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Course: Research Methods II

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Chapters 10 to 15

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Research Methods II

Section Four

Testing The Research Hypothesis

Research Methods II

Testing the hypothesis: Empirical verification of the relationship between the variables (collecting and analyzing the data)

Research Methods II

Chapter 10

Techniques of Data Collection

Research Methods II

Two important factors in data collection:

1. Sampling (from whom we collect the data)
2. Ethics (how to collect)

Research Methods II

- Data can be qualitative or quantitative.
- Qualitative words few, small, large, happy, competent)
- Quantitative words (size, frequency)

Research Methods II

Qualitative data should be translated into quantitative data:

1. **To be measurable**
2. **To be processed statistically**

Research Methods II

- From whom should we collect the data?
- If the population is too large, we should do sampling.

Research Methods II

- Population (universe) includes all the members of a unit (the size of population is relative).

Research Methods II

- Collecting data from the whole population is time and energy consuming and also very costly.

Research Methods II

What is the solution?

Instead of working on the population, we collect data on a number of representative members (sample).

Research Methods II

- Representative criterion:
- The sample should reflect the characteristics of the population.

Research Methods II

Randomization (the first sampling technique): the process by which every single member of a population is given an equal chance to be included in the sample (≠bias).

Research Methods II

Random samples:

1. **Simple random sampling**
2. **Systematic random sampling (for large populations, every nth subject is selected)**

Research Methods II

3. Stratified random sampling:

It takes the proportion of the subjects into account, so it is more representative and advantageous over simple random sampling.

Research Methods II

4. Cluster sampling: It is based on selecting larger units instead of individuals. As in selecting groups of freshmen from the universities in Tehran.

Research Methods II

Meeting the Representative Criterion is important. Why?

Because it helps us generalize the findings for the whole population.

Research Methods II

Non-Random samples are used when randomization is not possible. The data from non-random samples are not as valid/representative as the data from random samples.

Research Methods II

Non-Random Samples:

1. Accidental or availability samples: Selecting those available and willing to participate (person-on-the-street interview)

Research Methods II

2. Purposive sampling: Obtaining a certain type of members with pre-determined characteristics (selecting subjects from the already known people).

Research Methods II

- Deciding on the sample size depends on a number of factors: energy, cost, time, nature of research but the larger the better.

Research Methods II

- How large should the sample be?
- In educational settings, samples of 30 or more are large enough.

Research Methods II

- Ethics in research:
- If subjects are human beings, they have different attitudes, personalities, beliefs, backgrounds, nationalities, …

Research Methods II

- Eliciting information from unwilling subjects is unethical and the results are surely invalid.

Research Methods II

Ethical considerations (3):

1. **Anonymity**
2. **Privacy: freedom to answer questions on private matters.**
3. **Confidentiality**

Research Methods II

To do research, certain instruments are used:

1. Questionnaire
   A. Open-ended
   B. Closed

Research Methods II

Open-ended questionnaires have two problems:

1. Written replies are difficult to categorize, analyze and interpret.
2. The responses may not be valid.

Research Methods II

Closed (structured) questionnaire:

1. The choices are uniform

2. The questions are easy to answer

Research Methods II

Closed-ended questionnaires (problems):

1. The respondents almost have no freedom in answering the questions
2. The researchers bias influences the choices

Research Methods II

- The compromise between the two may be ideal: open-ended questions are classified and categorized.

Research Methods II

Distributing the questionnaire:

1. **Direct method: referring directly to the respondents**
2. **Indirect method: through mail (it can cover a large range of subjects)**

Research Methods II

Guidelines for constructing a questionnaire:

1. There should be a theory behind it

2. Clarity and wording are essential

Research Methods II

3. The ordering of the questions is critical from simple, interesting and neutral items to more difficult and personal)

Research Methods II

4. The content matters a lot. The questions should not be threatening and they should elicit honest responses and relevant to the subjects' area of interest.

Research Methods II

Observation (research instrument):

1. Direct **2. Indirect**

Important points: objectivity, consistency in observations and impartiality

Research Methods II

Interview:

1. Structured
2. Unstructured

Research Methods II

Tests (research instrument)

Two important concepts are:

1. Validity
2. Reliability

Research Methods II

Validity:

The extent to which a test is measuring what it is supposed to measure.

