Senior High School

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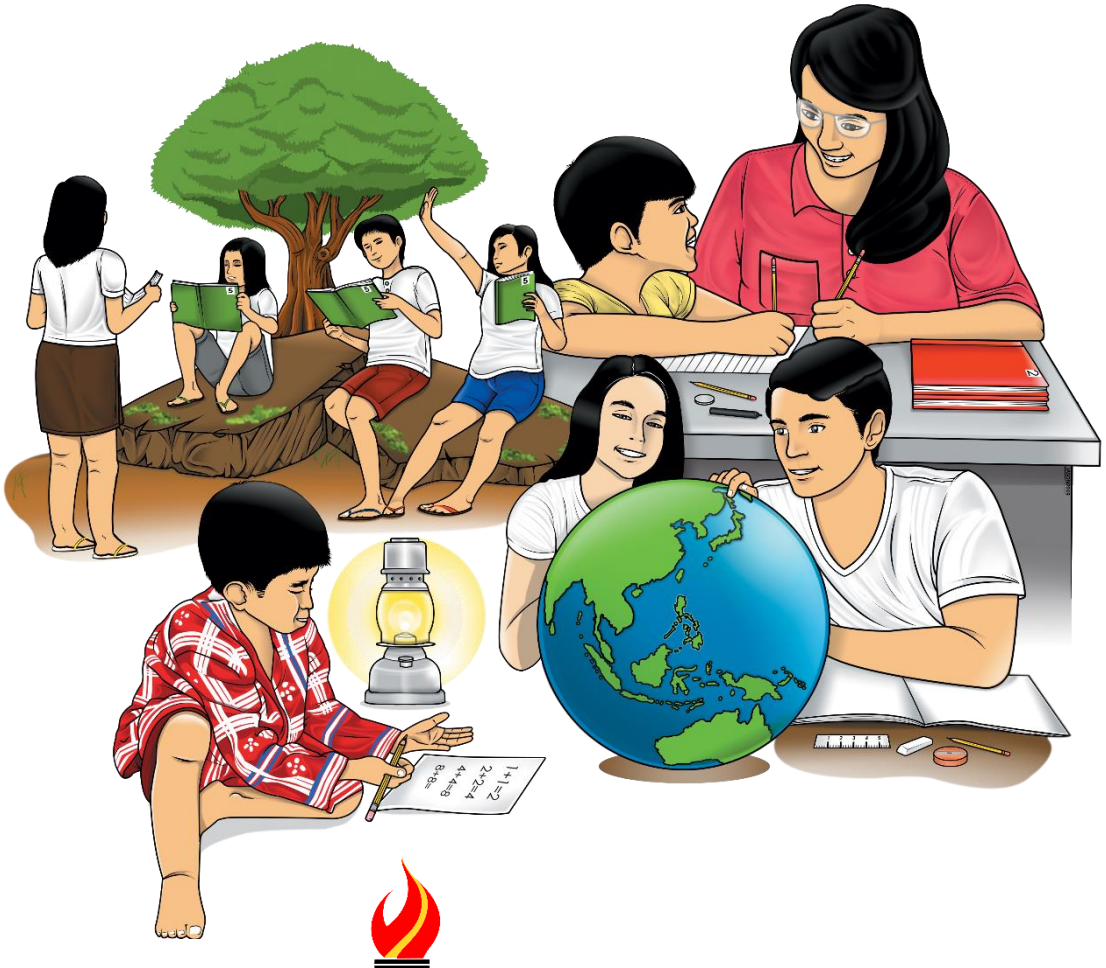
Statistics

Quarter 4 – Module 3: Formulating Appropriate Null and Alternative Hypotheses on a Population Mean



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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.

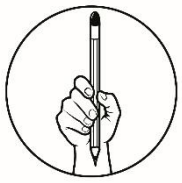
What I Need to Know

In the previous module, you learned about the parameters used in hypothesis testing. You were able to identify the parameters to be tested in given real-life problems. You also learned how to translate the parameter into mathematical symbols as the first step in hypothesis testing.

In this module, you will learn how to formulate null and alternative hypotheses on a population mean.

After going through this module, you are expected to:

1. identify the notation to be used in formulating hypotheses;
2. illustrate one-tailed and two-tailed tests;
3. differentiate null and alternative hypotheses; and
4. formulate null and alternative hypotheses.



What I Know

Choose the best answer to the given questions or statements. Write the letter of your answer on a separate sheet of paper.

1. In formulating the alternative hypothesis, what mathematical symbol is applicable to use in the statement, *"The average score of Grade 11 (ABM) in Business Statistics is 75."*?
   a. < b. > c. = d. ≠

2. A vacuum cleaner consumes less than 46 kwh per year. What hypothesis test can you use in this claim?
   a. left-tailed c. null hypothesis
   b. right- tailed d. alternative hypothesis

3. Which of the following steps is not included in formulating a hypothesis?
   a. Identify the claim to be tested.
   b. Translate the claim into mathematical symbols/notations.
   c. Use the data about the sample then compute the test statistic.
   d. Formulate first the null hypothesis and then the alternative hypothesis.

