Chapter-3

Research Methodology
To conduct any research work, the investigator needs to prepare a plan of action for her study that is called research design. It is a logical and systematic plan of action with reference to the collection and analysis of data to achieve the objectives of the proposed research study. Research design depends on the nature of the problem to be studied and is very specific.

The formidable problem that follows the task of defining the research problem is the preparation of the design of the research popularly known as the “research design”. Research design is needed because it facilitates the smooth sailing of the various research operations thereby making research as efficient as possible, yielding maximal information with minimal expenditure of efforts, time and money. Just as for the construction of a better, economical and attractive house, a blue print well thought out and prepared by an expert architect is needed; similarly a research plan for data collection and analysis in advance of the research project is needed. Research design in fact, has a great bearing on the reliability of the results arrived at and as such constitutes the firm foundation of the entire edifice of the research work.

Research methodology is a way to solve the research problem systematically. It may be understood as a science of studying how research is done scientifically. Keeping in view the aims and objectives of the study the investigator has organized the procedure of the study under the following heads: -

3.1 Research Technique

3.2 Sample

3.3 Measuring Techniques

3.4 Data Collection

3.5 Statistical Techniques
3.1 RESEARCH TECHNIQUE

In the planning of study the investigator attempts to select the method most appropriate to the particular problem under consideration, as the quality of research depends not only on the adequacy of the research design but also on the fruitfulness of the method of study. Descriptive survey method has been adopted in this study to investigate the problems, stress and well-being of adolescents who were joining coaching institutes for admission in professional courses.

A descriptive survey research is directed towards ascertaining the prevailing conditions and this method is essentially a technique for achieving quantitative description of the general characteristics of the group to be studied.

3.2 SAMPLE

Before one proceeds from research settings to collection of data, it becomes necessary to pause for a consideration of sampling. Good results always depend upon a reliable and representative sample. So great care has been taken in the selection of sample. For the present study the sample has been selected as described below.

3.2.1 Population of the study

The population of the study was those adolescents who had joined coaching institutes of Agra for their admission in professional courses.

3.2.2 Selection of the Institutes

First of all a list of coaching centers in Agra was obtained from Joint Director Office (Education) Rakabganj Agra. The list includes 410 registered coaching centers from which 257 placed in Agra. They are different in nature, pattern, type and time schedule. This is a long list of about fifty pages only the first and the last page of this list is placed in Appendix I, to avoid unnecessary bulk to thesis. However the entire list is available with the researcher. Out of the total listed coaching institutes, those institutes which were giving coaching for medical and engineering entrance examination, in all the three subjects that is physics, chemistry, mathematics/biology
under one roof were identified. Such institutes were 18 in number, the list of these 18 institutes placed in Appendix I. From these 18 coaching institutes the researcher randomly selected eight coaching institutes by lottery chit method. The investigator individually met the Director of each coaching institute and obtained permission to collect data from the students of their institutes. One institute was finally dropped from the selected eight institutes due to their unwillingness.

3.2.3 Sample selection criteria

While selecting the respondents for the study, it was decided that only those adolescents would be selected who fulfilled the following criteria: -

• The adolescents between the age ranges of 16 - 19 years were selected.
• The sample comprised of adolescents who had passed their X class and were studying in class XI or XII class.
• The selected subjects were the one who were living in hostels (those living as paying guest or with relatives were not selected).
• Only those adolescents who were taking full time coaching and were neglecting regular school classes were selected in the sample.
• The adolescents of XII class were the ones who had joined coaching from XI standard.

3.2.4 Sampling Technique

The sample is restricted to randomly selected seven coaching institutes of Agra city. It was seen that there were two entry levels in coaching institutes. Class XI entry was addressed as Foundation courses and that of XII class as Fresher courses. In the present study only those students were selected who had joined coaching at foundation level. In each coaching institutes there were two to six batches of XI and XII class in foundation courses. The number of batches depends upon the strength of the coaching institutes. Every class consisted of forty to fifty students. From each coaching institute the researcher selected four batches (two batches from XI class and two from XII class of foundation courses) by lottery chit method. Among these batches the researcher identified those students who fulfilled the selection criteria.
The researcher selected every alternate student among these identified students. The details of data collection are given in Table 3.1.

