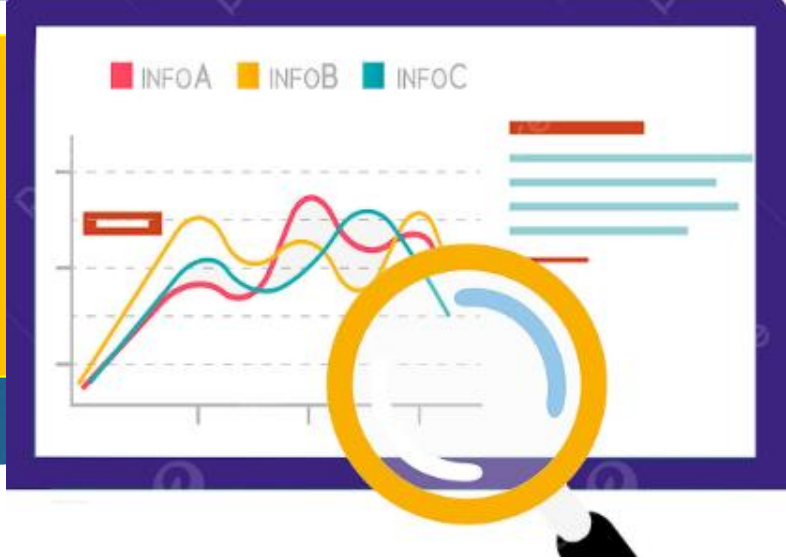
Understanding AND SYSTEMATICALLY COLLECTING DATA

QUARTER 1: LESSON1.2

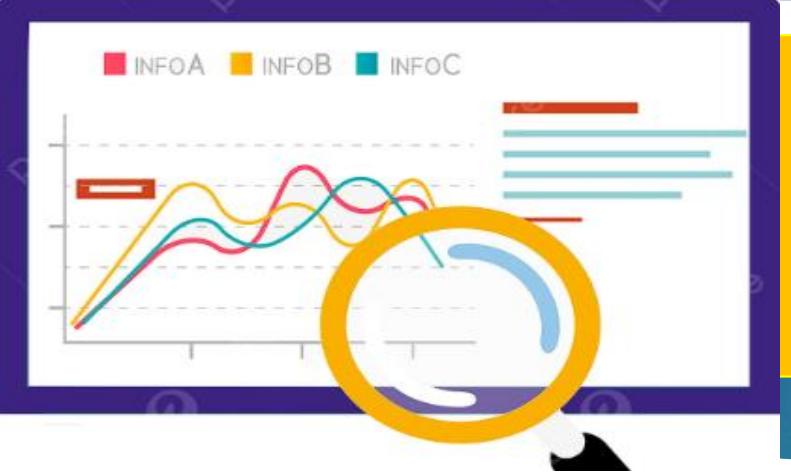
TEXTBOOK PAGES: 100 - 135

COMPETENCIES



The learner

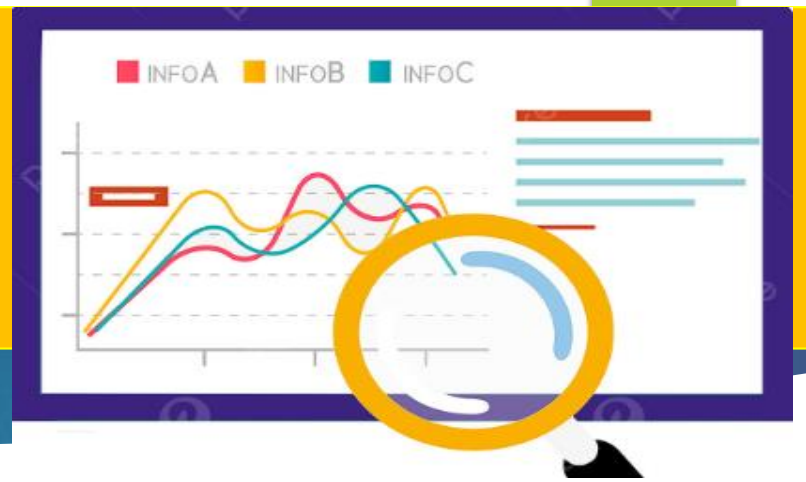
- Chooses appropriate quantitative research design
- Describes sampling procedure and sample
- Constructs an instrument and establishes its validity and reliability
- Describes intervention (if applicable)
- Plans data collection procedure
- Plans data analysis using statistics and hypothesis testing (if appropriate)
- Presents written research methodology



