MODUL
METODOLOGI PENELITIAN

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MODULE FOR METODOLOGI PENELITIAN

There will be 14 meetings:
1. INTRODUCTION
2. RESEARCH TYPES
3. RESEARCH DESIGN
4. RESEARCH VARIABLES
5. POPULATION AND SAMPLE
6. RESEARCH INSTRUMENT
7. ANALYSIS
8. HYPOTHESIS
9. DESCRIPTIVE STATISTICS
10. INFERENTIAL STATISTICS
11. EXPERIMENTAL RESEARCH
12. 12-14 STUDENT’S PRESENTATION

References
• 1. EDUCATIONAL RESEARCH BY CRESWELL
• 2. MODULE FOR METOPEN BY TITI ROKHAYATI
• 3. PENELITIAN KUANTITATIF DAN KUALITATIF R & D BY SUGIYONO
• 4. COHEN
• MATHIESSEN

1. INTRODUCTION
Research is a process of steps used to collect and analyze information to increase our understanding of a topic or issue. At a general level, research consist of three steps:

1. Pose a question
2. Collect data to answer question
3. Present an answer to the question.

The six steps in the process of research

1. Identifying a research problem
2. Reviewing the literature
3. Specifying a purpose of a research
4. Collecting data
5. Analyzing and interpreting the data
6. Reporting and evaluating research
1. Identifying a research problem
   a. Specifying a problem
   b. Justifying it
   c. Suggesting the need to study it for audience
2. Reviewing the literature
   a. Locating resources
   b. Selecting resources
   c. Summarizing resources
3. Specifying a purpose of a research
   a. Identifying the purpose statement
   b. Narrowing the purpose statement to research questions or hypothesis
4. Collecting data
   a. Selecting individual to study
   b. Obtaining permission
   c. Gathering information
5. Analyzing and interpreting the data
   a. Breaking down the data
   b. Representing the data
   c. Explaining the data
6. Reporting and evaluating research
   a. Deciding on audience
   b. Structuring the report
   c. Writing the report sensitively

The design of Research

1. Quantitative designs
   a. Experimental
   b. Correlational
   c. Survey
   1. Combined designs
      a. mixed methods
      b. action research
   2. Qualitative designs
      a. Grounded theory
      b. Ethnography
      c. Narrative

Quantitative Research Characteristics

1. Describing research problem through a description of trends or a need for an explanation of the relationship among variables
2. Providing a major role for the literature through suggesting the research questions to be asked and justifying the research problem and creating a need for the direction of the study
3. Creating purpose statement, research questions and hypotheses that are specific, narrow, measurable, and observable.
4. Collecting numeric data from large number of people using instruments with preset questions and responses
5. Analyzing trends, comparing group or relating variables using statistical analysis, and interpreting results by comparing them with the prior prediction and past research.
6. Writing the research report using standard, fixed structures and evaluation criteria and taking an objective and unbiased approach.

Quantitative Research Characteristics

1. Exploring a problem and developing a detailed understanding of a central phenomenon
2. Having the literature review play a minor role but justify the problem
3. Stating the purpose and research questions in a general and broad way so as to the participant’s experiences
4. Collecting data based on words from a small number of individuals so that the participants’ view are obtained
5. Analyzing the data for description and themes using text analysis and interpreting the larger meaning of the findings
6. Writing the report using flexible, emerging structures and evaluative criteria, and including the researchers’ subjective reflexivity and bias

Research designs

Experimental: experimental research procedures are ideally suited for educational practice. It is also called intervention studies or group comparison studies. Experimental designs are procedure in quantitative research in which the investigator determines whether an activity or materials make a different result for participants. It can be done by giving a set of activities to one group different from another group.

Correlational Designs

This research focuses on examining the association or relation of one or more variables than in testing the impact of activities or materials. Correlational designs are procedure in quantitative research in which investigators measure the degree of association between two or more variables using the statistical procedure of correlational analysis. This degree of association, expressed as a number, indicates whether the two variables are related or whether one can predict another. To
accomplish this, it studies a single group of individuals rather than two or more group in an experiment.

**Survey Designs**

It seeks to describe trends in a large population of individuals. A survey is a good procedure to use. Survey designs are procedures in quantitative research in which the researcher administers a survey or questionnaire to small group of people (sample) to identify trends in attitudes, opinions, behaviors, or characteristics of a large group of people (population).

**Grounded Theory Designs**

This research is systematic, qualitative procedures that researchers use to generate a general explanation (grounded in the views of participants, called grounded theory) that explain a process, action, or interaction among people. The procedure for developing this theory includes primarily collecting interview data, developing and relating categories (or themes) of information, and composing of figure or visual model that portrays the general explanation. In this way the explanation is “grounded” in the data from participants. From this explanation, the researcher constructs predictive statements about the experiences of individuals.

**Ethnographic Designs**

Examining one group of individuals in the setting where they live and work and in developing portrait of how they interact. Ethnographic designs are qualitative procedures for describing, analyzing and interpreting a cultural group’s shared pattern of behavior, belief, and language that develop over time. In ethnography the researcher provides a detailed picture of the culture-sharing group, drawing on various sources of information. The ethnographer also describes the group within its setting, explores themes or issues that develop over time as the group interacts, and details a portrait of the group.

**Narrative Research Designs**

It describes and interprets group behavior or ideas or in developing an explanation grounded in the experiences of many individuals. Narrative research designs are qualitative procedures in which researchers describe the lives of individuals, collect and tell stories about these individuals’ lives, and write narratives about their experiences.
Kontras Metode Kualitatif
Desain
- Umum
- Fleksibel
- Berkembang, tampil dalam proses penelitian

Metode Kuantitatif
Desain
- Spesifik, jelas, terinci
- Ditentukan secara mantap sejak awal
- Menjadi pegangan langkah demi langkah

Tujuan
- Memperoleh pemahaman makna : verstehen
- Mengembangkan teori
- Menggambarkan realitas yang kompleks

Tujuan
- Menunjukkan hubungan antara variabel
- Mentest teori
- Mencari generalisasi yang mempunyai nilai prediktif

Teknik Penelitian
- Observasi, participant observation
- Wawancara terbuka

Teknik Penelitian
- Eksperimen, survey, observasi berstruktur
- Wawancara berstruktur

Instrumen Penelitian
- Human Instrument
- Buku Catatan
- Recording

Instrumen Penelitian
- Test, angket, wawancara, skala
- Komputer, Kalkulator

Data
- Deskriptif
- Dokumen pribadi, catatan lapangan, ucapan responden, dokumen, dll

Data
- Kuantitatif
- Hasil pengukuran berdasarkan variabel yang dioperasionalkan dengan menggunakan instrumen