Table 3.1 Shows the details of data collection

<table>
<thead>
<tr>
<th>Coaching Institutes</th>
<th>Class/ Batch</th>
<th>No. of students enrolled</th>
<th>No. of students fulfilling the selection criteria</th>
<th>No. of students who filled the tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yogesh Mishra Classes</td>
<td>XI 1</td>
<td>50</td>
<td>23</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>XI 2</td>
<td>50</td>
<td>25</td>
<td>12</td>
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<tr>
<td></td>
<td>XII 3</td>
<td>50</td>
<td>21</td>
<td>10</td>
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<tr>
<td></td>
<td>XII 5</td>
<td>50</td>
<td>23</td>
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<tr>
<td>Pie Education</td>
<td>XI 2</td>
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<td>XII 3</td>
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<td>XII 4</td>
<td>48</td>
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<td>XII 6</td>
<td>48</td>
<td>21</td>
<td>10</td>
</tr>
<tr>
<td>Science Centre</td>
<td>XI 1</td>
<td>40</td>
<td>18</td>
<td>9</td>
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<td>XI 3</td>
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<td>Baluni Classes</td>
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<td>Parsdis Classes</td>
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<td>Kota Tutorial</td>
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<td>XI 4</td>
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<td>XII 6</td>
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<tr>
<td>Yash Classes</td>
<td>XI 3</td>
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<td></td>
<td>XII 1</td>
<td>44</td>
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<td>10</td>
</tr>
<tr>
<td></td>
<td>XII 6</td>
<td>43</td>
<td>21</td>
<td>11</td>
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</tbody>
</table>
Though 305 students filled the questionnaires and checklists. Five questionnaires and checklists that were not duly filled were dropped. Hence the study had to be limited to these 300 randomly selected students.

3.2.5 Size of the sample

A sample of 300 adolescent boys and girls between 16 to 19 years of age has been selected as the sample of the study.

3.3 MEASURING TECHNIQUES

In any scientific study the preparation of the tools and techniques largely depends upon the nature of the problem under investigation. While preparing the measuring tools and techniques for acquiring the kind of information required the following criteria have been kept in mind.

- Adequate responses are to be obtained in relation to the problem undertaken.
- Result should be objective.
- Obtained result should be reliable and valid.
- It should be economical in terms of cost and time of completion, easy in scoring and administration.

Keeping in view the above criteria the nature of problem as well as the nature of the kind of information required for the study, questionnaire and checklist technique has been adopted. Self-made questionnaires were used to assess stress and well-being whereas checklist was used to know the problems among adolescents of coaching institutes.

For the present study the investigator prepared the following tools (measures) --

- Adolescent stress questionnaire (ASQ)
- Well-being questionnaire for adolescents (WQA)
- Problem checklist for adolescents (PCA)
3.3.1 Questionnaires for assessment of stress and well-being

Two questionnaires (for stress and well-being) were prepared by the researcher by adopting the following steps:

3.3.1.1 Constructions and planning of questionnaires for stress and well-being

Initially the items were collected from available literature, books, research articles, research journals, projects in the field of human development and psychology, tools, internet, discussion with adolescents and their parents, teachers of coaching institutes and other means of information relevant to the subjects were consulted and reviewed with an endeavor, to get the insight of stress and well-being among adolescent. Such reviews, consultation and interactions gave a deep understanding acquaintance and ground reality of the problem area to the investigator. Thus the items that sounded pertaining to the subjects were collected and listed.

