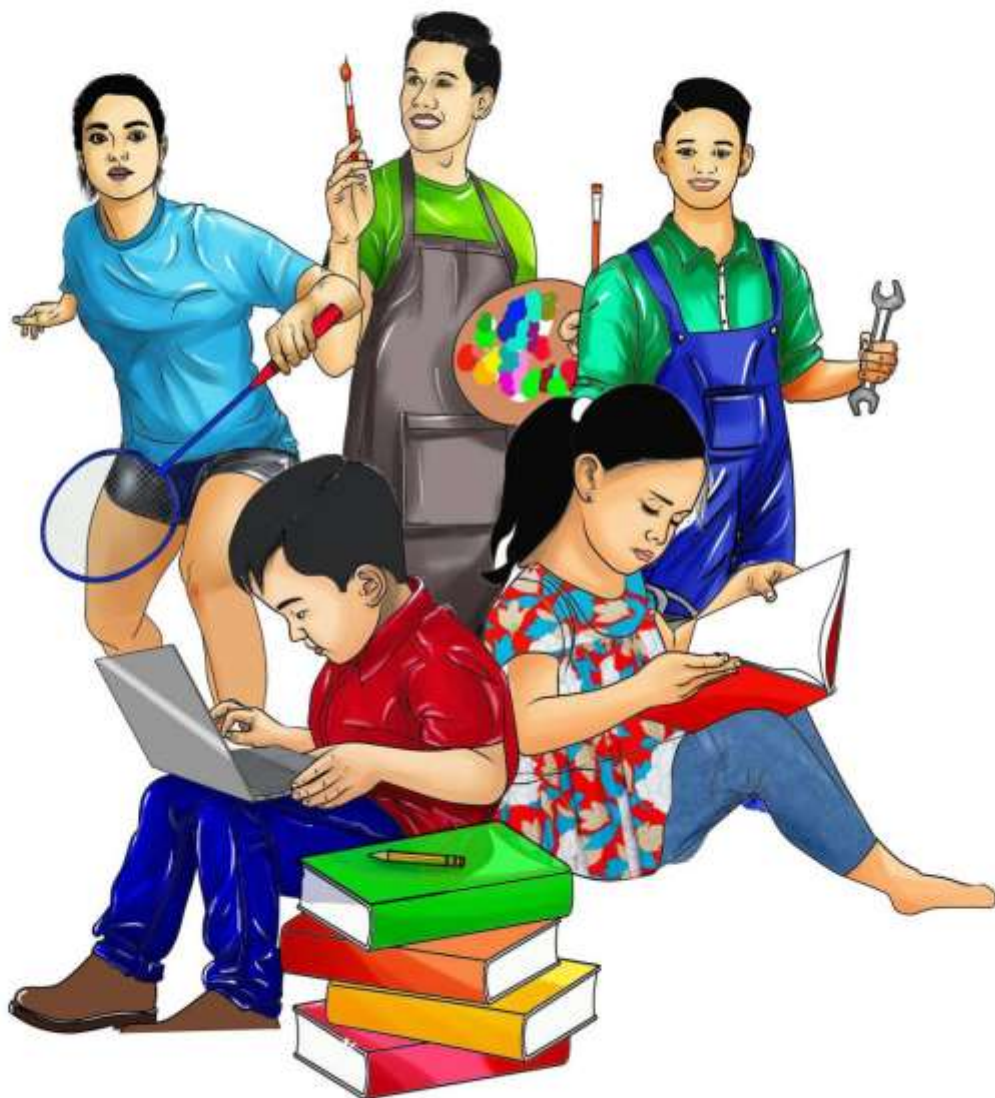


Mathematics

Quarter 4- Module 5 Week 6-7

**Analyzing and Interpreting Research
Data Using Other Statistical Methods**



AIRs - LM

GOVERNMENT PROPERTY
NOT FOR SALE

Mathematics 10
Quarter 4 – Module 5 (Week 6-7)
Analyzing and Interpreting Research Data
Using Other Statistical Methods

First Edition, 2021

Copyright © 2021
La Union Schools Division
Region I

All rights reserved. No part of this module may be reproduced in any form without written permission from the copyright owners.

