

the message and what medium is used to advertise. The frequency of exposure also decides the ability to recall an ad.

- ii) *Market share*: This is important when a new product is introduced. The following questions are to be answered:
1. Does the new product increase the total sales?
 2. Does it cannibalise any of the existing brands?

21.9 ADVERTISING RESEARCH

Advertising plays a vital role in marketing. It is a paid form of communication. The uses of advertising are many. Some of them are listed below:

1. Advertising provides information about products and services.
2. It induces a customer to go for trial.
3. It stimulates demand.
4. Advertising supports the salesman's effort to sell.
5. It adds value to the brand.

Advertising research basically concentrates on gathering information for making decisions with respect to (1) Generating awareness (2) Brand preference etc.

Advertising research can be classified into three main divisions. They are (1) Advertising message research (2) Advertising media research (3) Advertising evaluation research.

21.10 ADVERTISING MESSAGE RESEARCH

This research deals with "how well the message is conveyed". i.e. "how much is the believability of the message and "how well it is understood". The main test involved in ad message research is 'copy' testing. Copy testing helps the advertisers to present their message in different ways. The term 'copy' refers to verbal message, colour, picture, dramatizations etc. Copy testing can be of two types:

21.10.1 Pre-test

These are tests made before the copy is released. Pre-tests are used to find out any weakness that may be there in the copy, such as head line, illustration or any other. Pre-testing evaluates consumer response to the advertising copy, and also the way message is understood by the customer pre-testing helps to save any loss in ineffective advertisement.

Pre-testing can be done as early as idea generation stage to testing the final version before implementation.

Advertisement pre-testing

The methods used for pre-testing are:

- I. Copy test based on verbal response. Under this, we have
 - a. Consumer jury method
 - b. Portfolio test
 - c. Qualitative research
 - d. On the air test
 - e. Theatre persuasion test.
- II. Copy testing involving physiological responses. Under this, we have: (i) Galvanic skin response (ii) Pupil dilation response (iii) Eye movement tracking.
- III. Copy testing involving behavioural response – Under this, we have in-store persuasion.
 - a. *Consumer jury method:* In this method, the given advertisement is rated by a group of consumers, who represent potential buyers of the product. They rank the advertisement in order of preference based on interest. In this method, the basic assumption is that, the consumer/respondent will like at least one of the advertisements to which he is exposed to. A small questionnaire may be used in the consumer jury test.

Questionnaire:

1. What, according to you, is the purpose of the message?
2. What do you think regarding – how well the message is conveyed?
3. According to you – what impresses you most in this advertisement?
4. Which of the advertisements would you like to see again and again?
5. Which advertisement causes you to take a decision to buy?

A slightly different approach is adapted in case of a TV commercial. The procedure involves exposing the audience to the commercial and record at regular intervals, whether they liked or disliked were in different. The same can be done electronically, using programme analyser.

Limitations:

- a. It is difficult to ensure whether respondents chosen are truly representative of the population targeted.

- b. Individual members with the group may influence one another.
 - c. This method is unsuitable when the number of advertising copies to which the respondents are exposed is large. It will be very difficult to compare, evaluate or rank them.
- b. **Portfolio test:** In this method, the advertisements to be tested are packaged. A group of advertisements, usually six to eight in number is placed in a portfolio. Respondents are given sufficient time to go through the advertisement. After this, the respondents are asked to recall them on an aided or unaided basis. The interviewer may ask questions about the advertisement regarding the products or brands they remember. In case they are unable recall, the portfolio is again given back to the respondent. The interviewer may ask additional questions on the reaction of the customer to the advertisement, such as (1) credibility of the claim in the ad. (2) whether the customer is willing to use the product. Their replies are recorded.

Limitations: In this test the recall will depend on the customers' interest in the product. Greater the interest in the product, higher will be the recall rate and vice versa.

- c. **Qualitative research:** Focus groups and depth interviews are used in qualitative research to obtain information from the consumers. This group will discuss the positive and negatives of advertising copy. The group discusses the meaning they derive from the ads, consider the advantage of alternatives, and suggest improvements if any. The greatest advantage of this method is that the feedback is not expensive.
- d. **On the air test:** This method is used for TV commercials. This method is also known as the Day-after-recall method. The test consists of an on-air exposure of a finished commercial in one or more cities, following which several respondents are interviewed the following day to find out whether they can recall the message. The answers given by the respondents are converted into a score which is compared with the score obtained from similar studies. On this basis, the commercial is accepted or rejected.

Let us analyse the advantages and disadvantages of on the air test.

Advantage: This test is conducted in natural setting.

Disadvantages:

- ❖ It is doubtful whether the recall is related to behaviour of consumer.
- ❖ The recall is not necessarily related to change in the behaviour of the respondents.
- ❖ The reliability of the recall test score is questionable.
- ❖ The results of this test are likely to be influenced by city's demography such as education, age, time when the commercial was exposed, etc.

Due to above reasons, the straight recall type test is modified. The environment, namely natural settings have been retained, but questions added are other than those dealing with recall. One such version is called positive product response (PPR) which helps measure attitude. Some of the questions asked under this are –

1. Kindly describe the commercial that you saw.
2. What did you think of, when you saw the commercial?
3. What, according to you, is the main idea of the commercial?
4. Name the product that was advertised.

- e. *Theatre persuasion test:* In this method, a group of consumers (targeted consumers) are invited to a theatre. The sample size varies from 250 to 500 participants.

Once the respondents enter the theatre, they are told that a draw will be held for gifts. They are asked to complete a product preference list asking them which product they would prefer, if they win. All demographic data in the form is filled up. Participants are made to sit in the theatre irrespective of sex and age. After they view the commercial, they are asked to fill in an evaluation form. Participants are then asked to complete a second form for the draw, so that any change in product preferences can be noted. In addition to product preference, the form contains the following questions to be answered by the participants:

1. Reaction and interest to the commercial.
2. Recall the various aspects of commercial.
3. Interest in the product under consideration.
4. Continuous (scene by scene) reaction throughout the commercial.

Advantages:

The above test basically measures product/brand preferences.

Disadvantages:

1. A natural viewing is absent in an artificial environment.
2. Sometimes, participants make changes just because they think they are supposed to do.
3. Group members may influence others, who did not have their own reactions.

Despite the disadvantages, most consumer product companies resort to this test.

II. Copy Test (based on Psychological Response)

- a) *Galvanic skin response:* This is also known as electrodermal response. In this method, the respondent's perspiration is recorded. This reveals their emotional

reaction to the advertisement. The instrument is known as an electro-galvanometer. There are two electrodes, a small current is passed between the two electrodes. This acts as a stimulus and activates the sweat glands of respondents. However, this method is not very popular.

- b) *Pupil dilation response:* In this method, dilation and constriction of the pupils of the eyes is measured to a stimuli. The instrument used for this test is called Pupillometer. Dilation of the pupils is an indication of the respondent's interest in a product or advertisement. Some aspects of advertising can be measured using this method. However, it is very costly.
- c) *Eye movement tracking:* In this method, the viewers are asked to view an advertisement. During this period, a sensor aims a beam of infrared light at their eyes. The beam follows the eye movement and shows the exact spot, where the viewer is focusing. This tells the researcher which element of the ad is attracting the attention of the viewer and how long the viewer is focusing on them. Eye tracking can identify the strength and weakness in an advertisement.

III. Copy Test (based on Behavioural Response)

In-store persuasion:

The following steps are followed:

1. Intercept a quota sample of shoppers as they enter the retail store. Name them – sample 'X'.
2. Show these shoppers a set of advertisements. Allow them as much time as they wants to look at the advertisement.
3. Give the shoppers a list containing products with discounts available on each. The list should include products shown in the advertisement.
4. When the shoppers leave the retail store, note down whether they purchased any of the products whose advertisements, they saw. Based on this, the incidence of purchase is calculated.
5. Repeat the same experiment on another set of quota sample selected shoppers, who are not shown advertisement before shopping. Again, calculate the purchase incidence. Term this sample as 'Y'.
6. Compare the incidence of purchase between those mentioned under X and Y. Use a suitable statistical tool to find whether X and Y differ significantly or not.

21.10.2 Post Testing

This is a test conducted after money is spent on advertisement. It is more to do with the effectiveness of advertisement rather than copy testing. The basic difference in the two tests lies in the purpose for which it is conducted.

Post-advertisement testing is done after the ad has been run commercially. Advertisers are interested in finding out the overall communication impact of a completed advertising campaign—whether it has increased brand awareness, brand comprehension, brand preference, etc.

Assuming that advertisers have measured these before the campaign, the advertiser can draw a random sample of consumers after the campaign to assess the effectiveness. There are two categories of post tests (a) tests not based on respondent's memory and (b) tests based on respondent's memory. The question that arises is how soon the measurement should be carried out after the advertisement has run for the respondent to remember. Researchers believe that advertising tends to be forgotten very rapidly.

Tests not based on respondent's memory:

- i. Enquiry tests
- ii. Sales effect test
- i. *Enquiry tests:* This test is used in consumer marketing as well as B2B marketing. This method involves measuring the effectiveness of advertising on the basis of enquiries generated from offers or coupon advertisements appearing in different print media. The number of enquiries received indicates the ad effectiveness. Inquiry may be for more details or demonstration, etc.

Example: Many paint companies offer detailed catalogues on request. There are several ways of handling inquiry tests, which are as follows:

- a) Run the ad in the successive issues of the same medium.
- b) Running split run test, wherein there is a variation in the ad copy appearing in different copies of the same newspaper.
- c) Running the same ad in different media.

The first method will indicate the overall effectiveness of the ad campaign. The second will indicate the effect of variation in the ad. i.e., how good the variation is the third method will indicate the effectiveness of the medium.

However, the inquiry method is not very effective. Inquires received may not reflect the true measure of how good the ad is, in terms of drawing attention of providing

information. This is because the reader may read the ad, store the information, but may not inquire immediately. This may be due to the fact that the customer may not need that product at that time, when the ad is run. Also, it would be wrong to conclude that receiving less enquires implies less effectiveness of the ad. On the other hand, a customer who is badly in need of a product might inquire even if the quality of the ad is not good. The greatest advantage of this test is that it is inexpensive.

- ii. **Sales effect test:** In this test, the sales, response to advertisement is measured. It is difficult to ascertain or correlate whether there is any increase in sales due to a particular advertisement. Increase in sales may not be a true reflection of the effectiveness of the advertising.
- iii. **Simulated sales test:** In this test, the customers are exposed to alternative pieces of copy. For example, the copy to be tested can be in the form of stores display material. Two groups of identical store may be chosen. Copy A, pop display is placed in first group and copy B in the second group. Product sales are measured before and after the introduction of display material. The group which has the biggest increase in sales is supposed to have the best ad copy.

Tests (based on Respondent's Memory)

- i. Recognition Test
- ii. Recall Test
 - a. Aided recall
 - b. Unaided recall
- iii. Triple Association Test
 - i. **Recognition Test:** The researcher shows the respondents the issue of newspaper/periodical, which he claims to have read. They are asked to recognise the ad. This test is used to determine the incidence and intensity of reading an advertisement that is inserted. If the periodical in which the ad is inserted in a bi-monthly then the test will commence 3 to 6 days after the periodical has been released for sale. The test goes on for about 2-3 weeks. In recognition test, 100 to 150 individuals are given a copy of periodical. Assume that the periodical is *Woman's Era*, and the product advertised is cutlery. During the interview, the following questions are asked:
 1. Did you read *Women's Era* issue dated Nov 05?
Yes _____ No _____
 2. If yes, do you recall whether you have seen this advertisement for cutlery earlier?
Yes _____ No _____

3. What is the extent of your involvement in reading/seeing the advertisement?

Options:

- a) Don't remember having read the ad.
- b) Remember having seen the advertisement .
- c) Remember having seen the advertisement and could correlate the product, with which it is associated.
- d) Read half or more of the written material in the advertisement

All the above are mentioned in percentages. The drawbacks of this method are:

(1) False claims (2) Interviewer sensitivities (3) Doubtful reliability.

1. **False Claiming:** This refers to a situation where the respondent claims that he has seen the advertisement, but in reality, has not seen it. This could be because the respondent wants to please the interviewer. False claims lead to erroneous reporting of the effectiveness of the ad. It is also quite possible that interview fatigue may lead to an underreporting of effectiveness of the ad, since the respondent may not report an ad that he has seen.
2. **Interviewer Sensitiveness:** Interviewers are human beings. There is bound to be subjectivity. The tone, voice, or image of the interviewer in the eyes of the respondent, influences the outcome. Respondents may want to impress the interviewer or may not like to give an impression to interviewer that they lack knowledge. Sometimes, respondents may give an exaggerated version of the advertisement to please the interviewer.
3. **Reliability:** Just one or two insertions of the ad will not produce reliable results. A number of insertions are required to produce reliable results.

To summarise, we can say that the results of recognition method may be erroneous. There are two ways to overcome these shortcomings:

- ❖ Tachistoscopic method
- ❖ Pre-publication control method

Tachistoscopic method: The accuracy of results by this method is much higher. In this method the respondent is shown either the whole or part of the ad at high speed. Later, the respondent is asked to furnish further information on the ads seen by him. The correctness with which the respondent furnishes information will enable the interviewer to certify the claim of recognition.

Pre-publication control method: In this method, a recognition survey of previously unpublished advertisement is to be conducted, before the advertisement appears

in the print media. These advertisements are presented in a portfolio, along with advertisements which are already published, in an old issue of a periodical. After the survey, the scores obtained from false recognition from unpublished advertisements are to be subtracted from correct recognition after the ads have been published.

ii. **Recall Test:**

- a) **Aided recall:** This test uses aided recall. The respondent is shown the cover page of the periodical. He is asked whether he has seen the issue. To become eligible as an issue reader, the respondent should identify at least one article correctly. He is then shown a slide or cards of the advertisement, along with name of brands appearing in the issue. Thereafter, the respondent is asked to indicate the name of the brands and their advertisers he recalls seeing in the issue. He may further be probed about a particular advertisement, regarding the message conveyed, product associated with it etc. This indicates the accuracy of recall and the impact the advertisement has on the respondent. In the end, the interviewer shows the advertisement in the issue, and asks the respondent to confirm whether it was the same advertisement he was thinking of.
- b) **Unaided recall test:** In an unaided recall, the respondent is not given any help in recalling the ad. This method shows greater a degree of ad penetration. There are two methods in unaided recall; these are as follows:

Day after recall (DAR): In this method, the respondent is questioned the day after the ad appears.

Total prime time (TPT): Here, the viewer's television viewing time is researched.

Day after recall tests: There are some distinct disadvantages of this test: (1) High cost (2) Limited samples (3) Advertisement shown in test market can be seen by competitors. (4) The content of the programme may influence recall. Depending on in which programme the advertisement appears, the recall score may vary for the same brand. This may result in an inaccurate recall score. (5) Another disadvantage is that pre-recruited respondents to view the advertisement, they will pay increased attention to the programme in which ad is appearing, since they know that they will be tested the next day. This may lead to a higher level of recall, than what actually is true.

The major advantage is that these tests are field tests. A natural setting provides a realistic response.

- iii. **Triple Association Test:** In this test, the advertiser makes an attempt to identify the consumers' association with brands and their benefits. The main aim of the test is to

assess customers' abilities to associate the triplets namely (1) Product category (2) Brand name or advertiser (3) Copy theme in any order. Two of the triplets are read or shown to the respondent. He is asked to mention the remaining part of the triplets.

Example:

"Board the tour bus and leave the rest to us".

The two triplets in the above are:

1. *Product category:* Tourism industry
2. *Copy theme:* In this case, the slogan "Leave the rest to us" implies a hassle-free journey. The missing triplet is the name of the advertiser. The response is "Karnataka State Tourism Development Corporation". This is the correct association. Who is the advertiser, advertising for a detergent that claims "washes five clothes for just rupee one"? If the answer is 'Surf', it is correct. Here, the question is about the category of the product.

This test can be used to suit radio or television advertising for measuring consumer awareness. It can also be used to find suitable advertising stimuli pertaining to price, packaging etc.

21.11 ADVERTISING MEDIA RESEARCH

Media research is an important aspect, since the advertiser has to select the most efficient media. What type of media to be used? Is it newspaper, TV, or magazine? If TV, which channel programme? Should it be prime time or non-prime time? Should it be regional channels or national channels? To decide on all these **Media research** is to be carried out. Advertising media research is designed to prevent unnecessary wastage. Research also will help in optimising allocation of advertising expenditure.

The following are the information collected in **media research**:

1. *Media distribution:* This refers to individual medium circulation such as number of newspaper/periodical readers, television and radio set owners etc.
2. *Media audience:* This refers to number of people exposed to a media.
3. *Advertising exposure:* This refers to the message coming within the audience's attention range. It is to be understood that size of advertising exposure is lower than media audience, because audience who are exposed to an advertising medium may not notice a particular advertisement carried in it.

4. **Advertising perception:** This requires audience conscious awareness of the advertisement. Colour and the size affect the perception in print medium where as jingles, conversation, theme etc can change the perception in the broadcasting medium.
5. **Advertising communication:** This refers to how people comprehend the advertisement.
6. **Advertising purchase:** This refers to the number of people who buy the product after viewing a specific advertisement. This is nothing but sales response to advertisement.

21.11.1 Media Selection Research (Media Audience)

The main goal of the advertiser is to select a medium from among many available. The medium selected should be such that it reaches the maximum number of people and at a desired frequency. Therefore, the advertiser is concerned with:

1. What frequency of message is required to alter the consumer behaviour?
2. How many in the market segment can be reached with that frequency?

Newspaper as an advertising medium

Two considerations to be taken into accounts: (a) Circulation (b) Readership. There is a difference between circulation and readership. Sometimes, one copy of newspaper may be read by one or shared by many. That is the why circulation does not provide a good estimation of readership. Readership data is the more important indicator used in advertising media research while circulation data is readily available with select agencies. Readership is usually unknown. This information needs to be gathered by conducting surveys. The next question is to determine, who is a reader. A reader is someone who reads a newspaper in full or part or reads only the editorial during the specific period. This reference period is the day before interview, in case of a daily newspaper. Therefore, a respondent is defined as a reader of daily newspaper, partly or fully, on the day before the interview.

