



What Is This Module About?

In everyday life, we encounter situations that require us to get the average or middle value of a set of numbers or a given set of data. For instance, you have your grades for your different subjects in school for a given academic year and you want to know your average grade. By getting your average grade, you will have a good idea of how well or how poorly you have done in school. But how will you compute for the average value?

In this module, you will learn how to get the average of a given set of data. This average is also known in statistics as the **mean**. You will also learn about other measurements useful in statistics such as median, mode and range.

This module is made up of four lessons. These are:

Lesson 1 – *Mean*

Lesson 2 – *Median*

Lesson 3 – *Mode*

Lesson 4 – *Range*



What Will You Learn From This Module?

After studying this module, you should be able to:

- ◆ define **mean, median, mode, range** and other related terms;
- ◆ describe the differences among mean, median, mode and range;
- ◆ use mean, median and mode and range to analyze and interpret data to solve problems in daily life.



Let's See What You Already Know

Before you start studying this module, take the following test first to find out how well you know the topics to be discussed. Give what is asked for in each of the following items.

1. The following is a list of scores in a random survey on the IQs of 20 sixth grade students. What is the mean IQ?

129	120	118	137	111
116	113	115	101	120
99	102	121	79	104
77	96	112	117	113

2. The following are the monthly salaries of 10 employees from a small company.

Employee 1	P 3,500
Employee 2	P 3,500
Employee 3	P 3,400
Employee 4	P 3,300
Employee 5	P 3,300
Employee 6	P 3,200
Employee 7	P 2,700
Employee 8	P 2,600
Employee 9	P 2,500
Employee 10	P 2,200

Compute for the median salary.

3. A bookstore owner in your barangay wanted to know which of the services of the store is most popular among the consumers. She recorded the number of times a service is given in a week. Here are the data she collected:

Service	Number of Times Requested by Customers
Bookbinding	31
Ring binding	40
Photocopying	150
Typing	56
Gift wrapping	98

What is the modal popular service of the bookstore?

4. Find the range of each of the following sets of numbers.
- 2 4 9 11
 - 77 80 90 65 77 89
 - 1,299 2,580 4,098 9,100 1,100

Well, how was it? Do you think you fared well? Compare your answers with those in the *Answer Key* on page 24 to find out.

If all your answers are correct, very good! This shows that you already know much about the topics in this module. You may still study the module to review what you already know. Who knows, you might learn a few more new things as well.

If you got a low score, don't feel bad. This means that this module is for you. It will help you understand some important concepts that you can apply in your daily life. If you study this module carefully, you will learn the answers to all the items in the test and a lot more! Are you ready?

You may now go to the next page to begin Lesson 1.

Mean



In a community pool, Rachel is practicing for an upcoming swimming meet. In order to qualify in the eliminations, she needs to clock a time of 1.45 minutes. During her practice, she checks her time and takes note of her progress once in a while. For the first lap, she timed 1.40 minutes; for the second lap, she clocked 1.37 minutes and for the last lap, she clocked 1.49 minutes. Look at the data below:

1st lap = 1.40 minutes

2nd lap = 1.37 minutes

3rd lap = 1.49 minutes

What is her average lap time? Is her time enough for her to qualify in the swimming competition?

The average time Rachel clocked can also be referred to as the mean time. The **mean** is the arithmetic average of a set of given numbers. These given numbers are added up. In this case, the set of data consists of Rachel's lap times for three laps. These given numbers are added. The sum is divided by the number of scores.

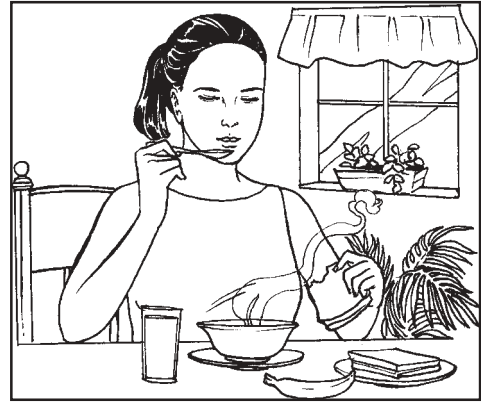
If we add all the given numbers, that is, $1.40 + 1.37 + 1.49$, we get a sum of 4.26 minutes. The total number of data is 3. Dividing the sum 4.26 minutes by 3, we get 1.42 minutes. This means that the mean of the data is 1.42 minutes. This means that Rachel's more than ready for the swimming competition.



