

SHS



# AIRs - LM in

## Statistics and Probability

### Quarter 4: Week 2- Module 10

### Formulating Hypothesis



GOVERNMENT PROPERTY  
**NOT FOR SALE**

## **Statistics and Probability**

Grade 11 Quarter 4: Week 2 - Module 10

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:** Olivia A. Cagujas, *TI*

**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**

In your previous lesson, you have learned about how to illustrate null and alternative hypothesis in words and in symbols.

This learning material will provide you more information and examples in formulating hypotheses.

After going through this learning material, you are expected to:

1. identify the parameter to be tested given in real-life problem.

**(M11/12SP-IVa-3)**

2. formulate the appropriate null and alternative hypotheses on a population mean. **(M11/12SP-IVb-1)**

*Subtasks:*

1. define parameter
2. formulate null and alternative hypothesis on a population mean
4. write the symbol for null and alternative hypothesis

*Before going on, check how much you know about this topic. Answer the pretest in a separate sheet of paper*

### Pretest

**Directions:** Read each item carefully, and select the correct answer. Write the letter of your choice in separate sheet of paper.

1. What do you call a claim (assumption) about one or more population parameter?  
A. Hypothesis      B. Illusion      C. Theoretical      D. Visionary
2. Which of the following refers to the numbers that summarize data from a sample?  
A. Parameter      B. Population      C. Statistics      D. Quantity
3. Which term refers to the measure of a characteristics of an entire population?  
A. Parameter      B. Population      C. Statistics      D. Quantity
4. Which of the following is **NOT** a population parameter?  
A.  $\mu$       B.  $\sigma$       C.  $\rho$       D.  $s^2$
5. Which of the following symbols denote alternative hypothesis?  
A.  $A_0$       B.  $A_1$       C.  $H_0$       D.  $H_1$
6. "A school principal claims that students in her school score an average of 7 out of 10 in exams". What should be the null hypothesis?  
A. Students in the school score an average of 7 out of 10 in exams.  
B. Students in the school score more than 7 out of 10 in exams.  
C. The principal in the school score an average of 7 out of 10 in exams.  
D. The principal in the school score more than 7 out of 10 in exams.
7. Which of the following symbols denote null hypothesis?  
A.  $A_0$       B.  $A_1$       C.  $H_0$       D.  $H_1$
8. Which term describes the average of a group characteristics (group could be a person, item or thing)?  
A. Population mean      C. Sample mean  
B. Population variance      D. Standard deviation
9. Which of the following refers to the unbiased estimate of the population mean?  
A. Population mean      C. Sample mean  
B. Population variance      D. Standard deviation
10. Which word describes the initial claim that is based on previous analyses or specialized knowledge?  
A. Alternative hypothesis      C. Null hypothesis  
B. Hypothesis testing      D. Population mean
11. Which term is also known as one-sided and two-sided hypothesis?  
A. Alternative hypothesis      C. Null hypothesis  
B. Hypothesis testing      D. Population mean
12. A researcher has exam result for students who took a training course for a national exam. The researcher wants to know if trained students score above the national average of 850. Which of the following is the parameter of interest?  
A. The researcher  
B. The training course  
C. The national exam  
D. The average score of 850
13. Refer to item 12, what will be the null hypothesis?  
A.  $H_0: \mu = 850$       B.  $H_0: \mu > 850$       C.  $H_0: \mu < 850$       D.  $H_0: \mu \neq 850$
14. Refer to item 12, what will be the alternative hypothesis?  
A.  $H_1: \mu = 850$       B.  $H_1: \mu > 850$       C.  $H_1: \mu < 850$       D.  $H_1: \mu \neq 850$

15. Which of the following refers to a statistical method that is used in making statistical decisions using experimental data?
- A. Research  
B. Hypothesis testing  
C. Analytical theory  
D. Statistical analysis



## Jumpstart

*For you to understand the lesson well, do the following activities. Have fun and good luck!*

### Activity 1: Fact or Bluff!

Read the given information in the table and accomplish the given activity below.

Terms	Definition
Population	It is the set of all people, objects, events, or ideas you want to investigate.
Sample	It is a subset of a population
Population mean	It is an average of a group characteristic. The symbol is " $\mu$ ".
Parameter	It is a useful component of statistical analysis. It refers to the characteristics that are used to define a given population.
Population parameter	It is a number that describes something about the entire group or population
Hypothesis Testing	It is an act in statistics whereby an analysts tests an assumptions regarding a population and parameter.
Null hypothesis	It is a type of hypothesis used in statistics that propose that no statistical significance exist in a set of a given observations. The symbol is " $H_0$ ".
Alternative hypothesis	It is a type of hypothesis used in statistics that contradicts the null hypothesis. The symbol is " $H_1$ or $H_a$ ".