Development Team of the Module

Author: Rustico R. Diaz

Editor: SDO La Union, Learning Resource Quality Assurance Team

Illustrator: Ernesto F. Ramos, Jr., *P II*

Management Team:

Atty. Donato D. Balderas, Jr.
Schools Division Superintendent

Vivian Luz S. Pagatpatan, PhD
Assistant Schools Division Superintendent

German E. Flora, PhD, *CID Chief*

Virgilio C. Boado, PhD, *EPS in Charge of LRMS*

Erlinda M. Dela Peña, EdD, *EPS in Charge of Mathematics*

Michael Jason D. Morales, *PDO II*

Claire P. Toluyen, *Librarian II*



Target

Statistical knowledge helps you use the proper methods to collect the data, employ the correct analyses, and effectively present the results. It is a crucial process behind how we make discoveries in science, make decisions based on data, and make predictions.

In this module, you will realize the importance of statistics to research in getting exact kind of description, having definite procedure, summarize results in a meaningful and convenient form, and draw general conclusions.

The most essential learning competency (MELC) for this module will be:

- Uses appropriate measures of position and other statistical methods in analyzing and interpreting research data. **(M10SP-IVf-g-1)**

After going through this module, you are expected to:

1. Recall different measures of central tendency and variability;
2. Identify other statistical methods needed in analyzing and interpreting research data; and
3. Use appropriate measures of position and other statistical methods in analyzing and interpreting research data.

Before you start doing the activities in this lesson, find out how much you already know about this module. Answer the pre-test on the next page in a separate sheet of paper.

PRE-ASSESSMENT

Directions: Read each mathematical statement carefully. Write the letter of your choice in a separate sheet of paper.

- Which of the following is the formula for weighted mean?
A. $\frac{\sum X}{N}$ B. $\frac{N}{2}$ C. $\frac{\sum fx}{\sum f}$ D. $\frac{\sum CF}{fc}$
- Of the 250 subjects of the research study, 40 said very much adequate or 5; 60 said very adequate or 4; 50 said adequate or 3; 55 said fairly adequate or 2; and 45 said inadequate or 1. What is the weighted mean of the research study?
A. 2.89 B. 2.98 C. 3.89 D. 3.98
- Using the result in number 2, what will be the findings in the research study?
A. very much adequate B. very adequate
C. adequate D. fairly adequate
- A national achievement test is administered annually to 3rd graders. The test has a mean score of 100 and a standard deviation of 15. If Jane's z-score is 1.20, what was her score on the test?
A. 100 B. 106 C. 112 D. 118
- What can you say about Jane's z-score of 1.20?
A. Her test score is equal to the mean.
B. Her test score is less than the mean.
C. Her test score is greater than the mean.
D. Her test score is 1.20 standard deviation greater than the mean.

For numbers 6-10 refer on the given data below.

The following data are the scores of 10 learners from different sections for the same 20-item Mathematics Test. You are interested in understanding how scores vary from different sections.

Learners	Leadership	Arguilla	Hope	Love
1	15	7	4	20
2	12	10	2	19
3	15	15	20	12
4	20	20	15	18
5	19	10	16	8

- What is the mean of Leadership?
A. 12.2 B. 14.2 C. 16.2 D. 18.2
- Which section has the largest coefficient of variation?
A. Arguilla B. Hope C. Leadership D. Love
- Which section has the smallest coefficient of variation?
A. Arguilla B. Hope C. Leadership D. Love

9. Which section has the most variability of test scores?
 A. Arguilla B. Hope C. Leadership D. Love
10. What does the most variability of test scores mean?
 A. Scores spread further around the mean.
 B. Scores compress further around the mean.
 C. Scores spread evenly below and above the mean.
 D. All of the above-mentioned interpretation.

