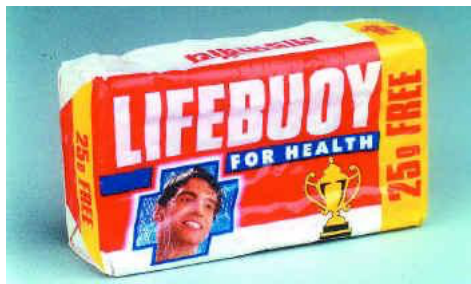# Marketing Research

Defining Marketing Research

Marketing research is the systematic and objective

- identification
- collection
- analysis
- dissemination
- and use of **information**

for the purpose of improving decision making related to the

    *   identification and

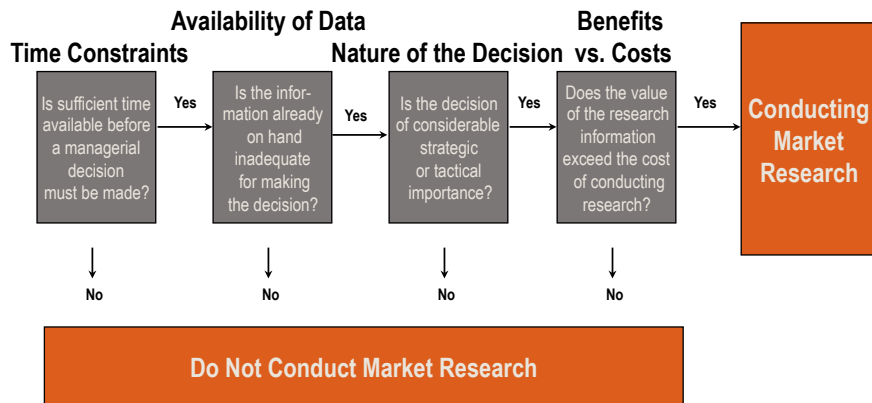   *   solution of problems and opportunities in business.

1992

Research Can fail

- New Coke in US
- Sony Walkman

Determining When to Conduct Market Research

Time Constraints	Availability of Data	Nature of the Decision	Benefits vs. Costs	
Is sufficient time available before a managerial decision must be made?	Is the information already on hand inadequate for making the decision?	Is the decision of considerable strategic or tactical importance?	Does the value of the research information exceed the cost of conducting research?	**Conducting Market Research**

Yes → Yes → Yes → Yes →

No ↓   No ↓   No ↓   No ↓

Do Not Conduct Market Research

Research Process

- Managerial Decision Problem
- Problem Definition
- Development of an Approach to the   Problem
- Research Design Formulation

- Fieldwork or Data Collection

- Data Preparation and Analysis

- Report Preparation and Presentation
- Managerial Decision

Disease vs Symptoms !!

Be aware

Management Decision Problem Vs. Market Research Problem

Management Decision Problem	Business Research Problem
Should a new product be introduced?	To determine consumer preferences and purchase intentions for the proposed new product.
Should the advertising campaign be changed?	To determine the effectiveness of the current advertising campaign.
Should the price of the brand be increased?	To determine the price elasticity of demand and the impact on sales and profits of various levels of price changes.

Applications

- Determine the basis of segmentation
- Establish market potential
- Creative advertising testing
- Evaluation of advertising effectiveness
- Product line pricing
- Price elasticity of demand

Approach to the Research

- Objective/Theoretical Foundations
- Analytical Model
- Research Questions
- Hypotheses

Theory & Models

1. The Law of Diminishing Marginal Utility is a generalization formulated from the observation of human nature. As we get more and more of a commodity, the satisfaction from it diminishes at some point of time.
2. Price Elasticity of Demand
3. Transaction cost Theory
4. Agency Theory
5. Communication/Advertisement: AIDA
6. Stimulus –Response -Action

Mathematical Models

Mathematical models explicitly specify the relationships among variables, usually in equation form.

$$y = a_0 + \sum_{i=1}^{n} a_i x_i$$

Where

y = degree of preference

a_0, a_i = model parameters to be estimated statistically

1. Managerial Decision Problem & Research Problem Definition

- Discussions with Decision Makers
- Interviews with Industry Experts
- Secondary Data Analysis
- Qualitative Research

2. Research (Designs)

- Exploratory – Qualitative

- Descriptive – Surveys

- Causal – Experiments

Research Design

- What to measure
  - Income, employee engagement, brand position, culture, leadership, entrepreneurial orientation, consumer behaviour…

- Whom to measure
  - Unit of analysis : Individual consumer or employee, Group-Family or team , Organisation etc

- Sampling: How many respondents, how to select

- How to collect data
  - Telephonic interview
  - One to one
  - OnLine survey…

- How to analyse data
  - Use of statistics
  - Univariate & Multivariate data analysis techniques

Data Analysis

- Quantitative: Excel, SPSS, AMOS..

- Qualitative: NVIVO…

Analysing Results and Reporting

- Data analysis……. Information

- Findings and conclusions

- Triangulation:

- Presentation

Research Designs

1. Exploratory

- Obtaining insights of situations.
- Understanding relationships and directions of linkages.
- Listing dimensions of situations.

Methods of Exploratory Research

- Qualitative research.
  - Interviews
  - Focus group discussions
  - Case studies
  - Ethnography.

- Pilot surveys
- Secondary data analysis

Uses of Exploratory Research

- Formulate a problem or define a problem more precisely
- Identify alternative courses of action
- Develop hypotheses

2. Descriptive Research

- Description of 'something'

- Something ??

