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**UNIT IV**

**MEASUREMENT AND SCALING TECHNIQUES**

**CATAGORICAL VARIABLES**

Categorical variables are qualitative data in which the values are assigned to a set of distinct groups or categories. These groups may consist of alphabetic (e.g., male, female) or numeric labels (e.g., male = 0, female = 1) that do not contain mathematical information beyond the frequency counts related to group membership. Instead, categorical variables often provide valuable social-oriented information that is not quantitative by nature (e.g., hair color, religion, ethnic group).

In the hierarchy of measurement levels, categorical variables are associated with the two lowest variable classification orders, nominal or ordinal scales, depending on whether the variable groups exhibit an intrinsic ranking.

**Categorical Data Definition**

Categorical data is a collection of information that is divided into groups. i.e., if an organisation or agency is trying to get a biodata of its employees, the resulting data is referred to as categorical. This data is called categorical because it may be grouped according to the variables present in the biodata such as sex, state of residence, etc.

Categorical data can take on numerical values (such as “1” indicating Yes and “2” indicating No), but those numbers don’t have mathematical meaning. One can neither add them together nor subtract them from each other.

**Types of Categorical Data**

There are two types of categorical data, namely; the nominal and ordinal data.

- **Nominal Data:** This is a type of data used to name variables without providing any numerical value. Coined from the Latin nomenclature “Nomen” (meaning name), this data type is a subcategory of categorical data.

Nominal data is sometimes called “labelled” or “named” data. Examples of nominal data include name, hair colour, sex etc.

Mostly collected using surveys or questionnaires, this data type is descriptive, as it sometimes allows respondents the freedom to type in responses. Although this characteristic helps in arriving at better conclusions, it sometimes poses problems for researchers as they have to deal with so much irrelevant data.

- **Ordinal Data:** This is a data type with a set order or scale to it. However, this order does not have a standard scale on which the difference in variables in each scale is measured.

Although mostly classified as categorical data, it is said to exhibit both categorical and numerical data characteristics making it in between. Its classification under categorical data has to do with the fact that it exhibits more categorical data character.

Some ordinal data examples include; Likert scale, interval scale, bug severity, customer satisfaction survey data etc. Each of these examples may have different collection and analysis techniques, but they are all ordinal data.

## **General Characteristics/Features of Categorical Data**

### **Categories**

There consist of two categories of categorical data, namely; nominal data and ordinal data. Nominal data, also known as named data is the type of data used to name variable, while ordinal data is a type of data with a scale or order to it.

### **Qualitative**

Categorical data is qualitative. That is, it describes an event using a string of words rather than numbers.

### **Analysis**

Categorical data is analysed using mode and median distributions, where nominal data is analysed with mode while ordinal data uses both. In some cases, ordinal data may also be analysed using univariate statistics, bivariate statistics, regression applications, linear trends and classification methods.

### **Graphical analysis**

It can also be analysed graphically using a bar chart and pie chart. A bar chart is mostly used to analyse frequency while a pie chart analysis percentage. This is done after grouping into a table.

### **Interval scale**

In the case of ordinal data, which has a given order or scale, the scale does not have a standardised interval. This is not applicable for nominal data.

### **Numeric values**

Although categorical data is qualitative, it may sometimes take numerical values. However, these values do not exhibit quantitative characteristics. Arithmetic operations cannot be performed on them.

## **Nature**

Categorical data may also be classified into binary and non-binary depending on its nature. A given question with options “Yes” or “No” is classified as binary because it has two options while adding “Maybe” to the given options will make it nonbinary.

## **Categorical Data Examples**

**i) Household Income:** Categorical data is mostly used by businesses when investigating the spending power of their target audience, to conclude on an affordable price for their products. For example:

What is your household income?

- Below \$30,001
- \$30,001 - \$40,000
- \$40,001 - \$50,000
- \$50,001 and above

This is a closed ended nominal data example.

## **ii) Education Level**

The level of education of a respondent may be requested for when filling forms for job applications, admission, training etc. This is used to assess their qualification for a specific role. Consider the example below:

What is your highest level of education?

- School SAT
- High School
- BSc.
- MSc.
- PhD

This is also a closed-ended nominal data example.

## **iii) Gender**

Respondents are asked for their gender when filling out a biodata. This is mostly categorised as male or female, but may also be nonbinary. For example:

What is your gender?

- Male
- Female

This is a binary and closed-ended nominal data example.

What is your gender? (Others signify)

- Male
- Female
- Others \_\_\_\_\_

This is a nonbinary and open-closed ended nominal data example.

