Module 5: Measurement and Scaling Techniques

Objectives

Studying this unit, you will be able to:

🞣 Recognize the tools of sound measurement

5.1 Introduction

In our daily life we are said to measure when we use some yardstick to determine weight, height, or some other feature of a physical object. We also measure when we judge how well we like a song, a painting or the personalities of our friends. We, thus, measure physical objects as well as abstract concepts. Measurement is a relatively complex and demanding task, specially so when it concerns qualitative or abstract phenomena. By measurement we mean the process of assigning numbers to objects or observations, the level of measurement being a function of the rules under which the numbers are assigned.

Measurement is a systematic way of assigning numbers or names to objects and their attributes. The *level of measurement* describes the relationship among these values. **Measurement** is assigning numbers or other symbols to characteristics of objects being measured, according to predetermined rules. Concept (or Construct) is a generalized idea about a class of objects, attributes, occurrences, or processes.

Relatively **concrete constructs** comprises of aspects such as Age, gender, number of children, education, income. Relatively **abstract constructs** take into accounts the aspects such as Brand loyalty, personality, channel power, satisfaction.

Scaling is the branch of measurement that involves the construction of an instrument that associates qualitative constructs with quantitative metric units. Scaling is the

procedure for determining the quantitative measure of abstract concepts like leadership, effectiveness of training programme etc.

Scaling is the generation of a continuum upon which measured objects are located.

Scale is a quantifying measure – a combination of items that is progressively arranged according to value or magnitude. The purpose is to quantitatively represent an item's, people, or event's place in the scaling continuum.

Types of Scaling Techniques

Measurement Scales: Tools of Sound Measurement

The researchers have identified many scaling techniques; today, we will discuss some of the most common scales used by business organizations, researchers, economists, experts, etc. These techniques can be classified as primary scaling techniques and other scaling techniques.

Let us now study each of these methods in-depth below:

Primary Scaling Techniques

The major four scales used in statistics for market research consist of the following
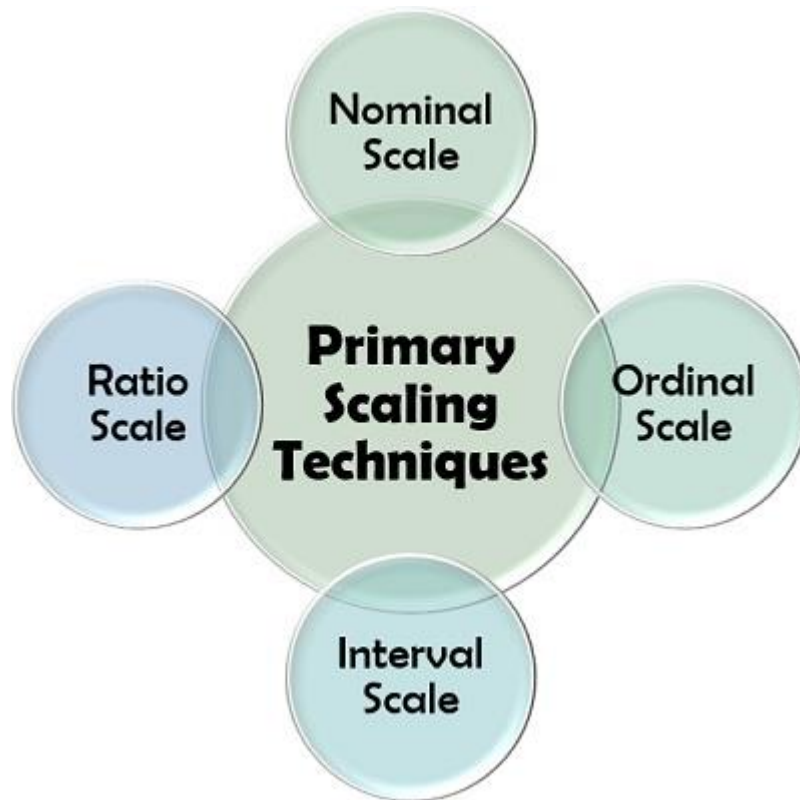
5.1.1 Nominal Scale

Nominal scales are adopted for non-quantitative (containing no numerical implication) labelling variables which are unique and different from one another.

Nominal Scale is simply a system of assigning numbers or categories to events in order to label them. The nominal scale does not possess order, distance or origin. E.g. numbers are assigned to volleyball players in order to identify them or to distinguish one player from the other. None of the values have any numerical significance. No rank or order is assigned in nominal scale.

Other examples:

Name of sate: Kerala ,T.N,M.P.,U.P

Colour: Red. Brown , Green

Gender-male, female or transgender.

Religious preference: Hinduism,christian,muslim,Budhism,other

In this scale, numbers are used to identify the objects. For example, University Registration numbers assigned to students, numbers on their jerseys.

