CHAPTER IV
ANALYSIS AND INTERPRETATION OF DATA

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ANALYSIS AND INTERPRETATION OF DATA

4.1.0. Introduction

This chapter presents the details of the analysis of the data with reference to testing the different hypotheses of the study. Chi-Square test was used for testing each of the hypotheses. Contingency Coefficient was calculated further in such cases where the Chi-Square value was found to be significant. For this purpose the data were classified into three groups, namely, High, Average, and Low, on each of the variable under consideration, thus providing a 3 x 3 Contingency Table in each case.

4.2.0. Testing of Hypotheses

Data were analysed in relation to the different Hypotheses framed in the study. Details of calculations for each of the Hypotheses are given further.

4.2.1. Hypothesis - I

The Hypothesis states, "There is no significant association between Attitude towards Mathematics and Achievement in Mathematics."

<table>
<thead>
<tr>
<th>Achievement Scores</th>
<th>Attitude Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean = 21.35</td>
<td>Mean = 64.02</td>
</tr>
<tr>
<td>SD = 5.71</td>
<td>SD = 9.40</td>
</tr>
</tbody>
</table>

N = 303
With reference to the Achievement scores, students who scored Mean + 1 Standard Deviation and above were grouped as High group; Students who scored Mean - 1 Standard Deviation and below were grouped as Low group; and students who scored between these two scores were grouped as Average group. The details of the score values for the formation of groups are shown below:

\[
M + 1 \text{ SD} = 21.35 + 5.71 = 27.06 \approx 27
\]
\[
M - 1 \text{ SD} = 21.35 - 5.71 = 15.64 \approx 16
\]

Therefore, on the Achievement Scorès:

Students who scored 27 and above formed the High group.
Students who scored between 17 and 26 formed the Average group.
Students who scored 16 and below formed the Low group.

In a similar way, the students were grouped as High, Average, and Low on the Attitude scores. The details of the score values for the formation of groups are shown below:

\[
M + 1 \text{ SD} = 64.02 + 9.40 = 73.42 \approx 73
\]
\[ M - 1 \text{ SD} = 64.02 - 9.40 = 54.62 \approx 55 \]

Therefore, on the Attitude Scores:

- Students who scored 73 and above formed the High group.
- Students who scored between 72 and 56 formed the Average group.
- Students who scored 55 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Attitude scores and Achievement scores as shown in Table - 6.

<table>
<thead>
<tr>
<th>Attitude</th>
<th>Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>High</td>
<td>13 (7.66)</td>
</tr>
<tr>
<td>Average</td>
<td>35 (35.29)</td>
</tr>
<tr>
<td>Low</td>
<td>6 (11.05)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>54</strong></td>
</tr>
</tbody>
</table>

(Expected frequencies are indicated in the brackets in each cell).
\[ \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \]

Where \( f_o \) = observed frequency in each cell.
\( f_e \) = expected frequency in each cell.

On calculating, \( \chi^2 = 18.3848 \)

\[ \text{df} = (r-1)(c-1) \]
\[ = (3-1)(3-1) \]
\[ = 2 \times 2 \]
\[ = 4 \]

Referring to Table E (Garrett, 1981), the obtained value of \( \chi^2 \) is found to be significant at 0.01 level. Therefore, the null hypothesis is rejected.

That is, there is a significant association between Attitude towards Mathematics and Achievement in Mathematics at 0.01 level.

This calls for further analysis and for this purpose Contingency Coefficient was calculated as follows:

\[ C = \sqrt{\frac{\chi^2}{N + \chi^2}} \]
\[ = \sqrt{\frac{18.3848}{303 + 18.3848}} \]
From the obtained value of $C$ it was found that there is a close association between Attitude towards Mathematics and Achievement in Mathematics.

4.2.2. Hypothesis - 2

The Hypothesis states, "There is no significant association between Educational Aspiration and Achievement in Mathematics."

Since the Achievement scores happen to be the same or were for testing Hypothesis - 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for testing Hypothesis - 2 also.

In a similar way, the students were grouped as High, Average, and Low on the Educational Aspiration scores. The details of the score values for the formation of groups are shown below.

\[
M + 1 \text{ SD} = 33.87 + 8.92 = 42.79 \approx 43
\]
Therefore, on the Educational Aspiration Scores:

Students who scored 43 and above formed the High group.

Students who scored between 42 and 26 formed the Average group.

Students who scored 25 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Educational Aspiration scores and Achievement scores as presented in Table 7.

<table>
<thead>
<tr>
<th>Educational Aspiration</th>
<th>Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>High</td>
<td>6 (9.80)</td>
</tr>
<tr>
<td>Average</td>
<td>40 (33.15)</td>
</tr>
<tr>
<td>Low</td>
<td>8 (11.05)</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
</tr>
</tbody>
</table>

(Expected frequencies are shown in the brackets in each cell).


\[ \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \]

Where \( f_o \) = observed frequency in each cell.
\( f_e \) = expected frequency in each cell.

On calculating, \( \chi^2 = 14.8278 \)

\[ df = (r-1)(c-1) \]
\[ = (3-1)(3-1) \]
\[ = 2 \times 2 \]
\[ = 4 \]

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is found to be significant at 0.01 level. Therefore, the null hypothesis is rejected.

Hence, there is a significant association between Educational Aspiration and Achievement in Mathematics at 0.01 level.

This calls for further analysis and for this purpose Contingency Coefficient was carried out as follows:

\[ C = \sqrt{\frac{\chi^2}{N + \chi^2}} \]
\[ = \sqrt{\frac{14.8278}{303 + 14.8278}} \]
From the obtained value of C it is concluded that there is a close association between Educational Aspiration and Achievement in Mathematics.

4.2.3. Hypothesis - 3

The Hypothesis states: "There is no significant association between Occupational Aspiration and Achievement in Mathematics".

Since the Achievement scores happen to be the same as were for testing Hypothesis - 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for testing Hypothesis - 3 also.

In a similar way, the students were grouped as High, Average, and Low on the Occupational Aspiration scores. The details of the score values for the formation of groups are shown below:

\[ M + 1 \text{ SD} = 52.31 + 10.00 \]
\[ = 62.31 \approx 62 \]
\[ M - 1 \ SD = 52.31 - 10.00 = 42.31 \approx 42 \]

Therefore, on the Occupational Aspiration Scores:

Students who scored 62 and above formed the High group.

Students who scored between 61 and 43 formed the Average group.

Students who scored 42 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Occupational Aspiration scores and Achievement scores as given in Table 8.

**Table - 8**

**A 3 x 3 Contingency Table Between Occupational Aspiration Scores and Achievement Scores**

<table>
<thead>
<tr>
<th>Occupational Aspiration</th>
<th>Achievement</th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>9 (9.62)</td>
<td>31  (32.97)</td>
<td>14  (11.41)</td>
<td>54</td>
</tr>
<tr>
<td>Average</td>
<td>39 (35.29)</td>
<td>125 (120.89)</td>
<td>34  (41.82)</td>
<td>198</td>
</tr>
<tr>
<td>Low</td>
<td>6 (9.09)</td>
<td>29  (31.14)</td>
<td>16  (10.77)</td>
<td>51</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>54</strong></td>
<td><strong>185</strong></td>
<td><strong>64</strong></td>
<td><strong>303</strong></td>
</tr>
</tbody>
</table>

(Expected frequencies are presented in the brackets in each cell).
\[ \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \]

Where \( f_o \) = observed frequency in each cell.
\( f_e \) = expected frequency in each cell.

