CHAPTER V

METHODOLOGY OF INVESTIGATION

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CHAPTER

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The procedure followed for collecting the data and the
statistical design employed for analysing the data are
explained hereunder.

METHOD OF COLLECTION OF DATA

Area Covered

When a study is to be undertaken, it is necessary to
define the area of operation.   In Andhra Pradesh, there are
three Universities - Osmania, Andhra, and Sri Ventateswara.
The area chosen for the present study is the area covered
by Sri Venkataswara University, Tirupati.   The following are
the reasons for choosing Sri Venkataswara University area :

1. Familiarity of the area for locating the places.

2. Ease of getting data from the area since the investigator worked in the colleges affiliated to the University.

3. Familiarity with the language of the area.

4. High incidence of failures at the degree examination of the University - Percentage of failures varies from 35 to 81 during the years 1964-68 (Table No. 1).

Colleges Covered

Sri Venkataswara University comprises of five districts - Cuddapah, Anantapur, Kurnool, Chittoor, and Nellore. As on 1967-68, there were 22 Degree Arts and Science Colleges in S.V. University area, ranging from two to seven colleges in each district. Of 22 colleges, 11 colleges (50 per cent) were managed by Government and the remaining 11 colleges (50 per cent) were managed by private bodies (aided) including one by the University. Out of 22 colleges, 20 are men's colleges and two are women's colleges.

The colleges differ in size, status, staff and instructional facilities. The results of the previous research show that conditions in the institute and efficiency of the teaching staff contribute to academic achievement of the students (Vide Chapter II - Instructional Factors). Therefore, it appears desirable to select colleges managed by one management and even under the same management those colleges

that are more or less equal in the standing, size, instructional
facilities and efficiency of teaching personnel, etc. Since
institutions run by Government are available in each district,
Government institutions are chosen for the study. Another
reason for choosing Government institutions was that since
the investigator then belonged to the Government organisation
(Lecturer in Government Colleges), his aim was to be of some
service to the Department by identifying the factors related
to achievement in those colleges and it seemed sensible to
confine the study to Government Colleges. Aided Arts and
Science Colleges managed by different managements vary in
size, staff, instructional facilities, etc. and hence
omitted from the study. The technical colleges (Engineering,
Medical, etc.) in these districts are excluded from the study.

As stated earlier, the college environment - size,
efficiency of Lecturers, instructional facilities - is
related to achievement and it is desirable to keep the
environment constant as far as possible to avoid its effect
on achievement. Three judges - (1) Registrar, S.V. University,
Tirupati who worked as Principal in several Government
institutions, (2) Senior-most Principal of Government
Colleges who served in many Government institutions in the
S.V. University area, (3) Joint Director of Public Instruction,
Andhra Pradesh, Hyderabad, who inspects the colleges and
has more knowledge about the condition of the colleges - were
requested to suggest one or two Government colleges from

each district of the S.V. University which are nearly equal
in the size, teaching efficiency, and instructional facilities.
The following are the colleges suggested by all the three
judges :

1. Government Arts College, Cuddapah,

2. Government Arts College, Anantapur,

3. Government Arts and Science College, Chittoor,

4. K.V.R. Government College for Women, Kurnool, and

5. D.K. Government College for Women, Nellore.

The sample for the study is drawn from the five
Government Colleges - three men's institutions and two
women's institutions - one from each district of the S.V.
University area. The list of the colleges in S.V. University
as on 1967-68 is at Appendix 18. The present study covered
about 20 per cent of the total colleges and 50 per cent of
the Government colleges. The two women's institutions
available are covered by the study.

The Sample

The study is concerned with factors related to academic
achievement at the first year Degree Examination held in
March-April 1968. According to University regulations,
examinations are held at the end of every year and the
students, failed or passed, can go to the next year of the
course. Hence all the students who appeared at the First
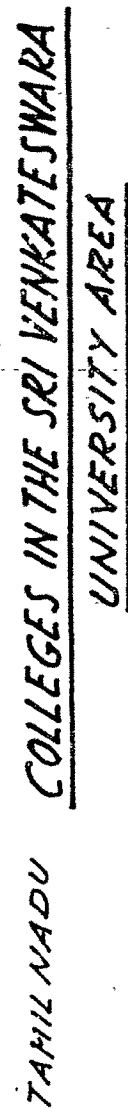Year Examination held in March-April 1968 were in the Second

Year of the course during the year 1968-69. This Second
Year students formed the sample for the study.