3.3.1.2 Adolescent stress questionnaire

Discussions and literature revealed that adolescents are exposed to stress which could be categorized into self-inflicted stress, peer-inflicted stress and parent-inflicted stress, which have been accepted as components of stress. The questionnaire of stress assessment is based on Bisht Battery of stress, a standardized tool prepared by Bisht (1971). The components of stress with their brief description are mentioned below.

➤ **Self-inflicted stress:** - Self-inflicted stress occurs when one feels forced to speed up, identify or shift direction in one’s behavior or one feels compelled to meet a higher standard of performance. One pushes himself to reach personal standards of excellence.

➤ **Peer inflicted stress:** - The stress exerted by a peer group in encouraging a person to change/improve his attitude, behavior and performance, to conform to the group’s actions, in competition with contemporaries for academic excellence.
Parent inflicted stress: - When parental ambitions and aspirations for the adolescents seem too high to achieve then frustration and anxiety can run rampant and they (adolescent) take it as a pressure on them. Parents pressurize adolescents to improve their performance and remind them of the sacrifices and hardships they are undergoing to give them a bright future.

The investigator framed the statement of the draft questionnaire logically and according to the objectives of the study, which were based on the above described components.

3.3.1.3 Well-being questionnaire for adolescents

This questionnaire was prepared by the investigator to assess the level of well-being among adolescents. Preparation and classification of components of the well-being scale are mainly based on the classification of well-being given by Ryff (1989) and Deiner (1992). To study the well-being of students with a focused approach to facing competitive examinations the following components of well-being were selected for assessment.

- Teaching satisfaction: - Teaching satisfaction refers to the neuro-physiological experience of contentment and being at ease in one’s teaching environment. It includes the perception of being able to comprehend classroom instructions.

- Physical health status: - Physical health status is a general condition of body, mind and vigor.

- Happiness: - Happiness is an emotion in which one experiences feelings ranging from contentment and satisfaction to bliss and intense joy. Happiness results in 'positive emotions' and 'positive activities'.

- Out of home adaptations: - Adjustment in the absence of trustworthy family support and away from home. This can also be termed as absence of homesickness. Homesickness is the distress or impairment caused by an actual or anticipated separation from home. It is characterized by acute longing and preoccupied action with thoughts of home and person there in.

- Recreational activities / interests: - Recreation activities are activities, which are indulged in for refreshing and diverging one’s physical and mental state.
The statements of the draft questionnaire have been framed logically and according to the objectives of the study, which have been based on the above described components.

### 3.3.1.4 Framing questions and preparation of draft for approval by experts

On the basis of areas determined and identification of components, various questions and statements were framed and categorized. In framing the items of the questionnaire, care was taken that the questions were clear, easily communicable, easy in language, short and unambiguous in nature. The questionnaires were prepared in English and contained 46 and 75 items respectively for stress and well-being questionnaire. These questionnaires have three options. Every question has to be replied by ticking any one option out of three options which were yes, uncertain and no. Both the questionnaires are self-administered and close ended type. The questionnaires have been designed in such a manner that relevant information could be derived through minimum quarries in minimum time, so that the objectives of the study are achieved.

### 3.3.1.5 Editing the statements

The purpose of scrutinizing the statements of both the questionnaires was –

- To revise or eliminate the ambiguous items.
- To ensure that the terminology used in the statement and items was consistent with the purpose.
- To ensure that the sense it carried was clear-cut and bold.
- To ensure that it was precise and clear in language and directly stated.

In editing the collected items and statements the help of experts in the field of Education, Home Science and Psychology was taken.
3.3.1.6 Pilot study (the first tryout of the questionnaires)

Based on the objectives of the study, preliminary questionnaires were prepared for the adolescents. To determine whether the data collected through questionnaires would warrant conclusions significant for the purpose of the study, a pretest was conducted on adolescent pupils. Under the direct supervision of the investigator eighty students of the XI and XII class (forty from each class) who have joined coaching institutes were asked to fill the questionnaires. In the light of their responses the final questionnaires were decided.

