CHAPTER 8
MULTIVARIATE ANALYSIS

8.1. Introduction

All the variables studied in this research do not show significant contribution in a bivariate analysis. Yet it is likely that some of them when combined in multivariate analysis account for the significant variance in predicting Academic Achievement of the students' sample under study. Therefore, to examine and compare the predictive efficiency of independent variables towards Academic Achievement of the university students, separately as also to see whether their conjoint effect is higher than their separate prediction, and likewise to determine the combination of these predictor variables which best explain the variance of the dependent variable, that is, academic achievement, the techniques of step-up regression analysis, multiple correlation and F-ratios were applied. This involved examining of contribution of independent variables – Personality Needs, Mental Maturity, and University Environment with their sub-variables – to the criterion variable Academic Achievement.

Multiple regression analysis is a method of analyzing the collective and separate contribution of two or more independent variables ‘X’ to the variations of a dependent variable ‘Y’ (Kerlinger, 1973). Keeping this in view, step-up regression equations were set up by adding one independent variable at a time to the previous one to examine their efficiency in predicting Academic Achievement of the university students. The technique of multiple correlation is used to test the specific combination of independent variables contributing to the maximum variance of the dependent variable.

The square of multiple correlation ($R^2$) called the coefficient of determination shows the proportion of variance of the criterion variable accounted for by the independent variables. To test the significance of difference between the value of multiple correlations (R’s) from one specific combination of independent variables to the subsequent combination of variables, F-ratios were calculated that are discussed in Sections I and II of this chapter.
8.2. Section I: Results of Step-Wise Regression Analysis

This part of the chapter contains results of regression analysis to examine the step-wise, conjoint contribution made by independent variables – Personality Needs, Mental Maturity and University Environment – and their sub-variables to the criterion variable, Academic Achievement, of the total sample under study. These results appear in Tables 8.1, 8.2 and 8.3.

Table 8.1
Step-wise Multiple Regression Coefficients

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>AACH</td>
<td>.887((a))</td>
<td>.786</td>
<td>.786</td>
<td>.906</td>
</tr>
<tr>
<td>AACH</td>
<td>.930((b))</td>
<td>.864</td>
<td>.863</td>
<td>.723</td>
</tr>
<tr>
<td>AACH</td>
<td>.933((c))</td>
<td>.871</td>
<td>.870</td>
<td>.705</td>
</tr>
<tr>
<td>AACH</td>
<td>.935((d))</td>
<td>.873</td>
<td>.872</td>
<td>.700</td>
</tr>
</tbody>
</table>

\(a\) Predictors: (Constant), MMA
\(b\) Predictors: (Constant), MMA, NORM
\(c\) Predictors: (Constant), MMA, NORM, AUNF
\(d\) Predictors: (Constant), MMA, NORM, AUNF, CHG

As can be seen from Table 8.1 the value of ‘R’ between the dependent variable, Academic Achievement, and the independent variable Mental Maturity is 0.887 which is significant at the 0.01 level. This may be interpreted to mean that the students with higher academic achievements are more mentally mature. The coefficient of determination (R\(^2\)) for this value of ‘R’ is 0.786, which means that 78.6 percent of the variance of Academic Achievement is accounted for by Mental Maturity.

In the next phase of step up regression and the computation of ‘R’ the second variable, i.e., Normlessness has been added. The value of ‘R’ in this case is 0.930 which is again significant at the 0.01 level and R\(^2\) for this value of ‘R’ is 0.864. It is obvious that the addition of the variable Normlessness has enhanced the value of ‘R’ and R\(^2\) and so also the amount of percentage of the variance of Academic Achievement accounted for by Normlessness. It means that as Normlessness has been added to the variable Mental Maturity, it has increased the value of the former. The percentage of variance accounted for by these variables in combination has gone up to 86.4 percent.

Furthermore, the addition of independent variable Adoption of Unfair Means has also led to an increase in the value of ‘R’ which is 0.933 and this is
again significant .01 level. $R^2$ for this value of ‘R’ is 0.871. This value of ‘R’ and the preceding ones i.e. the one with the addition of the variables Normlessness and Mental Maturity are much higher than the ‘R’s’ between independent variables taken individually and the criterion variable academic achievement. Moreover, there is a further increase in the percentage of variance of Academic Achievement accounted for by these variables in combination. The addition of the independent variable, Adoption of Unfair Means, has added to the total percentage of variance of Academic Achievement accounted for by the combination of these variables so far i.e. 86.4 percent, which is now 87.1 percent.

Lastly, with the addition of independent variable Change, the value of ‘R’ increased to 0.935 which is significant at 0.1 level. $R^2$ for this value of ‘R’ is 0.873, which explains that 87.3 percent of the variance of Academic Achievement is accounted for by these independent variables: Normlessness, Mental Maturity, Adoption of Unfair Means and Change in combination.

8.2.1. Analysis of Variance Between Multiple ‘R’s’ With Stepwise Addition of Independent Variables

In the next part of analysis, the significance of differences between ‘R’s’ have been computed along with F-ratios in order to see whether the addition of another variable contributed significantly towards the variance accounted for by the variable taken up earlier.

