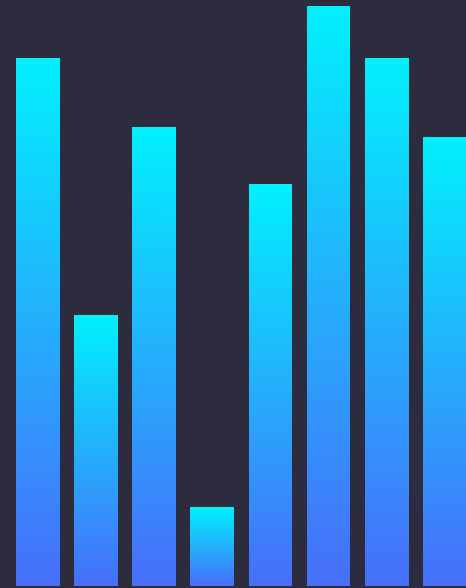
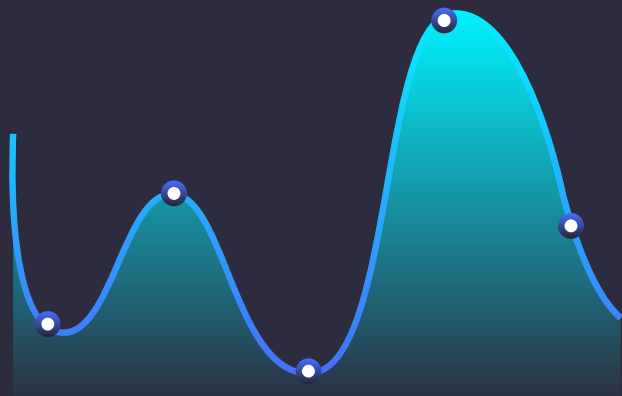


Chapter 7: Hypothesis Testing with One Sample



ACSTA101 – Professor MG





01

Introduction to Hypothesis Testing

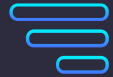




Definition: Hypothesis Test

A hypothesis test is a process that uses sample statistics to test a claim about the value of a population parameter.

For example, If a manufacturer advertises that its new hybrid car has a mean gas mileage of 50 miles per gallon, you might want to collect a sample of cars to test this claim.





Definitions

A statement about a population parameter is called a statistical hypothesis. To test a parameter, we state two hypothesis. If one is false, the other must be true.

A null hypothesis (H_0)

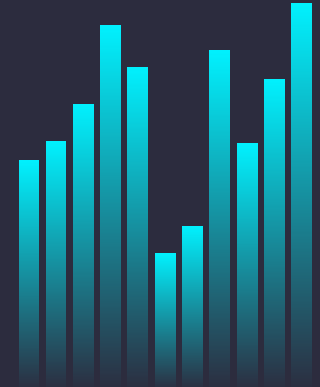
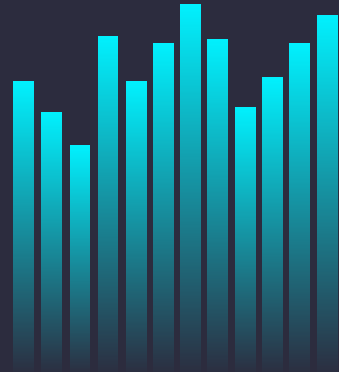
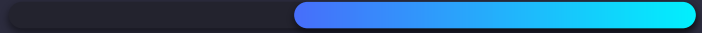
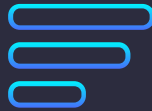
- A statistical hypothesis that contains a statement of equality
- It may contain the following symbols: \leq , $=$, or \geq



An alternative hypothesis (H_a)

- The complement of the null hypothesis
- It may contain the following symbols:
 $>$, \neq , or $<$





Verbal Statement H_0 <i>The mean is . . .</i>	Mathematical Statements	Verbal Statement H_a <i>The mean is . . .</i>
<i>. . . greater than or equal to k.</i> <i>. . . at least k.</i> <i>. . . not less than k.</i> <i>. . . not shorter than k.</i>	$\begin{cases} H_0: \mu \geq k \\ H_a: \mu < k \end{cases}$	<i>. . . less than k.</i> <i>. . . below k.</i> <i>. . . fewer than k.</i> <i>. . . shorter than k.</i>
<i>. . . less than or equal to k.</i> <i>. . . at most k.</i> <i>. . . not more than k.</i> <i>. . . not longer than k.</i>	$\begin{cases} H_0: \mu \leq k \\ H_a: \mu > k \end{cases}$	<i>. . . greater than k.</i> <i>. . . above k.</i> <i>. . . more than k.</i> <i>. . . longer than k.</i>
<i>. . . equal to k.</i> <i>. . . k.</i> <i>. . . exactly k.</i> <i>. . . the same as k.</i> <i>. . . not changed from k.</i>	$\begin{cases} H_0: \mu = k \\ H_a: \mu \neq k \end{cases}$	<i>. . . not equal to k.</i> <i>. . . different from k.</i> <i>. . . not k.</i> <i>. . . different from k.</i> <i>. . . changed from k.</i>





Examples: State the null and alternative hypotheses for the following. Then determine which hypothesis is the claim.