For numbers 11-15 refer on the given data below.

Data Set	\bar{x}	s
A	50	2
B	50	1.5
C	50	4

11. What is the coefficient of variation of Data Set A?
 A. 3% B. 4% C. 6% D. 8%
12. What is the coefficient of variation of Data Set B?
 A. 3% B. 4% C. 6% D. 8%
13. What is the coefficient of variation of Data Set C?
 A. 3% B. 4% C. 6% D. 8%
14. Which data set is the most variable?
 A. Data Set A B. Data Set B
 C. Data Set C D. None of these
15. Which data set is the least variable?
 A. Data Set A B. Data Set B
 C. Data Set C D. None of these

Well done. Now let's proceed to our module
 in Analyzing and Interpreting Research Data
 Using Other Statistical Methods.



Jumpstart

This section will test how well you can still remember concepts on the different statistical measures learned from your lower Mathematics. If you have forgotten the terms, be able to recall them by referring to your notes, books and other references. These concepts are needed in understanding this module

Activity 1: Let's Test your vocabulary.

Arrange the jumbled letters to form a word related to statistical measures then complete the table by writing the needed information.

	TERM	DEFINITION	FORMULA
1.NAEM			
2.ANDEMI			
3.DEOM			
4.RADDANTS NOVIADETI			
5.CERIANVA			

Activity 2: Remember Me!

Given the sample data: 46 69 32 60 52 41. Calculate the required measures from the table below.

Description	Value
Mean	
Median	
Mode	
Variance	
Standard Deviation	

Now that you are done recalling the previous lessons on the different measures in statistics, you are now ready for the next lesson.

Module 6

Analyzing and Interpreting Research Data using Other Statistical Methods

In this module, you will learn other statistical methods needed in analyzing and interpreting research data.



Discover

WEIGHTED MEAN/WEIGHTED AVERAGE

Weighted Mean is an average computed by giving different weights to some of the individual values. If all the weights are equal, then the weighted mean is the same as the arithmetic mean. It represents the average of a given data.

Example 1:

Suppose that a marketing firm conducts a survey of 1,000 households to determine the average number of TVs each household owns. The data show a large number of households with two or three TVs and a smaller number with one or four. Every household in the sample has at least one TV and no household has more than four. Find the mean number of TVs per household.

Number of TVs per Household	Number of Households
1	73
2	378
3	459
4	90

Solution:

Number of TVs per Household (x)	Number of Households (f)	fx
1	73	(1)(73) = 73
2	378	(2)(378) = 756
3	459	(3)(459) = 1377
4	90	(4)(90) = 360
	$\Sigma f = 1000$	$\Sigma fx = 2566$

$$\begin{aligned}\text{Weighted Mean} &= \frac{\Sigma fx}{\Sigma f} \\ &= \frac{2566}{1000}\end{aligned}$$

$$\text{Weighted Mean} = 2.566 \approx 3$$

The mean number of TVs per household in this sample is $2.566 \approx 3$.

Example 2.

Of the 100 subjects of the research study, 20 said very much adequate or 5; 35 said very adequate or 4; 18 said adequate or 3; 15 said fairly adequate or 2; and 12 said inadequate or 1. What is the weighted mean of the research study?

Solution:

Rating (x)	Number of subjects in the study (f)	fx
5	20	(5)(20) = 100
4	35	(4)(35) = 140
3	18	(3)(18) = 54
2	15	(2)(15) = 30
1	12	(1)(12) = 12
	$\Sigma f = 100$	$\Sigma fx = 336$

$$\begin{aligned}\text{Weighted Mean} &= \frac{\Sigma fx}{\Sigma f} \\ &= \frac{336}{100}\end{aligned}$$

$$\text{Weighted Mean} = 3.36 \approx 3$$

Interpretation: The findings of the research study is Adequate.