Sampel
Tabel 2. Perbandingan metodologi kuantitatif dan kualitatif #

<table>
<thead>
<tr>
<th>Butir bandingan</th>
<th>Kuantitatif</th>
<th>Kualitatif</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ontologi</td>
<td>Realitas adalah objektif dan singular</td>
<td>Realitas adalah subjektif dan banyak</td>
</tr>
<tr>
<td>2. Epistemologi</td>
<td>Peneliti bebas (independent) dari apa yang ditelitinya</td>
<td>Peneliti berinteraksi dengan apa yang diteliti</td>
</tr>
<tr>
<td>3. Aksiologi</td>
<td>Pertanyaan (inquiry) bebas dari pertimbangan nilai dan bias</td>
<td>Pertanyaan terikat nilai</td>
</tr>
<tr>
<td>4. Retorika</td>
<td>Formal dan suara impersonal</td>
<td>Informal dan suara personal</td>
</tr>
<tr>
<td>5. Tujuan</td>
<td>Generalisasi (rampidan) dan prediksi</td>
<td>Deskripsi yang kaya serta panjang dan pengembangan teori</td>
</tr>
<tr>
<td></td>
<td>Hukum universal</td>
<td>Pemahaman yang terkait dengan konteks</td>
</tr>
<tr>
<td>6. Permulaan</td>
<td>Kita tahu bahwa kita tidak tahu</td>
<td>Kita tidak tahu bahwa kita tidak tahu</td>
</tr>
<tr>
<td>(outset)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. RESEARCH TYPES

Types of Research – Definitions

a. **Action research** is a methodology that combines action and research to examine specific questions, issues or phenomena through observation and reflection, and deliberate intervention to improve practice.

b. **Applied research** is research undertaken to solve practical problems rather than to acquire knowledge for knowledge sake.

c. **Basic research** is experimental and theoretical work undertaken to acquire new knowledge without looking for long-term benefits other than the advancement of knowledge.

d. **Clinical trials** are research studies undertaken to determine better ways to prevent, screen for, diagnose or treat diseases.

e. **Epidemiological research** is concerned with the description of health and welfare in populations through the collection of data related to health and the frequency, distribution and determinants of disease in populations, with the aim of improving health.

f. **Evaluation research** is research conducted to measure the effectiveness or performance of a program, concept or campaign in achieving its objectives.

g. **Literature review** is a critical examination, summarisation, interpretation or evaluation of existing literature in order to establish current knowledge on a subject.

h. **Qualitative research** is research undertaken to gain insights concerning attitudes, beliefs, motivations and behaviours of individuals to explore a social or human problem and include methods such as focus groups, in-depth interviews, observation research and case studies.

i. **Quantitative research** is research concerned with the measurement of attitudes, behaviours and perceptions and includes interviewing methods such as telephone, intercept and door-to-door interviews as well as self-completion methods such as mail outs and online surveys.

j. **Service or program monitoring and evaluation** involves collecting and analysing a range of processes and outcome data in order to assess the performance.
of a service or program and to determine if the intended or expected results have been achieved.

3. RESEARCH DESIGNS

Types of research design (Nunan)

8 paradigms
2 pure paradigms
6 mixed paradigms

Paradigm 1: exploratory-interpretive
1. non experimental design
2. qualitative data
3. interpretive analysis

Paradigm 2: analytical-nomological
1. experimental or quasi experimental design
2. quantitative data
3. statistical analysis

Mixed forms

Paradigm 3: experimental-qualitative-interpretative
1. design: experimental or quasi experimental
2. data: qualitative
3. analysis: interpretive

Paradigm 4: experimental-qualitative-statistical
1. design: experimental or quasi experimental
2. data: qualitative
3. analysis: statistical

Paradigm 5: exploratory-qualitative-statistical
1. design: non experimental
   2. data: qualitative
   3. analysis: statistical

Paradigm 6: exploratory-quantitative-statistical
1. design: non experimental
2. data: quantitative
3. analysis: statistical

Paradigm 7: exploratory-quantitative-interpretive
1. design: non experimental
2. data: quantitative
3. analysis: interpretive

Paradigm 8: experimental-quantitative-interpretive
1. design: experimental or quasi experimental
2. data: quantitative
3. analysis: interpretive
4. RESEARCH VARIABLES

Variable: a property or characteristic which may differ from individual to individual or from group to group. A great deal of research is carried out in order to identify or test the strength of relationship between variables. When one variable influences or affects a second variable, the first variable is called independent the second is dependent.

Quantitative research is all about quantifying relationships between variables.

a. A variable is something that can change, such as 'gender' and are typically the focus of a study.
b. Variables are things like weight, performance, time, and treatment.

A. Types of Variable

1. An independent variable is one is manipulated by the researcher. It is like the knob on a dial that the researcher turns. In graphs, it is put on the X-axis.

2. A dependent variable is one which changes as a result of the independent variable being changed, and is put on the Y-axis in graphs.

In experiments, the IV is the variable that is controlled and manipulated by the experimenter; whereas the DV is not manipulated, instead the DV is observed or measured for variation as a presumed result of the variation in the IV.

"In nonexperimental research, where there is no experimental manipulation, the IV is the variable that 'logically' has some effect on a DV. For example, in the research on cigarette-smoking and lung cancer, cigarette-smoking, which has already been done by many subjects, is the independent variable." (Kerlinger, 1986, p.32)

When researchers are not able to actually control and manipulate an IV, it is technically referred to as a status variable (e.g., gender, ethnicity, etc.). Even though researchers do not actually control or manipulate status variables, researchers can, and often do, treat them as IVs (Heppner, Kivlighan & Wampold, 1999).

"The DV refers to the status of the 'effect'(or outcome) in which the researcher is interested; the independent variable refers to the status of the presumed 'cause,' changes in which lead to changes in the status of the dependent variable…any event or condition can be conceptualized as either an independent or a dependent variable. For example, it has been observed that rumor-mongering can sometimes cause a riot to erupt, but it has also been observed that riots can cause rumors to surface. Rumors are variables that can be conceived of as causes (IVs) and as effects (DVs)." (Rosenthal & Rosnow, 1991, p. 71)

The following is a hypothesis for a study.

1. "There will be a statistically significant difference in graduation rates of at-risk high-school seniors who participate in an intensive study program as opposed to at-risk high-
school seniors who do not participate in the intensive study program." (LaFountain & Bartos, 2002, p. 57)

IV: Participation in intensive study program.
DV: Graduation rates.

2. "A director of residential living on a large university campus is concerned about the large turnover rate in resident assistants. In recent years many resident assistants have left their positions before completing even 1 year in their assignments. The director wants to identify the factors that predict commitment as a resident assistant (defined as continuing in the position a minimum of 2 years).
The director decides to assess knowledge of the position, attitude toward residential policies, and ability to handle conflicts as predictors for commitment to the position." (LaFountain & Bartos, 2002, p. 8)

IV: knowledge of position, attitude toward policies, and ability to handle conflicts.
DV: commitment to position (continuing in position for 2 years or not continuing).

3. 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. It is a special type of independent variable.

4. An intervening variable is one that surfaces between the time the independent variables start operating to influence the dependent variable and the time their impact is felt on it. There is thus a temporal quality or time dimension.