**Directions:** Identify whether the given statement is fact or bluff. Write the word **“FACT”** if the statement is correct and **“BLUFF”** if it is not.

1. Null hypothesis is an statement that directly contradicts the initial statement.
2. Hypothesis testing refers to the set of all people, objects, events, or ideas that want to investigate.
3. Alternative hypothesis states that there is a difference between a parameter and a specific value.
4. Population parameter describes something about the entire group.
5. The symbol used to describe a null hypothesis is  $H_0$ .

## Activity 2. Match Me!

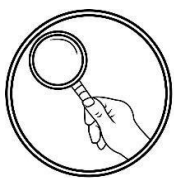
**Directions:** Below are the phrases which serves as guide in formulating hypothesis. Match the phrases in Column A with the symbols in Column B. Write your answer on a separate sheet of pad paper.

### Column A

1. is higher than
2. is decreased or reduced from
3. is exactly the same as
4. is not the same
5. is greater than or equal to

### Column B

- A.  $\neq$
- B.  $=$
- C.  $\geq$
- D.  $<$
- E.  $>$
- F.  $\leq$



## Discover

**Parameter** is used to describe the entire population being studied. A *population* is a set of all people, objects, events, or ideas wish to investigate. Usually parameter describes the average or mean of the population.

A *sample mean* is an estimate of the population mean. It is the average of a set of data or sample while *population mean* is an average of a group characteristics. The group could be a person, item or thing, like “all the people living on a certain place” or “all the dog owner in a subdivision” and others.

Two types of hypothesis:

The **null hypothesis** denoted by  **$H_0$** , is a statement that there is no difference

between a parameter and a specific value, or no phenomena is observed or there is no relationship between what you are comparing. This is what we want to test. It is the hypothesis to be tested. The null hypothesis is considered to be true, until we have sufficient evidence to reject it. Then, if we reject the null hypothesis, we are led to the alternative hypothesis.

**Alternative Hypothesis** denoted by  **$H_a$  or  $H_1$**  (read as “H one”), contradicts the null hypothesis. It allows the possibility of many values.

The two parameters of interest are denoted by  $\mu_1$  and  $\mu_2$ . If there is no difference between the two values, the relationship is written in symbol as:

$$\mu_1 - \mu_2 = 0$$

So, the null hypothesis would be written in symbol as:

$$H_0: \mu_1 = \mu_2$$

The symbol  $\neq$  in the alternative hypothesis suggest either a greater than ( $>$ ) relation or a less than ( $<$ ) relation.

### Steps in formulating null and alternative hypotheses

1. Identify the parameter of interest
2. Determine the claim to be tested (null or alternative)
3. Translate the claim into mathematical symbols or notations
4. Formulate the null and alternative hypotheses.

There are three different ways in writing hypothesis as illustrated below:

$$\begin{array}{lll} H_0: \mu = k & H_0: \mu \leq k & H_0: \mu \geq k \\ H_a: \mu \neq k & H_a: \mu > k & H_a: \mu < k \end{array}$$

Phrases such as equal to ( $=$ ), less than ( $<$ ), greater than ( $>$ ), greater than or equal to ( $\geq$ ), less than or equal to ( $\leq$ ) and not equal to ( $\neq$ ), and others are very important in formulating hypothesis.

Let's consider the following examples.

**Example 1.** A survey conducted the college students in their study stated that cell phone owners received an average of 65 texts every day. What parameter should these students consider proving this claim? State the null hypothesis and alternative hypothesis.

#### **Solution:**

The **parameter** of interest is the average number of text messages received every day.

The **null hypothesis** is the average texts every day is 65. In symbol,

$$H_0: \mu = 65 \text{ (claim).}$$

The **alternative hypothesis** is the average text received is not equal to 65". In symbol, **H<sub>a</sub>:  $\mu \neq 65$** .

**Example 2.** A nutritionist wants to estimate the mean amount of sodium consumed by children under the age of 10. From a random sample of 75 children under the age of 10, the nutritionist obtains a sample mean of 2993 milligrams of sodium consumed.

**Solution:**

The **parameter of interest** is the average amount of sodium consumed by the children under the age of 10.

The **null hypothesis** is the sample mean 2993 milligrams of sodium consumed. In symbol **H<sub>o</sub>:  $\mu = 2993$**  (claim).

The **alternative hypothesis** is the mean is not equal to 2993". In symbol, **H<sub>a</sub>:  $\mu \neq 2993$**

**Example 3.** A university wants to test if college students take less than five years to graduate from college, on the average.

**Solution:**

The **parameter of interest** is the average years to graduate from college.

