


Subject: Human Resource Management

Production of Courseware

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Paper 05: Research Methodology
Module 06: Measurement and Scaling



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| Items | Description of Module |
|-----------------------|--|
| Subject Name | Management |
| Paper Name | Research Methodology |
| Module Title | Measurement and Scaling |
| Module ID | Module 6 |
| Pre-Requisites | Understanding the major types of data and scales |
| Objectives | To study the types of data and scales |
| Keywords | Nominal, Ordinal, Measurement, Scales, Interval, Ratio |

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QUADRANT –I

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| 1. Module 6 : Measurement and Scaling |
| 2. Learning Outcome |
| 3. Data Types |
| 4. Sources of Measurement Errors |
| 5. Features of a Good Measurement |
| |
| Summary |

1. Module 6 : Measurement and Scaling

2. Learning Outcomes

Having finished this module, you will be able to:

- Know the meaning of measurement and scaling
- Understand the types of data
- Comprehend the sources of measurement errors
- Understand the features of a good measurement
- Become aware of the scaling designs

3. Introduction

Measurement in research is composed of allocating numbers to empirical events conforming to a set of rules. There a three level process picking up observable empirical events, using numbers or symbols to denote aspects of the events, and applying a mapping standard to rectify the observation to the symbol.

Concepts used in research may be categorized as objects or as properties. Objects contain the things of common experience, while properties are the features of the objects like weight, height, posture, attitudes and intelligence, leadership ability, class affiliation, or status. Various such properties of a person can be measured in a research study. Researchers do not measure objects or properties but indicants of properties rather the indicants of the properties of objects.

4. Data Types

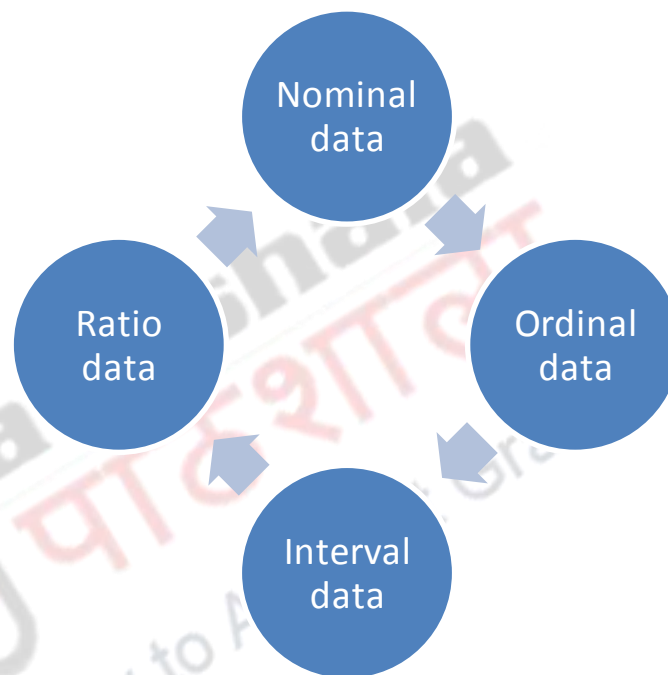


Figure 1 Type of Data

The widely accepted types of data are:

- Nominal data
- Ordinal data
- Interval data
- Ratio data

4.1 Nominal data

Nominal



Figure 2 Nominal Data (Adapted from cs.brown.edu)

The nominal data are very likely and to a wide extent collected in business and social science research than in any other. The nominal data divides a set into mutually exclusive and collectively exhaustive categories. Nominal classification may hold any count of various groups if the characteristics of the groups are being mutually exclusive and collectively exhaustive. Nominal scales have the minimum force of the four data kind since they propose no sequence or extent association and have no arithmetic source. Since the single way to give the quantity is the number of cases in every individual category, the researcher is restricted to the employment of mode as the measure of central tendency. This states which category has the largest members. There is no normally recognized unit of dispersion for nominal scales. Several tests for statistical significance may be used; generally applied is the chi-square test. For measures of association, phi, lambda, or other measures may be suitable.

While nominal data are least powerful, they are still helpful. Nominal scales are specifically helpful in exploratory work where the objective is to disclose relationship rather than obtain certain measurements. This sort of information is also employed to a great extent in survey and other ex post facto research when data are arranged by major sub-groups of the population. Such classification as marital status, gender of respondents' and exposure to a certain experience exist in great number. Cross-partition of these and other variables furnish insight into significant data trends. As a whole the data allocated with labels or names are looked up as the data in nominal scale. Since, every individual label or name shows a different category in the data, nominal data is also called as categorical data. Between two category variables, the comparison that can be made is that they are either equal or not equal. It is not possible to compare such variables with respect to the order of the labels. In research a YES/NO scale is nominal. It has no sequence and there is no space between YES and NO. The statistics which can be applied to nominal scales fall in the non-parametric class.