3.3.1.7 Final draft of the questionnaires

On the basis of result of pilot study modifications were done in questionnaires under the supervision of the guide. Each item was discussed, improved, and then approved, corrected or rejected. Finally some items were dropped which were of ambiguous nature. Ultimately 30 items of stress questionnaire and 50 items of well-being questionnaire were retained. These pre-tested questionnaires were finally developed to collect information from the respective sample. The details of the questions given in each sub section of the two questionnaires are given in table 3.2.

While printing the final draft of the questionnaires, care was taken that questionnaires were attractive in format, as well as in printing. It was ensured that it had proper and sufficient space for giving the appropriate answer. Care was also taken about the legibility and clarity and the size of the printed letters, such that it was easy to read.
Table 3.2 Shows the number of questions in initial and final draft of the questionnaires.

<table>
<thead>
<tr>
<th>Adolescent Stress Questionnaire (ASQ)</th>
<th>Number of Question</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial Draft</td>
</tr>
<tr>
<td>a. Self-inflicted Stress</td>
<td>17</td>
</tr>
<tr>
<td>b. Peer inflicted Stress</td>
<td>14</td>
</tr>
<tr>
<td>c. Parent inflicted Stress</td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well-Being Questionnaire for Adolescent (WQA)</th>
<th>Number of Question</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial Draft</td>
</tr>
<tr>
<td>a. Out of Home Adaptation</td>
<td>16</td>
</tr>
<tr>
<td>b. Happiness</td>
<td>13</td>
</tr>
<tr>
<td>c. Physical Health Status</td>
<td>17</td>
</tr>
<tr>
<td>d. Teaching Satisfaction</td>
<td>16</td>
</tr>
<tr>
<td>e. Recreational Activities</td>
<td>13</td>
</tr>
</tbody>
</table>

3.3.1.8 Reliability and validity of the questionnaires

Reliability means consistency in test scores and validity of test means that the test measures accurately for which it is made. Reliability and Validity of stress scale were .83 and .91 respectively. Reliability and Validity of well-being scale were .75 and .87 respectively.

3.3.1.9 Scoring procedure

For the different section of the questionnaires following procedure was adopted for the scoring of various items.

3.3.1.9.1 Scoring of adolescent stress questionnaire

Three option were used for assessing the stress among adolescent thus for, yes, uncertain and no the weighted score 3, 2, 1 was assigned respectively. The negative
items of the questionnaire were scored 1, 2, 3 (item no.1 of the ‘a’ section is negative item). The highest and lowest possible scores of stress were 90 and 30 respectively. (Prepared questionnaire is placed in Appendix II).

3.3.1.9.2 Scoring of the well-being questionnaire for adolescents

Scoring was done on a three options of the scale. The options are yes, uncertain and no, the weighted scores were 1, 2, and 3 respectively. The score for negative items have reserve scoring with the sequence of 3, 2, 1 (item no.1, 2, 3 of ‘b’ section and item no. 2, 3, 4 & 9 of the ‘d’ section are negative items). The highest and lowest possible scores of well-being questionnaire were 120 and 40 respectively.

In the fifth section of well-being which deals with recreational activities comparison between boys and girls was done on all the assessed criteria of recreation and percentages were calculated for seven criteria of recreation, namely listening to music, playing game on mobile phone, relaxing in park, exercising, participating in active games, adequacy of means of entertainment and number of movies seen between last two tests. Multiple responses were obtained for assessing the recreation through different uses of computer (chatting, playing game, surfing and listening music). Two questions of this section were open ended (question number 7 and 8). These questions obtained information regarding possessed recreational equipments and magazines and newspaper reading.

On the basis of the responses recreational equipment were categories as music system, television, cell phone, out door games, indoor games, light reading, radio, others and none. Magazines were classified in five categories namely educational, political, sports, children, literary and others. Non readers of magazines and newspaper were also identified. (Prepared questionnaire is placed in Appendix II).

