

Types of Variables in Research

INTRODUCTION

- Each person/thing we collect data on is called an ***observation*** (in our research work these are usually people/subjects).
- Observation (participants) possess a variety of ***characteristics***.
- If a characteristic of an observation (participant) is the same for every member of the group **i.e.** it does **not** vary, it is called a ***constant***
- If a characteristic of an observation (participant) differs for group members it is called a ***variable***.

MEANING OF VARIABLES

- ***A variable is a concept or abstract idea that can be described in measurable terms. In research, this term refers to the measurable characteristics, qualities, traits, or attributes of a particular individual, object, or situation being studied.***
- Anything that can vary can be considered a variable. For instance, *age* can be considered a variable because age can take different values for different people or for the same person at different times. Similarly, *Income* can be considered a variable because a person's Income can be assigned a value.

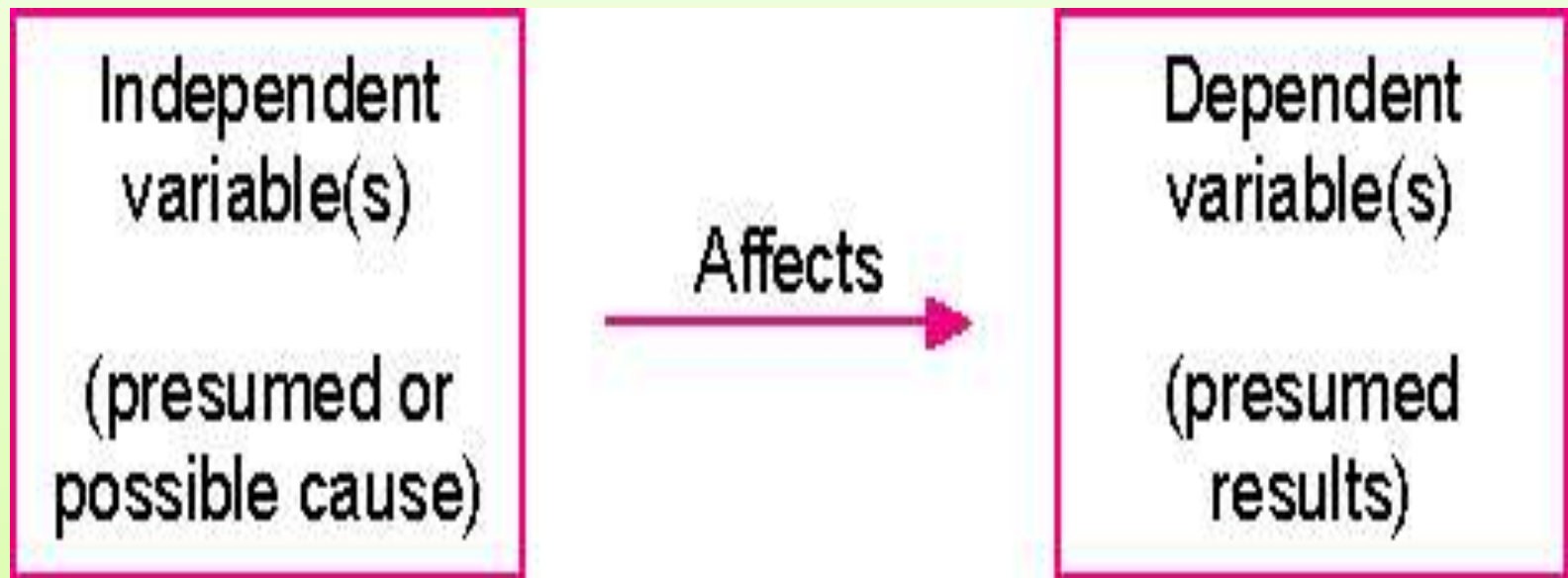
- Variables are properties or characteristics of some event, object, or person that can take on different values or amounts.
- A variable is not only something that we measure, but also something that we can manipulate and something we can control for.