On calculating, \( \chi^2 = 6.4747 \)

\[ df = (r-1)(c-1) \]
\[ = (3-1)(3-1) \]
\[ = 2 \times 2 \]
\[ = 4 \]

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is not significant. Thus, the null hypothesis is accepted.

Thus, there is no significant association between Occupational Aspiration and Achievement in Mathematics.

4.2.4. Hypothesis - 4

The Hypothesis states: "There is no significant association between Numerical Ability and Achievement in Mathematics".

Since the Achievement scores happen to be the same as were for testing Hypothesis - 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for testing Hypothesis - 4 also.
In a similar way, the students were grouped as High, Average, and Low on the Numerical Ability scores. The details of the score values for the formation of groups are shown below:

\[
M + 1 \text{ SD} = 25.15 + 5.50 \\
= 30.65 \approx 31 \\
M - 1 \text{ SD} = 25.15 - 5.50 \\
= 19.65 \approx 20
\]

Therefore, on the Numerical Ability Scores:

- Students who scored 31 and above formed the High group.
- Students who scored between 30 and 21 formed the Average group.
- Students who scored 20 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Numerical Ability scores and Achievement scores as shown in Table - 9.
Table - 9
A 3 x 3 Contingency Table Between Numerical Ability Scores and Achievement Scores

<table>
<thead>
<tr>
<th>Numerical Ability</th>
<th>Achievement</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Average</td>
<td>Low</td>
<td>Total</td>
</tr>
<tr>
<td>High</td>
<td>11 (8.20)</td>
<td>32 (28.09)</td>
<td>3 (9.72)</td>
<td>46</td>
</tr>
<tr>
<td>Average</td>
<td>37 (34.22)</td>
<td>115 (117.23)</td>
<td>40 (40.55)</td>
<td>192</td>
</tr>
<tr>
<td>Low</td>
<td>6 (11.58)</td>
<td>38 (39.69)</td>
<td>21 (13.73)</td>
<td>65</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
<td>185</td>
<td>64</td>
<td>303</td>
</tr>
</tbody>
</table>

(Expected frequencies are given in the brackets in each cell).

\[ \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \]

Where \( f_o \) = observed frequency in each cell.
\( f_e \) = expected frequency in each cell.

On calculating, \( \chi^2 = 13.0322 \)

\[ df = (r-1)(c-1) \]
\[ = (3-1)(3-1) \]
\[ = 2 \times 2 \]
\[ = 4 \]

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is found to be significant at 0.05 level. Therefore, the null hypothesis is rejected.
That is, there is a significant association between Numerical Ability and Achievement in Mathematics at 0.05 level.

This calls for further analysis and for this purpose Contingency Coefficient was computed as follows:

\[
C = \sqrt{\frac{x^2}{N + x^2}}
\]

\[
= \sqrt{\frac{13.0322}{303 + 13.0322}}
\]

\[
= \sqrt{\frac{13.0322}{316.0322}}
\]

\[
= \sqrt{0.0412369}
\]

\[
= 0.20
\]

From the obtained value of C, it can be said that there is a close association between Numerical Ability and Achievement in Mathematics.

4.2.5. Hypothesis

The Hypothesis states: "There is no significant association between Abstract Reasoning and Achievement in Mathematics."
Since the Achievement scores happen to be the same as were for testing Hypothesis - 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for testing Hypothesis - 5 also.

In a similar way, the students were grouped as High, Average, and Low on the Abstract Reasoning scores. The details of the score values for the formation of groups are shown below:

\[
M + 1 \text{SD} = 34.30 + 7.89 \\
= 42.19 \approx 42 \\
M - 1 \text{SD} = 34.30 - 7.89 \\
= 26.41 \approx 26
\]

Therefore, on the Abstract Reasoning Scores:
 Students who scored 42 and above formed the High group.
 Students who scored between 41 and 27 formed the Average group.
 Students who scored 26 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Abstract Reasoning scores and Achievement scores as presented in Table 10.
Table - 10
A 3 x 3 Contingency Table Between Abstract Reasoning Scores and Achievement Scores

<table>
<thead>
<tr>
<th>Abstract Reasoning</th>
<th>Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>High</td>
<td>18 (8.02)</td>
</tr>
<tr>
<td>Average</td>
<td>33 (39.03)</td>
</tr>
<tr>
<td>Low</td>
<td>3 (6.95)</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
</tr>
</tbody>
</table>

(Expected frequencies are indicated in the brackets in each cell).

\[ \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \]

Where \( f_o \) = observed frequency in each cell.
\( f_e \) = expected frequency in each cell.

On calculating, \( \chi^2 = 34.3369 \)

\[ df = (r-1)(c-1) \]
\[ = (3-1)(3-1) \]
\[ = 2 \times 2 \]
\[ = 4 \]

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is found to be significant at 0.01 level. Therefore, the null hypothesis is rejected.
Hence, there is a close association between Abstract Reasoning and Achievement in Mathematics at 0.01 level.

This calls for further analysis and for this purpose Contingency Coefficient was carried out as follows:

\[
C = \sqrt{\frac{\chi^2}{N + \chi^2}}
\]

\[
= \sqrt{\frac{34.3369}{303 + 34.3369}}
\]

\[
= \sqrt{\frac{34.3369}{337.3369}}
\]

\[
= \sqrt{0.1017881}
\]

\[
= 0.32
\]

From the obtained value of \( C \), it was found that there exists a very good association between Abstract Reasoning and Achievement in Mathematics.

4.2.6. Hypothesis - 6

The Hypothesis states: "There is no significant association between Space Relations and Achievement in Mathematics".

Since the Achievement scores happen to be the same as were for testing Hypothesis - 1, the same groupings of
High, Average, and Low (Refer Caption 4.2.1.) are maintained for testing Hypothesis - 6 also.

In a similar way, the students were grouped as High, Average, and Low on the Space Relations scores. The details of the score values for the formation of groups are shown below.

\[
\begin{align*}
M + 1 \text{ SD} &= 49.54 + 4.02 \\
&= 53.56 \approx 54 \\
M - 1 \text{ SD} &= 49.54 - 4.02 \\
&= 45.52 \approx 46
\end{align*}
\]

Therefore, on the Space Relations Scores:

Students who scored 54 and above formed the High group.

Students who scored between 53 and 47 formed the Average group.