- Market (Consumer)/Industry characteristics or function.

  - Market share
  - Market potential
  - Consumer characteristics
  - Segmentation
  - Brand positioning
  - Distribution characteristics

Methods of Descriptive Research

- Secondary data analyzed in a quantitative as opposed to a qualitative manner .
- Surveys Panels
- Observational and other data

3. Causal Research

- Conclusive research in which major objective is to get evidence regarding cause-effect relationship.

Experiment

- The process of manipulating one or more independent variables and

- measuring their effect on one or more dependent variables, while

- controlling external variables.

One-Group Pretest-Posttest Design

$$O_1 \qquad X\, O_2$$

- A group of test units is measured twice.
- There is no control group.
- The <u>treatment effect is computed as</u>
  <u>$O_2 - O_1$.</u>
- The validity of this conclusion is questionable since extraneous variables are largely uncontrolled.

Static Group Design

EG: X O_1
CG: O_2

- A two-group experimental design.
- The experimental group (EG) is exposed to the treatment, and the control group (CG) is not.
- Measurements on both groups are made only after the treatment.
- Test units are not assigned at random.
- The <u>treatment effect</u> would be measured as $O_1 - O_2$.

True Experimental Designs:
Pretest-Posttest Control Group Design

EG: R O_1 X O_2
CG: R O_3 O_4

Uses of Casual Research

- To understand which variables are the cause (independent variables) and which variables are the effect (dependent variables) of a phenomenon.

- To determine the nature of the relationship between the causal variables and the effect to be predicted.

- METHOD: Experiments

A Comparison of Basic Research Designs

	Exploratory	Descriptive	Causal
Objective:	Discovery of ideas and insights	Describe market characteristics or functions	Determine cause and effect relationships
Characteristics:	Flexible, versatile	Marked by the prior formulation of specific hypotheses	Manipulation of one or more independent variables
	Often the front end of total research design	Preplanned and structured design	Control of other mediating variables
Methods:	Expert surveys Pilot surveys Secondary data Qualitative research	Secondary data Surveys Panels Observation and other data	Experiments

Exploratory Research Tools

Focus Group Discussion

Group Size	8-12
Group Composition	Homogeneous, respondents, prescreened
Physical Setting	Relaxed, informal atmosphere
Time Duration	1-3 hours
Recording	Use of audiocassettes and videotapes
Moderator	Observational, interpersonal, and communication skills of the moderator

Depth Interview Techniques: Laddering

In **laddering**, the line of questioning proceeds from product characteristics to user characteristics. This technique allows the researcher to tap into the consumer's network of meanings.

Wide body aircrafts (product characteristic)

I can get more work done

I accomplish more

I feel good about myself (user characteristic)

Advertising theme: You will feel good about yourself when flying our airline. "You're The Boss."

Completion Techniques

In **Sentence completion**, respondents are given incomplete sentences and asked to complete them. Generally, they are asked to use the first word or phrase that comes to mind.

A person who shops at Big Bazaar is
_____

A person who shops at Flipkart values most…
_____

Shahrukh Khan is most liked by
_____

Sunny Deol is most liked by _____

Completion Techniques

In **story completion**, respondents are given part of a story – enough to direct attention to a particular topic but not to hint at the ending. They are required to give the conclusion in their own words.

A Cartoon Test

Let's see if we can pick up some house wares at Life Style
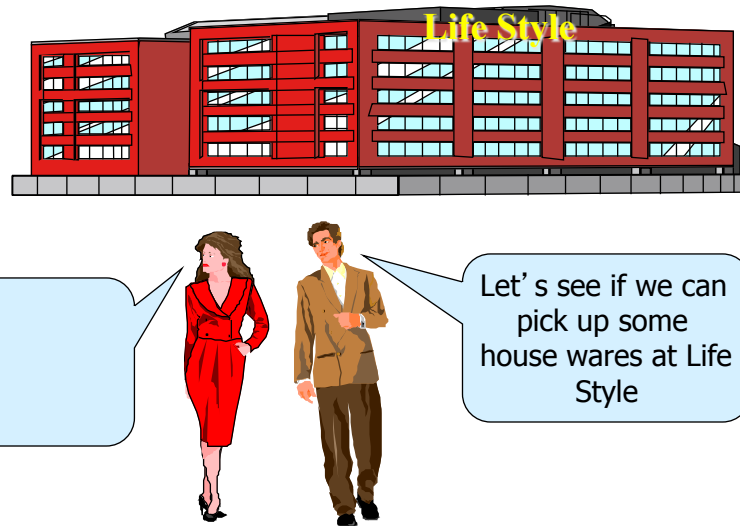
Expressive Techniques

Role playing   Respondents are asked to play the role or assume the behavior of someone else.

Third-person technique

Descriptive

This involves Measurement

Lets first discuss " Measurement"

Measurement

If u have to do researching to find out the relationship between Health & financial status of a customer,

- what will you measure ?
- How will you measure ?

- Data -------- Information

- Data Variables are CONCEPTS.

- Operationalisation of concepts.

