ACADEMIC PROGRAMME: BSCS COMPUTER SCIENCE

COURSE CODE AND TITLE: BSCS 305: COMPUTING RESEARCH METHODS

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METHOD SECTION

Expected Learning Outcomes:

By the end of this lesson, you should be able to:

i. Understand the types of variables
ii. Understand the scales of measurements in research

Introduction

- The methods section also describes in sufficient detail the types of variables in the study
- In particular, the procedure that is used in measuring the variables in the study should be explained
- We defined a variable as a measurable characteristic that assumes different values among the subjects
- Obtaining these different values for each subject on a particular variable was referred to as operational definition of the variable
- The operational definition of a variable is a significant step in the research process
- Two different studies having the same variables may have completely different results depending on the way each study operationalized the variables
- With time, standard measures have been dveloped for some variables, like time, IQ, blood pressure, length, age, volume, etc
- There are, however, many variables in any field which standard measures have not been developed
- Example, there are no agreed methods of measuring sadness, happiness, religiosity, the degree of a secure computer system, satisfaction from owning a car/house, reliability of software engineering procedures
- researchers therefore try to develop scales for measuring these abstract concepts and these scales differ, depending on the emphasis that each researcher gives to a certain concept
- There are 8 types of variables which include:

1. Independent variable
2. Dependent variable
3. Control variable
4. Extraneous variable
5. Intervening variable
6. Antecedent variable
7. Suppressor variable
8. Distorter variable

The types of variables that are used in a study influence the statistical method of analysis that can be applied and the type of research design

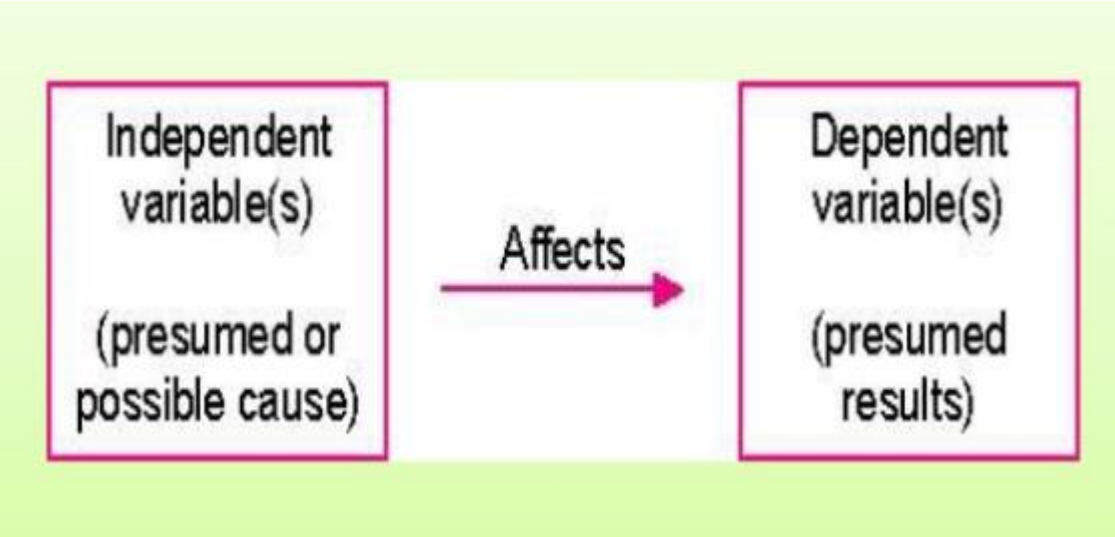
- ❖ An independent variable is a variable that a researcher manipulates in order to determine its effect or influence on another variable
- ❖ Independent variables are also called predictor variables because they predict the amount of variation that occurs in another variable
- ❖ Examine the following examples….

