3.1 INTRODUCTION

Research is a systematic effort in the direction of solution of a problem having direct or indirect bearing on human welfare. It is ‘systematic’ because it involves certain steps to be taken in definite orders. There may be more than one approach to solve a problem, some of them being better than others. Which approach or methodology is followed largely determines the dependability of research findings. So, the success of a researcher lies in his choice of methodology to be followed. Methodology includes all the plans, techniques and strategies follow in carrying out a research study. From the very beginning the investigation has been very particular to see that no loop-hole is left in the methodology followed in the present investigation. This chapter reports the details of the design of the study including technique of sample selection, development of research tools, techniques followed in data collection and analysis.

Plan of a research study entails overview of the total layout including a consideration of how the work is to be executed. It is at this stage that decision crucial for the accomplishment of the aims of the study as what measures of gathering data are to be used, how population is to be defined and sampled, what controls are to be applied, what kind of data pertinent to the study are to be collected and finally how it is to be analyzed and made. Needless to say that without proper planning difficulties to be encountered during the progress of the work cannot be anticipated and resolved. In fact,
successful completion of the study without preplanning becomes not only difficult, but impossible. The function of a research design is to organize the procedures of study so that error is minimized, effort is economized and relevant evidence is gathered efficiently. A considered discussion of all those aspects in respect of the present study is embodied in this chapter.

The method adopted for the present study can be categorized as descriptive statistical in nature. Descriptive research describes and interprets the current status, it is concerned with conditions or relationship that exist, practices, that prevail, beliefs, points of view or attitudes that are held, processes that are going on, effects that are being felt or trend that are developing. The process of description as employed in this research study goes beyond mere gathering and tabulation of data. It involves an element of interpretation of the meaning or significance of what is described. Thus, description is combined with comparison or contrast involving measurement, classification, interpretation and evaluation.

The use of inferential statistics has been made in deducing results from different statistical techniques employed for investigating the comparison of achievement between boys and girl students, socio-economical and school inputs factor with the above mentioned goals to be achieved.

3.2 METHODOLOGY

It is difficult task to classify educational research into methods because there is too much overlapping in their purpose and procedures. Thus there is
no natural system of categorizing research methods which may put the different methods neatly in clear cut compartments.

Research methodology is a way to systematically solve the research problem it may be understood as a science of studying now research is done scientifically.

The researcher has selected survey method as this method is concerned with the present and attempts to determine the status of phenomena under investigation.

**Survey method:**
The following are the main purpose and uses of survey methods of research:

Although the major purpose of survey method in research is to tell what is? i.e. to describe the problem or phenomenon, but many surveys go beyond a mere description of the existing situation. For example, the survey dealing with curriculum courses helps us in obtaining information not only about the strength and weaknesses of the current curriculum but also can elicit recommendation for change.

Descriptive surveys or normative surveys are often carried out as preliminary step to be followed by researcher employing more vigorous control and more objective methods.

Descriptive survey or studies are also a direct source of valuable knowledge concerning human behavior.
Descriptive studies are helpful for us in planning various educational programmes. School census, is perhaps, the most universal application of the descriptive method to educational planning. School surveys are conducted to help to solve the problems of various aspects of school i.e. school plants, school maintenance, teaching staff, curriculum, teaching methods, learning objectives and the like.

The purpose behind this method for research is acquiring of information about the characteristics and nature of the pupils their behavior patterns in life and classroom and their knowledge, skills, emotional intelligence and work or study.

3.3 POPULATION AND SAMPLE

A population, in statistical terms, may be defined as any identifiable and well specified group of individuals. A population may be finite or infinite. Finite population is one in which all the members can be easily counted. An infinite population is one whose size is unlimited and therefore, its members cannot be counted. Similarly, a population may be real or imaginary. A real population is one which actually exists and an imaginary population is one which exists only in the imagination. In psychological and educational research on many occasions the population is imaginary. Generally it is not possible to study the entire population in a single research study. There are two reasons for this; when the population is very large it is not possible to contact every individual unit. When dependable results can be obtained by studying a small portion of the population, there is no use of wasting time and money.
One very important use of inferential statistics is in drawing of inferences about larger populations on the basis of information obtained from smaller groups selected from the population. To state in other words, we wish to make statement or generalizations about the population on the basis of information’s obtained from the study of one more samples. The extent to which we can do this with reasonable accuracy depends on the adequacy or representativeness of the sample.

