CHAPTER V

STATISTICAL ANALYSIS AND INTERPRETATION OF RESULTS

5.1. Introduction

The investigator has attempted to investigate the effect of library use on academic achievement of post-graduate students, studying in the Faculties of Arts, Science and Education in the M.S. University of Baroda. It was stated in Chapter III while discussing the design of study that this study is basically concerned with the prediction of academic success of the post-graduate students in the M.S. University of Baroda as influenced by their use of the available library services on the campus. Specifically the investigator wanted to test the following hypothesis : There is no significant effect of the use of available library services on the academic achievement of post-graduate students in the Faculties of Arts, Science and Education in the M.S. University of Baroda.

5.2. Statistical Technique

Multiple regression analysis has been used as the statistical technique to test the above hypothesis. Multiple regression analysis has been chosen in this study because it is widely used in predictive studies, where it is required to estimate the change in the dependent variable from changes in two or more independent variables. The reasons for selecting this technique for the present study have been stated earlier while discussing the design of study.

Adequate statistical controls of ability and intelligence must be applied when an investigator is testing the predictive value of variables in relation to academic success (criterion) as it is measured by examination marks. Many statistical techniques have been developed to ensure successful control of these factors in such studies. One of these techniques is multiple regression analysis which has been used in the present study.

According to Ezekiel the multiple regression equation serves to sum up all the evidence of a large number of observations in a single statement which expresses in condensed form the extent to which differences

in the dependent variable tend to be associated with differences in each of the other variables.[1] Fisher has discussed the value of regression as a statistical tool in the following words : The idea of regression used usually to be introduced in connection with the theory of correlation but it is in reality a more general and simpler idea. Moreover, the regression coefficients are of interest and scientific importance in many classes of data where the correlation coefficient, if used at all, is an artificial concept of no real utility. The regression function does not depend on the frequency distribution of the independent variate, so that a true regression line may be obtained even when the scores are arbitrarily selected with regard to the independent variables.[2]

Schmid has clearly differenciated between the use and value of regression and the use and value of correlation. According to him, whenever the research worker is attempting to estimate the value of one variable from knowledge of the corresponding value of the other variable, then a regression of the dependent variable upon the independent variable is the statistic that furnishes the information described. On the other hand, when he is interested in determining a two way

relationship between the variables, the correlation coefficient is the appropriate statistic to be used.... When a research worker can, on logical grounds, say that he is concerned with the unidirectional relationship between two vafiables a regression coefficient may be appropriately used. Secondly, regression coefficients preserve the original units of the related variable. Thirdly, whereas coefficients of correlation are seriously affected by various types of selection on the independent variable, this is not true of the regression coefficient.[3]

The regression equation is in terms of the population values (or parameters). The best estimates of these parameters are obtained from sample values.The partial regression coefficients represent the weighted contribution that each independent variable makes to the total estimate of the dependent variable. The equation predicts the average change in the dependent variable for a unit change in any one of the independent variables, while the other independent variables are held constant.

Academic achievement of post-graduate students in the Faculties of Arts, Science and Education in the M.S. University of Baroda, as measured by their examination marks, has been used as the dependent variable in this study. An

attempt has been made to determine for the independent variable (level of the use of available library services) the variation in the dependent variable (academic achievement as measured by examination marks) directly due to this independent variable. This is how the effect of the use of available library services (independent variable) on the academic achievement as measured by examination marks (dependent variable) is to be estimated. It has also been possible to determine the variation in the dependent variable due to other independent variables, such as the level of intelligence of students, their past achievement as measured by their qualifying examination marks and their socio-economic status level. These independent variables have been used as control variables in this study for the reasons stated in detail in earlier chapters.

There is no unique statistical procedure for selecting variables in regression analysis. In the opinion of Prof. N.R.Draper two opposed criteria of selecting a resultant equation are usually involved. They are as follows :

1. To make the equation useful for predictive purposes we should want our model to include as many X's (independent variables) as possible so that reliable fitted values can be determined.

2. Because of costs involved in obtaining information on a large number of X's (independent variables) and subsequently monitoring them, we should like the equation to include as few X's as possible.

The compromise between these two extremes is what is usually called selecting the best regression equation.[4] In the present study only three independent variables have been used as control variables. It is a compromise as stated above. Because of the difficulty in collecting data on a large number of independent variables, their number is limited to only three. The reasons for choosing these three as the control variables have been stated earlier. These three variables have been used by other researchers in the prediction of academic success. Intelligence and achievement have been reported as the best predictors of future academic success. Socio-economic status has been used, because in the investigator's opinion it may be a factor which contributes to academic success at the post-graduate level in Indian conditions today.

Library use is considered to be made up of six factors in this study. They are as follows :

1. Books taken for home reading.
2. Time spent in reading on the library premises per week.

3. Books and journals read on the library premises per week.
4. Books owned
5. Books received per week from sources other than library.
6. Test of familiarity with library rules and regulations.

It has been discussed in the preceding Chapter how these variables have been measured and the tools and techniques used in collecting data for each of them . These six have been used as independent variables along with the three control variables listed earlier namely, level of intelligence, past academic achievement and socio-economic status. Thus there were nine independent variables in the regression equation along with the dependent variable (academic achievement as measured by examination marks).

5.3. Regression Equation

The regression equation for nine independent variables reads as follows :

$$Y = a_1 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9$$

Y is the dependent variable and X_1 ... to X_9 are independent variables, a_1 and b_1 to b_9 are unknown constants

in this equation. The constants b_1, b_2, b_3 etc. are known as the partial regression coefficients. The regression coefficient by represents the regression of Y on X_1, with X_2, X_3, ... X_9 held constant. In other words the coefficient b_1 shows the average change in Y for a unit increase in X_1 score, with X_2 to X_9 remaining unchanged or held constant. In the regression equation used in the present study the dependent variable and the nine independent variables are denoted as follows :

Dependent variable :

Y Academic achievement as measured by final examination marks.