As can be seen from Tables 8.1 and 8.2 the values of Multiple ‘R’ and corresponding $R^2$ between the dependent variable, Academic Achievement, and the independent variable Mental Maturity are 0.887 and 0.786 respectively, with F-ratio of 1096.252 being significant at 0.1 level. It means that 78.6 percent of the variance of Academic Achievement is accounted for by Mental Maturity.

The next step in regression analysis shows that with the addition of another independent variable i.e. Normlessness, the values of Multiple ‘R’ and corresponding $R^2$ are 0.930 and .864 respectively. F-ratio for significance of difference between the previous and this value of Multiple ‘R’ is 945.430 which is significant at 0.1 level.
It is obvious that the addition of the variable Normlessness has enhanced the value of 'R' and $R^2$ and so also the amount of percentage contribution to the criterion variable Academic Achievement. It means that as Normlessness has been added to the variable Mental Maturity, it has added to percentage of the variance of Academic Achievement accounted for by Mental Maturity and Normlessness in combination, now being 86.4 percent.

The next step shows that with the addition of another independent variable i.e. Adoption of Unfair Means, the values of Multiple 'R' and corresponding $R^2$ are 0.933 and 0.871 respectively. F-ratio for significance of difference between the previous and this value of Multiple 'R' is 667.167 which is significant at 0.1 level. This means that addition of independent variable Adoption of Unfair Means has increased the values of 'R' and $R^2$ significantly and hence the difference between them as indicated by the value of F is also significant at 0.1 level.

When the fourth independent variable i.e. Change, was added to the previous set of variables the coefficient of 'R' increased to 0.935 and corresponding $R^2$ to 0.873. Also F-ratio for significance of difference between the previous and this value of Multiple 'R' is 508.991 which is significant at 0.1 level. This means that addition of independent variable Change has
increased the values of ‘R’ more significantly and hence the difference between them (‘R’ mental maturity; ‘R’ Mental Maturity and Normlessness; ‘R’ Mental Maturity, Normlessness, and Adoption of Unfair Means; ‘R’ Mental Maturity, Normlessness, Adoption of Unfair Means and Change) as indicated by the value of F is also significant. The results obtained overall partially support Hypothesis No. 5 of this study. Also the obtained results indicate that 87.3 of the variance of Academic Achievement is accounted for by Mental Maturity, Personality Needs (only one sub-variable: Change), and University Environment (two sub-variables: Normlessness and Adoption of Unfair Means of University Environment) in combination. The results show that hypothesis No. 6 is partially tenable.

8.3. Section II: Discussion of Results of Step-Wise Regression Analysis

As it is obvious from the results presented in the previous section as well as the weights of betas given in Table 8.3 of this chapter, mental maturity, change (one sub-variable of personality needs) and Normlessness and Adoption of Unfair Means (two sub-variables of university environment) are found to be significant predictors of academic achievement. The analysis of results shows that step-wise adding of the independent variables has constantly added to the total percentage of variance of the dependent variable i.e. Academic Achievement.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Independent Variables</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AACH</td>
<td>MMA</td>
<td>.069</td>
<td>.002</td>
<td>.887</td>
<td>33.110</td>
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<tr>
<td></td>
<td>MMA</td>
<td>.050</td>
<td>.002</td>
<td>.639</td>
<td>22.381</td>
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<tr>
<td></td>
<td>NORM</td>
<td>-.081</td>
<td>.006</td>
<td>-.373</td>
<td>13.062</td>
</tr>
<tr>
<td>AACH</td>
<td>MMA</td>
<td>.046</td>
<td>.002</td>
<td>.595</td>
<td>19.855</td>
</tr>
<tr>
<td></td>
<td>NORM</td>
<td>-.063</td>
<td>.007</td>
<td>-.291</td>
<td>8.414</td>
</tr>
<tr>
<td></td>
<td>AUNF</td>
<td>-.034</td>
<td>.008</td>
<td>-.143</td>
<td>3.958</td>
</tr>
<tr>
<td>AACH</td>
<td>MMA</td>
<td>.046</td>
<td>.002</td>
<td>.598</td>
<td>20.081</td>
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<tr>
<td></td>
<td>NORM</td>
<td>-.064</td>
<td>.007</td>
<td>-.295</td>
<td>8.578</td>
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<tr>
<td></td>
<td>AUNF</td>
<td>-.033</td>
<td>.008</td>
<td>-.141</td>
<td>3.956</td>
</tr>
<tr>
<td></td>
<td>CHG</td>
<td>-.026</td>
<td>.011</td>
<td>-.048</td>
<td>2.305</td>
</tr>
</tbody>
</table>

a Dependent Variable: AACH

Table 8.3
Step-wise Multiple Regression Coefficients and Multiple Correlations for the Total Sample (N=300)
The value of 'R' reflecting the relationship of Academic Achievement to Mental Maturity is significant. The value of $R^2$ shows that 78.6 percent of variance of Academic Achievement is accounted for by Mental Maturity.

