CHAPTER 3
RESEARCH METHODOLOGY

3.1 INTRODUCTION
Research implies the study & exploring knowledge to get the new ideas. Research methodology is a way of solving the research problem systematically. Research Method & Research Methodology, these are two different but related terms. Research Method is a part of Research methodology.

The scope of Research Methodology as defined by Kotler\(^1\) “When we talk of research methodology, we not only talk of research methods but also consider the logic behind the methods we use in the context of our research study. We should explain why we are using a particular method or technique and why we are not using others so that research results are capable of being evaluated either by the researcher himself or by others.”

This says that the research design depends upon some common design questions like what to study, why to study, where to study & what type of data is required. The need is to follow the systematic step-by-step approach to solve a research problem.

As pointed out by Rozakis that “Before you begin your research, I recommend that you draft a working outline”.\(^2\)

Every research must start with a predefined & clear-cut objective. This requires that research objective should be defined clearly & planning should be done to get the answers to what, why & where type questions.
Research objective falls into following categories:\(^3\):

a) **Exploratory or Formulative research studies** – To achieve new insights of a concept.

b) **Descriptive research studies** – To analyze characteristics of something.

c) **Diagnostic research studies** – To determine the frequency with which something occurs.

d) **Hypothesis testing research studies (experimentation research)** – To test the relationship between variables (Correlational research)

Types of Research\(^3\):

a) Descriptive research & Analytical Research

b) Applied Research & Fundamental Research

c) Quantitative Research & Qualitative Research

d) Conceptual Research & Empirical Research

e) Other research categories – Simulative Research, Laboratory Research, Historical research, One Time Research, Longitudinal Research etc.

**Descriptive Research** – It include survey & fact-finding enquiries of different kinds. Here researcher has no control over variables. The researcher only reports that what has happened & what are happening. Only method suitable for this research is **Survey Method**.

**Analytical Research** – Such type of research uses the available information as the base to make the further critical evaluation.

**Applied Research** – Applied research implies for the action research. This research is intended for finding some solution to the problem.

**Fundamental Research** – As its name indicate this type of research is made for performing the basic or pure research. It is a theoretical research.
Quantitative Research is based on the measurement of some quantity or amount. This can be done by i) Inferential Experimental approach or ii) Simulation Approach.

Qualitative Research is concerned with the quality phenomenon.

Conceptual Research is related to some idea or theory or concept.

Empirical Research is based on experience or observation. It is data base research also called as Experimental Research. Here the researcher has full control over variables under study. A best way is to test the given hypothesis.

The researcher has used the Qualitative Research approach with Hypothesis testing research study to test the relationship between mobile service parameter variables from customer perception and their association with Overall Customer Satisfaction of mobile services.

3.2 OBJECTIVES OF THE STUDY

Service quality plays an important role in the growth of any service industry. Today’s customer is more keen & aware of quality. The customer satisfaction is directly related with the service quality whose main aim is to fulfill the customer need from customer perspective. A thorough & complete understanding of users requirement is the prime need to reduce the gap between service provider & customer.

Outcome of this Research will be beneficial to mobile service providers as well as government organization to understand service quality parameters from customer perception & expectation point of view. This may help to update the set benchmarks & so can improve the satisfaction level. Usually service is defined with what is to be delivered
& how it is delivered to customer. **What is to be delivered referred as technical quality and how that service is delivered to user is referred as functional quality**\(^4\).

Figure 3.1 shows that the customer perception towards what is delivered and how the service is delivered may differ from person to person, and customer perception may change from person to person.

![Customer Perception diagram](image)

**Fig. 3.1 : Customer Perception affecting Service Quality & so Service Satisfaction**

The **researcher** has incorporated the customer expectations regarding the mobile service quality.
The hypothesis of study is concentrated on the impact of mobile service parameters like:

**Network coverage, Billing services, Customer-care, Call drop, and Value Added Services on customer satisfaction.**

### 3.2.1 MAIN OBJECTIVES

The main objective of this research study is to identify the association of service quality parameters with overall customer satisfaction and highlight the pain areas to increase the satisfaction level in and around Pune and Pimpri Chinchwad area.