Let's Try This

Each type of food we eat contains a certain number of calories that our body needs in order to provide the energy we need in our everyday activities. Butter, for example, contains a large number of calories while nonfat foods contain few calories.

We need a certain amount of calorie intake for each day depending on our age and lifestyle. For an average teen, the required intake is about 2,000 calories.



Suppose your daily calorie intake for a week is as shown below. Determine if it satisfies the required dietary allowance (RDA).

Day	Number of Calories
Monday	2,300
Tuesday	1,900
Wednesday	2,100
Thursday	1,800
Friday	1,600
Saturday	2,700
Sunday	1,600

Let's solve for the mean together.

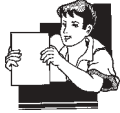
First, we need to add all the data. The data are the amounts of calories taken for seven days.

$$2,300 + 1,900 + 2,100 + 1,800 + 1,600 + 2,700 + 1,600 = 14,000$$

Next, we divide the sum by the number of given values. In this case, the number is 7. Therefore we divide the sum by 7.

$$\frac{14,000}{7} = 2,000$$

The mean daily calorie intake for the given week is 2,000 calories. This meets the required dietary allowance.



Let's Learn

To summarize, the following are the steps to be followed in computing for the mean:

STEP 1 Add all the given data.

STEP 2 Divide the sum by the total number of values.



Let's Try This

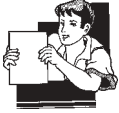


Suppose you want to know your household's average monthly electric consumption for the previous year. The following are the data you collected from your previous electric bills.

Month	Consumption (kilowatt-hours)
January	150
February	220
March	230
April	170
May	260
June	155
July	220
August	230
September	270
October	280
November	285
December	290

Compute for the mean monthly electric consumption.

If your answer is 230 kilowatt-hours, you're correct.



Let's Learn

The **mean**, also known as the arithmetic mean, is the average of a set of data. This is the value that best represents a group of numeric data.

The computation for the mean may be described using symbols. Let us use x to represent a single value in a given set of data.

The sum of a set of numeric data is represented by the capital Greek letter sigma (Σ). Whenever this symbol appears, it means that whatever follows it must be added. For example, the notation Σx indicates that all the numbers represented by x should be added.

The symbol N is also useful in statistical computation. This represents the number of numeric values in a given set of data.

Combining these three symbols (x , Σ , N) gives us the formula for computing the mean of a given set of data. If we let the mean be \bar{x} , the formula is:

$$\bar{x} = \frac{\Sigma x}{N}$$

where: \bar{x} = the mean

Σ = the sum of

N = number of data



Let's See What You Have Learned

1. The following is a list of the results of a random survey on the IQs of 20 sixth grade students. What is the mean IQ?

139	130	128	127	121
106	103	120	99	100
89	112	101	73	118
87	95	102	107	103

2. The following are Simon's final exam scores in five of his subjects:

Science	88
English	90
Reading	91
Social Studies	85
Home Economics	93

Suppose that Simon needs an average of 90 for his six subjects in order to be included in the honor roll, what should his grade in mathematics be?

Compare your answers with those in the *Answer Key* on page 24. Did you get a perfect score? If you did, that's very good. If you did not, just review the parts of the lesson you did not understand very well before moving on to Lesson 2.