Students who scored 46 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Space Relations scores and Achievement scores as given in Table - 11.
Table - 11
A 3 x 3 Contingency Table Between Space Relations Scores and Achievement Scores

<table>
<thead>
<tr>
<th>Space Relations</th>
<th>Achievement</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Average</td>
<td>Low</td>
<td>Total</td>
</tr>
<tr>
<td>High</td>
<td>23 (20.14)</td>
<td>71 (68.99)</td>
<td>19 (23.87)</td>
<td>113</td>
</tr>
<tr>
<td>Average</td>
<td>9 (11.41)</td>
<td>39 (39.08)</td>
<td>16 (13.52)</td>
<td>64</td>
</tr>
<tr>
<td>Low</td>
<td>22 (22.46)</td>
<td>75 (76.93)</td>
<td>29 (26.61)</td>
<td>126</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
<td>185</td>
<td>64</td>
<td>303</td>
</tr>
</tbody>
</table>

(Expected frequencies are shown in the brackets in each cell).

\[ \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \]

Where \( f_o \) = observed frequency in each cell.
\( f_e \) = expected frequency in each cell.

On calculating, \( \chi^2 = 2.6947 \)

\[ df = (r-1)(c-1) \]
\[ = (3-1)(3-1) \]
\[ = 2 \times 2 \]
\[ = 4 \]

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is not significant. Therefore, the null hypothesis is accepted.
Thus, there is no significant association between Space Relations and Achievement in Mathematics.

4.2.7. Hypothesis - 7

The Hypothesis states, "There is no significant association between each of the 14 Personality Characteristics, namely, Factors - A, B, C, D, E, F, G, H, I, J, O, Q₂, Q₃ and Q₄ (as given in the Cattell's HSPQ) and Achievement in Mathematics".

The calculations are presented for the scores obtained on each of the 14 Personality Characteristics (Factors A, B, C, D, E, F, G, H, I, J, O, Q₂, Q₃ and Q₄) separately as shown further.

4.2.7.1. Factor - A (Reserved, Detached, Critical, Aloof, Stiff - Warmhearted, Outgoing, Easygoing, Participating).

The Hypothesis with reference to Factor A is stated as: "There is no significant association between Factor A (as given in the Cattell's HSPQ) and Achievement in Mathematics".

Since the Achievement scores happen to be the same as were for testing Hypothesis - 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for this Hypothesis also.
In a similar way, the students were grouped as High, Average, and Low on the Factor A scores. The details of the score values for the formation of groups are shown below.

\[
M + 1 \ SD = 10.17 + 3.12 = 13.29 \approx 13 \\
M - 1 \ SD = 10.17 - 3.12 = 7.05 \approx 7
\]

Therefore, on the Factor A scores:

- Students who scored 13 and above formed the High group.
- Students who scored between 12 and 8 formed the Average group.
- Students who scored 7 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Factor A scores and Achievement scores as shown in Table - 12.

**Table - 12**

A 3 x 3 Contingency Table Between Factor A Scores and Achievement Scores

<table>
<thead>
<tr>
<th>Factor A</th>
<th>Achievement</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High (13 37)</td>
<td>44 (45 79)</td>
<td>17 (15 84)</td>
<td>75</td>
</tr>
<tr>
<td>High</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>32 (29 94)</td>
<td>98 (102 57)</td>
<td>38 (35 49)</td>
<td>168</td>
</tr>
<tr>
<td>Low</td>
<td>8 (10 69)</td>
<td>43 (36 63)</td>
<td>9 (12 67)</td>
<td>60</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
<td>185</td>
<td>64</td>
<td>303</td>
</tr>
</tbody>
</table>

(Expected frequencies are presented in the brackets in each cell).
\[ \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \]

Where \( f_o \) = observed frequency in each cell.
\( f_e \) = expected frequency in each cell.

On calculating, \( \chi^2 = 3.5551 \)

\[ df = (r-1)(c-1) \]
\[ = (3-1)(3-1) \]
\[ = 2 \times 2 \]
\[ = 4 \]

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is not significant. Therefore, the null hypothesis is accepted.

Hence, there is no significant association between Factor A and Achievement in Mathematics.

4.2.7.2. Factor - B: (Less-Intelligent, Concrete-Thinking, of Lower Scholastic Mental Capacity - More-Intelligent, Abstract-Thinking, Bright, of Higher Scholastic Mental Capacity).

The Hypothesis with reference to Factor B is stated as: "There is no significant association between Factor B (as given in the Cattell's HSPQ) and Achievement in Mathematics". 
Since the Achievement scores happen to be the same as were for testing Hypothesis - 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for this Hypothesis also.

In a similar way, the students were grouped as High, Average, and Low on the Factor B scores. The details of the score values for the formation of groups are shown below.

\[
M + 1 \text{SD} = 6.43 + 2.33 = 8.76 \approx 9
\]

\[
M - 1 \text{SD} = 6.43 - 2.33 = 4.10 \approx 4
\]

Therefore, on the Factor B scores:

Students who scored 9 and above formed the High group.

Students who scored between 8 and 5 formed the Average group.

Students who scored 4 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Factor B scores and Achievement scores as presented in Table 13.
Table - 13

A 3 x 3 Contingency Table Between Factor B Scores and Achievement Scores

<table>
<thead>
<tr>
<th>Factor B</th>
<th>High (Expected)</th>
<th>Average (Expected)</th>
<th>Low (Expected)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>17 (12.12)</td>
<td>43 (41.52)</td>
<td>8 (14.36)</td>
<td>68</td>
</tr>
<tr>
<td>Average</td>
<td>31 (30.83)</td>
<td>106 (105.63)</td>
<td>36 (36.54)</td>
<td>173</td>
</tr>
<tr>
<td>Low</td>
<td>6 (11.05)</td>
<td>36 (37.85)</td>
<td>20 (13.09)</td>
<td>62</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
<td>185</td>
<td>64</td>
<td>303</td>
</tr>
</tbody>
</table>

(Expected frequencies are provided in the brackets in each cell).

\[ \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e}, \]

Where \( f_o \) = observed frequency in each cell.

\( f_e \) = expected frequency in each cell.

On calculating, \( \chi^2 = 10.8906 \)

\[ df = (r-1)(c-1) \]
\[ = (3-1)(3-1) \]
\[ = 2 \times 2 \]
\[ = 4 \]

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is significant at 0.05 level. Therefore, the null hypothesis is rejected.
Thus, there is an association between Factor B and Achievement in Mathematics at 0.05 level.

This calls for further analysis and for this purpose Congingency Coefficient was computed as follows:

\[
C = \sqrt{\frac{\chi^2}{N + \chi^2}}
\]

\[
= \sqrt{\frac{10.8906}{303 + 10.8906}}
\]

\[
= \sqrt{\frac{10.8906}{313.8906}}
\]

\[
= \sqrt{0.0346955}
\]

\[
= 0.19
\]

From the above value of C, it is concluded that there exists a close association between Factor B and Achievement in Mathematics.

4.2.7.3. Factor - C: (Affected By Feelings, Emotionally Less Stable, Easily Upset, Changeable, of Lower Ego Strength - Emotionally Stable, Mature, Faces Reality, Calm, of Higher Ego Strength (not the same as 'egotistical').