Independent variables :

X_1 Past achievement as measured by qualifying examihation marks.

X_2 Level of intelligence as measured by raw scores on Raven's Progressive Matrices Test.

X_3 Socio-economic status level as measured by Dr.Kuppuswamy's Socio-economic Status Scale (Urban)

X_4 Library use as shown by the number of books taken for home reading during the academic year 1968-69.

X_5 Library use as measured by a test of familiarity with rules and regulations of the Hansa Mehta Library.

X_6 Library use as shown by the time spent (number of hours per week) in reading on the library premises.

X_7 Library use shown by the number of books and journal read per week in the reading room and stacks of the library.

X_8 Library use as shown by the number of books owned which are required for study.

X_9 Library use as shown by the number of books received per week from sources other than the Hansa Mehta Library.

The respective partial regression coefficients b_1, b_2, b_3 etc. in the above equation can be interpreted in the following way :

The regression coefficient b_1 shows the average change in academic achievement (measured by final examination marks) of post graduate students in the M.S. University of Baroda for a unit increase in their past achievement (measured by their qualifying examination marks) with all the remaining eight independent variables held constant. In a similar manner each of the partial regression coefficients can be explained. Thus the partial regression coefficient enables us to estimate the influence of a single independent variable on the dependent variable when the other independent variables are held constant or remain unchanged. In other words, the partial regression coefficient tells us about the direct contribution of an

independent variable on the dependent variable.

It has been stated earlier that the six library use variables namely, books taken for home reading, library familiarity test, time spent in reading on library premises, books and journals read on library premises, books owned and books received from other sources were combined to give a total library use index for each student in the sample. How this is done was discussed in the previous Chapter. Statistical analysis of the data has been done in two operations. At first, the six library use factors have been considered as separate independent variables. These six and the three control variables viz. past achievement, intelligence and socio-economic status constitute the nine independent variables in the first multiple regression equation. In the second equation, the six library use factors have been combined into a single variable, which along with the three control variables make up a total of four independent variables. The second regression equation reads as follows:

$$Y = a_1 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 \quad \text{where}$$

Y is the dependent variable (final examination marks) and X_1 , x_2 , x_3 and x_4 are the four independent variables, denoting respectively the past achievement (as measured

by qualifying examination marks), level of intelligence (measured by raw scores on Raven's Progressive Matrices Test), level of socio-economic status (as measured by Kuppuswamy's Socio-economic Status Scale) and the level of library use (total library use index obtained by combining the six library use variables). The respective partial regression coefficients are b_1 , b_2, b_3 and b_4 which are constants like a_1 . These regression coefficients can be interpreted as in case of the regression equation with nine independent variables described earlier. For example the regression coefficient b_4 shows average change in final examination scores (dependent variable Y) for a unit change in library use (independent variable X_4), with qualifying examination marks (independent variable X_1), level of intelligence ((independent variable X_2) and socio-economic status (independent variable X_3) remaining unchanged or held constant.

The value of partial regression coefficients can be found out by determining the unknown constants in the regression equation given above. The unknown constants in the equation

$Y = a_1 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4$ are a_1 , b_1 , b_2 , b_3 and b_4 . They can be obtained by solution of the

following set of equations :

$$1.\ \Sigma(yx_1) = \Sigma(x^2_1)b_1 + \Sigma(x_1x_2)b_2 + \Sigma(x_1x_3)b_3 + \Sigma(x_1x_4)b_4$$

$$2.\ \Sigma(yx_2) = \Sigma(x_1x_2)b_1 + \Sigma(x^2_2)b_2 + \Sigma(x_2x_3)b_3 + \Sigma(x_2x_4)b_4$$

$$3.\ \Sigma(yx_3) = \Sigma(x_1x_3)b_1 + \Sigma(x_2x_3)b_2 + \Sigma(x^2_3)b_3 + \Sigma(x_3x_4)b_4$$

$$4.\ \Sigma(yx_4) = \Sigma(x_1x_4)b_1 + \Sigma(x_2x_4)b_2 + \Sigma(x_3x_4)b_3 + \Sigma(x^2_4)b_4$$

$$5.\quad a_1 = \bar{y} - b_1\bar{x}_1 - b_2\bar{x}_2 - b_3\bar{x}_3 - b_4\bar{x}_4$$

$\bar{x}$ and $\bar{y}$ represent the mean value of each independent variable and the dependent variable respectively. The subscript indicates the particular variable. Similarly the symbols $\Sigma(yx_1)$, $\Sigma(yx_2)$, $\Sigma(yx_3)$, $\Sigma(yx_4)$, $\Sigma(x_1x_2)$, $\Sigma(x_2x_3)$ etc. represent the sums of products of the variables. Likewise the symbols

$\Sigma (x^2_1)$, $\Sigma (x^2_2)$ etc. represent the sums of the squares of variables. The bs are regression coefficients and are estimates of the parameters of the population. The four equations (Nos. 1, 2, 3, 4) are solved simultaneously to determine the values for regression coefficients b_1, b_2 , b_3 and b_4. Once the values for the four b's are calculated, a_1 can be calculated from the 5th equation.

$$a_1 = \bar{y} - b_1\bar{x}_1 - b_2\bar{x}_2 - b_3\bar{x}_3 - b_4\bar{x}_4$$

5.4. Analysis of Data

It was decided to process the data for each sample namely, M.A., M.Sc. and B.Ed. separately. This is because it was realised that the three samples cannot be considered as drawn from the same population. Curricular and instructional programmes differ to a considerable extent in the post-graduate courses in the Faculties of Arts, Science and Education.The B.Ed. course is considered as a post-graduate course in this study because it can be undertaken by a student after having successfully completed any first degree course. But unlike M.A. and M.Sc. courses, which are master's degree courses, it is only a first degree (bachelor's)course in Education. It involves the development of many skills which are not required in the M.A. or M.Sc. courses.