5. Control variable that is controled or it is made constant the effect of Indepandent Variable to Dependent Variable is not influenced by other factors.

5. POPULATION AND SAMPLE

Population is
All cases, situations, or individuals who share one or more characteristics.
A generalization area which consists of object or subject having certain quality and characteristics; it can be determined by the researcher to learn and to conclude.

Sample is
A subset of individuals or cases within a population
The researcher uses sample because of limitation of time, energy and money.
The sample which are taken from population must be representative

Sampling Technique
Sampling technique is a certain technique to take sample. According to Sugiyono (2008: 62), there are two types of sampling techniques namely Probability and Non-probability sampling.
Probability sampling includes simple random, proportionate stratified random, disproportionate stratified random, and area random.
Non-probability sampling includes systematically sampling, quota sampling, accidental/incidental sampling, purposive sampling, saturated sampling, and snowball sampling. The picture below will show more vividly about sampling techniques.

**Probability sampling**

1. Simple random sampling
   - It is taken from the population randomly without considering the strata
   - It is done if the members of the population are homogeneous

2. Proportionate stratified random sampling
   - It is done if the members of the population are heterogeneous and they have strata proportionally

3. disproportionate stratified random sampling
   - this technique is used if the population have strata but not proportional

4. Area (cluster) sampling
   - It is used to determine the samples if the object is in wide range.

**Non Probability sampling**

1. Systematically sampling
   - It is based on the order of the population member. They have been given the number in order.

2. quota sampling
   - this technique is used to determine the sample which has certain characteristics and the number that the researcher wants.

3. Incidental sampling
   - It happens incidentally without any intention

4. Purposive sampling
   - The sample are taken because of some considerations

5. Saturated sampling
   - it happens if all the members of population are being used. It is done when the number of the population is small.
6. Snowball sampling
   At first the number is just small but it is getting bigger.

6. RESEARCH INSTRUMENT
Kinds Of Instruments:

1. Test
2. Questionnaire
3. Interview
4. Observation
5. Documents

1. Test
To Test The Ability, Achievement And Mastery We Have Test. Test Can Be In The Form Of Written, Oral Or Behavior.

Kinds Of Test:
1. Multiple Choice
2. Matching
3. True – False
4. Completion / Gap Fill
5. Essay

Examples Of Test

A. Multiple Choice
   1. Nap
      a. a brief sleep
      b. a happy song
      c. a sharp rock
      d. a short meeting
   2. john was astounded to hear her answer
      a. greatly amused
      b. greatly relieved
      c. greatly surprised
      d. greatly anger

B. Matching
Match the words (similar meaning) below with the list of words on the right side:

1. Tired a. goat
2. Sheep  
3. Mouse

C. True-False
Put (T) if the statements are true and (F) if the statements are false
1. All westerners like to have free sex
2. The westerners are more individualist than Indonesians
3. Indonesians are monochronoist
4. The principle of time describes the characters of the people, Indonesia like to have ‘slowly but sure’

D. Completion
1. There are two concepts of time……and polychronoism.
2. …….is the transfer of culture from one generation to the next.

E. Essay
What are the causes of AIDS?
How do you describe about gender?

2. Questionnaire
If the data which will be collected are in the form of idea, opinion or personal experience even a community in a society the most suitable instrument is questionnaire. The questions can be varied. The example of questionnaire:
   a. Filling the gap / completion  
      Age:  
      Job:  
      Income:
   b. Choosing several answers  
      Religion: ( ) islam ( ) Catholic ( ) Christian ( ) Hinduism ( ) Buddhist
   c. Checking  
      Very good   good   bad   very bad
      Lighting
      Building
      Facility
   d. Scale questions  
      Completely Agree agree  disagree  completely disagree
My English ability helps me much on my job

e. Essay
   Give your reasons in choosing the department for your study
   ……………………………………………………………………………………………

3. Interview

Before interviewing we have to prepare the sheet

Example:
No.  name of father  children  income
1.
2.
3.
Your attitude about family planning
( ) supporting much
( ) supporting
( ) not clear
( ) disagree
( ) completely disagree

4. Observation

Similar to interview you also have to make the observation sheet

Grade  male  female  total

5. Documents

In using the document we have take them all so you are not permitted to have sampling technique. It is because you don’t have to make test, observation sheet or interview.
7. ANALYSIS

Statistics:
- Summary measure of a sample

Parameter
- Summary measure of a population

Two branches of the science of statistics
- Descriptive Statistics
- Inferential Statistics

Descriptive Statistics
Concerned with describing or characterizing the obtained sample data
Use of summary measures—typically measures of central tendency and spread
Measures of central tendency include the mean, median, and mode
Measures of spread include the range, variance, and standard deviation.
These summary measures of obtained sample data are called statistics

Inferential Statistics
Involves using obtained sample statistics to estimate the corresponding population parameters
Most common inference is using a sample mean to estimate a population mean (surveys, opinion polls)

Planning a study
Suppose you were interested in determining whether treatment X has an effect on outcome Y—there are several issues that need to be addressed so that a sound inference can be made from the study result
What is the population?
How will you select a sample that is representative of that population?
- There are many ways to produce a sample, but not all of them will lead to sound inference

Sampling Strategies
Probability samples—result when subjects have a known probability of entering the sample
– Simple random sampling
– Stratified sampling
– Cluster sampling
Non-probability samples—result when subjects do not have a known probability of entering the sample
– Quota sampling
– Convenience sampling
Probability samples can be made to be representative of a population
Non-probability samples may or may not be representative of a population—it may be difficult to convince someone that the sample results apply to any larger population

Planning a study—Validity Issues

Internal validity
– The extent to which the observed effect on the dependent variable is actually caused by the independent variable
– Depends on carefully controlling other potential causes of an effect
– Excessive control may result in artificial circumstances

External validity
– The extent to which one would expect the results from a study to be duplicated in the real world—in the larger population
– Depends on the representativeness of the sample
– Also depends on artificiality of the study
– Always a tension between maximizing internal vs. external validity

Efficacy studies
– Studies designed to determine the maximum effectiveness of a treatment under ideal conditions—internal validity

Effectiveness studies
– Studies designed to determine the likely effect of a treatment in the real world—external validity

Planning a study
Clinical trials are generally designed to be efficacy trials—highly controlled situations that maximize internal validity
We want to design a study to test the effect of treatment X on outcome Y, and try to make sure that any difference in Y is due to X
The simplest design would involve two groups—an experimental group and a control group—that are created through random assignment. In addition, neither the subjects nor the experimenter knows the group assignment (double blind)
Two groups to address the possibility of change in Y occurring regardless of treatment X
Random assignment to address the possibility that the two groups were different to begin with
Blinding to address the possibility that patient or experimenter expectations play a role in the outcome
At the end of this study you observe a difference in outcome Y between the experimental group and the control group.
All of the effort in designing the study with strict control is for one reason—at the end of the study you want only two plausible explanations for the observed outcome
  – Chance
  – Real effect of treatment X
The reason you want only these two explanations is because if you can rule out chance, you can conclude that treatment X must have been the reason for the difference in outcome Y
All inferential statistical tests are used to estimate the probability of the observed outcome assuming chance alone is the reason for the difference.
If there are multiple competing explanations for the observed result, then ruling out chance offers little information about the effectiveness of treatment X