Research Methods II

Types of Validity:

1. Content validity

2. Concurrent validity

3. Predictive validity

4. Construct validity

Research Methods II

- Content validity (logical or curricular validity):
- Correspondence between the content of the test and the materials to be tested.

Research Methods II

Concurrent Validity:

The degree to which the scores on a test are related to or correlated with the scores on another already established test given at the same time.

Research Methods II

- **Predictive Validity:**
- **The extent to which a test can predict how well an individual will perform on a future situation.**

Research Methods II

- Construct Validity:
- The extent to which a test measures an intended hypothetical construct (ability or trait such as intelligence, reading ability)

Research Methods II

- Constructs are mainly unobservable and manifested through behavior.

Research Methods II

- Reliability (consistency):
- The degree to which a test consistently measures whatever it measures.

Research Methods II

- Reliability is consistency of scores over time.
- Ways of establishing reliability: test-retest; parallel forms; split half; rational equivalence

Research Methods II

- Inventories:
- They are not tests but instruments to obtain information on one or more aspects of an individuals behavior (interest, attitude, …).

Research Methods II

- Likert scale is a scale used often in Inventories (strongly agree-agree-undecided-disagree-strongly agree)

Research Methods II

- Here the subjects may give socially acceptable responses. To avoid this, we can use Projective measures.

Research Methods II

- The purpose of the test is not clear to the respondent in Projective measures (mainly used in psychology).

Research Methods II

CHAPTER 11

Summarizing the Data

Research Methods II

- To organize the data, the first step is summarizing the data without losing any important piece of information.

Research Methods II

Summarizing the data includes:

1. **Coding the data**
2. **Performing simple numerical computations**
3. **Displaying the data in graphic form**

Research Methods II

- Coding the data:
- Data re coded differently on nominal, ordinal and interval scales (chapter 6).

Simple Numerical Computations

1. Simple frequency
2. Relative frequency
3. percentage
4. Cumulative frequency
5. Relative cumulative frequency
6. Percentile

Research Methods II

- Simple frequency:
- Counting the number of times a particular score has occurred in the data (absolute frequency = f).

X: score	Tally	f: absolute frequency
10	////	4
9	/////	6
8	///// ////	9

Research Methods II

- To make the absolute frequency more meaningful, the total number of scores should be taken into consideration.

Research Methods II

- When the number of absolute frequency is adjusted by taking the total number of scores into account, the outcome is called relative frequency (proportion).

$$rf = \frac{f \text{ (absolute f.)}}{N \text{ (total number of scores)}}$$

X	f	computations	r f
10	4	4/100 =.04	.04
9	6	6/100 =.06	.06

Research Methods II

To check the accuracy of the proportions, or rfs, the sum of rfs should equal 1 ($\Sigma r f = 1$)

Research Methods II

Percentage:

The number of occurrence of a score on the scale of 100 [p = rf (100) or p = f/N (100) because rf = f/N].

Research Methods II

To check the accuracy of the computations, the sum of the percentages should equal 100 ($\Sigma p = 100$). Remember: $\Sigma r f = 1$

Research Methods II

Up to now, we can say:

1. How many and what percentage of people obtained a score
2. How many and what percentage of people obtained the minimum and maximum scores.

Research Methods II

3. What the most frequent score is and how many people obtained it.

Research Methods II

Cumulative frequency (F):

shows the standing of a particular score within a group of scores.

Research Methods II

To check the accuracy of the computations, the value of the highest cumulative frequency should equal 100. If F = 100, how do we interpret it?

Research Methods II

If F equals 100, it means that all the subjects scored below the score corresponding to 100, i. e., 10 (table 11.5 p. 244)

Research Methods II

Relative Cumulative Frequency (RF)

To calculate RF, Cumulative Frequencies (F) are divided by N (in this case 100) → RF = F/N

Research Methods II

Percentile (P): relative cumulative frequency is multiplied by 100. Percentile scores show the rank of the subjects or scores on a scale of 100.

Research Methods II

What does the percentile rank of 100 mean?

It means 100 percent of scores fall at or below that score.