4.2 Ordinal data

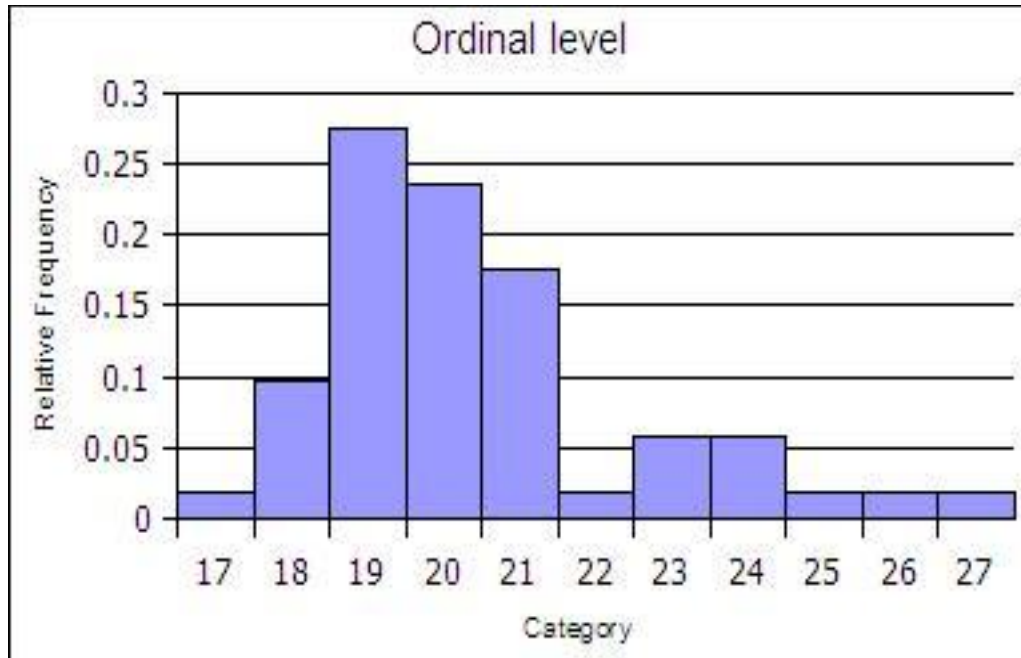


Figure 3 Ordinal Data (Adapted cosfms.fm)

The ordinal data includes the characteristics of nominal scale and an indicator of order. The fulfillment of the transitivity assumption which states if a is greater than b and b is greater than c, a will ever be greater than c is the need of the ordinal data. The application of an ordinal scale shows a statement of 'greater than' or 'less than' or 'equal to' without indicating the extent of greater or less. An ordinal concept can be generalized by saying that any number of cases can be ranked by stating 'superior to', 'happier than' or 'above' and when more than one property is of interest. A consumer may give ranks to different varieties of carbonated soft drinks according to flavor, color, carbonation, and a combination of all these. In order to develop a total index the researcher may use

Thurstone's Law of Comparative Judgment.

In terms of power of measurement ordinal scale is higher. The most common ordinal scale is giving a rank. When a consumer is asked to rank five kinds of beer from most preferred flavor to slightest preferred flavor, he creates a preference based on ordinal scale. The objective space between any two points on the subjective scale is absent. For the consumer the beer may be superior flavor to the second preferred beer but, to the other respondent the distance may be small. An ordinal scale merely permits us interpret gross order and not the comparative situational distances. Statistics such as media, mode, rank order correlation and analysis of variance can be used on the ordinal data.