**Two ways of using Inferential statistics**
Hypothesis testing—answering the question of whether or not treatment X may have no effect on outcome Y
Point estimation—determining what the likely effect of treatment X is on outcome Y

**Hypothesis Testing**
The goal of hypothesis testing is somewhat twisted—it is to disprove something you don’t believe
In this case you are trying to disprove that treatment X has no effect on outcome Y
You start out with two hypotheses
Null Hypothesis (H₀)
  – Treatment X has no effect on outcome Y
Alternative Hypothesis (H₁)
  – Treatment X has an effect on outcome Y
If the trial has been carefully controlled, there are only two explanations for a difference between treatment groups—efficacy of X, and chance
Assuming that the null hypothesis is correct, we can use a statistical test to calculate that the observed difference would have occurred. This is known as the significance level, or p-value of the test.
P-value
  – The probability of the observed outcome, assuming that chance alone was involved in creating the outcome. In other words, assuming the null hypothesis is correct, what is the probability that we would have seen the observed outcome.
  – This is only meaningful if chance is the only competing plausible explanation.
If the p-value is small, meaning the observed outcome would have been unlikely, we will reject that chance played the only role in the observed difference between groups and conclude that treatment X does in fact have an effect on outcome Y.

How small is small?

<table>
<thead>
<tr>
<th>Reality -&gt; Decision</th>
<th>$H_0$ is true</th>
<th>$H_0$ is false</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retain $H_0$</td>
<td>Correct Decision</td>
<td>Type II Error ($\beta$) (.2, .1)</td>
</tr>
<tr>
<td>Reject $H_0$</td>
<td>Type I Error ($\alpha$) (.05, .01)</td>
<td>Correct Decision</td>
</tr>
</tbody>
</table>

Choosing the right test

Typically one is interested in comparing group means.

If the outcome is continuous, and one independent variable:
- Two groups—t-test
- Three or more groups--ANOVA

If the outcome is continuous and there is more than one independent variable:
- ANOVA, if all independent variables are categorical
- ANCOVA or multiple linear regression, if some independent variables are continuous

If the outcome is binary:
- Logistic regression
- If outcome is time until a specified outcome:
- Survival analysis—Cox proportional hazards regression

Parametric vs. Non-parametric tests

Parametric tests are tests that use a known probability distribution to assess the p-value of the outcome.

Most outcomes do fairly closely follow a known probability distribution, and many tests are robust to violations of distributional assumptions, so the assigned p-value will be fairly accurate in many situations.

For unique situations, such as specialized outcomes or very skewed distributions, one can generate their own probability distribution to calculate a p-value. (jackknife, bootstrap, etc.)

Computers make these techniques very fast and easy.

Establishing Equivalence

A traditional hypothesis test can establish if two groups are different, not whether they are equivalent.
This is the methodology used when an investigator is interested in establishing the superiority of one treatment over another. If the goal of the investigator is to establish that a new treatment is substantially equivalent to an established treatment (no better or no worse than), a different methodology is required.

First, the investigator must define what is meant by equivalent—this involves establishing equivalence boundaries.

This is based on an informed judgment as to the largest difference that would still be considered clinically negligible. Next, you need to calculate a 90% confidence interval for the difference actually observed in the trial. If the 90% confidence interval falls entirely within the previously established equivalence boundaries, equivalence has been established at the p<.05 level.

When done in conjunction with a traditional hypothesis test, four outcomes are possible:

<table>
<thead>
<tr>
<th>Hypothesis test result -&gt;</th>
<th>Equivalence test result</th>
<th>Reject $H_0$</th>
<th>Retain $H_0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reject $H_0$ (Non-equivalence)</td>
<td>Statistically different, and equivalent</td>
<td>Not statistically different, and equivalent</td>
<td></td>
</tr>
<tr>
<td>Retain $H_0$ (Non-equivalence)</td>
<td>Statistically different, and not equivalent</td>
<td>Not statistically different, and not equivalent</td>
<td></td>
</tr>
</tbody>
</table>

**Non-inferiority**

Sometimes an investigator is only interested in whether a new treatment is no worse than an established treatment—it doesn’t matter if it is better.

In this case, only a lower equivalence boundary needs to be established, and one needs to show that the lower side of a 95% confidence interval does not cross that lower boundary. This results in a p<.025 level of significance.

**8. HYPOTHESIS**

HYPOTHESIS It is a tentative prediction or explanation of two or more variables The hypothesis is the most important mental tool the research has. It is important integral component of modern scientific research K. SYED, MPT (Ortho).
A formal statement about an expected relationship between two or more variables which can be tested through an experiment. (Nunan, 1992: 230)

**Purposes Of Hypothesis:**
- It provides bridge between theory and reality and in this sense unifying of two domains
- It provides powerful tool, for the advancement of knowledge since they enable the researcher to objectively enter new areas of discovery
- It provides direction for any research Endeavour by tentatively identifying the anticipated outcome.
- It is guide to the thinking process and the process of discovery It serves as a framework for drawing conclusions K. SYED, MPT (Ortho)

**advantages:**
Hypothesis builds researches confidence in his results Sound hypothesis gives direction to the inquiry A good hypothesis enriches theory K. SYED, MPT (Ortho)

**Characteristics of Hypothesis:**
- It should be clear and precise
- It should be capable of being tested
- It should state relationship between variables
- It should be limited in scope and must be specific
- It should be understandable
- It should be consistent with most known facts
- It should be test with amenable time
- It should be comprises needed explanations K. SYED, MPT (Ortho)

**Classification of hypothesis:**
- Directional hypothesis
- Non directional hypothesis
- Research hypothesis (Alternative)
- Statistical hypothesis (Null) K. SYED, MPT (Ortho)

**The forms of hypothesis**
- Descriptive: to know how far is the ability or how high is the motivation / productivity?
  - the test: one sample t-test
- Associative: to describe the relationship between variables
  - the test: product moment correlation
- Comparative: to describe the difference between one variable to the other
  - The test: one way anova

**Examples of hypothesis**
- using flip word game is effective for teaching vocabulary
- "There is a positive and significance influences of teaching vocabulary using Interactive CD Picture Dictionary on the students’ vocabulary mastery of the 4th grade students of SDN I Seren Purworejo in the academic year of 2009/2010".
teaching vocabulary by using outdoor activities to the fifth grade students is effective
• ‘there is a positive and significant relationship between grammar mastery and TOEFL scores on the students of the third grade of State Senior High School 5 Purworejo in the academic year of 2009/2010’.
• “There is a positive effect of using magic card as teaching-media toward the students’ English achievement of the eighth grade students of State Junior High School 12 of Purworejo in academic year 2009/2010.”