Addition of the second independent variable i.e. Normlessness further enhanced the total percentage of variance of Academic Achievement accounted for by this combination of independent variables, the total percentage now being 86.4 percent. These results meet the expectations.

The addition of the third independent variable, i.e., Adoption of Unfair means, led to a further increase in the total percentage of variance of Academic Achievement accounted for by this combination. Total percentage is now 87.1.

With the addition of the fourth independent variable, Change, the total percentage of variance of Academic Achievement accounted for by this combination of independent variables increased further, the total percentage now being 87.3.

These results further show that the three independent variables conjointly account for higher variance of the dependent variable i.e. Academic Achievement than it can be accounted for by taking up each of the independent variables separately. Together they are more meaningful in accounting for the prediction of Academic Achievement amongst the university students of the total sample studied in this research.

The above results along with the weights of betas given in Table 8.3 have an important implication, that is, all the three independent variables (with their sub-variables) contribute significantly to the explanation of the dependent variable i.e. Academic Achievement.

The above results along with the weights of betas given in Table 8.3 further show that Mental Maturity, Normlessness, Adoption of Unfair Means and Change are the main contributors/predictors of the Academic Achievement of students studied in this research. The effects of independent variables on dependent variable are given in the formulas below. Out of the total variance of 87.3% accounted by all the independent variables for Academic Achievement, greatest significance is that of Mental Maturity, 78.6 percent, followed by the next three variables of Normlessness, Adoption of Unfair Means and Change respectively making 7.7 percent, 0.7 percent and 0.2 percent.
Furthermore, Normlessness and Adoption of Unfair Means respectively account for only 7.7 percent and 0.7 percent of variance of Academic Achievement. Both these variables together account for only 8.4 percent of the variance of Academic Achievement. It means that University Environment accounts for 8.4 percent of the variance of the Academic Achievement of the university students studied in this research. Moreover, Change, a sub-variable of personality needs, accounts for only 0.2 percent of the Academic Achievement. It means that Personality Needs accounts for only 0.2 percent of the variance of Academic Achievement of the university students of this research. University Environment and Personality Needs together account for 8.6 of the variance of Academic Achievement in this study.

Although the personality needs and University Environment (two independent variables) are significant so far as Academic Achievement is concerned, a rather small amount of total variance (8.67%) is accounted for by both of them with their sub-variables (possibly due to significant inter-correlation amongst themselves). Besides their singular correlation with Academic Achievement, it can possibly be also due to significant inter-correlation between these two variables. At the same time, the same figure suggests the possibility that there may be factors other than those taken up in the present study as being potential predictors of Academic Achievement. These factors may be located in home environment, personal experience of the university students, peer relations and significant events that can be a turning point in every body’s life. Factors and forces accounting for Academic Achievement may be many and varied. The contribution of Mental Maturity, two sub-variables of the University Environment (Normlessness and Adoption of Unfair Means) and one sub-variable of Personality Needs (Change) to Academic Achievement in the present study is therefore considered significant. However, as far as the scope of the present study is concerned, the variables studied i.e. Mental Maturity, University Environment (Normlessness, Adoption of Unfair Means) and Personality Needs (Change) are significant predictors, independently, as well as conjointly and their conjoint contribution to Academic Achievement amongst university students is greater as compared to their contribution taken singularly. These results partially substantiate Hypotheses No. 5 and 6.
The relative effects of the three independent variables singly and conjointly on the dependent variable Academic Achievement are determined with the help of the following formulas.

The relative effect of Mental Maturity on Academic Achievement:
AACH = $\beta_1$ (Mental Maturity)
AACH = 3.344 + .887 = 4.231 (Mental Maturity)
The above equation shows that with the change of 1 unit in Mental Maturity, we can predict a change of 4.231 in Academic Achievement.

The relative effect of Normlessness on Academic Achievement:
AACH = $\beta_2$ (Normlessness)
AACH = 3.344 + (-.373) = 2.971 (Normlessness)
The above equation shows that with the change of 1 unit in Normlessness, we can predict a change of 2.971 in Academic Achievement.

The relative effect of Adoption of Unfair Means Academic Achievement:
AACH = $\beta_3$ (Adoption of Unfair Means)
AACH = 3.344 + (-.143) = 2.201 (Adoption of Unfair Means)
The above equation shows that with the change of 1 unit in Adoption of Unfair Means, we can predict a change of 2.201 in Academic Achievement.

The effect of Change on Academic Achievement:
AACH = $\beta_4$ (Change)
AACH = 3.344 + (-.048) = 3.296 (Change)
The above equation shows that with the change of 1 unit in independent variable Change, we can predict a change of 3.296 in Academic Achievement.

The following formula shows the combined contribution of the three independent variables to the dependent variable Academic Achievement.
AACH = $\beta_1$ (Mental Maturity) + $\beta_2$ (Normlessness) + $\beta_3$ (Adoption of Unfair Means) + $\beta_4$ (Change)
AACH = 3.344 + .887 (Mental Maturity) - .373 (Normlessness) - .143 (Adoption of Unfair Means) - .048 (Change)