A school publicizes that the proportion of its students who are involved in at least one extracurricular activity is 61%.

$$H_0: p = 0.61$$
$$H_a: p \neq 0.61$$

A company advertises that the mean life of its furnaces is more than 18 years.

$$H_0: \mu \geq 15$$
$$H_a: \mu < 15$$

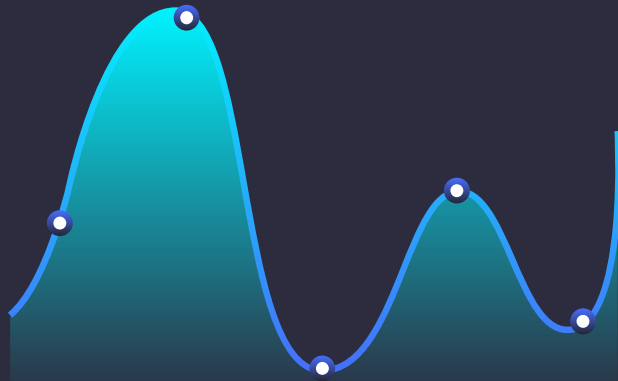
A car dealership announces that the mean time for an oil change is less than 15 minutes.

$$H_0: \mu \leq 18$$
$$H_a: \mu > 18$$





Testing a Hypothesis



To test the null and alternative hypotheses, we always start by assuming H_0 is true. We then use a random sample to either:

1. Reject the null hypothesis, or
2. Fail to reject the null hypothesis

Because we're only looking at a sample, it is always possible that we will make the wrong decision, we call these mistakes Type I or Type II errors.





Possible Errors

Type I Error

- A Type I error occurs if the null hypothesis is rejected when it is actually true.

Type II Error

- A Type II error occurs if the null hypothesis is not rejected when it is actually false.



	Truth of H_0	
Decision	H_0 is true.	H_0 is false.
Do not reject H_0 .	Correct decision	Type II error
Reject H_0 .	Type I error	Correct decision



Conducting Hypothesis Tests

In a hypothesis test, you'll need a level of significance (denoted α). It signifies the maximum probability you want to allow for making a Type I error.

Typical α values are 0.10, 0.05, and 0.01.

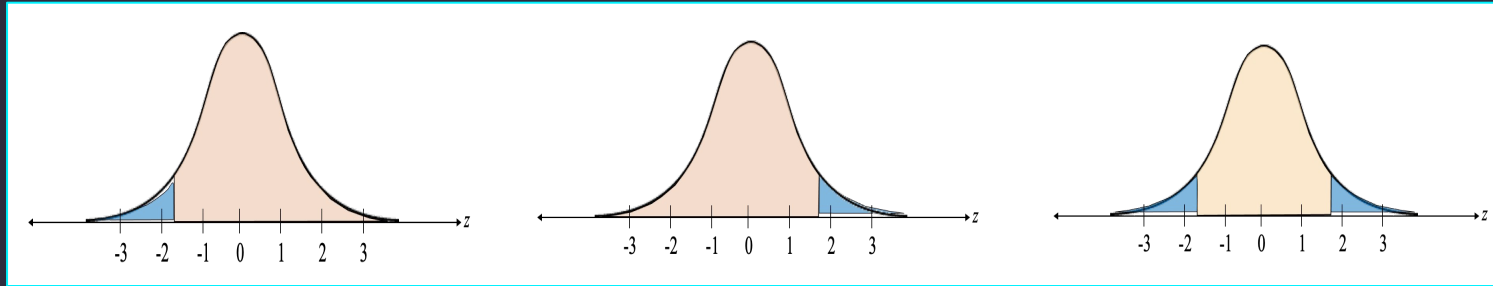
Once you have the hypotheses and significance level, collect the necessary test statistic from a random sample and convert it to a standardized value

Which standardized value?

- If you're testing a claim about population mean (μ), you will look at \bar{x} (sample mean) and convert it to either a critical value z (if σ is known) or t (if σ is unknown)
- If you're testing a claim about population proportion (p), you will look at \hat{p} and convert to a critical value z .



Types of Hypothesis Tests



Left-Tailed

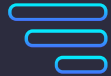
Use when the alternative hypothesis uses a $<$ symbol.

Right-Tailed

Use when the alternative hypothesis uses a $>$ symbol.

Two-Tailed

Use when the alternative hypothesis uses a \neq symbol.





Examples: Determine which type of hypothesis test to use.



A school publicizes that the proportion of its students who are involved in at least one extracurricular activity is 61%.

$$H_0: p = 0.61$$
$$H_a: p \neq 0.61$$

Two-tailed test

A company advertises that the mean life of its furnaces is more than 18 years.

$$H_0: \mu \geq 15$$
$$H_a: \mu < 15$$

Left-tailed test

A car dealership announces that the mean time for an oil change is less than 15 minutes.

$$H_0: \mu \leq 18$$
$$H_a: \mu > 18$$

Right-tailed test