The B.Ed. course in the M.S. University of Baroda follows the semester system and complete internal assessment. About one third weightage is given to practical work such as practice teaching, preparation of teaching aids and training in the operation of Audio-Visual machines. The theory course is organized in a number of courses, which are planned by the teachers in the Department of Education. They are also entirely responsible for the teaching and evaluation of their respective courses. Evaluation is done through a number of tests and assignments evenly spaced over the whole semester, not by an external examination conducted at the end of the year. It is clear that the B.Ed. programme differs from the M.A. and M.Sc. courses to a considerable extent.

Even the M.A. and M.Sc. courses are not alike in all respects, though the system of thirty per cent weightage to internal assessment in the final examination results is common to both. Many M.Sc. courses involve extensive laboratory work and some of them field visits and outdoor work. One would expect the students of the M.A. class to do extensive reading as part of their studies, for a supposition borne out in this study.

The three groups differ in their past achievement, intelligence and socio-economic status as well. These differences are shown by the means and standard deviations for the three samples for these variables.

Table 35 : Means and Standard Deviations of Past Achievement, Intelligence and Socio-economic Status for the Three Samples

Variable	Sample					
	M.A.		M.Sc.		B.Ed.	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
1. Past achievement	51.05	7.28	54.76	7.44	48.16	6.69
2. Intelligence	36.29	7.91	45.58	7.24	39.37	9.33
3. Socio-economic status	15.91	6.43	16.17	5.48	17.14	5.26

The fact that they differ in the level of their use of available library services on the campus is evident from an inspection of the means and standard deviations of the library use variables for the respective groups. To cite one example, their total library use index scores have the following means and standard deviations.

Table 36 : Means and Standard Deviations of Total Library Use Index Scores

Sample	Mean	S.D.
1. M.A.	36.64	11.14
2. M.Sc.	28.66	12.51
3. B.Ed.	18.21	9.96

It is clear from the above that the three samples cannot belong to the same population. Hence, the statistical analysis is performed separately for all the three samples. The data for the entire sample has also been statistically analysed. But, it is obvious that any conclusions drawn for the entire sample would be highly unreliable because of the reasons stated above. Therefore, the investigator has mostly limited his findings and interpretations to the three samples and they have been reported separately for each group. It goes without saying that any conclusions drawn would be applicable only to the populations from which these samples were selected namely, Sr.M.A. students, M.Sc. Final students and B.Ed. students in the Faculties of Arts, Science and Education of the M.S. University of Baroda.

The data has been statistically processed through the computer system of the Operations Research Group, Division of Sarabhai Technological Development Syndicate Pvt. Ltd., Baroda. Multiple regression analysis was performed through the appropriate Computer Programme. Eight sets of data were processed. Four sets with nine independent variables stated above for the three samples

namely, M.A., M.Sc. and B.Ed. and the entire sample were processed at first. Next the three samples and the entire sample were processed with four independent variables, which were obtained as a result of combining the six library use variables into one single variable. The programme out-put has reported the following for each set of data :

1. Means of all the variables.
2. Correlation matrix. (Intercorrelations for all the variables).
3. Partial regression coefficients for all independent variables.
4. Standard errors of the respective partial regression coefficients.
5. t values for the respective partial regression coefficients.
6. Analysis of variance for the multiple regression.
7. Coefficient of multiple correlation (R).
8. The value of the constant Alpha and its standard error.

5.5. Tests of Significance

Analysis of variance for the multiple regression in each set of data analyzed is available from the programme output. The F values given can be tested at predetermined level of significance. If F is significant, it means that

the independent variables used in the regression equation are good predictors of the dependent variable. The multiple correlation coefficient R is a measure which estimates the predictive power of the multiple regression equation. According to Professor Draper the predictive power of the multiple regression equation is often stated as a percentage through the factor $100R^2$.[5] The larger it is, the higher is the correlation between the dependent variable and its estimate as predicted by the independent variables.

The partial regression coefficients can be tested by applying the 'students' t test.

$$t = \frac{b - \beta}{S_b} \quad \text{where}$$

b = sample partial regression coefficient to estimate y from x

β = population partial regression coefficient

S_b = Standard error of the sample regression coefficient.

Therefore, to test the hypothesis that $\beta = 0$, the above equation reduces to

$$t = \frac{b}{S_b} = \frac{\text{partial regression coefficient in the sample}}{\text{standard error of the partial regression coefficient in the sample.}}$$

So if t is significant the hypothesis will be rejected.

In this study, it was decided to test the significance of both the F and t values at 5 per cent and 1 per cent levels of significance.

The programme output has reported the partial regression coefficients, their respective standard errors and the t values. In the following sections, the statistical results for all the sets of data are reported.

5.6. Statistical Results - I

Means and standard deviations of the dependent and independent variables used in this study have been already reported in the last Chapter. They are also given in Appendices I and II. The correlation matrix for each set of data processed has been given by the programme out put. Correlation coefficients showing relationship between the different variables in this study are of no use in finding out the effect of library use on academic achievement of students in the sample. No attempt has been made to calculate partial correlation coefficients for the relationship between different variables because the partial regression coefficients which tell the same story are worked out. The correlation matrices have been reported in Appendix VI.