The Hypothesis with reference to Factor C is stated as: "There is no significant association between Factor
C (as given in the Cattell's HSPQ) and Achievement in Mathematics. Since the Achievement scores happen to be the same as were for testing Hypothesis - 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for this Hypothesis also.

In a similar way, the students were grouped as High, Average, and Low on the Factor C scores. The details of the score values for the formation of groups are shown below:

\[
M + 1 \text{ SD} = 10.88 + 2.68 = 13.56 \approx 14
\]
\[
M - 1 \text{ SD} = 10.88 - 2.68 = 8.20 \approx 8
\]

Therefore, on the Factor C Scores:

Students who scored 14 and above formed the High group.
Students who scored between 13 and 9 formed the Average group.
Students who scored 8 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Factor C scores and Achievement scores as shown in Table - 14.
### Table - 14

A 3 x 3 Contingency Table Between Factor C Scores and Achievement Scores

<table>
<thead>
<tr>
<th>Factor C</th>
<th>High</th>
<th>Average</th>
<th>Low</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>10 (10.87)</td>
<td>38 (37.24)</td>
<td>13 (12.88)</td>
<td>61</td>
</tr>
<tr>
<td>Average</td>
<td>34 (32.26)</td>
<td>109 (110.51)</td>
<td>38 (38.23)</td>
<td>181</td>
</tr>
<tr>
<td>Low</td>
<td>10 (10.87)</td>
<td>38 (37.24)</td>
<td>13 (12.88)</td>
<td>61</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
<td>185</td>
<td>64</td>
<td>303</td>
</tr>
</tbody>
</table>

(Expected frequencies are given in the brackets in each cell).

\[ \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \]

Where \( f_o \) = observed frequency in each cell.
\( f_e \) = expected frequency in each cell.

On calculating, \( \chi^2 = 0.2882 \)

\[ df = (r-1)(c-1) \]
\[ = (3-1)(3-1) \]
\[ = 2 \times 2 \]
\[ = 4 \]

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is not significant. Therefore, the null hypothesis is accepted.
Thus, there is no significant association between Factor C and Achievement in Mathematics.

4.2.7.4. Factor - D: (Undemonstrative, Deliberate, Inactive, Stodgy, Phlegmatic - Excitable, Impatient, Demanding, Overactive, Unrestrained).

The Hypothesis with reference to Factor D is stated as: "There is no significant association between Factor D (as given in the Cattell's HSPQ) and Achievement in Mathematics".

Since the Achievement scores happen to be the same as were for testing Hypothesis 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for this Hypothesis also.

In a similar way, the students were grouped as High, Average, and Low on the Factor D scores. The details of the score values for the formation of groups are shown below:

\[ M + 1 \text{ SD} = 11.28 + 3.20 \]
\[ = 14.48 \approx 14 \]
\[ M - 1 \text{ SD} = 11.28 - 3.20 \]
\[ = 8.08 \approx 8 \]

Therefore, on the Factor D scores:
Students who scored 14 and above formed the High group.

Students who scored between 13 and 9 formed the Average group.

Students who scored 8 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Factor D scores and Achievement scores as given in Table - 15.

<table>
<thead>
<tr>
<th>Factor D</th>
<th>Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>High</td>
<td>11 (13.37)</td>
</tr>
<tr>
<td>Average</td>
<td>32 (30.12)</td>
</tr>
<tr>
<td>Low</td>
<td>11 (10.51)</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
</tr>
</tbody>
</table>

(Expected frequencies are indicated in the brackets in each cell).

\[ \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \]

Where \( f_o \) = observed frequency in each cell. 
\( f_e \) = expected frequency in each cell.
On calculating, $x^2 = 0.7343$

$$df = (r-1)(c-1)$$
$$= (3-1)(3-1)$$
$$= 2 \times 2$$
$$= 4$$

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is not significant. Therefore, the null hypothesis is accepted.

Hence, there is no significant association between Factor D and Achievement in Mathematics.

4.2.7.5. Factor - E: (Obedient, Mild, Easily Led, Accommodating, Submissive – Assertive, Competitive, Aggressive,Stubborn, Dominant).

The Hypothesis with reference to Factor E is stated as: "There is no significant association between Factor E (as given in the Cattell's HSPQ) and Achievement in Mathematics".

Since the Achievement scores happen to be the same as were for testing Hypothesis - 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for this Hypothesis also.
In a similar way, the students were grouped as High, Average, and Low on the Factor E scores. The details of the score values for the formation of groups are shown below:

\[ M + 1 \text{ SD} = 8.35 + 2.67 = 11.02 \approx 11 \]
\[ M - 1 \text{ SD} = 8.35 - 2.67 = 5.68 \approx 6 \]

Therefore, on the Factor E Scores:

- Students who scored 11 and above formed the High group.
- Students who scored between 10 and 7 formed the Average group.
- Students who scored 6 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Factor E scores and Achievement scores as presented in Table - 16.

**Table - 16**

A 3 x 3 Contingency Table Between Factor E Scores and Achievement Scores

<table>
<thead>
<tr>
<th>Factor E</th>
<th>Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>High</td>
<td>13 (12.12)</td>
</tr>
<tr>
<td>Average</td>
<td>23 (27.09)</td>
</tr>
<tr>
<td>Low</td>
<td>18 (14.79)</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
</tr>
</tbody>
</table>

(Expected frequencies are shown in the brackets in each cell).
\[ x^2 = \sum \frac{(f_o - f_e)^2}{f_e} \]

Where \( f_o \) = observed frequency in each cell.

\( f_e \) = expected frequency in each cell.

On calculating, \( x^2 = 2.977 \)

\[ df = (r-1)(c-1) \]
\[ = (3-1)(3-1) \]
\[ = 2 \times 2 \]
\[ = 4 \]

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is not significant. Therefore, the null hypothesis is accepted.

Thus, there is no significant association between Factor E and Achievement in Mathematics.

4.2.7.6. Factor - F: (Sober, Taciturn, Serious - Enthusiastic, Heedless, Happy-Go-Lucky).

The Hypothesis with reference to Factor F is stated as: "There is no significant association between Factor F (as given in the Cattell's HSPQ) and Achievement in Mathematics".
Since the Achievement scores happen to be the same as were for testing Hypothesis - 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for this Hypothesis also.

In a similar way, the students were grouped as High, Average, and Low on the Factor F scores. The details of the score values for the formation of groups are shown below:

\[
M + 1 \, SD = 9.50 + 2.76 \\
= 12.26 \approx 12 \\
M - 1 \, SD = 9.50 - 2.76 \\
= 6.74 \approx 7
\]

Therefore, on the Factor F scores:

Students who scored 12 and above formed the High group.

Students who scored between 11 and 8 formed the Average group.