To study the whole population is rather impracticable; a statistical process called sampling makes it possible to draw useful inferences or generalizations on the basis of careful observations or manipulation of variables, within a relatively small proportion of the population. The process of sampling generally refers to the method of selecting a small part or specimen of a large universe of subjects, in order to study some quality or characteristic of the whole. So, sampling is one of the most fundamental aspects of the total methodology followed in particular research study. It is an act of determining how many elements in a population are to be sampled, and how they are to be selected. A single member of the population is referred to as a population unit or element. The statistical values which refer to sample are called “statistics”. On the basis of statistics, we can estimate the corresponding population values called parameters. So, a statistical inquiry involves estimating an unknown “parameter”, on the basis of statistics obtained from a sample. This process is known as statistical inference (Best, 1977).
All the students studying in class IX constitute the population of the study. The age range of the members of the population is 14-17 years. This study was carried out in Government and Private secondary schools of three districts i-e Aurangabad, Nanded and Parbhani in Maharashtra.

Maharashtra has 31 districts. The geographical location of Maharashtra provides this state a special status among the Indian states.

Keeping in view the practical feasibility and the other conditions the investigator used purposive sampling. In purposive sampling the population is viewed as a collection of groups that are much the same. That is, strata are internally homogeneous and are internally heterogeneous. In purposive sampling, it is the subjects themselves which are selected at random. The investigator used this technique because schools provide the whole class for test administration. It is not possible to select a simple random sample in educational institutions.

To start with, a sample of 1600 class IX students was drawn from 40 schools of Maharashtra in which 20 was Government & 20 was Private schools and another sample of 40 headmasters of the school’s is selected for the study of school inputs, Due to the occasional absence of the student on the days of test administration, the number of cases was also reduced. As it was necessary to administer all the tests to the same subjects, those who had taken some tests and left others were not included in the sample for final analysis. So the final analysis was done on the collected data of 1567 students and 40 headmasters of the schools. The description of data is given below in the tabulated form.
3.3.1 DESCRIPTION OF THE SAMPLE

<table>
<thead>
<tr>
<th>S.No</th>
<th>Sample used for</th>
<th>Government schools</th>
<th>Private schools</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Academic achievement and socio-economic status of students</td>
<td>770</td>
<td>797</td>
<td>1567</td>
</tr>
<tr>
<td>2.</td>
<td>Head master’s sample for school inputs</td>
<td>20</td>
<td>20</td>
<td>40</td>
</tr>
</tbody>
</table>

3.3.2 TABLE OF GOVERNMENT SCHOOL’S SAMPLE

<table>
<thead>
<tr>
<th>Sr no.</th>
<th>Name of schools</th>
<th>Type</th>
<th>Medium of instruction</th>
<th>Male</th>
<th>Female</th>
<th>Total students</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Zilla parishad high school Aurangabad</td>
<td>Government</td>
<td>Urdu</td>
<td>18</td>
<td>22</td>
<td>40</td>
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<td>municipal corporation high school Aurangabad</td>
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<td>Government</td>
<td>Urdu</td>
<td>23</td>
<td>17</td>
<td>40</td>
</tr>
<tr>
<td>5</td>
<td>AMC Marathi high school</td>
<td>Government</td>
<td>Marathi</td>
<td>21</td>
<td>18</td>
<td>39</td>
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<td>Government</td>
<td>Urdu</td>
<td>19</td>
<td>14</td>
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<tr>
<td>6</td>
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<td>Sr no.</td>
<td>Name of schools</td>
<td>Type</td>
<td>Medium of instruction</td>
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<td>Female</td>
<td>Total students</td>
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<td>---------------------------------------------</td>
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<td>--------</td>
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<tr>
<td>5</td>
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<td>Ownership</td>
<td>Language</td>
<td>10th Pass %</td>
<td>12th Pass %</td>
<td>4th Year %</td>
</tr>
<tr>
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<td>6</td>
<td>Burhanuddin Urdu high school Aurangabad</td>
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<td>English</td>
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<td>22</td>
<td>47</td>
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<td>16</td>
<td>Al-Irfan residential school Khuldabad</td>
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<td>Nehru English high school Nanded</td>
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<td>19</td>
<td>Gyanmata Marathi high school</td>
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<td>School Name</td>
<td>Type</td>
<td>Language</td>
<td>Total</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>-----------------------------</td>
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<tr>
<td>Abdul Quader Urdu High</td>
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<tr>
<td>School Aurangabad</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Private School Students | 384 | 413 | 797 |