Summary of statistical results is given in the following sections for the different samples and the entire sample. To begin with the statistical results are given for those sets of data which were analysed for the multiple regression equation with nine independent variables.

M.A. Sample :

The following table gives the analysis of variance for the multiple regression for the M.A. sample.

Table 37 : Analysis of Variance for M.A. Sample, 9 Independent Variables

Source	DF	SS	MSS	F
Regression	9	1526.3141	169.5907	4.797
Error	46	1626.0979	35.3499	
Total	55	3152.4120		

Multiple correlation Coefficient 0.69

The table value of F for (9, 46) degrees of freedom at 1 per cent level of significance is 2.82. Therefore, the F ratio which is greater than 2.82 in the above table is significant at the 1% level. This means

that the independent variables in this multiple regression equation are good predictors of academic achievement of students in the M.A. sample.

Multiple correlation coefficient $R = 0.69$

So, $100\ R^2 = 100 \times (0.69)^2$

$= 47.61$

It is clear from the above figure that the predictive power of this regression equation can be expressed as 47.61 per cent.

The partial regression coefficients, their standard errors and the respective t values for the nine independent variables in the M.A. sample are given below.

Table 38 : Partial Regression Coefficients, Their Respective Standard Errors and t Values for the M.A. Sample, 9 Independent Variables

Variable	Partial Regression Coefficient	Standard Error	t Value	Remark:
X_1 Qualifying examination marks	0.6684	0.1227	5.4454	Sig.at 1% level
X_2 Intelligence	0.0900	0.1134	0.7940	
X_3 Socio-economic status	-0.0743	0.1285	-0.5779	
X_4 Books taken for home reading	0.0483	0.1015	0.4758	
X_5 Library familiarity test	-0.1063	0.3077	-0.3455	
X_6 Time spent in reading in the library	-0.4003	0.2527	-1.5841	
X_7 Books and journals read in the library	0.4014	0.4747	0.8457	
X_8 Books owned	0.2889	0.2451	1.1787	
X_9 Books received from other sources	0.0955	0.6019	0.1587	
	Alpha	14.8070		

The table value of t for 46 degrees of freedom is 2.688 at the 1 per cent level of significance. So it is seen that none of the t values except the one for variable X_1 (Qualifying examination marks) are significant at the 1 per cent level. None of the other t values are significant even at the 5 per cent level. (Table value of t for 46 degrees of freedom is 2.018 at the 5 per cent of significance).

As none of the t values for the six library use variables (X_4 to X_9) is significant at the 5 per cent level, the hypothesis is accepted. It can be said that there is no significant effect of the use of available library services on the academic achievement of post-graduate students in the Faculty of Arts in the M.S. University of Baroda.

The only variable which seems to be influencing the academic achievement of students in the M.A. class is their qualifying examination marks.

M.Sc. Sample :

The table given below shows the analysis of variance for multiple regression for the M.Sc. sample.

Table 39 : Analysis of Variance for M.Sc. Sample, 9 Independent Variables

Source	DF	SS	MSS	F
Regression	9	1449.9505	161.1056	4.470
Error	94	3387.7006	36.0394	
Total	103	4837.6511		
Multiple correlation Coefficient		0.55		

The table value of F for (9, 94) degrees of freedom at 1 per cent level of significance is 2.605. Therefore, the F value of 4.470 which is greater than 2.605 is significant at the 1 per cent level. Thus the independent variables in this regression equation can be termed as good predictors of the dependent variable.

The multiple correlation coefficient R = 0.55

So, $100\ R^2 = 100 \times (0.55)^2 = 30.25$

In other words, the predictive power of this regression equation is 30.25 per cent.

The partial regression coefficients, their standard errors and the respective t values are given below for the M.Sc. sample.

Table 40 : Partial Regression Coefficients, Their Respective Standard Errors and t Values for the M.Sc. Sample, 9 Independent Variables

Variable	Partial Regression Coefficient	Standard Error	t Value	Remarks
X_1 Qualifying examination marks	0.3232	0.0814	3.9701	Sig. at 1% level
X_2 Intelligence	0.1243	0.0878	1.4157	
X_3 Socio-economic status	0.2161	0.1161	1.8603	
X_4 Books taken for home reading	0.0522	0.0766	0.6807	
X_5 Library familiarity test	0.3955	0.2330	1.6978	
X_6 Time spent in reading in the library	0.1950	0.2155	0.9050	
X_7 Books and journals read in the library	0.1560	0.3230	0.4831	
X_8 Books owned	0.2361	0.3192	0.7396	
X_9 Books received from other sources	-0.0087	0.4263	-0.0205	
Alpha 20.7283				

The table values of t for 94 degrees of freedom at 1 per cent and 5 per cent levels of significance are 2.63 and 1.986 respectively. It is observed that the t value for the variable X_1 (Qualifying examination marks) is significant at 1 per cent level. All the other t values are not significant

both at 1 per cent and 5 per cent levels.

The hypothesis is accepted for this sample also, because none of the t values for the six library use variables (X_4 to X_9) is significant even at 5 per cent level. Therefore it is evident that there is no significant effect of the use of available library services on the academic achievement of post-graduate students in the Faculty of Science in the M.S. University of Baroda.

Like the M.A. sample, here too, the only variable which seems to be influencing their academic achievement is the qualifying examination marks.