The purpose of marking numbers, symbols, labels etc. in this type of scaling is not to establish an order but it is to simply put labels in order to identify events and count the objects and subjects. This measurement scale is used to classify individuals, companies, products, brands or other entities into categories where no order is implied. Indeed, it is often referred to as a **categorical scale**. It is a system of classification and does not place the entity along a continuum. It involves a **simple count of the frequency of the cases assigned to the various categories**, and if desired numbers can be nominally assigned to label each category.

Characteristics

1. It has no arithmetic origin.

2. It shows no order or distance relationship.

3. It distinguishes things by putting them into various groups.

Use: This scale is generally used in conducting in surveys and ex-post-facto research.

Example: Have you ever visited Bangalore?

Yes-1

No-2

'Yes' is coded as 'One' and 'No' is coded as 'Two'. The numeric attached to the answers has no meaning, and is a mere identification. If numbers are interchanged as one for 'No' and two for 'Yes', it won't affect the answers given by respondents. **The numbers used in nominal scales serve only the purpose of counting.**

The telephone numbers are an example of nominal scale, where one number is assigned to one subscriber. The idea of using nominal scale is to make sure that no two persons or objects receive the same number. Similarly, bus route numbers are the example of nominal scale.

"How old are you"? This is an example of a nominal scale.

"What is your PAN Card number?

Arranging the books in the library, subject wise, author wise - we use nominal scale.

It should be kept in mind that nominal scale has certain limitation, viz.

1. Nominal scale is the least powerful level of measurement.
2. It indicates no order or distance ie. there is no rank ordering.
3. No mathematical operation is possible.

Statistical implication - Calculation of the standard deviation and the mean is not possible. It is possible to express the **mode. Chi-square test is** the most common test of statistical significance that can be utilized, and for the measures of correlation, the contingency coefficient can be worked out.

Types of Nominal Scales

1. **Dichotomous**: A nominal scale that has only two labels is called 'dichotomous'; *for example*, Yes/No.

2. **Nominal with Order**: The labels on a nominal scale arranged in an ascending or descending order is termed as 'nominal with order'; *for example*, Excellent, Good, Average, Poor, Worst.

3. **Nominal without Order**: Such nominal scale which has no sequence, is called 'nominal without order'; *for example*, Black, White.

5.1.2 Ordinal Scale (Ranking Scale)

The ordinal scale is used for ranking in most market research studies. Ordinal scales are used to ascertain the consumer perceptions, preferences, etc. For example, the respondents may be given a list of brands which may be suitable and were asked to rank on the basis of ordinal scale:

1. Lux, 2. Liril, 3, Cinthol, 4. Lifebuoy, 5. Hamam

	Item	N umber of respondents
I	Cinthol	150
II	Liril	300
III	Hamam	250
IV	Lux	200
V	Lifebuoy	100
	Total	1,000

In the above example, II is mode and III is median.

Statistical implications: It is possible to calculate the mode and the median.

In market research, we often ask the respondents to rank the items, like for example, "A soft drink, based upon flavour or colour". In such a case, the ordinal scale is used. Ordinal scale is a ranking scale.

Rank the following attributes of 1-5 scale according to the importance in the microwave oven:

Attributes	Rank
A) Company Image	5
B) Functions	3
C) Price	2
D) Comfort	1
E) Design	4

Ordinal scale is used to arrange things in order. In qualitative researches, rank ordering is used to rank characteristics units from the highest to the lowest.

Characteristics

1. The ordinal scale ranks the things from the highest to the lowest.

2. Such scales are not expressed in absolute terms.

3. The difference between adjacent ranks is not equal always.

4. For measuring central tendency, median is used.

5. For measuring dispersion, percentile or quartile is used.

Scales involve the ranking of individuals, attitudes or items along the continuum of the characteristics being scaled.

From the information provided by ordinal scale, the researcher knows the order of preference but nothing about how much more one brand is preferred to another i.e., there is no information about the interval between any two brands. All of the information, a nominal scale would have given, is available from an ordinal scale. In addition, **positional statistics such as the median, quartile and percentile can be determined.** The two main methods are Spearman's Ranked Correlation Coefficient and Kendall's Coefficient. It is possible to test for order correlation with ranked data.

A student's rank in his graduation class involves the use of an ordinal scale. One has to be very careful in making statement about scores based on ordinal scales. For instance, if Ram's position in his class is 10 and Mohan's position is 40, it cannot be said that Ram's position is four times as good as that of Mohan. The statement would make no sense at all. Ordinal scales only permit the ranking of items from highest to lowest. Ordinal measures have no absolute values, and the real differences between adjacent ranks may not be equal. All that can be said is that one person is higher or lower on the scale than another, but more precise comparisons cannot be made. Thus, the use of an ordinal scale implies a statement of 'greater than' or 'less than' (an equality statement is also acceptable) without our being able to state how much greater or less. The real difference between ranks 1 and 2 may be more or less than

the difference between ranks 5 and 6. Since the numbers of this scale have only a rank meaning, the appropriate measure of central tendency is the median. A percentile or quartile measure is used for measuring dispersion. Correlations are restricted to various rank order methods. Measures of statistical significance are restricted to the non-parametric methods.