STANDARD DEVIATION (s)

The **Standard Deviation (s)** is the measure of dispersion/variability that involves all scores in the distribution rather than through extreme scores. It is also the most widely used measure of dispersion/variability.

Formula:

Ungrouped Data

$$s = \sqrt{\frac{\sum(X - \bar{X})^2}{n-1}}$$

where: s = standard deviation
 \sum = symbol for "summation"
X = individual scores
 \bar{X} = mean of all scores
n = total number of scores

Grouped Data

$$s = \sqrt{\frac{\sum f(X - \bar{X})^2}{n-1}}$$

where: s = standard deviation
 \sum = symbol for "summation"
X = midpoint of the class interval
 \bar{X} = mean of all scores
f = frequency of the class interval
n = total number of frequency

Example 1. Find the standard deviation (s) given the scores 16, 12, 16, 10, 18, 15, 12, 8, 15 and 8.

Solution:

Step 1: Compute for the Mean (\bar{X})

$$\bar{X} = \frac{\text{sum of all scores}}{\text{total number of scores}} = \frac{16+12+16+10+18+15+12+8+15+8}{10} = \frac{130}{10} = 13$$

Step 2: Compute for $X - \bar{X}$ and $(X - \bar{X})^2$, $\sum(X - \bar{X})^2$ and fill in the table

Scores (X)	$X - \bar{X}$	$(X - \bar{X})^2$
16	$16-13 = 3$	$3^2 = 9$
12	$12-13 = -1$	$-1^2 = 1$
16	$16-13 = 3$	9
10	$10-13 = -3$	9
18	$18-13 = 5$	25
15	$15-13 = 2$	4
12	$12-13 = -1$	1
8	$8 - 13 = -5$	25
15	$15-13 = 2$	4
8	$8-13 = -5$	25
		$\sum(X - \bar{X})^2 = 112$

Step 3: Apply the formula for standard deviation of Ungrouped Data

$$\begin{aligned}
 s &= \sqrt{\frac{\sum(X - \bar{X})^2}{n-1}} \\
 &= \sqrt{\frac{112}{10-1}} \\
 &= \sqrt{\frac{112}{9}}
 \end{aligned}$$

$$\mathbf{s = 3.53}$$

Example 2. Find the standard deviation (s) given the frequency distribution table below.

Scores	Frequency
18-20	3
15-17	10
12-14	15
9-11	6
6-8	8
3-5	3
0-2	5
	n = 50

Step 1: Compute for the mean

Note: To compute for the midpoint(X) get the middle score of each interval

Scores	Frequency (F)	Midpoint (X)	FX
18-20	3	19	57
15-17	10	16	160
12-14	15	13	195
9-11	6	10	60
6-8	8	7	56
3-5	3	4	12
0-2	5	1	5
	n = 50		$\sum FX = 545$

$$\bar{X} = \frac{\sum FX}{n} = \frac{545}{50} = 10.9$$

Step 2: Compute for $X - \bar{X}$, $(X - \bar{X})$, $f(X - \bar{X})^2$, $\sum f(X - \bar{X})^2$ and fill in the table.

Scores	Frequency (F)	Midpoint (X)	$X - \bar{X}$	$(X - \bar{X})^2$	$f(X - \bar{X})^2$
18-20	3	19	8.1	65.61	196.83
15-17	10	16	5.1	26.01	260.1
12-14	15	13	2.1	4.41	66.15
9-11	6	10	-0.9	0.81	4.86
6-8	8	7	-3.9	15.21	121.68
3-5	3	4	-6.9	47.61	142.83
0-2	5	1	-9.9	98.01	490.05
	n = 50				$\sum f(X - \bar{X})^2 = 1282.5$

Step 3: Apply the formula for standard deviation (s) of Grouped Data

$$\begin{aligned}
 s &= \sqrt{\frac{\sum f(X - \bar{X})^2}{n-1}} \\
 &= \sqrt{\frac{1282.5}{50-1}} \\
 &= \sqrt{\frac{1282.5}{49}} \\
 &= \sqrt{26.17} \\
 \mathbf{s} &= \mathbf{5.12}
 \end{aligned}$$

COEFFICIENT OF VARIATION (CV)

The **Coefficient of Variation (CV)** is a measure of relative variability. It is the ratio of the standard deviation to the mean (average). The CV is particularly useful when you want to compare results from two different surveys or tests that have different measures or values.