B.Ed. Sample :

The following table shows the analysis of variance for multiple regression for the B.Ed. sample

Table 41 : Analysis of Variance for the B.Ed.Sample, 9 Independent Variables

Source	DF	SS	MSS	F
Regression	9	2804.2890	311.5877	10.050
Error	131	4061.4340	31.0033	
Total	140	6865.7230		

Multiple Correlation Coefficient 0.64

The table value of F for (9,131) degrees of freedom at 1 per cent level of significance is 2.553. The F value in the above table is 10.050 which is much greater than the table value, and therefore, it is significant at 1 per cent level. In other words, the independent variables are good predictors of the dependent variable in this regression equation. The predictive power of the equation, as shown by the factor $100\ R^2$ is as follows :

Multiple correlation coefficient $R = 0.64$

$$100\ R^2 = 100 \times (0.64)^2$$

$$= 40.96$$

Thus the predictive power of the regression equation for the B.Ed. sample is 40.96 per cent.

The following table shows the partial regression coefficients, their standard errors and the respective t values for this sample.

Table 42 : Partial Regression Coefficients, Their Respective Standard Errors and t Values for the B.Ed. Sample, 9 Independent Variables

Variable	Partial Regression Coefficient	Standard Error	t Value	Remarks
X_1 Qualifying examination marks	0.0461	0.0734	-.0.6286	
X_2 Intelligence	0.3181	0.0550	5.7812	Sig.at 1% level
X_3 Socio-economic status	-0.0301	0.0984	-0.3059	
X_4 Books taken for home reading	0.2972	0.1069	2.7790	Sig.at 1% level
X_5 Library familiarity test	0.3449	0.1487	2.3195	Sig.at 5% level
X_6 Time spent in reading in library	-0.3188	0.3509	-0.9086	
X_7 Books and journals read in the library	-0.2367	0.3475	-0.6814	
X_8 Books owned	0.7202	0.2995	2.4040	Sig.at 5% level
X_9 Books received from other sources	0.0078	0.2902	0.0271	
Alpha	44.5651			

The table values of t for 131 degrees of freedom at 1 per cent and 5 per cent levels of significance are 2.619 and 1.98 respectively. It can be seen that the t values for the variables X_2 (Intelligence) and X_4 (Books taken for home reading)

are significant at 1 per cent level and the t values for the variables X_5 (Library familiarity test) and variable X_8 (Books owned) are significant at the 5 per cent level. All other t values are neither significant at the 1 per cent nor at 5 per cent level.

Out of the six library use variables used as independent variables in the multiple regression equation, three variables- namely, books taken for home reading (X_4) library familiarity test(X_5) and books owned (X_8) have significant t values. It can, therefore, be said that the hypothesis is rejected as far as these three library use variables are concerned. In other words, it can be said that there is a significant effect of the use of available library services (as measured by books taken for home reading, library familiarity test and books owned) on the academic achievement of post graduate students in the Faculty of Education in the M.S. University of Baroda. If library use is considered in terms of the other three library use variables namely, time spent in reading in the library (X_6), books and journals read in the library (X_7) and books received from other sources (X_9) then the hypothesis is accepted because none of the t values for these variables is significant at 5 per cent level.

That is to say, there is no significant effect of the use of available library services (as measured by the time spent in the library, books and journals read in the library and books received from other sources) on the academic achievement of post-graduate students in the Faculty of Education in the M.S. University of Baroda.

It is also clear from the above table that level of intelligence has a significant effect on the academic achievement of post-graduate students in the Faculty of Education in M.S. University of Baroda.

Entire Sample :

The analysis of variance for the multiple regression for the entire sample is as follows :

Table 43 : Analysis of Variance for the Entire Sample, 9 Independent Variables

Source	DF	SS	MSS	F
Regression	9	2887.4041	320.8227	6.029
Error	291	15485.9220	53.2162	
Total	300	18373.3260		
	Multiple correlation coefficient		0.40	

The table value of F for (9,291) degrees of freedom at 1 per cent level of significance is 2.482. So the F

value above is significant at 1 per cent. It means that the independent variables are good predictors of the dependent variable in this regression equation. The predictive power of the equation is shown by the factor $100\ R^2$. For the entire sample, Multiple correlation coefficient R = 0.40 So, $100\ R^2 = 100 \times (0.40)^2 = 16.00$.

The predictive power of the equation is 16 per cent.

The partial regression coefficients, their standard errors and the respective t values are given below for the entire sample.

Table 44 : Partial Regression Coefficients, Their Respective Standard Errors and t Values for the Entire Sample, 9 Independent Variables

Variable	Partial Regression Coefficient	Standard Error	t Value	Sig. Remarks
X_1 Qualifying examination marks	0.1237	0.0588	2.1019	Sig. at 5% level
X_2 Intelligence	0.2140	0.0500	4.2772	Sig. at 1% level
X_3 Socio-economic status	0.0769	0.0780	0.9865	
X_4 Books taken for home reading	-0.0116	0.0579	-0.2010	
X_5 Library familiarity test	0.1123	0.1317	0.8521	
X_6 Time spent in reading in library	-0.6037	0.1618	-3.7301	Sig. at 1% level
X_7 Books and journals read in library	0.1262	0.2521	0.5005	
X_8 Books owned	0.2663	0.1873	1.4214	
X_9 Books received from other sources	0.3478	0.2657	1.3090	
Alpha	39.3186			

