
</tr>
<tr>
<td>$N_1 = 15$</td>
<td>$N_1 = 15$</td>
<td>$N_1 = 15$</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>HIQA</th>
<th>ALOA</th>
<th>LLOA</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sum x = 64$</td>
<td>$\sum x = 65$</td>
<td>$\sum x = 65$</td>
<td></td>
</tr>
<tr>
<td>$\sum x^2 = 378$</td>
<td>$\sum x^2 = 385$</td>
<td>$\sum x^2 = 385$</td>
<td></td>
</tr>
<tr>
<td>$N_1 = 15$</td>
<td>$N_1 = 15$</td>
<td>$N_1 = 15$</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>HIQA</th>
<th>ALOA</th>
<th>LLOA</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sum x = 69$</td>
<td>$\sum x = 61$</td>
<td>$\sum x = 61$</td>
<td></td>
</tr>
<tr>
<td>$\sum x^2 = 405$</td>
<td>$\sum x^2 = 353$</td>
<td>$\sum x^2 = 361$</td>
<td></td>
</tr>
<tr>
<td>$N_1 = 15$</td>
<td>$N_1 = 15$</td>
<td>$N_1 = 15$</td>
<td></td>
</tr>
</tbody>
</table>

With the help of details given in the table-37, correction term, the sum of squares among the means was calculated. The total, sum of squares $SS_T$ were found from the original pre-test scores (vide appendix-E).
The various statistics are as follows.

\[ T = 593 \]

Correction term \[ \frac{T^2}{N} = \frac{(593)^2}{135} = \frac{351649}{135} \]

\[ = 2604.8 \]

\[ SS_T = \sum x^2 - \frac{T^2}{N} = 3579 - 2604.8 \]

\[ = 974.2 \]

\[ SS_S = 39201 \]

Sum of the squares among = \left( \text{Cell sum} \right)^2 \frac{n_1}{N} \frac{T^2}{N}

\[ = \frac{39201 \cdot 2}{15} - 2604.8 \]

\[ = 2613.4 \cdot 2604.8 \]

\[ = 8.6 \]

\[ SS \text{ within} = SS_T - SS \text{ Amongst} \]

\[ = 974.2 - 8.6 \]

\[ = 965.6 \]

Following the same procedure analysis of variance of post-test scores was done. The details are given on the following pages in this chapter. However, the comparative account of analysis of variance of pre-test and post-test scores is given in table-38.
TABLE 38

ANALYSIS OF VARIANCE OF PRE-TEST AND POST-TEST SCORES

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df.</th>
<th>Sum of squares</th>
<th>Mean Square</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-test</td>
<td>Post-test</td>
<td>Pre-test</td>
</tr>
<tr>
<td>Among means</td>
<td>8</td>
<td>8.6</td>
<td>14099.2</td>
</tr>
<tr>
<td>Within groups</td>
<td>126</td>
<td>965.6</td>
<td>15212.4</td>
</tr>
<tr>
<td>Total</td>
<td>134</td>
<td>974.2</td>
<td>29311.6</td>
</tr>
</tbody>
</table>

\[ F (\text{Pre-test scores}) = 0.13 \]
\[ F (\text{Post-test scores}) = 14.59 \]

It may be observed from the table-38 that since the value of F-ratio for pre-test is much less than 1, it evidently falls short of significance even at .05 level of confidence. It is, therefore, clear that the pre-test means do not differ significantly at all. It would seem, therefore, that the subjects were randomly assigned to the nine experimental combinations.

Since the initial learning in the biological concepts being taught through the programme was uniformly low (mean of the pre-test scores for each group being a little more
than 4). Analysis of co-variance to effect adjustment in the post-test scores was not carried out. The pre-test scores of the subjects are given in Appendix-B9.

It may be noted that henceforth all analyses were made on the basis of post-test scores only. The post-test scores of all the subjects are given in Appendix-B9.