Students who scored 7 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Factor F scores and Achievement scores as shown in Table - 17.
Table - 17
A 3 x 3 Contingency Table Between Factor F Scores and Achievement Scores

<table>
<thead>
<tr>
<th>Factor F</th>
<th>Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>High</td>
<td>16 (12.48)</td>
</tr>
<tr>
<td>Average</td>
<td>29 (30.30)</td>
</tr>
<tr>
<td>Low</td>
<td>9 (11.23)</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
</tr>
</tbody>
</table>

(Expected frequencies are presented in the brackets in each cell).

\[ \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \]

Where \( f_o \) = observed frequency in each cell.
\( f_e \) = expected frequency in each cell.

On calculating, \( \chi^2 = 4.2439 \)

\[ df = (r-1)(c-1) \]
\[ = (3-1)(3-1) \]
\[ = 2 \times 2 \]
\[ = 4 \]

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is not significant. Therefore, the null hypothesis is accepted.
Hence, there is no significant association between Factor F and Achievement in Mathematics.

4.2.7.7. Factor - G: (Disregards Rules, Expedient, Has weaker Super Ego Strength – Conscientious, Persistent, Moralistic, Staid, Has Stronger Super Ego Strength).

The Hypothesis with reference to Factor G is stated as: "There is no significant association between Factor G (as given in the Cattell's HSPQ) and Achievement in Mathematics".

Since the Achievement scores happen to be the same as were for testing Hypothesis - 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for this Hypothesis also.

In a similar way, the students were grouped as High, Average and Low on the Factor G scores. The details of the score values for the formation of groups are shown below:

\[
M + 1 \, SD = 12.28 + 2.66 = 14.94 \approx 15 \\
M - 1 \, SD = 12.28 - 2.66 = 9.62 \approx 10
\]

Therefore, on the Factor G Scores:
Students who scored 15 and above formed the High group.

Students who scored between 14 and 11 formed the Average group.

Students who scored 10 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Factor G scores and Achievement scores as given in Table - 18.

**Table - 18**

A 3 x 3 Contingency Table Between Factor G Scores and Achievement Scores

<table>
<thead>
<tr>
<th>Factor G</th>
<th>Achievement</th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Average</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>11 (11.76)</td>
<td>47 (40.30)</td>
<td>8 (13.94)</td>
<td>66</td>
</tr>
<tr>
<td>Average</td>
<td>31 (27.27)</td>
<td>93 (93.42)</td>
<td>29 (32.32)</td>
<td>153</td>
</tr>
<tr>
<td>Low</td>
<td>12 (14.97)</td>
<td>45 (51.29)</td>
<td>27 (17.74)</td>
<td>84</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
<td>185</td>
<td>64</td>
<td>303</td>
</tr>
</tbody>
</table>

(Expected frequencies are provided in the brackets in each cell).

\[ \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \]

Where \( f_o \) = observed frequency in each cell.

\( f_e \) = expected frequency in each cell.
On calculating, $\chi^2 = 10.7413$

\[ df = (r-1)(c-1) \]
\[ = (3-1)(3-1) \]
\[ = 2 \times 2 \]
\[ = 4 \]

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is significant at 0.05 level. Therefore, the null hypothesis is rejected at 0.05 level.

This calls for further analysis and for this purpose, Contingency Coefficient was carried out as follows:

\[ C = \sqrt{\frac{\chi^2}{N + \chi^2}} \]
\[ = \sqrt{\frac{10.7413}{303 + 10.7413}} \]
\[ = \sqrt{\frac{10.7413}{313.7413}} \]
\[ = \sqrt{0.0342361} \]
\[ = 0.19 \]

From the above value of $C$, it can be said that there is a close association between Factor G and Achievement in Mathematics.
The Hypothesis with reference to Factor H is stated as: "There is no significant association between Factor H (as given in the Cattell's HSPQ) and Achievement in Mathematics".

Since the Achievement scores happen to be the same as were for testing Hypothesis - 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for this Hypothesis also.

In a similar way, the students were grouped as High, Average, and Low on the Factor H scores. The details of the score values for the formation of groups are shown below:

\[ M + 1 \text{SD} = 10.56 + 2.95 = 13.51 \approx 14 \]
\[ M - 1 \text{SD} = 10.56 - 2.95 = 7.61 \approx 8 \]

Therefore, on the Factor H Scores:

Students who scored 14 and above formed the High group.

Students who scored between 13 and 9 formed the Average group.
Students who scored 8 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Factor H scores and Achievement scores as presented in Table - 19.

Table - 19
A 3 x 3 Contingency Table Between Factor H Scores and Achievement Scores

<table>
<thead>
<tr>
<th>Factor H</th>
<th>Achievement</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Average</td>
</tr>
<tr>
<td>High</td>
<td>8 (8.55)</td>
<td>30 (29.31)</td>
</tr>
<tr>
<td>Average</td>
<td>35 (32.08)</td>
<td>108 (109.90)</td>
</tr>
<tr>
<td>Low</td>
<td>11 (13.37)</td>
<td>47 (45.79)</td>
</tr>
</tbody>
</table>

Total 54 185 64 303

(Expected frequencies are given in the brackets in each cell).

\[ \chi^2 = \sum \frac{(f_0 - f_e)^2}{f_e} \]

Where \( f_0 \) = observed frequency in each cell.
\[ f_e \] = expected frequency in each cell.

On calculating, \( \chi^2 = 0.9165 \)

\[ df = (r-1)(c-1) \]
\[ = (3-1)(3-1) \]
\[ = 2 \times 2 \]
\[ = 4 \]
Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is not significant. Therefore, the null hypothesis is accepted.

Thus, it is concluded that there is no significant association between Factor H and Achievement in Mathematics.

4.2.7.9. Factor - I: (Tough-Minded, Rejects Illusions - Tender-Minded, Sensitive, Clinging, Over-Protected).

The Hypothesis with reference to Factor I is stated as: "There is no significant association between Factor I (as given in the Cattell's HSPQ) and Achievement in Mathematics".

Since the Achievement scores happen to be the same as were for testing Hypothesis - 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for this Hypothesis also.

In a similar way, the students were grouped as High, Average, and Low on the Factor I scores. The details of the score values for the formation of groups are shown below:

\[
M + 1 \ SD = 11.50 + 3.63 = 15.13 \approx 15
\]
\[
M - 1 \ SD = 11.50 - 3.63 = 7.87 \approx 8
\]
Therefore, on the Factor I Scores:

Students who scored 15 and above formed the High group.

Students who scored between 14 and 9 formed the Average group.

Students who scored 8 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Factor I scores and Achievement scores as shown in Table - 20.

Table - 20
A 3 x 3 Contingency Table Between Factor I Scores and Achievement Scores

<table>
<thead>
<tr>
<th>Factor I</th>
<th>Achievement</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>10 (12.12)</td>
<td>41 (41.52)</td>
<td>17 (14.36)</td>
<td>68</td>
</tr>
<tr>
<td>Average</td>
<td>32 (30.12)</td>
<td>101 (103.18)</td>
<td>36 (35.70)</td>
<td>169</td>
</tr>
<tr>
<td>Low</td>
<td>12 (11.76)</td>
<td>43 (40.30)</td>
<td>11 (13.94)</td>
<td>66</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
<td>185</td>
<td>64</td>
<td>303</td>
</tr>
</tbody>
</table>

(Expected frequencies are indicated in the brackets in each cell).

\[ \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \]

Where \( f_o \) = observed frequency in each cell.
\( f_e \) = expected frequency in each cell.
On calculating, $\chi^2 = 1.8343$

$$df = (r-1)(c-1)$$
$$= (3-1)(3-1)$$
$$= 2 \times 2$$
$$= 4$$

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is not significant. Therefore, the null hypothesis is accepted.