Let's Remember

- ◆ The mean, also known as the arithmetic mean, is the average of a set of numeric data. This is the number that best represents a group of numbers.
- ◆ To find the mean, we use the following formula:

$$\bar{x} = \frac{\sum x}{N}$$

where: \bar{x} = the mean

Σ = the sum of

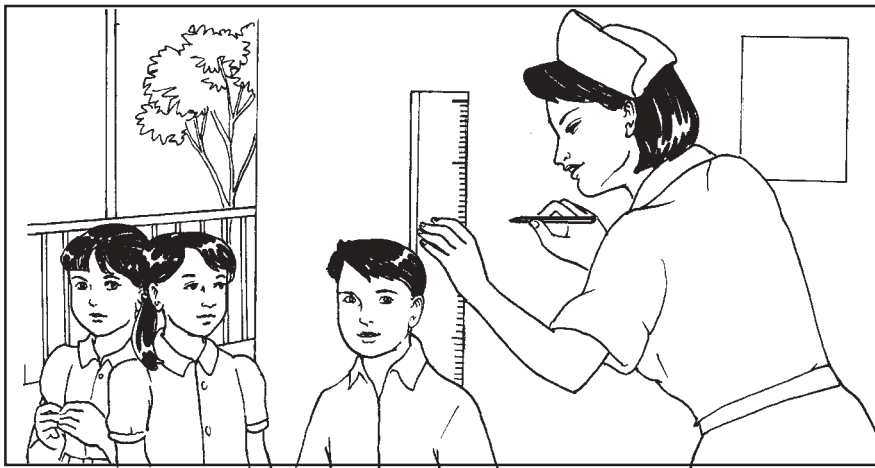
N = number of values

Median

In Lesson 1, you found out what the mean is and how to compute its value. This lesson will teach you all about the median, where it is used and how to find it. Read on to find out more.



Let's Study and Analyze



A municipal health officer visited a school to conduct a survey on the health and physical conditions of the children in the barangay. First she did a physical examination and tallied the age, weight and height of the students. Here is her tally of the weight (in pounds) of all the 10-year-old kids she examined:

90 89 77 72 84 100 98 71 75

These data seem to cluster around a central point, since they are more or less near one another in value. So we might as well look for the central point or the middle. But first we should arrange the data in such a way that they are either increasing or decreasing in order. This arrangement is called an **array**. Rearranging the data in decreasing order, we get:

Weight in Pounds (lb.)

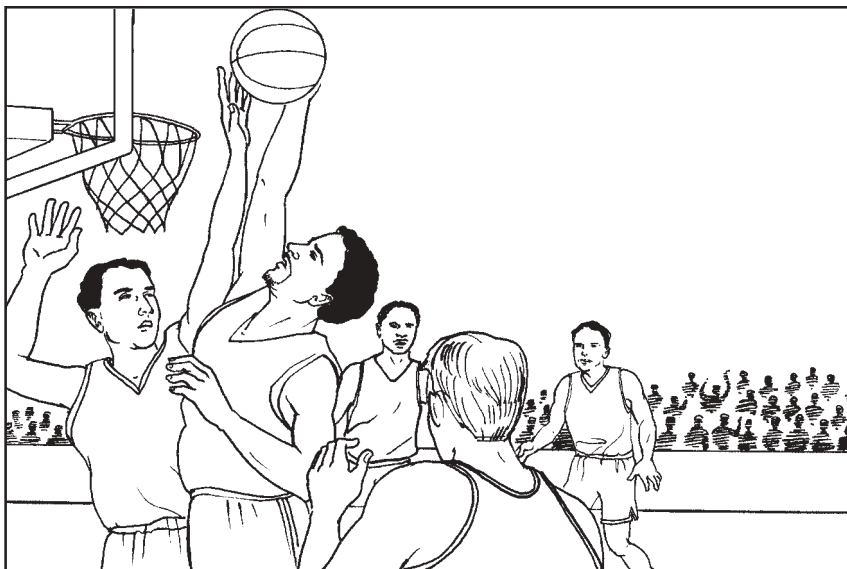
100
98
90
89
84
77
75
72
71

In locating the middle value, we simply look for the value with an equal number of values above and below it.

In the example, there are nine values and the middle value is 84. There are 4 values below and also 4 values above it. Therefore, 84 is the middle value. This is called the **median**. The median in this case is quite easy to determine because the number of values N is an odd number.