Two Main Objectives of study are:

- To find the impact of customer service parameters on customer satisfaction.

- To Develop a Customer Service Metric based Customer Satisfaction Index.

Study is done to reveal the main service quality parameters for cellular service from customer perspective & tries to find the association of five service parameters under study with the overall customer satisfaction.

### 3.2.1.1 SUB-OBJECTIVES

To understand the association of five service parameters with the customer satisfaction and to calculate the overall customer satisfaction index following sub objectives are formulated:

- To find out the association of network coverage on customer satisfaction
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- To find out the association of Billing services on customer satisfaction
- To find out the association of customer care on customer satisfaction
- To find out the association of call drop on customer satisfaction
- To find out the association of value added services on customer satisfaction
- To propose the Customer Satisfaction Index for mobile services

3.2.2 HYPOTHESIS OF STUDY

Hypothesis is usually concerned as the prime research instrument. It helps to suggest new findings & experimental observations. Hypothesis testing can help the decision makers of society & organization to get the real scenario of problem & corresponding probable solutions so that they can take the appropriate decisions. Based on above objectives & sub objectives the researcher has designed the hypothesis.

Main hypothesis of study

\[ H : \text{There is a positive association between Quality of Service parameters and the customer satisfaction.} \]

Sub hypothesis are:

\[ H1 : \text{There is a positive association of Network Coverage with Customer Satisfaction.} \]
\[ H2 : \text{There is a positive association of Billing Services of mobile with the customer satisfaction.} \]
\[ H3 : \text{There is a positive association of Customer Care of mobile services with the customer satisfaction.} \]
H4 : There is a negative association of Call Drop with customer satisfaction.

H5 : Value Added services has a neutral association with customer satisfaction.

The researcher has got satisfaction ratings after analyzing the customer response. These observed ratings are compared with the set benchmark as given by the TRAI. A customer satisfaction metrics has also been designed after understanding & incorporating the Customer responses. This will help the service provider to understand the real pain areas i.e. the major areas where they have to improve in order to raise the overall Customer Satisfaction Index.

3.3 RESEARCH METHODOLOGY

Getting quality is the key concern in today’s competitive world. With e-savvy customers & increasing number of service providers, it has become a tough challenge to service organizations in retaining the number of customers. In order to explore the customer perception & to maintain the service quality standard this research work is conducted.

In this research work the data is gathered through the sources of primary & secondary data collection strategies. A survey method is used in this study, to explore the key points, which are required to be considered while measuring the customer satisfaction. Questionnaire is prepared covering the five major service parameters considered by the researcher in her research study.

Researcher has conducted a survey on several Quality of Service parameters from customer perspective and build the customer service
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metrics to improve the reliability, performance and quality of mobile services after incorporating the voice of customer. With the collected data through survey the gap analysis has been done between the set benchmarks and actual services which customer receives (from customer’s perspective). Based on Customer Service Metrics for Mobile services the researcher has calculated the Customer Satisfaction Index. The study focuses on five basic service parameters from customer’s expectation point of view, which are: Network connectivity, call drops, Value Added Services, Billing information & customer care. Questionnaire is prepared covering all these parameters. Survey is conducted with these questionnaires from customers belonging to different service providers in and around Pune & Pimpri-Chinchwad area.

Likert scale is used as the measurement scale. Likert Scale is a rating scale used for measuring the strength of respondent agreement with a clear statement on five point ratings. Customer satisfaction measurement is done in this research using Likert scaling technique. For this customer survey has done on the five-point scale: Highly satisfied, Satisfied, Neutral, Dissatisfied, Highly dissatisfied. Positive & negative questions are categorized so that proper weights can be assigned. Respective weights are assigned to positive & negative rated questions. Using multiple regression base model the association of dependent variable with independent variable is found. Here the overall customer satisfaction is considered as the dependent variable and five service parameters i.e. Network coverage, Customer Care, Billing, Call Drop & Value Added Service are considered as five independent variables. Finally the Overall Satisfaction Index is
calculated using Multiple Regression Model. Customer Service Metrics is designed after incorporating the ratings as given by respondents.

