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1. Measurement and Scaling Theory

Identifying & Measuring Research Variables

Measurements are important in context of data collection from sample which is to be processed and analyzed further.

Concepts such as job satisfaction and effectiveness are mental images and are not directly measurable. Their meanings may vary significantly from one person to another. They need to be converted into a variable to become measurable. **An image, a perception, or a concept that can be measured and, thus, capable of assuming different values is called variable.**

In a research study, it is important that the concepts used should be further defined in operational terms so as to minimize the variations in respondents' understandings about the concept. If the construct 'class performance' is being used, it should be understood in the same sense by almost all the respondents.

Whenever people express these feelings or preferences, they do so based on certain criteria in their minds. Their judgment is based upon indicators that lead them to conclude and express that opinion. For example, objective of research is to study the pattern of wealth distribution in our society. The term wealth may entail indicators such as assets and income which may vary from one person to another. They need to be measured to study the pattern of wealth distribution.

Campbell defines measurement as "The assignment of numbers to represent properties."

"The assignment of numbers to objects to represent amounts or degrees of a property possessed by all the objectives."
- Torgerson

Measurement also have several purposes

- The researcher **constructs theories** to explain social and psychological phenomena (e.g., labor unrest, employee satisfaction), which in turn are used to derive hypotheses or assumptions. These hypotheses can be verified statistically only by measuring the variables in the hypotheses.
- Measurement makes the **empirical description of social and psychological phenomena** easier.

2. Types of Measurement

Measurement may be classified into four different levels, based on the characteristics of order, distance and origin.

Levels of measurement	Characteristics
Nominal	No order, distance or origin
Ordinal	Order, but no distance or origin
Interval	Both order and distance, but no origin
Ratio	Order, distance and origin

Types of Measurement

a) Nominal Measurement

This level of measurement consists in assigning numerals or symbols to different categories of a variable. The example of male and female applicants to an MBA program is an example of nominal measurement. The numerals or symbols are just labels and have no quantitative value. The number of cases under each category are counted. Nominal measurement is, therefore, the simplest level of measurement. It does not have characteristics such as order, distance or arithmetic origin.

Types of Measurement

b) Ordinal measurement

In this level of measurement, persons or objects are assigned numerals which indicate ranks with respect to one or more properties, either in ascending or descending order.

Example: Individuals may be ranked according to their "socio-economic class", which is measured by a combination of income, education, occupation and wealth. The individual with the highest score might be assigned rank 1, the next highest rank 2, and so on, or vice versa.

The numbers in this level of measurement indicate only rank order and not equal distance or absolute quantities. This means that the distance between ranks 1 and 2 is not necessarily equal to the distance between ranks 2 and 3.

Types of Measurement

Ordinal scales may be constructed using rank order, rating and paired comparisons. Variables that lend themselves to ordinal measurement include preferences, ratings of organizations and economic status. Statistical techniques that are commonly used to analyze ordinal scale data are the median and rank order correlation coefficients.

c) Interval measurement

This level of measurement is more powerful than the nominal and ordinal levels of measurement, since it has one additional characteristic – equality of distance. However, it does not have an origin or a true zero. This implies that it is not possible to multiply or divide the numbers on an interval scale.

Types of Measurement

The Centigrade or Fahrenheit temperature gauge is an example of the interval level of measurement. A temperature of 50 degrees is exactly 10 degrees hotter than 40 degrees and 10 degrees cooler than 60 degrees.

Since the interval scales are more powerful than nominal or ordinal scales, they also lend themselves to more powerful statistical techniques, such as standard deviation, product moment correlation and “t” tests and “F” tests of significance.

Types of Measurement

d) Ratio measurement

This is the highest level of measurement and is appropriate when measuring characteristics which have an absolute zero point. This level of measurement has all the three characteristics:

Order, distance and origin.

Example: Height, weight, distance and area.

Since there is a natural zero, it is possible to multiply and divide the numbers on a ratio scale. Apart from being able to use all the statistical techniques that are used with the nominal, ordinal and interval scales, techniques like the geometric mean and coefficient of variation may also be used.

Types of Measurement

The main limitation of ratio measurement is that it cannot be used for characteristics such as leadership quality, happiness, satisfaction and other properties which do not have natural zero points.