### 3.4 RESEARCH TOOLS USED

The dependability of research findings are not only determined planning, methodology, data analysis and interpretation but also on tools that are used to collect information or data. In a research study, while selecting research tools many considerations have to be kept in mind – such as objectives of the study, the amount of time to be devoted for the study, availability of suitable tests, their statistical characteristics etc. and gathering information about their, academic achievement and socioeconomic status, school inputs. The investigator used three different types of research tools:

1. Socio-economic status scale-developed by Sunil Kumar Upadhyay & Alka saxena.

2. The measure of academic achievement based on the marks obtained in the VIII\textsuperscript{th} grade examination conducted by the school.

3. School Inputs Assessment Questionnaire prepared by the investigator.
3.4.1 UPADHYAY-SAXENA SOCIO-ECONOMIC STATUS SCALE (US-SESS)

The investigator employed Upadhyay-saxena socio-economic status scale for measuring socio-economic condition of parents of the subjects. This test was chosen in preference to some other available tests primarily because it is a latest test. Unlike other widely used tests it is less affected by the vagaries of place and time. The constructor of the test claims that the test measures socio-economic status in a manner design to reduce, as much as possible, the influence of, economic climate, and educational level. the development of a tool for measuring S-E-S has attracted the attention of researchers in the past. For measuring the S-E-S, several scales have been developed. Kuppuswamy(1962)²,Pareek & Trivedi(1963)³,Aareon et al’s (1969)⁴, Kulshrestha & De(1970)⁵,Verma & Saxena(1990)⁶, Shah(1986)⁷ have developed scale for measuring S-E-S in the present era continuous changes in society have been taking place creating a need for a new scale of measuring S-E-S. The present scale is intended to measure the S-E-S of both urban & rural areas. The scale consist of 31 items in five parts related to (i) personal information (ii) family (iii) education (iv) income (V) others (cultural & material possessions)

**Reliability:** on 109 students of secondary school, the test retest reliability was found to be 0.83.

**Validity:** the validity of this scale was computed by correlating with SESS of shah (1986). it was found to be 0.78.this was also valid in terms of the
known group administration (N=22 for high SES group and N=18 for low S-
E-S group respectively) as it was found to measure high(by 95 per cent of
correctness) and low (by 95 per cent of correctness) socio-economic status
appropriately.

Scoring key:

- Personal information

Q.No.1 - 3 marks for open category.

- 2 marks for O.B.C category.

- 1 mark for SC & ST category.

Q.NO.2 - 4 marks for urban (length of domicile more than 5 year).

- 3 marks for urban (length of domicile less than 5 years).

- 2 marks for semi-urban (kasba)

- 1 mark for rural.

Maximum score in this section will be 07 and minimum will be 02.

- Family

Q.NO.1 -2 marks for joint,1 for single.

Q.NO.2 -2 marks for yes, 1 for no.

Q.NO.3 -2 for yes, 1 for no.

Q.NO.4 -2 for yes, 1 for no.
Maximum score in this section will be 08 and minimum will be 04.

- Education

Q.NO.1 - Zero for non-educated

1. mark for educated up to class IVth
2. mark for educated upto primary
3. mark for educated upto VIIth.
4. mark for educated upto Xth.
5. mark for educated upto XIIth.
6. mark for educated upto graduate.
7. mark for educated upto post graduate
8. mark for PhD, M.B.B.S, B.Tech, M.B.A

Q.NO.2 – scoring procedure as used in Q.NO.1 is repeated.

Q.NO.3 - 1 mark for each brother/sister studying in IX to XII

- 2 mark for each brother/sister studying in first degree level.