5.2 ANALYSIS OF MAIN EFFECTS AND INTERACTION EFFECTS

According to Lindquist, (1956), the weighted average of the simple effects for all levels of the control variable is known as the "main" effect of the treatments. Simple effect may be interpreted as the treatment effect for a given level of independent variable. In other words, the main effects of factors are the mean squares for the levels of factors. Besides the main effects of the two factors, there is possibility that there are interactions between these factors. Variations in interaction are those that are attributed to two or more variables acting together.

In the present study the data obtained from the experiment was analysed to determine the main effects of the two factors
and also their interaction with each other. For estimating main effects and interaction effects, the outcomes of the 3 x 3 factorial design are presented in table-39.

**Table-39**

OUTCOMES OF 3 x 3 FACTORIAL DESIGN

<table>
<thead>
<tr>
<th></th>
<th>HLOA</th>
<th>ALOA</th>
<th>LLOA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group-I</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Sigma x_1 = 1306$</td>
<td>$\Sigma x_2 = 1286$</td>
<td>$\Sigma x_3 = 1228$</td>
<td>$\Sigma x_1 = 3820$</td>
</tr>
<tr>
<td>$N_1 = 15$</td>
<td>$N_2 = 15$</td>
<td>$N_3 = 15$</td>
<td></td>
</tr>
<tr>
<td>$\bar{x}_1 = 87.06$</td>
<td>$\bar{x}_2 = 85.73$</td>
<td>$\bar{x}_3 = 81.86$</td>
<td>$\bar{x}_1 = 84.88$</td>
</tr>
<tr>
<td>$\Sigma x_1^2 = 113780$</td>
<td>$\Sigma x_2^2 = 110416$</td>
<td>$\Sigma x_3^2 = 101470$</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group-IV</th>
<th>Group-V</th>
<th>Group-VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Sigma x_4 = 1165$</td>
<td>$\Sigma x_5 = 1071$</td>
<td>$\Sigma x_6 = 1046$</td>
</tr>
<tr>
<td>$N_4 = 15$</td>
<td>$N_5 = 15$</td>
<td>$N_6 = 15$</td>
</tr>
<tr>
<td>$\bar{x}_4 = 77.66$</td>
<td>$\bar{x}_5 = 71.4$</td>
<td>$\bar{x}_6 = 69.73$</td>
</tr>
<tr>
<td>$\Sigma x_4^2 = 91387$</td>
<td>$\Sigma x_5^2 = 77565$</td>
<td>$\Sigma x_6^2 = 74382$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group-VII</th>
<th>Group-VIII</th>
<th>Group-IX</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Sigma x_7 = 929$</td>
<td>$\Sigma x_8 = 909$</td>
<td>$\Sigma x_9 = 888$</td>
</tr>
<tr>
<td>$N_7 = 15$</td>
<td>$N_8 = 15$</td>
<td>$N_9 = 15$</td>
</tr>
<tr>
<td>$\bar{x}_7 = 61.93$</td>
<td>$\bar{x}_8 = 60.6$</td>
<td>$\bar{x}_9 = 59.2$</td>
</tr>
<tr>
<td>$\Sigma x_7^2 = 62079$</td>
<td>$\Sigma x_8^2 = 57375$</td>
<td>$\Sigma x_9^2 = 56336$</td>
</tr>
</tbody>
</table>

$\Sigma x_{C_1} = 3400$ | $\Sigma x_{C_2} = 3266$ | $\Sigma x_{C_3} = 3162$ |
| $\bar{x}_{C_1} = 75.55$ | $\bar{x}_{C_2} = 72.57$ | $\bar{x}_{C_3} = 70.26$ |
Table-39 represents the overall view of the outcomes of 3 x 3 factorial design with nine treatment combinations constituting columns and rows.