9. DESCRIPTIVE STATISTICS

Descriptive statistics is the discipline of quantitatively describing the main features of a collection of data.[1] Descriptive statistics are distinguished from inferential statistics (or inductive statistics), in that descriptive statistics aim to summarize a data set, rather than use the data to learn about the population that the data are thought to represent. This generally means that descriptive statistics, unlike inferential statistics, are not developed on the basis of probability theory.[2] Even when a data analysis draws its main conclusions using inferential statistics, descriptive statistics are generally also presented. For example in a paper reporting on a study involving human subjects, there typically appears a table giving the overall sample size, sample sizes in important subgroups (e.g., for each treatment or exposure group), and demographic or clinical characteristics such as the average age, the proportion of subjects of each sex, and the proportion of subjects with related comorbidities.

Use In Statistical Analysis

Descriptive statistics provide simple summaries about the sample and the measures. Together with simple graphics analysis, they form the basis of quantitative analysis of data.

Descriptive statistics summarize data. For example, the shooting percentage in basketball is a descriptive statistic that summarizes the performance of a player or a team. This number is the number of shots made divided by the number of shots taken. A player who shoots 33% is making approximately one shot in every three. One making 25% is hitting once in four. The percentage summarizes or describes multiple discrete events. Or, consider the scourge of many students, the
grade point average. This single number describes the general performance of a student across the range of their course experiences.

Describing a large set of observations with a single indicator risks distorting the original data or losing important detail. For example, the shooting percentage doesn't tell you whether the shots are three-pointers or lay-ups, and GPA doesn't tell you whether the student was in difficult or easy courses. Despite these limitations, descriptive statistics provide a powerful summary that may enable comparisons across people or other units.

**Univariate analysis**

Univariate analysis involves the examination across cases of a single variable, focusing on three characteristics: the distribution; the central tendency; and the dispersion. It is common to compute all three for each study variable.

**Distribution**

The distribution is a summary of the frequency of individual or ranges of values for a variable. The simplest distribution would list every value of a variable and the number of cases who had that value. For instance, computing the distribution of gender in the study population means computing the percentages that are male and female. The gender variable has only two, making it possible and meaningful to list each one. However, this does not work for a variable such as income that has many possible values. Typically, specific values are not particularly meaningful (income of 50,000 is typically not meaningfully different from 51,000). Grouping the raw scores using ranges of values reduces the number of categories to something more meaningful. For instance, we might group incomes into ranges of 0–10,000, 10,001–30,000, etc.

Frequency distributions are depicted as a table or as a graph. Table 1 shows an age frequency distribution with five categories of age ranges defined. The same frequency distribution can be depicted in a graph as shown in Figure 2. This type of graph is often referred to as a histogram or bar chart.

**Central tendency**

The central tendency of a distribution locates the "center" of a distribution of values. The three major types of estimates of central tendency are the mean, the median, and the mode.

The mean is the most commonly used method of describing central tendency. To compute the mean, take the sum of the values and divide by the count. For example, the mean exam score is determined by summing all the scores and dividing by the number of students taking the exam. For example, consider the test score values:
The sum of these 7 values is 147, so the mean is \( \frac{147}{7} = 21 \).

The median is the score found at the middle of the set of values, i.e., that has as many cases with a larger value as have a smaller value. One way to compute the median is to sort the values in numerical order, and then locate the value in the middle of the list. For example, if there are 500 values, the median is the average of the two values in 250th and 251st positions. If there are 499 values, the value in 250th position is the median. Sorting the 7 scores above produces:

15, 15, 15, 20, 21, 25, 36

There are 7 scores and score #4 represents the halfway point. The median is 20. If there are an even number of observations, then the median is the mean of the two middle scores. In the example, if there were an 8th observation, with a value of 25, the median becomes the average of the 4th and 5th scores, in this case 20.5.

The mode is the most frequently occurring value in the set. To determine the mode, compute the distribution as above. The mode is the value with the greatest frequency. In the example, the modal value 15, occurs three times. In some distributions there is a "tie" for the highest frequency, i.e., there are multiple modal values. These are called multi-modal distributions.

Notice that the three measures typically produce different results. The term "average" obscures the difference between them and is better avoided. The three values are equal if the distribution is unimodal and symmetric (e.g. like the bell-shaped normal distribution).

**Dispersion**

Dispersion is the spread of values around the central tendency. There are two common measures of dispersion, the range and the standard deviation. The range is simply the highest value minus the lowest value. In our example distribution, the high value is 36 and the low is 15, so the range is \( 36 - 15 = 21 \).

The standard deviation is a more accurate and detailed estimate of dispersion because an outlier can greatly exaggerate the range (as was true in this example where the single outlier value of 36 stands apart from the rest of the values). The standard deviation shows the relation that set of scores has to the mean of the sample. Again let's take the set of scores:

15, 20, 21, 36, 15, 25, 15
to compute the standard deviation, we first find the distance between each value and the mean. We know from above that the mean is 21. So, the differences from the mean are:

\[15 - 21 = -6\]
\[20 - 21 = -1\]
\[21 - 21 = 0\]
\[36 - 21 = 15\]
\[15 - 21 = -6\]
\[25 - 21 = +4\]
\[15 - 21 = -6\]

Notice that values that are below the mean have negative differences and values above it have positive ones. Next, we square each difference:

\[(-6)^2 = 36\]
\[(-1)^2 = 1\]
\[(+0)^2 = 0\]
\[(15)^2 = 225\]
\[(-6)^2 = 36\]
\[(+4)^2 = 16\]
\[(-6)^2 = 36\]

Now, we take these "squares" and sum them to get the sum of squares (SS) value. Here, the sum is 350. Next, we divide this sum by the number of scores minus 1. Here, the result is \(350 / 6 = 58.3\). This value is known as the variance. To get the standard deviation, we take the square root of the variance (remember that we squared the deviations earlier). This would be \(\sqrt{58.3} = 7.63\).

Although this computation may seem convoluted, it’s actually quite simple. In English, we can describe the standard deviation as:

"the square root of the sum of the squared deviations from the mean divided by the number of scores minus one"

The standard deviation allows us to reach some conclusions about specific scores in our distribution. Assuming that the distribution of scores is close to "normal", the following conclusions can be reached:

- approximately 68% of the scores in the sample fall within one standard deviation of the mean
- approximately 95% of the scores in the sample fall within two standard deviations of the mean
- approximately 99% of the scores in the sample fall within three standard deviations of the mean
For instance, since the mean in our example is 21 and the standard deviation is 7.63, we can from the above statement estimate that approximately 95% of the scores will fall in the range of 21 − (2×7.63) to 21 + (2×7.63) or between 5.74 and 36.26. Values beyond two standard deviations from the mean can be considered "outliers". 36 is the only such value in our distribution. Outliers help identify observations for further analysis or possible problems in the observations. Standard deviations also convert measures on very different scales, such as height and weight, into values that can be compared.