Television as an advertising medium

Radio and TV are very different from newspapers, when it comes to measuring the size of audience. In TV, the programme and advertising message is mixed. It is difficult to separate the two. There are four ways to measure – the size of the audience for any TV or radio programme: (1) Coincidental method (2) Audimeter (3) People meter (4) Dairy method.

1. **Coincidental method:** In this method, a sample household, which has telephones and currently watches the TV or listens to radio are contacted. Respondents are contacted over the phone and asked whether anyone at home is listening to radio or watching television, and if so, what programme and channel/station they are tuned. Further, they are also asked, what is the name of the sponsor or what product is being advertised.

Ratings are based on what percentage of those contacted are watching a particular programme.

Advantages:

- ❖ Since the questions asked pertain to current programmes, there is no need to recall or remember past events. Results are therefore accurate.
- ❖ It is a fast method and economical too.

Disadvantages:

- ❖ Only homes that have telephones are included.
 - ❖ Calling homes is limited to certain hours of the day and night, say 8 a.m. to 10 p.m. Programmes outside these hours cannot be included.
 - ❖ If the programme is very short, then the number of people who could be interviewed is limited.
 - ❖ Since only a limited number of homes are contacted, no one can measure the size of the total audience for a given programme.
 - ❖ Rural homes are left out.
2. *Audimeter:* This is an audience measurement device. This is fixed to the television sets of the panel households. This device will record the time when the TV sets are on, the channel to which it is tuned and the duration of tuning. This information is transmitted through telephone to central computer for analysis.

$$\text{Share of audience} = \frac{\text{Number of homes watching a particular programme}}{\text{Total number of people watching the TV (includes any other programme)}}$$

Advantages:

- ❖ Since the audience sample remains constant, the total audience count can be obtained.
- ❖ The duplication effect can be studied (i.e., the same ad appearing in several channels viewed by audience).

Disadvantages:

- ❖ The audimeter will indicate that the TV is on. As a matter of fact, no one may be watching. Therefore, the assumption is on and someone is watching programme may not be correct.
- ❖ The audimeter does not provide the demographic breakup such as age, sex, occupation of the viewer.

3. *People meter:* To overcome the disadvantages of audimeter, the people meter is introduced. This gadget consists of a remote-controlled box with buttons. Signals are sent to a control box kept on the top of TV set. Members of the household will press a button whenever they want to watch TV. Information about who watches the programmes is recorded electronically.

Disadvantages:

- ❖ People in the household may keep the TV on, but may not be watching.
- ❖ The reliability factor may pose a problem, especially with teenagers and children.

4. *Dairy method:* First, a household panel is constituted. Each member of the household is given a diary to record their viewing the TV or listening to the radio. This method assumes that the panel members will co-operate by recording their viewing/disviewing at the time it occurs. Therefore, it is presumed to be accurate.

Advantages:

- ❖ Less expensive
- ❖ Data on individual viewing programme can be obtained.

Disadvantages:

- ❖ Minute-by-minute monitoring as in audimeter not possible
- ❖ Many respondents may forget to record what they viewed.
- ❖ Some respondents may record the programme watched only once a week. A particular programme may be overstated, while less popular programmes may be understated.
- ❖ The halo-effect may be present in some popular programmes
- ❖ There is also possibility that some respondents might think that it is too much of an effort to maintain the dairy over a long period of time.

21.11.2 Media planning research

Media plan determines the best way to get the advertisers' message across to the market through various media vehicles. In essence, the goal of the media plan is to find that combination of the media, which enables the marketer to communicate the message in the most effective manner to the largest number of potential clients, at the lowest possible cost.

The following are some of the activities carried out in connection with media planning:

- Setting the media objectives.
- Selecting broad media class. Eg: print, electronic etc.
- Selecting the media within the class—in case of print media, either newspapers or periodicals.
- How much media space and time should be bought?
- Who constitutes the audience?
- What is the size of the audience?

Terminologies used in media planning

Media vehicle: It refers to the mode by which the message is transmitted. Eg: Cable, banner, magazine.

Reach: It refers to the size of the audience exposed to a particular media vehicle. If a newspaper has a circulation of 3 lakh households in the area covered, where the total number of household is 10 lakh, then the newspaper coverage is said to be 30%.

$$\text{Reach} = \frac{\text{Circulation}}{\text{Total number of households}} = \frac{300000}{1000000} = 30\%$$

The above does not indicate the audience size with respect to readership. This brings us the difference between 'circulation' and 'readership'.

Circulation: The circulation refers to the total number of copies sold of a particular newspaper or magazine. The circulation indicates only the potential audience size of a newspaper or a magazine. It does not necessarily mean that delete this number of people actually read the publication.

Readership: It refers to the number of people who actually read the publication.

Frequency: The frequency refers to the number of times a person or a household is exposed to the same advertising in a programme during a given period.

$$= \frac{\text{Total No. of exposure}}{\text{Reach}}$$

If there a small sample household, say 300, has a reach of 50%, then the frequency is six (6).

Continuity: This refers to whether advertisement is repeated on a continuous basis or intermittently.

Gross rating point (GRP):

$$= \text{Reach} \times \text{Frequency}$$

Example: A media planner may like to know in which programme the advertisement is to be inserted. He proceeds as follows:

Programme X has a reach of 60 at an average frequency of 5. Therefore, the GRP rating is $60 \times 5 = 300$.

Programme Y has a reach of 70 at an average frequency of 4. Therefore, the GRP rating is $70 \times 4 = 280$.

Although programme Y has a higher reach, the media planner will choose programme X because of the better GRP rating.

Cost per thousand (CPM):

This is applicable and used as a yardstick in print media:

$$\text{CPM} = \left(\frac{\text{Page rate} \times 1,000}{\text{Circulation}} \right)$$

If a daily newspaper has a circulation of 3 lakh and charges Rs. 30,000/- for full page ad, then the cost per thousand would be $\text{CPM} = \frac{30,000 \times 1,000}{3,00,000} = \text{Rs. } 100$. This represents the average advertising cost that the advertising has to bear for placing the advertising copy in every 1,000 circulate copies of the publication. As a general rule, the publication which offers the lowest cost per thousand circulation is chosen as the advertising vehicle by advertisers.

Illustration:

Consider two newspapers, *The Statesman* and *The Hindu*:

Let us calculate the cost efficiency.

	The Statesman	The Hindu
Per page cost	Rs. 156,000	Rs. 144,000
Circulation	4 million	3.1 million
Circulation	$\frac{156,000 \times 1,000}{40,00,000}$	$\frac{144,000 \times 1,000}{31,00,000}$
CPM	39	46.45

It is evident from the above, that even though cost per page is higher in *The Statesman*, it is cost efficient.

CPRP: This is the yardstick used in broadcast media. It is the cost per rating point based on the number of times shown.

$$\text{CPRP} = \frac{\text{Cost of the commercial}}{\text{Audience of the programme}} \times 1,000$$

The cost of the commercial will depend on whether it is a prime time commercial or otherwise. Also, whether the advertisement is to be inserted in the daytime programme or at night. Due to these variations, CPM and CPRP cannot be compared.

Media planning in India

Electronic	Print media	Outdoor/other media
Doordarshan channels, Private Satellite channels – 100 cinema – mass media	Newspaper – National, Regional English or Periodicals – National, Regional English or Vernacular	Bill boards. Wall paintings. Balloon advertising. In-stadia advertising. Transit advertising.
T.R.P-Television Rating Points used to evaluate channels DART – Doordarshan Audience Research Television Rating		

Media Mix: The total combination of media is known as media mix. An advertiser may like to reach the audience through different media. He may do this due to: (1) Cost factor (2) To utilize some of the intrinsic value of the media.

Sometimes, an ad is aired on the radio in brief. Followed by this, more details are given in the print media.

Example: ICICI personal loan. Message on radio is– “8% interest, Call Today.” Followed by this, a detailed ad on bank loan details advertised in newspapers, along with terms and conditions, is published. This is a combination of media.

For the launch of a new product, there could be a press conference, followed by an advertisement in the print media. In the press conferences, leading personalities media and people are called for the launch; again, a combination or mix of media is used.

21.11.3 Media Scheduling

Scheduling is very important for advertisers, since they desire the maximum reach. The main idea is that the advertisement must produce maximum impact.

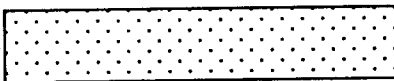
Example: An advertiser who wishes to schedule 15 spots in a given month can schedule this in any one of the following ways:

1. Concentrate and complete all the exposure within the first or second week of the month.
2. To space it throughout the month.
3. To intermittently space it throughout the entire month.

Some of the scheduling methods are (i) Continuity (ii) Flighting (iii) Pulsing

- i. **Continuity:** Continuity refers to the continuous pattern which may be everyday or every week. The key here is that there is no advertising period.

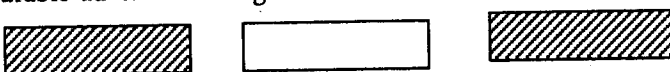
Example: Such a strategy is used for advertising food products, detergents, cosmetics etc.

Continuous advertising → 

- ii. **Flighting:** Flighting employs advertisement of advertising and non-advertising. At some period there is heavy advertising (during festival season) and at other times, there is no advertising.

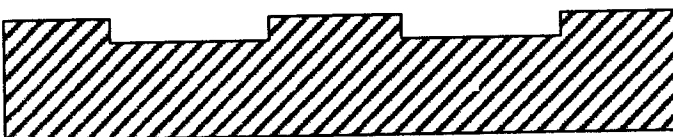
Example:

1. Educational institutions advertise only during the admission period.
2. Consumer durable advertise during the festive season.

Flighting → 

- iii. **Pulsing:** Pulsing is a combination of both methods. In the pulsing strategy, the continuity is maintained. At certain times advertising efforts are stepped up.

Example: Automobile advertisements, which peak during January and March of every year. This is because the auto companies are aware that most corporates take advantage of depreciation benefits during this period. Also, companies advertise during festivities.

Pulsing → 

Reach/scheduling

While establishing the reach, care must be taken to see that there is no duplication. If one advertisement is placed in two serials and if the same population is targeted for both, there will be duplication and wastage. This has to be avoided. It is in the context that we should recall the difference between GRP and TRP. Target rating points (TRP) does not include wastage coverage.

SUMMARY

Marketing research has grown leaps and bounds over the years. This has led to the application of research in several areas.

Product research is one area of application. Product research will help in designing the product i.e. it will help in providing attributes required by the customer. Product research helps in translating customer's need into manufacturer's language, experiments are conducted in product research and scaling techniques are used. New products are test marketed. Through this, consumer's response are gathered.

Over the year, advertising research also has received the attention of researcher's, under Advertising research, researcher is concerned about message, appeals, media etc.

Ad copies are pre/post tested some of the tests are psychological test, Laboratory test, consumer jury test, day after recall test etc.

Media research is done to find out the most efficient media for carrying the message to the target audience. Among the infinite number of alternatives available, the combination which optimizes reach and frequency is to be selected. In media selection advertiser must pre fix his potential prospects, then only frequency can be ascertained based on the change required in consumer behavior. Media selection is a very complicated process because not only general type of media is to be selected, within which specific selections are to be made. Media scheduling is very important for the research, since they need maximum reach.

KEYWORDS

Product	Product line
Repositioning	Product testing
Concept testing	Morphological analysis
Monadic test	Paired comparison
Triadic	Double pair test
Portfolio test	Theatre persuasion test
DAR	TPT
CPRP	GRP

Audi meter

People meter

Readership

Media mix

REVIEW QUESTIONS

1. What is a product concept?
2. What is product research?
3. What are the sources of new product ideas?
4. What are the categories of new products?
5. What is morphological Analysis?
6. What is concept testing? How is it useful in marketing research?
7. What is sequential product development?
8. What is simultaneous product development?
9. Explain the steps involved in new product development.
10. Why is product testing necessary?
11. Explain the methods involved in product testing.
12. Explain the term test marketing. What are its uses?
13. What factors would affect test marketing?
14. What should be the duration for running a test market?
15. What is advertising research, and what are its purposes?
16. What is meant by pre-testing of advertisement?
17. Explain the methods used for pre-testing. Give examples.
18. Describe pre-testing methods based on verbal responses.
19. Describe pre-testing methods based on psychological responses.
20. What is in-store persuasion method of pre-testing?
21. What are the advantages and disadvantages of aided and unaided recall?
22. Why is post-testing necessary?
23. Explain the tests for post-testing.
24. What is the recognition test?

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25. What problems were encountered in recognition test?
26. What is TRP? Give an example.
27. What is media research?
28. Explain the terms (1) Reach (2) Frequency (3) GRP (4) TRP (5) Circulation (6) Readership (7) CPM (8) CPRP.
29. What information is being collected for media research?
30. Explain: (a) Newspaper as an advertising medium (b) Television as an advertising medium.
31. Explain the method used to measure the size of TV audience.
32. What is media scheduling? Why is it required?
33. What methods are being used for scheduling?

Case Studies in Indian Context



In this chapter, the following cases are discussed:

- ❖ Ready to Eat Food
- ❖ Repatriates Co-operative Bank
- ❖ EDP at a Management Institute
- ❖ Tasty Foods
- ❖ Prestige Neck-ties
- ❖ ABC Milk Federation
- ❖ Moonlight Restaurant
- ❖ Angel Market Research Agency
- ❖ Sandwich Corner
- ❖ Tomato Growers Dilemma
- ❖ Ethical Issues
- ❖ Tourism

CASE-1 Ready to Eat Food

Mr. Ravi, a qualified food technologist was an NRI working at "Ready to eat food" manufacturing company in the Middle East. He completed his basic degree in science from India and proceeded to the US to do Masters degree in food technology. He completed the same and joined a Dubai based company as food specialist. The company manufactured variety of "ready to eat food", which was distributed through big retailer chains. The company enjoyed a great reputation.

After working for 10 years, Mr. Ravi wanted to return to his motherland and wanted to set up a unit in his native Chennai. He had toying with an idea of setting up a factory where, "ready to eat products" could be manufactured. During his earlier visits, he made enquires with known people to ascertain "whether his intention to set up a ready to eat product would find customers." His initial data gathering gave a positive indication.

He was told that with changing demography and lifestyles in service sectors like IT, most families had couples at work. Time was a major constraint. Hence his "ready to eat food" would find acceptance. All this information was gathered by "word of mouth".

His close friends informed him of a foreign company to have started this business and appeared to be doing well. This did not bother Mr. Ravi, since he knew that he could meet the taste of Indian customer better than any multinational. On the contrary, Mr. Ravi was glad that this new foreign company was doing well, which was an encouraging signal.

Even though ready to eat food was popular abroad, and word of appreciation yielded positive, Mr. Ravi still wanted to ascertain the feasibility of setting the project. He had a variety of questions to be answered. If you were to be the advisor, how would you proceed?

ISSUES FOR DISCUSSION

1. Will the tradition-bound Indian society accept a "ready to eat food"? How will you proceed to confirm this?
2. What product variety should be introduced? Should the taste be similar to the existing company's product or different? If so, which product to start with?
3. What research would you conduct to decide packing, storing and distribution of the product?
4. What promotion research do you need to do?

CASE-2 Repatriates Co-operative Bank

Repatriate Co-op Bank is located in a town with a population of about 2 lakh. Its two main competitors were Bharat Co-operative Bank Textile Workers Co-op Bank. The size of all the three banks in terms of number of shareholders, assets, were more or less the same. Interest offered on S.B and F.D were more or less the same.

The main services offered by Repatriate Co-op Bank were savings bank, vehicle and personal loan, mortgage loan, Jewel loan etc. The bank had an ATM operating 24 hours. The services offered by other two banks were also similar.

Since services offered by all the three banks were similar, the board of directors of Repco Bank decided to find, loyalty of current customers to the bank. The bank also wanted a measure of how customers perceive the various services offered by the institution.

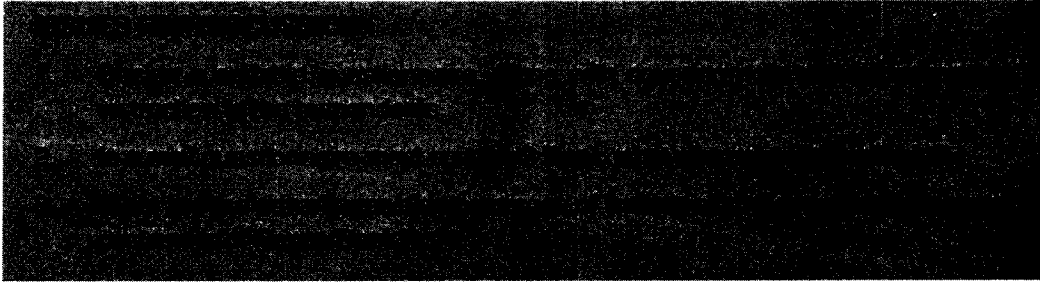
In the light of the above, the company appointed a leading market research agency to conduct a survey among 2,000 current customers. The decision of the bank was that, if this survey indicates anything worthwhile, a similar survey would be conducted on current non-customers too.

The following was the specific information sought by the bank from the M.R agency:

1. What percentage of the current bank customers of Repco Bank use the services of competitors for one or more services?
2. For which service of the competitors does the current customer go?
3. Of the two competitors, who has the largest percentage of Repco Bank customer as their customers as well?
4. How do the Repco Bank customers perceive the following attributes of the bank?
 - a) Locational advantage
 - b) Quickness
 - c) Ambiance
 - d) Convenience of working hours
 - e) Courtesy of Staff
 - f) Correctness/Accuracy
 - g) Use of Technology
 - h) How important is each of the above to Repco customers?
 - i) Do the above attributes have any relations with age, education, sex, annual income, numbers of years of association with Repco Bank?

A mail questionnaire has to be sent to the respondents of Repco Bank, along with a covering note and reply envelope.

Contd...