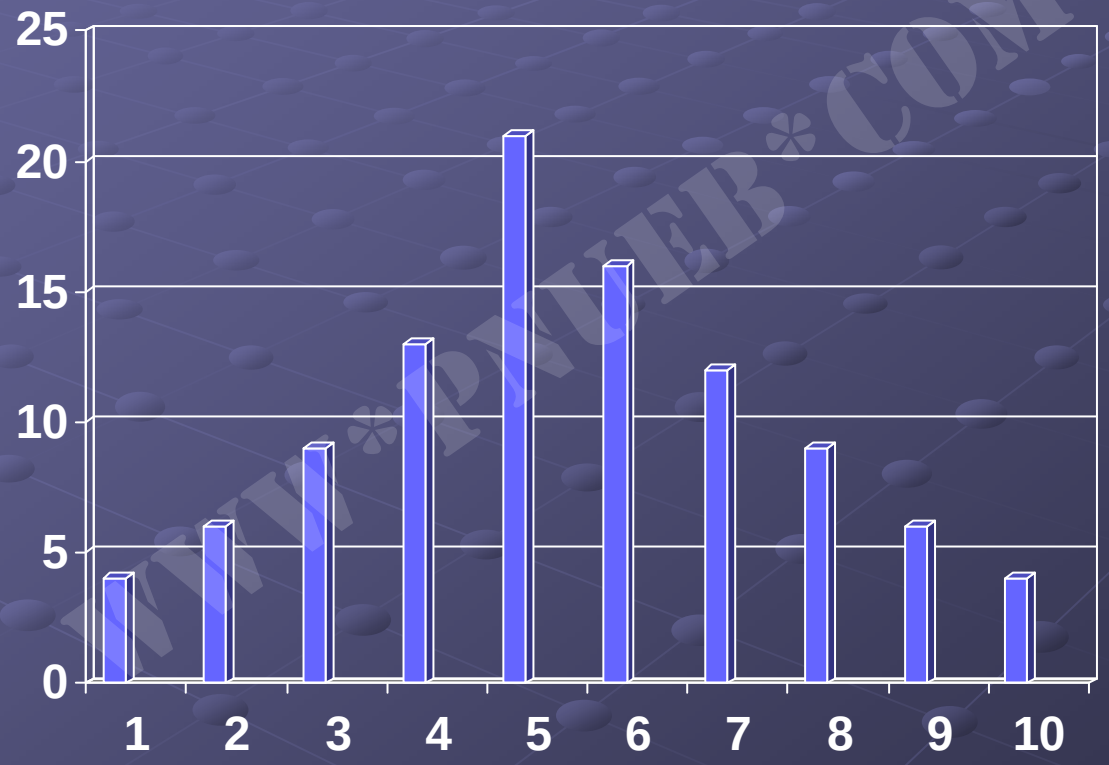
Research Methods II

What does it mean if one gets a percentile rank of 80?

It means that he scored higher than 79 percent of the subjects and lower than 19 percent of them.

Research Methods II

- Displaying the data: to show the data, the first step is displaying them in tables, the second step is summarizing the data on graphs.



Research Methods II

- Mode is the most frequent score in a polygon. Different shapes may be formed based on the place and number of modes.

Research Methods II

1. Unimodal distribution
2. Bimodal distribution
3. skewed distribution

Research Methods II

- Negatively skewed: (a few low scores cause the skewedness)
- Positively skewed: (a few high scores cause the skewedness)

Research Methods II

- Flat distribution happens when no score is obtained more frequently than the other scores.

Research Methods II

CHAPTER 12
DESCRIBING THE DATA

Research Methods II

Describing the data:

A set of procedures which lead to finding certain figures showing the data accurately and briefly.

Research Methods II

The most useful figures are:

1. Measures of central tendency

2. Measures of variability

Research Methods II

Measures of central tendency:

Numbers toward the center of the distribution would be better representatives of the scores

Research Methods II

- Most of the scores tend to fall around the center of the distribution. This is called central tendency.

Research Methods II

Measures of central tendency:

1. Mode
2. Median
3. Mean

The Mode:

The most frequently obtained score in the distribution (around the peak of the distribution).

1 2 2 3 3 3 **4444** 5 5 5 6 6 7

Research Methods II

Limitations of the Mode:

1. **When the scores are not many, a shift in one or two scores changes the mode.**
2. **For flat distributions, mode is useless.**

The Median:

The point or score value which falls at the 50th percentile of a distribution.

Research Methods II

- The Median is useful for skewed or asymmetric distributions. The Median is not sensitive to extreme scores (figures on p. 265).