- 3 mark for each brother/sister studying above first degree level.

Q.NO.4 - 1 mark for private.

- 2 mark for Govt. and aided.
-3 mark for convent/public.

Q.NO.5 -1 mark for Hindi.

-2 mark for English.

Q.NO.6 -1 mark for yes, Zero for no.

Q.NO.7 -1 mark for yes, Zero for no.

Q.NO.8 -1 mark for yes, Zero for no.

Q.NO.9 -1 mark for yes, Zero for no

Q.NO.10 -1 mark for yes, Zero for no

Maximum score in this section will be 34 and minimum will be 02.

- Income

Q.NO.1 -1 mark for each source of income with a maximum of 3 marks.

Q.NO.2 -1 mark for labour

-2 mark for skilled labour/small farmer up to 2 acres.

-3 marks for small farmer below 5 acres/small business/fourth class employee

-4 mark for teachers/Avg. business/farmer up to 10 acres of land.

-5 mark for college & university teacher/class 2 service/large business/managerial Service.
- 6 marks for managerial executive/factory ownership/class 1 service

Q.NO. 3 - the scoring procedure as used in Q.NO. 2 is to be repeated.

Q.NO. 4 - 1 mark for total per month income up to Rs. 5,000

- 2 marks for total per month income up to Rs. 12,000
- 3 marks for total per month income up to Rs. 18,000
- 4 marks for total per month income up to Rs. 25,000
- 5 marks for total per month income up to Rs. 35,000
- 6 marks for total per month income above then to Rs. 35,000

Maximum score in this section will be 21 and minimum will be 02.

- Others

Q.No. 1 - 1 mark for yes, zero for no

Q.No. 2 - 1 mark for each 2 room with a maximum of 4 marks

Q.No. 3 - 1 mark for room rent up to Rs. 1000

- 2 mark for room rent up to Rs. 2500
- 3 mark for room rent up to Rs. 4000
- 4 mark for room rent above then Rs. 4000

Q.No. 4 - 1 mark for yes no

Q.No. 5 - 1 mark for (i)
- 2 marks for (ii)

- 3 marks for (iii)

With a maximum of 5 marks.

Q.No. 6 - 1 mark for each servant with a maximum of 4 marks

Q.No. 7 - 2 marks for (i)

- 1 mark for (ii)

- or zero for (iii)

Q.No. 8 - 2 marks for yes, 1 for no

Q.No. 9 - 2 marks for yes, 1 for no

Q.No. 10 - 1 mark for each

Q.No. 11 - zero for no

- 1 mark for up to Rs.100

- 2 marks for up to Rs.500

- 3 marks for above then Rs.500 Maximum score in this section will be 31 and minimum will be 03
3.4.2 TABLE OF SCORING FOR SESS

<table>
<thead>
<tr>
<th>S-E-S Category</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
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<td>High</td>
<td>Between 62 to 74</td>
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<tr>
<td>Above Average</td>
<td>Between 62 to 74</td>
</tr>
<tr>
<td>Average</td>
<td>Between 49 to 61</td>
</tr>
<tr>
<td>Below Average</td>
<td>Between 36 to 48</td>
</tr>
<tr>
<td>Low</td>
<td>35 or below</td>
</tr>
</tbody>
</table>

3.4.3 SCHOOL INPUTS ASSESSMENT QUESTIONNAIRE

To tryout the item questionnaire was administered in 36 private & public schools. The respondents were the heads of these secondary schools. The respondent were asked to fill up the whole questionnaire as per given direction.

**Scoring:** The scoring of this questionnaire is very simple one. Since the school inputs assessment questionnaire consists of 3 parts, only the main part that is part 2\textsuperscript{nd} & part 3\textsuperscript{rd} were to be scored on the basis of weightage given to each items. The part 2\textsuperscript{nd} which contain 45 items of YES/NO type indicate the possession of an attribute or characteristics & thus yes amount for one score & similarly no stands for ‘0’ score. In case of MCQ items 5 alternative choices are provided to each item. The each choice has been
assigned its weight age on the model likert scale (5 point scale) that is ‘a’ has been assigned 1 score B-2, C-3 and so on. On this pattern the questionnaire was scored.