The table values of t for 291 degrees of freedom at 1 per cent and 5 per cent levels of significance are 2.591 and 1.97. It can be observed that the t values for the variables X_1 (Qualifying examination marks) and X_2 (Intelligence) are significant at 5 per cent and 1 per cent levels respectively. It is also observed that the numerical t value for the variable X_6 (Time spent in reading in the library) is greater than 2.591, which is the table value of t at 1 per cent level of significance. So, the t value for variable X_6 is significant at 1 per cent level. X_6(Time spent in reading in the library) being one of the library use variables the hypothesis is rejected as far as library use as measured by this variable (Time spent in reading in the library)is concerned). Thus it can be said that there is a significant effect of the use of available library services (measured by the time spent in reading in the Library) on the academic achievement of post-graduate students in the Faculties of Arts, Science and Education in the M.S. University of Baroda. This effect is in the negative direction, because the t value is negative. None of the t values for the other five library use variables are significant even at the 5 per cent level. So the hypothesis is accepted as far as these five library use variables are concerned. In other words, it can be said that there is no

significant effect of the use of available library services (as measured by books taken for home reading, library familiarity test, books and journals read in the library, books owned and books received from other sources) on the academic achievement of post-graduate students of the Faculties of Arts, Science and Education in the M.S. University of Baroda.

5.7. Statistical Results - II

It has been discussed in the previous chapter how the six library use variables have been combined into one single variable, which has been called the total library use index. In the second phase of statistical analysis, the multiple regression equation consisted of four independent variables namely, qualifying examination marks, intelligence, socio-economic status and the total library use index. The results of the statistical analysis for the M.A., M.Sc., B.Ed. and entire sample are given below.

M.A. Sample :

The analysis of variance for the multiple regression for the M.A. sample is as follows.

Table 45 : Analysis of Variance for the M.A. Sample, 4 Independent Variables

Source	DF	SS	MSS	F
Regression	4	1323.6516	330.9129	9.228
Error	51	1828.7604	35.8580	
Total	55	3152.4120		

Multiple correlation coefficient 0.65

The table value of F for (4,51) degrees of freedom at 1 per cent level of significance is 3.712. So the F value above is significant at 1 per cent level. It can be said that the independent variables are good predictors of the dependent variable in this regression equation. The predictive power of the equation, as expressed by 100 R^2, is given below.

Multiple correlation coefficient R = 0.65

$$100\ R^2 = 100 \times (0.65)^2 = 42.25$$

Thus the predictive power of this equation is 42.65 per cent.

The partial regression coefficients, their standard errors and the respective t values for the four independent variables are given below for the M.A. sample.

Table 46 : Partial Regression Coefficients, Their Standard Errors and t Values for the M.A. Sample, 4 Independent Variables

Variable	Partial Regression Coefficient	Standard Error	t Value	Remarks
X_1 Qualifying examination marks	0.6403	0.1121	5.7094	Sig. at 1% level
X_2 Intelligence	0.0819	0.1034	0.7920	
X_3 Socio-economic status	-0.1165	0.1254	-0.9290	
X_4 Total library use index	-0.0063	0.0740	-0.0859	
	Alpha	22.8821		

The table values of t for 51 degrees of freedom at 1 per cent and 5 per cent levels of significance are 2.678 and 2.009 respectively. Thus it can be seen that the t value for only X_1 (Qualifying examination marks) is significant at 1 per cent level. The t value of total library use index (Variable X_4) is not significant at 5 per cent level and therefore the hypothesis is accepted. Thus, there is no significant effect of the use of available library services (as measured by total library use index) on the academic achievement of post-graduate students in the Faculty of Afts in M.S. University of Baroda.

M.Sc. Sample :

The analysis of variance for multiple regression of the M.Sc. sample is given below.

Table 47 : Analysis of Variance for the M.Sc. Sample, 4 Independent Variables

Source	DF	SS	MSS	F
Regression	4	1375.3390	343.8350	9.831
Error	99	3462.3112	34.9728	
Total	103	4837.6511		
	Multiple correlation coefficient		0.53	

The table value of F for (4,99) degrees of freedom at 1 per cent level of significance is 3.512. So the F

value in the above table is significant at 1 per cent level. Therefore, it can be stated that the independent variables are good predictors of the dependent variable in this regression equation. The predictive power of the equation is as follows:

Multiple correlation coefficient $R = 0.53$

So, $100\ R^2 = 100 \times (0.53)^2$

$= 27.09$

The predictive power of this multiple regression equation is 27.09 per cent.

The following table shows the partial regression coefficients, their standard errors and the respective t values for the M.Sc. sample.

Table 48 : Partial Regression Coefficients, Their Standard Errors and t Values for the M.Sc. Sample, 4 Independent Variables

Variable	Partial Regression Coefficient	Standard Error	t Value	Remarks
X_1 Qualifying examination marks	0.3266	0.0785	4.1602	Sig.at 1% level
X_2 Intelligence	0.1257	0.0854	1.4712	
X_3 Socio-economic status	0.2172	0.1119	1.9417	
X_4 Total library use index	0.1468	0.0477	3.0754	Sig. at 1% level
	Alpha	22.88211		

The table values of t for 99 degrees of freedom at the 1 per cent and 5 per cent levels of significance are 2.63 and 1.981 respectively. It can be seen from the above table that the t values for the variables X_1 (Qualifying examination marks) and X_4 (Total library use index) are significant at 1 per cent level. So the hypothesis is rejected for this sample. It can be said that there is a significant effect of the use of available library services on the academic achievement of post-graduate students in the Faculty of Science in the M.S. University of Baroda.

B.Ed. Sample :

The analysis of variance for the multiple regression for the B.Ed. sample is given below.