The best way to calculate the median is to arrange scores from high to low:

10 9 9 8 **8** 8 7 7 6

When the number of scores is not odd, the average of the two scores in the middle will be the median:

10 10 9 9 8 8 7 6 6 5 4 4

Research Methods II

The Mean or Average (the most basic and frequent measure):

The sum of the scores divided by the total number of scores.

$$\bar{X} = X1+X2+X3+ \ldots + X\ n/N$$

Or $$\bar{X} = \Sigma X / N$$

Research Methods II

The mean is the balance point of the scores: the algebraic sum of the differences of all scores from the mean is zero: $\Sigma (X - X \text{ bar}) = 0$

(look at page 267)

Research Methods II

- The problem with the mean is that it is very sensitive to extreme scores if the number of scores is not many.

Research Methods II

In skewed distribution, mean is not a good representation of the data (here median is a better measure). If the scores are distributed symmetrically, the mean is the best measure.

Research Methods II

- In bell shaped or symmetrical distributions, Mode, Median and Mean are the same (page 270).

Research Methods II

- The scatteredness of the scores around the mean is another important feature of distribution referred to dispersion of the scores or variability.

Research Methods II

Measures of Variability:

1. range
2. Variance
3. Standard Deviation

Research Methods II

- The greater the differences between the scores, the more spread or scattered the scores are in the distribution.

Research Methods II

The Range:

The difference between the highest and lowest scores:

Range = X highest – X lowest

Research Methods II

- The range is not very reliable since it is very sensitive to maximum and minimum scores. It depends on two extreme scores in the distribution.

Research Methods II

The Standard Deviation:

It applies to the variability of all the scores in a distribution. It is sensitive to all scores (as opposed to the Range).

Research Methods II

- Variation of scores is considered the distance of scores from the central point (mean).

Research Methods II

- In the discussion of the mean we said that the sum of the differences from the mean equals zero. To solve the problem, we square the deviations.

S	X	X - Xbar	$(X - Xbar)^2$
1	2	2 – 4 = - 2	+ 4
2	4	4 – 4 = 0	0
3	6	6 – 4 = + 2	+ 4
			Σ = + 8

Research Methods II

Degree of freedom refers to one piece of information which does not contribute to the computations.

The variance:

Square of the standard deviation:

$$V = S^2$$

Research Methods II

CHAPTER 13
STANDARD SCORES

Research Methods II

Raw scores can not be interpreted, nor can they be compared.

What should we do?

Research Methods II

In order to make scores comparable, we have to convert them into a single score.

This score is called a standard score.

Research Methods II

- Standard scores should be independent of the scales from which the raw scores are obtained.

Research Methods II

The normal distribution:

Normal distribution with large data is bell-shaped and symmetric with the most frequently occurred scores in the middle (p. 286).

Research Methods II

- In a normal distribution (hypothetical, abstract, mathematical idealization), the mode, median and mean fall on the same point (in the middle).

Research Methods II

Properties of a normal distribution:

Data based distributions approximate the properties of the normal distribution.

Research Methods II

1. A normal distribution is unimodal. The greater the distance between an obtained score and the mean, the smaller the frequency of that score.

Research Methods II

What is the most frequent score in a normal distribution?

The one which falls on the mean of the distribution.

Research Methods II

2. A normal distribution is symmetric. The two sides of the distribution from the mean are equal in shape and frequency.

Research Methods II

3. The third property results from the first two: the mode, median and mean are equal in value because of symmetry and bell-shape.

Research Methods II

This issue is important in determining the percentage of scores around the mean.

Research Methods II

4. A normal distribution is asymptotic. The curves never meet the horizontal line.

Research Methods II

It means that the normal distribution is continuous for all values of a variable from + infinite to – infinite.

Research Methods II

- Nearly one third (34.13%) of scores fall between the mean and 1 SD above/below the mean.

Research Methods II

- 96% of the scores fall between two standard deviations above and 2 SDs below the mean (p. 288) .

Research Methods II

Standard scores:

Different tests have different means and SDs. TOEFL has the mean of 500 and SD of 100.

Research Methods II

- Standard scores show the relative position of raw scores in the distribution independent of the mean and SD of raw scores.

Research Methods II

- Raw scores are not comparable but standard scores are because they are on the same scale.

Research Methods II

- Z score is one of the best standard scores. It takes the mean and SD of the raw score into account.
- Z = X – Xbar / S

Research Methods II

- When the raw scores are converted into Z scores, the Z values can be plotted to construct a frequency distribution called Z distribution.