CASE - 3 **Executive Development Programme at a Management Institute**

An autonomous management institute of repute was well-known for the high quality of the students graduating and entering to the corporate world. The institute's main mission was to extend this high quality of education to those who could not undertake a full time college programme. Therefore, the institute conducted programmes aimed at providing education and training in several areas of management to working executives. These working executives attended the programmes either their own (after working hours) or sponsored by the company where they were working.

The executive development programme had three tiers. The First tier was to develop supervisory personal, the Second and Third tiers were meant for middle level and top level executive. The main emphasis of this programme was to improve trainee's managerial, decision-making, human relation skills. Over a period of time the enrolment to this programme was on the decline. The institute was at a loss to explain, why such a thing was happening? The institute was very sure that the many of the doubts raised by the programme participants were amply cleared and the feedback from the participants was very positive, with no negatives in the feed back form. Despite this, the institute could not trace the reason for the declining attendance. The institute wondered, whether the decline was caused by economic factors or increased competition from other education providers. Could it be due to content or structure of the programme, or could it be due to the fact that it was not properly promoted and not properly targeted at the right level.

Consequently, a major promotion programme was conducted by mailing the brochures which indicated the content and the structure of the course. The mailing was done, both for those who attended the past programme and others (freshers).

QUESTIONS

1. What is the research problem?
2. What is the decision problem?
3. What will be your advice to the management institute regarding the method of addressing the research problem?
4. What data should be collected and how this data can be used to answer the research question?

CASE-4 Tasty Foods

Tasty Foods (India) Ltd. is a wholly owned subsidiary of delicious foods, a giant German based restaurants chain. Tasty food was famous for its continental cuisine. The chain of restaurants was well spread across Europe. It was eyeing the Asian continent for a long time. In 1996, it entered Japan and gained enormous success. The same year it entered Malaysia, Singapore and made a landmark.

The Asian market was had prove to be lucrative, as the chain had more than 100 restaurants across these countries. The chain thought of entering the Indian sub-continent, which was supposed to have enormous potential. In 2001, the chain made a survey, and the survey revealed the shocking information that, most food-lovers were vegetarians. Unfortunately, the chain was well-known for its non-vegetarian cuisine, especially, Barbecue and Dover sole. The chain also gathered information that McDonalds and Tricon groups of restaurants had already set up their operation, but adopted vegetarian cuisine. The chain was surprised to find that McDonalds, very well-known for its Hamburgers (Beef) and chicken burgers had adopted Indian dishes and were running successfully. Moreover, Tricon has set up a 100% pure vegetarian restaurant in Ahmedabad where the majority were vegetarians.

The chain was in a dilemma. But it finally decided to launch its restaurants in different metros of the country, with its world famous non-vegetarian cuisine. The cuisine also contained vegetarian dishes but not many. The restaurant had a poor response rate in the first six months. The chain incurred a loss of Rs. 2 crores in this period, and hence thought of closing some of its restaurants. Then it appointed a well renowned market research agency to find out what went wrong. Research findings revealed that if the chain wanted to survive and succeed in the Indian market it had to add vegetarian dishes to its cuisine.

The main problem was that the cuisine of the chain was predominantly non-vegetarian, and did not contain many vegetarian dishes. It appealed to the global headquarters in Germany to solve the problem, by suggesting vegetarian dishes. The headquarters after consulting the experts advised the chain to stick to the non-vegetarian cuisine. It also suggested that the chain might run the restaurants in particular metros where more number of non-vegetarian food lovers were present and close down rest of the restaurants. Contrary to this decision, the chain was firm to introduce many vegetarian cuisine and asked the expert team to find vegetarian dishes irrespective of its acceptance by customers.

QUESTIONS

1. Mention the proper research design to find out 'consumers opinion' on cuisine.
2. Suggest suitable locations, sample size and technique and scales to be used to find out accurate opinion.
3. What appropriate data collection would you suggest and the instrument to be used for this situation?
4. Mention the necessary components that the instruments contain to find the consumer opinion accurately.

CASE-5 Prestige Neck ties

Neckties have been in vogue in India for several decades. Prior to the 60s neckties were imported from France or England and a couple of other countries. It was Zodiac that gave the necessary impetus to the domestic tie industry in the 70s. This was followed by a firm in Bombay called 'designers tie', a private limited manufacturing company in 1971. The ties were sold under the name 'fashion', which later took the name 'Prestige'. Designer ties remained the only well-known players specializing in neck wear, other companies manufacturing tie, treat the tie as an additional item in men's wear market.

Today, the market for ties is flooded with a number of brands such as Zodiac, Park Avenue etc. Prestige tie was facing stiff competition from new entrants from the US, Japan etc. Customers' tastes seemed to be shifting from domestic to foreign brands. The government was allowing imports freely due to liberalization and the market was flooded. This import policy likely to gain further momentum due to entry of many foreign retailers. These retailers treat the tie as a part of an important dress item. This has further added value to the product, with more choice to customers. Apart from the discouraging trend domestic tie, there was another unfavourable trend in recent times, the onslaught of denim wear and casual wear resulting in the reduced usage of ties.

Prestige is now seriously thinking of sponsoring a comprehensive study on the necktie market in India. It would like the proposed study to enlighten it on the consumer profile, its image of local brand vis-a-vis other brands to the various segments in the tie market. The company would like the study to lay great emphasis on market segmentation.

QUESTION

You have been approached by the company for the proposed study. How would you proceed with it, keeping in mind three major issues pointed out by Prestige?

CASE - 6 ABC Milk Federation

ABC Milk Federation, a well-known public sector milk federation in India, has commanding a leadership position in the market for the last three and half decades. ABCMF has 500 milk processing units. The total turnover of the company is over Rs. 20,000 crores. ABCMF staff head count is 26,000. The product portfolio of the company is milk and its by-products. For example, milk is a basic products of the company and ghee, butter, curd, milkshake, doodhpedha, paneer, sweets, milk drinks, ice creams and chocolates etc., are the by-products.

ABCMF'S supply chain is very strong. It has about 1.5 lakh trucks to procure milk from every nook and corner of India and supply packaged milk to all parts of the country. Since ABCMF is a public sector under taking, its social responsibility is greater than any private organisation. This social responsibility forced the company to procure all the milk supplied by the farmers, though there is no requirement. Eventually, the company was caught in the mismatch of demand and supply. Supply of milk was more than the demand in the market.

As explained in the first paragraph, the company started producing various by-products with the excess milk which remained after supply of packaged milk to the customer. Even after producing by-products, barrels of milk remained the excess. Milk is a perishable product, and it can not be stored for more than two weeks with the available technology. So, the best alternative for the company was to convert the milk into milk powder. By producing and selling the milk powder, the company incurred Rs 1.00/loss per liter. Profits made by the company in milk and other dairy products was being eaten away in milk powder. Year ending, ABCMF made no profit. This has been a major problem of the company for the last one decade. The above problem drove the company to mounting losses.

Keeping in mind the company's responsibility towards the farmers and inevitability to purchase milk supplied by the farmers, answer the following issues.

ISSUES FOR DISCUSSION

1. Design a research for ABCMF to solve the long pending problem.
2. If you conduct a study, who are the sample respondents for data collection?
3. If you were to be the general manager of ABCMF, what are the alternatives you would have thought?

CASE-7 Moonlight Restaurant

Moonlight restaurant was located in a small town of Karnataka. This town is well-known for its educational institutions, both in engineering and medical science. A large population consists of students from all over India. The restaurant owner is a qualified hotel management graduate, and hence believed in running the hotel professionally. This restaurant opened only for dinner and snacks and hence was kept open from 6 p.m. till well past midnight. Prices of items were reasonable and sales revenue grew satisfactorily. The ambiance was good and hence attracted crowds during late evenings. The main concern was that there was news in the air, that two or three fashionable restaurants are going to open within one year, close to Moonlight restaurant. This was a definite threat to Moonlight's owner Mr. Bala. He wanted to conduct an opinion survey of his current customers.

Mr. Bala got a questionnaire designed, which was to be handed over to customers who visited the hotel. A total of 1,000 questionnaires, over a period of time was distributed to all customers. If a family consisted of 4-5 persons, the head of the family was asked to fill up. An incentive of 5% off from the bill was offered to fill the questionnaire.

A record of "how many answered all questions", and "how many filled partially" was kept, along with the total food bill of these 1,000 respondents.

The questionnaire is as follows:

1. How did you come to know about Moonlight restaurant?
 - a. From newspaper advertisement
 - b. Friends and relatives
 - c. From business people
 - d. From TV clippings
 - e. Passing this way and noticed
 - f. From College Faculty
 - g. Other sources
2. How far are you located from here?
 - a. Less than 1 km.
 - b. 1 to 3 km.
 - c. More than 3 km.
3. Before this visit, how many times have you visited this restaurant?
 - a. 1 to 2 times
 - b. 3 to 4 times
 - c. 5 to 7 times
 - d. Never come here before
4. Do you intended to come again after today?

Yes _____ No _____ Can't say _____
5. Rank the following - In Moonlight restaurant, which attribute according to you is the best? Indicate your preference.
 - a. Quality of food
 - b. Price charged
 - c. Ambiance
 - d. Variety of food
 - e. Service of staff

Contd...

6. Rank the following - In case you have to select a restaurant in general, which attribute would you prefer (rank the alternatives)

a. Quality of food	b. Service of staff
c. Variety of food	d. Ambiance
e. Price charged	

7. Sex

_____ Male _____ Female

8. Age is

_____ below 20 _____ 21-25 _____ 26-30 _____ 31-40

9. Occupation _____

_____ salaried, _____ Business, _____ Govt Servant

10. Your educational level

_____ High School, _____ Under graduate,

_____ Degree graduate _____ Doctorate

_____ Masters Degree

QUESTIONS

1. For each of the questions in the questionnaire, what level of scale measurement would you use for the data collected (i.e. Normal, ordinal, interval, ratio)?

2. Which questions would you use to analyse the following?

a) How much customer loyalty does Moonlight restaurant enjoy?

b) Does customer perception of Moonlight restaurant vary, in terms of whether the customers are

i. Male or female

ii. Perception of locals vs those who come a distance

3. Are customers' perceptions about Moonlight restaurant relative to their impressions about other restaurants? Do they have a bearing and how much they spend at the restaurant?

CASE-8 Angel Market Research Agency

This is a company having branches all over India. Their activity includes market research service provision, advertising research, project consultancy and recruitment. Among all the above services, the organisation offers a two-week marketing research training programme to employees of various companies. The highlight of this programme is to train those employees, who will be conducting market research on their own. It was also meant for those who use marketing research information in decision-making.

The first week of the programme is spent in explaining to the participant, a feel of the nature and potential utility of market research. Topics for discussion would include: (a) Role of research (b) Different applications (c) How it helps decision-making (d) What M.R can accomplish and what it cannot (e) How effective is overall organizational decision. All the above discussions are done through quoting live examples from real life situation. During the second week, participants are asked to discuss role that M.R can play in different situations. Participants are told that they should focus on the following four issues:

1. Can market research be helpful to solve the problem?
2. If the answer is 'yes', in what ways and situations will it help?
3. What type of marketing research activities are likely to be beneficial in generating information which is relevant to given situation?
4. If the answer is 'no' explain what are the limitations or impediments which are likely to prevent marketing research from being useful?

The following examples were used by Angel Market Research Agency during their training programme.

SITUATION-1: AUTO COMPONENT MANUFACTURER

An auto component manufacturer has a very large customer base. The firm has developed a new spark plug as one of its components. This newly-designed component (spark plug) is expected to greatly increase the reliability when installed in a car. However, the improved version of the component will cost about 40% more than the present component being sold.

SITUATION-2: XYZ – INSURANCE FIRM

A major life insurance company is becoming increasingly concerned about the increasing lapse rate in life insurance policies it has sold to its customers. Lapse rate means the percentage of policy holders who drop out after some period of time. For eg: If 20,000 policies are sold and 1,000 of them dropout within a year, the lapse rate is 5%. During the last five years, XYZ firm's lapse rate is 10%. During first year of its marketing, its policies with its lapse rate increasing to 18% during last year.

Contd...

QUESTION

Assuming you are one of the participant in Angel's two week market research training programme:

1. What are your reaction to each of the above two situations?
2. Address the issues that participants in the programme are asked to discuss. Answer the four questions discussed during the training programme with respect to the two situations.

CASE-9 Sandwich Corner

Sandwich corner was a regional fast food chain, with 150 outlets throughout the country. The balance sheet of previous year showed that, last year's sales varied from Rs. 6 lakhs to Rs. 12 lakhs per outlet depending on size and location, average sales per outlet was around Rs. 8 lakhs.

Recently, Sandwich Corner introduced pizza to its menu in a selected group of 30 outlets. This was the costliest item, around Rs.65 per piece. The management wanted to evaluate the potential impact of pizza on over all sales in the selected outlets, before deciding whether to offer the pizza, in all its outlets.

Before selecting the 30 outlets for test marketing, all the outlets were arranged from smallest to biggest, based on previous year sales. Then, using systematic random sampling, one outlet between first and sixth outlet in the list is chosen. This method is continued till 30 outlets are chosen. The previous year's annual sale per outlet, within the group of 30 was Rs. 7 lakhs.

Pizza was introduced in the beginning of July, and monthly sales in 30 test outlets were monitored up to end of December. During this 6 month period, from July to December, point of promotion displays was setup in all the outlet selling pizza. The message was "Try out the special dish exclusively made for you". Except for 'point of purchase' display in 30 outlets, no other form of promotion was undertaken. The reason for not promoting in newspapers, radio was that pizza was not available in all the outlets. In the same city, one outlet offered pizza and the other did not. Therefore the management thought that mass media may not be appropriate for promotion.

STUDY OF SALES IMPACT ON THE INTRODUCTION OF PIZZA

Average monthly sales during six month period (July through December) for the test were approximately Rs. 60,000 per month. The average monthly sales for the same outlets, during the six months preceding the introduction of pizza (January through July) had been Rs. 68,000 per month. The management of Sandwich Corner was quite disappointed with these results. For comparison purpose. The management examined the first six months and second six months average monthly sales for the 30 test outlets during the past two years. The figures are as follows:

	Jan. – June	July – Dec.
Last year	70,000	68,000
Year before last	66,000	63,000

After comparing this year's sales in these test outlets, with the sales figure tabulated, the management concluded that pizza "was not a viable new product" capable of significantly adding to Sandwich Corner's sales. Therefore they decided to withdraw the product.

Contd...

QUESTIONS

1. Do you agree/disagree with the decision made by Sandwich Corner? Why? Give reasons.
2. Do you think that the research implied in this situation was an experiment? If so, what type of experimental design was used? Explain in detail.
3. If you were to find the impact on sales by introducing pizza, what would you do differently? Why? Explain.

CASE-10 Tomato Growers Dilemma

India is a country comprising over 6 lakh villages and 741 million people dwelling in rural areas. The main occupation of Indians is agriculture. More than half of the Indians depend on agriculture. During the early 80's, Indian farmers, especially those who were growing tomatoes on a large scale encountered a major problem in the area of harvesting. Tomato is a labour intensive crop and large scale tomato growers were depending on labourers for harvesting and transporting it to the market. Tomato is a perishable product, so tomato growers need large number of labourers at a time. Availability of labour was a problem.

To aid the farmers, harvesting machines were introduced into the market. Large scale growers of tomatoes were very happy because the machine was introduced to overcome the problem of non-availability of labourers. Their happiness was short lived, because farmers found that there was a massive wastage of tomatoes while harvesting by machines.

It was felt that, the wastage was due to the layout of plantation and the distance between the rows in planting. So farmers were asked to follow the guidelines given by concerned authorities (i.e. agriculture department) in plantation to minimise the wastage during the harvesting time. Farmers followed the guidelines given by agricultural department. Even then they could not decrease the wastage of tomatoes.

Subsequently, joint study was conducted by agriculture department and farmers to identify the problem. This time, they felt that wastage was due to improper handling in the operation of machine. To overcome this, machine operators were trained to handle the machine. Despite this, the wastage did not decrease. The government was quite serious and asked the authorities to take appropriate steps to solve the problem at the earliest. The investigation team defined the problem differently. They stated that the harvesting machine was the problem. Based on this statement, the machine was altered and tested. The problem could still not be solved. It was now obvious that the mistake was in problem identification. As a management student, could you analyse and answer the following issues.

ISSUES FOR DISCUSSION

1. Why was there a failure in problem definition?
2. Explain the systematic method of identifying and defining the problem.
3. What could be the problem in the above case?
4. What are the possible solutions to the problem of tomato growers?

CASE - 11 Ethical Issues

A reputed two-wheeler agency located in North India needed a decision about whether to import or not, a relatively unknown brand of bike to supplement its domestic product. To facilitate the decision-making, the agency approached a reputed market research firm. The main purpose is to conduct a study, to determine potential consumer interest and demand for imported bikes. The result of the survey showed that, not only were respondents aware of the bike, there was a positive interest among the respondents. Consequently the agency took a decision to import the bike.

A press conference was held involving media, such as newspapers, magazine, TV, etc. Important personalities were invited. The company also expressed interest in inviting the survey participants, who had expressed their interest. This was proposed by the agency to have better interaction with respondents. Keeping this in mind, the company asked the research firm to furnish the names, addresses and phone numbers of the respondents. The research firm refused to comply with this request. They argued that to do this is a violation of respondents promised anonymity.

QUESTIONS

1. What could be some of the consequences of providing respondents' detail to the agency?
2. Do you think that the research firm should comply with the agency's request?
3. Does the scooter/bike agency have the right to receive the participants' names since it has paid for research?
4. If only questions on interest were asked and not on sales potential, would it make a difference?