Microsoft Excel & SPSS is used as statistical software tools for data analysis.

### 3.3.1 STAGES OF RESEARCH PROCESS

Following were the steps covered during the entire research process while studying the mobile services from customer perspective:

- **Topic Formulation**
- **Designing Objective & Hypothesis**
- **Gathering the Data**
- **Analysis of Data**

Analysis of data include following stages:

- Factor analysis is done on different questions to get the major factors. Which gives Network coverage, Billing, After Sales Service, Value Added Services & call drop as five major factors affecting service quality.
- Positive & Negative questions are identified & accordingly weightage is assigned to every response as given by the respondent.
- Using multiple regression base model the Index is calculated.
- Chi square test is used for hypothesis testing.

The structured questionnaire method and interview is used to collect the primary data. The parameters of questionnaire under survey are
selected with the help of secondary data, which include the yearly press releases of TRAI\textsuperscript{5} and earlier research done on similar track for all over India by Voice of India.

### 3.4 COLLECTION OF DATA

In order to have the accuracy, this study has gathered the desired data through Primary & Secondary sources of data. Primary data is taken directly from the users. Published articles, paper and other related information on net, journal, and magazine are taken as secondary source. As defined by Anderson & Arsenault

“The primary source of data is one where the person providing the data is actually present whereas a secondary data source is one where the data comes from one who is not present at the time when that data was collected.”\textsuperscript{6}

#### 3.4.1 COLLECTION OF PRIMARY DATA

Primary Data is concerned with the crucial data, which is directly given by respondents on first hand. A primary source is a source of information, which is gathered at the time of study directly from the information provider. Here the primary doesn’t mean the superior data, but it refers to the data created by the direct stakeholders of the study. In this research study the direct stakeholders of survey are mobile subscribers. They are the primary source for this study. The researcher has interviewed 568 mobile users for gathering the primary data for this study.
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- **Primary Source:**
  Data was gathered by researcher using questionnaire and by interviewing variety of customers directly. This direct input, in form of customer voice has brought in the conceptual clarity.

Benchmark values are collected from the records of several circulars issued by TRAI.

### 3.4.1.1 OBSERVATION METHOD

Observation is one of the powerful ways of collecting the primary data. Data can be gathered through observation by watching the behavior of phenomenon carefully. The meaningful information is extracted after listening to the respondent. Through the observation in the study of cellular mobile service satisfaction the researcher has observed that the customer expectation differs from person to person with respect to age, gender & profession. The researcher has also observed that the customer is more interested in better network coverage with prompt service from the customer care and minimum billing charges.

Two types of observations are there: **Participants observation & Non-Participants observation.** In case of non-participant observation the researcher remains a passive observer and do not get involved in the observation activity. In Participants observation, the researcher is also involved as a part of observation process along with other group members. **In this study the researcher herself has observed the reactions of cell users as being one of the subscriber.**

Observation method despite of its simplicity for getting the primary data has certain limitations. The observed information may not represent their normal behavior. Observation method may not provide the reliable
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information in Hawthorne Effect. When a change in the behavior of persons is being attributed to their being observed then it is known as “Hawthorne Effect”. A biased observer may not provide the correct information. Since the observer may differ in perception & so the extracted information through observation for similar situation may differ from observer to observer.

3.4.1.2 INTERVIEW METHOD

Interview technique is used to gather the information directly from people by asking them some suitable questions. With this the researcher collects several facts from people by interacting with them either through structured way or unstructured way. This involves one to one interaction between the interviewer & interviewee. The researcher has collected the primary data for the study of mobile services by interacting one to one with several mobile service users in and around Pune and Pimpri-Chinchwad area. This has gathered the customer voice with reference to their perception regarding the service quality. Advantage of interviewing technique is that here both the interviewer & interviewee have the freedom to formulate the question & to specify the facts respectively.