## **iv) Customer satisfaction**

After rendering service to customers, businesses like to get feedback from customers regarding their service to improve. For example;

Kindly rate your customer service experience with us

- Very poor
- Poor
- Neutral
- Good
- Very good

The above is an example of an ordinal data collection process. The responses have a specific order to them, listed in ascending order.

#### **v)Brand of soaps**

When doing competitive analysis research, a soap brand may want to study the popularity of its competitors among their target audience. In this case, we have something of this nature:

Which of the following soap brands are you familiar with?

- Lux
- Dove
- Olay

This is a multiple-choice nominal data collection example.

#### **vi)Hair colour**

This is a key categorical data example used in profiling a respondent. Although not accurate, a person's hair colour together with some racially prominent traits may be used to predict whether the person is black, caucasian, Hispanic, etc. For example:

What is your hair colour?

- Blonde
- Brunette
- Brown
- Black
- Red

This is a closed-ended example of nominal data.

#### **vii)Surveys or Questionnaires**

Online surveys are commonly used to carry out investigations on certain topics. The data gathered in some cases are categorical.

How many siblings do you have?

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The above is an example of an open-ended nominal data collection form. The response may be quantitative but will possess qualitative properties.

#### **viii)Happiness level**

This example may be used by a therapist or psychologist when examining a patient for mental illness. It is usually collected together with some important data that may affect a person's mental health.

Rate your happiness level on a scale of 1-5.

This is an ordinal data example.

#### **ix)Motives for employees to work better:**

Companies who want to improve employee productivity may use this method to discover what motivates employees to work better. For example:

What motivates you to work better? (Others specify)

- Peer motivation
- Recognition
- Professional growth opportunities
- Friendly work culture
- Others \_\_\_\_\_

This is a closed open-ended nominal data collection example.

#### **x) Motives for travelling:**

Travel and tourism companies ask their customers or target audience this question to inform marketing strategies.

What are your motives for travelling? (Others specify)

1. Business
2. Leisure
3. Family
4. Study
5. Health
6. Others \_\_\_\_\_

This is a closed open-ended nominal data collection example.

#### **xi) Interval scale**

An event planning company may use an interval scale to get the demographics of attendees of a particular event. It is also used by Instagram and Facebook to give audience insights. For example: In which of the following age bracket do you fall?

- Below 21 years
- 21 to 35 years
- 36 to 58 years
- 59 years and above

This is an example of ordinal data collection.

#### **xii) Checking account location**

Some timesheet calculator tool collects real-time employee location so that employers can know which employee is at work and which one isn't. This is also used in several other cases. For example:

When a user gives Instagram access to his/her location, it uses this data to give insights using a bar chart. E.g. 50% is from Texas, 30% from Texas and 20% from Colorado.

#### **xiii) Bug severity**

When software companies perform quality assurance testing to discover bugs in the software, the bugs are treated according to their severity level.

When a bug bounty hunter submits a bug to a company, it is given a severity level like critical, medium or low. This is an example of ordinal data.

**xiv) Likert scale:** A Likert scale is a point scale used by researchers to take surveys and get people's opinion on a subject matter. Consider this example:

How will you rate the desert served tonight?

1. Very good
2. Good
3. Neutral

4. Bad
5. Very bad

This is a 5 point Likert scale, a common example of ordinal data.

#### **xv)Proficiency level**

Employees measure a job applicant's proficiency level in skills required to perform well in the job. This helps in choosing the best applicant for the job.

What is your proficiency level in excel?

- Advanced
- Intermediate
- Novice

This is a simple example of ordinal data.

#### **Categorical Data Variables**

A categorical variable is a variable type with two or more categories. Sometimes called a discrete variable, it is mainly classified into two (nominal and ordinal).

For example, if a restaurant is trying to collect data of the amount of pizza ordered in a day according to type, we regard this as categorical data. When gathering the data, the restaurant will group the number of orders according to the type of pizza (e.g. pepperoni, chicken etc.) ordered. In this case, the type of pizza ordered is the **Categorical variable**.

Categorical Data Variables are divided into two, namely; ordinal variable and nominal variable.

**Nominal Data Variable:** This type of categorical data variable has no intrinsic ordering to its categories. For example, marital status is a categorical variable having two categories (single and married) with no intrinsic ordering to the categories.

There are two main categories of nominal data variables, namely; matched and unmatched category. Below are the tests carried out on each category:

#### **Matched Category**

- McNemar Test: This is a distribution-free test for paired nominal data (2 groups).
- Cochran's Q Test: This is a test carried out on 3 or more groups.

#### **Unmatched Category**

- Fisher's Exact Test: This test is used when the expected frequency is less than 5.
- Chi-Square Test: This test is used when the expected frequency is 5 or more.