Research Methods II

Z distribution contains three features:

1. The magnitude of Z indicates how many SDs a raw score is above or below the mean (Z is positive or negative).

Research Methods II

2. The mean of Z distribution is always Zero (X bar z = 0) .
3. The standard deviation and variance of the scores are the same and equal 1.

Research Methods II

Transferring the raw score into Z score does not change the shape of the distribution. A skewed distribution of raw scores will lead to a skewed distribution of Z scores.

Research Methods II

- By converting raw scores into z scores we can compare the raw scores (p. 290-293).

Research Methods II

- The emotional problem of announcing Z scores: an average person may get 500 on TOEFL so his Z score is 0. this is very embarresing (Z = 500 – 500 / 100 = 0).

How do we calculate the raw score from the Z score?

$$Z = X - X\ bar / S \rightarrow X - X\ bar = Z\ (S)$$

$$\rightarrow X = X\ bar + Z\ (S)$$

A person's Z score is 0 in TOEFL and the X bar of this test is 500 and SD is 100, what is his raw score?

$X = X\ bar + Z\ (S) = 500 + 0\ (100) = 500$

Most IQ tests have the X bar of 100 and SD of 10, so a Z score of zero means the IQ of 100: X = X bar + Z (S) → X = 100 + 0 (10) = 100

Research Methods II

What does it mean if one gets 550 on TOEFL?

Because 1 SD is 100 so his score is half an SD above the Mean (p. 388).

Research Methods II

SECTION FIVE
INFERENTIAL STATISTICS

Research Methods II

- Researchers are interested in describing the characteristics of the population from which the sample is taken.

Research Methods II

- The goal of research is to describe, predict and explain phenomena.

Research Methods II

There are two approaches to statistics:

1. Descriptive
2. Inferential

Research Methods II

- Descriptive statistics refers to analysing, describing and interpreting the data obtained from a sample.

Research Methods II

- Inferential statistics refers to techniques used to generalize the findings from a sample to the population.

Research Methods II

Any characteristic determined through descriptive statistics is called a statistic.

Any characteristic determined through inferential statistics is called a parameter.

Research Methods II

- The mean and SD of a sample are statistics while those of a population are parameters. We make inferences from sample statistics to population parameters.

Descriptive statistics

Sample

Statistic

Inferential statistics

population

Parameter

Research Methods II

- Since we do not have access to the whole population, we make estimations about population parameters.

Research Methods II

- Inferential statistics deals with the world of probability (errors are inevitable in making inferences).

Research Methods II

CHAPTER 14

PROBABILITY AND HYPOTHESIS TESTING

Research Methods II

- The researcher is interested in finding the results of hypothesis testing in new situations.

Research Methods II

- Inferential statistics is used to make generalizations about the population.

Research Methods II

- The researchers make a probabilistic statement that the hypothesis is supported.

Research Methods II

- In order to make probabilistic statements, we should be familiar with the concept of probability and its applications in data analysis.

Research Methods II

We make probabilistic staements in everyday life:

A. about the weather condition

B. about our daily activities

C. about the test results, …

Research Methods II

There are two kinds of prediction:

1. based on feeling and hunch
2. based on information. The more information, the stronger the prediction.

Research Methods II

- Predictions are made on the basis of available information but every prediction ha a certain degree of probability to hold true.

Research Methods II

- As the number of occurrence increases and approaches infinity, the out come will approximate normal distribution.

Research Methods II

For example, what is the possibility of giving a correct answer to a true false item?

It is %50 in two events (the desired and undesired events).

Research Methods II

What is the number of possible events on a 20 four-choice-item test?

It is 80, twenty of them are desired events.

Research Methods II

- Probability of an event (p) = number of desired events / number of possible outcomes (for one true false item: p = 1 / 2 = .5)

Research Methods II

- What is the probability of getting a score correspondent to the mean?
- It is very high because the mean is in the middle of the normal curve with the highest frequency.

Research Methods II

- The more distant a given score from the mean, the less the probability of that score belonging to the distribution.

Research Methods II

- To determine the probability of a score quantitatively, the raw score should be converted into a Z score which should be interpreted on the basis of the probability distribution.

Research Methods II

If a raw score is 24, the mean is 20 and SD is 4, what is the probability of having the score of 24?

Z = (24 – 20) / 4 = +1 and we know that Z = +1 means percentile rank of 84 and the area beyond the Z of 1 is 16% so the probability of having 24 is 16% (p. 314).