3.4.1.3 QUESTIONNAIRE METHOD

Questionnaire is a list of questions related to the research problem. Number of questionnaire consisting of a series of questions related to mobile phone service quality parameters were distributed among different respondents.

3.4.2 COLLECTION OF SECONDARY DATA

Secondary source of data is defined as that data which has already been collected by some one else and published or defined somewhere
else. During the research study if the researcher is extracting the desired information from that source for the purpose of study then, such source is referred as the secondary source of data. Researcher has referred several secondary source during the study which are enlisted below:

- **Secondary Source**:
  
  Secondary source of data used by researcher includes: published articles, research papers, published books, different research work done previously, relevant papers or journals, magazine etc. Researcher has done discussions on various discussion forums, and also used other different types of reports from Internet sites and blog sites.

The gathered secondary sources of data mainly grouped into following categories:

### 3.4.2.1 Government Publications:

- Various Press Releases by Telecom Regulatory Authority of India.
- Statistical Data of Subscribers on COAI, Cellular Operators Association in India

### 3.4.2.2 Earlier Research

- Yearly survey conducted by the cyber media publication through JuxtConsult, on user satisfaction.\(^8\)
- Various survey conducted by service providers on customer satisfaction through J. D Power and Associates.\(^9\)
- Court Employee satisfaction by National Center for State Court.\(^10\)

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- Mobile user satisfaction research in Canada.\textsuperscript{11}
- Measurement of Customer Satisfaction in Banking Industry.\textsuperscript{12}
- Measurement of Customer Satisfaction Index of Bank in Korea.\textsuperscript{13}

3.5 RELIABILITY & VALIDITY OF QUESTIONNAIRE

As per the IEEE definition of Reliability : “A scale or test is reliable to the extent that repeat measurements, made by it under constant conditions will give the same result”.

As per IEEE the Reliability is defined as the ability of a system or a component to perform its required function(s) consistently for a specified period of time. The researcher has ensured the reliability of gathered information for the research study by considering some questions like :

- Who are the respondents (With respect to Age, Profession, Gender)?,
- When the information was taken?,
- Is there any consistency of collected data through different sources?,
- What were the sources (primary & secondary) of considering the basic service quality parameters?

“Validity means the success of the scale in measuring what it sets out to measure, so that differences between individual’s scores can be taken as representing true differences in the characteristic under study.”\textsuperscript{14}
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The **Validity** of data depends upon the reliability of data. As defined by Cohen and Swerdlik in statistical term “The validity coefficient is (always) less than or equal to the square root of the test’s reliability coefficient multiplied by the square root of the criterion’s reliability coefficient.”\(^{15}\)

The result of research study is powerful and valid if it gives the same result with repetitive measurements. With this the validity of research emerges. The process or system will be unreliable if the repeated measurement gives different result.

### 3.6 QUESTIONNAIRE DESIGNING

Questionnaire was designed with positive & negative questions according to which weights were assigned to these questions on 5-point weight scale. Likert scaling was used while formulating the questions on service satisfaction & service quality with attributes as highly satisfied, satisfied, neutral, dissatisfied & highly dissatisfied or very good, good, neutral, poor, very poor.

Entire questionnaire was classified into six parts. The part 1 was covering the general questions related to the demographic details, profession, factors while selecting the cellular service & other details.

Part 2, 3, 4, 5 & 6 of questionnaire were for the five different service parameters. Questions related to Network Coverage of mobile phone service were covered in part 2. Part 3 of questionnaire was having the questions like billing information & billing services. Part 4 was designed using the questions related to the customer care services like control on
unwanted messages, activation, complaints handling. Part 5 was based on call drop frequency & part 6 of questionnaire was associated with Value Added Services.