Other statistics

In research involving comparisons between groups, emphasis is often placed on the significance level for the hypothesis that the groups being compared differ to a degree greater than would be expected by chance. This significance level is often represented as a p-value, or sometimes as the standard score of a test statistic. In contrast, an effect size conveys the estimated magnitude and direction of the difference between groups, without regard to whether the difference is statistically significant. Reporting significance levels without effect sizes is problematic, since for large sample sizes even small effects of little practical importance can be statistically significant.

Examples Of Descriptive Statistics

Most statistics can be used either as a descriptive statistic, or in an inductive analysis. For example, we can report the average reading test score for the students in each classroom in a school, to give a descriptive sense of the typical scores and their variation. If we perform a formal hypothesis test on the scores, we are doing inductive rather than descriptive analysis. Some statistical summaries are especially common in descriptive analyses. Some examples follow.

- Measures of central tendency
- Measures of dispersion
- Measures of association
- Cross-tabulation, contingency table
- Histogram
- Quantile, Q-Q plot
- Scatterplot
- Box plot
10. INFERENTIAL STATISTICS

Pearson's correlation coefficient

Definition

Pearson's correlation coefficient between two variables is defined as the covariance of the two variables divided by the product of their standard deviations:

\[ \rho_{X,Y} = \frac{\text{cov}(X, Y)}{\sigma_X \sigma_Y} = \frac{E[(X - \mu_X)(Y - \mu_Y)]}{\sigma_X \sigma_Y}, \]

The above formula defines the population correlation coefficient, commonly represented by the Greek letter \( \rho \) (rho). Substituting estimates of the covariances and variances based on a sample gives the sample correlation coefficient, commonly denoted \( r \):

\[ r = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2} \sqrt{\sum_{i=1}^{n}(Y_i - \bar{Y})^2}}. \]

An equivalent expression gives the correlation coefficient as the mean of the products of the standard scores. Based on a sample of paired data \((X_i, Y_i)\), the sample Pearson correlation coefficient is

\[ r = \frac{1}{n - 1} \sum_{i=1}^{n} \left( \frac{X_i - \bar{X}}{s_X} \right) \left( \frac{Y_i - \bar{Y}}{s_Y} \right) \]

where

\[ \frac{X_i - \bar{X}}{s_X}, \bar{X}, \text{ and } s_X \]
are the standard score, sample mean, and sample standard deviation, respectively.

Mathematical properties

The absolute value of both the sample and population Pearson correlation coefficients are less than or equal to 1. Correlations equal to 1 or -1 correspond to data points lying exactly on a line (in the case of the sample correlation), or to a bivariate distribution entirely supported on a line (in the case of the population correlation). The Pearson correlation coefficient is symmetric: \( \text{corr}(X,Y) = \text{corr}(Y,X) \).

A key mathematical property of the Pearson correlation coefficient is that it is invariant (up to a sign) to separate changes in location and scale in the two variables. That is, we may transform \( X \) to \( a + bX \) and transform \( Y \) to \( c + dY \), where \( a, b, c, \) and \( d \) are constants, without changing the correlation coefficient (this fact holds for both the population and sample Pearson correlation coefficients). Note that more general linear transformations do change the correlation.

The Pearson correlation can be expressed in terms of uncentered moments. Since \( \mu_X = \text{E}(X), \sigma_X^2 = \text{E}[(X - \text{E}(X))^2] = \text{E}(X^2) - \text{E}^2(X) \) and likewise for \( Y \), and since

\[
\text{E}[(X - \text{E}(X))(Y - \text{E}(Y))] = \text{E}(XY) - \text{E}(X)\text{E}(Y),
\]

the correlation can also be written as

\[
\rho_{X,Y} = \frac{\text{E}(XY) - \text{E}(X)\text{E}(Y)}{\sqrt{\text{E}(X^2) - (\text{E}(X))^2} \sqrt{\text{E}(Y^2) - (\text{E}(Y))^2}}.
\]

Alternative formulae for the sample Pearson correlation coefficient are also available:

\[
\tau_{xy} = \frac{\sum x_i y_i - n \bar{x} \bar{y}}{ns_x s_y} = \frac{n \sum x_i y_i - \sum x_i \sum y_i}{\sqrt{n \sum x_i^2 - (\sum x_i)^2} \sqrt{n \sum y_i^2 - (\sum y_i)^2}}.
\]

The above formula suggests a convenient single-pass algorithm for calculating sample correlations, but, depending on the numbers involved, it can sometimes be numerically unstable.

**Interpretation**

The correlation coefficient ranges from \(-1\) to \(1\). A value of \(1\) implies that a linear equation describes the relationship between \(X\) and \(Y\) perfectly, with all data points lying on a line for which \(Y\) increases as \(X\) increases. A value of \(-1\) implies that all data points lie on a line for which \(Y\) decreases as \(X\) increases. A value of \(0\) implies that there is no linear correlation between the variables.
More generally, note that \((X_i - X)(Y_i - Y)\) is positive if and only if \(X_i\) and \(Y_i\) lie on the same side of their respective means. Thus the correlation coefficient is positive if \(X_i\) and \(Y_i\) tend to be simultaneously greater than, or simultaneously less than, their respective means. The correlation coefficient is negative if \(X_i\) and \(Y_i\) tend to lie on opposite sides of their respective means.

Geometric interpretation

Regression lines for \(y = g_x(x)\) [red] and \(x = g_y(y)\) [blue]

For uncentered data, the correlation coefficient corresponds with the cosine of the angle \(\phi\) between both possible regression lines \(y = g_x(x)\) and \(x = g_y(y)\).

For centered data (i.e., data which have been shifted by the sample mean so as to have an average of zero), the correlation coefficient can also be viewed as the cosine of the angle \(\theta\) between the two vectors of samples drawn from the two random variables (see below).

Some practitioners\[who?] prefer an uncentered (non-Pearson-compliant) correlation coefficient. See the example below for a comparison.

As an example, suppose five countries are found to have gross national products of 1, 2, 3, 5, and 8 billion dollars, respectively. Suppose these same five countries (in the same order) are found to have 11%, 12%, 13%, 15%, and 18% poverty. Then let \(x\) and \(y\) be ordered 5-element vectors containing the above data: \(x = (1, 2, 3, 5, 8)\) and \(y = (0.11, 0.12, 0.13, 0.15, 0.18)\).

By the usual procedure for finding the angle \(\theta\) between two vectors (see dot product), the uncentered correlation coefficient is:

\[
\cos \theta = \frac{x \cdot y}{\|x\| \|y\|} = \frac{2.93}{\sqrt{103}\sqrt{0.0983}} = 0.920814711.
\]
Note that the above data were deliberately chosen to be perfectly correlated: \( y = 0.10 + 0.01 \, x \). The Pearson correlation coefficient must therefore be exactly one. Centering the data (shifting \( x \) by \( \mathbb{E}(x) = 3.8 \) and \( y \) by \( \mathbb{E}(y) = 0.138 \)) yields \( x = (-2.8, -1.8, -0.8, 1.2, 4.2) \) and \( y = (-0.028, -0.018, -0.008, 0.012, 0.042) \), from which

\[
\cos \theta = \frac{x \cdot y}{\|x\| \|y\|} = \frac{0.308}{\sqrt{30.8} \sqrt{0.00308}} = 1 = \rho_{xy},
\]

as expected.