Types of Measurement Scales

Nominal scale

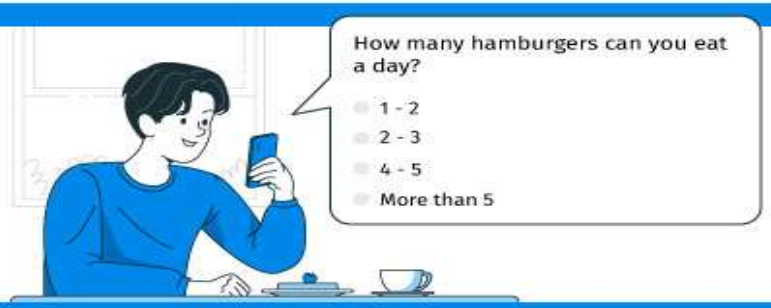
It's used to label variables in different classifications and does not imply a quantitative value or order.

Ordinal Scale

It's used to represent non-mathematical ideas such as frequency, satisfaction, happiness, a degree of pain, etc.

Interval Scale

It's defined as a numerical scale where the order of the variables as well as the difference between these variables is known.



Ratio Scale

It's a variable measurement scale that not only produces the order of the variables, but also makes the difference between the known variables along with information about the value of the true zero.

3.Characteristics of Good Measurement

A good measurement tool must possess the following characteristics –

a. **Unidimensionality:** This means that the measurement scale should not measure more than one characteristic at a time.
b. **Linearity:** A good measurement scale should follow the straight-line model.
c. **Validity:** This means that a measurement scale should measure what it is supposed to measure.
d. **Reliability –** This refers to consistency. The measurement scale should give consistent results.
e. **Accuracy and Precision –** The measurement scale should give an accurate and precise measure of what is being measured.

Characteristics of Good Measurement

f. Simplicity: A measurement tool should not be very complicated or elaborate.

g. Practicability: The measurement tool should be easy to understand and administer. There should be proper guidelines regarding its purpose and construction procedure, so that the results of a test can be interpreted easily.

4. Types of scales

Measurement of variables is central to research studies. According to Stevens, measurement scales can be of four types:

a) **Nominal Scale**

It is also termed as classificatory scale. A variable being measured on a nominal scale may have one, two or more sub-categories depending upon the extent of variation.

For example: Gender can be classified into two sub-categories; male and female

b) Ordinal or ranking scale

It usually ranks the subgroups in a certain sequence or order.

For example: Exam marks can be measured either quantitatively, that is, in absolute terms or in percentage terms or qualitatively using subcategories like above average, average or below average. The distance between these sub-categories may or may not be equal.

The socio-economic status can be categorized as lower class, middle class, and higher class. The middle class can further be divided into lower middle, middle-middle, and higher middle. The attitudinal or Likert scale also falls in the same category.

c) Interval scale

An interval scale has all the characteristics of an ordinal scale. In addition, it uses a unit of measurement with an arbitrary starting and terminating points.

For example: Celsius scale is from 0˚C to 100˚C.

d) Ratio scale

They are used to gather quantitative information. It combines the properties of nominal, ordinal & interval scales.

In addition, it has its own property. It has a fixed starting point. Ratio scale consists of equidistant points and has a meaningful zero point. If we ask respondents about their ages, the difference between any two years would always be the same, the zero signifies the absence of age or birth.

Attitudinal Scale

If you want to ascertain the attitude of people towards a leader, the questionnaire framed may be open-ended or close-ended. If the questionnaire is open-ended, it may invite respondents from sample to describe the attitude they hold towards leadership quality. If the researcher has framed close-ended questions, the respondent is given options such as strongly agree (SA), agree (A), undecided (U), disagree (D), strongly disagree (SD).

As the attitudinal scales are very important in qualitative research, the different types of scales.

i. Likert scale
ii. Thurstone scale
iii. Guttman scale

Statements about a leader	SA	A	U	D	SD
1. Know the subject well (+)					
2. Willing to solve people's problems' (+)					
3. Have poor communication skills (-)					
4. Is hard to approach (-)					
5. Good leadership skills (+)					
6. Liking/disliking (+/-)					

Strongly agree (SA), agree (A), undecided (U), disagree (D), strongly disagree (SD).