3.7 PROFILE OF THE RESEARCH

The research study group includes all the customers who are currently availing the mobile phone services. The subscribers availing services of Idea, AirTel, Hutch, Reliance, BSNL and Tata indicom belonging to Pune & Pimpri-Chinchwad region are included in this survey. The group consists of both the genders i.e. male & female. Customers were selected belonging to students, businessmen, unemployed persons, corporate employees and Government employees. The researcher interviewed them individually & questionnaires on mobile service satisfaction were filled.

3.8 VARIABLES OF THE STUDY

Variable is some concept that can be measured. As defined by Kerlinger: “A variable is a property that takes on different values. Putting it redundantly, a variable is something that varies. A variable is a symbol to which numerals or values are attached.”16

As defined by Black & Champion “ Variable is a rational units of analysis that can assume any one of a number of a designated sets of values.”17

As per Ranjit Kumar “ Variable is an image, perception or concept that is capable of measurement and hence capable of taking on different values.”18
Variables need to be understood clearly in order to measure any concept. The research study covers different types of variables related to service quality parameters. These variables are classified into three broad categories:

A] Dependent Variables
B] Independent Variables
C] Intervening Variables / Extraneous Variables

A] Dependent Variables
These are the effect variables whose value depends upon some causal characteristics. In the research study of Mobile Services from Customer’s Perception, the **Customer Satisfaction** is defined as the **dependent variable**. This customer satisfaction level depends upon several factors including customer perception. Dependent variable can be measured with the help of Independent Variables & Extraneous Variables.

B] Independent Variables
These are the variables, which are responsible for bringing out any changes on the dependent variable. The mobile service satisfaction is a dependent variable and is affected by several service attributes. Following are the major service areas, which affects the customer satisfaction and so considered as independent variable in study:


3. Customer Care : After Sales Service, Activation time, Complaints Handling Mechanism, Unwanted messages.


5. Value Added Services : VAS Satisfaction, VAS related Problems.

These independent variables are used during mobile services study from customer perspective, for the calculation of satisfaction score.

C] Intervening Variables / Extraneous Variables
To measure the relationship of dependent variable with independent variables many times we have to measure some independent variables, which may affect the relationship positively or negatively. Such variables are called as Intervening & Extraneous variables. When it becomes mandatory to measure such variables to establish the relationship then they are called as Intervening variables. To measure the satisfaction against the network service, billing services, Customer Care, Call drop & Value Added services which are independent variables, it is mandatory to measure the network connectivity, network problem, network coverage, call charges, billing updates, activation time, help extended to resolve various complaints, frequency of call drop, call drop within & outside region, problem in using value added services. Such
variables, which need to be measured to show the relationship between dependent & independent variables, are called as **Intervening variables**.

**Extraneous variables** are those variables, which may affect the dependent variable. Such variables may not cause any change directly to the dependent variable but if measured can give some effect on the dependent variable. The customer perception is an extraneous variable which if considered may cause changes to the customer satisfaction level for mobile services. Perception is dynamic and changes from person to person. Various extraneous variables, related to the mobile service satisfaction and perception, are considered during the research study. These are:

- Age of Mobile user (Perception may differ with age).
- Profession of mobile user
- Duration of using the mobile a day
- Money spent on mobile service per month
- Use of Service cared (Prepaid or Postpaid)
- Gender of mobile user
- Type of mobile service
- Frequency of availing the value added service
- Factor while selecting the mobile service

These extraneous variables may affect the relationship between the mobile service quality & service satisfaction from customer perception. A demographic variable belongs to extraneous type of variable.
3.9 SAMPLE DESIGNING

Sample designing is a systematic plan for gathering the desired sample from the given universe. The research study has considered the Pune and Pimpri-Chinchwad geographic location as the universe for gathering the desired sample.

3.9.1 SAMPLE SIZE

Sample size refers to the number of data to be gathered for the research study from the given population. The research study was covering a universe with infinite population and so the sample size was calculated through the pilot survey. A pilot study was conducted on 200 customers to get the value of standard deviation. Then with 95% of confidence level the sample size is calculated.