4. The sign of the alternative hypothesis in a left-tailed test is always _____
   a. Equal c. less than
   b. not equal d. greater than

5. A scientist invented a substance that increases the life of an automobile battery. If the mean lifetime of the battery is 24 months, then what are his hypotheses?
   a. $H_o: \mu = 24,\ H_a: \mu \neq 24$
   b. $H_o: \mu = 24, H_a: \mu > 24$
   c. $H_o: \mu = 24,\ H_a: \mu \leq 24$
   d. $H_o: p = 24,\ H_a: p > 24$

6. A researcher reports that the average salary of an accountant is more than ₱40,000. A sample of 30 accountants has a mean salary of ₱42,500. At a = 0.05 test, it is found out that an accountant earns more than ₱40,000 a month. The standard deviation of the population is ₱3,000. What is the alternative hypothesis?
   a. The average salary of an accountant is equal to ₱40,000.
   b. The average salary of an accountant is greater than ₱40,000.
   c. The average salary of an accountant is less than or equal to ₱42,500.
   d. The average salary of an accountant is greater than or equal to ₱42,500.

7. What kind of hypothesis is illustrated in the statement below?
   "There is no significant difference between the average weekly allowances of morning and afternoon students in Mabunga Integrated High School."
   a. one-tailed test
   b. two-tailed test
   c. null hypothesis
   d. alternative hypothesis

8. "The introduction of modern computers affects the performance of the students." What kind of hypothesis is it?
   a. Null
   b. Mean
   c. alternative
   d. standard deviation

9. Consider this statement: "New cars are expected to last an average of at least three (3) years before needing major service." Which of the following is the null hypothesis?
   a. $H_o: \mu \leq 3$ b. $H_o: \mu < 3$ c. $H_o: \mu > 3$ d. $H_o: \mu \geq 3$

10. Which is the correct null hypothesis of the claim below? "Students take an average of less than five (5) years to graduate from college."
    a. $H_o: \mu = 5$ b. $H_o: \mu < 5$ c. $H_o: \mu \neq 5$ d. $H_a: \mu < 5$

11. In the driver's test, an average of 300 drivers passes on their first try. We want to test if more than an average of 300 passes on the first try. Which inequality symbols are correct (=, ≠, ≥, <, ≤, >) for the null and alternative hypotheses - $H_o: \mu$ __ 300 $H_a: \mu$ __ 300?
    a. <, > b. =, ≠ c. ≤, ≥ d. =, >

12. Which of these is a correct alternative hypothesis for a two-tailed test?
    a. $H_a: \mu \neq 7$ b. $H_a: \mu = 7$ c. $H_a: \mu > 7$ d. $H_a: \mu < 7$

13. In a commercial, a new diet program would like to claim that their methods result in a mean weight loss of more than 22kgs in two (2) weeks. To determine if this is a valid claim, they hire an agency that then selects 25 people to be placed on this diet. What is the test of the hypothesis?
    a. null
    b. alternative
    c. one-tailed test
    d. two-tailed test

14. A researcher estimated that the average height of a building in the Philippines is at least 150 meters. A random sample of 15 buildings is selected and has the mean of 168 meters. What are the null and alternative hypotheses?
    a. $H_o: \mu > 150, H_a: \mu \leq 150$
    b. $H_o: \mu = 150, H_a: \mu \neq 150$
    c. $H_o: \mu = 150, H_a: \mu \geq 150$
    d. $H_o: \mu \geq 150, H_a: \mu < 150$

15. A survey reported that teenagers spend an average at most four (4) hours each day on social media. The organization thinks that, currently, the mean is higher. Fifteen (15) randomly chosen teenagers were asked how many hours per day do they spend on social media. The sample mean was 4.5 hours with a sample standard deviation of 2.0. What is the test of the hypothesis?
    a. left-tailed test
    b. two-tailed test
    c. hypothesis test
    d. right-tailed test

Lesson 1 Formulating Appropriate Null and Alternative Hypotheses on a Population Mean

In statistics, hypothesis testing is the process of using statistical tests to determine whether an observed difference between two or more samples is statistically significant or not. From a practical point of view, hypothesis testing allows you to collect samples and make decisions based on facts, not on how you feel or what you think is right. To be able to prove your assumptions, you must state first the null and alternative hypotheses.

This module will start by recalling your knowledge of the equality/inequality symbols. This concept will help you understand how to a formulate hypothesis.

What's In

Activity 1. No More No Less!

Which of the given equality/inequality expressions describes each situation? Select the best answer and write the letter of your choice on a separate sheet of paper.