Did u know? What is the difference between nominal and ordinal scales?

In nominal scale numbers can be interchanged, because it serves only for the purpose of counting.

Numbers in Ordinal scale have meaning and it won't allow interchangeability.

1. Students may be categorized according to their grades of A, B, C, D, E, F etc. where A is better than B and so on. The classification is from the highest grade to the lowest grade.
2. Teachers are ranked in the University as professor, associate professors, assistant professors and lecturers, etc.
3. Professionals in good organizations are designated as GM, DGM, AGM, SR.MGR, MGR, Dy. MGR., Asstt. Mgr. and so on.

5.1.3 Interval Scale

Interval scale is more powerful than the nominal and ordinal scales. The distance given on the scale represents equal distance on the property being measured. Interval scale may tell us "How far the objects are apart with respect to an attribute?" This means that the difference can be compared. The difference between "1" and "2" is equal to the difference between "2" and "3".

Interval scale uses the principle of **"equality of interval"** i.e., the intervals are used as the basis for making the units equal assuming that intervals are equal.

It is only with an interval scaled data that researchers can justify the use of the **arithmetic mean as the measure of average**. The interval or cardinal scale has equal units of measurement thus, making it possible to interpret not only the order of scale scores but also the distance between them. However, it must be recognized that **the zero point on an interval scale is arbitrary** and is not a true zero. This, of course, has implications for the type of data manipulation and analysis. We can carry out on data collected in this form. It is possible to add or subtract a constant to all of the scale values without affecting the form of the scale but one cannot multiply or divide the values. It can be said that two respondents with scale positions 1 and 2 are as far apart as two respondents with scale positions 4 and 5, but not that a person with score 10 feels twice as strongly as one with score 5. Temperature is interval scaled, being measured either in Centigrade or Fahrenheit. We cannot speak of 50°F being twice as hot as 25°F since the corresponding temperatures on the centigrade scale, 100°C and -3.9°C, are not in the ratio 2:1.

Interval scales may be either numeric or semantic.

Characteristics

1. Interval scales have no absolute zero. It is set arbitrarily.

2. For measuring central tendency, mean is used.

3. For measuring dispersion, standard deviation is used.

4. For test of significance, t-test and f-test are used.

5. Scale is based on the equality of intervals.

Use: Most of the common statistical methods of analysis require only interval scales in order that they might be used. These are not recounted here because they are so common and can be found in virtually all basic texts on statistics.

1. How many hours you spend to do class assignment every day?

(a) < 30 min.

(b) 30 min. to 1 hr.

(c) 1 hr. to 1½ hrs.

(d) > 1½ hrs.

Statistical implications: We can compute the range, mean, median, etc.

5.1.4 Ratio Scale

Ratio scale is a special kind of internal scale that has a **meaningful zero point.** With this scale, length, weight or distance can be measured. In this scale, it is possible to say, how many times greater or smaller one object is being compared to the other.

These scales are used to measure actual variables. The highest level of measurement is a ratio scale. This has the properties of an interval scale together with a fixed origin or zero point.

Examples of variables which are ratio scaled include weights, lengths and times. Ratio scales permit the researcher to compare both differences in scores and in the relative magnitude of scores. For instance, the difference between 5 and 10

minutes is the same as that between 10 and 15 minutes, and 10 minutes is twice as long as 5 minutes. Given that sociological and management research seldom aspires beyond the interval level of measurement, it is not proposed that particular attention be given to this level of analysis. Suffice it, to say that virtually all statistical operations can be performed on ratio scales.

Characteristics

> 1. This scale has an absolute zero measurement.

> 2. For measuring central tendency, geometric and harmonic means are used.

Use: Ratio scale can be used in all statistical techniques.

Example: Sales this year for product A are twice the sales of the same product last year.

Statistical implications: All statistical operations can be performed on this scale.

5.2 Techniques of Developing Measurement Tools

The scale construction techniques are used for measuring the attitude of a group or an individual.

In other words, scale construction technique helps in estimate the interest or behaviour of an individual or a group towards others or another's environment rather than oneself. While performing a scale construction technique, you need to consider various decisions related to the attitude of the individual or group. A few of these decisions are:

- Determining the level of the involved data; identifying whether it is nominal, ordinal, interval or ratio.

- Identifying the useful statistical analysis for the scale construction.
- Identifying the scale construction technique to be used.
- Selecting the physical layout of the scales.
- Determining the scale categories that need to be used.

Summary

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