What if we are given a set of data with an even number of values?

Let's take a look at the following example.



In game 1 of the inter-barangay basketball championship in the town of Maagap, the Barangay Maliksi team beat the Barangay Matulin team with the following scores made by the Barangay Maliksi players:

Atienza	48
Dador	13
Diata	13
Caraig	10
Santos	9
Palacio	6

Notice that in the given set of data, there is a value higher than the rest. If we look for the middle score but use the method for computing the mean, the score that we will get will be higher than the true value. The computed middle score will be higher because one score is too high compared to the other scores. The scores of Dador, Diata, Caraig, Santos and Palacio are close to each other. However, there is one value that is too high compared to the other scores: that of Atienza. We say that the score of Atienza is an unusually large value. Any value in a given set of data that is unusually large or unusually small compared to the other values is called an **outlier**.

So instead of computing for the mean, we look for the median. The median is the midpoint in a set of values or the value that is exactly in the middle of the array such that the same number of values is above and below it. However, in the example given, we need to do more than look for the middle score because there is an even number of scores.

For a set of values with an even number of values N , the median is computed by getting the average of the two middle values. In the case of the given example, the two middle scores are those of Diata and Caraig. These are 13 and 10. The median is computed by getting the average of these two scores. The average of 10 and 13 is 11.5.

Therefore, we say that the median is 11.5.

Note that there is no 11.5 in the given set of data, which means that the median is not a score but a point that divides a distribution along the middle.

Try to solve the following example on your own.



Let's Try This



Suppose that you will take a college entrance exam. The exam consists of four parts: math, science, reading comprehension and English. In order to pass the exam, you need an average score of 85. If your scores in the four tests are:

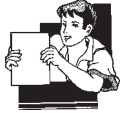
Math	88
Science	87
Reading comprehension	85
English	78

What is the mean? _____

What is the median? _____

Will you be able to pass the exams if the median was used to compute for the average instead of the mean? By how much will the average score change?

Compare your answers with those in the *Answer Key* on page 24.



Let's Learn

The **median** is the value that divides a given set of data or a distribution into two equal halves wherein 50% of the values are above it while 50% are below it.

The median is not greatly affected by extremely high or low values. If one or more values in the set of data are too high or too low compared to the rest, then the median is a better measure of central tendency than the mean. These extreme values are called **outliers**.

If the data seem to cluster around a central point and they are more or less near each other in value, we might as well look for the median.

There are two different cases considered in finding the median of a given set of data.

Case 1 The number of values N is odd.

In the array of values, the median is the middle value.

Case 2 The number of values N is even.

In the array of values, the median is the average of the two middle values.



Let's See What You Have Learned

Give what is asked for in each of the following problems.

1. The following are the monthly salaries of 9 employees from a small company.

Employee 1 P3,500

Employee 2 P3,400

Employee 3 P3,300

Employee 4 P3,300

Employee 5 P3,100

Employee 6 P2,700

Employee 7 P2,600

Employee 8 P2,500

Employee 9 P2,200

Find the median wage.

Compare your answers with those in the *Answer Key* on page 25. Did you get a perfect score? If you did, that's very good. If you did not, don't worry. Just review the parts of the lesson you did not understand very well. Afterward, you may proceed to Lesson 3.



Let's Remember

- ◆ The **median** is the value that divides a given set of data or distribution into two equal halves wherein 50% of the values are above it and 50% are below it.
- ◆ There are two different cases considered in finding the median of a given set of data.

Case 1 The number of values N is odd.

In this case, the middle value is the median.

Case 2 The number of values N is even.

In this case, the median is the average of the two middle values.

Mode

You found out in the previous lessons that the average of a given set of values can be determined by finding the mean or the median. In this lesson, you will find out how to find the mode and its difference it from the mean and the median.