Research Methods II

What is the probability of getting the raw score of 28?

Since the Z = +2, the percentile rank is 98 and the probability is only 2 percent (appendix 1, p. 388).

Research Methods II

- With greater scores the Z score is higher and the probability of such scores would decrease (appendix 1, p. 388)

Research Methods II

- The scores corresponding to the Z of +1 or -1 would have the same probability because the Z distribution is symmetric.

Research Methods II

- What is the probability of a certain mean score belonging to a certain population?
- The population mean is represented by μ (mew) and the SD is σ (sigma).

If μ = 500; Xbar = 520 and Sx = 100, what is the probability of this particular group belonging to the population? (pages 316-319).

Research Methods II

Hypothesis testing:

Whether a score belongs to a population or not or whether a group belongs to a population or not (320-324).

Research Methods II

- Testing directional and nondirectional hypothesis:
- Directional (either positive or negative).
- Nondirectional/null (no relationship)

Research Methods II

- Making a directional hypothesis is more demanding since we should strong evidence to support a directional hypothesis but it is easier to test (p. 325).

	Probability level	$\alpha = .05$	$\alpha = .01$
Z >1.64/2.33 Support	Directional One-tailed	1.64	2.33
Z >1.96/2.58 Rejection	Nondirectional Two-tailed	1.96	2.58

Research Methods II

CHAPTER 15

COMPARING THE MEANS

Research Methods II

- Researchers are also interested in determining the significance of a difference between two sample means and making generalizations.

Research Methods II

We used Z values for large samples, for small samples we need t values (when the sample becomes large enough >120 the t and Z values become identical).

Research Methods II

Testing the difference between two means:

Pages 338-343

Research Methods II

Degrees of freedom:

Pages: 344-346

Research Methods II

- Matched T-Test:
- If the scores on two variables are obtained from one group (pages 347-351)

Research Methods II

Assumptions underlying T-Test:

1. the scores are measured on an interval scale (not nominal or ordinal).

2. every subject should be assigned only to one group in independent group t-test.

Research Methods II

3. every subject's score must be independent of any other subject's score.
4. the scores should be approximately normally distributed.

Research Methods II

- **Note: the most important assumption is that the t-test is used to compare the means of *only* two groups.**

Research Methods II

When there are more than two groups, the acceptable number of comparisons is

K – 1: when there are three groups only two comparisons are possible.

Research Methods II

Chapter 16
Writing the Research Paper

Research Methods II

- The results of research should be reported to inform the other scholars and students of what you have done. This is done to expand the territory of knowledge.

Research Methods II

- The typical format of a journal article

1. Preliminaries
2. Abstract
3. Introduction
4. Method
5. Results
6. Discussion
7. References

Research Methods II

- Preliminaries include:

1. The cover page (see the samples in the book)
2. The table of content page
3. The abstract page (a summary of the entire journal article

Research Methods II

- The abstract normally includes (1) a statement of the purpose (2) a description of the participants (subjects) (3) an explanation of what the subjects did during the research process, and (4) important results (all in one page or half a page).

Research Methods II

- The introduction section includes:

1. Review of literature (a discussion of previous research studies in the same area)
2. Statement of the purpose (providing the rationale or the goal of the present study)

Research Methods II

- The method section includes:

1. The subjects (those who participated in the study and the research was done on them).
2. The design (the way the participants were grouped and tested, chapter 9- this section is also labeled **Data Analysis** or **Statistical Procedure**)

Research Methods II

3. Materials (describing the materials or research instruments –tests, questionnaire, survey, ...- used in the study)
4. Procedures (describing how the study was conducted and what the subjects did)

Research Methods II

- The Result Section includes presents the results in three possible ways (1) describing them within the text of the article (2) summarizing them in tables, and (3) constructing graphs for better and easier understanding.

Research Methods II

- The discussion Section includes a technical report of how the statistical analysis turned out and a non technical description of the results with regard to the purpose of the study; sometimes the justification of the results is also provided; also suggestions for further studies are given here; this part is also labeled **Conclusion**.

Research Methods II

- The reference Section includes books and articles used and referred to throughout the article. Using a reference without mention the source is illegal and called **Plagiarism**. You can use APA style (American Psychological Association) in writing your report and references. TRY APA on the internet.

Research Methods II

Research Methods II

The End

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