Besides English and Telugu, Degree Class students choose
variety of optional groups, namely, (1) Mathematics, Physics,
Chemistry, (2) Chemistry, Botany, Zoology, (3) History,
Economics, Politics, (4) History, Economics, Psychology,
(5) History, Economics, Philosophy, (6) History, Economics,
Language (Telugu, English...... etc.). The students who
offered (1) Mathematics, Physics, Chemistry (MPC),
(2) Chemistry, Botany, Zoology (CBZ), (3) History, Politics,
Economics (HPoEc) as optional groups only were covered by
the study.

The study covered 104 males of HPoEc Group, 110 males
of MPC Group, 108 males of CBZ Group and 74 females of CBZ
Group. The number of candidates appeared at the First Year
Degree Examination held in March-April 1968 with HPoEc,
MPC, CBZ Groups, both men and women put together, are 1041,
666, 941 respectively. These figures include those who
failed in 1967 and reappeared in 1968. The figures of men
and women appeared for the examination are not available to
the Investigator. The sample covered by the study is 10 per
cent of HPoEc Group, 17 per cent of MPC Group, 12 per cent
of CBZ Group in the case of males and 8 per cent of CBZ Group
in the case of females. The number of candidates appeared
(all groups of students put together) for B.A. and B.Sc.
Examination held in March-April 1968 is 1677 and 1895

Table - 2 :   The Sample Covered by the Study- College wise, sex wise and group wise.

College	Sample tested						Absentees						Final sample					
	MPC		CBZ		HPE		MPC		CBZ		HPE		MPC		CBZ		HPE	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1. Govt. College, Cuddapah	41	-	50	15	40	-	9	-	13	5	8	-	32	-	37	10	32	-
2. Govt. College, Anantapur	46	-	52	14	56	-	8	-	17	3	14	-	38	-	35	11	42	-
3. Govt. College, Chittoor	51	-	51	9	40	-	11	-	15	2	10	-	40	-	36	7	30	-
4. K.V.R G.C., Kurnool	-	-	-	35	-	-	-	-	-	7	-	-	-	-	-	28	-	-
5. D.K. G.C., Nellore	-	-	-	24	-	-	-	-	-	6	-	-	-	-	-	18	-	-
Total:	138	-	153	97	136	-	28	-	45	23	32	-	110	-	108	74	104	-

N

ANDHRA PRADESH

GUNTUR

MAHBUBNAGA

KURNOOL

ADONI

KURNOOL

GUNTAKAL

NANDYAL

MARKAPUR

NELLORE

KANDUKUR

KAVALI

NELLORE

VAKADU

GUDUR

VENKATAGIRI

KALAHASTI

RAYADURG

ANANTAPUR

ANANTAPUR

HINDUPUR

LEPAKSHI

PRODDATUR

CUDDAPAH

CUDDAPAH

CHITTOOR

MADANAPALLI

CHITTOOR

TIRUPATI

BAY OF BENGAL

MYSORE

TAMILNADU

UNIVERSITY COLLEGES

ARTS & SCIENCE COLLEGE (GRADUATE, POST GRADUATE AND RESEARCH)

ENGINEERING COLLEGE (GRADUATE)

POST GRADUATE CENTRE

AFFILIATED COLLEGES

ARTS AND SCIENCE

ENGINEERING

COLLEGE OF EDUCATION

MEDICAL COLLEGE (GRADUATE COURSE)

MEDICAL COLLEGE (GRADUATE & POST-GRADUATE COURSES)

COLLEGE OF MUSIC & DANCE

ORIENTAL COLLEGES

COLLEGES IN THE SRI VENKATESWARA

UNIVERSITY AREA

respectively. The study covered 6 per cent of the total
B.A. students (104 out of 1677) and 15 per cent of the total
B.Sc. students (292 out of 1895). The study covered a sample
population and not total population. The decision in favour
of a carefully drawn sample is based on certain considerations
such as reduction in time, in labour, in cost.

Several sets of data were collected from the sample
selected, namely, their marks, their level of intelligence,
personality, need for achievement and home environment. In the
process of administration of tests for measuring intelligence,
personality, etc. some students were absent for one test or
the other. In the final analysis of results only students
who were present for all the tests were included.