5. Likert scale

It is also termed as summated rating scale. It is the easiest to construct. It is based upon the assumption that each statement or item on the scale has equal attitudinal value, importance, or weight. The quality of a leader may have many dimensions like use of knowledge base, communication skills, presentation of contents, organization of material, promptness to solve people's problems, etc. Respondents may have different attitudes towards different aspects.

Likert scale

Some statements may be positive, some negative, and some neutral. Then, the scores may be assigned to different responses, and the score of each respondent is calculated. Some respondents may have more positive attitude than others. There can be numerical scale as well. Instead of SA, A, U, D, and SD, it will have values 5,4,3,2 and 1.

Agreement

- Strongly Agree
- Agree
- Undecided
- Disagree
- Strongly Disagree

Frequency

- Always
- Often
- Sometimes
- Rarely
- Never

Importance

- Very Important
- Important
- Moderately Important
- Slightly Important
- Unimportant

Likelihood

- Almost Always True
- Usually, True
- Occasionally True
- Usually Not True
- Almost Never True

- Definitely
- Probably
- Possibly
- Probably Not
- Definitely Not

Quality

- Excellent
- Good
- Fair
- Poor
- Very Poor

6. Analyzing data from a Likert scale?

- Summarize using a median or a mode (not a mean as it is ordinal scale data); the mode is probably the most suitable for easy interpretation.

- Display the distribution of observations in a bar chart (it can't be a histogram, because the data is not continuous).

7. Thurstone scale

Thurstone scale is defined as a unidimensional scale that is used to track respondent's behavior, attitude or feeling towards a subject. This scale consists of statements about a particular issue or topic where each statement has a numerical value that indicates the respondent's attitude towards the topic as favorable or unfavorable. Respondents indicate the statements that they agree with, and an average is computed. A mean score of the agreements or disagreements is calculated as the attitude of the respondent towards the topic.

8. Characteristics of Thurstone Scale Question

- **They are two stepped:** A Thurstone scale question is never administered at the first iteration stage without the rating by judges. This is an important characteristic of this question as the options that a respondent sees are weighted and there is consensus of them being in the survey.

- **Mean or median is always calculated:** Since each option is weighted, the mean or median is calculated for each option. This also forms the basis of the selection method for use in the final survey.

- **Only agree or disagree options:** The respondent selects only based on the agreement or disagreement with the statement.

How to conduct?

Step 1 – Develop statements: Develop many agree/disagree statements on a certain topic. For example, if you wanted to find out people's attitudes towards the policy of diversity hiring in an organization, your statements may include:

1. Policy on diversity hiring is wrong.
2. Diversity hiring takes away jobs from deserving candidates.
3. Diversity hiring brings different viewpoints to the team.
4. Diversity hiring brings out the best in the local community.
5. Diversity hiring aids in increasing the reputation of a brand.

Rank each statement with a panel of judges: The next step would be to have a panel of judges rate each item on a scale of 1 to 11 where 1 is the least favorable attitude towards the common vector – diversity hiring and 11 is an extremely favorable attitude. It is important to note that the judges are required to rate each option and not agree or disagree with them.

Calculate median and/or mean and Interquartile range (IQR): The data collected from all judges is to then be analyzed to draw up a table with the mean or median values in the ascending order. Using median or mean is a personal choice and the options throw up accurate results in the use of either. If you have 50 statements, you need to have 50 means/medians and 50 IQR's.

Where to use?

- **Surveys that measure opinions:** The Thurstone scale question produces quantifiable data about the measures of strength of the respondents' opinions.

- **Those that gauge attitudes or feelings:** This scale is used effectively in customer satisfaction to predict future purchasing trends and in employee engagement to calculate turnover.

9. Guttman scale

It is mainly based on ratio scale. It requires more time to develop. It is one of the three unidimensional scales, the other two being – Likert Scale and Thurstone Scale. It is 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 Respondents' 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.

Guttman Scale Characteristics

- **Uni-dimensional 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 based on 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.

GUTTMAN SCALE

QuestionPro