CASE - 12 **Tourism**

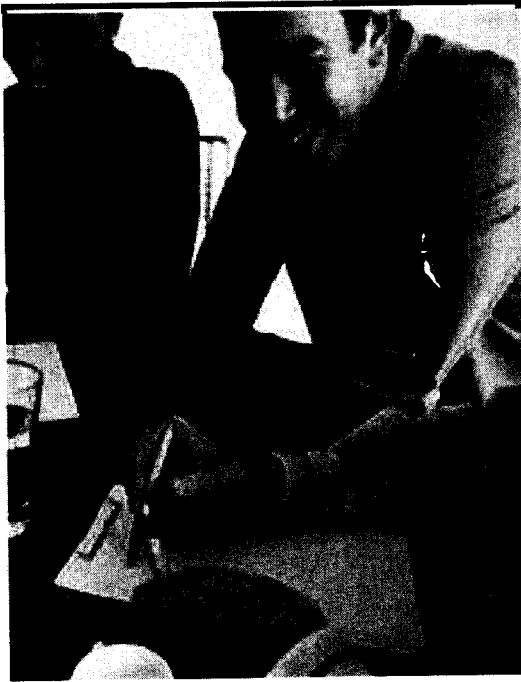
KS.T.D.C is a premier organisation to promote tourism in the State of Karnataka. People from all parts of the country and abroad visit different parts of Karnataka every year. Soon after the capital of Karnataka, Bangalore was identified as the Silicon Valley of India, the number of tourists visiting Karnataka is on the rise. Both domestic and foreign tourists are drawn here.

It is the opinion of global travellers that India is a top holiday destination. The important aspect to be remembered is to remove all impediments or barriers to tourists. K.S.T.D.C is considering a detailed study on those who visited Karnataka during the last 3 years. It is intended towards answering the following.

ISSUES FOR DISCUSSION

1. Profile of tourist based on important attributes/characteristics.
2. What people want from the tourist department vs what is currently offered.
3. What are the difficulties or hardship tourists face?
4. Opinion/Suggestion by the tourist which will enable K.S.T.D.C to woo more tourists by improving its services:
 - a) Prepare data collection form for the above information
 - b) Prepare a report giving proper explanation for each of the above questions.

Guidelines for Project Work



In this chapter, the following questions are discussed:

- ❖ What is project work?
- ❖ Why project work is necessary?
- ❖ How to prepare the report?
- ❖ What are the few research topics to be studies?
- ❖ Formats of different parts of report.

23.1 PROJECT WORK (MEANING)

Project work is the study of real life situation with a view to provide, solution by using management suitable concepts. Therefore project work involves factual data collection, interpretation and drawing conclusions along with suggesting appropriate recommendation to solve the problem.

23.2 WHY IS IT NECESSARY?

Project is an important exercise for the students in working on a problem either identified by the student, faculty or the organization assigning such a project.

Project work is the best way to apply theoretical concept learnt, to solve practical problem. It is a method in which the concepts learnt in the classroom can be applied in a scientific manner. Doing a project exposes the candidate to practical situation. It helps learning systematic data collection and presenting the result in a comprehensive way.

23.3 PREPARATION OF THE REPORT

23.3.1 Project Reporting-Organisational Study/Internship Study

Chapter no.	Contents	Page no.
	Executive Summary	
1	Introduction	
2	Industry Profile	
3	Company Profile	
4	McKinsey's 7S Framework	
5	Product / Service Profile	
6	Financial Analysis	
7	SWOT Analysis	
8	Learning experience	
	Bibliography	
	ANNEXURE	
	Annexure 1	
	Annexure 2	
	Annexure 3	

Introduction

In introduction objective of the project should explained clearly.

Industry Profile

Example Textile Industry

Contents for coverage are:

- Textile market origin
- World textile market and its growth
- Indian textile market growth both organized and small scale
- Present status and future prospects of textile industry in India
- Share of exports of Indian textiles as a percentage of GDP
- Important players in textile market.

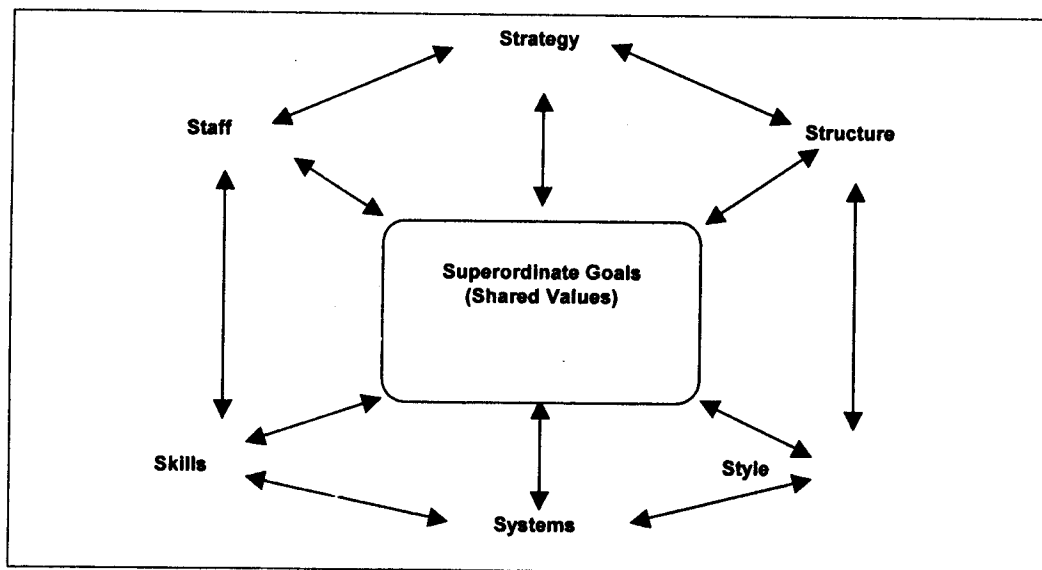
Company profile

- Background details of the company – (a) Business unit and (b) Product portfolio
- Year of incorporation, registered office etc.
- Ownership pattern: Public, private or partnership, proprietorship etc.
- Joint collaborations and ventures, if any, for technical and non-technical process
- Management style: Hired professionals or family run
- Organizational structure: Key persons etc.
- Infrastructural facilities
- Achievements, awards, if any
- Quality policy, Vision and Mission Quality objective and practices in the context of ISO certification.

Illustration of Vision and mission statements of a Company dealing in Courier/Cargo

<p style="text-align: center;">VISION</p> <p>To emerge as one of the Top 3 Express Courier, Cargo & Logistics Companies in India through commitment to Quality Service & Customer Delight.</p> <p style="text-align: center;">MISSION</p> <ul style="list-style-type: none"> ● To be a learning Organisation ● To develop and market a range of Value-Added Products & Services. ● All our Customers must experience "More value for Money" with our "Proactive Approach" supported by World Class Technology. 	<p style="text-align: center;">STRATEGIC INTENT</p> <ul style="list-style-type: none"> ● To accelerate our revenue growth and profitability maintaining a human face through innovative and cost-effective methods. ● To develop a vibrant organization, responding to the aspirations of our growing customer base. <p style="text-align: center;">CORE VALUES</p> <ul style="list-style-type: none"> ● Customer is our Partner ● Service-minded people make our organization. ● Encouraging Creativity, Innovation & Entrepreneurship. ● Sensitive concern for Environment, Justice, Fair Play & Integrity. ● Maintaining WIN-WIN relationship with all our External & Internal Customers. ● We Acknowledge, We Respond.
---	--

McKinsey's 7S Framework (Theoretical input)



Structure

It is the skeleton of the whole organization edifice. It prescribes the formal relationships among various positions and activities. Arrangements about reporting relationships, roles to be performed, rules and procedures that exist to guide the various activities performed by members form part of organization structure.

Structure with respect to organization and functional disciplines are also be studied:

Example Marketing: Structure of sales department

Structure of marketing department

Structure of departments aiding marketing such as

Advertisement, promotion and PR

Regional office and branches, if any.

Skills

Skill is considered as one of the most crucial attributes or capabilities of an organization. These are developed over a period of time and is dependent on number of factors; the kind of people in the organization, the top management system, external environmental influences etc.

Skills are classified as;

- (1) Single skill
- (2) Multi-disciplinary skills

Skill classification:

- Marketing skills
- Engineering skills
- Research skills
- Product development skills
- Combination of the above

Skill matrix: With respect to various levels of people in the organization such as:

- Operators
- Supervisors
- Middle level managers
- Top level managers

Training Programme is an integral part in imparting the desired skills.

Systems

System followed by the organization may be studied with respect to the respective functional area. Eg. In case of manufacturing, some of the following systems may be studied in detail.

- Production planning and control systems
- Inventory control systems
- Process control systems
- Storage systems – FG, WIP, RM etc.
- Materials issue system – FIFO, LIFO, JIT etc.

If HR, some of the following systems may be studied:

- Merit rating system or performance appraisal system
- Reward and punishment system
- Communication system – By whom, To whom
- System for imparting necessary skills – Training of different layers in an organisation
- Grievance handling system
- Recruitment System etc.

If Marketing:

- Sales forecasting system
- Order receiving system

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- Order execution system
- Logistic system
- Payment collection system / Credit system

If Quality:

- Goods receipt system
- Vendor evaluation system
- Material issue /Bin card system
- In-process quality control system

Staff: Classification of staff :-

- Technical staff
- Non-technical staff
- Administrative staff /Supervising staff

Criteria used for selection of the above categories.

- (a) Career planning – of staff
- (b) Job rotation – to enhance multidisciplinary skills

Style

Style is tangible evidence of what management considers important by the way it collectively spends time and attention and uses symbolic behaviour.

Style can be participative or autocratic. It could be top down or bottom up. Two or three instances in the organization should be taken as an example to illustrate the type of style that is being followed by the organization.

Eg.: Style of management followed for various types of decisions, in top down approach could be as follows:

Machinery selection

Incentive scheme formulation

Discount to a customer

Credit extension etc.

For an activity such as above, the style followed in decision making should be illustrated in the report.

Eg.: Style of management for some of participative decision making could be

- Quality circle
- Suggestion scheme
- Works committee
- Cross-functional teams interaction etc.

Strategy

Strategy is defined as the determination of the basic long term objectives of an enterprise and the adoption of courses of action and allocation of resources necessary to achieve these goals.

Strategy followed by the company could be any one of the following:

Example:

- Market leadership
- Product differentiation
- Quality emphasis
- Export orientation
- Product development

If Market leadership, then any one or all of the below may be followed:

- Celebrity used
- Promotion scheme
- Advertisement
- Segmentation
- Line filling

Shared Values (Vision/Mission/Quality policy)

Shared values are what engender trust. Values are the identity by which a company known throughout its business area. These values must be explicitly stated as both corporate objectives and individual values. These values can be understood in the vision and mission statements of the company.

Vision and mission statement of the company would indicate the short-term and long term goals to be achieved by the company.

Example of Vision/Mission/Quality Policy of an Engineering concern

Vision: Incorporate technology as the key differentiator and tool to deliver growth and sustain the position of leadership.

Mission: Consider the world as our market and make international quality standards our bench mark.

Quality Policy: Maintain Consistent quality that exceeds the expectation of the customer.

Product/Services

1. Products/services profile
2. Features of different products and services
3. Markets covered
4. Major competitor for each product/services
5. Share of the market vis-à-vis competitors.

Financial analysis

1. Analysis of the Balance sheet and Profit & Loss Account for previous years
2. Computation of important ratios and interpretation
3. Segmentwise /productwise income distribution

Swot Analysis

Everyday business faced with new challenges, strengths, weaknesses, opportunities and threats. The good thing is what happens to be a threat to the competitor could turn into a golden opportunity for you. All you need to do is keep your eyes open and take the right actions.

The SWOT (Strengths, Weaknesses, Opportunities, Threats) Analysis is a powerful technique to throw light on the business possibilities. SWOT Analysis helps to build strategies in a more streamlined manner and create a niche in the market.

Strengths

- What do people in your market see as your strength?
- What advantages does your company have?
- How do you compare yourself with your competitors?
- What unique low-cost resources do you have access to?

Look at the strengths in the context of competition. If you are comparing your product with a competitor, who has a large share of the market, your owning large share of the market is not a strength, but a necessity.

Weaknesses

- What should you avoid?
- How could you improve?
- What people in your market likely to see as your weaknesses?

You might need to get into your customers' or competitors' shoes to check if there are weaknesses that they perceive but you may have overlooked. It is more an internal versus an external view.

Opportunities

- Where are the good opportunities your company could leverage?
- What are the interesting and promising trends you are aware of?

Opportunities could come your way through:

- Changes in the technology you use,
- Changes in the market,
- Changes in government policies that are relevant to your business,
- Changes in your target audience, such as lifestyles,
- Events in your industry.

You can discover new opportunities by analysing your strengths. You could also look at your weaknesses and think about the potential opportunities opening up if you eliminate your weaknesses.

Threats

- What obstacles do you face?
- What is your competitor doing?
- Is changing technology threatening your position?
- Do you have bad debt or cash-flow problems?
- Could any of your weaknesses seriously threaten your business?
- Are the required specifications for your job, products or services changing?

Such an analysis will often throw light on the future course of action, both in terms of putting problems into perspective and pointing out what needs to be done.

Strengths and Weaknesses are internal, Opportunities and Threats relate to external factors.

Learning experience

Following are to be explained in this chapter.

- (1) Knowledge gained during the study.
- (2) Relevance of theory and practice.
- (3) Enhancement in knowledge before and after the study.
- (4) Key observation made

Bibliography

Bibliography, the last section of the report comes after appendices. Appendices contains questionnaires and other relevant material of the study. The bibliography contains the source of every reference used and any other relevant work that has been consulted. It imparts an authenticity regarding the source of data to the reader.

Bibliography are of different types viz., bibliography of works cited; this contains only the items referred in the text. A selected bibliography lists the items which the author thinks are of primary interest to the reader. An annotated bibliography gives brief description of each item. The method of representing bibliography is explained below.

Books

Name of the author, title of the book (underlined), publisher's detail, year of publishing.

- Single Volume Works. Dube, S. C. "India's Changing Villages", Routledge and Kegan Paul Ltd., 1958, p. 76.

Chapter in an edited book

- Warwick, Donald P., "Comparative Research Methods" in Balmer, Martin and Donald Warwick (eds.) 1983, pp. 315-30.

Periodicals Journal

- Dawan Radile (2005), "They Survived Business World" (India), May 98, pp. 29-36.

Newspaper, Articles

- Kumar Naresh, "Exploring Divestment" The Economic Times (Bangalore), August 7, 1999 p. 14.

Website

- www.infocom.in.com

For citing Seminar paper

- Krishna Murthy, P., “*Towards Excellence in Management*” (Paper presented at a Seminar in XYZ College Bangalore, July 2000).

23.3.2 Project Reporting - Survey Projects or Summer Projects**Contents of Summer Projects/survey Project**

Chapter no.	Title of the chapter	Page no.
	Declaration	
	Certificates	
	Acknowledgement	
	Executive summary	
1	Introduction to the project	
2	Research design and methodology	
3	Theoretical perspective of the study	
4	Company and industry profile	
5	Data analysis and interpretation	
6	Summary of findings and suggestions	
	Bibliography	
	Appendix	

Executive summary

Following are covered in executive summary

1. Statement of the problem
2. Important objectives
3. Brief methodology
4. Major findings
5. Important recommendations

Introduction

1. Brief background of the research topic.
2. Developments in the field of research topic in last five years.
3. Present situation driving the researcher to choose the topic.
4. Future growth potentials, are to be explained in this chapter.

Research design and methodology

- i. **Statement of the problem:** Why the research has been undertaken? To be explained.
- ii. **Review of literature:** It means reviewing the old and related studies to get the in-depth understanding of the research topic, reviewed studies must be chronologically explained under this concept. Refer chapter-9 to know, how to write review of literature.
- iii. **Objectives of the study:** What researcher wanted to achieve by undertaking this study is to be explained in specific.
For example: To study the factors influencing the customer satisfaction etc.
- iv. **Research design:** What type of research it is to be explained. For example: Descriptive, exploratory or experimental.
- v. **Scope of the study:** Scope of the study means what the study covers. Each and every aspect cannot be covered in a particular study due to the constraints of time and resources.
For example, scope can be study covering only garments manufacturers in a specified metro or study covering purchase pattern of a particular socio economic group etc.
- vi. **Data sources**
 - ❖ Primary data
 - ❖ Secondary data
- vii. **Sampling design**
 - ❖ **Sample unit:** Who is to be interviewed? To be explained.
 - ❖ **Sample size:** How many are to be interviewed? To be explained.
 - ❖ **Sample technique:** How to choose the sample respondent? To be explained. For example convenient or random or stratified or cluster or quota sampling.
- viii. **Field work and area of the study:** Area for which study is undertaken and how the researcher planned the field work to collect the data from the sample respondents is to be explained.
- ix. **Research instrument:** What instrument is used to collect the primary data from the respondents is to be explained. Example questionnaire, interview etc.
- x. Statistical tools for analysis
- xi. **Limitations of the study:** While scope of the study explains the coverage of issues/ variables, the limitation will explain what is not covered and the reasons thereof. It basically deals with the constraints faced by the researcher.

xii. Chapter layout

Following is to be explained

- (1) total number of chapters in the project
- (2) subject matter of each chapter

Theoretical perspective of the study

Theoretical perspective refers to the theory part which are related to the project. For eg. If the study is being conducted to find out whether sales promotion has any impact on increase in sales, the relevant theoretical background will have to be explained with respect to:

- Concept of sales promotion
- Types of sales promotion
- Advantage and disadvantages of sales promotion etc.

Company and industry profile

Refer previous pages in internship study.

Data analysis and interpretation

Analysis and interpretation means, the insights of the researcher, significant observations and findings, how researcher understands the situation and why those values are occurring, are to be explained in detail.

Summary of findings and suggestions

Findings should have bearings on objectives. Each objective must have at least one finding in case of multiple objectives. Suggestion should be based on the findings. If there is no correlation between objectives, findings and suggestions, the purpose of the research is not achieved by the researcher. Therefore, findings and suggestions must be constructive, in order to fulfill the purpose of the research.

23.4 LIST OF SOME STUDY TOPICS

Retailing

1. A survey on the factors that influence consumers to make their purchase from departmental store

2. The comparative analysis on the role of consumer loyalty towards organized and unorganized sector in retailing
3. Role of retailers in influencing consumers' buying decision – Food products
4. Consumer opinion on setting up a large departmental store
5. A survey on the impact of credit facilities by retailers to consumers in boosting the retail sales.