Let's Study and Analyze



Suppose you wanted to buy a pair of rubber shoes that your son will use in his PE class. You went to a department store and checked out the available brands. You wanted to know which brand of rubber shoes is the most saleable so the saleslady gave you a rundown of the department store's shoe sales for the past month. Here are the data:

Brand of Shoes	Number of Pairs Sold
Mike	11
Aide	7
Reverse	9
Tom	10

The brand of shoes that is most saleable is Mike, with 11 pairs sold in the past month. Mike is called the **mode** or **modal category** of the data.

Based on the given example, what do you think is the definition of **mode**?



Tina works in a small business company and has a monthly salary of ₱10,000. The following are the monthly salaries of her fellow employees.

- Anne ₱15,000
- Gilbert ₱18,000
- Diana ₱10,000
- Walter ₱9,000
- Nan ₱9,000

Can we consider Tina’s salary the modal salary?

Let us present the data in a **frequency distribution table** to be able to analyze them more easily. A frequency distribution table simply lists how often or how frequent a value is recorded.

Score	Frequency
₱ 18,000	1
₱ 15,000	1
₱ 10,000	2
₱ 9,000	2

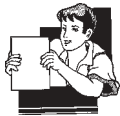
Only Gilbert has salary of ₱18,000 so we put 1 under the column **Frequency**. Likewise, only Anne has a salary of ₱15,000 so the frequency is also 1. Tina and Diana both earn ₱10,000 a month, hence the frequency is 2. Walter and Nan both earn ₱9,000 a month, hence the frequency of ₱9,000 is also 2.

A set of data that has two values or categories occurring with the highest frequency is considered **bimodal**.

In the preceding example, the two most frequently occurring values are adjacent. This means that the mode of the set of data is just the average of these values.

$$\frac{P10,000 + P9,000}{2} = P 9,500$$

The mode is P9,500. Can we now say whether Tina's salary is the mode?



Let's Learn

The **mode** or **modal category** is the value or category that occurs with the highest frequency in a given set of data. We use the term **modal category** in a counting of categories such as determining the winner of the presidential elections.

The mode is the only measure of central tendency that can be used in qualitative data.

We simply look for the value or category that occurred the most number of times to find the mode of a set of given data. In some cases, however, two or more values or categories occur the same number of times. If they are adjacent, the mode is their average. If these values or categories are nonadjacent, we say that the set of data has multiple modes.



Let's See What You Have Learned

Give what is asked for in each of the following problems.

1. A beauty parlor owner in your barangay wants to know which of the services of the parlor is the most popular among customers. She asked Thelma to record the number of times a service is given in the parlor in a week. Here are the data Thelma collected.

Service	Number of Times Requested by Customers
Manicure	65
Pedicure	41
Haircut	102
Hot oil	34
Hair color/dye	15

What is the modal service?

2. The following frequency distribution table shows the scores of 36 students in their test in mathematics.

Score	Frequency
49	1
48	1
47	2
45	2
40	3
37	2
34	4
33	1
32	5
31	5
30	2
29	3
27	2
24	1
23	1
19	1

What is the mode?

Compare your answers with those in the *Answer Key* on page 25. Did you get a perfect score? If you did, that's very good! If you did not, don't worry. Just review the parts of the lesson you did not understand very well before moving on to Lesson 4.



Let's Remember

- ◆ The mode is the value or category that occurs with the highest frequency in a given set of data.
- ◆ When a given set of data has two or more adjacent values that occurred the same number of times, then the mode is their average.

Range

In the previous lessons, you found out what the different measures of central tendency are. In this lesson, you will find out how variability in a set of data is measured.



Let's Study and Analyze



The owner of a newspaper stand wanted to make a tally of her sales. She made the following record of number of newspapers sold daily for 30 days.

32	25	45	38	42	70
66	52	63	53	39	66
39	30	28	40	71	58
60	36	47	61	72	74
74	67	62	59	55	42

Just by examining the data, we can more or less predict the average without having to compute it. But aside from knowing the central value or central tendency, we can also know the span of the given values or what is known as the **range**.

The range is the most basic measure of variability. It is the difference between the lowest and the highest values in a given set of data.