Table 49 : Analysis of Variance for the B.Ed. Sample, 4 Independent Variables

Source	DF	SS	MSS	F
Regression	4	2534.5151	633.6288	19.896
Error	136	4331.2079	31.8471	
Total	140	6865.7230		
Multiple correlation coefficient			0.61	

The table value of F for (4,136) degrees of freedom at 1 per cent of level of significance is 3.457. The F value in the above table is therefore significant at 1 per cent

level. It can be said that the independent variables in this regression equation are good predictors of the dependent variable. The predictive power of the regression equation is given below.

Multiple correlation coefficient $R = 0.61$

So, $100 R^2 = 100 \times (0.61)^2$

$= 37.21$

The predictive power of the regression equation is 37.21 per cent.

The table given below shows the partial regression coefficients, their standard errors and the respective t values for the B.Ed. sample.

Table 50 : Partial Regression Coefficients, Their Standard Errors and t Values for the B.Ed. Sample, 4 Independent Variables

Variable	Partial Regression Coefficient	Standard Error	t Value	Remarks
X_1 Qualifying examination marks	-0.0697	0.07313	-0.9541	
X_2 Intelligence	0.3360	0.0548	6.1328	Sig. at 1% level
X_3 Socio-economic status	-0.0285	0.0949	-0.3012	
X_4 Total library use index	0.2388	0.0501	4.7662	Sig. at 1% level
	Alpha 45.5862			

The table values of t for 136 degrees of freedom at 5 per cent and 1 per cent levels of significance are 1.98 and 2.615 respectively. It is observed from the above table that the t values for the variable X_2 (Intelligence) and the variable X_4 (Total library use index) are significant at 1 per cent level. The hypothesis is, therefore, rejected for this sample. That is to say, there is a significant effect of the use of available library services (as measured by the total library use index) on the academic achievement of post-graduate students in the Faculty of Education in the M.S. University of Baroda. The other variable which is significantly influencing the academic achievement of the students in the B.Ed. group is the level of intelligence.

Entire Sample :

The following table shows the analysis of variance for the multiple regression for the entire sample.

Table 51 : Analysis of Variance for the Entire Sample, 4 Independent Variables

Source	DF	SS	MSS	F
Regression	4	1901.4498	475.3624	8.542
Error	296	16471.8760	55.6482	
Total	300	18373.3260		
Multiple correlation coefficient			0.32	

The table value of F for (4,296) degrees of freedom at 1 per cent level is 3.386. The F value in the above table is therefore significant at the 1 per cent level. This means that the independent variables in this regression equation are good predictors of the dependent variable. The predictive power of the regression equation is as follows :

Multiple correlation coefficient $R = 0.32$

So, $100 R^2 = 100 \times (0.32)^2$

$= 10.24$

The predictive power of this regression equation can be said to be 10.24 per cent.

The partial regression coefficients, their standard errors and the respective t values for the entire sample are given below.

Table 52 : Partial Regression Coefficients, Their Standard Errors and t Values for the Entire Sample, 4 Independent Variables

Variable	Partial Regression Coefficient	Standard Error	t Value	Remarks
X_1 Qualifying examination marks	0.0842	0.0593	1.4195	
X_2 Intelligence	0.2318	0.0498	4.6517	Sig. at 1% level
X_3 Socio-economic status	0.1253	0.0781	1.6043	
X_4 Total library use index	-0.0355	0.0335	-1.0602	
Alpha	40.9673			

The table values of t for 296 degrees of freedom at 5 per cent and 1 per cent levels of significance are 1.97 and 2.59 respectively. It is clear from the table above that the t value for the variable X_4 (Total library use index) is not significant at 5 per cent level of significance. Therefore the hypothesis is accepted. It can be said that there is no significant effect of the use of available library services (as measured by the total library use index) on the academic achievement of post graduate students in the Faculties of Arts, Science and Education in the M.S. University of Baroda. The only variable which has a significant t value at 1 per cent level of significance in this sample is intelligence (variable X_2) and so it has a significant effect on the academic achievement of students in the entire sample.

The results for the various sets of data which have been statistically analyzed are given above. The hypothesis is tested for the three samples namely, M.A., M.Sc., and B.Ed. as well as the entire sample for the two phases of statistical operations; first with nine independent variables and then with four. The acceptance or rejection of the hypothesis in each case by applying the 'Student's' t test has been reported. These statistical results are interpreted in the following sections.

5.8. Interpreation of Results

The following interpretations can be drawn from the statistical results reported in the preceding sections.

1. The F values in the analysis of variance for the multiple regressions in all the eight sets of data analyzed are significant at 1 per cent level of significance. This means that the independent variables in all the eight multiple regression equations have proved to be good predictors of the dependent variable. In other words, the selection of the independent variables, nine in the first phase of statistical analysis and four in the second phase has been effectively done. These independent variables are definitely influencing the academic achievement of students in the populations from which the samples are drawn.

2. The predictive power of the multiple regression equation has been stated as 100 R^2 in this study. The multiple correlation coefficient R is a measure of the correlation between the observed values of the dependent variable and its estimate as predicted by the independent variables in the regression equation. The greater this measure is, the higher is the correlation between the dependent variable and all the independent variables acting together. The values of 100 R^2 range between 10.24 ~~per cent~~ to 47.61 ~~per cent~~ for the eight regression equations. If the two sets of entire sample are

not taken into consideration the maximum and minimum values of 100 R^2 for the six regression equations for M.A., M.Sc. and B.Ed. samples are 47.61 ~~per cent~~ and 27.09 ~~per cent~~. It is clear that the degree of predictive power of the regression equations could have been increased if more independent variables were included in the multiple regression equations. However, the independent variables included in the regression models in this study account for approximately 27 per cent to 48 per cent variation in the dependent variable, that is the academic achievement of post graduate students in the Faculties of Arts, Science and Education in the M.S. University of Baroda, when it is measured by their final examination marks.