3.3.3 Problem checklist for adolescents

This was prepared by the investigator in order to assess problems of adolescents. Problem checklist makes it easy to obtain information about adolescents accurately and has been used for keeping track of specific problem. The prepared checklist was based on the problem checklist for adolescent’s by Pandey & Joshi.
Informal visits to coaching institutes, discussion with experts, various current issues from newspaper and Internet helped in constructing the checklist. The problem checklist has focused on four broad categories of problems which are-

- **Academic problems**: Academic problems encountered when student is motivated to reach a goal but is blocked by some academic obstacles i.e. academic settings, poor performance, tutors, teaching pattern, tough competition, tutorials and course content etc.

- **Psycho-emotional problems**: Those problems which were exerted by the society and affect the mental, emotional and physical state of an organism.

- **Peer and living condition related problems**: Peer problems occur when a person is not compatible with the peer he associates with. Similarly inability to adjust to the living environment gives rise to the living problem.

- **Food and financial problems**: Dislike/non acceptance of the served meals account for food problems. The problems that occur due to limited availability of finances account for financial problems.

The checklist was framed according to the objectives of the study, which have been based on the above described components.

### 3.3.3.1 Construction of the checklist

In the present study following steps were adopted for preparing the checklist.

### 3.3.3.2 Planning the checklist

While planning the checklist utmost care was taken to ensure that the objectives of the study are achieved. The checklist has been designed in such a manner that relevant information can be derived through minimum quarries and minimum time.

### 3.3.3.3 Determination of areas for different sections of the checklist

The general information of the previous questionnaires was used in the checklist. It was decided to seek information regarding the prevalence of problem. The adolescents who were living away from home face these problems. The checklist
attempts to identify different type of problems which may be academic problems, psycho-emotional problems, problems with roommates and friends, financial problem, affective problem, food related problems and problem with the living condition. In coaching institutes the adolescents have to develop a study routine which is drastically different from the one they have followed in the last ten years which result in academics problems. Due to future uncertainties an adolescent seem not to have any control over the situation and faces some psycho-emotional problem. Adolescents may have to share his room with the person who is not a family member for which they are unaccustomed. A lot of things that were done for him by his parents are now handled by him all these results in problem among adolescents.

3.3.3.4 Collection of items and statements

Informal meetings with adolescent, books, newspaper, research articles, research journals, internet, discussions with the experts and supervisor helped in constructing the check list and collecting all that which sounded pertaining to the subjects. In order to form some idea about the problems of the students of coaching institutes, few informal discussion were done. An idea was given to them about the nature of the information that was to be sought from them. On the basis of the discussion the following areas of problems emerged-a) Academic b) Psycho-emotional c) Peer and living condition related d) Food and financial.

3.3.3.5 Framing statements and preparation of draft for approval by experts

On the basis of identification of problem areas various statements were framed and categorized by investigator. These statements were framed in English and contained 75 items. Problem has to be replied by ticking on statements. This checklist is self-administrated and close-ended type. In framing the item of the checklist care was taken that statement should be unambiguous, brief and easy to understand in meaning and language.
3.3.3.6 Editing of the statements

The purpose of editing the statements was given in previous section 3.3.1.5.

In editing the final draft the help of experts in the field of Education, Home Science and Psychology was taken. After consistent scrutiny of the statements checklist was finally drafted with 55 statements. The section wise distribution of items in the checklist is given in table 3.3.