Cyber - Marketing

1. An opinion survey on the impact of internet in buying a product/service
2. A survey on analyzing of Internet users' preference on Horizontal portals
3. A survey on users' opinion about paid services (Bulk Mail storage & other value added services) over Internet
4. Role of internet in influencing consumer buying decision on consumer durable
5. A survey on analyzing the effectiveness of local portals in influencing consumers to buy over internet.

Advertising & Sales promotions

1. Effectiveness of print media on consumer buying decision - product to be selected
2. Effectiveness Outdoor media on consumer buying decision – product to be selected
3. Analysis on the relationship between leading TV serials and the effectiveness of advertisement
4. Analysis on the effectiveness of dealer sales promotion in motivating the retailers – select the organisation
5. Consumers' opinion on the influence of sales promotion on their buying decision - product to be selected by candidate.

FMCG

1. Role of brand loyalty in influencing consumer buying decision – Cosmetics
2. Analysis on the effectiveness of small packets in boosting consumers' consumption pattern – product to be selected by candidate
3. Analysis on the frequency of consumers' consumption pattern-toilet products

4. Comparative analysis on the consumer preference on buying the national and store brands of grocery products – Eg.: Atta
5. Survey on the factors that influence the consumer preference of brands and consumption pattern-Eg.: Biscuits.

Consumer durables

1. Analysis on the relationship between price and features in influencing consumer buying decision – product to be selected by candidate
2. Analysis on the consumers' opinion on exchange promotion scheme - Any white goods such as Fridge
3. Comparative analysis on the factors that influence customer to buy two wheelers
Eg.: Victor V/s Passion
4. Analysis on the decision making pattern in a family in buying consumer durables
5. Analysis on the consumer's opinion on buying extra Television to a home in the emerging scenario of multiple private channels.

Production Management

1. Manufacturing Process
2. Plan Layout study
3. Material Handling facilities Vs Cost saving
4. Production Planning & Control – Various functions
5. Production Scheduling
6. Resource Planning – Use of software
7. Shop Floor Planning & Control – Stagewise progress study
8. Quality Control – Methods, tools adopted
9. Materials management – Procurement process
10. Purchasing, Purchasing policies
11. Materials Storing methods
12. Inventory Management – Example: JIT, ABC or VED analysis

Financial Management

1. Collection Mechanism adopted by the organization
2. Credit Policies Adopted
3. Inventory Management Practices followed by the organization

4. Banking Operations of Financial Transactions
5. Funds flow and Cash flow exercises
6. Budgetary Control in operation
7. Taxation - Corporate & Excise
8. Determination of cost production - procedures & practices
9. Internal Audit & Control mechanism adopted
10. Mobilisation & Deployment of Funds
11. Mutual Fund Performance evaluation
12. Investors Perception about any given financial products/services
13. Branch Profitability of a particular Bank
14. Working Capital Management
15. Housing loan Bank performance evaluation
16. Evaluation of Insurance Schemes
17. Awareness of Derivative Trading practice

23.5 FORMATS

Contents of the report

1. Title page
2. Declaration by the student
3. Guides certificate
4. Acknowledgement
5. Table of content
6. List of tables
7. List of graphs
8. Executive summary
9. Introduction
10. Research design and methodology
11. Theoretical perspective of the study

12. Company and industry profile
13. Data analysis and interpretation
14. Summary of findings and recommendations
15. Bibliography
16. Appendix
 - i. Questionnaire
 - ii. Project related paper cuttings
 - iii. Pictures and diagrams related to project
 - iv. Any other relevant things

Title page

A Report on
"Assessment of Employee Satisfaction towards Existing Performance Appraisal
System"

(With reference to -----)

In partial fulfillment of the requirement of the award of the degree of
Degree to be awarded

Submitted by
Name of the Student

Under the Guidance of
Name of the Guide

Emblem of the
University or
Institute

Name & Address of the University or Institute
Month & Year of submission

Format of Student's Declaration

I hereby declare that the project entitled _____
_____ is prepared by me under the guidance of Mr. _____
_____ (Name of the Internal Guide).

I also declare that this project is towards the partial fulfillment of the requirement for the degree of _____ Degree in Business Management of _____ University has been the result of my own efforts and this project has not been formed a basis for the award of any other degree or any other university.

Place:

Date:

Candidate's name with signature

Format of Certificate of Project Guide

This is to certify that the project report entitled-----
----- has been prepared by Mr. -----in
partial fulfillment of the requirement for the award of ----- Degree in Business
Management from ----- University and has been carried out **under my supervision
and guidance** and that no part of report has been submitted for the award of any other
degree /diploma.

Place:

Date:

Signature of Project Guide

Format of Acknowledgement

I am extremely grateful to Mr. -----() for giving me an opportunity to do the research project in your esteemed organization.

I would like to express my deep gratitude and sincere thanks to our faculty Mr. ----- for his encouragement and guidance through out the period of this study.

My special thanks to the Principal for his supportive role and advice and valuable suggestions which helped me.

Finally I thank all other faculty members of the institute for their constant support without which study would not have been successful.

Place:

Date:

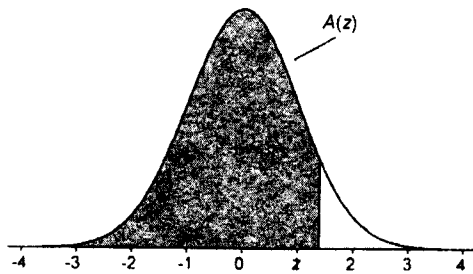
Candidate's name with signature

Statistical Tables

In this chapter, the following tables are presented:

- ❖ Cumulative normal distribution
- ❖ Critical values of the t distribution
- ❖ Critical values of the F distribution
- ❖ Critical values of the chi-squared distribution
- ❖ Critical values of D in the Kolmogorov-Smirnov One-sample Test
- ❖ Critical values of r in the Runs Test
- ❖ Critical values of t in the Wilcoxon matched-pairs Signed-ranks Test
- ❖ Critical values of KD in the Kolmogorov-Smirnov Two-sample Test
- ❖ Critical values of D in the Kolmogorov-Smirnov Two-sample Test
- ❖ Table of Probabilities associated with values as large as observed values of C_r^2 in the Friedman Two-way Analysis of Variance by ranks $k=3$
- ❖ Table of Probabilities associated with values as large as observed values of H in the Kruskal One-way Analysis of Variance by ranks
- ❖ Table of Critical values of r_s the Spearman rank correlation coefficient
- ❖ Table of Critical Factorials
- ❖ Table of Binomial coefficient

Cumulative Standardized Normal Distribution



$A(z)$ is the integral of the standardized normal distribution from $-\infty$ to z (in other words, the area under the curve to the left of z). It gives the probability of a normal random variable not being more than z standard deviations above its mean. Values of z of particular importance:

z	$A(z)$	
1.645	0.9500	Lower limit of right 5% tail
1.960	0.9750	Lower limit of right 2.5% tail
2.326	0.9900	Lower limit of right 1% tail
2.576	0.9950	Lower limit of right 0.5% tail
3.090	0.9990	Lower limit of right 0.1% tail
3.291	0.9995	Lower limit of right 0.05% tail

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.6	0.9998	0.9998	0.9999							

F Distribution: Critical Values of F (5% significance level)

v_1	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20
1	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54	241.88	243.91	245.36	246.46	247.32	248.01
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.41	19.42	19.43	19.44	19.45
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.71	8.69	8.67	8.66
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.87	5.84	5.82	5.80
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.64	4.60	4.58	4.56
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.96	3.92	3.90	3.87
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.53	3.49	3.47	3.44
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.24	3.20	3.17	3.15
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.03	2.99	2.96	2.94
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.86	2.83	2.80	2.77
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.74	2.70	2.67	2.65
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.64	2.60	2.57	2.54
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.55	2.51	2.48	2.46
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.48	2.44	2.41	2.39
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.42	2.38	2.35	2.33
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.37	2.33	2.30	2.28
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.33	2.29	2.26	2.23
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.29	2.25	2.22	2.19
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.26	2.21	2.18	2.16
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.22	2.18	2.15	2.12
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.20	2.16	2.12	2.10
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.17	2.13	2.10	2.07
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.15	2.11	2.08	2.05
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.13	2.09	2.05	2.03
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.11	2.07	2.04	2.01
26	4.22	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.15	2.09	2.05	2.02	1.99
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20	2.13	2.08	2.04	2.00	1.97
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19	2.12	2.06	2.02	1.99	1.96
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18	2.10	2.05	2.01	1.97	1.94
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.04	1.99	1.96	1.93
35	4.12	3.27	2.87	2.64	2.49	2.37	2.29	2.22	2.16	2.11	2.04	1.99	1.94	1.91	1.88
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.95	1.90	1.87	1.84
50	4.03	3.18	2.79	2.56	2.40	2.29	2.20	2.13	2.07	2.03	1.95	1.89	1.85	1.81	1.78
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.86	1.82	1.78	1.75
70	3.98	3.13	2.74	2.50	2.35	2.23	2.14	2.07	2.02	1.97	1.89	1.84	1.79	1.75	1.72
80	3.96	3.11	2.72	2.49	2.33	2.21	2.13	2.06	2.00	1.95	1.88	1.82	1.77	1.73	1.70
90	3.95	3.10	2.71	2.47	2.32	2.20	2.11	2.04	1.99	1.94	1.86	1.80	1.76	1.72	1.69
100	3.94	3.09	2.70	2.46	2.31	2.19	2.10	2.03	1.97	1.93	1.85	1.79	1.75	1.71	1.68
120	3.92	3.07	2.68	2.45	2.29	2.18	2.09	2.02	1.96	1.91	1.83	1.78	1.73	1.69	1.66
150	3.90	3.06	2.66	2.43	2.27	2.16	2.07	2.00	1.94	1.89	1.82	1.76	1.71	1.67	1.64
200	3.89	3.04	2.65	2.42	2.26	2.14	2.06	1.98	1.93	1.88	1.80	1.74	1.69	1.66	1.62
250	3.88	3.03	2.64	2.41	2.25	2.13	2.05	1.98	1.92	1.87	1.79	1.73	1.68	1.65	1.61
300	3.87	3.03	2.63	2.40	2.24	2.13	2.04	1.97	1.91	1.86	1.78	1.72	1.68	1.64	1.61
400	3.86	3.02	2.63	2.39	2.24	2.12	2.03	1.96	1.90	1.85	1.78	1.72	1.67	1.63	1.60
500	3.86	3.01	2.62	2.39	2.23	2.12	2.03	1.96	1.90	1.85	1.77	1.71	1.66	1.62	1.59
600	3.86	3.01	2.62	2.39	2.23	2.11	2.02	1.95	1.90	1.85	1.77	1.71	1.66	1.62	1.59
750	3.85	3.01	2.62	2.38	2.23	2.11	2.02	1.95	1.89	1.84	1.77	1.70	1.66	1.62	1.58
1000	3.85	3.00	2.61	2.38	2.22	2.11	2.02	1.95	1.89	1.84	1.76	1.70	1.65	1.61	1.58

t Distribution: Critical Values of t

Degrees of freedom	Two-tailed test: One-tailed test:	Significance level					
		10% 5%	5% 2.5%	2% 1%	1% 0.5%	0.2% 0.1%	0.1% 0.05%
1		6.314	12.706	31.821	63.657	318.309	636.619
2		2.920	4.303	6.965	9.925	22.327	31.599
3		2.353	3.182	4.541	5.841	10.215	12.924
4		2.132	2.776	3.747	4.604	7.173	8.610
5		2.015	2.571	3.365	4.032	5.893	6.869
6		1.943	2.447	3.143	3.707	5.208	5.959
7		1.894	2.365	2.998	3.499	4.785	5.408
8		1.860	2.306	2.896	3.355	4.501	5.041
9		1.833	2.262	2.821	3.250	4.297	4.781
10		1.812	2.228	2.764	3.169	4.144	4.587
11		1.796	2.201	2.718	3.106	4.025	4.437
12		1.782	2.179	2.681	3.055	3.930	4.318
13		1.771	2.160	2.650	3.012	3.852	4.221
14		1.761	2.145	2.624	2.977	3.787	4.140
15		1.753	2.131	2.602	2.947	3.733	4.073
16		1.746	2.120	2.583	2.921	3.686	4.015
17		1.740	2.110	2.567	2.898	3.646	3.965
18		1.734	2.101	2.552	2.878	3.610	3.922
19		1.729	2.093	2.539	2.861	3.579	3.883
20		1.725	2.086	2.528	2.845	3.552	3.850
21		1.721	2.080	2.518	2.831	3.527	3.819
22		1.717	2.074	2.508	2.819	3.505	3.792
23		1.714	2.069	2.500	2.807	3.485	3.768
24		1.711	2.064	2.492	2.797	3.467	3.745
25		1.708	2.060	2.485	2.787	3.450	3.725
26		1.706	2.056	2.479	2.779	3.435	3.707
27		1.703	2.052	2.473	2.771	3.421	3.690
28		1.701	2.048	2.467	2.763	3.408	3.674
29		1.699	2.045	2.462	2.756	3.396	3.659
30		1.697	2.042	2.457	2.750	3.385	3.646
32		1.694	2.037	2.449	2.738	3.365	3.622
34		1.691	2.032	2.441	2.728	3.348	3.601
36		1.688	2.028	2.434	2.719	3.333	3.582
38		1.686	2.024	2.429	2.712	3.319	3.566
40		1.684	2.021	2.423	2.704	3.307	3.551
42		1.682	2.018	2.418	2.698	3.296	3.538
44		1.680	2.015	2.414	2.692	3.286	3.526
46		1.679	2.013	2.410	2.687	3.277	3.515
48		1.677	2.011	2.407	2.682	3.269	3.505
50		1.676	2.009	2.403	2.678	3.261	3.496
60		1.671	2.000	2.390	2.660	3.232	3.460
70		1.667	1.994	2.381	2.648	3.211	3.435
80		1.664	1.990	2.374	2.639	3.195	3.416
90		1.662	1.987	2.368	2.632	3.183	3.402
100		1.660	1.984	2.364	2.626	3.174	3.390
120		1.658	1.980	2.358	2.617	3.160	3.373
150		1.655	1.976	2.351	2.609	3.145	3.357
200		1.653	1.972	2.345	2.601	3.131	3.340
300		1.650	1.968	2.339	2.592	3.118	3.323
400		1.649	1.966	2.336	2.588	3.111	3.315
500		1.648	1.965	2.334	2.586	3.107	3.310
600		1.647	1.964	2.333	2.584	3.104	3.307
-		1.645	1.960	2.326	2.576	3.090	3.291

Continued.....

F Distribution: Critical Values of F (5% significance level)

ν_1	25	30	35	40	50	60	75	100	150	200
1	249.26	250.10	250.69	251.14	251.77	252.20	252.62	253.04	253.46	253.68
2	19.46	19.46	19.47	19.47	19.48	19.48	19.48	19.49	19.49	19.49
3	8.63	8.62	8.60	8.59	8.58	8.57	8.56	8.55	8.54	8.54
4	5.77	5.75	5.73	5.72	5.70	5.69	5.68	5.66	5.65	5.65
5	4.52	4.50	4.48	4.46	4.44	4.43	4.42	4.41	4.39	4.39
6	3.83	3.81	3.79	3.77	3.75	3.74	3.73	3.71	3.70	3.69
7	3.40	3.38	3.36	3.34	3.32	3.30	3.29	3.27	3.26	3.25
8	3.11	3.08	3.06	3.04	3.02	3.01	2.99	2.97	2.96	2.95
9	2.89	2.86	2.84	2.83	2.80	2.79	2.77	2.76	2.74	2.73
10	2.73	2.70	2.68	2.66	2.64	2.62	2.60	2.59	2.57	2.56
11	2.60	2.57	2.55	2.53	2.51	2.49	2.47	2.46	2.44	2.43
12	2.50	2.47	2.44	2.43	2.40	2.38	2.37	2.35	2.33	2.32
13	2.41	2.38	2.36	2.34	2.31	2.30	2.28	2.26	2.24	2.23
14	2.34	2.31	2.28	2.27	2.24	2.22	2.21	2.19	2.17	2.16
15	2.28	2.25	2.22	2.20	2.18	2.16	2.14	2.12	2.10	2.10
16	2.23	2.19	2.17	2.15	2.12	2.11	2.09	2.07	2.05	2.04
17	2.18	2.15	2.12	2.10	2.08	2.06	2.04	2.02	2.00	1.99
18	2.14	2.11	2.08	2.06	2.04	2.02	2.00	1.98	1.96	1.95
19	2.11	2.07	2.05	2.03	2.00	1.98	1.96	1.94	1.92	1.91
20	2.07	2.04	2.01	1.99	1.97	1.95	1.93	1.91	1.89	1.88
21	2.05	2.01	1.98	1.96	1.94	1.92	1.90	1.88	1.86	1.84
22	2.02	1.98	1.96	1.94	1.91	1.89	1.87	1.85	1.83	1.82
23	2.00	1.96	1.93	1.91	1.88	1.86	1.84	1.82	1.80	1.79
24	1.97	1.94	1.91	1.89	1.86	1.84	1.82	1.80	1.78	1.77
25	1.96	1.92	1.89	1.87	1.84	1.82	1.80	1.78	1.76	1.75
26	1.94	1.90	1.87	1.85	1.82	1.80	1.78	1.76	1.74	1.73
27	1.92	1.88	1.86	1.84	1.81	1.79	1.76	1.74	1.72	1.71
28	1.91	1.87	1.84	1.82	1.79	1.77	1.75	1.73	1.70	1.69
29	1.89	1.85	1.83	1.81	1.77	1.75	1.73	1.71	1.69	1.67
30	1.88	1.84	1.81	1.79	1.76	1.74	1.72	1.70	1.67	1.66
35	1.82	1.79	1.76	1.74	1.70	1.68	1.66	1.63	1.61	1.60
40	1.78	1.74	1.72	1.69	1.66	1.64	1.61	1.59	1.56	1.55
50	1.73	1.69	1.66	1.63	1.60	1.58	1.55	1.52	1.50	1.48
60	1.69	1.65	1.62	1.59	1.56	1.53	1.51	1.48	1.45	1.44
70	1.66	1.62	1.59	1.57	1.53	1.50	1.48	1.45	1.42	1.40
80	1.64	1.60	1.57	1.54	1.51	1.48	1.45	1.43	1.39	1.38
90	1.63	1.59	1.55	1.53	1.49	1.46	1.44	1.41	1.38	1.36
100	1.62	1.57	1.54	1.52	1.48	1.45	1.42	1.39	1.36	1.34
120	1.60	1.55	1.52	1.50	1.46	1.43	1.40	1.37	1.33	1.32
150	1.58	1.54	1.50	1.48	1.44	1.41	1.38	1.34	1.31	1.29
200	1.56	1.52	1.48	1.46	1.41	1.39	1.35	1.32	1.28	1.26
250	1.55	1.50	1.47	1.44	1.40	1.37	1.34	1.31	1.27	1.25
300	1.54	1.50	1.46	1.43	1.39	1.36	1.33	1.30	1.26	1.23
400	1.53	1.49	1.45	1.42	1.38	1.35	1.32	1.28	1.24	1.22
500	1.53	1.48	1.45	1.42	1.38	1.35	1.31	1.28	1.23	1.21
600	1.52	1.48	1.44	1.41	1.37	1.34	1.31	1.27	1.23	1.20
750	1.52	1.47	1.44	1.41	1.37	1.34	1.30	1.26	1.22	1.20
1000	1.52	1.47	1.43	1.41	1.36	1.33	1.30	1.26	1.22	1.19

Continued.....