TYPES OF VARIABLES

Dependent and Independent Variables

- **Independent variables** are variables which are manipulated or controlled or changed. It is what the researcher studies to see its relationship or effects.
 - *Presumed or possible cause*
- **Dependent variables** are the outcome variables and are the variables for which we calculate statistics. The variable which changes **on account of** independent variable is **known as dependent variable**. i.e. It is influenced or affected by the independent variable
 - *Presumed results(Effect)*

The Relationship between Independent and Dependent Variables



Example

- Imagine that a tutor asks 100 students to complete a maths test. The tutor wants to know why some students perform better than others. Whilst the tutor does not know the answer to this, she thinks that it might be because of two reasons: (1) some students spend more time revising for their test; and (2) some students are naturally more intelligent than others. As such, the tutor decides to investigate the effect of revision time and intelligence on the test performance of the 100 students. What are the dependent and independent variables for the study ?

Solution

- Dependent Variable: **Test Mark** (measured from 0 to 100)
- Independent Variables: **Revision time** (measured in hours) **Intelligence** (measured using IQ score)

Activity

- Identify the dependent and Independent Variables for the following examples:
 1. A study of teacher-student classroom interaction at different levels of schooling.
 2. A comparative study of the professional attitudes of secondary school teachers by gender.

Solution

1. **Independent variable:** Level of schooling, four categories – **primary, upper primary, secondary and junior college.**

Dependent variable: Score on a classroom observation inventory, which measures teacher – student interaction

2. **Independent variable:** Gender of the teacher – male, female.

Dependent variable: Score on a professional attitude inventory.

Moderator Variable

- It is a special type of independent variable.
- The independent variable's relationship with the dependent variable may change under different conditions. That condition is the moderator variable.
- That factor which is measured, manipulated, or selected by the experimenter to discover whether it modifies the relationship of the independent variable to an observed phenomenon.

Example

- A strong relationship has been observed between the quality of library facilities (X) and the performance of the students (Y). Although this relationship is supposed to be true generally, it is nevertheless contingent on the interest and inclination of the students. It means that only those students who have the interest and inclination to use the library will show improved performance in their studies.
- In this relationship **interest and inclination** is moderating variable i.e. which moderates the strength of the association between X and Y variables

Quantitative and Qualitative Variables

- Quantitative variables are ones that exist along a continuum that runs from low to high. Interval, and ratio variables are quantitative.
- Quantitative variables are sometimes called continuous variables because they have a variety (continuum) of characteristics.
- Height in inches and scores on a test would be examples of quantitative variables.

Quantitative and Qualitative Variables

- Qualitative variables do not express differences in amount, only differences.
- They are sometimes referred to as categorical variables because they classify by categories. Ordinal, Nominal variables are qualitative
- Nominal variables such as gender, religion, or eye color are categorical variables. Generally speaking, categorical variables

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graph TD; Variable[Variable] --> Qualitative[Qualitative]; Variable --> Quantitative[Quantitative]; Qualitative --> Nominal[Nominal]; Qualitative --> Ordinal[Ordinal]; Quantitative --> Interval[Interval]; Quantitative --> Ratio[Ratio];
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Variable

Qualitative

Quantitative

Nominal

Ordinal

Interval

Ratio

A black and white photograph of Albert Einstein, looking towards the camera with a slight smile, his right arm raised pointing at a chalkboard. On the chalkboard, the text 'Measurement Scales' is written at the top, followed by a list of four scales: 'Nominal', 'Ordinal', 'Interval', and 'Ratio'.

Measurement Scales

Nominal

Ordinal

Interval

Ratio

Nominal Scale

- Nominal Scale, also called the categorical variable scale, is defined as a scale used for labeling variables into distinct classifications and doesn't involve a quantitative value or order.
- This scale is the simplest of the four variable measurement scales.

Nominal Scale Examples

- Gender
- Political preferences
- Place of residence

What is your Gender	What is your Political preference?	Where do you live?
M- Male F- Female	1- Independent 2- Democrat 3- Republican	1- Suburbs 2- City 3- Town

Ordinal Scale

- Ordinal Scale is defined as a variable measurement scale used to simply depict the order of variables(what's important and significant) and not the difference between each of the variables(differences between each one is not really known)
- For example, is the difference between “OK” and “Unhappy” the same as the difference between “Very Happy” and “Happy?” We can't say.

- Ordinal scales are typically measures of non-numeric concepts like satisfaction, happiness, discomfort, etc.
- “Ordinal” is easy to remember because it sounds like “order” and that’s the key to remember with “ordinal scales”—it is the *order* that matters.

- **Example:**

On a survey you might code Educational Attainment as 0=less than high school; 1=some high school.; 2=high school degree; 3=some college; 4=college degree; 5=post college. In this measure, higher numbers mean *more* education. But is distance from 0 to 1 same as 3 to 4? Of course not.