**Reliability of the questionnaire:** the test retest reliability of School Inputs assessment questionnaire was administered in the same school after 1 month time duration. The results than obtained were compared both category & component wise. (Excellent, satisfactory poor) it was found that the retest date perfectly matched with the initially obtained data. High coefficients of correlation are=0.92 was obtained.

**Validity:** In this case (pre & post test) content validity was thought to be the best method of validation of school inputs assessment questionnaire. In the first place an agreement on various dimensions of representation of the inputs of school program was achieved. This was done by large school interaction with the experts & others in the field.

3.5 DATA COLLECTION

Fortunately, the tests administered were not very technical as far their administration is concerned. So, the investigator decided to visit the schools himself for data collection. The tests were administered on the section of class IX and strict adherence to the instructions given by the authors of the test was maintained. As it is the investigator himself reached to the heads of the respective schools for collecting data regarding school inputs and
student’s achievement. The investigator visited and collected the data from different Government and Private schools personally.

Ro seek cooperation of principals and teachers of these schools, the investigator received introduction letters from his supervisor and Dean of the Department of Education, Integral University. In which they had requested to the concerned principals to co-operate in this task. Consequently, the present principals and the teachers of the schools visited for data collection co-operated fully in the process of test satisfactorily. The investigator is thankful to all them.

3.6 HURDLES IN DATA COLLECTION

Unfortunately, the data collection work took more than expected time due to some unforeseen difficulties encountered during the data collection process; the main difficulties were as follows:

1. UNAVAILABILITY OF PRINCIPALS & TEACHERS.

One of the main reason researcher encountered was unavailability of principals in the schools due to some official or personal work so their deputy teacher did not allow researcher the data gathering. It was possible after consultation with their head or simply they gave the specific date to the researcher for data gathering. It delayed the work more than expected.

2. LACK OF TEACHER’S KNOWLEDGE ON RESEARCH WORK.
Some of the teachers of private schools who don’t know about the research procedure of data collection resembled researcher as a Government official who came for cross checking of school so they refused to give data from school records and deputed peon with researcher to know the real truth about the researcher.

3. VACATIONS AND HOLIDAYS.

Gazzetted holidays, winter vacations half working days on weekends in the schools, short period or half school time on Fridays and Saturdays in some schools, functions of the school such as parents meeting, student’s analysis proved to be other obstacles in data collection.

4. B.ED TRAINEE TEACHERS.

In most of the schools there was a noticeable rush of the B.ed trainee teachers which in turn partially affected the normal activities of the schools.

5. TEST & EXAMINATION PROBLEM.

Various examinations such as class test, monthly and terminal examinations also proved hurdle in the normal work of data collection.

3.7 STATISTICAL TECHNIQUES EMPLOYED

In this study the researcher has chosen statistical techniques which are found to be most appropriate and compatible to the collected data. Each statistical method is based upon its own specific assumptions regarding the nature of the sample. Its universe and research conditions. Keeping the objectives of the present study the following statistical techniques is used. Mean, Standard Deviation (S.D), ‘F’ test (To see overall difference among
many means)’t’ test (To see the significant differences between two means). For more rigorous analysis a Regression Analysis technique will be used to know the extent to which the dependent variable should be predicted on a set of independent variables.

3.8 FORMULA USED

3.8.1. CALCULATION OF MEAN (m)

"The mean of a distribution of scores is the value on the scores scale corresponding to the sum of the scores divided by their number or size of sample."

The mean is the sum of separate scores or measures divided by their numbers.

The formula used for mean is;

\[ M = A + \left[ \frac{\sum fd}{N} \right] \times C1 \]

Where,

\( N \) = Total number of the students

\( M \) = Assumed mean

\( \sum fd \) = Sum of the product of frequency and deviation.

\( A \) = Assume

C.I. = Class Internal
3.8.2. CALCULATION OF STANDARD DEVIATION (SD)

"The square root of the variance is called the root mean square deviation or the standard deviation."