Formula:

$$CV = \frac{\text{standard deviation}(s)}{\text{Mean}(\bar{X})} \times 100$$

Example

A researcher is comparing two multiple-choice tests with different conditions. In the first test, a typical multiple-choice test is administered. In the second test, alternative choices (i.e. incorrect answers) are randomly assigned to test takers. The results from the two tests are:

	Regular Test	Randomized Answers
Mean	59.9	44.8
SD	10.2	12.7

Trying to compare the two test results is challenging. Comparing standard deviations doesn't really work, because the means are also different. Calculation using CV helps to make sense of the data:

	Regular Test	Randomized Answers
Mean	59.9	44.8
SD	10.2	12.7
CV	17.03	28.35

Looking at the standard deviations of 10.2 and 12.7, you might think that the tests have similar results. However, when you adjust for the difference in the means, the results have more significance:

Regular test: CV = 17.03

Randomized answers: CV = 28.35

This means that Randomized answers are more variable/more spread to the mean than the Regular Test.

Remember:

- The higher the Coefficient of Variation the more variable it is, which means that the data is more spread to the mean.
- The Coefficient of Variation should only be used to compare positive data on a ratio scale. The CV has little or no meaning for measurements on an interval scale.

STANDARD SCORE (z-score)

A **standard score** (aka, a **z-score**) indicates how many standard deviations an element is from the mean. A standard score can be calculated from the following formula.

$$z = \frac{(X - \mu)}{\sigma}$$

where:

z - z-score

X - value of the element

μ - mean of the population

σ - standard deviation.

Here is how to interpret z-scores.

- A z-score less than 0 represents an element less than the mean.

- A z-score greater than 0 represents an element greater than the mean.
- A z-score equal to 0 represents an element equal to the mean.
- A z-score equal to 1 represents an element that is 1 standard deviation greater than the mean; a z-score equal to 2, 2 standard deviations greater than the mean; etc.
- A z-score equal to -1 represents an element that is 1 standard deviation less than the mean; a z-score equal to -2, 2 standard deviations less than the mean; etc.

Example 1.

A national achievement test is administered annually to 3rd graders. The test has a mean score of 150 and a standard deviation of 12. If Mike's score in the test is 172, what was his z- score?

Solution

$$\begin{aligned}
 z &= \frac{(X - \mu)}{\sigma} \\
 &= \frac{172 - 150}{12} \\
 &= \frac{22}{12} \\
 z &= 1.83
 \end{aligned}$$

Mike's z-score is 1.83 which means that his score is 1.83 standard deviation greater than the mean.

Example 2.

Suppose Rica took the same test in example 1 and her z-score is 1.32. What would be her test score?

Solution

$$\begin{aligned}
 z &= \frac{(X - \mu)}{\sigma} \\
 1.25 &= \frac{X - 150}{12} \\
 (1.25)(12) &= X - 150 \\
 15 &= X - 150 \\
 150 + 15 &= X \\
 165 &= X
 \end{aligned}$$

Rica's score in the test is 165.



Explore

Activity 3: What is my Weight to you?

Compute for the weighted mean of the sample Math Attitudes Survey and give appropriate interpretation of the result.

MATH ATTITUDES SURVEY				
1. Math is one of my favorite subjects.				
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
2. I feel confident that I can learn new Math topics.				
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
3. I enjoy Math class.				
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
4. In the past years I have enjoyed Math class.				
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
5. Math is an important subject to learn.				
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
6. I receive good grades in Math class.				
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

Weighted Mean: _____ Description: _____

Interpretation:



Deepen

Activity 4: What's My Real Score?