4.3 Interval scale

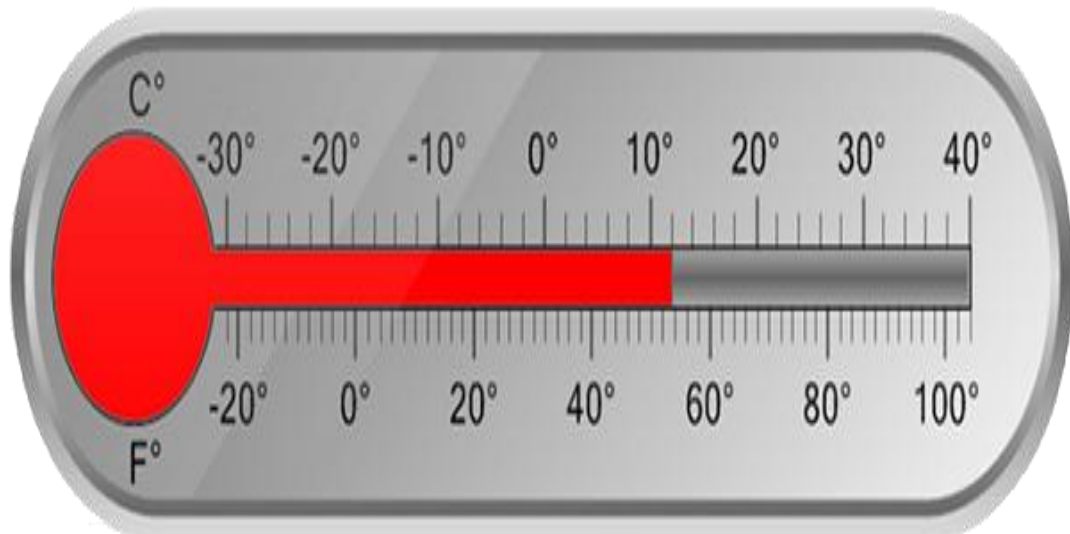


Figure 4 Interval scale (Adapted from answerminer.com)

This scale is well recognized quality level survey rating scale. When a person is enquired to estimate his satisfaction with software on a 7 point scale, starting with Dissatisfied to Satisfied, one is employing an interval scale. It is so because it is assumed to have same distance points between each of the scale components. We can interpret differences in the distance along the scale. This is opposite to an ordinal scale where differences in order are only talked about, not differences in the degree of order. Metrics define interval scales such as logarithms. In such cases, the spaces are well known equal but they are strictly explained on the basis of metric applied. Interval scale data ordinarily use parametric statistical methods such as average, standard deviation, correlation, regression, factor analysis and analysis of variance may be used on interval scale.

4.4 Ratio scales

A ratio scale denotes the highest point in any scale of measurement and not usually accessible in social research. The factor that definitely indicates a ratio scale is that it has a real zero point. The measurement of length is the easiest example of a ratio scale. The excellent way to compare interval and ratio scales is to observe temperature. The Centigrade scale has a zero point however, it is an arbitrary one. The Fahrenheit scale has its identical point at -32°. So, even though temperature glances at it as a ratio scale while it is an interval scale.

5. Source of Measurement Errors

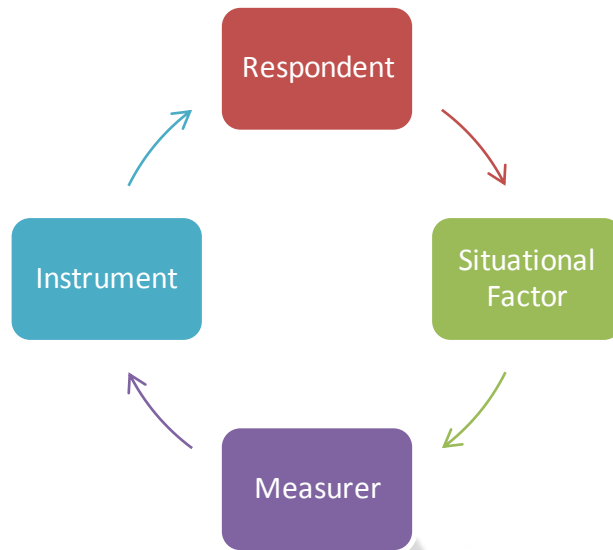


Figure 5 Sources of Measurement Errors

A standard study should be structured and controlled for strictly stated and distinct measurement of the variables. Since the achievement of this goal is unlikely, we must identify the sources of potential error and make an attempt to remove, to make ineffective, or otherwise treat them. Large potential error is systematic while the remainder is random. Measured differences can come from several sources. However, four major sources of error may be the respondent, the situation, the measure, and the instrument.

5.1 The respondent

Opinion difference will come from relatively stable characteristics of the respondent that affect the scores which include employee status, ethnic group membership, and nearness to plants. Many of these dimensions will be anticipated in the design but others of a less obvious nature will not be. A traumatic experience a given respondent had with an organization or its personnel may turn a respondent reluctant to express robust feelings containing negation or may have little understanding of the company but be unwilling to accept ignorance. This reluctance can lead to an interview of 'guesses'. Respondents may also suffer from temporary factors like fatigue, boredom, anxiety, or divert concentration; these restrict the capability to reply accurately and fully. Hunger, impatience, or general variation in mood may also have an impact.