The sample originally tested, absentees and the final
sample included in the study are given in Table No. 2.

Preliminary Steps taken to
Facilitate Collection of Data

Before starting for collecting data, the following
preliminary steps were taken by the Investigator to speed up
the process of collection of data :

1. Permission of the Director of Public Instruction,
   Andhra Pradesh, Hyderabad, who controls the Government
   Colleges in the State, to collect the data and to

test the students of the colleges was obtained by
the Investigator.

2. The Director of Public Instruction instructed the
   Principals of the Colleges concerned to help the
   Investigator in collecting the data required and
   in testing the students.

3. In turn, the Principals of the Colleges requested
   the Lecturers and college clerical staff to assist
   the Investigator.

4. The Investigator contacted the Principals by
   correspondence to know the time suitable for them
   and accordingly the scheme for collecting data in
   the months of July, August and September 1968 from
   the five colleges was finalised and intimated to
   the Principals.

5. Decision was taken by the Investigator to collect
   the data needed by a personal visit to the colleges
   concerned and by seeking the cooperation of the
   Principal and the Lecturers.

With these preliminary steps, the Investigator started
the work of data collection.

Data Needed for the Study

Since the study is concerned with finding out the
relationship between academic achievement and the variables

(1) Home environment, (2) Intelligence, (3) Personality, and
(4) Need for achievement, two sets of data are needed -
(1) Academic achievement (Marks) in different subjects at
the First Year of the Degree Examination held in March-April
1968, and (2) the scores of students on their home environment,
intelligence, personality, and need for achievement.

Collection of Marks

The first set of data required is the marks obtained
in different subjects by the students who offered
(1) Mathematics, Physics, Chemistry, (2) Chemistry, Botany,
Zoology, and (3) History, Economics, Politics at the First
Year Degree Examination held in March-April 1968. These
marks for the students selected can be obtained from either
the colleges concerned or the University. The Investigator
collected the marks of the students required from the
registers maintained in the colleges. The marks are collected
after announcing the results of the examination held in
March-April 1968, i.e. during the period of July to September
1968. The marks are collected using the proforma given
below :

PROFORMA FOR COLLECTING MARKS

Name of the College :

Class :

Group :   Section :

Name of the Student	Reg. No.	Marks obtained in									
		Eng-lish	Telu-gu	Maths.	Phy-sics	Chem-istry	Bot-any	Zoo-logy	Hist-ory	Eco-no-mics	Pol-iti-cs
		E	T	M	P	C	B	Z	H	Ec	Po

Measurement of Home Environment, Intelligence,

Need for Achievement, and Personality

   (a) Tests Administered :

        The second set of data, namely, Home Environment,

Intelligence, Need for Achievement, and Personality are

measured by the tests shown below :

1. Socio-Economic Status : Kuppuswamy SES Scale

2. Home Environment   : Questionnaire-cum-rating scale
                             developed by the Investigator

3. Intelligence   : Cattell's Culture Fair Test of
                             Intelligence - Scale 3 - Form A
                             (1963 edition) and Form B (1961
                             edition)

4. Need for Achievement : Mukherjee's Sentence Completion
                             Test.

5. Personality   : Cattell's 16 P.F. Form A (1962
                             edition) and Form B (1961 edition).

(b) <u>Administration of the Tests</u> :

<u>Time of Administration of Tests</u> : The tests
measuring Intelligence, Personality, Need for Achievement,
and Home Environment can be administered just before or after
the examinations. In the present case the tests are adminis-
tered just after the examinations, i.e. in the months of
July, August and September, 1968, after re-opening of the
colleges after Summer Vacation. Since these variables, i.e.
Intelligence, Personality, Need for Achievement, and Home
Environment will be changed by growth and experience and
hence affect the relationships with academic achievement,
time was not lost in measuring these variables.

<u>Time Table for Testing</u> : For every college, a time
table for testing was drawn by the Investigator indicating
(1) the students to be tested, (2) date and time of testing,
(3) room for testing, and (4) name of the test to be adminis-
tered. The regular time table of the college was used for
preparing this time table. This time table was handed over
to the Lecturers concerned so that they can know the periods
meant for testing and keep the students at the disposal of
the Investigator during those periods.