Hence, it can be said that there is no significant association between Factor I and Achievement in Mathematics.


The Hypothesis with reference to Factor J is stated as: "There is no significant association between Factor J (as given in the Cattell's HSPQ) and Achievement in Mathematics".

Since the Achievement scores happen to be the same as were for testing Hypothesis - 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for this Hypothesis also.

In a similar way, the students were grouped as High,
Average, and Low on the Factor J scores. The details of the score values for the formation of groups are shown below:

\[ M + 1 \, SD = 9.66 + 2.67 \]
\[ = 12.33 \approx 12 \]
\[ M - 1 \, SD = 9.66 - 2.67 \]
\[ = 6.99 \approx 7 \]

Therefore, on the Factor J Scores:

Students who scored 12 and above formed the High group.
Students who scored between 11 and 8 formed the Average group.
Students who scored 7 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Factor J scores and Achievement scores as given in Table - 21.

Table - 21
A 3 x 3 Contingency Table Between Factor J Scores and Achievement Scores

<table>
<thead>
<tr>
<th>Factor J</th>
<th>Achievement</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Average</td>
<td>Low</td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>10 (13.37)</td>
<td>42 (45.79)</td>
<td>23 (15.84)</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>34 (30.30)</td>
<td>102 (103.80)</td>
<td>34 (35.91)</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>10 (10.34)</td>
<td>41 (35.41)</td>
<td>7 (12.25)</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
<td>185</td>
<td>64</td>
<td>303</td>
<td></td>
</tr>
</tbody>
</table>

(Expected frequencies are presented in the brackets in each cell).
\[ \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \]

Where \( f_o \) = observed frequency in each cell.

\( f_e \) = expected frequency in each cell.

On calculating, \( \chi^2 = 8.1279 \)

\[ df = (r-1)(c-1) \]
\[ = (3-1)(3-1) \]
\[ = 2 \times 2 \]
\[ = 4 \]

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is not significant. Therefore, the null hypothesis is accepted.

Thus, it is concluded that there is no significant association between Factor J and Achievement in Mathematics.

4.2.7.11. Factor - 0: (Self-Assured, Placid, Secure, Complacent, Untroubled - Apprehensive, Self-Reproaching, Insecure, Worrying, Guilt Prone).

The Hypothesis with reference to Factor 0 is stated as: "There is no significant association between Factor 0 (as given in the Cattell's HSPQ) and Achievement in Mathematics".
Since the Achievement scores happen to be the same as were for testing Hypothesis - 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for this Hypothesis also.

In a similar way, the students were grouped as High, Average, and Low on the Factor 0 scores. The details of the score values for the formation of groups are shown below:

\[
\begin{align*}
M + 1 \text{SD} &= 9.78 + 2.80 \\
&= 12.58 \approx 13 \\
M - 1 \text{SD} &= 9.78 - 2.80 \\
&= 6.98 \approx 7
\end{align*}
\]

Therefore, on the Factor 0 Scores:

Students who scored 13 and above formed the High group.

Students who scored between 12 and 8 formed the Average group.

Students who scored 7 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Factor 0 scores and Achievement scores as presented in Table - 22.
Table - 22
A 3 x 3 Contingency Table Between Factor 0 Scores and Achievement Scores

<table>
<thead>
<tr>
<th>Factor 0</th>
<th>Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>High</td>
<td>8 (9.09)</td>
</tr>
<tr>
<td>Average</td>
<td>38 (34.93)</td>
</tr>
<tr>
<td>Low</td>
<td>8 (9.98)</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
</tr>
</tbody>
</table>

(Expected frequencies are provided in the brackets in each cell).

\[ \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \]

Where \( f_o \) = observed frequency in each cell.
\( f_e \) = expected frequency in each cell.

On calculating, \( \chi^2 = 4.8283 \)

\( df = (r-1)(c-1) \)
\( = (3-1)(3-1) \)
\( = 2 \times 2 \)
\( = 4 \)

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is not significant. Therefore, the null hypothesis is accepted.
Hence, it can be said that there is no significant association between Factor 0 and Achievement in Mathematics.

4.2.7.12. Factor - Q₂ (Sociably Group-Dependent, A "Joiner" and Sound Follower - Self-Sufficient, Prefers Own Decisions, Resourceful).

The Hypothesis with reference to Factor Q₂ is stated as: "There is no significant association between Factor Q₂ (as given in the Cattell's HSPQ) and Achievement in Mathematics".

Since the Achievement scores happen to be the same as were for testing Hypothesis - 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for this Hypothesis also.

In a similar way, the students were group as High, Average, and Low on the Factor Q₂ scores. The details of the score values for the formation of groups are shown below:

\[
M + 1 \text{SD} = 10.48 + 2.61 = 13.09 \approx 13
\]

\[
M - 1 \text{SD} = 10.48 - 2.61 = 7.87 \approx 8
\]

Therefore, on the Factor Q₂ Scores:
Students who scored 13 and above formed the High group.

Students who scored between 12 and 9 formed the Average group.

Students who scored 8 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Factor Q₂ scores and Achievement scores as given in Table - 23.

Table - 23
A 3 x 3 Contingency Table Between Factor Q₂ Scores and Achievement Scores

<table>
<thead>
<tr>
<th>Factor Q₂</th>
<th>Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>High</td>
<td>12 (11.58)</td>
</tr>
<tr>
<td>Average</td>
<td>30 (29.76)</td>
</tr>
<tr>
<td>Low</td>
<td>12 (12.65)</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
</tr>
</tbody>
</table>

(Expected frequencies are indicated in the brackets in each cell).

\[ \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \]

Where \( f_o \) = observed frequency in each cell.

\( f_e \) = expected frequency in each cell.
On calculating, $\chi^2 = 1.0633$

$$\text{df} = (r-1)(c-1)$$
$$= (3-1)(3-1)$$
$$= 2 \times 2$$
$$= 4$$

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is not significant. Therefore, the null hypothesis is accepted.

Thus, it was found that there is no significant association between Factor Q₂ and Achievement in Mathematics.

4.2.7.13. Factor - Q₃: (Uncontrolled, Lax, Follows: Own Urges, Careless of Social Rules, Has Low Integration - Controlled, Socially-Precise, Self-Disciplined, Compulsive, Has High Self-Concept Control).

The Hypothesis with reference to Factor Q₃ is stated as: "There is no significant association between Factor Q₃ (as given in the Cattell's HSPQ) and Achievement in Mathematics".