To calculate the sample size \( n \) for a population following formula is used. If we know the standard deviation \( \sigma \) with an error no greater than \('e'\) by calculating a confidence interval with confidence corresponding to \( z \), then the necessary sample size \( n \) will be:

\[
\frac{z^2 \times \sigma^2}{e^2}
\]

Fig. 3.2 : Formula for sample size calculation

By carrying out a pilot study on 200 customers the standard deviation \( \sigma \) value was calculated.

\[
\sigma = 0.72
\]

With 95% of confidence level the value of \( z \) (from table) is received.

\[
z = 1.960 \text{ (95% confidence level)}
\]
With standard error of .06 the sample size is calculated. The calculated sample size was **560**. The research study has gathered total **575** samples. Valid **568** samples are considered for the data analysis.

### 3.9.2 SELECTING SAMPLING

Every research requires gathering of some sample from the population in order to process the survey. Since the mobile service satisfaction research survey is limited to the Pune & Pimpri-Chinchwad geographic location and so samples are gathered from this location only. Various cellular service providers are having their subscribers in Pune & Pimpri-Chinchwad area. BSNL, Tata Indicomm, Reliance, AirTel, Idea and HutchVoda are the service providers whose subscribers have filled the questionnaire. It has been observed that the BSNL, Idea & AirTel have more number of subscribers in Pune & Pimpri-Chinchwad area compared to the Tata Indicomm, Reliance and Hutch service providers.

<table>
<thead>
<tr>
<th>Service Provider</th>
<th>Sample Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 BSNL</td>
<td>75</td>
<td>13.2%</td>
</tr>
<tr>
<td>2 Idea</td>
<td>173</td>
<td>30.46%</td>
</tr>
<tr>
<td>3 AirTel</td>
<td>187</td>
<td>32.92%</td>
</tr>
<tr>
<td>4 HutchVoda</td>
<td>46</td>
<td>8.10%</td>
</tr>
<tr>
<td>5 Reliance</td>
<td>54</td>
<td>9.51%</td>
</tr>
<tr>
<td>6 Tata Indicomm</td>
<td>33</td>
<td>5.81%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>568</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Based on the survey on all over India conducted by JuxtConsultant minimum 2% of overall sampling data of each service provider is taken into consideration.²⁰
3.9.3 SIMPLE RANDOM SAMPLING METHOD

There are several sampling techniques like: Random Sampling, non-random sampling & mixed sampling techniques. Simple random sampling technique is a sample collection technique, where all elements of the universe are treated equally. In case of random sampling, respondents are picked up randomly from the population. This random selection of respondents could be based on the concept of some random number generator logic.

As stated by McBurney “The basic random sampling is used when we believe that the population is relatively homogeneous with respect to the questions of interest.”\(^{21}\)

As defined by the Fraenckl and Wallen “A simple random model is one in which each and every member of the population has an equal chance of being selected. It is the best way yet advised by human beings for obtaining a sample that is representative of the population from which it has been selected.”\(^{22}\)

The research study uses the mixed sampling technique for gathering the desired sample. Since the number of subscribers is infinite in the specified geographical location under study and so the quota sampling with Simple Random Sampling technique is used. The researcher has considered the Gender & Age as the desired quota for selecting the sample. From the considered quota, samples were gathered by filling the questionnaire after interviewing these mobile users during the period of March 2007 to February 2008.
3.10 STATISTICS OF THE RESEARCH

To complete the research process the use of statistical tools & techniques are required. Statistical tools help in analyzing the data and in drawing conclusions & findings from the gathered data. The large volume of data requires to be coded accurately so that can be read easily as and when required and so can be analyzed effectively. The research study uses several statistical tools mainly, to calculate the sample size with unknown number of population, and to perform the hypothesis testing. Further the research study uses factor analysis to identify the major factors affecting the customer service satisfaction. Finally the multiple regression analysis is used to calculate the service satisfaction Index.