F Distribution: Critical Values of F (1% significance level)

v_1	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20
v_2															
1	4052.18	4999.50	5403.35	5624.58	5763.65	5858.99	5928.36	5981.07	6022.47	6055.85	6106.32	6142.67	6170.10	6191.53	6208.73
2	98.50	99.00	99.17	99.25	99.30	99.33	99.36	99.37	99.39	99.40	99.42	99.43	99.44	99.44	99.45
3	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49	27.35	27.23	27.05	26.92	26.83	26.75	26.69
4	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80	14.66	14.55	14.37	14.25	14.15	14.08	14.02
5	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29	10.16	10.05	9.89	9.77	9.68	9.61	9.55
6	13.75	10.92	9.78	9.15	8.75	8.47	8.26	8.10	7.98	7.87	7.72	7.60	7.52	7.45	7.40
7	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72	6.62	6.47	6.36	6.28	6.21	6.16
8	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91	5.81	5.67	5.56	5.48	5.41	5.36
9	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35	5.26	5.11	5.01	4.92	4.86	4.81
10	10.04	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94	4.85	4.71	4.60	4.52	4.46	4.41
11	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63	4.54	4.40	4.29	4.21	4.15	4.10
12	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39	4.30	4.16	4.05	3.97	3.91	3.86
13	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19	4.10	3.96	3.86	3.78	3.72	3.66
14	8.86	6.51	5.56	5.04	4.69	4.46	4.28	4.14	4.03	3.94	3.80	3.70	3.62	3.56	3.51
15	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89	3.80	3.67	3.56	3.49	3.42	3.37
16	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78	3.69	3.55	3.45	3.37	3.31	3.26
17	8.40	6.11	5.18	4.67	4.34	4.10	3.93	3.79	3.68	3.59	3.46	3.35	3.27	3.21	3.16
18	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.71	3.60	3.51	3.37	3.27	3.19	3.13	3.08
19	8.18	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52	3.43	3.30	3.19	3.12	3.05	3.00
20	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46	3.37	3.23	3.13	3.05	2.99	2.94
21	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.51	3.40	3.31	3.17	3.07	2.99	2.93	2.88
22	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45	3.35	3.26	3.12	3.02	2.94	2.88	2.83
23	7.88	5.66	4.76	4.26	3.94	3.71	3.54	3.41	3.30	3.21	3.07	2.97	2.89	2.83	2.78
24	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26	3.17	3.03	2.93	2.85	2.79	2.74
25	7.77	5.57	4.68	4.18	3.85	3.63	3.46	3.32	3.22	3.13	2.99	2.89	2.81	2.75	2.70
26	7.72	5.53	4.64	4.14	3.82	3.59	3.42	3.29	3.18	3.09	2.96	2.86	2.78	2.72	2.66
27	7.68	5.49	4.60	4.11	3.78	3.56	3.39	3.26	3.15	3.06	2.93	2.82	2.75	2.68	2.63
28	7.64	5.45	4.57	4.07	3.75	3.53	3.36	3.23	3.12	3.03	2.90	2.79	2.72	2.65	2.60
29	7.60	5.42	4.54	4.04	3.73	3.50	3.33	3.20	3.09	3.00	2.87	2.77	2.69	2.63	2.57
30	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.07	2.98	2.84	2.74	2.66	2.60	2.55
35	7.42	5.27	4.40	3.91	3.59	3.37	3.20	3.07	2.96	2.88	2.74	2.64	2.56	2.50	2.44
40	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99	2.89	2.80	2.66	2.56	2.48	2.42	2.37
50	7.17	5.06	4.20	3.72	3.41	3.19	3.02	2.89	2.78	2.70	2.56	2.46	2.38	2.32	2.27
60	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82	2.72	2.63	2.50	2.39	2.31	2.25	2.20
70	7.01	4.92	4.07	3.60	3.29	3.07	2.91	2.78	2.67	2.59	2.45	2.35	2.27	2.20	2.15
80	6.96	4.88	4.04	3.56	3.26	3.04	2.87	2.74	2.64	2.55	2.42	2.31	2.23	2.17	2.12
90	6.93	4.85	4.01	3.53	3.23	3.01	2.84	2.72	2.61	2.52	2.39	2.29	2.21	2.14	2.09
100	6.90	4.82	3.98	3.51	3.21	2.99	2.82	2.69	2.59	2.50	2.37	2.27	2.19	2.12	2.07
120	6.85	4.79	3.95	3.48	3.17	2.96	2.79	2.66	2.56	2.47	2.34	2.23	2.15	2.09	2.03
150	6.81	4.75	3.91	3.45	3.14	2.92	2.76	2.63	2.53	2.44	2.31	2.20	2.12	2.06	2.00
200	6.76	4.71	3.88	3.41	3.11	2.89	2.73	2.60	2.50	2.41	2.27	2.17	2.09	2.03	1.97
250	6.74	4.69	3.86	3.40	3.09	2.87	2.71	2.58	2.48	2.39	2.26	2.15	2.07	2.01	1.95
300	6.72	4.68	3.85	3.38	3.08	2.86	2.70	2.57	2.47	2.38	2.24	2.14	2.06	1.99	1.94
400	6.70	4.66	3.83	3.37	3.06	2.85	2.68	2.56	2.45	2.37	2.23	2.13	2.05	1.98	1.92
500	6.69	4.65	3.82	3.36	3.05	2.84	2.68	2.55	2.44	2.36	2.22	2.12	2.04	1.97	1.92
600	6.68	4.64	3.81	3.35	3.05	2.83	2.67	2.54	2.44	2.35	2.21	2.11	2.03	1.96	1.91
750	6.67	4.63	3.81	3.34	3.04	2.83	2.66	2.53	2.43	2.34	2.21	2.11	2.02	1.96	1.90
1000	6.66	4.63	3.80	3.34	3.04	2.82	2.66	2.53	2.43	2.34	2.20	2.10	2.02	1.95	1.90

Continued.....

F Distribution: Critical Values of F (5% significance level)

v_1	25	30	35	40	50	60	75	100	150	200
1	249.26	250.10	250.69	251.14	251.77	252.20	252.62	253.04	253.46	253.68
2	19.46	19.46	19.47	19.47	19.48	19.48	19.48	19.49	19.49	19.49
3	8.63	8.62	8.60	8.59	8.58	8.57	8.56	8.55	8.54	8.54
4	5.77	5.75	5.73	5.72	5.70	5.69	5.68	5.66	5.65	5.65
5	4.52	4.50	4.48	4.46	4.44	4.43	4.42	4.41	4.39	4.39
6	3.83	3.81	3.79	3.77	3.75	3.74	3.73	3.71	3.70	3.69
7	3.40	3.38	3.36	3.34	3.32	3.30	3.29	3.27	3.26	3.25
8	3.11	3.08	3.06	3.04	3.02	3.01	2.99	2.97	2.96	2.95
9	2.89	2.86	2.84	2.83	2.80	2.79	2.77	2.76	2.74	2.73
10	2.73	2.70	2.68	2.66	2.64	2.62	2.60	2.59	2.57	2.56
11	2.60	2.57	2.55	2.53	2.51	2.49	2.47	2.46	2.44	2.43
12	2.50	2.47	2.44	2.43	2.40	2.38	2.37	2.35	2.33	2.32
13	2.41	2.38	2.36	2.34	2.31	2.30	2.28	2.26	2.24	2.23
14	2.34	2.31	2.28	2.27	2.24	2.22	2.21	2.19	2.17	2.16
15	2.28	2.25	2.22	2.20	2.18	2.16	2.14	2.12	2.10	2.10
16	2.23	2.19	2.17	2.15	2.12	2.11	2.09	2.07	2.05	2.04
17	2.18	2.15	2.12	2.10	2.08	2.06	2.04	2.02	2.00	1.99
18	2.14	2.11	2.08	2.06	2.04	2.02	2.00	1.98	1.96	1.95
19	2.11	2.07	2.05	2.03	2.00	1.98	1.96	1.94	1.92	1.91
20	2.07	2.04	2.01	1.99	1.97	1.95	1.93	1.91	1.89	1.88
21	2.05	2.01	1.98	1.96	1.94	1.92	1.90	1.88	1.86	1.84
22	2.02	1.98	1.96	1.94	1.91	1.89	1.87	1.85	1.83	1.82
23	2.00	1.96	1.93	1.91	1.88	1.86	1.84	1.82	1.80	1.79
24	1.97	1.94	1.91	1.89	1.86	1.84	1.82	1.80	1.78	1.77
25	1.96	1.92	1.89	1.87	1.84	1.82	1.80	1.78	1.76	1.75
26	1.94	1.90	1.87	1.85	1.82	1.80	1.78	1.76	1.74	1.73
27	1.92	1.88	1.86	1.84	1.81	1.79	1.76	1.74	1.72	1.71
28	1.91	1.87	1.84	1.82	1.79	1.77	1.75	1.73	1.70	1.69
29	1.89	1.85	1.83	1.81	1.77	1.75	1.73	1.71	1.69	1.67
30	1.88	1.84	1.81	1.79	1.76	1.74	1.72	1.70	1.67	1.66
35	1.82	1.79	1.76	1.74	1.70	1.68	1.66	1.63	1.61	1.60
40	1.78	1.74	1.72	1.69	1.66	1.64	1.61	1.59	1.56	1.55
50	1.73	1.69	1.66	1.63	1.60	1.58	1.55	1.52	1.50	1.48
60	1.69	1.65	1.62	1.59	1.56	1.53	1.51	1.48	1.45	1.44
70	1.66	1.62	1.59	1.57	1.53	1.50	1.48	1.45	1.42	1.40
80	1.64	1.60	1.57	1.54	1.51	1.48	1.45	1.43	1.39	1.38
90	1.63	1.59	1.55	1.53	1.49	1.46	1.44	1.41	1.38	1.36
100	1.62	1.57	1.54	1.52	1.48	1.45	1.42	1.39	1.36	1.34
120	1.60	1.55	1.52	1.50	1.46	1.43	1.40	1.37	1.33	1.32
150	1.58	1.54	1.50	1.48	1.44	1.41	1.38	1.34	1.31	1.29
200	1.56	1.52	1.48	1.46	1.41	1.39	1.35	1.32	1.28	1.26
250	1.55	1.50	1.47	1.44	1.40	1.37	1.34	1.31	1.27	1.25
300	1.54	1.50	1.46	1.43	1.39	1.36	1.33	1.30	1.26	1.23
400	1.53	1.49	1.45	1.42	1.38	1.35	1.32	1.28	1.24	1.22
500	1.53	1.48	1.45	1.42	1.38	1.35	1.31	1.28	1.23	1.21
600	1.52	1.48	1.44	1.41	1.37	1.34	1.31	1.27	1.23	1.20
750	1.52	1.47	1.44	1.41	1.37	1.34	1.30	1.26	1.22	1.20
1000	1.52	1.47	1.43	1.41	1.36	1.33	1.30	1.26	1.22	1.19

Continued.....

F Distribution: Critical Values of F (1% significance level)

v_1	25	30	35	40	50	60	75	100	150	200
v_2	6239.83	6260.65	6275.57	6286.78	6302.52	6313.03	6323.56	6334.11	6344.68	6349.97
2	99.46	99.47	99.47	99.47	99.48	99.48	99.49	99.49	99.49	99.49
3	26.58	26.50	26.45	26.41	26.35	26.32	26.28	26.24	26.20	26.18
4	13.91	13.84	13.79	13.75	13.69	13.65	13.61	13.58	13.54	13.52
5	9.45	9.38	9.33	9.29	9.24	9.20	9.17	9.13	9.09	9.08
6	7.30	7.23	7.18	7.14	7.09	7.06	7.02	6.99	6.95	6.93
7	6.06	5.99	5.94	5.91	5.86	5.82	5.79	5.75	5.72	5.70
8	5.26	5.20	5.15	5.12	5.07	5.03	5.00	4.96	4.93	4.91
9	4.71	4.65	4.60	4.57	4.52	4.48	4.45	4.41	4.38	4.36
10	4.31	4.25	4.20	4.17	4.12	4.08	4.05	4.01	3.98	3.96
11	4.01	3.94	3.89	3.86	3.81	3.78	3.74	3.71	3.67	3.66
12	3.76	3.70	3.65	3.62	3.57	3.54	3.50	3.47	3.43	3.41
13	3.57	3.51	3.46	3.43	3.38	3.34	3.31	3.27	3.24	3.22
14	3.41	3.35	3.30	3.27	3.22	3.18	3.15	3.11	3.08	3.06
15	3.28	3.21	3.17	3.13	3.08	3.05	3.01	2.98	2.94	2.92
16	3.16	3.10	3.05	3.02	2.97	2.93	2.90	2.86	2.83	2.81
17	3.07	3.00	2.96	2.92	2.87	2.83	2.80	2.76	2.73	2.71
18	2.98	2.92	2.87	2.84	2.78	2.75	2.71	2.68	2.64	2.62
19	2.91	2.84	2.80	2.76	2.71	2.67	2.64	2.60	2.57	2.55
20	2.84	2.78	2.73	2.69	2.64	2.61	2.57	2.54	2.50	2.48
21	2.79	2.72	2.67	2.64	2.58	2.55	2.51	2.48	2.44	2.42
22	2.73	2.67	2.62	2.58	2.53	2.50	2.46	2.42	2.38	2.36
23	2.69	2.62	2.57	2.54	2.48	2.45	2.41	2.37	2.34	2.32
24	2.64	2.58	2.53	2.49	2.44	2.40	2.37	2.33	2.29	2.27
25	2.60	2.54	2.49	2.45	2.40	2.36	2.33	2.29	2.25	2.23
26	2.57	2.50	2.45	2.42	2.36	2.33	2.29	2.25	2.21	2.19
27	2.54	2.47	2.42	2.38	2.33	2.29	2.26	2.22	2.18	2.16
28	2.51	2.44	2.39	2.35	2.30	2.26	2.23	2.19	2.15	2.13
29	2.48	2.41	2.36	2.33	2.27	2.23	2.20	2.16	2.12	2.10
30	2.45	2.39	2.34	2.30	2.25	2.21	2.17	2.13	2.09	2.07
35	2.35	2.28	2.23	2.19	2.14	2.10	2.06	2.02	1.98	1.96
40	2.27	2.20	2.15	2.11	2.06	2.02	1.98	1.94	1.90	1.87
50	2.17	2.10	2.05	2.01	1.95	1.91	1.87	1.82	1.78	1.76
60	2.10	2.03	1.98	1.94	1.88	1.84	1.79	1.75	1.70	1.68
70	2.05	1.98	1.93	1.89	1.83	1.78	1.74	1.70	1.65	1.62
80	2.01	1.94	1.89	1.85	1.79	1.75	1.70	1.65	1.61	1.58
90	1.99	1.92	1.86	1.82	1.76	1.72	1.67	1.62	1.57	1.55
100	1.97	1.89	1.84	1.80	1.74	1.69	1.65	1.60	1.55	1.52
120	1.93	1.86	1.81	1.76	1.70	1.66	1.61	1.56	1.51	1.48
150	1.90	1.83	1.77	1.73	1.66	1.62	1.57	1.52	1.46	1.43
200	1.87	1.79	1.74	1.69	1.63	1.58	1.53	1.48	1.42	1.39
250	1.85	1.77	1.72	1.67	1.61	1.56	1.51	1.46	1.40	1.36
300	1.84	1.76	1.70	1.66	1.59	1.55	1.50	1.44	1.38	1.35
400	1.82	1.75	1.69	1.64	1.58	1.53	1.48	1.42	1.36	1.32
500	1.81	1.74	1.68	1.63	1.57	1.52	1.47	1.41	1.34	1.31
600	1.80	1.73	1.67	1.63	1.56	1.51	1.46	1.40	1.34	1.30
750	1.80	1.72	1.66	1.62	1.55	1.50	1.45	1.39	1.33	1.29
1000	1.79	1.72	1.66	1.61	1.54	1.50	1.44	1.38	1.32	1.28

Continued.....