In computing the range, we use the following formula:

$$R = X_H - X_L$$

where: R is the range;

X_H is the highest value; and

X_L is the lowest value.

In our example, the lowest value is 25 while the highest value is 74.

$$X_H = 74$$

$$X_L = 25$$

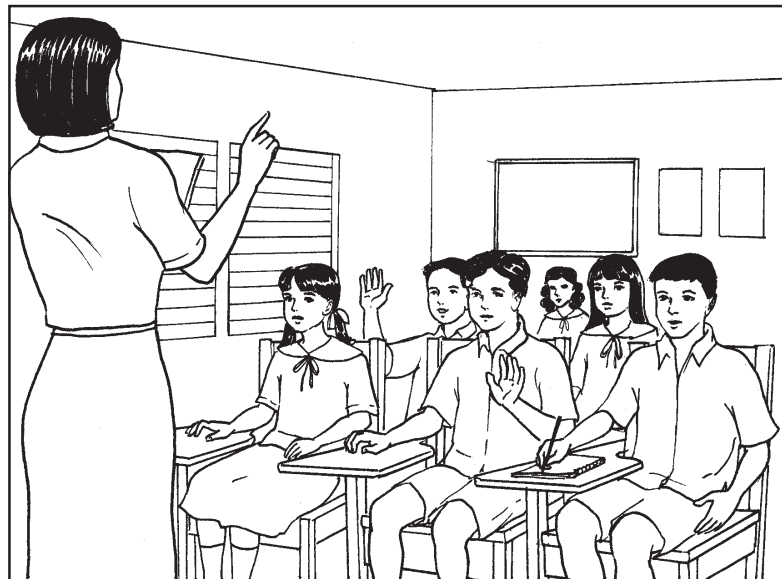
Substituting these values in the formula,

$$\begin{aligned} R &= X_H - X_L \\ &= 74 - 25 \\ &= 49 \end{aligned}$$

Therefore, the range is 49.



Let' Try This



The following are the results of a random survey on the IQs of 20 fifth grade students. What is the range of their IQs?

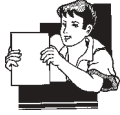
140	129	127	127	122
106	103	110	99	101
89	113	101	73	104
87	95	103	107	103

What is the highest value X_H ? _____

What is the lowest value X_L ? _____

Solve for the range.

Compare your answers with those in the *Answer Key* on page 25.



Let's Learn

The **range** is the difference between the highest and lowest values in a given set of data. It is computed by using the formula:

$$R = X_H - X_L$$

where: R is the range;

X_H is the highest value; and

X_L is the lowest value.



Let's See What You Have Learned

1. The following are the scores of 20 students in a math exam. Find the range of their scores.

40	39	27	50	43
28	16	37	33	49
44	34	23	39	22
45	19	28	47	38

2. Find the range of each of the following sets of numbers.
 - a. 1 3 8 10
 - b. 88 90 100 75 87 99
 - c. 1,999 2,880 4,298 9,000 1,500

Compare your answers with those in the *Answer Key* on page 25. Did you get a perfect score? If you did, that's very good. If you did not, that's okay. Just review the parts of the lesson you did not understand very well before moving on to the next part of the module.



Let's Remember

- ◆ The range is a measure of variability in a set of data.
- ◆ The range is computed by using the formula:

$$R = X_H - X_L$$

where: R is the range;

X_H is the highest value; and

X_L is the lowest value.

You have now reached the end of the module. Congratulations! Did you enjoy studying this module? Did you learn a lot from it? The following is a summary of its main points to help you remember them better.



Let's Sum Up

This module tells us that:

- ◆ The mean, also known as the arithmetic mean, is the average of a set of values. The formula is:

$$\bar{x} = \frac{\sum x}{N}$$

where: \bar{x} = the mean

Σ = the sum of

N = number of scores

- ◆ The **median** is the value that divides a given set of data or distribution into two with 50% of the values above it and 50% below it.

There are two cases considered in finding the median of a given set of data.

Case 1 The number of values N is odd.