Table 3.3 Shows the number of items in the initial and final draft of the problem checklist

<table>
<thead>
<tr>
<th>S.O.</th>
<th>Sub-Sections</th>
<th>Number of Questions</th>
<th>Initial Draft</th>
<th>Final Draft</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Academic Problems</td>
<td></td>
<td>27</td>
<td>21</td>
</tr>
<tr>
<td>b.</td>
<td>Psycho-Emotional Problems</td>
<td></td>
<td>19</td>
<td>13</td>
</tr>
<tr>
<td>c.</td>
<td>Peer and Living Condition Related Problems</td>
<td></td>
<td>16</td>
<td>10</td>
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<tr>
<td>d.</td>
<td>Food and Financial Problems</td>
<td></td>
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</tbody>
</table>

3.3.3.7 Pilot study

The pilot study was done on eighty adolescent who had joined coaching institutes for admission in medical and engineering. On the basis of pilot study certain modifications were made.

3.3.3.8 Reliability and validity of the checklist

Reliability and Validity of the checklist was 0.77 and 0.88 respectively.
3.3.3.9 Scoring of the checklist

A score of one was given for the presence of the problem and score of zero was given for the absence of problem. Thus the highest score, which the subject can obtain on problem check list is 55. (Prepared questionnaire is placed in Appendix II).

3.4 DATA COLLECTION

Data was collected through questionnaires and checklist. The adolescents who were attending coaching institutes filled both questionnaires and checklist. After explaining the nature of the study, permission was taken from the Directors of each of the selected coaching institutes. At the pre decided time and date in small group of size ranging 15 – 20 students questionnaires and checklist were administered.

On the appointed day, the questionnaires and checklist were distributed to the students. The aim of the research was explained to them and they were asked to fill the inventories without consulting each other. For most of the students filling up a questionnaire was a new experience. It was made clear to them that it was not an examination and there were no right and wrong answers and they are free to write and tick whatever they felt was true for them. They were asked not to write their name on the questionnaire to assure them of their anonymity and get correct responses.

3.4.1 Difficulties in data collection

The investigator faced the following difficulties during data collection.

- District authorities were reluctant to give the list of coaching institutes of Agra.
- Identification and physical verification of coaching institutes were required to identify the institutes that fell in two categories (preparing students only for medical or engineering entrance examination and giving coaching of all the three subjects i.e. physics, chemistry mathematics/biology under one roof).
- A total number of 135 responses were required for filling up the questionnaires and checklist; it was not possible to get responses on all the
items in one setting so the researcher had to make repeated visits to the coaching institutes.

- Adolescents were not easily available for data collection as at times they were busy with classes and tests.
- Also at times data collection was postponed because of the upcoming examination series of the students.

3.5 STATISTICAL TECHNIQUES

The collected data were coded tabulated and analyzed using various statistical techniques; the statistical tests were used to know the relationship between dependent and independent variables among the various group of study.

1. Percentage

Comparisons were made on the basis of the percentage. For drawing the percentage the frequency of a particular cell was multiplied by 100 and divide by total number of the respondents in that particular category to which they belonged.

\[
\text{Percentage} = \frac{X_i}{\Sigma X_i} \times 100
\]

Where,

- \(X_i\) = obtained score
- \(\Sigma X_i\) = Total score

2. Arithmetic Mean

Arithmetic mean is the average used in the present study. Arithmetic mean of a serious, if the figure obtained by dividing total value of various items by their number.

\[
\bar{X} = \frac{\Sigma X}{n}
\]
Where:

\[ \overline{X} = \text{Arithmetic mean} \]
\[ \Sigma X = \text{Sum of scores} \]
\[ n = \text{Number of cases} \]

3. Standard Deviation

It is usually denoted by letter \( \sigma \) (small sigma) of Greek alphabet and is a measure of dispersion. Standard deviation is the square root of the arithmetic mean (average) of the squares of the deviations measured from the mean or assumed mean.

\[ \sigma = \sqrt{\frac{(\Sigma fu^2 - (\Sigma fu)^2/n)}{(n-1)}} \]

Where:-

\( \sigma \) = Standard Deviation

\( \Sigma fu^2 \) = Sum of the product of frequency and square of deviation from assumed mean

\( \Sigma fu \) = Sum of the product of frequency and deviation from assumed mean

\( n \) = Number of observations

\( i \) = Class interval

4. Test of significance

t-test can be expressed as-

\[ t = \frac{\overline{X}_1 - \overline{X}_2}{\text{C.S.E.}} \]

Where- \( \overline{X}_1 \) and \( \overline{X}_2 \) the means of the first and second group.