Where: \( \Sigma X_1, \Sigma X_2, \Sigma X_3, \Sigma X_4, \Sigma X_5, \Sigma X_6, \Sigma X_7, \Sigma X_8 \) and \( \Sigma X_9 \) represent total scores of different groups, \( \bar{X}_1, \bar{X}_2, \bar{X}_3, \bar{X}_4, \bar{X}_5, \bar{X}_6, \bar{X}_7, \bar{X}_8, \bar{X}_9 \) represent mean scores of different groups, \( N_1, N_2, N_3, N_4, N_5, N_6, N_7, N_8 \) and \( N_9 \) indicate the number of subjects in different groups, \( \Sigma X_{C_1}, \Sigma X_{C_2} \) and \( \Sigma X_{C_3} \) indicate the sum of column scores, \( \bar{X}_{C_1}, \bar{X}_{C_2} \) and \( \bar{X}_{C_3} \) represent column mean scores, \( \Sigma X_{r_1}, \Sigma X_{r_2} \) and \( \Sigma X_{r_3} \) indicate sum of row scores, \( \bar{X}_{r_1}, \bar{X}_{r_2} \) and \( \bar{X}_{r_3} \) represent the row mean scores.

Measures for the whole sample are as follows:

\[
\Sigma X = 9828 \\
\Sigma X^2 = 96589584 \\
N = 135 \\
\bar{X} = 72.8
\]

From the measures given in Table-39 main effects and interaction effects were investigated by computing F-ratio in order to find:

(1) Whether there is significant difference among the performance of subjects belonging to high, average and low level of aspiration groups.
(ii) Whether there is a significant difference among the performance of subjects belonging to high, average and low socio-economic status groups.

(iii) Whether or not the two variables, level of aspiration and socio-economic status, have a combined effect on the performance of the subjects.

The effects investigated by the first and second analysis are called "main effects", whereas the third is referred to as the "interaction effect". The end products of these analyses will be three F-ratios, two of which indicate the significance of the two main effects and the third that of the interaction effect.

In the present study the F-ratios were computed by following the five steps as given by Donald Ary, Lucy, C.J., Asghar, R(1972) in their book entitled "Introduction to research in education" page 146.

STEP 1: The first step is to find out the total sum of squares ($\sum x_t^2$), the sum of squares between groups ($\sum x_d^2$), and sum of squares within groups ($\sum x_w^2$).

(i) Total sum of squares was calculated using the formula:

$$\sum x_t^2 = \sum x^2 - \left( \frac{\sum x}{N} \right)^2$$
where \( \left( \frac{\Sigma X}{N} \right)^2 \) is the correction term which can be be calculated by squaring the total scores of all the individuals and then dividing it by the number of individuals. The correction term derived in the present experiment was as follows:

\[
\left( \frac{\Sigma X}{N} \right)^2 = \left( \frac{9828}{135} \right)^2 = 715478.4
\]

Therefore \( \Sigma X^2_c = \Sigma X^2 - 715478.4 \)

\[
= 744790 - 715478.4
\]

\[
= 29311.6
\]

(ii) Sum of the squares between groups is the index of sum of the squared deviations of the group means from the grand mean. It was found by applying the following formula:

\[
\Sigma X_b^2 = \left( \frac{\Sigma X_1}{n_1} \right)^2 + \left( \frac{\Sigma X_2}{n_2} \right)^2 + \left( \frac{\Sigma X_3}{n_3} \right)^2 + \ldots + \frac{\left( \Sigma X \right)^2}{N}
\]

In the present study this value was calculated as:

\[
\Sigma X_b^2 = \frac{(1306)^2}{15} + \frac{(1286)^2}{15} + \frac{(1228)^2}{15} + \frac{(1165)^2}{15} + \frac{(1071)^2}{15} + \]

\[
\frac{(1046)^2}{15} + \frac{(929)^2}{15} + \frac{(909)^2}{15} + \frac{(888)^2}{15} - 715478.4
\]
\[ \frac{10943664}{15} = 715478.4 \]
\[ = 14099.2 \]

(iii) Sum of the squares within groups is the index of sum of the squared deviations of each individual score from its own group mean. Formula used for computing sum of the squares within group is:

\[ \Sigma X^2_w = \Sigma X^2_t - \Sigma X^2_d \]

Applying the formula to the present data the value was found to be:

\[ \Sigma X^2_w = 29311.6 - 14099.2 \]
\[ = 15212.4 \]