Overview of the Lesson

- After learning about Quantitative Research, its definition, strengths and weaknesses, kinds, its variables and their uses, and its importance in the different fields in the society, now let us learn more about it. In this lesson, you will learn more about:

SUB-TOPICS



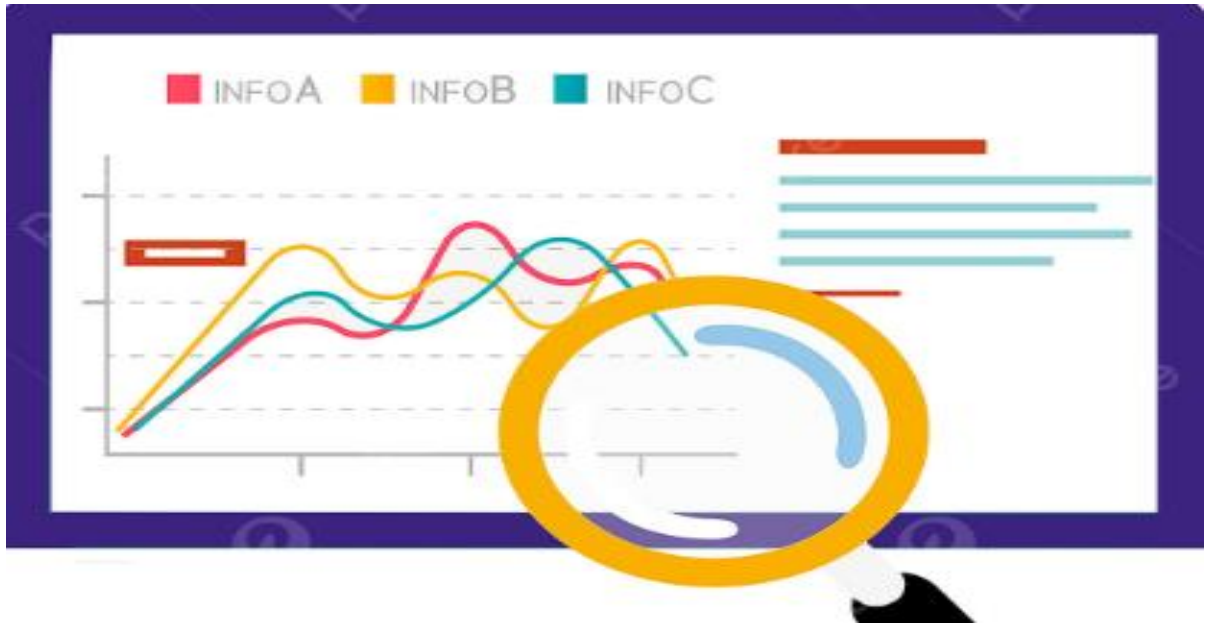
- Quantitative Research Designs
- Samples and Sampling Methods
- Types of Random Sampling in Quantitative Research
- Instruments in Quantitative Research
- Instrument Validity and Reliability
- Planning the Data Collection Procedure
- Treatment in Experimental and Quasi-Experimental Studies
- Designing the Data Analysis Procedure.

This is very important in order to prepare you for the actual gathering of data.

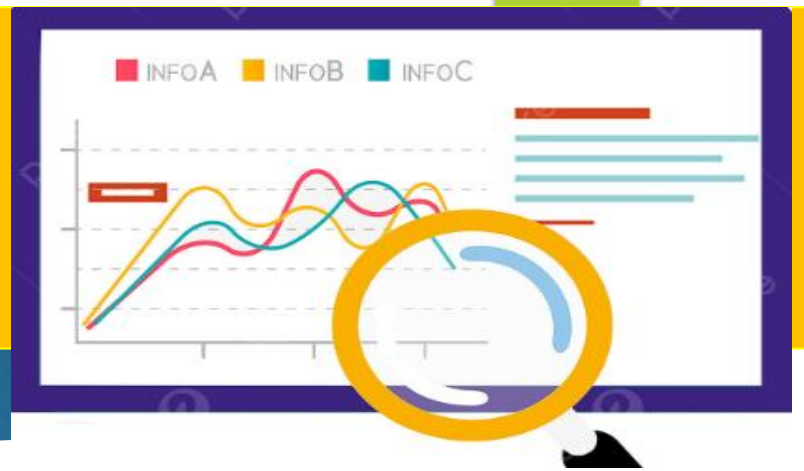
COMPETENCIES

Formative Question:

- **Why is it necessary for researchers to know and understand about quantitative research designs?**



COMPETENCIES



The learner:

- Choose an appropriate quantitative research design
- Describe the sampling procedure and sample
- Construct an instrument and establish its validity and reliability
- Describe intervention
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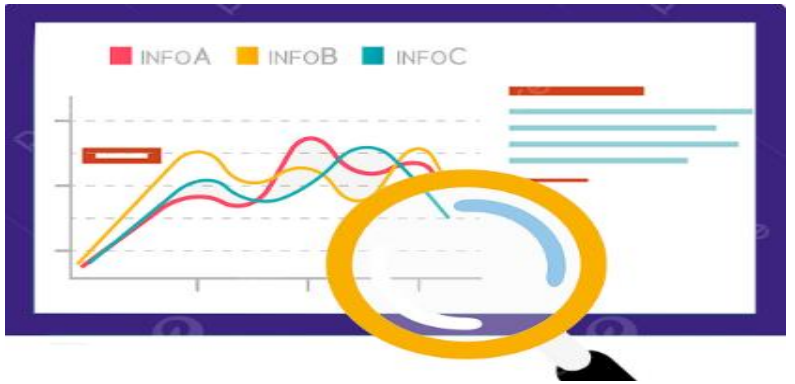
Kinds of Quantitative research

5 GENERAL KINDS OF QUANTITATIVE RESEARCH:

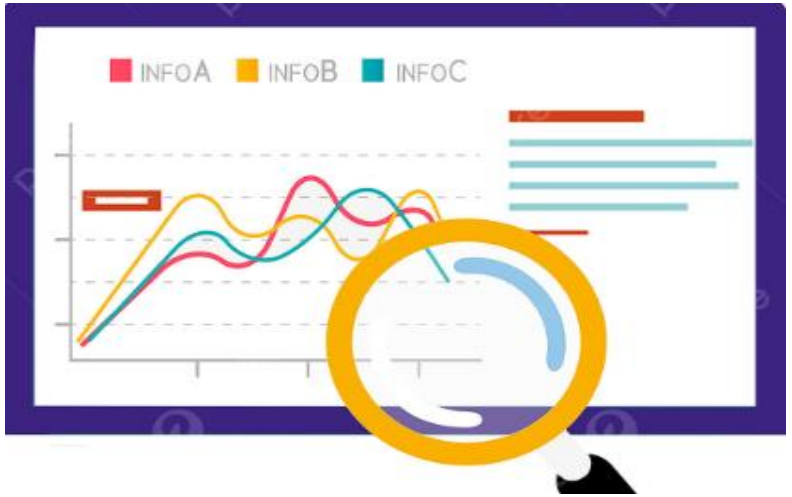


1. Descriptive Research
2. Correlational Research
3. Ex Post Facto Research
4. Quasi- Experimental Research
5. Experimental Research

Quantitative Research designs

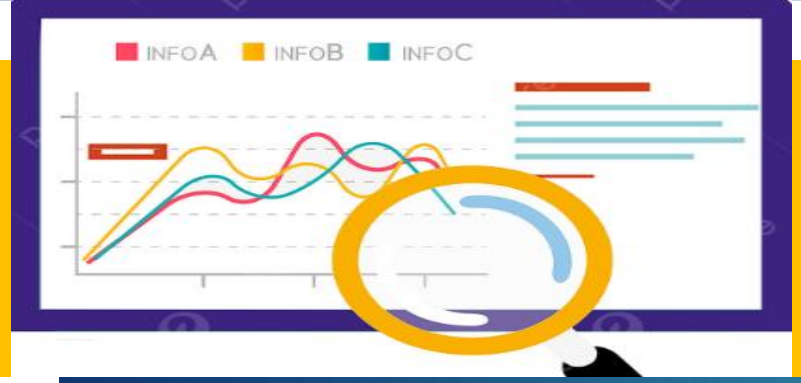
These Research Designs are also referred to as :

- Descriptive
- Correlational
- Ex post facto
- Quasi-experimental
- Experimental
- Prototyping



Quantitative Research Designs

RESEARCH DESIGN - refers to an overall strategy that a researcher uses to logically and coherently integrate the various components of a study.



Descriptive Research Design

- AIM: to observe and report on a certain phenomenon, type of behavior, or trait as it takes place or manifests itself.
- The RESEARCHER archives this objective by using RATING SCALES and OTHER MEANS to MEASURE the VARIABLES as they occur.
- Does not use experimental manipulation.