C.S.E. means combined standard error. It is calculated by the following formula-

\[ \text{C.S.E.} = \text{C.S.D.} \sqrt{\frac{1}{n_1} + \frac{1}{n_2}} \]
Where \( n_1 \) and \( n_2 \) are the number of observations in the first and second group respectively.

C.S.D. is the combined standard deviation. It is calculated by the following formula:

\[
C.S.D. = \sqrt{\frac{(n_1 - 1)\sigma_1^2 + (n_2 - 1)\sigma_2^2}{n_1 + n_2 - 2}} \quad \text{if} \quad n_1 \leq 30
\]
\[
C.S.D. = \sqrt{\frac{n_1\sigma_1^2 + (n_2 - 1)\sigma_2^2}{n_1 + n_2 - 1}} \quad \text{if} \quad n_1 > 30
\]
\[
C.S.D. = \sqrt{\frac{(n_1 - 1)\sigma_1^2 + n_2\sigma_2^2}{n_1 + n_2 - 2}} \quad \text{if} \quad n_1 \leq 30
\]
\[
C.S.D. = \sqrt{\frac{n_1\sigma_1^2 + n_2\sigma_2^2}{n_1 + n_2}} \quad \text{if} \quad n_1 > 30
\]
\[
C.S.E. = \sqrt{\frac{\sigma_1^2 + \sigma_2^2}{n}}
\]

\( \sigma_1 \) and \( \sigma_2 \) are standard deviations of the first and second group respectively.

5. Correlation coefficient (r)

A mathematical method of measuring the intensity and magnitude of the linear relationship between two variables of the series, suggested by Karl Pearson (1936). The coefficient of correlation or the product moment correlation is calculated by the following formula:

\[
r = \frac{n\Sigma \Sigma u v - \Sigma u \Sigma v}{\sqrt{[n\Sigma u^2 - (\Sigma u)^2][n\Sigma v^2 - (\Sigma v)^2]}}
\]
Where:

\[ r \quad = \quad \text{Correlation coefficient} \]
\[ n \quad = \quad \text{Number of observations} \]
\[ \sum \sum f_{uv} \quad = \quad \text{Sum of the product of deviation of x and y variables with their frequency} \]
\[ \sum f_u \quad = \quad \text{Sum of the product of deviation of x variable with the frequency} \]
\[ \sum f_v \quad = \quad \text{Sum of the product of deviation of y variable with the frequency} \]
\[ \sum f_{u}^2 \quad = \quad \text{Sum of the product of squares of deviation of y variable with the frequency} \]
\[ \sum f_{v}^2 \quad = \quad \text{Sum of the product of squares of deviation of x variable with the frequency} \]

6. Formula for testing correlation coefficient by t-test

\[ t = r \sqrt{\frac{n - 2}{1 - r^2}} \]

\[ n \quad = \quad \text{Number of observation} \]
\[ r \quad = \quad \text{Correlation coefficient} \]

7. Chi-Square test \((X^2)\)

The chi square is one of the simplest and most widely used nonparametric test in statistical work. The quantity of \(X^2\) describes the magnitude of the discrepancy between theory and observation. It is calculated as-

\[ X^2 = \sum \frac{(O - E)^2}{E} \]

Where:

\[ O \quad = \quad \text{Observed frequencies} \]
\[ E \quad = \quad \text{Expected frequencies} \]
Expected Frequency (E) = \frac{\text{Sum of rows} \times \text{sum of columns}}{\text{Total observation}}

7. Quartile

Q_i = i \left( \frac{n + 1}{4} \right)^{\text{th}}

Where,

i = 1, 2, 3