<u>Order of Administration of Tests</u> : The problem is
which test is to be administered first. Excepting Culture-
fair Intelligence Test, other tests may be administered
without following any sequence of administration. When more
than one form is used in the case of 16 P.E. the sequence

does not matter (Cattell and Eber, 1957, p.3). When both

forms A and B of Culture Fair Test of Intelligence are to be

used, it is better to administer Form A first, giving some

pause (from a few days upto a month) without giving the forms

one after the other (Cattell and Cattell, 1959, p.10). Two

forms of personality or intelligence tests are not administered

one after the other without a break. In between personality

and intelligence tests, either the Sentence Completion Test

or the Home Environment Questionnaire is administered to

provide change for the students. The following sequence of

testing is followed.

1. Culture Fair Test Form A

2. Socio-economic Status Scale

3. Home Environment Questionnaire-cum-Rating Scale

4. 16 P.F. Form A

5. Culture Fair Test Form B

6. Sentence Completion Test

7. 16 P.F. Form B

Duration of Testing in a Day : Students were tested

in groups. Socio-economic status scale and Home Environment

Questionnaire-cum-Rating Scale were administered at a time

in a day. The other tests were administered one in a day.

A gap of one or two days was given between two testings in

the case of men's institutions. This was possible since

there were several groups of students to be tested from the

same institute. In the case of women's institutions,

testing was there on every day since there was only one group
for testing. Only one test was administered in a day. The
testing period in a day ranged from one hour to one and a
half hour.

Type of Testing Followed : Tests can be administered
in two ways - individual administration and group administra-
tion. In the present case group administration was followed.
Students were tested in groups of 25 to 35. Wherever the
section consisted of more than 35 students, the section was
divided into two groups and tested. Tests were administered
in regular class periods.

The tests were administered following the usual
procedures of test administration, i.e. establishing rapport,
following time limits, and other instructions laid down in
the manuals of the tests, collection of answer sheets,
expressing thanks to the testees for cooperation they extended.

(c) Scoring of Answer Sheets : The answer sheets are
scored following the scoring procedures explained in Chapter
IV and the scores on different variables are obtained.

The data thus collected are listed properly, i.e.
college-wise, group-wise, and are analysed following the
statistical design.

5.2 STATISTICAL DESIGN OF THE STUDY

The present study is concerned with finding out the relationship between each dependent variable (academic achievement, i.e. marks in individual or group of subjects) and the four broad independent variables (Home Environment, Personality, Need for Achievement, and Intelligence) and also the joint and relative contribution of these independent variables to the prediction of the dependent variables. To find out the relationship between independent and dependent variables, correlation analysis is done by calculating coefficient of correlation, and to find out the contribution of the independent variables to the prediction of the dependent variables multiple regression analysis is done.

Calculation of Coefficient of Correlation

(a) Conversion of Raw Scores (Marks) into Standard Scores : In the case of relationships of the independent variables with the marks in individual subjects, raw scores (marks) may be used for calculations. But in the case of relationships with total marks in two or more subjects (marks in languages, in the group Mathematics, Physics, Chemistry, etc.) it is necessary to use standard scores since a mark of one in one subject may not be equal to one mark in the other subject in terms of difficulty. Though two boys got equal total marks, they differ in their achievement since they differ on their achievement in the individual

subjects on which the total is based. Experience tells us too that it is easy to get marks in certain subjects than in others.

In the present study, maximum marks allotted to some subjects at the First Year Degree Examination are 100 (English, Telugu, Mathematics, History, Economics, Politics) and the maximum marks allotted to certain other subjects are 75 only (Physics, Chemistry, Botany, Zoology). In the case of subjects with 75 marks as maximum, the marks in these subjects are first raised to 100 to have common weightage for all the subjects and these marks are then converted into standard scores.

Of the several methods of converting raw scores into standard scores, the Investigator used the following formula for converting raw scores into standard scores with means=50 and standard deviation = 10 (Garrett, 1969, p.313) :

$$X' = \frac{\sigma'}{\sigma} (X - M) + M'$$

where X' = a standard score in the new distribution

σ' = standard deviation of standard scores

σ = standard deviation of raw scores

X = a score in the raw score distribution

M = Mean of raw scores

M' = Mean of standard score distribution.

(M' is taken as 50 and σ' is taken as 10 in the present case).