Descriptive research design

- **LIMITATION:** its inability to establish causal relationship, that is one variable cannot be claimed as the cause of another variable.
- **WHEN TO USE THIS:** when little is known about a topic or when the study is exploratory in nature…

Sample study:

Assessing Nurses' Attitudes Toward Death and Caring for Dying Patients in a Comprehensive Cancer Center

By

- Lange, M.
- Thom, B.
- Kine. N.E., 2008

Correlational Research Design

- AIM: to determine whether an increase or decrease in one variable corresponds to the increase or decrease in another.

Correlational research design

CHARACTERISTICS:

- It does not seek to establish a cause-effect relationship but mere association among variables.
- Experimental manipulation is not used .
- Variables are measured as they occur.

SAMPLE STUDY:

The Relationship Between Service Quality and Customer Satisfaction in the Telecommunication Industry: Evidence from Nigeria

- By Ojo, O., 2010

Ex post Facto Research Design

- AIM: to infer a cause from the already existing effects.

Ex post facto research design

- It does not use experimental manipulation although it attempts to establish a causal relationship between variables.
- It cannot be said that a change in the variables takes place in the actual study.
- It is used when the study being conducted is exploratory and little is known about the phenomenon or behavior being studied.

Sample study

Comparison of Personal, Social and Academic Variables Related to University Drop-out and Persistence

- By Bernardo, A., et al., 2016

Ex post facto research

The Difference Between Experimental and Ex - Post Facto Research Explained in a Simple Way (youtube.com)

QUASI-EXPERIMENTAL and EXPERIMENTAL RESEARCH DESIGNS

notes…

can be distinguished for the presence of an **INTERVENTION applied to the subjects** in the study.

notes…

- **INTERVENTION- or TREATMENT-** involves the manipulation of the independent variable in an experiment.
- The presence of the **INTERVENTION** can be attributed as the **cause of changes** in the **dependent variable**.

notes…

- **TREATMENT GROUP-** is the group of participants subjected to the intervention.
- **CONTROL GROUP-** refers to the participants not subjected to the intervention.
- Interventions are utilized in quasi-experimental and experimental studies.

Quasi-Experimental Research Design

AIM: to establish a causal relationship between 2 variables.

- The effect is presumed to have occurred during the study itself.
- So, experimental manipulation is applied to the subjects to some extent.
- The subjects are divided into 2 intact groups. But the Intact group has already been established before the study takes place.

Quasi-experimental research design

- **EXAMPLE**:
- a group of individuals with the same educational background, same nationality, or age bracket. It is necessary to ensure matching between the 2 groups based on relevant observable characteristics like education, aptitude, age, and wealth.
- Participants are not randomly assigned to either the treatment or control group. So, there is LACK OF RANDOMNESS in this type of research design.

Quasi-experimental research design

- Quasi-experimental research design provides LIMITED CONCLUSIVENESS in establishing the causal relationship between variables.

SAMPLE STUDY

The Impact of Smoking Bans on Smoking and Consumer Behavior: Quasi-Experimental Evidence from Switzerland

- By
- Boes, S.,
- Marti, J.,
- Maclean, J.C., 2014

Experimental Research Design

- Also known as TRUE EXPERIMENTAL RESEARCH DESIGN

- AIM: to establish a cause-effect relationship (similar to ex post facto and quasi-experimental designs)

Experimental research design

- But, EXPERIMENTAL RESEARCH applies variable manipulation more extensively.
- It does not only assign groups but specific individuals to the control and treatment groups.
- This ensures greater control on the part of the researcher and less threats to the study's validity.

Experimental research design

LIMITATIONS:

- 1.not all variables can be experimentally controlled and manipulated.
- 2. some procedures in the experimental design may be impractical and unethical as in the case of clinical setting.
- 3. studies under the experimental design may be prone to HAWTHORNE EFFECT

Experimental research design

HAWTHORNE EFFECT - refers to the observed change in behavior of the participants who know that they are being observed.

SAMPLE STUDY

Reading Electronic Books as a Support for Vocabulary, Story Comprehension, and Word Reading in Kindergarten and First Grade

- By Karat, 2010

Prototyping Research Design

- It is a development approach to improve the planning and execution of creative designs such as software or technology development.
- It is typically performed for experimental purposes.

EXAMPLE: the development of world wide web or the internet

Usual procedures in developing prototypes:

1. Identify the objectives for developing the prototype.
2. Identify risks that may potentially hinder the development of the prototype.