5.2 Situational factor

Any existing state that exerts a force on the interview create serious effects on the interviewer-respondent rapport is a situational factor. If another person is present, that person can disturb responses by joining in, by diverting attention or only by presence. If the respondents believe that their identity will not be secret, they may be not be willing to express some of their feeling. Intercept interviews are not to draw detailed responses while-in-house interviews more usually do.

5.3 The Measurer

The interviewer can twist responses by rearranging the sequence of words, paraphrasing, or changing the sequence of questions. Conventional in outward look and action inserts bias. Inflections of voice and conscious or unaware prompting with smiles, nods, and so forth may inspire with confidence or dissuade certain replies. Careless mechanical process-checking of the incorrect response or inability to record full replies- will clearly twist results. In the data analysis

stage, wrong coding, reckless tabulation, and erroneous statistical calculation may bring in further errors.

5.4 The Instrument

An imperfect instrument can create distortion in two major ways. First, it can be too confusing and vague. The use of difficult words and syntax, beyond the understanding of the respondent is representative. Leading questions, unclear meanings, built in defects, and several questions suggest the width of problem.

A major difficulty is to find sort out instrument insufficiency is imperfect sampling of the population of content items. Seldom does the instrument explore all the potentially important issues. Even if the general problems are examined, the questions may not include adequate facets of each area of concern. While we might study a corporation's image as an employer in terms of salary and wage scales, promotion opportunities, and work stability, perhaps such as working conditions, company management relations with organized labor, and retirement and other benefit programs should also be included.

6. A Good Measurement

A tool should be an exact pointer of what one is concerned to measuring. There are three major criteria for evaluating an instrument including validity, reliability and practicality.

6.1 Validity

Validity relates to the degree to which a test measures what one actually desires to measure. A widely accepted classification of validity consists of content, criterion-related, construct.

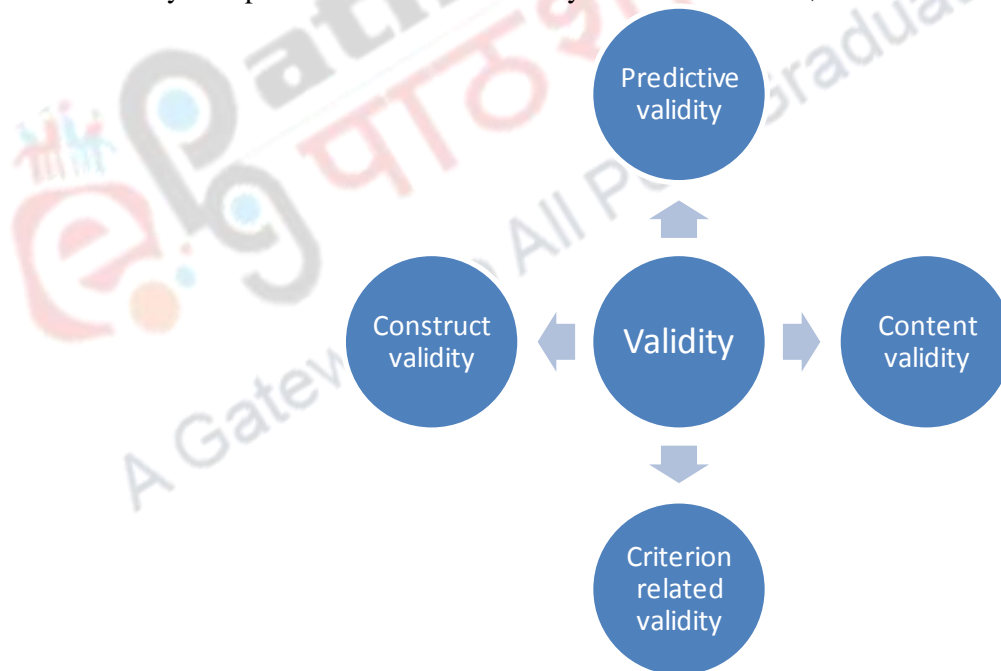


Figure 6 Types of validity

6.1.1 Content Validity

Content validity refers to the space to which a measure covers adequately the topic under study. It is the representativeness or adequacy in sampling of the content of a measuring instrument. If the instrument contains a sample which is representative of the population of

the subject matter of interest, content validity is satisfactory. In order to assess the content validity of an instrument, one must first consent on the elements constituting adequate inclusion of the problem. For example, what knowledge, attitudes, and opinions are relevant to the measurement of public image of an organization and what forms of these opinions are relevant positions on these. In an employee satisfaction study, one must first decide the factors influencing employee satisfaction. If the questionnaire adequately covers the issues defined as the relevant dimensions, the instrument is deemed to have good content validity. Content validity is basically judgmental. The items of a test must be studied, each item being weighed for its presumed representative quality of the universe. This implies that each item must be evaluated for its supposed relevance to the property being measured, which is no easy task. Usually, other 'competent' judges should judge the content of the items. The population of the content must, if possible, be well defined. The judges need to be given specific instruction for giving judgments, as well as with specification of what they are judging. Then a method for accumulating uninfluenced judgments can be used.