Since the Achievement scores happen to be the same as were for testing Hypothesis - 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for this Hypothesis also.
In a similar way, the students were grouped as High, Average, and Low on the Factor Q₃ scores. The details of the score values for the formation of groups are shown below:

\[
\begin{align*}
M + 1 \text{ SD} &= 11.36 + 2.89 \\
&= 14.25 \approx 14 \\
M - 1 \text{ SD} &= 11.36 - 2.89 \\
&= 8.47 \approx 8
\end{align*}
\]

Therefore, on the Factor Q₃ Scores:

Students who scored 14 and above formed the High group.

Students who scored between 13 and 9 formed the Average group.

Students who scored 8 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Factor Q₃ scores and Achievement scores as shown in Table - 24.

**Table - 24**

A 3 x 3 Contingency Table Between Factor Q₃ Scores and Achievement Scores

<table>
<thead>
<tr>
<th>Factor Q₃</th>
<th>Achievement</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Average</td>
<td>Low</td>
<td>Total</td>
</tr>
<tr>
<td>High</td>
<td>15 (11.94)</td>
<td>35 (40.91)</td>
<td>17 (14.15)</td>
<td>67</td>
</tr>
<tr>
<td>Average</td>
<td>31 (33.86)</td>
<td>123 (116.00)</td>
<td>36 (40.13)</td>
<td>190</td>
</tr>
<tr>
<td>Low</td>
<td>8 (8.20)</td>
<td>27 (28.09)</td>
<td>11 (9.72)</td>
<td>46</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
<td>185</td>
<td>64</td>
<td>303</td>
</tr>
</tbody>
</table>

(Expected frequencies are presented in the brackets in each cell).
\[\chi^2 = \sum \frac{(f_o - f_e)^2}{f_e}\]

Where \(f_o\) = observed frequency in each cell.
\(f_e\) = expected frequency in each cell.

On calculating, \(\chi^2 = 3.5167\)

\[df = (r-1)(c-1)\]
\[= (3-1)(3-1)\]
\[= 2 \times 2\]
\[= 4\]

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is not significant. Therefore, the null hypothesis is accepted.

Hence, it can be said that there is no significant association between Factor Q3 and Achievement in Mathematics.


The Hypothesis with reference to Factor Q4 is stated as: "There is no significant association between Factor Q4 (as given in the Cattell's HSPQ) and Achievement in Mathematics".
Since the Achievement scores happen to be the same as were for testing Hypothesis - 1, the same groupings of High, Average, and Low (Refer Caption 4.2.1.) are maintained for this Hypothesis also.

In a similar way, the students were grouped as High, Average, and Low on the Factor Q₄ scores. The details of the score values for the formation of groups are shown below:

\[ M + 1 \text{ SD} = 10.96 + 3.35 = 14.31 \approx 14 \]
\[ M - 1 \text{ SD} = 10.96 - 3.35 = 7.61 \approx 8 \]

Therefore, on the Factor Q₄ Scores:

- Students who scored 14 and above formed the High group.
- Students who scored between 13 and 9 formed the Average group.
- Students who scored 8 and below formed the Low group.

Based on the above groupings, a 3 x 3 Contingency Table was formed between Factor Q₄ scores and Achievement scores as presented in Table - 25.
Table - 25
A 3 x 3 Contingency Table Between Factor Q₄ Scores and Achievement Scores

<table>
<thead>
<tr>
<th>Factor Q₄</th>
<th>High</th>
<th>Average</th>
<th>Low</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>12 (12.83)</td>
<td>44 (43.96)</td>
<td>16 (15.21)</td>
<td>72</td>
</tr>
<tr>
<td>Average</td>
<td>28 (27.80)</td>
<td>92 (95.25)</td>
<td>36 (32.95)</td>
<td>156</td>
</tr>
<tr>
<td>Low</td>
<td>14 (13.37)</td>
<td>49 (45.79)</td>
<td>12 (15.84)</td>
<td>75</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
<td>185</td>
<td>64</td>
<td>303</td>
</tr>
</tbody>
</table>

(Expected frequencies are given in the brackets in each cell).

\[ \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \]

Where \( f_o \) = observed frequency in each cell.

\( f_e \) = expected frequency in each cell.

On calculating, \( \chi^2 = 1.6749 \)

\[ df = (r-1)(c-1) \]
\[ = (3-1)(3-1) \]
\[ = 2 \times 2 \]
\[ = 4 \]

Referring to Table E (Garrett, 1981), the obtained value of Chi-Square is not significant. Therefore, the null hypothesis is accepted.
Thus, it is concluded that there is no significant association between Factor Q₄ and Achievement in Mathematics.

4.3.0. Summary of Results

Before summing up the results to provide a comprehensive picture, the results as obtained when each of the Hypotheses of the study were tested are given. They are as follows:

1. There is a significant association between Attitude towards Mathematics and Achievement in Mathematics. This association can be considered as close as the value of C was found to be equal to 0.24.

2. There is a significant association between Educational Aspiration and Achievement in Mathematics. This association can be considered as close as the value of C was found to be equal to 0.22.

3. There is no significant association between Occupational Aspiration and Achievement in Mathematics.

4. There is a significant association between Numerical Ability and Achievement in Mathematics. This association can be considered as close as the value of C was found to be equal to 0.20.
5. There is a significant association between Abstract Reasoning and Achievement in Mathematics. This association can be considered as very good as the value of C was found to be equal to 0.32.

6. There is no significant association between Space Relations and Achievement in Mathematics.

7.(i) There is no significant association between the Personality Characteristic Factor A (Reserved - Warmhearted) and Achievement in Mathematics.

(i) There is a significant association between Personality Characteristic Factor B (Less-Intelligent - More-Intelligent) and Achievement in Mathematics. This association can be considered as close as the value of C was found to be equal to 0.19.

(iii) There is no significant association between Personality Characteristic Factor C (Affected by Feelings - Emotionally Stable) and Achievement in Mathematics.

(iv) There is no significant association between Personality Characteristic Factor D (Undemonstrative - Excitable) and Achievement in Mathematics.

(v) There is no significant association between Persona-
lity Characteristic Factor E (Obedient - Assertive) and Achievement in Mathematics.

(vi) There is no significant association between Personality Characteristic Factor F (Sober - Enthusiastic) and Achievement in Mathematics.

(vii) There is a significant association between Personality Characteristic Factor G (Disregards Rules - Conscientious) and Achievement in Mathematics. This association can be considered as close as the value of C was found to be equal to 0.19.

(viii) There is no significant association between Personality Characteristic Factor H (Shy - Adventurous) and Achievement in Mathematics.

(ix) There is no significant association between Personality Characteristic Factor I (Tough-Minded - Tender-Minded) and Achievement in Mathematics.

(x) There is no significant association between Personality Characteristic Factor J (Zestful - Circumspect-Individualism) and Achievement in Mathematics.

(xi) There is no significant association between Personality Characteristic Factor O (Self-Assured - Apprehensive) and Achievement in Mathematics.
(xii) There is no significant association between Personality Characteristic Factor $Q_2$ (Sociably Group-Dependent – Self-Sufficient) and Achievement in Mathematics.