**Table 40**

**SUMMARY OF ANALYSIS OF VARIANCE**

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>SS</th>
<th>df.</th>
<th>MS</th>
<th>F</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>14099.2</td>
<td>8</td>
<td>1762.4</td>
<td>14.59</td>
<td>0.01</td>
</tr>
<tr>
<td>Within groups</td>
<td>15212.4</td>
<td>126</td>
<td>120.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>29311.6</td>
<td>134</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table-40 summarizes the results of the calculations so far, together with the results of further calculations. The first column of this table lists the three sources of variance: between-groups variance, within-groups variance, and total variance. The second column contains the sums of squares, which have already been calculated. The third column in this table lists the number of degrees of freedom associated with each source of variance. The number of degrees of freedom for between-groups variance is equal to \((G-1)\), \(G\) being the number of groups. In the present study this value is \(9-1 = 8\). The degrees of freedom for within-groups variance is \(n_1 - 1 + n_2 - 1 + \ldots\). In the present experiment this value is \(15-1 + 15-1 + 15-1 + 15-1 + 15-1 + 15-1 + 15-1 + 15-1 + 15-1 = 126\). The number of degrees of freedom for total variance equals \(N-1\); in this study its value is \(135-1 = 134\). This value could also be obtained by adding the between-groups and within-groups degrees of freedom.

**STEP 2:** The second step in computation of F-ratios consists in breaking down the sum of the squares between groups into three separate sums of squares:

(a) the sum of squares between columns \((\Sigma x^2 C)\).
(b) the sum of squares between rows \((\Sigma x^2 R)\).
(c) the sum of squares for interaction between columns and rows \((\Sigma x^2 int)\).
(a) Between-columns sum of the squares:

It represents the sum of the squared deviations due to the difference between the column means and the grand mean. It is found by using the following formula:

\[
\sum x_{bc}^2 = \frac{\left( \sum x_{C_1} \right)^2}{n_{C_1}} + \frac{\left( \sum x_{C_2} \right)^2}{n_{C_2}} + \frac{\left( \sum x_{C_3} \right)^2}{n_{C_3}} - \frac{\left( \sum x \right)^2}{N}
\]

Using this formula, the sum of the squares between columns for the present data was found to be:

\[
\sum x_{bc}^2 = \frac{(3400)^2}{45} + \frac{(3266)^2}{45} + \frac{(3162)^2}{45}
\]

\[= 715478.4\]

\[= 632.71\]

(b) Between-rows sum of squares: It is the sum of the squared deviations due to the difference between the row means and the grand mean. In the present study, it was calculated by applying the following formula:

\[
\sum x_{br}^2 = \frac{\left( \sum x_{R_1} \right)^2}{n_{R_1}} + \frac{\left( \sum x_{R_2} \right)^2}{n_{R_2}} + \frac{\left( \sum x_{R_3} \right)^2}{n_{R_3}} - \frac{\left( \sum x \right)^2}{N}
\]
\[
\begin{align*}
&= \frac{(3820)^2}{45} + \frac{(3282)^2}{45} + \frac{(2726)^2}{45} \quad 715478.4 \\
&= 13299.37
\end{align*}
\]

(c) The sum of squares interaction:

It is the part of deviation between the group means and the overall means that is due neither to row difference nor to column differences. In other words, this is the difference between the total of the sum of the squares between groups and sum of the squares between columns plus the sum of squares between rows; that is,

\[
\Sigma x^2_{\text{int}} = \Sigma x^2_{\text{b}} - (\Sigma x^2_{\text{bc}} + \Sigma x^2_{\text{br}})
\]

Expressed in words, the interaction sum of squares is equal to the between groups sum of squares minus between-columns sum of the squares and between rows sum of squares. For the present experiment the interaction value is:

\[
\Sigma x^2_{\text{int}} = 14099.2 - (632.71 + 13299.37) \\
= 167.12
\]

STEP 3: Determining the degrees of freedom associated with each source of variation. These were found as follows:

df. for between columns sum of squares = C - 1

df. for between rows sum of squares = R - 1

df. for interaction = (C - 1) (R - 1)
\[ \text{df. for between groups sum of squares} = (G - 1) \]
\[ \text{df. for within group sum of squares} = (n - 1) \]
\[ \text{df. for total sum of squares} = N - 1 \]

where:

\[ C = \text{the number of columns} \]
\[ R = \text{the number of rows} \]
\[ G = \text{the number of groups} \]
\[ n = \text{the number of subjects in one group} \]
\[ N = \text{the number of subjects in all groups} \]

**STEP 4:** Finding mean square values

This value was obtained by dividing each sum of square by its associated number of degree of freedom.