Mean and standard deviations are calculated using the

usual formulae shown below (Garrett, 1969, pp. 27,53).

$$M = \frac{\leq X}{N}$$

where M = Mean,

  X = Score, and

  N = Number of scores.

$$\sigma = \sqrt{\frac{\leq X^2}{N} - M^2}$$

where σ = Standard Deviation,

  X = Raw Score,

  M = Mean, and

  N = Number of cases.

Thus, conversion tables were developed for each subject and these tables were used for converting the marks in individual subjects to standard scores.

(b) Formula used for the Calculation of Coefficient of Correlation : The relationships between independent variables and dependent variables are found by finding out the coefficient of correlation between scores on independent variables and standard scores on dependent variables. In the case of individual subjects, the standard scores of these subjects are correlated with the scores on the independent variables. In the case of relationships with total marks in groups of subjects, their standard scores are added to get composite

standard scores for that group and these composite standard scores are used to find correlation with the independent variables.

The coefficient of correlation is found by using the following formula (Garrett, 1969, p.142) :

$$r = \frac{\leq XY - N \, M_x M_y}{\sqrt{(\leq X^2 - N \, M_x^2)(\leq Y^2 - N \, M_y^2)}}$$

where X and Y are obtained scores,

M_x and M_y are the means of the X and Y series respectively,

$\leq X^2$ and $\leq Y^2$ are the sums of the squared X and Y values,

and N is the number of cases.

(c) Significance of Coefficient of Correlation : To know whether there is significant relationship between two variables, the coefficient of correlation obtained is tested for statistical significance with reference to the values given by Garrett in Table No. 25 of his book (Garrett, 1969, p.201).

(d) Details of Independent and Dependent Variables between which Correlations are Calculated :

In the present study, coefficients of correlations are calculated between each dependent variable and the independent variables shown below and their statistical significance is tested.

Dependent Variables (Marks in)	Independent Variables

Dependent Variables (Marks in)

1. English (E), (M)
2. English (E), (F)
3. Telugu (T), (M)
4. Telugu (T), (F)
5. Mathematics (M), (M)
6. Physics (P), (M)
7. Chemistry (C), (M)
8. Chemistry (C), (F)
9. Botany (B), (M)
10. Botany (B), (F)
11. Zoology (Z), (M)
12. Zoology (Z), (F)
13. History (H), (M)
14. Economics (E), (M)
15. Politics (Po), (M)
16. Languages (T + E),(M)
17. Languages (T + E),(F)
18. M P C Group, (M)
19. C B Z Group, (M)
20. C B Z Group, (F)
21. H Po Ec Group, (M)
22. Total marks, (M)
23. Total marks,(F)

Independent Variables

I. Home Environment

1. Parental value on education and academic achievement
2. Emotional climate in the home
3. Parental encouragement
4. Educational facilities in the home
5. Socio-economic status

II. 6. Need for achievement

III. 7. Intelligence

IV. Personality

8. Personality Factor A
9. Personality Factor C
10. Personality Factor E
11. Personality Factor F
12. Personality Factor G
13. Personality Factor H
14. Personality Factor I
15. Personality Factor L
16. Personality Factor M
17. Personality Factor N
18. Personality Factor O
19. Personality Factor Q1
20. Personality Factor Q2
21. Personality Factor Q3
22. Personality Factor Q4

M = Males;   F = Females

Multiple Regression and Correlation Analysis

(a) Choosing the Technique : The statistical technique
to be chosen depends upon the purpose of the study. In this
particular case, the main aim of the study is to know to what
extent can academic achievement be predicted by four variables
put together and the relative contribution of each variable
to the total contribution. The relative contribution of a
variable is its contribution of share to the total contri-
bution when it is acting in the presence of other four
variables. The right method appears to be canonical
correlational analysis. This requires lot of complicated
calculations and the computer has to be used, provided,
however, programme of canonical correlation analysis is
available. Enquiries at the computer centres at Ahmedabad
and Baroda revealed that such a programme was not available.

Next best appears to be the application of latest
method of step-wise multiple regression and correlation
analysis. This method add or subtract one predictor at a
time to the regression equation, seeking the 'best' set of
predictors. The variables are added or deleted depending
upon the statistical significance of their contribution to
the prediction. This programme was also not available.

Then the next course open to the Investigator was to
go in for factor analysis or the usual method of multiple
regression and correlation analysis. He has chosen the latter

because of his familiarity with this technique.