**Ordinal Data Variable:** This type of categorical variable has an intrinsic ordering to its categories. For example, when studying the severity of the bug in the software, severity is a categorical variable with ordered categories which are; critical, medium and low.

There are two main categories of ordinal data variables, namely; matched and unmatched category. Below are the tests carried out on each category:

#### **Matched Category**

- Wilcoxon signed-rank test: This is a test used to assess the differences between 2 groups of matched samples.

- Friedman 2-way ANOVA: This is used to find differences in matched sets of 3 or more groups.

### **Unmatched Category**

- Wilcoxon rank-sum test: This test is used to investigate 2 groups of independent samples.
- Kruskal-Wallis 1-way test: This is used to investigate 3 or more groups.

### **Uses of Categorical Data**

- **Job Application**

When applying for jobs, employers collect both nominal and ordinal data. This includes the job seeker's biodata and a combination of relevant skills and experience. Employers do this to determine the best candidate for the job.

- **E-commerce**

When placing an order for a product or service on an e-commerce website, one is required to input some details which are regarded as categorical data. The data collected in this case is nominal.

- **Online Dating**

Users of online dating platforms are usually required to input a set of categorical data to match them with the right person. This data may include personal information and partner preferences.

- **Customer Service**

Organizations or companies use this after selling their product or service to a customer. This is used to know how the customer feels about the company's service to improve the overall customer experience.

- **Surveys & Questionnaires**

Categorical data is used to gather information from both online and offline survey or questionnaire as the case may be. The type of categorical data used may differ depending on the aim of data collection.

- **Personality tests:**

This is a common test that is used for investigating the kind of personality traits a respondent possess. This test is used by companies for investigating whether a personality trait is compatible with the company work culture.

### **Disadvantages of Categorical Data**

- There is a limit to the kind of statistical analysis that can be performed on categorical data.
- The options in categorical data do not have a standardised interval scale. Therefore, respondents are not able to effectively gauge their options before responding.
- Quantitative analysis cannot be performed on categorical data. Therefore numerical or arithmetic operations can not be performed.

### **What is the best tool For Collecting Categorical Data?**

Categorical data may easily be collected through various collection techniques using Formplus form builder. This online form builder provides effective categorical data gathering and management.

Formplus not only provide easy data collection through customisable form feature but also create data analytics which helps drive easy and proper decision making. It also contains useful statistical data analysis features, making it the best tool for collecting categorical data.

## **Differences Between Categorical and Numerical Data**

Categorical and Numerical data are the main types of data. These data types may have the same number of subcategories, with two each, but they have many differences. These differences give them unique attributes which are equally useful in statistical analysis.

Numerical data are quantitative data types. For example: weight, temperature, height, GPA, annual income, etc. are classified under numerical or quantitative data.

In comparison, categorical data are qualitative data types. Some examples include: name, hair colour, qualification etc.

### **Conclusion**

As you can see, there is a non-exhaustive list of categorical data examples which can be given to better understand the meaning and purpose of qualitative data. When working with data management, it's crucial to clearly understand some of the main terms, including quantitative and categorical data and what their role is.

The distinction between categorical and quantitative variables is crucial for deciding which types of data analysis methods to use. The first step towards selecting the right data analysis method today is understanding categorical data.

Quantitative data are analyzed using descriptive statistics, time series, linear regression models, and much more. For categorical data, typically only graphical and descriptive methods are used.

## **Quantitative data types**

### **Interval Data: Definition**

Interval data, also called an integer, is defined as a data type which is measured along a scale, in which each point is placed at equal distance from one another. Interval data always appears in the form of numbers or numerical values where the distance between the two points is standardized and equal.

Interval data cannot be multiplied or divided, however, it can be added or subtracted. Interval data is measured on an interval scale. A simple example of interval data: The difference between 100 degrees Fahrenheit and 90 degrees Fahrenheit is the same as 60 degrees Fahrenheit and 70 degrees Fahrenheit.

In market research or in any other forms of social, economic or business research interval data plays a pivotal role. What makes interval data so popular and in-demand is because interval data supports almost all statistical test and transformations in obtaining quantitative data.

Interval data has very distinctive attributes that make it distinct in comparison to nominal data, ordinal data or even ratio data. Interval data doesn't have a defined absolute zero point which is present in ratio data. The lack of absolute point zero makes comparisons of direct magnitudes impossible. For example, Object A is twice as large as Object B is not a possibility in interval data.

### **Interval Data Analysis**

Since interval data is quantitative data type almost all the methods used to analyze quantitative can be used. Here are a few examples:

#### **1. Trend analysis**

Trend analysis is a popular interval data analysis technique, used to draw trends and insights by capturing survey data over a certain period of time. In other words, a trend analysis on interval



data is conducted by capturing data using an interval scale survey in multiple iterations, using the same question.