3.10.1 TOOLS USED FOR DATA ANALYSIS

Researcher uses several statistical tools during the data analysis. Since the sample size of study is large and so the Chi Square testing as a statistical tool is used. To prove the hypothesis and to show the major findings the cross tabulation, histograms, diagrams with bar charts are used. For this, the research study uses:

- Computer with software like SPSS 10, and Microsoft Excel.
- SPSS is used for the cross tabulation, chi-square testing, factor analysis, Multiple regression Analysis
- Excel is used to draw several bar graphs & frequency distribution charts & tables.

3.10.2 CHI-SQUARE TEST & CROSS TABULATION

The cross-tabulation is a 2 x 2 table and is used to show the relationship between categorical data. Cross tabulation is used as a basis for performing the Chi-Square test.
“Chi-Square test is used when people have been measured on one categorical independent variable and one categorical dependent variable.”

Chi-Square test is a non-parametric analysis and an important test to perform the hypothesis testing. It is basically used when the sample size is large. It is symbolically written as $\chi^2$.

The Chi-Square statistic is computed by summing up the squared deviations [ Observed value (O) minus Expected value (E) ] divided by the Expected value of each cell.

It can also be used to determine if categorical data shows any dependency or independency Thus, the Chi-Square test is applicable in large number of problems. The researcher uses it mainly for:

- Testing the significance of association between two attributes.
- To perform the hypothesis testing.

Steps involved in applying the Chi-square test are as follows (these are the steps which are used by the researcher during the data analysis to perform the hypothesis testing):

1. Store the data with each variable in one column.
2. Identify positive & negative questions and assign weight (1 to 5 or 5 to 1).
3. Prepare the cross tabulation to calculate the expected frequencies on the basis of the given hypothesis or on the basis of null hypothesis. Usually in case of a 2 x 2 or any contingency
table, the expected figure of any given cell is worked out as under:

**Expected Frequency of Any cell =**

\[ ( \text{Row Total for the Row of that cell} \times \text{Column total for the column of that cell}) / \text{Grand Total} \]

4. Obtain the difference between the Observed and Expected figures and find out the squares of such difference i.e., calculate \((O_{ij} - E_{ij})^2\).

5. Divide the quantity \((O_{ij} - E_{ij})\) obtained as stated above by the corresponding expected frequency to get \((O_{ij} - E_{ij}) / E_{ij}\) and this should be done for all the cell frequencies / figures or the group of frequencies.

6. Find the summation of \((O_{ij} - E_{ij}) / E_{ij}\) values. This is the required \(\chi^2\) value.

Chi-Square test helps the researcher to choose the exact result out of the collected data. This calculated value, when compared with the tabulated value for the calculated degree of freedom and a given confidence level, will help the researcher either to accept or reject the null hypothesis. The following formula is commonly used to calculate “\(\chi^2\) “ value:

\[
\chi^2 = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}}
\]

**Fig. 3.3 : Chi- Square Test Formula**
Where:

\[ O_{ij} : \text{Observed Frequency/figure of the cell in the } i^{th} \text{ row and } j^{th} \text{ column.} \]

\[ E_{ij} : \text{Expected Frequency/figure of the cell in the } i^{th} \text{ row and } j^{th} \text{ column.} \]

**Degree of Freedom:**

\[ df = (c - 1) ( r - 1) \]

where:

\[ c : \text{the number of column.} \]
\[ r : \text{the number of rows.} \]

The \( \chi^2 \) value obtained as such should be compared with relevant table value of \( \chi^2 \). If the calculated value of \( \chi^2 \) is equal to or exceeds the table value for the given confidence level, then the difference between the observed & the expected frequencies/figure is taken as significant, but if the table value is more than the calculated value of \( \chi^2 \) then the difference is considered as insignificant.