(example: the damage that a prototype may cause)

3. Formulate a hypothesis for developing the prototype.

4. Construct the prototype and assess its functionality. Conduct an experiment which will help in assessing the effectiveness of the prototype.

5. Examine the results of the experiment and enhance the prototype based on these results.

Samples and Sampling Methods

SAMPLING

- refers to the process of systematically selecting individuals, units, or groups to be analyzed during the conduct of study.

SAMPLING

REASON for SELECTING the SAMPLES :

To get information about the target population

SAMPLING

GOAL in RESEARCH:

To make sure that the samples selected represent the target population.

GENERALIZABILITY

- Generalizability is the degree to which you can apply the results of your study to a broader context. Research results are considered generalizable when the findings can be applied to most contexts, most people, most of the time.

Example of Generalizability

- Suppose you want to investigate the shopping habits of people in your city. You stand at the entrance to a high-end shopping street and randomly ask passersby whether they want to answer a few questions for your **survey**.
- Do the people who agree to help you with your survey accurately represent all the people in your city? Probably not. This means that your study can't be considered generalizable.

- Generalizability is determined by how representative your sample is of the target population. This is known as external validity.

4 Ways to determine the Sample Size

- HEURISTICS
- Literature review
- Formulas
- Power Analysis

HEURISTICS

- Is a term normally used in QUALITATIVE STUDIES as a research approach that utilizes introspection.
- In QUANTITATIVE RESEARCH, it refers to the rule of thumb for the sample size used in a study.

HEURISTICS

- Heuristics are rules of thumb that direct decision-making and sometimes result in biases that cause particular patterns of errors.
- From: International Encyclopedia of the Social & Behavioral Sciences, 2001

HEURISTICS

- A rule of thumb is a heuristic guideline that provides simplified advice or some basic rule-set regarding a particular subject or course of action.
- By James Chen updated March 29, 2021
- Heuristics are shortcuts or simple rules of thumb to make quick decisions
- ex: keep things as simple as possible

Suggested Sample Sizes in Quantitative Research Designs

(Lunenburg and Irby, 2008)

RESEARCH DESIGN	NO. OF PARTICIPANTS
SURVEY (design)	800
CORRELATIONAL	100 - 200
EX POST FACTO	30+
EXPERIMENTAL	30 or more

Literature Review

- You may want to read studies similar to yours and check the sample size that they used.
- These studies can serve as reference in proving the validity of the sample size that you plan to use.

Formula

- Formula by the National Education Association in the United States can be used to compute for the needed sample size. (page 107-108)
- Each variable in the formula has a set value you can use for the computation.

$$S = \frac{X^2NP(1-P)}{d^2(N-1) + X^2P(1-P)}$$

FORMULA

- S= required sample size
- x^2= table value of chi-square for 1 degree of freedom at the desired confidence level $(1.96)^2$
- N= population size
- P= population proportion (0.5)
- d= the degree of accuracy expressed as a proportion (.05)

FORMULA

Let us use the formula in obtaining the ideal sample size for a given population. For instance, the sample size for a population of 105 people is computed as follows:

$$S = \frac{(1.96)^2 (105) (0.50) (1 - 0.50)}{[(.05)^2 (105 - 1)] + [(1.96)^2 (0.50) (1-0.50)]}$$

GIVEN:

$$S = \frac{(1.96)^2\,(105)\,(0.50)\,(1 - 0.50)}{[\,(.05)^2\,(105 - 1)\,] + [\,(1.96)^2\,(0.50)\,(1-0.50)\,]}$$

$$S = \frac{(\,3.8416\,)\,(\,105\,)\,(0.50\,)\,(0.50\,)}{[\,(\,0.0025\,)\,(\,104\,) + [\,(\,3.8416\,)\,(0.50)\,(0.50)\,]}$$

$$S = \frac{100.842}{0.26 + 0.9604}$$

$$S = \frac{100.842}{1.2204} = 82.63 \text{ (or sample size of 83 participant)}$$

FORMULA

Use the formula below, and get the sample size for a population of 200 people.

$$S = \frac{X^2NP(1-P)}{d^2(N-1) + X^2P(1-P)}$$

GIVEN:

$$S = \frac{(1.96)^2\,(200)\,(0.50)\,(1 - 0.50)}{[\,(.05)^2\,(200 - 1)\,] + [\,(1.96)^2\,(0.50)\,(1-0.50)\,]}$$

$$S = \frac{(\,3.8416\,)\,(\,200\,)\,(0.50\,)\,(0.50\,)}{[\,(\,0.0025\,)\,(\,199\,) + [\,(\,3.8416\,)\,(0.50)\,(0.50)\,]}$$

$$S = \frac{192.08}{0.4975 + 0.9604}$$

$$S = \frac{192.08}{1.4579} = 131.75 \text{ (or sample size of 132 participant)}$$

Power Analysis

- It is the most precise strategy in determining the sample size
- It is founded on the principle of *statistical power*.