F Distribution: Critical Values of F (0.1% significance level)

v_1	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20
v_2	4.05e05	5.00e05	5.40e05	5.62e05	5.76e05	5.86e05	5.93e05	5.98e05	6.02e05	6.06e05	6.11e05	6.14e05	6.17e05	6.19e05	6.21e05
2	998.50	999.00	999.17	999.25	999.30	999.33	999.36	999.37	999.39	999.40	999.42	999.43	999.44	999.44	999.45
3	167.03	148.50	141.11	137.10	134.58	132.85	131.58	130.62	129.86	129.25	128.32	127.64	127.14	126.74	126.42
4	74.14	61.25	56.18	53.44	51.71	50.53	49.66	49.00	48.47	48.05	47.41	46.95	46.60	46.32	46.10
5	47.18	37.12	33.20	31.09	29.75	28.83	28.16	27.65	27.24	26.92	26.42	26.06	25.78	25.57	25.39
6	35.51	27.00	23.70	21.92	20.80	20.03	19.46	19.03	18.69	18.41	17.99	17.68	17.45	17.27	17.12
7	29.25	21.69	18.77	17.20	16.21	15.52	15.02	14.63	14.33	14.08	13.71	13.43	13.23	13.06	12.93
8	25.41	18.49	15.83	14.39	13.48	12.86	12.40	12.05	11.77	11.54	11.19	10.94	10.75	10.60	10.48
9	22.86	16.39	13.90	12.56	11.71	11.13	10.70	10.37	10.11	9.89	9.57	9.33	9.15	9.01	8.90
10	21.04	14.91	12.55	11.28	10.48	9.93	9.52	9.20	8.96	8.75	8.45	8.22	8.05	7.91	7.80
11	19.69	13.81	11.56	10.35	9.58	9.05	8.66	8.35	8.12	7.92	7.63	7.41	7.24	7.11	7.01
12	18.64	12.97	10.80	9.63	8.89	8.38	8.00	7.71	7.48	7.29	7.00	6.79	6.63	6.51	6.40
13	17.82	12.31	10.21	9.07	8.35	7.86	7.49	7.21	6.98	6.80	6.52	6.31	6.16	6.03	5.93
14	17.14	11.78	9.73	8.62	7.92	7.44	7.08	6.80	6.58	6.40	6.13	5.93	5.78	5.66	5.56
15	16.59	11.34	9.34	8.25	7.57	7.09	6.74	6.47	6.26	6.08	5.81	5.62	5.46	5.35	5.25
16	16.12	10.97	9.01	7.94	7.27	6.80	6.46	6.19	5.98	5.81	5.55	5.35	5.20	5.09	4.99
17	15.72	10.66	8.73	7.68	7.02	6.56	6.22	5.96	5.75	5.58	5.32	5.13	4.99	4.87	4.78
18	15.38	10.39	8.49	7.46	6.81	6.35	6.02	5.76	5.56	5.39	5.13	4.94	4.80	4.68	4.59
19	15.08	10.16	8.28	7.27	6.62	6.18	5.85	5.59	5.39	5.22	4.97	4.78	4.64	4.52	4.43
20	14.82	9.95	8.10	7.10	6.46	6.02	5.69	5.44	5.24	5.08	4.82	4.64	4.49	4.38	4.29
21	14.59	9.77	7.94	6.95	6.32	5.88	5.56	5.31	5.11	4.95	4.70	4.51	4.37	4.26	4.17
22	14.38	9.61	7.80	6.81	6.19	5.76	5.44	5.19	4.99	4.83	4.58	4.40	4.26	4.15	4.06
23	14.20	9.47	7.67	6.70	6.08	5.65	5.33	5.09	4.89	4.73	4.48	4.30	4.16	4.05	3.96
24	14.03	9.34	7.55	6.59	5.98	5.55	5.23	4.99	4.80	4.64	4.39	4.21	4.07	3.96	3.87
25	13.88	9.22	7.45	6.49	5.89	5.46	5.15	4.91	4.71	4.56	4.31	4.13	3.99	3.88	3.79
26	13.74	9.12	7.36	6.41	5.80	5.38	5.07	4.83	4.64	4.48	4.24	4.06	3.92	3.81	3.72
27	13.61	9.02	7.27	6.33	5.73	5.31	5.00	4.76	4.57	4.41	4.17	3.99	3.86	3.75	3.66
28	13.50	8.93	7.19	6.25	5.66	5.24	4.93	4.69	4.50	4.35	4.11	3.93	3.80	3.69	3.60
29	13.39	8.85	7.12	6.19	5.59	5.18	4.87	4.64	4.45	4.29	4.05	3.88	3.74	3.63	3.54
30	13.29	8.77	7.05	6.12	5.53	5.12	4.82	4.58	4.39	4.24	4.00	3.82	3.69	3.58	3.49
35	12.90	8.47	6.79	5.88	5.30	4.89	4.59	4.36	4.18	4.03	3.79	3.62	3.48	3.38	3.29
40	12.61	8.25	6.59	5.70	5.13	4.73	4.44	4.21	4.02	3.87	3.64	3.47	3.34	3.23	3.14
50	12.22	7.96	6.34	5.46	4.90	4.51	4.22	4.00	3.82	3.67	3.44	3.27	3.14	3.04	2.95
60	11.97	7.77	6.17	5.31	4.76	4.37	4.09	3.86	3.69	3.54	3.32	3.15	3.02	2.91	2.83
70	11.80	7.64	6.06	5.20	4.66	4.28	3.99	3.77	3.60	3.45	3.23	3.06	2.93	2.83	2.74
80	11.67	7.54	5.97	5.12	4.58	4.20	3.92	3.70	3.53	3.39	3.16	3.00	2.87	2.76	2.68
90	11.57	7.47	5.91	5.06	4.53	4.15	3.87	3.65	3.48	3.34	3.11	2.95	2.82	2.71	2.63
100	11.50	7.41	5.86	5.02	4.48	4.11	3.83	3.61	3.44	3.30	3.07	2.91	2.78	2.68	2.59
120	11.38	7.32	5.78	4.95	4.42	4.04	3.77	3.55	3.38	3.24	3.02	2.85	2.72	2.62	2.53
150	11.27	7.24	5.71	4.88	4.35	3.98	3.71	3.49	3.32	3.18	2.96	2.80	2.67	2.56	2.48
200	11.15	7.15	5.63	4.81	4.29	3.92	3.65	3.43	3.26	3.12	2.90	2.74	2.61	2.51	2.42
250	11.09	7.10	5.59	4.77	4.25	3.88	3.61	3.40	3.23	3.09	2.87	2.71	2.58	2.48	2.39
300	11.04	7.07	5.56	4.75	4.22	3.86	3.59	3.38	3.21	3.07	2.85	2.69	2.56	2.46	2.37
400	10.99	7.03	5.53	4.71	4.19	3.83	3.56	3.35	3.18	3.04	2.82	2.66	2.53	2.43	2.34
500	10.96	7.00	5.51	4.69	4.18	3.81	3.54	3.33	3.16	3.02	2.81	2.64	2.52	2.41	2.33
600	10.94	6.99	5.49	4.68	4.16	3.80	3.53	3.32	3.15	3.01	2.80	2.63	2.51	2.40	2.32
750	10.91	6.97	5.48	4.67	4.15	3.79	3.52	3.31	3.14	3.00	2.78	2.62	2.49	2.39	2.31
1000	10.89	6.96	5.46	4.65	4.14	3.78	3.51	3.30	3.13	2.99	2.77	2.61	2.48	2.38	2.30

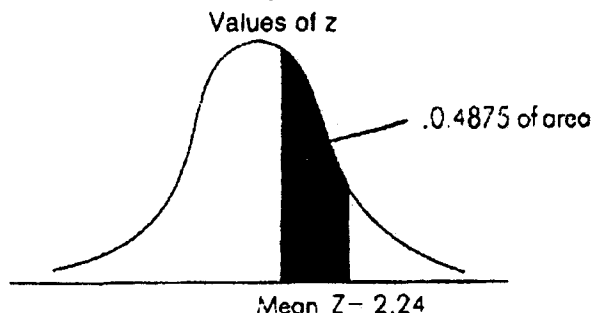
χ^2 (Chi-Squared) Distribution: Critical Values of χ^2

<i>Degrees of freedom</i>	<i>Signific ance level</i>		
	5%	1%	0.1%
1	3.841	6.635	10.828
2	5.991	9.210	13.816
3	7.815	11.345	16.266
4	9.488	13.277	18.467
5	11.070	15.086	20.515
6	12.592	16.812	22.458
7	14.067	18.475	24.322
8	15.507	20.090	26.124
9	16.919	21.666	27.877
10	18.307	23.209	29.588

Table of Critical Values of D in the Kolmogorov-Smirnov One-sample Test

Sample size (N)	Level of significance for $D = \text{maximum } F_d(X) - S_N(X) $				
	.20	.15	.10	.05	.01
1	.900	.925	.950	.975	.995
2	.684	.726	.776	.842	.929
3	.565	.597	.642	.708	.828
4	.949	.525	.564	.624	.733
5	.446	.474	.510	.565	.669
6	.410	.436	.470	.521	.618
7	.381	.405	.438	.486	.577
8	.358	.381	.411	.457	.543
9	.339	.360	.388	.432	.514
10	.322	.342	.368	.410	.490
11	.307	.326	.352	.391	.468
12	.295	.313	.338	.375	.450
13	.284	.302	.325	.361	.433
14	.274	.292	.314	.349	.418
15	.266	.283	.304	.338	.404
16	.258	.274	.296	.328	.392
17	.250	.266	.288	.318	.381
18	.244	.259	.278	.309	.371
19	.237	.252	.272	.301	.363
20	.231	.246	.264	.294	.356
25	.21	.22	.24	.27	.32
30	.19	.20	.22	.24	.29
35	.18	.19	.21	.23	.27
Over 35	$\frac{1.07}{\sqrt{N}}$	$\frac{1.14}{\sqrt{N}}$	$\frac{1.22}{\sqrt{N}}$	$\frac{1.36}{\sqrt{N}}$	$\frac{1.63}{\sqrt{N}}$

Areas Under the Standard Normal Probability Distribution between the Mean and Positive



Example:

To find the area under the curve between the mean and a point 2.24 standard deviation to the right of the mean, look up the value opposite 2.2 and under 0.04 in the table; 0.4875 of the area under the curve lies between the mean and a z value of 2.24.

%	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3848	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4335	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4939
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4926	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990

Table of Critical Values of r in the Runs Test

$n_1 \backslash n_2$	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2											2	2	2	2	2	2	2	2	2
3					2	2	2	2	2	2	2	2	2	3	3	3	3	3	3
4				2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4
5			2	2	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5
6		2	2	3	3	3	3	4	4	4	4	5	5	5	5	5	6	6	6
7		2	2	3	3	3	4	4	5	5	5	5	5	6	6	6	6	6	6
8		2	3	3	3	4	4	5	5	5	6	6	6	6	6	7	7	7	7
9		2	3	3	4	4	5	5	5	6	6	6	7	7	7	7	8	8	8
10		2	3	3	4	5	5	5	6	6	7	7	7	7	8	8	8	8	9
11		2	3	4	4	5	5	6	6	7	7	7	8	8	8	9	9	9	9
12	2	2	3	4	4	5	6	6	7	7	7	8	8	8	9	9	9	10	10
13	2	2	3	4	5	5	6	6	7	7	8	8	9	9	9	10	10	10	10
14	2	2	3	4	5	5	6	7	7	8	8	9	9	9	10	10	10	11	11
15	2	3	3	4	5	6	6	7	7	8	8	9	9	10	10	11	11	11	12
16	2	3	4	4	5	6	6	7	8	8	9	9	10	10	11	11	11	12	12
17	2	3	4	4	5	6	7	7	8	9	9	10	10	11	11	11	12	12	13
18	2	3	4	5	5	6	7	8	8	9	9	10	10	11	11	12	12	13	13
19	2	3	4	5	6	6	7	8	8	9	10	10	11	11	12	12	13	13	13
20	2	3	4	5	6	6	7	8	9	9	10	10	11	12	12	13	13	13	14

Table of Critical Values of r in the Runs Test (Continued)

$n_2 \backslash n_1$	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
2																				
3																				
4				9	9															
5			9	10	10	11	11													
6			9	10	11	12	12	13	13	13	13									
7				11	12	13	13	14	14	14	14	15	15	15						
8				11	12	13	14	14	15	15	16	16	16	17	17	17	17	17	17	17
9					13	14	14	15	16	16	16	17	17	18	18	18	18	18	18	18
10					13	14	15	16	16	17	17	18	18	18	19	19	19	20	20	20
11					13	14	15	16	17	17	18	19	19	19	20	20	20	21	21	21
12					13	14	16	16	17	18	19	19	20	20	21	21	21	22	22	22
13						15	16	17	18	19	19	20	20	21	21	22	22	23	23	23
14						15	16	17	18	19	20	20	21	22	22	23	23	23	24	24
15						15	16	18	18	19	20	21	22	22	23	23	24	24	25	25
16							17	18	19	20	21	21	22	23	23	24	25	25	25	25
17							17	18	19	20	21	22	23	23	24	25	25	26	26	26
18							17	18	19	20	21	22	23	24	25	25	26	26	27	27
19							17	18	20	21	22	23	23	24	25	26	26	27	27	27
20							17	18	20	21	22	23	24	25	25	26	27	27	28	28

Table of Critical Values of t in the Wilcoxon Matched-pairs Signed-ranks Test

n	Level of significance for one-tailed test		
	0.25	.01	.005
	Level of significance for two-tailed test		
	.05	.02	.01
6	0	—	—
7	2	0	—
8	4	2	0
9	6	3	2
10	8	5	3
11	11	7	5
12	14	10	7
13	17	13	10
14	21	16	13
15	25	20	16
16	30	24	20
17	35	28	23
18	40	33	28
19	46	38	32
20	52	43	38
21	59	49	43
22	66	56	49
23	73	62	55
24	81	69	61
25	89	77	68

Table of Critical Values of K_D in the Kolmogorov-Smirnov Two-Sample Test
(Small Sample)

N	One-tailed test		Two-tailed test	
	$\alpha = .05$	$\alpha = .01$	$\alpha = .05$	$\alpha = .01$
3	3	—	—	—
4	4	—	4	—
5	4	5	5	5
6	5	6	6	6
7	5	6	6	6
8	5	6	6	7
9	6	7	6	7
10	6	7	7	8
11	6	8	7	8
12	6	8	7	8
13	7	8	7	9
14	7	8	8	9
15	7	9	8	9
16	7	9	8	10
17	8	9	8	10
18	8	10	9	10
19	8	10	9	10
20	8	10	9	11
21	8	10	9	11
22	9	11	9	11
23	9	11	10	11
24	9	11	10	12
25	9	11	10	12
26	9	11	10	12
27	9	12	10	12
28	10	12	11	13
29	10	12	11	13
30	10	12	11	13
35	11	13	12	
40	11	14	13	

**Table of Critical Values of D in the Kolmogorov-Smirnov Two-Sample Test
(Large Samples: Two-tailed Test)**

Level of significance	Value of D so large as to call for rejection of H_0 at the indicated level of significance, where $D = \text{maximum } S_{n_1}(X) - S_{n_2}(X) $
.10	1.22 $\sqrt{\frac{n_1 + n_2}{n_1 n_2}}$
.05	1.36 $\sqrt{\frac{n_1 + n_2}{n_1 n_2}}$
.025	1.48 $\sqrt{\frac{n_1 + n_2}{n_1 n_2}}$
.01	1.63 $\sqrt{\frac{n_1 + n_2}{n_1 n_2}}$
.005	1.73 $\sqrt{\frac{n_1 + n_2}{n_1 n_2}}$
.001	1.95 $\sqrt{\frac{n_1 + n_2}{n_1 n_2}}$

Table of Probabilities Associated with Values as Large as Observed Values of Cr^2 in the Friedman Two-way Analysis of Variance by Ranks $k = 3$

N = 2		N = 3		N = 4		N = 5	
Cr^2	p	Cr^2	p	Cr^2	p	Cr^2	p
0	1.000	.000	1.000	.0	1.000	.0	1.000
1	.833	.667	.944	.5	.931	.4	.954
3	.500	2.000	.528	1.5	.653	1.2	.691
4	.167	2.667	.361	2.0	.431	1.6	.522
		4.667	.194	3.5	.273	2.8	.367
		6.000	.028	4.5	.125	3.6	.182
				6.0	.069	4.8	.124
				6.5	.042	5.2	.093
				8.0	.0046	6.4	.039
						7.6	.024
						8.4	.0085
						10.0	.00077

N = 6		N = 7		N = 8		N = 9	
Cr^2	p	Cr^2	p	Cr^2	p	Cr^2	p
.00	1.000	.000	1.000	.00	1.000	.000	1.000
.33	.956	.286	.964	.25	.967	.222	.971
1.00	.740	.857	.768	.75	.794	.667	.814
1.33	.570	1.143	.620	1.00	.654	.889	.865
2.33	.430	2.000	.486	1.75	.531	1.556	.569
3.00	.252	2.571	.305	2.25	.355	2.000	.398
4.00	.184	3.429	.237	3.00	.285	2.667	.328
4.33	.142	3.714	.192	3.25	.236	2.889	.278
5.33	.072	4.571	.112	4.00	.149	3.556	.187
6.33	.052	5.429	.085	4.75	.120	4.222	.154
7.00	.029	6.000	.052	5.25	.079	4.667	.107
8.33	.012	7.143	.027	6.25	.047	5.556	.069
9.00	.0081	7.714	.021	6.75	.038	6.000	.057
9.33	.0055	8.000	.016	7.00	.030	6.222	.048
10.33	.0017	8.857	.0084	7.75	.018	6.889	.031
12.00	.00013	10.286	.0036	9.00	.0099	8.000	.019
		10.571	.0027	9.25	.0080	8.222	.016
		11.143	.0012	9.75	.0048	8.667	.010
		12.286	.00032	10.75	.0024	9.556	.0060
		14.000	.000021	12.00	.0011	10.667	.0035
				12.25	.00086	10.889	.0029
				13.00	.00026	11.556	.0013
				14.25	.000061	12.667	.00066
				16.00	.0000036	13.556	.00035
						14.000	.00020
						14.222	.000097
						14.889	.000054
						16.222	.000011
						18.000	.000006

(Continued)