- Conceptual clarity of what to measure & how to measure

- Metric Data: Interval, Ratio

- Non metric data : Ordinal, Nominal

Primary Scales of Measurement

Scale				
Nominal	Numbers Assigned to Runners	7	8	3 Finish
Ordinal	Rank Order of Winners	Third place	Second place	First place Finish
Interval	Performance Rating on a 0 to 10 Scale	8.2	9.1	9.6
Ratio	Time to Finish, in	15.2	14.1	13.4

Primary Scales of Measurement

Scale	Basic Characteristics	Common Examples	Marketing Examples	Permissible Statistics Descriptive	Inferential
Nominal	Numbers identify & classify objects	Social Security nos., numbering of football players	Brand nos., store types	Percentages, mode	Chi-square, binomial test
Ordinal	Nos. indicate the relative positions of objects but not the magnitude of differences between them	Quality rankings, rankings of teams in a tournament	Preference rankings, market position, social class	Percentile, median	Rank-order correlation, Friedman ANOVA
Interval	Differences between objects	Temperature (Fahrenheit)	Attitudes, opinions, index	Range, mean, standard	Product-moment
Ratio	Zero point is fixed, ratios of scale values can be compared	Length, weight	Age, sales, income, costs	Geometric mean, harmonic mean	Coefficient of variation

Preference for Toothpaste Brands Using Rank Order Scaling

Form

Brand	Rank Order
1. Crest	_____
2. Colgate	_____
3. Aim	_____
4. Gleem	_____
5. Macleans	_____
6. Ultra Brite	_____
7. Close Up	_____
8. Pepsodent	_____
9. Plus White	_____
10. Stripe	_____
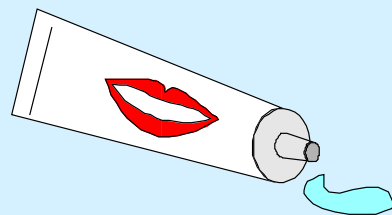
Comparative Scaling Techniques
Constant Sum Scaling

- Respondents allocate a constant sum of units, such as 100 points to attributes of a product to reflect their importance.
- If an attribute is unimportant, the respondent assigns it zero points.
- If an attribute is twice as important as some other attribute, it receives twice as many points.
- The sum of all the points is 100. Hence, the name of the scale.

Importance of Bathing Soap Attributes
Using a Constant Sum Scale

Form

Attribute	Average Responses of Three Segments		
	Segment I	Segment II	Segment III
1. Mildness	8	2	4
2. Lather	2	4	17
3. Shrinkage	3	9	7
4. Price	53	17	9
5. Fragrance	9	0	19
6. Packaging	7	5	9
7. Moisturizing	5	3	20
8. Cleaning Power	13	60	15
Sum	100	100	100

Continuous Rating Scale

How would you rate Big Bazar as a department store?

Version 1

Probably the worst - - - - -- Probably the best

Version 2

Probably the worst - - - - - - - - - - -- Probably the best

0   10   20   30   40   50   60   70   80   90   100

Version 3

	Very bad	Neither good nor bad	Very good	

Probably the worst - - - - - - - - - - - - - -- - - - -- - - - - - - - - - - - - - -Probably the best

0   10   20   30   40   50   60   70   80   90   100

Likert Scale

The **Likert scale** requires the respondents to indicate a degree of agreement or disagreement with each of a series of statements about the stimulus objects.

		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
1.	BBsells high quality merchandise.	1	2X	3	4	5	
2.	BB has poor in-store service.		1	2X	3	4	5
3.	I like to shop at BB.	1	2	3X	4	5	

Semantic Differential Scale

The **semantic differential** is a seven-point rating scale with end points associated with <u>bipolar labels that have semantic meaning.</u>

```
Big Bazar  IS:
Powerful       --:--:--:--:-X-:--:--: Weak
Unreliable     --:--:--:--:--:-X-:--: Reliable
Modern         --:--:--:--:--:-X-: Old-fashioned
```

A Semantic Differential Scale for Measuring Self- Concepts, Person Concepts, and Product Concepts

1) Rugged	:---:---:---:---:---:---:---:	Delicate
2) Excitable	:---:---:---:---:---:---:---:	Calm
3) Uncomfortable	:---:---:---:---:---:---:---:	Comfortable
4) Dominating	:---:---:---:---:---:---:---:	Submissive
5) Thrifty	:---:---:---:---:---:---:---:	Indulgent
6) Pleasant	:---:---:---:---:---:---:---:	Unpleasant
7) Contemporary	:---:---:---:---:---:---:---:	Obsolete
8) Organized	:---:---:---:---:---:---:---:	Unorganized
9) Rational	:---:---:---:---:---:---:---:	Emotional
10) Youthful	:---:---:---:---:---:---:---:	Mature
11) Formal	:---:---:---:---:---:---:---:	Informal
12) Orthodox	:---:---:---:---:---:---:---:	Liberal
13) Complex	:---:---:---:---:---:---:---:	Simple
14) Colorless	:---:---:---:---:---:---:---:	Colorful
15) Modest	:---:---:---:---:---:---:---:	Vain

Balanced and Unbalanced Scales

Balanced Scale		Unbalanced Scale	
Jovan Musk for Men is		Jovan Musk for Men is	
Extremely good	_____	Extremely good	_____
Very good	_____	Very good	_____
Good	_____	Good	_____
Bad	_____	Somewhat good	_____
Very bad	_____	Bad	_____
Extremely bad	_____	Very bad	_____

Rating Scale Configurations

A variety of scale configurations may be employed to measure the gentleness of Cheer detergent. Some examples include:

Cheer detergent is:

1) Very harsh --- --- --- --- --- --- --- Very gentle

2) Very harsh   1   2   3   4   5   6   7   Very gentle

3) . Very harsh
   .
   .
   . Neither harsh nor gentle
   .
   .
   . Very gentle

4)
____	____	____	____	____	____	____
Very harsh	Harsh	Somewhat Harsh	Neither harsh nor gentle	Somewhat gentle	Gentle	Very gentle

5)
-3	-2	-1	0	+1	+2	+3
Very harsh			Neither harsh nor gentle			Very gentle

Some Unique Rating Scale Configurations

Thermometer Scale

Instructions: Please indicate how much you like McDonald's hamburgers by coloring in the thermometer. Start at the bottom and color up to the temperature level that best indicates how strong your preference is.