## **2. SWOT Analysis**

Analysis conducted to evaluate an organization's strengths, weaknesses, opportunities, and threats is called SWOT analysis and is widely used to evaluate interval data. Strengths and weaknesses are internal aspects of an organization while opportunities and threat are external to an organization. An organization can measure interval data to evaluate market competition as well as plan future marketing activities using the SWOT analysis results.

## **3. Conjoint Analysis**

Conjoint Analysis is an advanced level market research technique usually implemented to analyze how individuals make complicated decisions in an interval scale. Which factors are important for customers before they make decisions where they have multiple options available at their disposal.

## **4. TURF Analysis**

TURF analysis stands for Totally Unduplicated Reach and Frequency analysis- is a method that allows a marketer to analyze the potential of market research for a combination of products and services. It evaluates the interval data of customers reached by a particular source of communication and its frequency. This analysis technique is used by researchers to understand whether a new product or service will be well-received in the target market or not. This analysis method was primarily used for designing media campaigns but has expanded to being used in product distribution and line analysis.

## **Key Characteristics of Interval Data**

Here are a few characteristics of Interval data:

- **Measurement:** Interval data is measured using an interval scale, which not only shows the order and direction but also shows the exact difference in the value. For example, the markings on a thermometer or a ruler are equidistant, in simpler words they measure the same distance between the two markings.
- **Interval Difference:** The distances between each value on interval data is equal. For example, the difference between 10 cm and 20 cms is the same as 20 cms and 30 cms.
- **Calculation:** In interval data, one can add or subtract values but cannot divide or multiply. Almost all statistical analysis are applicable when calculating interval data, mean, mode, median etc.
- **Point Zero:** Absolute zero point is arbitrary, which means a variable can be measured even if it has a negative value like temperature can be -10 below zero but height cannot be below zero.

## **Interval Data Examples**

1. One can measure time during the day using a 12-hour clock, this is a good example of interval data. Time in a 12-hour format is a rotational measure that keeps restarting from zero at set periodicity. These numbers are on an interval scale as the distance between them is measurable and comparable. For example, the difference between 5 minutes and 10 minutes is the same as 15 minutes and 20 minutes in a 12-hour clock.

2. The temperature measured in Fahrenheit and Celsius but not in Kelvin. If you measure temperature in Fahrenheit and Celsius then it will be considered interval data as 0 is arbitrary. But in Kelvin, 0 is absolute. There can't be a temperature below zero degrees in Kelvin.

3. When you calculate intelligence score in an IQ test. There is no zero point for IQ. According to psychological studies, a person cannot have zero intelligence, therefore in this example, zero is arbitrary. IQ is numeric data expressed in intervals using a fixed measurement scale.

4. Test scores of examination like SAT. Scores in SAT test are in the range of 200-800. The numbers from 0 to 200 are not used when they scale the raw score (number of questions answered correctly) to the section score. The reference point is not an absolute zero, thus, it qualifies to become interval data.

5. Age is also a variable that can be measured on an interval scale. For example, if A is 15 years old and B is 20 years old, it not only clear than B is older than A, but B is elder to A by 5 years.

**Interval data** is one of the most used data types. Survey tools offer several ways to capture interval data. When a survey is deployed to a respondent, with a certain demographic question that asks respondents to state their income, these figures can range from zero to infinity!

For example:

**Please state your annual income**

- Below \$40,000
- \$40,000- \$60,000
- \$60,000- \$80,000
- \$80,000- \$100,000
- Above \$100,000

Numerical data collected in this manner can be categorized into groups, in the above mentioned examples groups can based on the respondents annual income. People falling under same income category.

There are multiple survey question types which can be used to generate interval data. This data obtained is rich for insights but a researcher must think through carefully before deploying them in a survey.

### **Ratio Data: Definition**

Ratio Data is defined as quantitative data, having the same properties as interval data, with an equal and definitive ratio between each data and absolute "zero" being treated as a point of origin. In other words, there can be no negative numerical value in ratio data.

For example:

Four people are randomly selected and asked how much money they have with them. Here are the results : \$20, \$40, \$60, and \$80.

- Is there an order to this data? Yes,  $\$20 < \$40 < \$60 < \$80$ .
- Are the differences between the data values meaningful? Sure, the person who has \$40 has \$20 more than the person with \$20.
- Can we calculate ratios based on this data? Yes, because \$0 is the absolute minimum amount of money a person could have with them.

- The person with \$80 has four times as much as the person with \$20.

Ratio data has all properties of interval data such as – data should have numeric values, a distance between the two points are equal, etc. but, unlike interval data where zero is arbitrary, in ratio data, zero is absolute.