The purpose of regression analysis is to develop an equation to predict the criterion variable with the help of a number of predictor variables. In most of the books on statistics (Garrett, 1960; Snedecor, 1956; Ferguson, 1959), problems dealing with three to five variables are taken and multiple regression and correlations are worked out as examples. These books recommend the use of computers when the variables are more than five. In the present study, the computer service at Physical Research Laboratory, Ahmedabad, was used since the variables to be used in the programme are twenty-two.

(b) <u>Calculation of Regression Coefficients</u> : Detailed account of the formulae and calculations of multiple regression and correlations is beyond the scope of the present report. However, some salient points are given to make the calculations clear. The regression equation can be written as -

$$Y = a + b_1x_1 + b_2x_2 + \ldots\ldots\ldots\ldots b_nx_n \qquad (1)$$

where Y is the criterion to be predicted;

a is the constant; and b_1, b_2 ....b_n are the regression coefficients corresponding to the predictor variables x1, x2 ....xn. The values of b1, b2, ... bn can be obtained by developing and solving the normal

equations. Of the several methods available for solving them, two important methods are - Wherry-Doolittle method and Atkin's method (Ferguson, 1959, p.301; Garrett, 1960, p.426). In the present case, Wherry-Doolittle method is used for obtaining b values. If the values of b's are known, a can be calculated and regression equation can be written substituting the values for a, b1, b2, ...bn.

(c) <u>Significance of Regression Coefficient</u> : For testing the significance of regression coefficients, at first the covariance matrix was formed by deriving the 'c' values calculated on solving the normal equations by the method given by Fisher. The residual mean square (S^2) was obtained on dividing the residual sum of squares by degrees of freedom. The standard error of each coefficient was the square-root of the product of the residual mean sum of squares with the respective 'c' values derived from the first diagonal of the covariance matrix. The 't' of a coefficient is the ratiom of the coefficient to the respective standard error, i.e. $t = b1/S.Eb1$ where $S.Eb1$ is the standard error of the coefficient b1. Whether a regression coefficient is significant or not is tested with reference to 't' values found in Table No. D (Garrett, 1960, p.449).

(d) <u>Calculation of Beta Coefficients</u> : The regression coefficients (b's) are found from the σ's of the tests, and that these, in turn, depend upon the unity in which the test is scored. The b coefficients give the weights of the scores in the independent variables, X2, X3.....Xn, but not the contributions of these variables without regard to the scoring system employed. The b's tell the amount by which scores in X2, X3 ...... and Xn must be multiplied in order to give the 'best' prediction of Y. But these weights do not give us the relative importance of the variables in predicting the criterion (Garrett, 1960, pp. 417-418). Ferguson (1959, p.302) also points out "an appreciation of the relative contributions of the independent variables in predicting the criterion is not readily grasped by simple inspection of the multiple regression coefficients. The evaluation of the relative contributions of the different variables is not a simple matter of direct comparison of the relative magnitude of the regression coefficients but requires also a consideration of the correlation terms". The relative contribution is given by 'beta weights' or beta coefficients (β) - (Garrett, 1960, p.417). When expressed in terms of σ scores, regression coefficients are called beta coefficients and they may be calculated directly from the b's as follows (Garrett, 1960, p.418) :

$$\beta 12.34 \ldots\ldots\ldots n = b12.34 \ldots\ldots n \; \frac{\sigma 2}{\sigma 1}$$

(e) <u>Calculation of R</u> : Multiple R is an extension

of the theory of simple linear correlation. When three

or more variables are being studied, the correlation

between two variables is sometimes misleading and may be

erroneous if there is little or no correlation between the

variables other than that brought about by their common

dependence upon one or several other variables. The R

indicates the strength of relationship between one variable

and other variables taken together. It is also the

correlation between the predicted values of the dependent

variable and its obtained values. Of the several methods

available, the following formulae is used for calculating

multiple R (Garrett, 1960, p.419).

R^2 may be expressed in terms of beta coefficients (β)

and the zero order correlations (r's) as follows :

$$R^2_1 (23......n) = \beta 12.34......n \ r12 + \beta 13.24 ..... n \ r13$$

$$+ \ \beta 1n.23 ....(n-1) \ r1n \qquad (2)$$

R^2_1 (23......n) gives the proportion of the variance of

the criterion measure (X1) attributable to the joint

action of the variables X2, X3 ....Xn. The advantage

of this formula is that we can get the individual as well

as joint contribution of the variables to the prediction

of the criterion. The total percentage of criterion

variance explained by all the variables jointly is given

by $100R^2$ and the percentage of criterion variance explained

by individual variable is given by $100r\beta$ (100 X correlation$\succeq$ coefficient X beta coefficient of the concerned variable).