The **null hypothesis** is the college students take less than five years to graduate from college. In symbol, **H<sub>o</sub>:  $\mu \geq 5$** .

The **alternative hypothesis** is the college students take more than five years to graduate from college. In symbol, **H<sub>a</sub>:  $\mu < 5$**  (claim)

**Example 4:** The average height of Grade 11 female students is above 158 cm. Their adviser wants to test the students' claim.

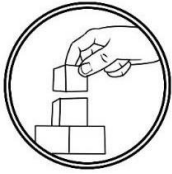
**Solution:**

The **parameter of interest** is the average height of the Grade 11 female students.

The **null hypothesis** is the average height of Grade 11 students is above 158 cm. In symbol, **H<sub>o</sub>:  $\mu \leq 158$** .

The alternative hypothesis is the average height of Grade 11 students is not above 158 cm. In symbol, **H<sub>a</sub>:  $\mu > 158$**  (claim) .





## Explore

Here are some enrichment activities for you to work on to master and strengthen the basic concepts you have learned from this lesson.

### Enrichment Activity 1: Complete Me!

**Directions:** Read and analyze the given problem, then give what is asked to complete the table below. Use a separate sheet of paper for your answer.

*A teacher wants to know if listening to popular music affects the performance of pupils. A class of 50 grade 1 pupils was used in the experiment. The mean score was 83 and the standard deviation is 5. A previous study revealed that  $\mu = 82$  and the standard deviation  $\sigma = 10$*

Question	Answer
1. Identify the parameter of interest.	
2. What is the null hypothesis?	
3. What is the alternative hypothesis?	
4. Write in symbol the null hypothesis.	
5. Write in symbol the null hypothesis.	

**Assessment 1.** Read and analyze the given problem.

Identify the parameters to be tested on real-life problem. State the null and alternative hypothesis. Write your answer on the answer sheet provided.

1. A researcher wants to estimate the number of hours that 5-year old children spend watching television. A sample of 50 five-year old children was observed to have a mean viewing time of 3 hours. The population is normally distributed with a standard deviation of 0.5.

Parameter: \_\_\_\_\_

$H_0$ : \_\_\_\_\_

$H_1$ : \_\_\_\_\_

2. The average height of grade 11 female students is 158.2 cm. The mean height of a sample of 100 female students is 160 cm with a standard deviation of 6 cm.

Parameter: \_\_\_\_\_

$H_0$ : \_\_\_\_\_

$H_1$ : \_\_\_\_\_

3. The net weight of a packet of a snack brand is 130 g. A sample of 80 packs yielded a sample mean weight of 112 g with standard deviation of 15 g.

Parameter: \_\_\_\_\_

$H_0$ : \_\_\_\_\_

$H_1$ : \_\_\_\_\_

4. A statistics class at a large high school suspects that students at their school are getting less than 8 hours of sleep on average. To test their theory, they randomly sample 42 of these students and ask them how many hours of sleep they get per night. The mean from the sample is  $\bar{x} = 7.5$  hours.

Parameter: \_\_\_\_\_

$H_0$ : \_\_\_\_\_

$H_1$ : \_\_\_\_\_

5. A restaurant owner installed a new automated drink machine. The machine is designed to dispense 530 mL of liquid on the medium size setting. The owner suspects that the machine may be dispensing too much in medium drinks. They decide to take a sample of 30 medium drinks to see if the average amount is significantly greater than 530mL.

Parameter: \_\_\_\_\_

$H_0$ : \_\_\_\_\_

$H_1$ : \_\_\_\_\_

### Enrichment Activity 2: Fill the Missing Piece!

**Directions:** Complete the table below by writing the parameter, null hypothesis and alternative hypothesis.

1. A study of all homes sold at auction in Laguna last year showed that the average sale price for such homes was Php 650,000.00	Parameter:
2. A researcher made a random sample of 100 deaths and found that the average life span of Filipinos is 69.3.	Null Hypothesis: Alternative Hypothesis:

Assuming a population standard deviation of 7.8 years, does this seem to indicate that the life span today is lesser than 70 years? In this case, what parameters should the researcher consider?	
3. A survey conducted the college students in their study stated that cell phone owners received an average of 65 texts every day. What parameter should these students consider proving this claim?	Null Hypothesis: Alternative Hypothesis:

**Assessment 2.** Complete the following hypothesis by providing the appropriate symbol.

1. We want to test if college students take less than five years to graduate from college,  
on the average.

$$H_o: \mu \_ 5$$

$$H_a: \mu \_ 5$$

- 2.. The school wants to test whether the mean grade point average in the Philippines colleges is different from 2.0 (out of 4.0).

$$H_o: \mu \_ 2$$

$$H_a: \mu \_ 2$$

3. The owner of a Pepsi Cola that sells a particular bottled juice claims that average capacity of a bottle of their product is 355 ml. Is the claim true?