An excellent example of ratio data is the measurement of heights. Height could be measured in centimeters, meters, inches, or feet. It is not possible to have a negative height. When comparing to interval data, for example, the temperature can be – 10-degree Celsius, but height cannot be negative, as stated above.

Ratio data can be multiplied and divided, and this is one of the significant differences between ratio data and interval data, which can only be added and subtracted. In ratio data, the difference between 1 and 2 is the same as the difference between 3 and 4, but also here 4 is twice as much as 2. This comparison is impossible in interval data.

### **Ratio Data Analysis**

Ratio data, alongside the 3 other variable measurement scales, is fundamentally a quantitative data capturing method. This means all types of statistical analysis techniques can be applied to Ratio Data.

Below are some of the popular ratio data analysis techniques:

- **Trend analysis**

Trend analysis is a popular ratio data analysis technique used to draw trends and insights by capturing survey data over a certain period of time. In other words, trend analysis on ratio data is conducted by capturing data using a ratio scale survey in multiple iterations, using the same question. Trend analysis also plays a critical role in the predictive analysis, where a set of time-bound data is compared and analyzed for predicting future trends.

- **SWOT Analysis**

Analysis conducted to evaluate an organization's strengths, weaknesses, opportunities, and threats is called SWOT analysis and is widely used to evaluate ratio data. Strengths and weaknesses are internal aspects of an organization, while opportunities and threats are external to an organization. An organization can measure ratio data to evaluate market competition as well as plan future marketing activities using the SWOT analysis results.

- **Conjoint Analysis**

Conjoint Analysis is an advanced level market research technique usually implemented to analyze how individuals make complicated decisions on a ratio scale. It helps find important factors for customers before they make decisions when they have multiple options available at their disposal. Marketers can test their websites, conduct price research, or improve product features using conjoint analysis.

- **Cross Tabulation**

Cross-tabulation, in statistics, is a method to understand the relationship between multiple variables. The contingency table, also known as a crosstab, is used to establish a correlation between multiple ratio data variables in a tabular format. Informed decisions can be taken after analyzing the data from a contingency table. Market researchers usually analyze customer intent and product performance using cross-tabulation as they provide a comparison between two or more variables.

- **TURF Analysis**

TURF analysis stands for Totally Unduplicated Reach and Frequency analysis- is a method that allows a marketer to analyze the potential of market research for a combination of products and services. It

evaluates the ratio data of customers reached by a particular source of communication and its frequency. This analysis technique is used by researchers to understand whether a new product or service will be well-received in the target market or not. This analysis method was used mainly for designing media campaigns but has expanded to being used in product distribution and line analysis.

### **Characteristics of Ratio Data**

**1. Absolute Point Zero** – Ratio data is measured on a ratio scale. One of the distinctive characteristics of ratio data is the true absolute zero point, which makes the data relevant and meaningful in a manner where it is right to say, “one object is twice as long as the other” or 4 has twice the value as 2.

**2. No Negative Numerical Value** – Ratio data doesn’t have any negative numerical value. For a value to be a ratio data researcher, first must evaluate if it meets all the criteria of interval data and has an absolute zero point. For example, weight cannot be negative, -20 Kgs doesn’t exist.

**3. Calculation** – Ratio data values can be added, subtracted, divided, and multiplied. A unique statistical analysis is possible for ratio data. Chi-square can be calculated using a ratio scale for ratio data. Mean, mode and median can also be calculated for the ratio data.

#### Ratio Data Examples

Following are the most commonly used examples of ratio data that can be used in surveys to extract ratio data:

#### **What is your weight in kgs?**

- Less than 50 kgs
- 51-60 kgs
- 61-70 kgs
- 71-80 kgs
- 81-90 kgs
- Above 90 Kgs

#### **What is your height in feet and inches?**

- Less than 5 feet.
- 5 feet 1 inch – 5 feet 5 inches
- 5 feet 6 inches- 6 feet
- More than 6 feet

#### **What is the number of burgers you can eat daily?**

- 1-2
- 2-3
- 3-4
- 4-5
- 5-6
- More than 6

### **Comparative Scaling Techniques for Survey Research**

Scaling emerged from the social sciences in an attempt to measure or order attributes with respect to quantitative attributes or traits. Scaling provides a mechanism for measuring abstract concepts. A comparative scale is an ordinal or rank order scale that can also be referred to as a nonmetric scale. Respondents evaluate two or more objects at one time and objects are directly compared with one another as part of the measuring process. For example you could ask someone if they prefer listening to MP3s through a Zune or an iPod. You could take it a step further and add

some other MP3 player brands to the comparison. MP3 players would be scaled relative to each other and the scale position of any one player would depend on the the scale position of the remaining players. Because they are being compared differences such as who has the click wheel are effectively forced. Where this is limiting is evident when you find no standard of comparison outside the objects being compared. No generalizations are made outside of these objects. Often used when physical characteristics of objects are being compared.