1. The survey shows that the number of students (n) who have parents with a house of their own is less than 20.
   a. $n < 20$ b. $n > 20$ c. $n \leq 20$ d. $n \geq 20$
2. Mother gives me at most P200 allowance (n) in a week.
   a. $n \geq 200$ b. $n \leq 200$ c. $n > 200$ d. $n < 200$
3. Larry is an industrious appliance salesman. His average sales (n) in a week is at least P10, 000.
   a. $n < 10,000$ b. $n > 10,000$ c. $n \leq 10,000$ d. $n \geq 10,000$
4. A son's savings (n) is greater than P1,500.
   a. $n = 1{,}500$ b. $n \neq 1{,}500$ c. $n > 1{,}500$ d. $n \geq 1{,}500$
5. Marco's salary (n) is equal to P20, 000.
   a. $n = 20{,}000$ b. $n \neq 20{,}000$ c. $n \leq 20{,}000$ d. $n < 20{,}000$

Guide Questions:

1. How did you find the previous activity? Was it easy or difficult?
2. What previously learned principle did you apply in the activity?
3. Were you able to determine the correct expression that corresponds to each situation? Elaborate.
4. Do you think you will apply these activities in formulating null and alternative hypotheses?

Notes to the Teacher

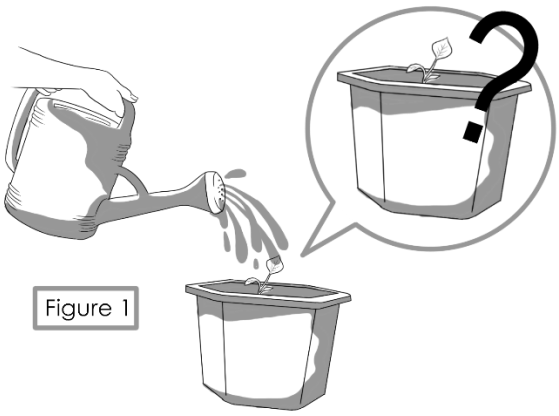
Check the level of readiness of the students. If the students failed to answer all the items correctly, provide another activity to recall past lessons that involve translating verbal phrase into symbols and comparison of quantities using different equality and inequality symbols.

What's New

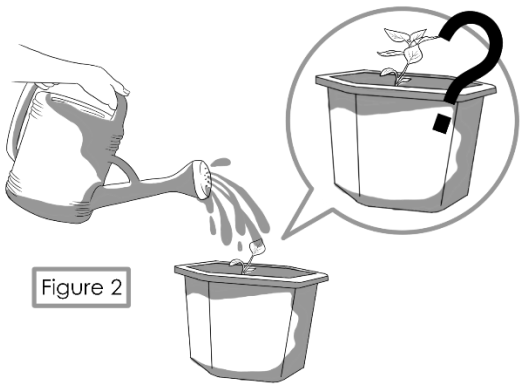
Activity 2. Differentiate It!

Examine the pictures below then answer the guide questions that follow.

"Effect of a Fertilizer on Plant Growth"



Without Fertilizer



With Fertilizer

Guide Questions:

1. What have you observed between the two figures?
2. Do you think the fertilizer has an effect on the plant?
3. What do you think are the variables shown in the pictures?
4. Is there any relationship among the variables in Figure 1 and Figure 2?
5. How do these pictures relate to the hypothesis?

What is It

A **statistical hypothesis** is a statement about a parameter and deals with evaluating the value of a parameter.

In statistical hypothesis testing, there are always two hypotheses: the **null** and the **alternative** hypotheses. Below is a comparison between the two.

Null Hypothesis (H_o)	**Alternative Hypothesis (H_a)**
- It states that there is no difference between population parameters (such as mean, standard deviation, and so on) and the hypothesized value. - There is no observed effect. - The null hypothesis is often an initial claim that is based on previous analyses or specialized knowledge.	- It states that the population parameter has some statistical significance (smaller, greater, or different than) with the hypothesized value. - There is an observed effect. - The alternative hypothesis is what you might believe to be true or hope to prove true.

To state the null and alternative hypotheses correctly:

1. *Identify the parameter in a given problem.*
2. *Identify the claim to be tested that may show up in null or alternative hypothesis.*
3. *Translate the claim into mathematical symbols/notations.*
4. *Formulate first the null hypothesis (H_o) then alternative hypothesis (H_a) based on the three different ways in writing hypothesis as illustrated below:*

$\boldsymbol{H_o}: \mu = \boldsymbol{k}$	$\boldsymbol{H_o}: \mu \leq \boldsymbol{k}$	$\boldsymbol{H_o}: \mu \geq \boldsymbol{k}$
$\boldsymbol{H_a}: \mu \neq \boldsymbol{k}$	$\boldsymbol{H_a}: \mu > \boldsymbol{k}$	$\boldsymbol{H_a}: \mu < \boldsymbol{k}$

Hypothesis-Testing Common Phrases

=	is equal to is the same as is exactly the same as has not changed from	≠	is not equal to is not the same is different from has changed from
>	is increased is greater than is higher than is above is bigger than is longer than is more than	<	is decreased is less than is lower than is below is smaller than is decreased or reduced from is not more than
≥	is at least is not less than is greater than or equal to	≤	is at most is not more than is less than or equal to

Let us take an example from your previous activity.
"The survey shows that the number of students (n) who have parents with a house of their own is less than 20."