**Interpretation of the size of a correlation**

Several authors\(^{[4][5]} \) have offered guidelines for the interpretation of a correlation coefficient. However, all such criteria are in some ways arbitrary and should not be observed too strictly.\(^{[5]} \) The interpretation of a correlation coefficient depends on the context and purposes. A correlation of 0.9 may be very low if one is verifying a physical law using high-quality instruments, but may be regarded as very high in the social sciences where there may be a greater contribution from complicating factors. Inference

<table>
<thead>
<tr>
<th>Correlation</th>
<th>Negative</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>−0.09 to 0.0</td>
<td>0.0 to 0.09</td>
</tr>
<tr>
<td>Small</td>
<td>−0.3 to −0.1</td>
<td>0.1 to 0.3</td>
</tr>
<tr>
<td>Medium</td>
<td>−0.5 to −0.3</td>
<td>0.3 to 0.5</td>
</tr>
<tr>
<td>Strong</td>
<td>−1.0 to −0.5</td>
<td>0.5 to 1.0</td>
</tr>
</tbody>
</table>

A graph showing the minimum value of Pearson's correlation coefficient that is significantly different from zero at the 0.05 level, for a given sample size.

Statistical inference based on Pearson's correlation coefficient often focuses on one of the following two aims. One aim is to test the null hypothesis that the true correlation coefficient \( \rho \) is equal to 0, based on the value of the sample correlation coefficient \( r \). The other aim is to construct a confidence interval around \( r \) that has a given probability of containing \( \rho \).
11. EXPERIMENTAL RESEARCH

Experimental (Quantitative)

a. True Experiment
b. Quasi-Experiment
c. Meta-Analysis (pre-experimental)

From Lauer and Asher, *Composition Research: Empirical Designs* and MacNealy, *Empirical Research in Writing*

1. Assessing Methods
   a. Research Question(s) is/are key
   b. Methods must answer the research question(s)
   c. Methodology guides application
   d. Epistemology guides analysis
   e. All must include “rigor”

2. Quantitative Descriptive Studies
   a. Isolates systematically the most important variables (often from case studies) and to quantify and interrelate them (often via survey or questionnaire)
   b. Possible to collect large amounts of data
   c. Not as disruptive
   d. Biases not as likely
   e. Data restricted to information available

3. Experimental Research: True Experiment
   a. Random sampling, or selection, of subjects (which are also stratified)
   b. Introduction of a treatment
   c. Use of a control group for comparing subjects who don’t receive treatment with those who do
   d. Adherence to scientific method (seen as positive, too)
   e. Must have both internal and external validity
   f. Treatment and control might seem artificial

6. Meta-Analysis
   a. Takes the results of true and quasi-experiments and identifies interrelationships of conclusions
   b. Systematic
   c. Replicable
   d. Summarizes overall results
   e. C/C apples and oranges?
   f. Quality of studies used?
4. Problems with Experimental Research
   a. Generalizations need to be qualified according to limitation of research methods employed
   b. Controlled settings don’t mirror actual conditions; unnatural
   c. Difficult to isolate a single variable
   d. Doesn’t allow for self-reflection (built-in)
   e. Generalizations need to be qualified according to limitation of research methods employed
   f. Controlled settings don’t mirror actual conditions; unnatural
   g. Difficult to isolate a single variable
   h. Doesn’t allow for self-reflection (built-in)

5. What Makes Research Good?
   a. Validity
   b. Reliability
   c. Replicability
   d. Consistent application/analysis
   e. “Trustworthiness”
   f. Rigor

6. Validity in Research
   a. Refers to whether the research actually measures what it says it’ll measure. Validity is the strength of our conclusions, inferences or propositions.
   b. **Internal Validity**: the difference in the dependent variable is actually a result of the independent variable
   c. **External Validity**: the results of the study are generalizable to other groups and environments outside the experimental setting
   d. **Conclusion Validity**: we can identify a relationship between treatment and observed outcome
   e. **Construct Validity**: we can generalize our conceptualized treatment and outcomes to broader constructs of the same concepts

7. Validity and Reliability
   The relationship between reliability and validity is a fairly simple one to understand: a measurement can be reliable, but not valid. However, a measurement must first be reliable before it can be valid. Thus reliability is a necessary, but not sufficient, condition of validity. In other words, a measurement may consistently assess a phenomena (or outcome), but unless that measurement tests what you want it to, it is not valid.

8. Rigor in Research
   a. Validity and Reliability in conducting research
   b. Adequate presentation of findings: consistency, trustworthiness
   c. Appropriate representation of study for a particular field: disciplinary rigor
   d. Rhetorical Rigor: how you represent your research for a particular audience
Research Design
A researcher working within this methodology creates an environment in which to observe and interpret the results of a research question. A key element in experimental research is that participants in a study are randomly assigned to groups. In an attempt to create a causal model (i.e., to discover the causal origin of a particular phenomenon), groups are treated differently and measurements are conducted to determine if different treatments appear to lead to different effects.

Assumptions

Experimental research is usually thought to be generalizable. This methodology explores cause/effect relationships through comparisons among groups (Lauer & Asher 152). Since participants are randomly assigned to groups, and since most experiments involve enough individuals to reasonably approximate the populations from which individual participants are drawn, generalization is justified because "over a large number of allocations, all the groups of subjects will be expected to be identical on all variables" (155).

Example

A simplified example: Six composition classrooms are randomly chosen (as are the students and instructors) in which three instructors incorporate the use of electronic mail as a class activity and three do not. When students in the first three classes begin discussing their papers through e-mail and, as a result, make better revisions to their papers than students in the other three classes, a researcher is likely to conclude that incorporating e-mail within a writing classroom improves the quality of students' writing.

Results

Although experimental research is based on cause/effect relationships, "certainty" can never be obtained, but rather results are "probabilistic" (Lauer and Asher 161). Depending on how the researcher has presented the results, they are generalizable in that the students were selected randomly. Since the quality of writing improved with the use of e-mail within all three classrooms, it is probable that e-mail is the cause of the improvement. Readers of this study would transfer the results when they sorted out the details: Are these students representative of a group of students with which the reader is familiar? What types of previous writing experiences have these students had? What kind of writing was expected from these students? The researcher must have provided these details in order for the results to be transferable.

12. 12-14 STUDENT’S PRESENTATION
References


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**ADDITIONAL EXPLANATION**

**The T-Test**

The t-test assesses whether the means of two groups are statistically different from each other. This analysis is appropriate whenever you want to compare the means of two groups, and especially appropriate as the analysis for the posttest-only two-group randomized experimental design.