The Investigator got the regression coefficients and 't' values calculated from the computer Centre, Physical Research Laboratory, Ahmedabad. The rest of the calculations were done by him to find multiple R and contribution of the variables by using the tabular form noted below :

Variable	σ_v	σ_c	$\dfrac{\sigma_v}{\sigma_c}$	b	β	r	$r\beta$	$100r\beta$
1								
2								
3								
.								
.								
.								
.								
21								
22								

Since the values of σ_v, σ_c, b, r were available with the Investigator (of course, got them calculated through Computer Centre), β's ($\beta = \dfrac{\sigma_v}{\sigma_c} \times b$) were calculated first, and R^2 was calculated using the formula No. 2. The contribution of each variable, (i.e. percentage of variance explained) is given by $100\ r\beta$. The total contribution of the variables (percentage of total

variance explained) is given by sum of $100 \ r \beta$. R^2 is given by the sum of $r \beta$ and R is calculated.

The value of R is also given by the computer. The values given by the computer were checked with those calculated by the Investigator and there were differences ranging from .001 to .006. The Investigator retained the values got by him.

After testing for significance of regression coefficients, if some of them are found to be non-significant, then multiple regression and correlation may be carried on only with the significant variables and then the fall off increase in the value of multiple R may be observed. This process has to be continued till significant variables are found, eliminating non-significant predictors after (t' test. This method has not been followed, though desired, since it costs more to the Investigator. Moreover, the purpose of the investigation was to find out the total variance explained by the four variables and their relative contribution, this procedure is not warranted too.

Thus, in the present study the R is calculated using the formula No. 2 and the total variance explained by the four variables and their relative contribution is found. Also are found the potential predictors and their contribution when they are acting along with the other variables covered by the study.

Another way of calculating total contribution and relative contribution, when there are several variables, is to find multiple correlation with two variables and then add the third variable and find multiple R with three variables. The increase in multiple R and the consequential variance explained is attributed to the variable added. But this does not represent the full contribution of the variables added later, since whatever is in common space will have been credited to the earlier ones (Cattell, 1966, p.290). Moreover, which two variables are to be taken first to calculate multiple R is also a problem. The size of the simple correlations does not indicate the order of choosing the variables for analysis. Peaker has made this point clear when he says, "relevance of a particular variable depends not only upon its simple correlation with the criterion, but also on its correlation with its fellows, and with their correlations among themselves" (Central Advisory Council for Education, 1967, pp. 179-180). Since the Investigator is not sure whether the four variables are inter-related or not, this method has not been chosen.

(f) <u>Significance of R</u> : The value of R is tested for significance by calculating 'F' which is given by the following formula (Ferguson, 1959, p.301).

$$ F = \frac{R^2}{1 - R^2} \quad \frac{N - K - 1}{K} $$

where R = multiple correlation coefficient,

N = number of observations, and

K = number of independent variables.

The Table F (Garrett, 1960, p.451) is used to check up whether R is significant or not.

(g) Details of Criterion Variables for which Multiple Regression and Correlation Analysis is done : Since the Investigator expected differential predictors with regard to achievement in certain groups of subjects, the multiple regression and correlation analysis is confined to eight types of achievement criteria, namely, Achievement in (1) Languages (Males), (2) Languages (Females), (3) MPC Group (Males), (4) CBZ Group (Males), (5) CBZ Group (Females), (6) HPoEc Group (Males), (7) Total subjects (Males), and (8) Total Subjects (Females).

(h) Combination of Groups for Analysis : In this study, three groups of male students, namely, MPC (N=110), CBZ (N=108), HPoEc (N=104) and one group of female students of CBZ Group (N=74) were covered. In the case of subjects studied in common, relevant groups were combined, for example, three groups of male students were combined for achievement in English, Telugu, Languages (English and Telugu), total achievement (N=322), and MPC and CBZ Groups were combined for achievement in Chemistry (N=218). The female group was analysed separately.

The standard scores in individual subjects are added to get composite standard scores in groups of subjects and these standard scores are used in analysis.

In the next chapter, results based on correlation analysis are presented and discussed.