3. The partial regression coefficients represent the weighted contribution that each independent variable makes to the total estimate of the dependent variable. The equation will predict the average change in the dependent variable for a unit change in any one of the independent variables, the others being held constant. The partial regression coefficients can be tested for significance of difference by applying the 'Students' t test. The t values for the partial regression coefficients for all the independent variables were tested at the 1 per cent and 5 per cent levels of significance for all the eight sets of data analysed. The t values for the six library use variables were tested for the three samples and the entire sample. It is observed that the t values for all the six library use variables are not

not significant at 5 per cent level for the M.A. and M.Sc. samples and so, the hypothesis is accepted in case of these two groups. It means that there is no significant effect of the use of available library services (as measured by each of the six library use variables) on the academic achievement (as measured by the final examination marks) of the post-graduate students of the Faculties of Arts and Science in the M.S. University of Baroda. In other words, it appears that factors such as books taken for home reading, test of familiarity with rules and regulations of the Hansa Mehta Library, time spent in reading on the library premises per week, books and journals read in the library per week, books owned and books received from other sources per week have no contribution to make towards the academic achievement of the M.A. and M.Sc. students as measured by their final examination marks.

4. When the t values for the partial regression coefficients of the six library use variables are examined for the B.Ed. sample it is seen that three of the t values are significant (Two at 1 per cent and one at 5 per cent level). The three variables for which t values are significant are books taken for home reading, test of familiarity with the Hansa Mehta Library rules and regulations and books owned. The hypothesis is rejected as far as library use is considered to be made up of these variables. Therefore it can be said that these

there is a significant effect of books taken for home reading, familiarity with the Hansa Mehta Library's rules and regulations and books owned (all measures of library use) on the academic achievement of B.Ed. students as measured by their final examination marks.

5. The t values for the other three library use variables are not significant at 5 per cent level for the B.Ed. sample. So the hypothesis is accepted as far as library use is considered in terms of these variables. It can, therefore, be said that there is no significant effect of time spent in reading in the library, books and journals read in the library and books received from other sources on the academic achievement of B.Ed. students as measured by their final examination marks.

6. The only t value which is significant at 1 per cent level in the entire sample for any one of the six library use variables is time spent in reading in the library. But this t value is negative, because the partial regression coefficient is negative. The hypothesis is rejected, for this variable of library use. It has to be said that there is a significant effect of library use as considered in terms of the time spent in reading in the library on the academic achievement of students from which the entire sample was drawn and that this effect is manifested in the negative direction. This interpretation is a little surprising. But as stated earlier in this Chapter interpretations based on the entire sample are of

doubtful meaning because of the heterogenous character of this sample.

7. When the six library use variables are combined into a single variable named as the total library use index, the t value for this variable in the M.A. sample is not significant at 5 per cent level and the hypothesis is accepted. That is to say, there is no significant effect of the use of available library services (as measured by the total library use index) on the academic achievement (as measured by their final examination marks) of post graduate students in the Faculty of Arts in the M.S. University of Baroda.

8. The t value for the total library use index is significant at 1 per cent level for the M.Sc. sample. So the hypothesis is rejected. In other words, there is a significant effect of the use of available library services (as measured by the total library use index) on the final examination marks (academic achievement) of the post-graduate students in the Faculty of Science in the M.S. University of Baroda.

9. The t value for the total library use index is also significant at 1 per cent level for the B.Ed. sample. So the hypothesis is rejected. Like the M.Sc. students, there is a significant effect of the total library use index (a measure of library use) on the academic achievement (as measured by final examination marks) of B.Ed. students of the Faculty of Education in the M.S. University of Baroda.

10. In the entire sample the total library use index t value is not significant at the 5 per cent level and the hypothesis is accepted. Thus, it may be said that there is no significant effect of the use of available library services (as measured by the total library use index) on the academic achievement of post-graduate students in the Arts, Science and Education Faculties of the M.S. University of Baroda, as measured by their final examination marks.

It may be noted that interpretations based on the statistical results for the entire sample are not reliable because this sample is not drawn from a homogenous population as already stated.

5.9. Summary

Multiple regression analysis has been selected as the technique to analyze data in this study because it enables to estimate the direct influence of the independent variable (library use) upon the dependent variable (academic achievement of post-graduate students), when the effects of other independent variables (past achievement, level of intelligence and socio-economic status) are held constant. Thus, it is possible to control the variation due to past achievement, intelligence and socio-economic status in the estimation of the effect of library use on academic achievement.

The statistical analysis is performed in two phases. The six library use variables along with the three control variables have been used as independent variables at first in the statistical analysis. In the next operation the total library use index obtained by combining the six library use variables has been used as an independent variable along with the three control variables mentioned above. All these analyses have been done for the three samples namely, M.A., M.Sc. and B.Ed. as well as for the entire sample. Thus eight sets of data have been analyzed.

The analysis of variance, F ratios, multiple correlation coefficient (R), partial regression coefficients for all independent variables, their respective standard errors and t values, and the constant alpha are reported for each set of data analyzed. The F ratio is tested for significante at 1 per cent level and the predictive power of the regression equation (expressed by the factor 100 R^2) is given for each set. Similarly the respective t values for the various partial regression coefficients are tested for significance at the 5 per cent level. The hypothesis is accepted or rejected depending upon the significance(at 5 per cent level of significance)or otherwise of the t values of partial regression coefficients of library use variables.

The statistical results for each set of data are interpreted in the concluding sections of this chapter.

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