Form:

Like very much

100
75
50
25
0

Dislike very much
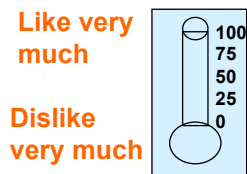
Smiling Face Scale

Instructions: Please point to the face that shows how much you like the Barbie Doll. If you do not like the Barbie Doll at all, you would point to Face 1. If you liked it very much, you would point to Face 5.

Form:

1	2	3	4	5
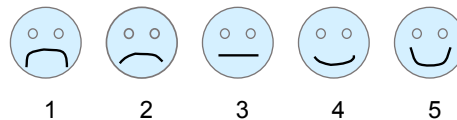
Instrument/ Questionnaire Design

Questionnaire Definition

- A **questionnaire** is a formalized set of questions for obtaining information from respondents.

Questionnaire Objectives

- It must translate the information needed into a set of specific questions that the respondents can and will answer.

- A questionnaire must **uplift, motivate, and encourage the respondent to become involved in the interview, to cooperate, and to complete the interview.**

- A questionnaire should minimize response error.

Individual Question Content
Are Several Questions Needed Instead of One?

- Sometimes, several questions are needed to obtain the required information in an unambiguous manner. Consider the question,

"Do you think Coca-Cola is a tasty and refreshing soft drink?"   (Incorrect)

- Such a question is called a **double-barreled question**, because two or more questions are combined into one. To obtain the required information, two distinct questions should be asked:

"Do you think Coca-Cola is a tasty soft drink?" and
"Do you think Coca-Cola is a refreshing soft drink?"

        (Correct)

Overcoming Inability To Answer
Is the Respondent Informed?

- In situations where not all respondents are likely to be informed about the topic of interest, **filter questions** that measure familiarity and past experience should be asked before questions about the topics themselves.
- A "don't know" option appears to reduce uninformed responses without reducing the response rate.

Overcoming Inability To Answer
Can the Respondent Remember?

How many gallons of soft drinks did you consume during the last four weeks?
　　(Incorrect)

How often do you consume soft drinks in a typical week?
　　(Correct)
1. 　　____ Less than once a week
2. 　　____ 1 to 3 times per week
3. 　　____ 4 to 6 times per week
4. 　　____ 7 or more times per week

Overcoming Inability To Answer
Can the Respondent Articulate?

- Respondents may be unable to articulate certain types of responses, e.g., describe the atmosphere of a department store.
- Respondents should be given aids, such as pictures, maps, and descriptions to help them articulate their responses.

Overcoming Unwillingness To Answer
Effort Required of the Respondents

- Most respondents are unwilling to devote a lot of effort to provide information.

Overcoming Unwillingness To Answer

Please list all the departments from which you purchased merchandise on your most recent shopping trip to a department store.   (Incorrect)

In the list that follows, please check all the departments from which you purchased merchandise on your most recent shopping trip to a department store.

1.	Women's dresses	____
2.	Men's apparel	____
3.	Children's apparel	____
4.	Cosmetics	____
.		
.		
.		
16.	Jewelry	
17.	Other (please specify)	____ (Correct)

Overcoming Unwillingness To Answer

Context
- Respondents are unwilling to respond to questions which they consider to be inappropriate for the given context.
- The researcher should manipulate the context so that the request for information seems appropriate.

Legitimate Purpose
- Explaining why the data are needed can make the request for the information seem legitimate and increase the respondents' willingness to answer.

Sensitive Information
- Respondents are unwilling to disclose, at least accurately, sensitive information because this may cause embarrassment or threaten the respondent's prestige or self-image.

Choosing Question Structure
Multiple-Choice Questions

- In multiple-choice questions, the researcher provides a choice of answers and respondents are asked to select one or more of the alternatives given.

Do you intend to buy a new car within the next six months?

_____	Definitely will not buy
_____	Probably will not buy
_____	Undecided
_____	Probably will buy
_____	Definitely will buy
_____	Other (please specify)

Choosing Question Structure
Dichotomous Questions

- A **dichotomous question** has only two response alternatives: yes or no, agree or disagree, and so on.
- Often, the two alternatives of interest are supplemented by a neutral alternative, such as "no opinion," "don't know," "both," or "none."

Do you intend to buy a new car within the next six months?

   _____ Yes
   _____ No
   _____ Don't know

Choosing Question Structure
Scales

- Scales were discussed in detail in Chapters 8 and 9:

Do you intend to buy a new car within the next six months?

Definitely	Probably	Undecided	Probably	Definitely
will not buy	will not buy		will buy	will buy
1	2	3	4	5

Choosing Question Wording
Define the Issue

- Define the issue in terms of who, what, when, where, why, and way (the six Ws). Who, what, when, and where are particularly important.

Which brand of shampoo do you use?
     (Incorrect)

Which brand or brands of shampoo have you
personally used at home during the last month?
In case of more than one brand, please
list all the brands that apply.   (Correct)

Choosing Question Wording

The W's	Defining the Question
Who	**The Respondent** It is not clear whether this question relates to the individual respondent or the respondent's total household.
What	**The Brand of Shampoo** It is unclear how the respondent is to answer this question if more than one brand is used.
When	**Unclear** The time frame is not specified in this question. The respondent could interpret it as meaning the shampoo used this morning, this week, or over the past year.
Where	At home, at the gym, on the road?