Power Analysis

STATISTICAL POWER

- Refers to the probability of rejecting a false null hypothesis, thus suggesting that THERE IS, INDEED, A RELATIONSHIP BETWEEN THE INDEPENDENT AND DEPENDENT VARIABLES.

Power Analysis

NULL HYPOTHESIS

- States that there is NO RELATIONSHIP between variables.

- **CORRELATIONAL RESEARCH** –the null hypothesis states that this relationship is indeed absent.

- **EXPERIMENTAL, QUASI-EXPERIMENTAL, & EX POST FACTO STUDIES-** the null hypothesis states that the independent variable has NO EFFECT on the dependent variable.

- Ideally, a study possesses a statistical power of 80%.
- **POWER ANALYSIS** is used to determine the sample size sufficient for measuring the effect size of a treatment.
- **EFFECT SIZE-** refers to the degree of difference between the control and treatment groups.

- **If the Statistical power – indicates the existence of a relationship between the independent and dependent variables…**

- **the Effect Size- indicates the extent of the relationship between these 2 variables.**

- The **HIGHER THE EFFECT SIZE**, the **GREATER THE DIFFERENCE** BETWEEN THE CONTROL AND TREATMENT GROUPS.

PURPOSIVE SAMPLING VS RANDOM SAMPLING

- **PURPOSIVE SAMPLING (qualitative studies)**
- Is the deliberate selection of samples based on their characteristics.
- May not sufficiently represent the target population in the study.

PURPOSIVE SAMPLING VS RANDOM SAMPLING

- **RANDOM SAMPLING (quantitative studies)**
- Involves the selection of a group of participants from a larger population BY CHANCE.
- The researcher is expected to obtain samples that will represent the population where they are taken.

Types of Random Sampling

1. Simple Random Sampling
2. Stratified Random Sampling
3. Cluster Sampling
4. Systematic Sampling

Simple Random Sampling

- All individuals in a given population have an equal chance of being selected .
- It is considered the best way to obtain a representative sample.

Simple Random Sampling

TECHNIQUE FOR SIMPLE RANDOM SAMPLING:

- **Fish Bowl Technique-** you select participants by drawing out names from a transparent glass bowl.

Stratified Sampling

- All members in the population can all be selected by chance.
- However, the population is divided into subgroups (or strata).
- The samples are selected from the subgroups and NOT from the population as a whole.
- It is best used when the characteristics of the subgroups may influence the variables being measured. Meaning, the data obtained can be also grouped into different classes creating more nuances in the analysis.
- It must be made sure that all subgroups are represented in the sample adequately.
- https://www.youtube.com/watch?v=sYRUYJYOpG0

Cluster Sampling

- https://www.youtube.com/watch?v=QOxXy-I6ogs
- **Grouping of population into subgroups or clusters**
- **The clusters are not created based on specific characteristics or traits--- heterogeneous clusters**
- **Specific participants were not selected from each subgroup/cluster. Instead, 2 whole subgroups or clusters were selected to meet the planned sample size of 4 participants.**
- **Problem: possibility of inadequate representation of each type of characteristic among the population.**
- **How to overcome: a large number of samples should be used from different subgroups or clusters.**

Systematic Sampling

- Participants are selected from a list based on their order in the population or a predetermined interval.
- Interval is obtained by dividing the population size by the sample size for the study.
- Example: page 112

Instruments in Quantitative Research

INSTRUMENTS

- Are tools used to gather data for a particular research topic.

COMMON INSTRUMENTS FOR QUANTITATIVE RESEARCH:

- Tests (performance - based or paper-and-pencil)
- Questionnaires
- Interviews
- Observations

Interviews and Observations

- are often used in qualitative research. However, they can be used in quantitative research as long as the required responses or analyzed data are numerical in nature.

Observation, interview and assessment of performance tasks

- are prone to subjectivity. For this, consider having another coder or evaluator to help you gather and analyze data. This is to improve the validity and reliability of data.

Compute for the INTER-CODER or INTER-RATER AGREEMENT

INTER-CODER or INTER-RATER AGREEMENT

- refers to the level of concurrence between the scores given by two or more raters.