### **Guttman Scaling**

This can also be referred to as a cumulative scoring or scalogram analysis. The intent of this survey is that the respondent will agree to a point and their score is measured to the point where they stop agreeing. For this reason questions are often formatted in dichotomous yes or no responses. The survey may start out with a question that is easy to agree with and then get increasingly sensitive to the point where the respondent starts to disagree. You may start out with a question that asks if you like music at which point you mark yes. Four questions later it may ask if you like music without a soul and which is produced by shady record labels only out to make money at which point you may say no. If you agreed with the first 5 questions and then started disagreeing you would be rated a 5. The total of questions you agreed to would be added up and your final score would say something about your attitude toward music.

### **Rasch Scaling**

This probabilistic model provides a theoretical basis for obtaining interval level measurements based on counts from observations such as total scores on assessments. This analyzes individual differences in response tendencies as well as an item's discrimination and difficulty. It measures how respondents interact with items and then infers differences between items from responses to obtain scale values. This model is typically used analyze data from assessments and to measure abilities, attitudes, and personality traits.

### **Rank-Order Scaling**

This gives the respondent a set of items and then asks the respondent to put those items in some kind of order. The "order" could be something like preference, liking, importance, effectiveness, etc. This can be a simple ordinal structure such as A is higher than B or be done by relative position (give each letter a numerical value as in A is 10 and B is 7). You could present five items and ask the respondent to order each one A-E in order of preference. In Rank-Order scaling only  $(n-1)$  decisions need to be made.

### **Constant Sum Scaling**

With this ordinal level technique respondents are given a constant sum of units such as points, money, or credits and then asked to allocate them to various items. For example, you could ask a respondent to reflect on the importance of features of a product and then give them 100 points to allocate to each feature of the product based on that. If a feature is not important then the respondent can assign it zero. If one feature is twice as important as another then they can assign it twice as much. When they are done all the points should add up to 100.

### **Paired Comparison Scale**

This is an ordinal level technique where a respondent is presented with two items at a time and asked to choose one. This is the most widely used comparison scale technique. If you take  $n$

brands then  $[n(n-1)/2]$  paired comparisons are required. A classic example of when paired comparison is used is during taste tests. For example you could have a taste test in which you have someone try both Coke and Pepsi and then ask them which one they prefer.

### **Bogardus Social Distance Scale**

This is a cumulative score that is a variant of the Guttman scale, agreement with any item implies agreement with the preceding items. This scale is used to measure how close or distant people feel toward other people. Social distance is a concern when it comes to issues related to racial integration or other forms of equality. This is applicable to team formation in the work place for example. Some people accept other people easily and use trustworthiness as the basis of their relationship with other people. Other people do not accept people who are not like them and tend to keep those that are not like them at arms length.

### **Q-Sort Scaling**

This is a rank order procedure where respondents are asked to sort a given number of items or statements and classify them into a predetermined number of sets (usually 11) according to some criterion such as preference, attitude, or behavioral intent. Using cards that note an item to be ranked is the most popular and simplest method to use in the sorting process. In order to increase statistical reliability at least 60 cards should be used and no more than 140. This is good for discriminating among a large group of items in a relatively short amount of time.

### **Continuous Rating Scale**

**Definition:** The **Continuous Rating Scale** is a Noncomparative Scale technique wherein the respondents are asked to rate the stimulus objects by placing a point/mark appropriately on a line running from one extreme of the criterion to the other variable criterion.

The continuous rating scale is also called as a **Graphic Rating Scale**. Here the respondent can place a mark anywhere on the line based on his opinion and is not restricted to select from the values as previously set by the researcher. The continuous scale can observe many forms, i.e. it can either be vertical or horizontal; scale points, in the form of numbers or brief descriptions, may be provided, and if these are provided, then the scale points might be few or many.

Once the ratings are obtained, the researcher splits up the line into several categories and then assign the scores depending on the category in which the ratings fall. We can say that the continuous rating scale possesses the characteristics of **description, order and distance**. *By description, we mean*, the unique tags, name or labels used to designate each scale value. The *order* refers to the relative position of the descriptors, and the *distance* means an absolute difference between the descriptors is known and can be expressed in unitary terms.

One of the advantages of the continuous rating scale is that it is easy to construct. But, however, the scoring is burdensome and reckless. Also, these rating scales provide little information. Therefore, the continuous rating scale has limited use in the marketing research. Despite the limitations, due to the increased popularity of computer-assisted personal interviewing (**CAPI**), a technique wherein the respondent and interviewer give answers via computers, the use of the continuous scaling technique has been increased.