Interval scale

- Interval Scale is defined as a numerical scale where the order of the variables is known as well as the difference between these variables. Variables which have familiar, constant and computable differences are classified using the Interval scale.
- Interval scale contains all the properties of ordinal scale, in addition to which, it offers a calculation of the difference between variables. The main characteristic of this scale is the equidistant difference between objects.

- In statistics, interval scale is frequently used as a numerical value can not only be assigned to variables but calculation on the basis of those values can also be carried out.
- Calendar years and time also fall under this category of measurement scales.
- Likert scale is the most-used interval scale examples.

Ratio Scale

- Ratio Scale is defined as a variable measurement scale that not only produces the order of variables but also makes the difference between variables known along with information on the value of true zero.
- It is calculated by assuming that the variables have an option for zero, the difference between the two variables is the same and there is a specific order between the options.

- In addition to the fact that the ratio scale does everything that a nominal, ordinal and interval scale can do, it can also establish the value of absolute zero.

- **Examples**

The following questions fall under the Ratio Scale category:

- What is your daughter's current height?
 - Less than 5 feet.
 - 5 feet 1 inch – 5 feet 5 inches
 - 5 feet 6 inches- 6 feet
 - More than 6 feet
- What is your weight in kilograms?
 - Less than 50 kilograms
 - 51- 70 kilograms
 - 71- 90 kilograms
 - 91-110 kilograms
 - More than 110 kilograms

Continuous and Discontinuous Variables

- If the values of a variable can be divided into fractions then we call it a ***continuous variable***.
- Such a variable can take infinite number of values. Income, temperature, age, or a test score are examples of continuous variables.
- These variables may take on values within a given range or, in some cases, an infinite set.

- Any variable that has a limited number of distinct values and which cannot be divided into fractions, is a ***discontinuous variable***.
- Such a variable is also called as ***categorical variable or classificatory variable, or discrete variable***.
- Some variables have only two values, reflecting the presence or absence of a property: employed-unemployed or male-female have two values. These variables are referred to as **dichotomous**.
- There are others that can take added categories such as the demographic variables of race, religion. All such variables that produce data that fit into categories are said to be discrete/categorical/classificatory, since only certain values are possible.

VARIABLES EXAMPLES	Examples
Dichotomous	<ul style="list-style-type: none"> •Gender:Male and female •Variables Type of property: Commercial and residential •Pregnant and non pregnant •Alive and dead •HIV positive and HIV negative •Education: Literate and illiterate
Trichotomous	<ul style="list-style-type: none"> •Residence:Urban, semi urban and rural Variables • Religion: Hindu, muslim, and Christianity.
Multiple Variables	<ul style="list-style-type: none"> •Blood groups: A,B,AB and O

DEMOGRAPHIC VARIABLES:

- “Demographic variables are characteristics or attributes of subjects that are collected to describe the sample”. They are also called sample characteristics.
- It means these variables describe study sample and determine if samples are representative of the population of interest.
- Although demographic variables cannot be manipulated, researchers can explain relationships between demographic variables and dependent variables.
- Some common demographic variables are age, gender, occupation, marital status, income etc.

Extraneous variable

- It happens sometimes that after completion of the study we wonder that the actual result is not what we expected. In spite of taking all the possible measures the outcome is unexpected. It is because of extraneous variables
- Variables that may affect research outcomes but have not been adequately considered in the study are termed as **extraneous variables**. Extraneous variables exist in all studies and can affect the measurement of study variables and the relationship among these variables.

- Extraneous variables that are not recognized until the study is in process, or are recognized before the study is initiated but cannot be controlled, are referred to as ***confounding variables***. These variables interfere with the results of the existing activity.
- Certain external variables may influence the relationship between the research variables, even though the researcher cannot see it. These variables are called ***intervening variables***.

Control Variable

- Sometimes certain characteristics of the objects under scrutiny are deliberately left unchanged. These are known as constant or controlled variables.
- The variables that are not measured in a particular study must be held constant, neutralized/balanced, or eliminated, so they will not have a biasing effect on the other variables.
- In the ice cube experiment, one constant or controllable variable could be the size and shape of the cube. By keeping the ice cubes' sizes and shapes the same, it's easier to measure the differences between the cubes as they melt after shifting their positions, as they all started out as the same size.