$$H_o: \mu \_ 355$$

$$H_a: \mu \_ 355$$

4. A study of every national park's sales receipts for August shows they brought in an  
average of more than ten million dollars in revenue.

$$H_o: \mu \_ 10,000,0000$$

$$H_a: \mu \_ 10,000,000$$

5. A researcher wants to estimate the average height of women aged 20 years old. From a simple random sample of 45 women, the researcher obtains a sample mean  
height of 63.9 inches.

$$H_o: \mu \_ 63.9$$

$$H_a: \mu \_ 63.9$$



## ***Deepen***

In this activity, you will upgrade your comprehension on hypothesis testing. The scoring rubric below will be used in assessing your output.

### **Activity 1. Real-Life Scenarios!**

#### **What you need**

Bond paper

Ballpen

#### **What you have to do**

1. Give at least 2 real-life scenarios around you.
2. Identify the parameters given to be tested.
3. Formulate the null and alternative hypothesis.

#### **Rubrics for Scoring**

5	4	3	2	1
Give at least 2 real-life scenarios and answer what is being asked correctly.	Give 1 real-life scenario and answer what is being asked.	Answer 1 real-life scenario but NOT clearly answer what is being asked	Answer is NOT clearly stated on what is being asked	Answer is NOT connected to the question.



A. 1                      B. 2                      C. 3                      D. 4

7. What do you call a number that describes a population characteristic?  
A. mean      B. parameter      C. sample      D. variable
8. What do you call the set of all people, objects, events, or ideas you want to investigate?  
A. data      B. population      C. sample      D. statistics
9. When the null hypothesis is rejected, which of the following is true?  
A. The conclusion is guaranteed  
B. The conclusion is not guaranteed  
C. There is a sufficient evidence to back up the decision  
D. There is no sufficient evidence to back up the decision.
10. Which of the following symbol refers to greater than or equal to in formulating hypothesis?  
A.  $\leq$       B.  $\geq$       C.  $>$       D.  $<$
11. What hypothesis refers to a statement that shows a difference between two parameters?  
A. alternative hypothesis      B. directional test  
C. null hypothesis      D. non- directional test
12. Which statement does **NOT** refer to a parameter?  
A. That city has a population of more than 567,345.  
B. There are 305 doctors in Naguilian District Hospital  
C. The number of students enrolled at the Mala Elementary School is 278.  
D. A survey of 2000 federation members had shown that 25% believed policed should have the right to take industrial action.
13. A researcher has exam result for students who took a training course for a national exam. The researcher wants to know if trained students score above the national average of 850. Which of following is the parameter of interest?  
A. The researcher  
B. The training course  
C. The national exam  
D. The average score of 850
14. Refer to item 12, what will be the null hypothesis?  
A.  $H_0: \mu = 850$       B.  $H_0: \mu > 850$       C.  $H_0: \mu < 850$       D.  $H_0: \mu \neq 850$
15. Refer to item 12, what will be the alternative hypothesis?  
A.  $H_1: \mu = 850$       B.  $H_1: \mu > 850$       C.  $H_1: \mu < 850$       D.  $H_1: \mu \neq 850$

*Great job! You made it. Congratulations!*

# ***References***

## **Printed Materials:**

Department of Education, Bureau of Learning Resources (DepEd-BLR). (2016). Lesson 1: Statistics and Probability Learner's Material (pp 216-222). Pasig City, Philippines Belecina, Baccay & Mateo 2016). Statistics and Probability (First Edition). Quezon City, Philippines: Rex Bookstore, Inc.

Statistics and Probability for Senior High School (pp 145- 148). Malabon City, Philippines, Lactuan, Lactuan Oredina and et al.; Jimczyville Publications

## **Website:**

<https://towardsdatascience.com/hypothesis-testing-in-real-life-47f42420b1f7>

[https://www.investopedia.com/terms/n/null\\_hypothesis.asp](https://www.investopedia.com/terms/n/null_hypothesis.asp)

<https://towardsdatascience.com/everything-you-need-to-know-about-hypothesis-testing-part-i-4de9abebbc8a>

<https://analyse-it.com/docs/user-guide/distribution/continuous/parameter-hypothesis-test>

<https://link.quipper.com/en/organizations/5a09119abc453f00340006d4/curriculum>

<https://courses.lumenlearning.com/introstats1/chapter/null-and-alternative-hypotheses/>

<https://www.investopedia.com/terms/h/hypothesis-testing.asp>

<https://www.khanacademy.org/math/statistics-probability/significance-tests-one-sample/idea-of-significance-tests/e/writing-null-and-alternative-hypothesis-informal>