1. The influence of alcohol on reaction time
2. The influence of programming experience on developer promotion
3. The influence of gender on career choice

- The varia
- bles alcohol, programming experience, and gender are all independent variables
- In example one, the amount of alcohol in the blood may increase reaction time
- In example two, the number of years one has programmed may enhance their chances of getting promoted
- In example three, males may tend to choose certain types of careers while females choose other types of careers.
- Independent variables may be divided into two – those that the researcher has manipulative control (experimental type of independent variables) and those which have already occurred and hence a researcher has no manipulative control (measurement type of independent variables)

Dependent Variable

- The variable that is expected to change as a result of the manipulation of the independent variable; that which is measured in a study



Control variable

- ❖ It is a variable that is not allowed to be changed unpredictably during an experiment
- ❖ They are expected to remain constant

Extraneous variables

- ❖ Extraneous variables are those variables that affect the outcome of a research study either because the researcher is not aware of their existence or if the researcher is aware, they are not in control of them
- ❖ An extraneous variable will affect the outcome of a study unless it is controlled through a control variable
- ❖ The validity and generalization of a study will depend on the degree in which extraneous variables are accounted for
- ❖ If extraneous variables are not considered, it will be hard to determine how much influence on the dependent variable is due to an extraneous variable, and how much is due to independent variables
- ❖ Extraneous variables are sometimes referred to confounding variables because they confound the effects of the independent variable on the dependent variable
- ❖ In the of reaction time for drivers with high alcohol content in blood, it can be found out that those drivers who take more time to react to emergencies could be over 50 years of age.

- This means that age could also be another variable that could influence the dependent variable
- The researcher should establish the degree that the extraneous variable affects the dependent variable apart from the independent variable
- Gender could also be another extraneous variable in this
- Therefore the researcher should account for the two

Intervening variables

- Intervening variable is a special case of extraneous variable
- The difference between extraneous and intervening variables is in the causal relationships
- With an extraneous variable, there is no causal link between the independent and the dependent variable
- The logical status of an intervening variable is that it is recognized as being caused by the independent variable and as being a determinant of the dependent variable

- Example, in a study on absenteeism among female workers, married women were found to have a high rate of absenteeism compared to women employees.
- One could conclude that marital status is a determinant of absenteeism
- One can argue that a variable amount of housework could be the cause of absenteeism
- An intervening variable here is amount of housework
- When the ‘amount’ of work is controlled, there was no difference in the absenteeism
- Therefore ‘amount of work’ is a consequence of marital status and a determinant of absenteeism

Antecedent variables

- The logic of introducing an antecedent variable is the same as that of introducing an intervening variable
- The antecedent variable comes before the independent variable
- An antecedent variable does not interfere with the established relationship between an independent and a dependent variable
- Rather, an antecedent variable clarifies the influence that precedes such a relationship

- There are three conditions that must hold for a variable to be classified as an antecedent variable:
- The variables, including the antecedent variable must be related in some logical sequence
- When the antecedent variable is controlled for, the relationship between the independent and the dependent variables should not disappear, rather, it should be enhanced
- When the independent variable is controlled for or is influence removed, there should not be any relationship between the antecedent variable and the dependent variable
- Probing into causal sequences is of great importance in understanding many phenomena
- Political stability could mean more investments – more investments mean more job opportunities – more job opportunities could mean reduced child mortality rates

Suppressor variables

- In the extraneous variables, there is a possibility of having a false relationship between two variables due to the intrusion of another uncontrolled variable
- That is, one can find a positive relationship between an independent and dependent variable simply because they both spuriously related to a third variable
- When the third extraneous variable is controlled for, the original relationship between the independent and dependent variable disappears
- In a sense, a suppressor variable is an extraneous variable, which, when not controlled for removes a relationship between the two variables

- When a suppressor variable is not controlled for in a study it intercedes to cancel out, minimize or conceal a true relationship between the independent and the dependent variables
- In this case, it is the non-relationship between the independent and the dependent variable that is said to be spurious
- When a suppressor variable is introduced in the study as a control variable, a true relationship emerges
- Example, if a researcher wants to measure the impact of alcohol in the blood on the reaction time for drivers
- If the researcher hypothesises that age and gender affects the reaction time
- The researcher decides to sample only males aged between 25 and 30 years
- On undertaking the researcher, the researcher finds out that there is no relationship between the two variables
- Assume that the researcher used red flash light to measure the reaction time
- Participants were given some alcohol, different amounts, and a red flash light was shone on them
- Unknown to the researcher is that the color red has a suppressing effect on the influence of alcohol – such that no matter the amount of alcohol that one has taken, red light made the participants react faster than expected
- This means that the color of light was a suppressor variable
- If the color of light was changed to a neutral one, say white, there could be a change in the results