The claim used the word "less than" which as seen in the table above, corresponds to the symbol (<). *Therefore, the answer is* ***n<20.***

Note:
H_o always has = symbol in it. H_a never has an = symbol in it. The choice of symbol depends on the wording of the hypothesis test. However, be aware that many researchers use = (equal sign) in the null hypothesis, even with > or < as the symbol in the alternative hypothesis. Notice also that the notation of alternative hypothesis complements the null hypothesis.

Illustrative Examples:

1. **The average weight of all Grade 11 students in Senior High School is 169cm. Is this claim true?**

   Solution: First, identify the parameter which is the mean height of all Grade 11 students. Since it is a population mean, use the notation $\boldsymbol{\mu}$. The claim in this example is that ***the average weight is 169 cm*** which translates to $\boldsymbol{\mu = 169}$ and is considered as null hypothesis. To formulate the alternative hypothesis, write the complement/opposite of the null hypothesis which is ***the average weight is not equal to 169 cm.***

   $\boldsymbol{H_o}$**:** The average weight of all Grade 11 students is 169 cm. / $\boldsymbol{H_O: \mu = 169}$ **(claim)**
   $\boldsymbol{H_a}$: The average weight of all Grade 11 students is not 169 cm./ $\boldsymbol{H_a: \mu \neq 169}$

2. **The average price per square meter of a residential lot in an exclusive subdivision is above ₱15,000. A buyer wants to test the agent's claim.**

   Solution: In this hypothesis, the parameter is the average. Therefore, you will use the symbol **μ**. The claim ***is above ₱15,000*** can be written as $\mu > ₱15,000$ and ***greater than*** falls at alternative hypothesis, $H_a: \mu > ₱15,000$. Since you have already formulated the alternative, the null hypothesis will be $H_o: \mu \leq ₱15,000$ as a complement of **>.** You can also write your null hypothesis as $H_o: \mu = ₱15,000$.

   $H_o: \mu \leq ₱15,000$ ***or*** $H_o: \mu = ₱15,000$
   $H_a: \mu > ₱15,000$ **(claim)**

3. **Holistic Fitness Center claims that its members reduced an average of 13 pounds after joining the center. An independent agency that wanted to check this claim took a sample of 40 members and found that they reduced an average of 12 pounds with the standard deviation of 4 pounds. Determine the null and alternative hypotheses.**

   Solution: In this example, the parameter to be tested is the ***average*** and the claim is ***reduced by 13 pounds***. The claim that pertains to the parameter has the notation of (<). Therefore, the claim is found at the alternative hypothesis and can be written as $H_a: \mu < 13$**.** The null hypothesis would be $H_o: \mu \geq 13$ **or** $H_o: \mu = 13$**.**

   $H_o: \mu \geq 13$ **or** $H_o: \mu = 13$**.**
   $H_a: \mu < 13$ **(claim)**

4. **The treasurer of a municipality claims that the average net worth of families in the municipality is at least ₱730,000. A random sample of 50 families from this area produced a mean net worth of ₱860,000 with a standard deviation of ₱65,000. What are the null and alternative hypotheses?**

   Solution: In this example, the parameter is the ***average*** and the claim is that the average is **at least** ₱730,000. The word ***at least*** has the notation of (≥) which means that the claim is at the null hypothesis. In the alternative hypothesis, you will use (<) as its complement. Therefore:

   $H_O: \mu \geq ₱730,000$ **or** $H_O: \mu = ₱730,000$ **(claim)**
   $H_a: \mu < ₱730,000$

5. **An academic organization claimed that Grade 11 students' study time is at most 240 minutes per day, on average. Another survey was conducted to find whether the claim is true. The group took a random sample of 30 students and found a mean study time of 300 minutes with standard deviation of 90 minutes. What are the null and alternative hypotheses?**

Solution: The parameter used in this example is ***average (μ)*** and the claim is that average is **at most** 240 minutes. The word ***'at most'*** has the notation of (≤) which means that claim is at the null hypothesis. The null hypothesis would be $\boldsymbol{H_0}: \mu \leq \mathbf{240}$. To formulate the alternative, use the notation (>) as the complement of (≤). Therefore, the alternative hypothesis is $\boldsymbol{H_a}: \mu > \mathbf{240}$.