**STEP 5:** Computation of F-ratio

The F-ratios were computed for the main and interaction effects by dividing each of three components between groups mean squares by the within groups mean square.

The results of the calculations based on the data presented in table-39 are summarized in table-41.
### TABLE-41

**SUMMARY OF 3 x 3 MULTIFACTOR ANALYSIS OF VARIANCE**

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>SS</th>
<th>df.</th>
<th>MS</th>
<th>F</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between columns</td>
<td>632.71</td>
<td>2</td>
<td>316.35</td>
<td>2.62</td>
<td>Not significant</td>
</tr>
<tr>
<td>(Level of aspiration)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between rows</td>
<td>13299.37</td>
<td>2</td>
<td>6649.68</td>
<td>55.07</td>
<td>Significant at .01 level of confidence</td>
</tr>
<tr>
<td>(Socio-economic status)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Columns by rows interaction (LOA x SES)</td>
<td>167.12</td>
<td>4</td>
<td>41.78</td>
<td>0.34</td>
<td>Not significant</td>
</tr>
<tr>
<td>Between groups</td>
<td>14099.2</td>
<td>8</td>
<td>1762.4</td>
<td>14.59</td>
<td>.01</td>
</tr>
<tr>
<td>Within groups</td>
<td>15212.4</td>
<td>126</td>
<td>120.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>29311.6</td>
<td>134</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.3

**SIGNIFICANCE OF F-RATIOS**

In table-41, four F-ratios have been depicted. To find the significance of each of these values the F-table
Fig. 5-1. INTERACTION EFFECT OF LOA X SES.
was consulted and appropriate conclusions were drawn as under:

- Between column ratio (2.62) was not significant since it is less than the value shown in the table which is 3.07 and 4.78 at .05 and .01 levels of significance respectively.

- Between rows F-ratio (55.07), is significant since it exceeded the table value even at .01 level of confidence.

- Interaction F-ratio (0.346) was also not significant since it is even less than one. Evidently it is not significant at .05 and .01 levels of confidence.

5.4
INTERPRETATION
OF F-RATIOS

The first F-ratio (between columns) in table-41 is not significant which means that the three levels of aspiration do not differ significantly from one another in their effect on the performance of the subjects on the programmed text. This analysis is a comparison between the combined performance of groups I, IV and VII with combined performance of groups II, V and VIII and groups III, VI and IX.
The second F-ratio (between rows) was found to be significant at .01 level of confidence. It was based upon the comparison of the performance of the subjects in groups I, II and III with those in groups IV, V, VI and VII, VIII, and IX. From the significance of this F-ratio it may be inferred that the difference between the performance of subjects belonging to three levels of socio-economic status (high, average and low) is beyond chance expectation. Examining the data given in table-39, we find that the subjects in the high socio-economic status groups have obtained a combined mean of 84.88 as compared to a mean of 72.93 for those who belong to average socio-economic status groups and a mean of 60.57 for those who belong to low socio-economic status groups. Since we have a significant F-ratio for the difference, it was concluded that under conditions similar to those of the present experiment, a higher level of performance on a linear programme is expected of those subjects who belong to high socio-economic status rather than the subjects belonging to average or low socio-economic status groups.

The third F-ratio indicates the interaction effect between the two independent variable viz, level of aspiration and socio-economic status. This F-ratio was not significant and thus it can be concluded that socio-economic status and level of aspiration of subjects do not interact significantly.
to bring about significant differences in performance on the programmed text.