Distorter variables

- A distorter variable is a variable that converts what was thought of as a positive relationship into a negative relationship, and vice versa
- This effect leads a researcher into drawing erroneous conclusions from the data
- When a distorter variable is controlled for, a true relationship is obtained

MEASUREMENT SCALES

- The operational definition of variables yields information or data which can then be analyzed
- In empirical studies, the data is usually quantitative and hence, can only be analyzed quantitatively
- In studies that yield such data, statistical procedures can be used to analyze the data
- The choice of the statistical procedure to be applied is largely determined by the type of measurement scale used in the operationalization of the variable
- There are four measurement scales which include nominal, ordinal, interval, and ratio

Nominal scale

- Nominal scale is the lowest level of measurement
- This scale merely groups subjects from the sample into categories
- Subjects or cases in each category have some common set of characteristics
- Examples of variables which can be measured at the nominal scale include sex, race, marital status, employment status, language, roofing materials, religion, type of a computer, color, etc
- A researcher might include variable 'gender' – and operationalize as 'male' or 'female'
- The researcher would then record the frequencies in each category, for example 40 males, 31 female

Ordinal scale

- Ordinal scale is an improvement of the nominal scale
- Used when there is a deferring degree of the attribute being measured among the subjects
- An ordinal scale not only groups subjects into categories, but it also ranks them into some order
- This could be in an increasing order
- In ordinal scale, numerals are used to represent relative position or order among the values of the variables
- Examples of variables in the ordinal scale include social class, military rank
- The order in the ordinal scale does not imply a quantitative diction
- Although there is some order between groups, it is hard to know the difference between one group and another

- If a researcher was looking for stability of an information system in use – and assigned numeral 3 to the most stable IS and 1 to the least stable IS, there is no way of knowing whether the difference in stability between group 2 and 3 is the same as the difference in stability between groups 1 and 2
- In other words, the difference between groups is not necessarily equal
- An ordinal scale does not give the level of precision that is desired in a research study, especially when strong statistical procedures are to be applied

Interval scale

- In an interval scale, the numerals assigned to each measure are ranked in order and the intervals between numerals are equal
- This means that numerals represent quantities and mathematical operations on the numerals would yield meaningful values
- However, these mathematical operations are limited to additions and deductions – multiplication and division are not applicable
- Also, there is no true zero point
- The maximum and minimum points of the scale are only arbitrary
- An example is a test in class
- In a subject test which is out of 100, two students score 60 and 30
- This does not imply that the student who scored 60 knows twice as much as the one who scored 30
- A student who scores a zero does not imply that there is absence of knowledge – it only implies the lowest score in the exam
- An example of interval scale measures include temperatures (Fahrenheit), test scores

Ratio scale

- The ratio scale is the highest level of measurement
- It is also the most precise method of measuring variables
- It has all the other characteristics of other scales (nominal, ordinal, and interval)
- The only addition of this is that it has a true zero point and that all operations can be applied to yield meaningful values
- Most physical objects can be measured using the ratio scale
- Example weight, area, blood pressure, distance, age, and height
- The interval between numerals are equal, and that mathematical operations yield meaningful values

- For example, a building which is 60 meters tall is twice as tall as another building which is 30 meters tall
- The difference between 80 kilograms and 60 kilograms, is exactly the same as the difference between 40 kilograms and 20 kilograms
- We can also indicate that 0 meters means there is no height

Summary of measurement scales

Summary of measurement scales

Scale	Characteristics	Statistics applicable
Nominal	• Subjects classified under a common characteristic	Measure of central tendency e.g mode
Ordinal	• Subjects classified in order • Numerals reflect increasing amounts of the attribute but not at intervals	Measure of central tendency e.g mode, median
Interval	• Numerals reflect increasing amounts of the attribute with equal intervals • A zero point does not exist; it is only arbitrary	• Measures of central tendency: mode, median, mean • Measures of dispersion: range, standard deviation, variance
Ratio	• Numerals reflect increasing amounts of the attribute with equal intervals. A true zero point exists	• Measures of central tendency: mode, median, mean • Measures of dispersion: range, standard deviation, variance

Further E-Resource Readings

Lune, H., & Berg, B. L. (2016). *Qualitative research methods for the social sciences*. Pearson Higher Ed.

7.0 REFERENCE JOURNALS

Lazar, J., Feng, J. H., & Hochheiser, H. (2017). *Research methods in human-computer interaction*. Morgan Kaufmann.