$\boldsymbol{H_0}: \mu \leq \mathbf{240}$ **or** $\boldsymbol{H_0}: \mu = \mathbf{240}$ **(claim)**
$\boldsymbol{H_a}: \mu > \mathbf{240}$

One-Tailed and Two-Tailed Test

The alternative hypothesis can take another form depending on the value of the parameter. The parameter may increase, decrease, or changed from the null value. An alternative hypothesis predicts not only the difference of sample mean from the population mean but also how it would be different in a specific direction - lower or higher. This test is called a **directional** or **one-tailed test** because the rejection region is entirely within one tail of the distribution.

On the other hand, some hypotheses predict only that one value will be different from another, without additionally predicting which will be higher. The test of such a hypothesis is **nondirectional** or **two-tailed** because an extreme test statistic in either tail of the distribution (positive or negative) will lead to the rejection of the null hypothesis of no difference.

One-Tailed	***Two-Tailed***
• Alternative hypothesis contains the greater than (>) or less than (<) symbols • It is directional (either right-tailed or left-tailed)	• Alternative contains the inequality (≠) symbol. • It has no direction.

The table below shows the null and alternative hypotheses stated together with the directional test.

	Two-Tailed Test	**Right-Tailed Test**	**Left-Tailed Test**
Null Hypothesis	$H_o: \mu = \mu_o$	$H_o: \mu = \mu_o$ or $H_o: \mu \leq \mu_o$	$H_o: \mu = \mu_o$ or $H_o: \mu \geq \mu_o$
Alternative Hypothesis	$H_a: \mu \neq \mu_o$	$H_a: \mu > \mu_o$	$H_a: \mu < \mu_o$

Illustrative Examples:

Determine the hypotheses and the hypothesis test.

1. **Teacher A wants to know if mathematical games affect the performance of the students in learning Mathematics. A class of 45 students was used in the study. The mean score was 90 and the standard deviation was 3. A previous study revealed that $\mu = 85$ and the standard deviation $\sigma = 5$.**

The parameter is the population mean $\mu = 85$. You can write the hypotheses into symbols: $H_0 : \mu = 85$ and $H_a : \mu \neq 85$. The phrase ***'affects performance'*** has no clue of the direction of the study, so it implies either an increase or decrease in performance. This tells you that the test is a ***two-tailed test.***

$\boldsymbol{H_0 : \mu = 85}$ **and** $\boldsymbol{H_a : \mu \neq 85}$ ***(two-tailed test)***

2. **A piggery owner believes that using organic feeds on his pigs will yield greater income. His average income from the previous year was ₱120, 000. State the hypothesis and identify the directional test.**

   In this example, the null hypothesis is $\boldsymbol{H_0 : \mu = 120,000}$. You may notice that the hypothesis used the phrase ***'greater income'*** that is associated with greater than. Therefore, $\boldsymbol{H_a : \mu > 120,000}$. This hypothesis uses inequality symbol (>) so it is ***one-tailed test*** and it uses ***greater than*** which specifically called for the ***right-tailed test.***

   $\boldsymbol{H_0 : \mu = 120,000}$ **and** $\boldsymbol{H_a : \mu > 120,000}$ **(*right-tailed test)***

3. **The average waiting time of all costumers in a restaurant before being served is less than 20 minutes. Determine the hypotheses and the directional test.**

   You may notice that the hypothesis used the phrase ***'less than'*** which denotes that the alternative hypothesis is $\boldsymbol{H_a : \mu < 20}$. This hypothesis uses the inequality symbol (<) so it is a ***one-tailed test*** and it used **less than** what is specifically called for the ***left-tailed test.*** In this example, the null hypothesis is $\boldsymbol{H_0 : \mu \geq 20}$**.**

   $\boldsymbol{H_0 : \mu \geq 20}$ **and** $\boldsymbol{H_a : \mu < 20}$ **(*left-tailed test)***

What's More

Activity 3. Fill Me!

Determine what is asked in each problem as indicated by the blanks.

1. A school principal claims that the Grade 11 students in her high school have a mean score of 92.

   Parameter: _____ Null Hypothesis: _____

   Claim: mean score of 92 Alternative Hypothesis: H_a: μ ≠ 92

2. A medicine company has manufactured and claimed that their medicine pill contains an average of 14mg of an active ingredient.
   Parameter: average Null Hypothesis: _____
   Claim: average of 14mg Alternative Hypothesis: _____

3. A certain product produced by a manufacturing company is supposed to weigh at least 12lbs.
   Parameter: _____ Null Hypothesis: H_o: μ ≥ 121
   Claim: weigh at least 12lbs Alternative Hypothesis: _____

4. The Bureau of Internal Revenue claims that the mean wait time for taxpayers during a recent tax filing is at most 8.7 minutes. A random sample of 11 taxpayers has a mean wait time of 8.7 minutes and a standard deviation of 2.7 minutes. Is there enough evidence to reject the claim at a significance level of 0.10?
   Parameter: mean Null Hypothesis: _____
   Claim: _____ Alternative Hypothesis: H_a: μ > 8.7

5. According to a company, the mean pH level of the river water is 7.4. A researcher randomly selected 15 river water samples and found out that the mean is 6.7 with a standard deviation of 0.24.
   Parameter: mean
   Claim: mean pH level of the water river is 7.4
   Null Hypothesis: _____
   Alternative Hypothesis: _____

Activity 4. Let' s Hypothesize

Write the null hypothesis and alternative hypothesis in notations for each given situation.