Choosing Question Wording
Use Ordinary Words

"Do you think the distribution of soft drinks is
adequate?"   (Incorrect)

"Do you think soft drinks are readily available
when you want to buy them?"
        (Correct)

Choosing Question Wording
Use Unambiguous Words

In a typical month, how often do you shop in
department stores?
_____ Never
_____ Occasionally
_____ Sometimes
_____ Often
_____ Regularly   (Incorrect)

In a typical month, how often do you shop in
department stores?
_____ Less than once
_____ 1 or 2 times
_____ 3 or 4 times
_____ More than 4 times   (Correct)

Choosing Question Wording
Avoid Leading or Biasing Questions

- A **leading question** is one that clues the respondent to what the answer should be, as in the following:

Do you think that patriotic Americans should buy imported automobiles when that would put American labor out of work?

_____ Yes
_____ No
_____ Don't know

(Incorrect)

Do you think that Americans should buy imported automobiles?

_____ Yes
_____ No
_____ Don't know

(Correct)

Choosing Question Wording
Avoid Implicit Alternatives

- An alternative that is not explicitly expressed in the options is an implicit alternative.

1. Do you like to fly when traveling short distances?   (Incorrect)

2. Do you like to fly when traveling short distances, or would you rather drive?

(Correct)

Choosing Question Wording
Avoid Implicit Assumptions

- Questions should not be worded so that the answer is dependent upon implicit assumptions about what will happen as a consequence.

  1. Are you in favor of a balanced budget?

     (Incorrect)

  2. Are you in favor of a balanced budget if it would   result in an increase in the personal income tax?
     (Correct)

Choosing Question Wording
Avoid Generalizations and Estimates

"What is the annual per capita expenditure on groceries in your household?"   (Incorrect)

"What is the monthly (or weekly) expenditure on groceries in your household?"

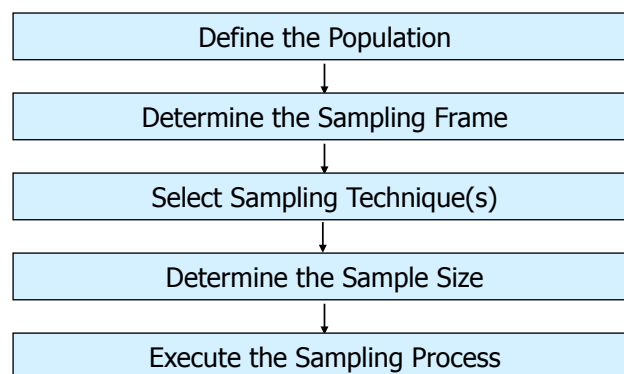*and*

"How many members are there in your household?"
      (Correct)

Sampling:
Design and Procedures

The Sampling Design Process

Define the Population

↓

Determine the Sampling Frame

↓

Select Sampling Technique(s)

↓

Determine the Sample Size

↓

Execute the Sampling Process

Sample Sizes Used in Marketing Research Studies

Type of Study	Minimum Size	Typical Range
Problem identification research (e.g. market potential)	500	1,000-2,500
Problem-solving research (e.g. pricing)	200	300-500
Product tests	200	300-500
Test marketing studies	200	300-500
TV, radio, or print advertising (per commercial or ad tested)	150	200-300
Test-market audits	10 stores	10-20 stores
Focus groups	2 groups	4-12 groups

Convenience Sampling

Convenience sampling attempts to obtain a sample of convenient elements. Often, respondents are selected because they happen to be in the right place at the right time.

- use of students, and members of social organizations
- mall intercept interviews without qualifying the respondents
- department stores using charge account lists
- "people on the street" interviews

Judgmental Sampling

Judgmental sampling is a form of convenience sampling in which the population elements are selected based on the judgment of the researcher.

- test markets
- purchase engineers selected in industrial marketing research
- bellwether precincts selected in voting behavior research
- expert witnesses used in court

Quota Sampling

Quota sampling may be viewed as two-stage restricted judgmental sampling.
- The first stage consists of developing control categories, or quotas, of population elements.
- In the second stage, sample elements are selected based on convenience or judgment.

Control Characteristic	Population composition Percentage	Sample composition Percentage	Number
Sex			
Male	48	48	480
Female	52	52	520
	100	100	1000

Snowball Sampling

In **snowball sampling**, an initial group of respondents is selected, usually at random.

- After being interviewed, these respondents are asked to <u>identify others</u> who belong to the target population of interest.
- Subsequent respondents are selected based on the referrals.

Simple Random Sampling

- Each element in the population has a known and equal probability of selection.
- Each possible sample of a given size (n) has a known and equal probability of being the sample actually selected.
- This implies that every element is selected independently of every other element.

Systematic Sampling

- The sample is chosen by selecting a random starting point and then picking every ith element in succession from the sampling frame.
- The sampling interval, i, is determined by dividing the population size N by the sample size n and rounding to the nearest integer.
- When the ordering of the elements is related to the characteristic of interest, systematic sampling increases the representativeness of the sample.
- If the ordering of the elements produces a cyclical pattern, systematic sampling may decrease the representativeness of the sample.

  For example, there are 100,000 elements in the population and a sample of 1,000 is desired. In this case the sampling interval, i, is 100. A random number between 1 and 100 is selected. If, for example, this number is 23, the sample consists of elements 23, 123, 223, 323, 423, 523, and so on.