**Frequent usage of Cross tabulation:**

1. They are easy to understand. They appeal to people that do not want to use more sophisticated measures.
2. They can be used with any level of data: nominal, ordinal, interval, or ratio. Cross tabs treats all data as if it is nominal.
3. A table can provide greater insight than single statistics.
4. It solves the problem of empty or sparse cells.
5. They are simple to conduct.
3.10.3 FACTOR ANALYSIS

“Factor is a combination of variables whose shared correlations explain a certain amount of the total variance. After rotation factors are designed to demonstrate underlying similarities between groups of variables”.

Factor analysis helps to make the group of related variables & name that group as a factor. Factor refers to some number of variables that correlate with each other in some manner & shares few common characteristics. Factor Analysis is a statistical procedure to extract such factors. It is a way of data reduction to identify the limited number of factors that represents most of the characteristics common in some number of variables to which it is representing as a variable. A factor explains the variance of manifest variables. Four basic steps involved in factor analysis are:

1. Calculate a correlation matrix of all variables used in analysis.
2. Extract factors
3. Rotate Factors to create a more understandable factor structure.
4. Interpret result.

The researcher has taken a number of variables belonging to mobile services while doing the survey & questionnaire was prepared using these variables. Factor analysis was applied to extract the variables. This has extracted the five major factors:

- Network Coverage, Billing Services, Customer Care, Call Drop & Value Added Services.
The researcher uses these five factors as independent variables and calculated their relationship with the Customer Satisfaction of mobile services.

**Fig. 3.4 : Data Reduction through Factor Analysis**

The extracted factors through factor analysis are:

**Factor / Component 1 : Network Connectivity**

Network Satisfaction + Network Coverage + Network range + Connectivity problem
Factor / Component 2: Call Drop
Call drop frequency + call drop within and outside region, partial or complete call drop

Factor / Component 3: Customer Care
Help from service provider, Timely information from customer care, Activation time, Help in controlling the unwanted messages, frequency of receiving unwanted messages.

Factor / Component 4: Billing Services
Call charges, Billing satisfaction, Billing updates

Factor / Component 5: Value Added Services
Different Value Added Services used by the user, frequency of using them, problems while using them, Awareness of VAS.

3.10.4 MULTIPLE REGRESSION ANALYSIS
Regression analysis is a statistical technique used to calculate the dependent variable value using one or more independent variables. When the number of independent variables is more than one then such analysis is known as the Multiple Regression Analysis. \(^{28}\)

The research study calculates the satisfaction score with the help of variance values of independent variables. Multiple regression analysis gives a significant correlation between the mobile customer satisfaction and the network coverage, Billing services, Customer care, Call Drop and Value Added Services. Multiple regression analysis helps to understand that, from the given number of independent variables what all variables are strongly related with dependent variable and who all
are having weak relation. This is calculated through the regression equation. The regression model is prepared using different variables. By using the Enter method following regression equation was found by the researcher:

**Overall Service Satisfaction =**

\[
.00696 + .948 \times Q.18\text{VAS} \\
+ .0257 \times Q.19 + .0274 \times Q.20 \\
- .00399 \times Q.25 - .00891 \times Q.26 \\
+ .00295 \times Q.31 + .0183 \times Q.35 \\
- .0154 \times Q.39 - .0045 \times Q.40 \\
+ .0013 \times Q.41 + .00518 \times Q.42
\]

Where as:

- Q.18 : How do you rate your service provider on account of VAS?
- Q.19 : Rating to the network service of current service provider?
- Q 20 : Satisfied with the connectivity provided by your service provider?
- Q.25 : Are you satisfied with the call charges charged by the operator?
- Q 26 : Happy with the billing service? (Including tariffs of prepaid)
- Q 31 : Satisfied with the After Sales Service given by the company?
- Q 35 : How much time did it take for activation
- Q 39 : Do you face the problem of Call drops frequently?
- Q 40 : What is the frequency of call drop per day?
- Q 41 : Percentage of call drops within region?
- Q 42 : Percentage of call drop outside region?

This shows the positive and negative association of various variables with the overall service satisfaction of mobile services.
3.11 REFERENCES

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