1. Mrs. Dela Cruz claims that her students scored an average of 91 in their Mathematics quiz. The master teacher wants to know whether the teacher's claim is acceptable or not.
   H_o: _____
   H_a: _____

2. A car manufacturer claims that the mean selling price of all cars manufactured is only ₱150,000. A consumer agency wants to test whether the mean selling price of all the cars manufactured exceeds ₱150, 000.
   H_o: _____
   H_a: _____

3. A manufacturer of soft drinks claims that all labeled 1.5-liter bottles contain an average of 1.49 liters of soft drinks. A retailer wishes to test whether the mean amount of soft drinks in a labeled 1.5-liter bottle is less than 1.49 liters.

   H_o: _____

   H_a: _____

4. A bus company in Manila claims that the mean waiting time for a bus during rush hour is less than 12 minutes. A random sample of 30 waiting times has a mean of 15 minutes with a standard deviation of 4.8 minutes.

   H_o: _____

   H_a: _____

5. The average power consumption of an air conditioner is at most 2,700 watts as claimed by the owner. A survey made by an electric power company found out that the mean consumption is 3,000 with a standard deviation of 225.

   H_o: _____

   H_a: _____

Activity 5. One-Tailed or Two-Tailed!

Identify whether the given hypothesis is one-tailed or two-tailed. Write ONE if it is one-tailed and TWO if it is two-tailed test.

1. A used car dealer says that the mean price car in the Philippines is at least ₱350,000.

2. PAG-ASA reported that the mean annual rainfall in the Philippines is at most 4,064mm.

3. According to the survey, the average cost of visiting doctors is ₱500.

4. The mean age of students in a university in the previous years was 27 years old. An instructor thinks the mean age for students is older than 27. She randomly surveys 56 students and finds that the sample mean is 29 with a standard deviation of 2.

5. The mean work week for engineers in a new company is believed to be about 40 hours. A newly hired engineer hopes that it is shorter. She asks 10 engineering friends for the lengths of their mean work weeks. Based on the results, should she count on the mean work week to be shorter than 40 hours?

Activity 6. Formu-Tail

Formulate the null and alternative hypotheses. Identify whether it is one-tailed or two-tailed. If the hypothesis is one tailed, identify its direction whether it is left or right. Write your answer on a separate sheet of paper.

1. The average salary of an accountant is **₱24,620** per month in the Philippines.
   H_o: _____ H_a: _____ _____-tailed test

2. A normal smartphone battery manufacturer claims that the mean life of a certain type of battery is more than 650 hours.
   H_o: _____ H_a: _____ _____-tailed test

3. According to an international shipping company, a package from the US can arrive in Manila in an average of less than 8 business days.
   H_o: _____ H_a: _____ _____- tailed test

4. The average price of a certain type of car is greater than ₱600,000.
   H_o: _____ H_a: _____ _____-tailed test

5. A research organization reports that the mean of adult grocery shoppers who never buy the store brand in Metro Manila is 300.
   H_o: _____ H_a: _____ _____- tailed test

6. A study claims that the mean survival period for certain cancer patients treated immediately with chemotherapy and radiation is 24 months.
   H_o: _____ H_a: _____ _____- tailed test

7. The average pre-school cost for tuition fees last year was ₱ 15,500. The following year, 20 schools had a mean of ₱ 13, 100 and standard deviation of ₱ 2,500.
   H_o: _____ H_a: _____ _____- tailed test

8. A magazine reports that a typical shopper spends less than 10 minutes in line waiting to check out. A sample of 30 shoppers at the DM Supermarket showed a mean of 9.5 minutes with a standard deviation of 2.7 minutes.
   H_o: _____ H_a: _____ _____-tailed test

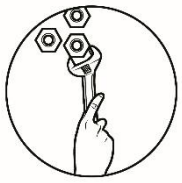
9. The principal of Mabundok High School claims that the students in his school have above-average intelligence. A random sample of 30 students' IQ scores have a mean score of 113. The mean population IQ is 100 with a standard deviation of 15. Is there any evidence to support his claim?
   H_o: _____ H_a: _____ _____-tailed test

10. The owner of BYD manufacturer claims that their batteries last an average of at most 350 hours under normal use. A researcher randomly selected 20 batteries from the production line and tested them. The tested batteries had a mean life span of 270 hours with a standard deviation of 50 hours.
    H_o: _____ H_a: _____ _____-tailed test

What I Have Learned

Complete the following statements.