**The following are the most commonly used itemized rating scales:**

1. **Likert Scale:** A Likert Scale is a scale with **five response categories** that ranges from “**strongly disagree**” to “**strongly agree**”, wherein the respondent is asked to indicate the degree of agreement or disagreement with each of the statements related to the stimulus object under analysis.
2. **Semantic Differential Scale:** The semantic differential scale is a **seven-point rating scale** with the extreme points having the semantic meaning. The scale is used to measure the meaning or semantics of words, especially the bi-polar adjectives (**such as “evil” or “good”, “warm” or “cold”**) to derive the respondent’s attitude towards the stimulus object.
3. **Stapel Scale:** Stapel scale is a **single adjective** rating scale with **10 categories** ranging from **-5 to +5** with no zero points. This scale is usually a vertical scale in which the single adjective is placed in the middle of the even-numbered range (-5 to +5). The respondent is asked to identify how correctly or incorrectly each term describes the stimulus object by choosing an appropriate response category.

The itemized rating scale is widely used in marketing research and serve as a basic component of more complex scales, such as Multi-Item Scales.

## **Likert Scale**

**Definition:** A **Likert Scale** is a scale used to measure the attitude wherein the respondents are asked to indicate the level of agreement or disagreement with the statements related to the stimulus objects.

The Likert Scale was named after its developer, **Rensis Likert**. It is typically a five response category scale ranging from “**strongly disagree**” to “**strongly agree**”. The purpose of a Likert scale is to identify the attitude of people towards the given stimulus objects by asking them the extent to which they agree or disagree with them.

Often, the respondents are presented with questionnaires containing the set of statements to rate their attitude towards the objects. **For example**, the respondents might be asked to rate their purchase experience with shoppers stop by assigning the score as (**1= strongly disagree, 2= disagree, 3= neither agree nor disagree, 4= agree, 5= strongly agree**) to the series of statements given below:

- Shoppers stop sell high-quality merchandise.
- I like to shop from shoppers stop.
- It offers several credit schemes.
- It charges fair prices.
- I like the way shoppers stop advertises its products.

The data obtained from the Likert Scale are typically treated as the interval. Thus, we can say that Likert scale possesses **description, order and distance** characteristics. **Description** means the unique labels or tags designated to each value of the scale; **Order** means the relative position of the descriptor and **Distance** implies that the absolute differences between the descriptors is known and can be expressed in units.

For the purpose of analysis, each statement is allotted a numerical score ranging from either 1 to 5 or -2 to +2. The analysis could be done item wise, or a total score can be computed by summing

up all the items for each respondent. One of the advantages of a Likert scale is that it is easy to construct and administer.

The major limitation of this scaling technique is that it is time-consuming and requires much more time as compared to other itemized scaling techniques. This is because each respondent is required to read every statement given in a questionnaire before assigning a numerical value to it. Another limitation of a Likert scale is that it could be misunderstood at times, especially when the responses are unfavorable.

### **Guttman Scale Definition**

Guttman scale is one of the three unidimensional scales, the other two being – Likert Scale and Thurstone Scale. Guttman scale also called cumulative scaling or scalogram analysis is created with elements that can possibly be ordered in a hierarchical manner. It is representative of the extreme “attitude” of respondents, i.e. extremely positive or negative, about the subject in-hand. This scale is used by researchers in situations where a unidimensional scale for a continuum of opinions is required. “Uni”-dimensional scale indicates that the answer options have only one measurement parameter, i.e., a range of numbers can be associated with the scale. For instance, “On a scale of 0-10, how satisfied are you with the service of this airline?” – can be indicated with unidimensional answer options.

Guttman scale has a list of statements. It can be inferred that respondents who agree to the statement placed at the end of this list, would have agreed to all the other statements above the last one. Each statement will have a corresponding weight associated with it. The cumulation of the weight according to respondent feedback will help researchers in predicting the number of statements agreeable to the respondents. For example, on a 5 scale Guttman scale, if a respondent scores 3 – it indicates that he/she has agreed to the first 3 statements of the scale if a different respondent scores 5 – it indicates that he/she has agreed to all the statements on this cumulative scale.

The main goal of this scale is to filter those respondents who comply with 100% of the statements mentioned in the scale. But, practically it is highly improbable that respondents totally comply with a series of statements and thus, scalogram analysis is conducted to evaluate the closest set of statements that the target audience agrees with. Bogardus scale is a popular example of the Guttman scale.