In describing your instruments, consider the ff:

1. actual instrument used
2. purpose of the instrument
3. Developer of the instrument (institution or other researchers)
4. number of items or sections in the instrument
5. response format used (multiple choice, yes or no)
6. scoring for the responses
7. Reliability and validity of the study

3 Ways of developing an instrument for quantitative research

1. Adopting an instrument-

utilizing an instrument that has been used in well-known institutions or reputable studies and publications. These have been tested by their developers and other researchers.

POPULAR SOURCES OF INSTRUMENTS:

Professional journals and websites

(Tests in Print and IRIS Digital Repository)

2. Modify an existing instrument

3. Create your own instrument

Instrument Validity

VALIDITY – refers to the degree to which an instrument measures what it is supposed to measure.

Instrument Validity

TYPES OF VALIDITY

1. Face validity
2. Content validity
3. Construct validity
4. Concurrent validity
5. Predictive validity

FACE VALIDITY

- When it “appears” to measure the variables being studied…
- (a subjective process because it does not ensure that the instrument has actual validity)

CONTENT VALIDITY

- Refers to the degree to which an instrument covers a representative sample (or specific elements) of the variable to be measured.
- (a subjective process which is done with the help of a list of specifications. The list of specifications is provided by experts in your field of study)

CONSTRUCT VALIDITY

- Refers to the degree to which an instrument measures the variables being studied as a whole.
- The instrument is able to detect what should exist theoretically.
- a CONSTRUCT is often an intangible or abstract variable such as personality, intelligence, or moods. If your instrument cannot detect this intangible construct, it is considered INVALID.

TYPES OF CRITERION VALIDITY

- 1. CONCURRENT VALIDITY
- 2. PREDICTIVE VALIDITY

CONCURRENT VALIDITY

- Refers to the degree that an instrument predicts the characteristics of a variable in a certain way.
- when it is able to predict results similar to those of a test already validated in the past

- **EXAMPLE of testing a CONCURRENT VALIDITY**: whether an admission test produces results similar to those of the National Achievement Test

- **PREDICTIVE VALIDITY**
- Is when it produces results similar to those of another instrument that will be employed in the future.
- **EXAMPLE of testing PREDICTIVE VALIDITY:**
- employing college admission tests in mathematics. This will be used to predict the future performance of the students in mathematics.

Bigger picture of a sample:

- You are conducting a study on the writing skills of students.
- Use true-or-false test
- (measures FACE VALIDITY-measures one's knowledge of writing)
- (lacks: CONSTRUCT VALIDITY-does not measure actual writing skills like content knowledge, cohesiveness and organization or harmony, connectedness, oneness, unity and facility with the language)
- Above variables mentioned are considered CONSTRUCTS since they are highly ABSTRACT.

- You rework the TEST and focus on the grammar skills of students.
- (the test lacks CONTENT VALIDITY-fails to cover other items under writing skills like:
- Sentence structure, organization, and content relevant to the topic)
- So these items must be taken note of in an actual writing test to address lack of content validity)
- It must be checked if the instrument has PREDICTIVE VALIDITY- if it is able to predict ACADEMIC PERFORMANCE of students in their ENGLISH SUBJECTS.
- It must be checked if the instrument produces RESULTS similar to those of an English writing test which has been previously administered – this will prove that the most recent writing test administered has CONCURRENT VALIDITY.

Instrument Reliability

RELIABILITY

Refers to the consistency of the measures of an instrument

Is an aspect involved in the accuracy of measurement

4 TYPES OF RELIABILITY

TEST-RETEST RELIABILITY

is achieved by administering an instrument twice to the same group of participants and then computing the consistency of scores

*Retest will be 2 weeks from the first test to record a higher correlation between the variables tested in the study

EQUIVALENT FORMS RELIABILITY

Is measured by administering two tests identical in all aspects except the actual wording of items.

* 2 tests have the same coverage, difficulty level, test type, and format.

EX: conducting a PRE-TEST then a POST TEST

INTERNAL CONSISTENCY RELIABILITY

Is a measure of how well the items in two instruments measure the same construct

INTER-RATER RELIABILITY

Measures the consistency of scores assigned by two or more raters on a certain set of results

*kappa coefficient- is one of the most popular statistical tools in measuring inter-rater reliability.

*the higher the value of the kappa coefficient, the more reliable the instrument is.

*a coefficient value of at least 0.70 indicates that the instrument is reliable.