(xiii) There is no significant association between Personality Characteristics Factor $Q_3$ (Uncontrolled – Controlled) and Achievement in Mathematics.

(xiv) There is no significant association between Personality Characteristic Factor $Q_4$ (Relaxed – Tense) and Achievement in Mathematics.

To sum up, the study has showed that achievement in Mathematics is significantly associated with the variables Attitude towards Mathematics, Educational Aspiration, Numerical Ability, Abstract Reasoning, and the Personality Characteristics Less-Intelligent – More-Intelligent, and Disregards Rules – Conscientious.

On the other hand, the Achievement in Mathematics is not significantly associated with the variables Occupational Aspiration, Space Relations, and the Personality Characteristics Reserved – Warmhearted, Affected by Feelings – Emotionally Stable, Undemonstrative – Excitable, Obedient – Assertive, Sober-Enthusiastic, Shy – Adventurous, Tough-
Minded - Tender-Minded, Zestful - Circumspect-Individualism, 
Sociably Group-Dependent - Self-Sufficient, Uncontrolled 
- Controlled, and Relaxed - Tense.

4.4.0. Discussion of Results

The present study has shown that there is a significant association between Attitude towards Mathematics and Achievement in Mathematics. The results of the studies by Samant (1944), Peskin (1965), Neale (1969), Kulkarni, Naidu & Arya (1970), Ohuche (1980), and Cheung (1988) have also suggested relationship to different extents between the two variables under consideration. The positive association found does not indicate whether positive attitude towards Mathematics is developed because of some achievement or vice versa. Whatever might be the starting point, it is of importance to note that since the two variables are associated, efforts by all concerned should be to promote a positive attitude towards Mathematics which may initiate some achievement in the subject.

The present investigation has tried to find out whether any association exists between Achievement in Mathematics and each of the variables, Educational Aspiration and Occupational Aspiration, separately. Though no specific study reviewed has dealt with the Achievement in Mathematics
in particular, there are some studies which have taken achievement in general as the variable. Pierce (1952), Menon (1973) and Das (1986) have found a significant relationship between Educational Aspirations of students and their academic achievement. Austin (1964), Nichols & Davis (1964), Prenter & Steward (1972), and Deka (1985) have found a significant relationship between Occupational Aspiration and academic achievement. In the present study which has considered Achievement in Mathematics in particular, it has been found that the variable has a significant association with Educational Aspiration while not so with Occupational Aspiration. The result has to be looked into considering the subject of study under consideration, that is, Mathematics and the region in which the study has been conducted. The sample for the study is drawn from three of the States of North-East India where majority of the population are tribals. Till recently the educational opportunities provided to them were very meagre and even today they are at a very low order when compared to the rest of the country. As the people of the region are getting exposed more and more to the progress and development through a gradual improvement in the transport and communication system, there is an increase in their desire to get better educated. Thus, their educational aspiration would have become higher and conse-
quently because of their serious efforts would have achieved higher also, thus resulting in an association between these two variables. But, it must be noted that the region can be said as poor as far as industrialisation is considered. Hardly any major industry can be found in all the three States considered in the study, namely, Nagaland, Meghalaya, and Manipur. This environment may be thought of as not inducing students to aspire for jobs which are considered high on any Occupational Scale, though they might have quenched their thirst for knowledge by studying well and achieving high on the school subjects including Mathematics.

Numerical Ability, Abstract Reasoning, and Space Relations were the three Specific Abilities which were hypothesized to have association with Achievement in Mathematics. Results of the study have indicated that while Numerical Ability and Abstract Reasoning have significant associations, Space Relations was found to have no association with Achievement in Mathematics. Except for the studies by Chhikara (1985) and Tiwari (1986) which reported a positive relationship between reasoning abilities and achievement of concepts, no study in particular to the association of each of the concepts of Numerical Ability, Abstract Reasoning, and Space Relations taken separately, with Achievement in Mathematics was found. Mathematics which a high school student studies
may be more loaded with the requirement of Numerical Ability and Abstract Reasoning, and less with Space Relations. Hence or otherwise, the teachers may give more attention to promote the abilities of Numerical Ability and Abstract Reasoning and thus it is possible for the lesser development of the ability of Space Relations in students. This may be a plausible reason for the result of the study, that is, a significant association between each of Numerical Ability and Abstract Reasoning with Achievement in Mathematics and no association between Space Relations and Achievement in Mathematics.

The present study attempted to find out whether each of the Personality Characteristics as measured on 14 HSPQ have an association with Achievement in Mathematics. Studies on similar lines by Ainsworth (1967), Srivastava (1974), Seetha (1975), and Gopalacharyulu (1984) have given varied results. But they cannot be compared with the present study as these studies differ in their criterion of achievement from that used in the present study. The present study concluded that only two Personality Characteristics, namely, Factor B and Factor G, have an association with Achievement in Mathematics. Factor B indicates the continuum Less-Intelligent, Concrete-Thinking, of Lower Scholastic Mental Capacity – More-Intelligent, Abstract-Thinking, Bright, of Higher
Scholastic Mental Capacity. This means that a student who has higher intelligence and has higher abstract thinking power may be expected to have a higher Achievement in Mathematics. This finding also adds support to the result, which is already discussed, that Abstract Reasoning ability has an association with Achievement in Mathematics. The Factor G indicates the continuum Disregards Rules, Expedient, Has Weaker Super-ego Strength - Conscientious, Persistent, Moralistic, Staid, Has Stronger Super-ego Strength. This means that a student who is conscientious and persistent in nature may be expected to achieve higher in Mathematics. This seems to be plausible as Mathematics is a subject which requires a conscienious and persistent effort on the part of the student to obtain mastery. All the other 12 Personality Characteristics, namely, Factors A (Reserved - Warmhearted), C (Affected by Feelings - Emotionally Stable), D (Undemonstrative - Excitable), E (Obedient - Assertive), F (Sober - Enthusiastic), H (Shy - Adventurous), I (Tough-Minded - Tender-Minded), J (Zestful-Circumspect-Individualism), O (Self-Assured - Apprehensive), Q₂ (Sociably Group-Dependent - Self-Sufficient), Q₃ (Uncontrolled - Controlled), and Q₄ (Relaxed - Tense), seem to be involved more with the affective aspects of an individual's personality. Mathematics is claimed as a subject which is more practical in nature.
A mathematician is considered more as a square person. Hence, the result obtained in the study that none of the above Personality Characteristics has an association with Achievement in Mathematics seems plausible.

Looking to the results of the study in their entirety, it may be said that a student, who is having positive Attitude towards Mathematics, who is having higher Educational Aspiration, who is having greater Numerical and Abstract Reasoning Abilities, who is more Intelligent and who is Conscientious, may be expected to have higher Achievement in Mathematics. Some of these variables can be attributed to nature. Others are to be nurtured by parents, teachers and other persons concerned, if the students are to be helped to improve their Achievement in Mathematics.