N = 2		N = 3		N = 4			
Cr ²	p	Cr ²	p	Cr ²	p	Cr ²	p
.0	1.000	.2	1.000	.0	1.000	5.7	.141
.6	.958	.6	.958	.3	.992	6.0	.105
1.2	.834	1.0	.910	.6	.928	6.3	.094
1.8	.792	1.8	.727	.9	.900	6.6	.077
2.4	.625	2.2	.608	1.2	.800	6.9	.068
3.0	.542	2.6	.524	1.5	.754	7.2	.054
3.6	.458	3.4	.446	1.8	.677	7.5	.052
4.2	.375	3.8	.342	2.1	.649	7.8	.036
4.8	.208	4.2	.300	2.4	.524	8.1	.033
5.4	.167	5.0	.207	2.7	.508	8.4	.019
6.0	.042	5.4	.175	3.0	.432	8.7	.014
		5.8	.148	3.3	.389	9.3	.012
		6.6	.075	3.6	.355	9.6	.0069
		7.0	.054	3.9	.324	9.9	.0062
		7.4	.033	4.5	.242	10.2	.0027
		8.2	.017	4.8	.200	10.8	.0016
		9.0	.0017	5.1	.190	11.1	.00094
				5.4	.158	12.0	.000072

Table of Probabilities Associated with Values as Large as Observed Values of H in the Kruskal-Wallis One-way Analysis of Variance by Ranks

Sample sizes			H	p	Sample sizes			H	p
n_1	n_2	n_3			n_1	n_2	n_3		
2	1	2	2.7000	.500	4	3	2	6.4444	.008
2	2	1	3.6000	.200				6.3000	.011
2	2	2	4.5714	.067				5.4444	.046
			3.7143	.200				5.4000	.051
								4.5111	.098
								4.4444	.102
3	1	1	3.2000	.300					
3	2	1	4.2857	.100	4	3	3	6.7455	.010
			3.8571	.133				6.7091	.013
								5.7909	.046
								5.7273	.050
3	2	2	5.3572	.029				4.7091	.092
			4.7143	.048				4.7000	.101
			4.5000	.067					
			4.4643	.105	4	4	1	6.6667	.010
3	3	1	5.1429	.043				6.1667	.022
			4.5714	.100				4.9667	.048
			4.0000	.129				4.8667	.054
								4.1667	.082
								4.0667	.102
3	3	2	6.2500	.011					
			5.3611	.032					
			5.1389	.061	4	4	2	7.0364	.006
			4.5556	.100				6.8727	.011
			4.2500	.121				5.4545	.046
								5.2364	.052
3	3	3	7.2000	.004				4.5545	.098
			6.4889	.011				4.4455	.103
			5.6889	.029					
			5.6000	.050	4	4	3	7.1439	.010
			5.0667	.086				7.1364	.011
			4.6222	.100				5.5985	.049
								5.5758	.051
4	1	1	3.5714	.200				4.5455	.099
								4.4773	.102
4	2	1	4.8214	.057					
			4.5000	.076	4	4	4	7.6538	.008
			4.0179	.114				7.5385	.011
								5.6923	.049
4	2	2	6.0000	.014				5.6538	.054
			5.3333	.033				4.6539	.097
			5.1250	.052				4.5001	.104
			4.4583	.100					
			4.1667	.105	5	1	1	3.8571	.143
4	3	1	5.8333	.021	5	2		5.2500	.036
			5.2083	.050				5.0000	.048
			5.0000	.057				4.4500	.071
			4.0556	.093				4.2000	.095
			3.8889	.129				4.0500	.119

(Continued)

Sample sizes			H	p	Sample sizes			H	p
n_1	n_2	n_3			n_1	n_2	n_3		
5	2	2	6.5333	.008	5	4	4	5.6308	.050
			6.1333	.013				4.5487	.099
			5.1600	.034				4.5231	.103
5	3	1	5.0400	.056	5	5	1	7.7604	.009
			4.3733	.090				7.7440	.011
			4.2933	.122				5.6571	.049
			6.4000	.012				5.6176	.050
5	3	2	4.9600	.048	5	5	2	4.6187	.100
			4.8711	.052				4.5527	.102
			4.0178	.095				7.3091	.009
			3.8400	.123				6.8364	.011
5	3	3	5.1273	.046	5	5	3	5.1273	.046
			6.9091	.009				4.9091	.053
			6.8218	.010				4.1091	.086
			5.2509	.049				4.0364	.105
5	4	1	5.1055	.052	5	5	4	7.3385	.010
			4.6509	.091				7.2692	.010
			4.4945	.101				5.3385	.047
			7.0788	.009				5.2462	.051
5	4	2	6.9818	.011	5	5	5	4.6231	.097
			5.6485	.049				4.5077	.100
			5.5152	.051				7.5780	.010
			4.5333	.097				7.5429	.010
5	4	3	4.4121	.109	5	5	5	5.7055	.046
			6.9545	.008				5.6264	.051
			6.8400	.011				4.5451	.100
			4.9855	.044				4.5363	.102
5	4	2	4.8600	.056	5	5	5	7.8229	.010
			3.9873	.098				7.7914	.010
			3.9600	.102				5.6657	.049
			7.2045	.009				5.6429	.050
5	4	3	7.1182	.010	5	5	5	4.5229	.099
			5.2727	.049				4.5200	.101
			5.2682	.050				8.0000	.009
			4.5409	.098				7.9800	.010
5	4	3	4.5182	.101	5	4	3	5.7800	.049
			7.4449	.010				5.6600	.051
			7.3949	.011				4.5600	.100
			5.6564	.049				4.5000	.102

Table of Critical Values of r_s , the Spearman Rank Correlation Coefficient

N	Significance Level (one-tailed test)	
	.05	.01
4	1.000	
5	.900	1.000
6	.829	.943
7	.714	.893
8	.643	.833
9	.600	.783
10	.564	.746
12	.506	.712
14	.456	.645
16	.425	.601
18	.399	.564
20	.377	.534
22	.359	.508
24	.343	.485
26	.329	.465
28	.317	.448
30	.306	.432

Table of Critical Factorials

N	NI
0	1
1	1
2	2
3	6
4	24
5	120
6	720
7	5040
8	40320
9	362880
10	3628800
11	39916800
12	479001600
13	6227020800
14	87178291200
15	1307674368000
16	20922789888000
17	355687428096000
18	6402373705728000
19	121645100408832000
20	2432902008176640000

Table of Binomial Coefficients

N	$\binom{N}{0}$	$\binom{N}{1}$	$\binom{N}{2}$	$\binom{N}{3}$	$\binom{N}{4}$	$\binom{N}{5}$	$\binom{N}{6}$	$\binom{N}{7}$	$\binom{N}{8}$	$\binom{N}{9}$	$\binom{N}{10}$
0	1										
1	1	1									
2	1	2	1								
3	1	3	3	1							
4	1	4	6	4	1						
5	1	5	10	10	5	1					
6	1	6	15	20	15	6	1				
7	1	7	21	35	35	21	7	1			
8	1	8	28	56	70	56	28	8	1		
9	1	9	36	84	126	126	84	36	9	1	
10	1	10	45	120	210	252	210	120	45	10	1
11	1	11	55	165	330	462	462	330	165	55	11
12	1	12	66	220	495	792	924	792	495	220	66
13	1	13	78	286	715	1287	1716	1716	1287	715	286
14	1	14	91	364	1001	2002	3003	3432	3003	2002	1001
15	1	15	105	455	1365	3003	5005	6435	6435	5005	3003
16	1	16	120	560	1820	4368	8008	11440	12870	11440	8008
17	1	17	136	680	2380	6188	12376	19448	24310	24310	19448
18	1	18	153	816	3060	8568	18564	31824	43758	48620	43758
19	1	19	171	969	3876	11628	27132	50388	75582	92378	92378
20	1	20	190	1140	4845	15504	38760	77520	125970	167960	184756

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Glossary

A

Accuracy: Criterion used to evaluate a research report.

Area Sampling: It is a type of cluster sampling. Clusters are formed based on geographical locations.

ANOVA: It is a statistical technique employed to determine, if samples came from the population with equal means.

Aided recall: An approach of questioning that attempts to stimulate respondents memory with clues about the object of interest.

Attribute: Characteristic of an object or person.

Applied Research: Research undertaken to solve specific real life problems.

Audimeter: A device hooked to TV to record when the set is tuned, and the channel to which it is tuned.

B

Bivariate Analysis: It is a multi variate analysis using two variables.

Bipolar adjectives: It is a scale that has adjective at each end, that is antonym.

Before measure effect: The effect caused by alerting the respondents to the fact, that they are being studied.

Balanced scale: A scale with same number of favourable and unfavourable responses.

Bivariate statistics: Statistics used when a researcher investigates two variables at a time.

C

Coding: Technical procedure by which data is categorised. It specifies the categories into which responses are to be placed.

Census: Involves all units of the population.

Chi-square Test: A non-parametric test. This test will reveal whether there is any significant relationship between two variables.

Cartoon test: It is a projective technique. In this method cartoon characters are the 3rd party.

Cluster Analysis: A technique for segmenting Eg. – Customers, products etc.

Causal research: A research designed to determine cause and effect relationship.

Conjoint Analysis: Techniques in which respondents valuation of attributes are inferred from the preference they express for various combinations of these attributes.

Construct validity: Trait, which the instrument is in fact measuring. It is the construct, measured by the scale.

Content validity: Represents how appropriate is a measuring instrument for getting the desired information.

Concomitant variation: It is the extent to which cause and effect vary together.

Convenience sample: Sample selected by researcher based on his convenience.

Cross-sectional study: Investigation involving a sample of element selected from the population of interest at a single point of time.

Cross-tabulation: It is method of counting the number of cases which fall into each of the categories when the categories are based on two or more variables considered simultaneously.

Correlation: A statistical technique which explains the extent to which the two variables are related.

Continuity: It is a media scheduling strategy.

Consumer Jury: A method of pretesting an ad by using a panel of consumers who are representative of target audience.

D

Depth interview: It is an unstructured personal interview.

Descriptive research: This is a research design method. The emphasis is on determining the frequency with which something occurs.

Dichotomous question: Question with just fixed alternatives.

D.S.S: Decision support system. This is nothing but, collection of rules, procedures used for retrieving the data.

Data Base: An organised storage of data.

Delphi technique: It is a group judgement. Each member makes an individual judgement and then each member is given opportunity to revise his or her judgement after seeing that of others.

Disguised: A form in which the samples are not aware that they are under study.

Degree of freedom: The number of observations that can vary freely under certain conditions.

(Double Barreled Question): Two questions clubbed into one.

Day after recall score: This represents the percentage of viewers who can remember seeing a particular advertisement the day after.

E

Ethics: Moral standards or code of conduct.

Editing: Inspection and correction of questionnaires.

Experiment: Scientific investigation in which the researcher studies dependent variables by altering independent variables.

Exploratory research: This research is used to generate ideas when the hypothesis is vague.

Extraneous variable: These variables affect the response of test units. Also known as confounding variable.

External validity: The degree to which the results of an experiment can be generalised beyond the experimental situation to other population.

External data: Data that originate outside the organisation for which research is being done.

Electro dermal response: It is a measure of consumer reaction level to an advertisement.

Ex post facto research: Study of the current state and factors causing it.

F

Factor Analysis: It is a technique used to study interrelationship among many variables.

Factorial design: This is an experimental design when the effect of two or more variables are being studied simultaneously.

Field edit: Preliminary edit conducted by field supervisor. This is done to correct glaring omissions.

F-Statistics: Measure of the variance between groups divided by the variance within group.

Focus group: Group discussion focused on a series of topics. The group is headed by a moderator.

Frequency: The number of times target audience is exposed to media vehicle during a specific period.

Field experiments: Experiment carried out in natural settings.

Flighting: It refers to a media scheduling pattern, in which period of advertising is alternated with period of no advertising.

G

GRP: Gross Rating Points. This is obtained by multiplying the reach of the media schedule by the average frequency.

H

Hypothesis: A presumption that a researcher wants to verify.

Horse racing alternative: It refers to a product testing method, where several products of the same company are put to test against one another.

I

Instrumentation effect: Effect of change in the measuring instrument on the experimental results.

Internal validity: Ability of an experiment to show relationship unambiguously.

Interval scale: Scale where the units have the same width throughout.

Interval estimate: It is a range within that a parameter is expected to lie.

Internal data: Data which originates within the organisation.

Inquiry test: A test designed to measure effectiveness of an advertisement.

J

Judgement sampling: This is a non-probability sampling.

Jingles: Songs about a brand that carries an advertising theme.

K

Kolmogorov-Smirnov test: This is a test to find whether two independent samples are drawn from the same population or not.

Kruskal-Wallis test: Rank sum test that analyses whether two or more independent samples are drawn from identical population or from two or more population with the same median. This is also known as H-test.

L

Latin square design: It is an experimental design.

Likert scale: Scale in which respondent indicates agreement or disagreement.

Leading/Loading Question: A question which gives clue to the respondent.

Longitudinal study: This involves fixed samples of elements that are measured repeatedly over a period of time.

Least square method: A method to fix trend lines.

Laboratory test: Tests of consumer reaction to advertising under controlled conditions.

M

Mail Questionnaire: Questionnaire administered by mail.

Median/Mean: A measure of central tendency.

Maturation: This occurs during research study; changes that takes information sought by the researcher and the information generated.

Mortalities: Refers to respondents dropping out of experiment.

M.D.S: Multi-dimensional scaling used to draw perceptual map.

Multivariate Analysis: Studying two or more variables.

Mall intercept: This is a method of data collection in which the shoppers are the sampling elements.

M.I.S: Information used to make marketing decisions.

Morphological analysis: Refers to a special technique in brainstorming.

Monadic test: A method of product testing.

N

Nominal scale: It is a scale where numbers are assigned to objects solely for identification purposes.

Non-parametric test: Statistical tests applicable when the data follows nominal and ordinal measurement. These are distribution free tests.

Non-probability sample: Where every element in the universe does not have equal chance of getting included.

Non-response error: This is a non-sampling error, in which respondent does not answer.

O

Omni Bus panel: Panel in which the information collected from participated panel members varies from study to study.

Ordinal scale: A measurement that assigns only order used; for ranking.

Observation error: It is a non-sampling error.

Open-ended question: A question to which there are no fixed answers. Respondent can answer in his own words.

On air test: A method of testing the effectiveness of an advertisement broadcasted through TV or Radio.

P

Paired comparison: This is a test conducted to find preferences. The respondent is required to take two objects at a time.

Parametric test: These tests are used when variables are measured on interval scale.

Perceptual Map: A spatial representation of the perceived relationship among objects. These objects could be products or brands.

Probability sampling: A sampling method where there is equal chance for every element being included.

Projective technique: An indirect method of questioning. A technique of qualitative research.

Pretesting: A practice of administering a questionnaire to a small group of respondents.

Predictive validity: This is established by correlating the measurement score with the future criterion.

Pop-ups: Advertisement window on the Internet.

Portfolio test: A laboratory method of testing the advertisement.

Pulsing: It is a media scheduling method.

Q

Qualitative research: Research designed mainly for exploratory purposes.

Quota sampling: It is a sampling method, where each sub-group is represented.

R

Ratio scale: This scale has an absolute zero and hence it allows comparison of absolute magnitudes.

Rank order scale: A scale in which respondents rank the items.

Reach: The number of different audience members exposed at least once to a media vehicle in a given period.

Refusal: It is a non-sampling error because the respondent refuses to answer.

Regression analysis: The statistical technique used to derive an equation.

Recording Error: Error that occurs due to improper recording.

Reliability: An error component of measurement instrument.

Retail Store Audit: It is data collected by research firms whose employees visit sample of stores at fixed interval for checking the stock.

Research design: A plan which indicate the methods and procedures to be used for collecting the data and data analysis.

S

Sample: Selecting a subset.

Sampling Frame: It is the list of population, from where sample is selected.

Scattered diagram: It is a two-dimensional graph in which data regarding two variables are plotted.

Secondary data: Data already collected and published.

Semantic differential: A scale to make attitude measurement. Bipolar adjectives are used at the two extreme ends of the scale.

Sentence completion test: It is a projective technique where in the respondents are required to complete a sentence. It is a non-structured, disguised form of questioning.

Snow ball sampling: It is a type of non-probability sampling, based on referrals.

Split runs: Two or more versions of advertisements are printed in alternative copies of a particular issue of a magazine. It is an ad effectiveness test.

Standard deviation: It is a measure of dispersion.

Stratified Random Sampling: It is a probability sampling procedure. Population is divided into strata and sample is selected at random from each strata.

Syndicated data: Secondary data gathered by agencies sold to clients.

Systematic sampling: It is a probability sampling where the sampling interval remains constant.

T

TAT (Thematic apperception test): It is a non-structured disguised form of questioning. Respondents may be shown a picture and asked questions about it.

Target rating points: The number of persons in the primary target audience group that the media will reach.

Theatre testing: It is an advertisement effectiveness pre-testing method. In this method the consumers view ads in a theatre setting and evaluate it.

Thurstone scale: It is an attitude measurement scale with 11 statements; respondents are asked to respond to these statements.

True panel: It is a panel which participates in longitudinal study.

Type-I Error: This error occurs when a true null hypothesis is rejected.

Type-II Error: This error occurs when a false null hypothesis is accepted.

U

Univariate: Problem of analysing a single variable.

Unaided recall test: In this method respondents are asked to remember an ad and answer the questions.

Unbalanced scale: A scale with uneven number of favourable and unfavourable choices. Therefore, this type of scale will be skewed in one direction.

Unique selling proposition (USP): It refers to a product or a service attribute that is distinctive to a particular brand.

Unstructured observation: In this method, the observer judges, whether it is worthwhile recording an observation or not.

V

Validity: This indicates how much of the scores measured reflects the actual.

Variable: Anything that may assume different numerical value.

Variance: A measure of variability or dispersion.

W

Word association test: This is a test in qualitative research.

World Wide Web (www): The commercial component of the Internet.

Z

Z-test: A univariate hypothesis test using the standardised normal distribution.

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