1. _____ is a statement about a parameter and deals with evaluating the value of parameter.
2. The two kinds of hypothesis are_____ and _____.
3. To formulate a hypothesis, the steps are:
   a. _____
   b. _____
   c. _____
   d. _____
4. The test of hypothesis can be _____ if the alternative hypothesis uses ≠ symbol or _____ if it uses $<$ *or* $>$ symbols.
5. The null hypothesis and alternative hypothesis can be denoted as _____ and _____, respectively.



What I Can Do

Cite five (5) research questions used in real life and formulate your null and alternative hypotheses.

Example: Is it true that turmeric can prevent viruses?

H_o: Drinking turmeric cannot prevent viruses.

H_a: Drinking turmeric can prevent viruses.

Assessment

Multiple Choice: Choose the best answer to the given questions or statements. Write the letter of your answer on a separate sheet of paper.

1. This hypothesis states that there is no difference between population parameters and the hypothesized value.
   a. hypothesis
   b. null hypothesis
   c. alternative hypothesis
   d. two-tailed hypothesis

2. When the value of parameter has significant difference with the hypothesized value, then it is called _____.
   a. one-tailed test
   b. two-tailed test
   c. null hypothesis
   d. alternative hypothesis

3. The sign of the alternative hypothesis in a left-tailed test is always_____.
   a. equal b. less than c. not equal d. greater than

4. If the researcher wishes to test the claim that the mean of the population is 75, the appropriate null hypothesis is:
   a. $\mu \leq 75$ b. $\mu \geq 75$ c. $\mu \neq 75$ d. $\mu = 75$

5. A researcher thinks that if expectant mothers use vitamins, the birth weight of the babies will increase. The average birth weight of the population is 3.9 kgs. What is the alternative hypothesis?
   a. $H_a: \mu > 3.9$ b. $H_a: \mu < 3.9$ c. $H_a: \mu = 3.9$ d. $H_a: \mu \neq 3.9$

6. According to the report, the average weight of a Filipino newborn baby is 2. 8 kgs. Mellissa wants to perform a significance test to see if this holds true in her nation. She takes a random sample of babies and observes that the average weight of newborns is 3kgs. What is the null hypothesis?
   a. A. $H_a: \mu > 2.8$ b. $H_a: \mu < 2.8$ c. $H_a: \mu = 2.8$ d. $H_a: \mu \neq 2.8$

7. What kind of hypothesis is illustrated below?
   The mean score of all Grade 11 students is higher than 75.
   a. one-tailed test
   b. two-tailed test
   c. null hypothesis
   d. alternative hypothesis

8. "A modern approach in the advertisement will not increase the demand for a product." This is an example of _____ hypothesis.
   a. Null
   b. Mean
   c. alternative
   d. right-tailed

9. What is the alternative hypothesis in the following statement?
"The number of defective batteries produced by the company is not equal to 15 batteries a day as claimed by the manager."
a. $\mu = 15$ b. $\mu \neq 15$ c. $\mu > 15$ d. $\mu < 15$

10. Which is the correct null hypothesis of the given statement?
"According to the owner, an average of 500 people buys foods at McDonalds during breakfast and lunch hours."
a. $H_o = 500$ b. $H_o \neq 500$ c. $H_o < 500$ d. $H_o > 500$

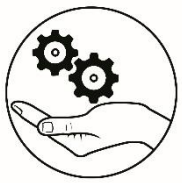
11. On average, the household electricity consumption in the country was about 248.1-kilowatt-hours in 2015. Electricity was used primarily for lighting purposes, cooking, recreation, and space cooling. Which inequality symbols are correct (=, ≠, ≥, <, ≤, >) for the null and alternative hypotheses: H_o: μ __ 248.1 H_a: μ __ 248.1?
a. $=, >$ b. $<, >$ c. $=, \neq$ d. $\leq, \geq$

12. Which is the correct alternative hypothesis for a one-tailed test?
a. $\mu = 25$ b. $\mu \neq 25$ c. $\mu \geq 25$ d. $\mu < 25$

13. A teacher in Math announced that the mean score of Grade 9 students in the first quarterly assessment in Mathematics was 89 and the standard deviation was 6. One student, who believed that the mean score was less than this, randomly selected 30 students and computed the mean score. What kind of test of hypothesis can describe this?
a. left-tailed b. two-tailed c. right-tailed d. multiple-tailed