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- *the higher the value of the kappa coefficient, the more reliable the instrument is.
- *a coefficient value of at least 0.70 indicates that the instrument is reliable.

3 WAYS OF MEASURING THE INTERNAL CONSISTENCY RELIABILITY

1. **split-half coefficient (split-half reliability)-** is obtained by administering a single instrument aimed at measuring only one construct. However, in computing the results, the items of the instrument are divided (or split) into 2 sets; the results for these 2 sets are then compared with each other.
2. **Cronbach's alpha-** measures reliability with respect to each item and construct being examined by the instrument.
3. **Kuder-Richardson formula-** tests reliability in terms of instruments of a dichotomous nature, such as yes or no tests.

PLANNING THE DATA COLLECTION PROCEDURE (pp. 118)

BEFORE

1. Develop your data collection instruments and materials.
2. Seek permission from the authorities and heads of the institutions or communities where you will conduct your study.
3. Select and screen the population using appropriate sampling techniques.
4. Train the raters, observers, experiments, assistants, and other research personnel who may be involved in data gathering.
5. Obtain informed **consent** from the participants.
6. Pilot-test the instruments to determine potential problems that may occur when they are administered.

DURING

1. Provide instructions to the participants and explain how the data will be collected.
2. Administer the instruments, and implement the intervention or treatment, **if applicable**.
3. As much as possible, utilize **triangulation** in your method.

*** **Triangulation –** a technique for validating the data using two or more sources and method.

AFTER

1. Immediately encode or transcribe and archive your data.
2. Safeguard the confidentiality of your data.
3. Examine and analyze your data using the appropriate statistical tools.

TREATMENT IN EXPERIMENTAL AND QUASI-EXPERIMENTAL STUDIES

1. Write and introductory paragraph that contains background information relevant to the experiment.
2. Extensively describe the procedure that you will use in the control group.
3. Clearly explain the procedure that you will use in the treatment group.
4. Explain the basis for undertaking a particular step in your intervention.

DESIGNING THE DATA ANALYSIS PROCEDURE

DESIGNING THE DATA ANALYSIS PROCEDURE

- In quantitative research, **data analysis** involves the use of statistical tests to address your research questions or objectives.
- These statistical tests shall examine the relationship between the **dependent variable** and **independent variable**.
- The data involving these two variables are also known as the **bivariate data**.

DESIGNING THE DATA ANALYSIS PROCEDURE

- A **parametric tests** rests on a number of assumptions about the distribution of data (or the frequency of their occurrence.)

✓ have more statistical power
✓ often mathematical in nature
✓ utilize more statistical information
✓ Meaning, can detect whether indeed the independent variable significantly affects the dependent variable or not

DESIGNING THE DATA ANALYSIS PROCEDURE

- A **non-parametric test** rests on a **few or no** assumptions regarding the distribution of the data.

Here are some points to consider when choosing statistical tests for your study.

1. Use **parametric tests** if you are using **interval or ratio scales**.
   Use **non-parametric tests** if your measurement scale is **ordinal or nominal**.
2. Use your **parametric tests** if your sample size is **30 or more per group.** Use **non-parametric** tests if your sample size is **fewer than 30.**
3. Use **parametric tests** if the distribution of your **data is normal.**
   Use **non-parametric tests** if the distribution of your data deviates markedly from **normality or normal distribution.**

Here are some points to consider when choosing statistical tests for your study.

A. **Kurtosis** – the measure of the heaviness of the tail of the distribution, thus indicating the presence of numerous outliers in your data

B. **Skewness** – the lack of evenness in the distribution of data

Here are some points to consider when choosing statistical tests for your study.

- **Kurtosis and skewness** both help describe certain aspects of data distribution
- ✓ The closer their value to zero is, the more the data reach normal distribution
- ✓ Your data will help you determine the right statistical technique to use in your research

The following are the statistical techniques that you can use in quantitative research:

PURPOSE	Statistical Techniques	
	PARAMETRIC	NON-PARAMETRIC
❖ To test the relationship between two variables	✓ Pearson's r	➢ Phi coefficient (nominal, dichotomous variables) ➢ Spearman's rho (ordinal)
❖ To test the difference between two data sets from one group (e.g. pretest and posttest)	✓ T-test for two dependent samples	➢ McNemar change test (nominal dichotomous variables) ➢ Wilcoxon signed-rank test (ordinal)
❖ To test the difference between data sets from two different groups (e.g. control group and	✓ T-test for independent variables	➢ Two-way chi-square (qualitative in general) ➢ Mann-Whitney U test (ordinal)