![Figure 1. Idealized distributions for treated and comparison group posttest values.](image-url)
Figure 1 shows the distributions for the treated (blue) and control (green) groups in a study. Actually, the figure shows the idealized distribution -- the actual distribution would usually be depicted with a histogram or bar graph. The figure indicates where the control and treatment group means are located. The question the t-test addresses is whether the means are statistically different.

What does it mean to say that the averages for two groups are statistically different? Consider the three situations shown in Figure 2. The first thing to notice about the three situations is that the difference between the means is the same in all three. But, you should also notice that the three situations don't look the same -- they tell very different stories. The top example shows a case with moderate variability of scores within each group. The second situation shows the high variability case. the third shows the case with low variability. Clearly, we would conclude that the two groups appear most different or distinct in the bottom or low-variability case. Why? Because there is relatively little overlap between the two bell-shaped curves. In the high variability case, the group difference appears least striking because the two bell-shaped distributions overlap so much.

![Figure 2. Three scenarios for differences between means.](image)

This leads us to a very important conclusion: when we are looking at the differences between scores for two groups, we have to judge the difference between their means relative to the spread or variability of their scores. The t-test does just this.

**Statistical Analysis of the t-test**

The formula for the t-test is a ratio. The top part of the ratio is just the difference between the two means or averages. The bottom part is a measure of the variability or dispersion of the scores. This formula is essentially another example of the signal-to-noise metaphor in research: the difference between the means is the signal that, in this case, we think our program or treatment introduced into the data; the bottom part of the formula is a measure of variability that is essentially noise that may make it harder to see the group difference. Figure 3 shows the formula for the t-test and how the numerator and denominator are related to the distributions.
The top part of the formula is easy to compute -- just find the difference between the means. The bottom part is called the **standard error of the difference**. To compute it, we take the variance for each group and divide it by the number of people in that group. We add these two values and then take their square root. The specific formula is given in Figure 4:

$$SE(\bar{x}_T - \bar{x}_C) = \sqrt{\frac{var_T}{n_T} + \frac{var_C}{n_C}}$$

Figure 4. Formula for the Standard error of the difference between the means.

Remember, that the variance is simply the square of the **standard deviation**.

The final formula for the t-test is shown in Figure 5:

$$t = \frac{\bar{x}_T - \bar{x}_C}{\sqrt{\frac{var_T}{n_T} + \frac{var_C}{n_C}}}$$

Figure 5. Formula for the t-test.
The t-value will be positive if the first mean is larger than the second and negative if it is smaller. Once you compute the t-value you have to look it up in a table of significance to test whether the ratio is large enough to say that the difference between the groups is not likely to have been a chance finding. To test the significance, you need to set a risk level (called the alpha level). In most social research, the "rule of thumb" is to set the alpha level at .05. This means that five times out of a hundred you would find a statistically significant difference between the means even if there was none (i.e., by "chance").

You also need to determine the degrees of freedom (df) for the test. In the t-test, the degrees of freedom is the sum of the persons in both groups minus 2. Given the alpha level, the df, and the t-value, you can look the t-value up in a standard table of significance (available as an appendix in the back of most statistics texts) to determine whether the t-value is large enough to be significant. If it is, you can conclude that the difference between the means for the two groups is different (even given the variability). Fortunately, statistical computer programs routinely print the significance test results and save you the trouble of looking them up in a table.

The t-test, one-way Analysis of Variance (ANOVA) and a form of regression analysis are mathematically equivalent (see the statistical analysis of the posttest-only randomized experimental design) and would yield identical results.

QUESTIONS

I. Introduction
   1. What is the objective of quantitative research?
   2. The differences between quantitative research? and qualitative research.
   3. How many kinds of quantitative research? Mention!
   4. What about qualitative research? There are also some kinds of it, try to mention and explain them!
   5. There are some problems of experimental research, what are they? Elaborate your answer!
   6. Mention some of the requirements of becoming a good research!
   7. How many validity are there in a research? Explain!
   8. What is the synonym of rigor?

II. Research Types and Design
   1. Mention all the types of research!
   2. Explain three of them using your own words!
   3. What types of research are appropriate for language learning?
   4. There are 8 types of research design from Nunan. How many paradigms do you know and clear enough to elaborate them?
   5. There major components of research design, what are they?
6. Explain one shot case study based on your understanding!

IV. Research variables
1. What is variable?
2. How many kinds of variable? Explain each of them!
3. Make a research title which have variables!
4. Analyse the variables!
5. Why they have different types of variable?
6. What is the function of moderator variable?
7. Why in a research usually the researcher just want to have two variables? What are they?
8. The relationship between students’ emotional question and their ability in reaching their expectation in life: a case study in offices the alumnae of English Department of UMP in 2012. Analyse the title! Is it appropriate to be the quantitative research title
9. Find another appropriate titles!

V. Population and Sample
1. What is population?
2. Sample is…..
3. How many sampling technique are there? Mention!
4. How many are there in probability sampling?
5. What about non probability sampling?
6. Can you give illustration how to have snowball sampling?
7. Why saturated sampling is used?
8. Refer to no 7 what is the indonesian words?

VI. Research Instrument
1. How many kinds of instrument?
2. Which instrument that you have ever used?
3. Why do you use that?
4. Can you make use of interview to measure ability?
5. Why? Why not?
6. Make five questions to test about structure!
7. How to make a good distractor?
8. In having interview can you record it using tape recorder? After recording what will you do?
9. How to give point for essay questions? Give me your explanation!
10. What is questionnaire?
11. What must not you do if you use document in your research as the instrument?
VII. Analysis
1. What are included in descriptive statistics?
2. Find the mean of the list of students’ mark
   78 98 76 65 75 68 77 81 75 66 71 67 73 69 77
3. Then find the mode and median
4. How to test the hypothesis?
5. What is null hypothesis and alternative hypothesis?
6. What is the use of point estimation?
7. What is the use of t-test?
8. What do you use if there are more than one independent variables?
9. In finding difference why the hypothesis is rejected?
10. For the social we use 5% significance level, why?

VIII. Hypothesis
1. What is hypothesis?
2. What are the purposes of hypothesis?
3. The advantages of hypothesis are…
4. Mention the characteristics of hypothesis!
5. How many forms of hypothesis?
6. Give some examples of hypothesis!

IX. Descriptive Statistics
1. What are included in central tendency?
2. How to calculate mean?
3. How to get mode and median?
4. What is dispersion?
5. What are the measures of dispersion?
6. What are the differences between dispersion and standard deviation?
7. Mention some examples of descriptive statistics!

X. Inferential Statistics
1. Inferential Statistics can be used to find hypothesis, how it can be happened?
2. Before doing this statistics what must the researcher do?
3. There some test analysis which can be used to test the comparison, difference and effectiveness, when you have one independent variable what test will you use?
4. There are two popular correlation, what are they?
5. What are the differences between the two?
6. What are the formula for correlation product moment?
7. How will you read it in English?
8. \( \sum = \) it can be read as….
9. \( \sqrt{} = \) it is read ….
10. \( x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \) is read….
11. The highest correlation is….