The symbol for S.D. is the Greek Latin symbol Sigma (σ)

The formula is: (For grouped)

\[
\text{S.D.} = \sigma = C.I. \sqrt{\frac{\sum fx^2}{N} - (\frac{\sum fd}{N})^2}
\]

Where, \( C.I. = \text{Class Interval} \)
\( \sum fx = \text{Sum of product of frequency & deviation} \)
\( \sum fd = \text{Sum of product of fd & deviation} \)
\( N = \text{Total number of the students.} \)

3.8.3 CALCULATION OF T-VALUE

For testing difference between means of two samples, general definition of \( t \) is

\[
t = \frac{\bar{X}_1 - \bar{X}_2}{S_{DX}}
\]

Where \( \bar{X}_1 \) and \( \bar{X}_2 \) are two means of samples of size \( N_1 \) and \( N_2 \) and \( S_{DX} \) is the standard error of difference. The means \( \bar{X}_1 \) and \( \bar{X}_2 \) are given as

\[
\bar{X}_1 = \frac{\Sigma X_1}{N_1} \quad \text{and} \quad \bar{X}_2 = \frac{\Sigma X_2}{N_2}
\]
i) FOR HOMOGENEOUS DATA

\[ S_{DX} = \sqrt{\frac{\sum x_1^2 + \sum x_2^2}{N_1 + N_2 - 2}} \left( \frac{1}{N_1} + \frac{1}{N_2} \right) \] (for pooled variance)

Degree of freedom = \( N_1 + N_2 - 2 \)

ii) FOR NON-HOMOGENEOUS DATA

\[ S_{DX} = \sqrt{\frac{\sum x_1^2}{N_1(N_1 - 1)} + \frac{\sum x_2^2}{N_2(N_2 - 1)}} \]

and Degree of freedom = \( \frac{S_{DX}^2}{\left( \frac{\sum x_1^2}{N_1(N_1 - 1)} \right)^2 + \left( \frac{\sum x_2^2}{N_2(N_2 - 1)} \right)^2} - 2 \)

In the above relation

\[ \sum x_1^2 = \sum_{i=1}^{N_1} (x_1 - \bar{X}_1)^2 \text{ And } \sum x_2^2 = \sum_{i=1}^{N_2} (x_2 - \bar{X}_2)^2 \]

3.8.4 F – TEST

When significance of the difference among several means is desired, F – Test is applied. Assume that we wish to study the effects of the \( r \) different experimental groups of size \( N \).

The F – Test is defined as

\[ F = \frac{\text{Variance between samples}}{\text{Variance within samples}} \]
Following procedures (steps) are adopted to calculate the variance between and within samples. For simplicity we assume here \( r = 4 \) samples.

**Step 1: MEAN OF EACH SAMPLE**

<table>
<thead>
<tr>
<th></th>
<th>Sample I</th>
<th>Sample II</th>
<th>Sample III</th>
<th>Sample IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A_1</td>
<td></td>
<td>B_1</td>
<td>C_1</td>
<td>D_1</td>
</tr>
<tr>
<td>A_2</td>
<td></td>
<td>B_2</td>
<td>C_2</td>
<td>D_2</td>
</tr>
<tr>
<td>A_3</td>
<td></td>
<td>B_3</td>
<td>C_3</td>
<td>D_3</td>
</tr>
<tr>
<td>.</td>
<td></td>
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</tr>
<tr>
<td>.</td>
<td></td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>A_N</td>
<td></td>
<td>B_N</td>
<td>C_N</td>
<td>D_N</td>
</tr>
<tr>
<td>Total</td>
<td>( \Sigma A_i )</td>
<td>( \Sigma B_i )</td>
<td>( \Sigma C_i )</td>
<td>( \Sigma D_i )</td>
</tr>
<tr>
<td>Mean of each sample</td>
<td>( \bar{A} = \frac{\Sigma A_i}{N} )</td>
<td>( \bar{B} = \frac{\Sigma B_i}{N} )</td>
<td>( \bar{C} = \frac{\Sigma C_i}{N} )</td>
<td>( \bar{D} = \frac{\Sigma D_i}{N} )</td>
</tr>
</tbody>
</table>

Grand Mean \( \bar{X} = \frac{\bar{A} + \bar{B} + \bar{C} + \bar{D}}{r} \)