14. Determine the null and alternative hypotheses.
"It was claimed that the average monthly income of aircraft pilot was ₱116, 714.00. A random sample of 45 pilots is selected and it is found out that the average monthly salary is ₱ 120,000. Using a 0.01 level of significance, can it be concluded that there is an increase in the average monthly income of pilots?"
a. H_o: $\mu = ₱116,714.00, H_a$: $\mu \leq ₱116,714.00$
b. H_o: $\mu = ₱116,714.00, H_a$: $\mu \neq ₱116,714.00$
c. H_o: $\mu = ₱116,714.00, H_a$: $\mu > ₱116,714.00$
d. H_o: $\mu = ₱116,714.00, H_a$: $\mu < ₱116,714.00$

15. Which directional test is illustrated in the given problem below?
In a recent survey, the average amount of money students have in their wallet is ₱200.00 with standard deviation of 45. A teacher feels that the average amount is lower. She surveyed 80 randomly selected students and found that the average amount is ₱35.
a. left-tailed b. two-tailed c. alternative d. right-tailed



Additional Activities

Activity 6. Let Us Take a Challenge!

1. Based on the data provided in a known website article entitled "Tuition Fee Guide: 2019 Cost of College Education in the Philippines", the average tuition fee in private colleges and universities is greater than ₱145,000 a year. Suppose that we want to perform a hypothesis test to find whether the average tuition fee is greater than ₱145.000.
   a. Determine the null and alternative hypotheses for the hypothesis test.
   b. Classify the hypothesis as two-tailed, left-tailed, or right-tailed.

2. A traffic enforcer believes that the number of cars passing through a certain intersection during rush hours on weekdays follows a normal distribution with an average of 800. A new highway is opened, and it is hypothesized that the number of cars passing through the intersection will decrease as a result. A sample of 15 weekdays is taken, and the mean number of cars passing through the intersection is 750 with a sample standard deviation of 42.
   a. Determine the null and alternative hypotheses for the hypothesis test.
   b. Classify the hypothesis as two-tailed, left-tailed, or right-tailed.

Answer Key

What I Know

1. C
2. A
3. C
4. C
5. B
6. B
7. C
8. C
9. D
10. A
11. D
12. A
13. C
14. D
15. D

What's In

Activity 1

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

What's More

Activity 3

1. Mean, H_o: $\mu = 92$
2. H_o: $\mu = 14$, H_o: $\mu \neq 14$
3. Average, H_a: $\mu < 121$
4. mean weight time is at most 8.7,
   H_o: $\mu \leq 8.7$
5. H_o: $\mu = 7.4$, H_a: $\mu \neq 7.4$

Activity 4

1. $\mu = 91$, $\mu \neq 91$
2. $\mu = 150{,}000$,
   $\mu > 150{,}000$
3. $\mu = 1.49$, $\mu < 1.49$
4. $\mu \geq 12$, $\mu < 12$
5. $\mu \leq 2{,}700$,
   $\mu > 2{,}700$

Activity 5

1. ONE
2. ONE
3. TWO
4. ONE
5. ONE

Activity 6

1. $\mu = ₱24{,}620$,
   $\mu \neq ₱24{,}620$
   two-tailed
2. $\mu \leq 650$ or $\mu = 650$
   $\mu > 650$
   right-tailed
3. $\mu \geq 8$ or $\mu = 8$
   $\mu < 8$
   left-tailed
4. $\mu \leq ₱600{,}000$ or
   $\mu = ₱600{,}000$
   $\mu > ₱600{,}000$
   right-tailed
5. $\mu = 300$, $\mu \neq 300$
   two-tailed
6. $\mu = 24$ $\mu \neq 24$
   two-tailed
7. $\mu = ₱15{,}500$, $\mu \neq ₱15{,}500$
   two-tailed
8. $\mu \geq 10$ or $\mu = 10$
   $\mu < 10$
   left-tailed
9. $\mu = 100$
   $\mu > 100$
   right-tailed
10. $\mu \leq 350$ or $\mu = 350$
    $\mu > 350$
    right-tailed

What I Have Learned

1. Statistical hypothesis
2. Null Hypothesis , Alternative Hypothesis
3. To formulate a hypothesis, the steps are:
   a. Identify the parameter in each problem.
   b. Identify the claim to be tested that may show up in null or alternative hypothesis.
   c. Translate the claim into mathematical symbols/ notations.
   d. Formulate first the null hypothesis (H_o) then alternative hypothesis (H_a)
4. Two-tailed test, one-tailed test
5. H_o, H_a

Additional Activities

1. a. H_o: $\mu = ₱145{,}000$,
   H_a: $\mu > ₱145{,}000$
   b. Right-tailed test
2. a. H_o: $\mu = 800$,
   H_a: $\mu < 800$,
   b. Left-tailed test

Assessment

1. B
2. D
3. B
4. D
5. A
6. C
7. D
8. A
9. B
10. A
11. C
12. D
13. A
14. C
15. A

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