In the array of values, the median is the middle value.

Case 2 The number of values N is even.

In the array of values, the median is the average of the two middle values.

- ◆ The mode is the value or category that occurs with the highest frequency. It is the one which occurs the most number of times among all the other categories or values in the set of data.
- ◆ The range is the difference between the highest and lowest values in a given set of data. The formula is

$$R = X_H - X_L$$

where: R is the range;

X_H is the highest value; and

X_L is the lowest value.



What Have You Learned?

- A. The following are the grades of four students in an aptitude exam composed of five subjects.

	Math	Science	Language	Reading	Abstract
Camille	89	90	83	83	81
Ella	86	86	87	89	88
Angela	80	73	93	89	87
Kate	82	82	83	83	81

Complete the following table using the given data above.

	Mean	Median	Mc
Camille			
Ella			
Angela			
Kate			

- B. Solve the following problems.

1. Jerbeck got the following final grades.

Science	87
English	88
Reading	90
Social studies	93
Home economics	95

Suppose she needs an average of 90 in her six subjects in order to be included in the honor roll, what should her grade in math be?

2. Jeff and Marie are studying typing. In six speed tests, Jeff was able to record the following speeds in number of words per minute:

56 55 63 62 49 62

while Marie had the following speeds:

58 63 71 51 59 64

Compare their median speeds. Who is the faster typist?

3. The following frequency distribution table shows the scores of 35 students in their math test.

Scores	Frequency
99	1
96	1
94	2
90	2
80	3
74	5
68	4
66	2
62	5
60	2
58	3
54	2
48	1
46	1
38	1

What is the mode?

4. The following are the scores of 20 students in a science exam. Find the range of their scores.

40 39 27 50 43
28 19 37 33 50
44 34 23 39 22
45 19 28 47 38

Compare your answers with those in the *Answer Key* on pages 25 and 26. If you got a score of:

- 23–25 Very good! You learned a lot from this module. You are now ready to move on to the next module.
- 18–22 Good! Just review the items that you missed.
- 11–17 Satisfactory. Review the parts of the module you did not understand very well.
- 0–10 You should study the whole module again.



Answer Key

A. Let's See What You Already Know (pages 1–3)

- 110
- P3,250
- Photocopying
- 9
 - 25
 - 8,000

B. Lesson 1

Let's See What You Have Learned (page 7)

- 108
- 93

Let x = grade in math

$$\frac{88 + 90 + 91 + 85 + 93 + x}{6} = 90$$

$$\frac{447 + x}{6} = 90$$

$$447 + x = 540$$

$$447 - 447 + x = 540 - 447$$

$$x = 93$$

C. Lesson 2

Let's Try This (page 11)

Mean = 84.5

Median = 86

You will be able to pass the exams if the median is used instead of the mean. The average score will change by 1.5 points.

Let's See What You Have Learned (pages 12–13)

1. P3,100
2. Mike: 59
Maria: 59
They have the same typing speed.

D. Lesson 3

Let's See What You Have Learned (pages 16–17)

1. haircut
2. 31.5

E. Lesson 4

Let's Try This (page 19)

$$X_H = 140$$

$$X_L = 73$$

$$R = 67$$

Let's See What You Have Learned (page 20)

1. 34
2. a. 9
b. 25
c. 7,500

F. What Have You Learned? (pages 22–23)

A.

	Mean	Median	Mode	Range
Camille	85.2	83	83	9
Ella	87.2	87	86	3
Angela	84.4	87	(none)	20
Kate	82.2	82	82	2

- B. 1. 87
2. Jeff: 59
Marie: 61
Therefore, Marie is the faster typist.
3. 74 and 62. The set of data is bimodal.
4. 31



References

Ho, Ju Se T., et al. *21st Century Mathematics: Third Year*. Quezon City: Phoenix Publishing House, Inc., 1996.

Lacuesta, Debbie P. *Basic Statistical Concepts*. Quezon City: SEAMEO INNOTECH, 1998.

Mathematics III SEDP Series. Quezon City: IMC, 1991.