**Step 2: SUM OF SQUARES BETWEEN THE SAMPLES (SSBS)**
<table>
<thead>
<tr>
<th>Sample I</th>
<th>Sample II</th>
<th>Sample III</th>
<th>Sample IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(\bar{A} - \bar{X})^2$</td>
<td>$(\bar{B} - \bar{X})^2$</td>
<td>$(\bar{C} - \bar{X})^2$</td>
<td>$(\bar{D} - \bar{X})^2$</td>
</tr>
<tr>
<td>a</td>
<td>b</td>
<td>c</td>
<td>d</td>
</tr>
<tr>
<td>a</td>
<td>b</td>
<td>c</td>
<td>d</td>
</tr>
<tr>
<td>a</td>
<td>b</td>
<td>c</td>
<td>d</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>$a_N$</td>
<td>$b_N$</td>
<td>$c_N$</td>
<td>$d_N$</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Na</strong></td>
<td><strong>Nb</strong></td>
<td><strong>Nc</strong></td>
</tr>
</tbody>
</table>

Sum of squares between samples (SSBS) = $N(a + b + c + d)$

Mean sum of the squares of sample (Variance between samples)

$$VBS = \frac{N(a + b + c + d)}{(r - 1)}$$

**Step 3: TOTAL SUM OF SQUARES WITHIN SAMPLES**

<table>
<thead>
<tr>
<th>Sample I</th>
<th>Sample II</th>
<th>Sample III</th>
<th>Sample IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(A_i - \bar{A})^2$</td>
<td>$(B_i - \bar{B})^2$</td>
<td>$(C_i - \bar{C})^2$</td>
<td>$(D_i - \bar{D})^2$</td>
</tr>
<tr>
<td>$a_1$</td>
<td>$b_1$</td>
<td>$c_1$</td>
<td>$d_1$</td>
</tr>
<tr>
<td>$a_2$</td>
<td>$b_2$</td>
<td>$c_2$</td>
<td>$d_2$</td>
</tr>
</tbody>
</table>
Total sum of squares within the samples (SSWS)

\[ SSWS = \sum (A_i - \bar{A})^2 + \sum (B_i - \bar{B})^2 + \sum (C_i - \bar{C})^2 + \sum (D_i - \bar{D})^2 \]

Mean sum of squares within samples (Variance within samples)

\[ VWS = \frac{SSWS}{N - r} \]

**ALL THE RESULTS CAN BE TABULATED AS FOLLOWS**

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Sum of square</th>
<th>Degree of freedom</th>
<th>Variances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Samples</td>
<td>Sum of squares between the samples (SSBS)</td>
<td>( r - 1 )</td>
<td>( \frac{SSBS}{r-1} )</td>
</tr>
<tr>
<td>Within Samples</td>
<td>Total sum of squares within samples (SSWS)</td>
<td>( N - r )</td>
<td>( \frac{SSBS}{N-1} )</td>
</tr>
<tr>
<td>Total</td>
<td>SSBS + SSWS</td>
<td>( N - r - 1 )</td>
<td></td>
</tr>
</tbody>
</table>
Null hypothesis states that there is no significant difference between the samples under study. The starting point of all statistical tests is the statement of null hypothesis (Ho), which is a ‘no difference hypotheses’.

A null hypothesis is a hypothesis that proposes no relationship or difference between two variables. "In the standard hypothesis-testing approach to science one attempts to demonstrate the falsity of the null hypothesis, leaving one with the implication that the alternative, mutually exclusive, hypothesis is the acceptable one." (Reber, 1985)\(^8\).

A null hypothesis is "the hypothesis that there is no relationship between two or more variables, symbolized as \(H_0\)" (Rosenthal & Rosnow, 1991)\(^9\).

A null hypothesis makes a judgment about whether the obtained differences between the samples are due to some true differences or due to some chance errors. The tests of null hypothesis are generally called tests of significance, the outcome of which is stated in terms of probability figures or levels of significance.

If the difference between the experimental group and the control group is very small, the experimenter is likely to accept the null hypothesis, indicating the fact that the small difference between these two groups is due to sampling error or some other chance fluctuations. On the other hand, if
the difference between the experimental group and the control group is too large, the experimenter is likely to refute or reject the null hypothesis, indicating the fact that the obtained differences are real differences between or among samples under study.