Stratified Sampling

- A two-step process in which the population is partitioned into subpopulations, or strata.
- The strata should be mutually exclusive and collectively exhaustive in that every population element should be assigned to one and only one stratum and no population elements should be omitted.
- Next, elements are selected from each stratum by a random procedure, usually SRS.
- A major objective of stratified sampling is to increase precision without increasing cost.

Stratified Sampling

- The <u>elements within a stratum should be as homogeneous as possible, but the elements in different strata should be as heterogeneous as possible.</u>
-
- The <u>stratification variables</u> should also be closely related to the characteristic of interest.
- Finally, the variables should decrease the cost of the stratification process by being easy to measure and apply.
- In proportionate stratified sampling, the size of the sample drawn from each stratum is proportionate to the relative size of that stratum in the total population.
- In disproportionate stratified sampling, the size of the sample from each stratum is proportionate to the relative size of that stratum and to the standard deviation of the distribution of the characteristic of interest among all the elements in that stratum.
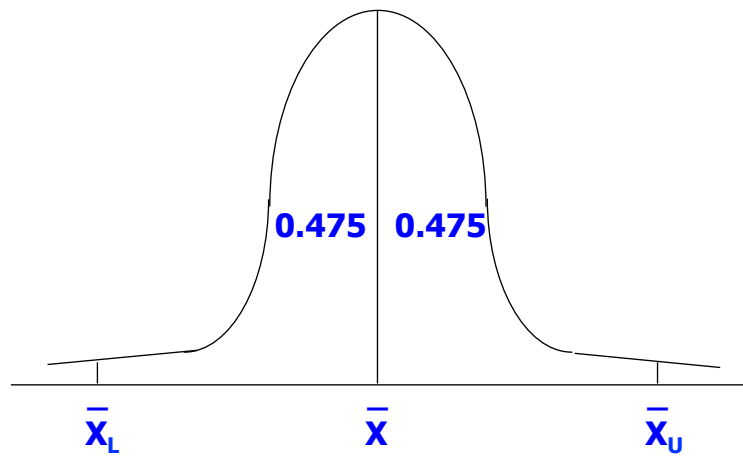