6.1.2 Criterion related validity

Criterion-related validity indicates the success of measures used for predicting or estimation. The researcher may desire to predict an outcome or estimate the existence of a current behavior or condition. The first is predictive and second is concurrent validity, respectively. They differ only in a time perspective.

Criterion-related validity is examined by making a comparison of test or scale scores with one or more external variables, or criteria believed to measure the attribute under study. One is more concerned with the predictive validity than what the test measures. In criterion-related validation, the fundamental interest is often greater in the criterion, than in the predictors. The higher the correlation, the better the validity is. All tests are predictive as they predict a kind of outcome, about some present or future state of affairs. Aptitude tests predict future achievement; achievement tests tend to predict current and future achievement and competence; and intelligence tests are able to predict ability to learn solving problems. The greatest problem of criterion-related validity is the criterion itself. Obtaining criteria may even be difficult. What criterion can be used to test the predictive validity of a musical aptitude test? Cronbach has particularly stressed the decision aspects of criterion-related validation. A test high in criterion-related validity assists researchers take successful decisions in assigning people to treatments, conceiving treatments broadly.

6.1.3 Construct validity

The concept of content validity is one of the most significant developments in modern measurement theory and practice. It is a significant advancement as it combines psychometric notions with theoretical concepts. The measurement expert seeks to explain individual differences in the test scores of a measuring instrument. His interest is usually more in the property being measured than in the test itself.

A researcher generally starts with the constructs or variables entering into the relation. He might have discovered a positive correlation between two measures. The researcher wants to know why this relation exists, what is behind it. He necessarily knows constructs entering the relationship.

6.1.4 Predictive validity

The predictive validity involves the ability of a phenomena measured at one point of time to predict another phenomenon in future. If the correlation coefficient between the two is high, measure has a high predictive ability. As an example, consider the use of the common admission test to shortlist candidates for admission to the MBA program in a business school. The CAT scores are supposed to predict the candidate's aptitude for studies.

6.2 Reliability

Reliability is related with consistency, accuracy and predictability of the measure. It indicates the extent to which a process of measurement is devoid of random errors. Two methods may be used for checking the reliability of a scale: Test-retest reliability and split-half reliability



Figure 7 Reliability

6.2.1 Test-retest reliability

In this method, measurements repeated of the same respondents using the same measure under similar conditions are taken. A scale is reliable when the two score are highly correlated.

6.2.2 Split-half reliability

Split-half method is applied in case of multiple item measure. The number of items is divided on random basis into two equal parts and a correlation coefficient between the two is computed. A high correlation indicates that the internal consistency of the construct takes to greater reliability. Cronbach alpha can also be used test the internal consistency of multiple item scale.

Summary

Measurement in research is composed of allocating numbers to empirical events conforming to a set of rules. The widely accepted types of data are nominal data, ordinal data, interval data and ratio data. The nominal data divides a set into mutually exclusive and collectively exhaustive categories. The ordinal data includes the characteristics of nominal scale and an indicator of order. The standard survey rating scale is an interval scale. A ratio scale denotes the highest point in any scale of measurement and not usually accessible in social research. The factor that definitely indicates a ratio scale is that it has a real zero point. The measurement of length is the easiest example of a ratio scale. The excellent way to compare interval and ratio scales is to observe temperature. Four major sources of error are the situation, the measure the respondent, and the instrument. A tool must accurately measure what we are interested in measuring. Three major criteria for evaluating a measure are validity, reliability and practicality. Validity refers to the degree a test measures we actually wish to measure. A widely accepted classification of validity consists of content, criterion-

related, construct. The content validity of a measure is the degree to which it adequately covers the topics under study. Criterion-related validity indicates the success of measures used for predicting or estimation. The researcher may desire to predict an outcome or estimate the existence of a current behavior or condition. The first is predictive and second is concurrent validity, respectively. They differ only in a time perspective. In construct validity the researcher wants to know why a relation exists, predictive validity involves the ability of a phenomena measured at one time to predict another phenomenon in future. Consistency, accuracy and predictability show the reliability of the scale. In Test-retest reliability repeated measurements of the same respondents applying the same scale in similar conditions are taken.