Null hypothesis to a statistical method of interpreting conclusions about population characteristics’ that are inferred from the variable relationships observed in samples. The null hypothesis asserts that observed differences or relationships results merely from chance errors inherent in the sampling process. Most hypotheses are exactly the opposite of null hypothesis. In such a case if the researcher rejects the null hypothesis, he or she accepts the research hypothesis, concluding that the magnitude of the observed variable relationship is probably too great to attribute to sampling error.

3.10 LEVEL OF SIGNIFICANCE

In the sense of Fisher\textsuperscript{10}, statistical significance is a statistical assessment of whether observations reflect a pattern rather than just chance. When used in statistics, the word significant does not mean important or meaningful, as it does in everyday speech: with sufficient data, a statistically significant result may be very small in magnitude.

Popular levels of significance are 10\% (0.1), 5\% (0.05), 1\% (0.01), 0.5\% (0.005), and 0.1\% (0.001). If a test of significance gives a p-value lower than or equal to the significance level, the null hypothesis is
rejected at that level. Such results are informally referred to as 'statistically significant (at the \( p = 0.05 \) level, etc.)'. The confidence with which an experimenter rejects or accepts a null hypothesis depends upon the level of significance adopted. When a t-value is 1.96 or more, we may reject the null hypothesis at 0.05 level of significance and when a t-value is 2.58 or more, we reject the null hypothesis at 0.01 level of significance. Further the 0.01 level is more accurate than the 0.05 level.

If the null hypothesis is rejected at 0.05 level, it means that 5 times in 100 replications of the experiments, the null hypothesis is true and 95 this hypothesis would be false. In other words, this suggests that a 95% probability exists that the obtained results are due to experimental treatment rather than due to some chance factors. The 0.01 level suggests that 99% probability exists that the obtained results are due to experimental treatment and hence, once in 100 replications of the experiments, the null hypothesis would be true. So the levels of significance have much importance in research process.

3.11 ONE-TAILED OR TWO-TAILED TEST OF SIGNIFICANCE

In statistical significance testing, a one-tailed test or two-tailed test are alternative ways of computing the statistical significance of a data set in terms of a test statistic, depending on whether only one direction is considered extreme (and unlikely) or both directions are considered extreme. Alternative names are one-sided and two-sided tests; the terminology "tail" is because the extremes of distributions are often small, as in the normal distribution or "bell curve".
If the test statistic is always positive (or zero), only the one-tailed test is generally applicable, while if the test statistic can assume positive and negative values, both the one-tailed and two-tailed test are of use.

A statistical test in which the critical area of a distribution is one-sided so that it is either greater than or less than a certain value, but not both. If the sample that is being tested falls into the one-sided critical area, the alternative hypothesis will be accepted instead of the null hypothesis. The one-tailed test gets its name from testing the area under one of the tails (sides) of a normal distribution, although the test can be used in other non-normal distributions as well.

When a hypothesis state that the mean of the experimental group is not higher/lower than the mean of the control group, then it is called a directional hypothesis, which indicates a direction of difference. In this case, we are concerned with only one end of the distribution. In this situation we apply a one-tailed test. For this test at 0.05 level, the 5% area of rejection is either at the upper tail or at lower tail of the curve and the t-value is ±1.64. For a one tailed test at 0.01 level, the t-value for rejection of the null hypothesis is ±2.33.

In a two-tailed test the researcher is interested in evaluating the difference between the groups. The null hypothesis states that the mean of the experimental group is equal to the mean of the control group that is there is no significant difference between the means of the experimental group and control group. In this case we consider our concern with both tails of the distribution. For a two tailed test the 5% area of rejection is divided equally
between upper & lower tails of the curve and the t-value is ±1.96. And at 0.01 level the t-value is ±2.58. So both one-tailed and two-tailed test are of much significance in statistical testing.
REFERENCES:


5. KULSHRESTHA, & De., (1970), ‘A Study of Intelligence and Scholastic Attainment of X and XI Class Students in Uttar Pradesh’. Doctoral thesis (Phil.) Allahabad University, Allahabad, India.