Donald, A. Lucy-C.J., Asghar. R. (1972), described a procedure by which we can calculate the mean that would be expected for each group if there had been no interaction between the independent variables, as is the case in the present findings. It is done by adding the difference for the column that group is in and the difference for the row that the group is in to the grand mean (72.79). Table-42 shows the expected values of each group.

**Table-42**

**Expected Value of Means for Nine Treatment Combinations**

<table>
<thead>
<tr>
<th>Group</th>
<th>Overall mean</th>
<th>Level of aspiration difference (Column)</th>
<th>Socio-economic status difference (Row)</th>
<th>Expected Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group-I</td>
<td>72.79</td>
<td>+2.76</td>
<td>+12.09</td>
<td>87.64</td>
</tr>
<tr>
<td>Group-II</td>
<td>72.79</td>
<td>-0.22</td>
<td>+12.09</td>
<td>84.66</td>
</tr>
<tr>
<td>Group-III</td>
<td>72.79</td>
<td>-2.53</td>
<td>+12.09</td>
<td>82.35</td>
</tr>
<tr>
<td>Group-IV</td>
<td>72.79</td>
<td>+2.76</td>
<td>+0.14</td>
<td>75.69</td>
</tr>
<tr>
<td>Group-V</td>
<td>72.79</td>
<td>-0.22</td>
<td>+0.14</td>
<td>70.4</td>
</tr>
<tr>
<td>Group-VI</td>
<td>72.79</td>
<td>-2.53</td>
<td>+0.14</td>
<td>70.4</td>
</tr>
<tr>
<td>Group-VII</td>
<td>72.79</td>
<td>+2.76</td>
<td>-12.22</td>
<td>63.33</td>
</tr>
<tr>
<td>Group-VIII</td>
<td>72.79</td>
<td>-0.22</td>
<td>-12.22</td>
<td>60.35</td>
</tr>
<tr>
<td>Group-IX</td>
<td>72.79</td>
<td>-2.53</td>
<td>-12.22</td>
<td>58.04</td>
</tr>
</tbody>
</table>
The procedure consists in calculating the overall mean or mean for all the subjects. It was found to be 72.79. Then the means for students belonging to the high, average and low levels of aspiration and socio-economic status were also computed separately. The means for the three levels of aspiration were found to be 75.55, 72.57 and 70.26 respectively, while means for the three levels of socio-economic status were 84.88, 72.93 and 60.57 respectively.

The mean for 45 subjects belonging to high level of aspiration (75.55), is 2.76 greater than the overall mean. The mean for 45 subjects belonging to average level of aspiration (72.57), is 0.22 is less than overall mean. And the mean for 45 subjects in low level of aspiration group (70.26), is also, 2.53 less than the mean of all the subjects (as shown in table-42).

Whereas the mean for 45 subjects belonging to the high socio-economic group (84.88) is, 12.09 higher than the overall mean. The mean for 45 subjects in average socio-economic status group (72.93) is also, 0.14, greater than the overall mean. The mean for 45 students belonging to low socio-economic status group (60.57), was found to be, 12.22 less than the mean of all the subjects (as shown in table-42).
Furthermore, the mean that would be expected for each of the nine groups was also calculated as shown in the table-42, by adding the difference for the column that group is in and the difference for the row that group is in to the grand mean.

The actual group means were then compared with the expected group means. The comparative values are shown in the table-43.

**TABLE-43**

**COMPARISON OF ACTUAL AND EXPECTED MEANS**

<table>
<thead>
<tr>
<th></th>
<th>ACTUAL</th>
<th>EXPECTED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HLOA</td>
<td>ALOA</td>
</tr>
<tr>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>HSES</td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td></td>
<td>87.06</td>
<td>85.73</td>
</tr>
<tr>
<td>ASES</td>
<td>IV</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>77.66</td>
<td>71.4</td>
</tr>
<tr>
<td>LSES</td>
<td>VII</td>
<td>VIII</td>
</tr>
<tr>
<td></td>
<td>61.93</td>
<td>60.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>75.55</td>
</tr>
</tbody>
</table>

From the table-43 it can be interpreted that:

- Group I, III, V, VI, VII did less well than expected whereas performance of subjects in group II, IV, VIII and IX was better than expected.