Complete the table below and answer the questions that follow.

The Grade 10 Learners as part of their Performance Assessment are task to conduct a survey of 50 Learners Towards their 20-Item Summative Test. The result of the survey is as follows:

Learner No.	Leadership	Arguilla	Hope	Love
1	20	15	6	13
2	18	12	8	18
3	12	11	12	12
4	16	20	5	11
5	8	16	10	10

Section	Mean (\bar{X})	Standard Deviation (s)	Coefficient of Variation (%)
Leadership			
Arguilla			
Hope			
Love			

Questions:

1. Which section is the most variable according to coefficient of variation?
2. Which section is the least variable according to coefficient of variation?
3. What is the z-score of a learner with a score of 15 in Arguilla?
4. Interpret the result in #3.



Gauge

POST ASSESSMENT

Directions: Read each question carefully. Write the letter of your choice in a separate sheet of paper.

1. Scores on a history test have average of 80 with standard deviation of 6. What is the z-score for a student who earned a 75 on the test?
A. 0.83 B. 0.38 C. -0.38 D. -0.83
2. Of the 50 subjects of the research study, 10 said very much adequate or 5; 8 said very adequate or 4; 12 said adequate or 3; 13 said fairly adequate or 2; and 7 said inadequate or 1. What is the weighted mean of the research study?
A. 3.20 B. 3.02 C. 2.20 D. 2.02
3. Using the result in number 2, what will be the findings in the research study?
A. very much adequate B. very adequate
C. adequate D. fairly adequate
4. A national achievement test is administered annually to 3rd graders. The test has a mean score of 100 and a standard deviation of 12. If Rhea's z-score is -1.25, what was her score on the test?
A. 80 B. 85 C. 90 D. 100
5. What can you say about Rhea's z-score of -1.25 in question number 4?
A. Her test score is equal to the mean.
B. Her test score is less than the mean.
C. Her test score is -1.25 standard deviation less than the mean.
D. Her test score is -1.25 standard deviation greater than the mean.

13. What is the coefficient of variation of Data Set C?

- A. 26.14 B. 20.14 C. 14.14 D. 8.14

14. Which data set is the most variable?

- A. Data Set A B. Data Set B
C. Data Set C D. None of these

15. Which data set is the least variable?

- A. Data Set A B. Data Set B
C. Data Set C D. None of these

Congratulations! Job well done.

REFERENCES:

Printed Materials:

Pagala, R. C. Statistics Revised Edition

Paler-Calmorin, L., & Calmorin-Piedad, L. Statistics With Computer: Rex Book Store

Asaad, A. S., & Hailaya, W. M. Statistics As Applied To Education And Other Related Fields: Rex Book Store

Websites:

<https://statisticsbyjim.com/basics/importance-statistics/#:~:text=Statistical%20knowledge%20helps%20you%20use,on%20data%2C%20and%20make%20predictions.>

[https://stattrek.com/descriptive-statistics/measures-of-position.aspx#:~:text=Statisticians%20often%20talk%20about%20the,aka%2C%20z%2Dscores\)](https://stattrek.com/descriptive-statistics/measures-of-position.aspx#:~:text=Statisticians%20often%20talk%20about%20the,aka%2C%20z%2Dscores))

<https://www.superprof.co.uk/resources/academic/maths/statistics/descriptive/variance-problems.html>

<https://www.superprof.co.uk/resources/academic/maths/statistics/descriptive/variance-problems.html>

<https://www.statisticshowto.com/probability-and-statistics/how-to-find-a-coefficient-of-variation/>

<https://www.thoughtco.com/z-scores-worksheet-3126534>

https://www.researchgate.net/publication/331440353_A_LESSON_PLAN_IN_Measures_of_Position_Quartile