### **Guttman Scale Characteristics**

- **Unidimensional in nature:** Guttman scale has statements in the order of difficulty – from the least difficult to the most difficult and is thus, unidirectional in nature. In a 10-item Guttman scale, if a respondent score 8 – it is indicative of the fact that the respondent agrees with the first 8 statements of the scale and disagrees with the last two statements of the scale.
- **Deterministic model:** The responses are considered according to the last agreed statement of the scale and are cumulative of the responses. The answers to all the statements can be judged on the basis of this cumulative score due to the deterministic nature of this scale.



- **Reproducible questions are added:** Guttman scale only has questions which are reproducible, which means that those questions which will not be able to produce desired results will be eliminated from the scale and only those questions which can boost the purpose of scalability will be included.
- **Ordinal nature of data:** The list of statements is arranged in an ordinal manner, i.e., from the minimum important statement to the maximum important statement.

## Steps for developing a Guttman Scale with Examples

To explain the process of developing a Guttman scale in detail, we will be considering an example – After the school shootings across the U.S., should laws be designed for the staff and administration to carry guns to school? It has been a raging topic amongst students after the intensity of the shootings has enhanced over the past few years.

There are five main steps in the process of developing a Guttman scale.

- **Clarify the objective of using Guttman scale:** Every scaling method should have a clearly defined objective for effective implementation. In the above-mentioned example, if students wish to calculate a cumulative score of those in support of staff and administration possessing guns in school – this can be their objective for conducting a Guttman scale. In the objective, it needs to be made clear whether all staff members or just some possessing guns will fulfill the purpose.
- **Create a list of statements:** In order to gain desired insights about designing of laws, those in charge can create a list of statements for the scale or involve specialists so that effective statements can be included in the scale.
  - I support the prohibition of sales of gun bump stocks.
  - I do not support any regulations on gun sales to the civilian population. I support the prohibition of gun sales to civilians altogether.
  - I support stricter background checks during the process of gun sales.
  - I support prohibiting gun sales to mentally ill people.

Guttman scale statements are often expected to be 80-100 in number for reasonable results.

- **Associate values to each of the statements:** The experts involved in the process of developing the statements should assign values to each of the statements according to their importance to the topic of laws against school shootings. The experts are expected to answer Yes – if the statement is in favor of laws against school shootings and No- if the statement is not in favor of laws against school shootings. Also, a very critical aspect needs to be addressed at this step – the values assigned should not involve personal opinions of the experts and instead should merely be on the basis of their contribution towards laws for school shootings.
- **Structurize the Guttman scale for analysis:** Analysis of Guttman scale is the most important step. The answers received for various statements can be represented in a Matrix.

Respondent	Statement 1	Statement 2	Statement 3	Statement 4	Statement 5
5	Yes	Yes	Yes	Yes	Yes
10	Yes	Yes	Yes	Yes	–
15	Yes	Yes	Yes	–	–
16	Yes	–	–	Yes	–
20	Yes	Yes	–	–	–
21	–	–	–	–	–

In the above-mentioned matrix, in the first row, if someone agrees to statement 5, it indicates that the individual must have agreed to the preceding statements, i.e. – statement 1 to statement 4. Also, there can be exceptions in the respondent answers but generally, those respondents who agree to statement 4 would have agreed to the statements 1 to statement 3. In case there is a restrictive list of statements, it is extremely convenient for marketers to analyze data but when a large data is collected, analysis becomes a tough step. In that case, marketers are expected to analyze a subset that is closest to the desired cumulative.

**Application 1:** Guttman scale is used to evaluate an organization’s hierarchical structure.

By including questions that analyze the employee hierarchy such as:

- I am willing to contribute towards the social causes supported by my organization.
- I am willing to work longer hours to complete the assigned task.
- I am willing to communicate better with my team members.
- I am willing to attend conferences and seminars

**Application 2:** This cumulative scaling method can also be used to measure a customer journey.

In this case, the below-mentioned questions can be a part of the scale:

- I could easily solve my problem by contacting the customer service team.
- I could get the products delivered to my doorstep.
- I could get in touch with the support team quickly.
- I could look for the required products easily on the company’s website.
- I could make the payment for the products easily.

### Guttman Scale Advantages

- **Highly hierarchical and structured in nature:** Due to the hierarchical and structured nature of this scale, it can be extremely productive in short surveys and questionnaires. For example, to analyze social distance, employee hierarchy, stages of evolution etc.
- **Implemented to gain insights for multiple queries:** Guttman scale includes multiple statements for the respondents to answer which occupies a short space in an online survey.
- **More intuitive than other uni-dimensional scales:** The way in which the answers are represented in this scale makes Guttman scale extremely intuitive for users.
- **Produces data in a ranked manner:** The statements mentioned in this scale have their degree of importance and values associated accordingly. Thus, the results of this scale are in terms of ranks.