Types of Cluster Sampling

```
                    ┌─────────────────┐
                    │ Cluster Sampling│
                    └─────────────────┘
          ┌──────────────────┼──────────────────┐
          ▼                  ▼                  ▼
  ┌──────────────┐   ┌──────────────┐   ┌──────────────┐
  │  One-Stage   │   │  Two-Stage   │   │  Multistage  │
  │   Sampling   │   │   Sampling   │   │   Sampling   │
  └──────────────┘   └──────────────┘   └──────────────┘
              ┌──────────────┴──────────────┐
              ▼                             ▼
      ┌──────────────┐             ┌──────────────┐
      │ Simple Cluster│            │  Probability │
      │   Sampling    │            │ Proportionate│
      └──────────────┘            │ to Size Sampling│
                                  └──────────────┘
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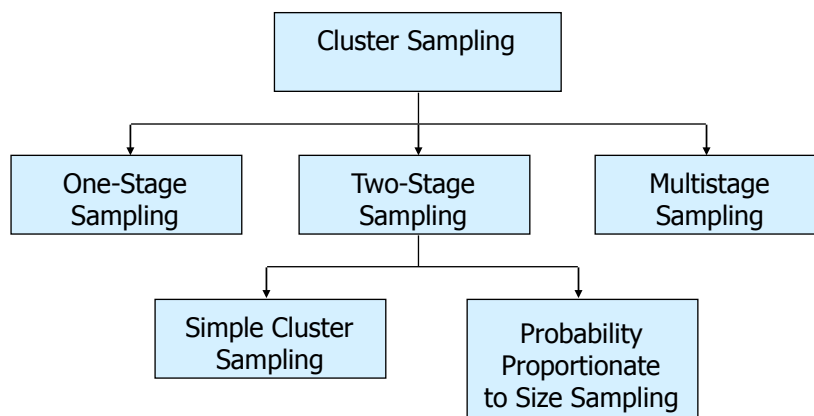
95% Confidence Interval

0.475 | **0.475**

$\overline{X}_L$ $\overline{X}$ $\overline{X}_U$

Data Collection & Analysis

Data collection

- Personal
- Mail
- Telephonic
- Online…

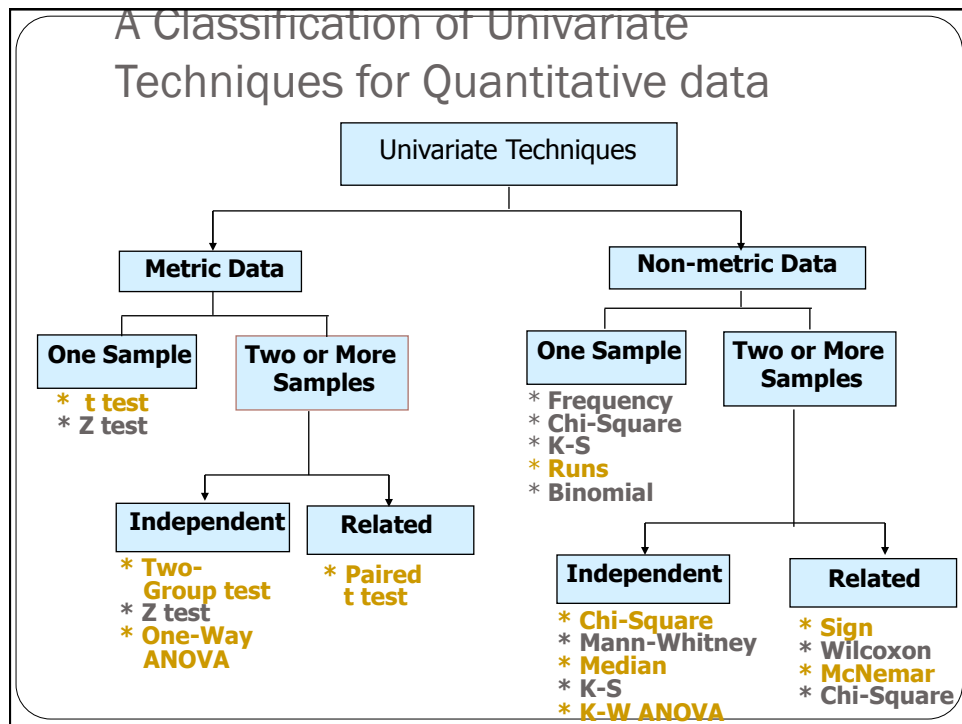## Data entry & Cleaning

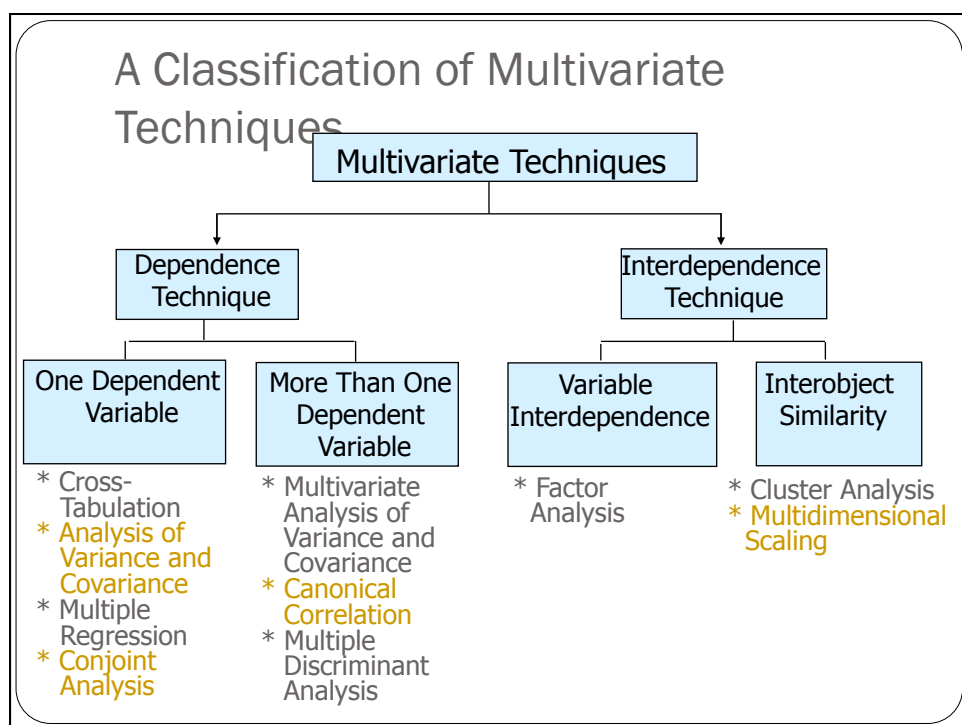- Xl format
- Identify outliars

Data Analysis Techniques

Qualitative Data

- SPSS Text
- NVIVO

A Classification of Univariate Techniques for Quantitative data

```
                    Univariate Techniques
                              |
          +-------------------+-------------------+
          |                                       |
     Metric Data                            Non-metric Data
          |                                       |
   +------+------+                         +-------+-------+
   |             |                         |               |
One Sample   Two or More              One Sample      Two or More
             Samples                                   Samples
```

One Sample
* **t test**
* Z test

Two or More Samples

Independent
* **Two-Group test**
* Z test
* **One-Way ANOVA**

Related
* **Paired t test**

One Sample
* Frequency
* Chi-Square
* K-S
* **Runs**
* Binomial

Two or More Samples

Independent
* **Chi-Square**
* Mann-Whitney
* **Median**
* K-S
* **K-W ANOVA**

Related
* **Sign**
* Wilcoxon
* **McNemar**
* Chi-Square

A Classification of Multivariate Techniques

```
                  Multivariate Techniques
                           |
         +-----------------+-----------------+
         |                                   |
   Dependence                        Interdependence
   Technique                            Technique
         |                                   |
   +-----+-----+                       +-----+-----+
   |           |                       |           |
One Dependent  More Than One        Variable    Interobject
Variable       Dependent            Interdependence  Similarity
               Variable
```

One Dependent Variable
* Cross-Tabulation
* Analysis of Variance and Covariance
* Multiple Regression
* Conjoint Analysis

More Than One Dependent Variable
* Multivariate Analysis of Variance and Covariance
* Canonical Correlation
* Multiple Discriminant Analysis

Variable Interdependence
* Factor Analysis

Interobject Similarity
* Cluster Analysis
* Multidimensional Scaling

Discriminant analysis

Discriminant analysis is a technique for analyzing data when the criterion or <u>dependent variable is categorical and the predictor or independent variables are interval in nature.</u>

The objectives of discriminant analysis are as follows:

- Development of **discriminant functions**, or linear combinations of the predictor or independent variables, which will best discriminate between the categories of the criterion or dependent variable (groups).

Discriminant Analysis Model

The **discriminant analysis model** involves linear combinations of the following form:

$D = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + \ldots + b_k X_k$

where

D	=	discriminant score
b 's	=	discriminant coefficient or weight
X 's	=	predictor or independent variable

- The coefficients, or weights (*b*), are estimated so that the groups differ as much as possible on the values of the discriminant function.
- This occurs when the ratio of between-group sum of squares to within-group sum of squares for the discriminant scores is at a maximum.

Factor Analysis

- **Factor analysis** is a general name denoting a class of procedures primarily used for data reduction and summarization.
- Factor analysis is an **interdependence technique** in that an entire set of interdependent relationships is examined without making the distinction between dependent and independent variables.
- Factor analysis is used in the following circumstances:
  - To identify underlying dimensions, or **factors**, that explain the correlations among a set of variables.
  - To identify a new, smaller, set of uncorrelated variables to replace the original set of correlated variables in subsequent multivariate analysis (regression or discriminant analysis).
  - To identify a smaller set of salient variables from a larger set for use in subsequent multivariate analysis.

Factor Analysis Model

Mathematically, each variable is expressed as a linear combination of underlying factors. The covariation among the variables is described in terms of a small number of common factors plus a
unique factor for each variable. If the variables are standardized,
the factor model may be represented as:

$$X_i = A_{i\,1}F_1 + A_{i\,2}F_2 + A_{i\,3}F_3 + \ldots + A_{im}F_m + V_iU_i$$

where

X_i	=	i th standardized variable
A_{ij}	=	standardized multiple regression coefficient of
		variable i on common factor j
F	=	common factor
V_i	=	standardized regression coefficient of variable i on
		unique factor i
U_i	=	the unique factor for variable i
m	=	number of common factors

Factor Analysis Model

The unique factors are uncorrelated with each other and with the common factors. The common factors themselves can be expressed as linear combinations of the observed variables.

$F_i = W_{i1}X_1 + W_{i2}X_2 + W_{i3}X_3 + . . . + W_{ik}X_k$

where

F_i =   estimate of i th factor

W_i =   weight or factor score coefficient

k   =   number of variables

Factor Analysis Model

- It is possible to select weights or factor score coefficients so that the first factor explains the largest portion of the total variance.
- Then a second set of weights can be selected, so that the second factor accounts for most of the residual variance, subject to being uncorrelated with the first factor.
- This same principle could be applied to selecting additional weights for the additional factors.

Cluster Analysis

- Cluster analysis is a class of techniques used to classify objects or cases into relatively homogeneous groups called *clusters*. Objects in each cluster tend to be similar to each other and dissimilar to objects in the other clusters. Cluster analysis is also called *classification analysis*, or *numerical taxonomy*.

An Ideal Clustering Situation

Variable 1

Variable 2
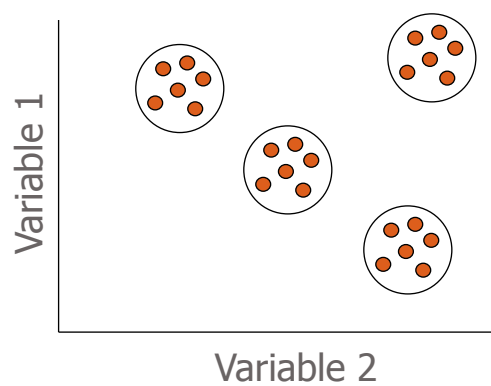
A Practical Clustering Situation
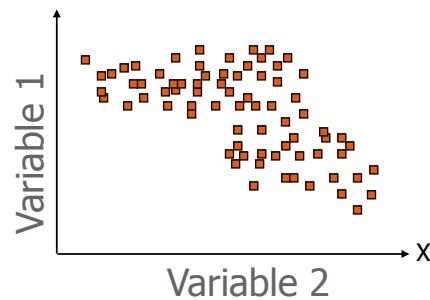
Multidimensional Scaling (MDS)

- **Multidimensional scaling (MDS)** is a class of procedures for representing perceptions and preferences of respondents spatially by means of a visual display.
- Perceived or psychological relationships among stimuli are represented as geometric relationships among points in a multidimensional space.
- These geometric representations are often called spatial maps. The axes of the spatial map are assumed to denote the psychological bases or underlying dimensions respondents use to form perceptions and preferences for stimuli.

A Spatial Map of Toothpaste Brands
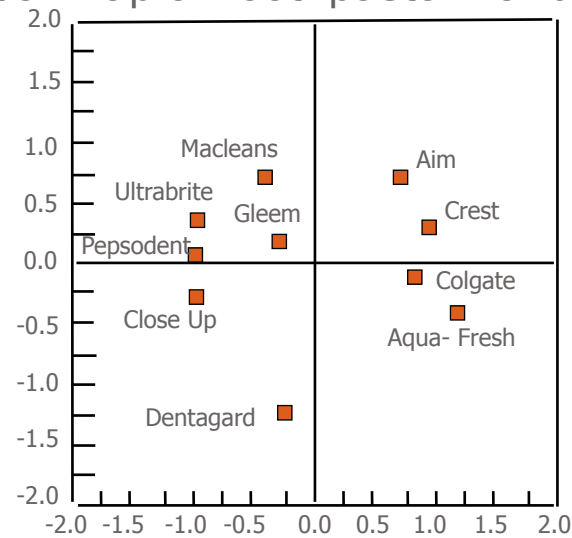
- For more detail read book on Marketing Research by Naresh K Malhotra
- http://www.pearsoned.co.in/web/books/9788131731819_Marketing-Research_Naresh-K-Malhotra.aspx