Pick Up

The Warm Up

The claim that we weigh evidence against in a significance test is called the **null hypothesis (H_0).** The claim that we are trying to find evidence for is the **alternative hypothesis (H_a)**.

The alternative hypothesis is **one-sided** if it states that a parameter is *greater than* the null value or if it states that the parameter is *less than* the null value.

The alternative hypothesis is **two-sided** if it states that the parameter is *different from* the null value (it could be either greater than or less than).

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H_a: $\mu > 17.2$

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H_a: $\mu > 17.2$

H_0: $\mu = 36$
H_a: $\mu \neq 36$

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The alternative hypothesis is **two-sided** if it states that the parameter is *different from* the null value (it could be either greater than or less than).

1. **Are you college bound?** The U.S. Bureau of Labor Statistics estimates that 69.7% of high school graduates enroll in a college or university. Bernard has great pride in the quality of his large high school. He thinks the proportion of college-bound students is greater for last year's graduating class.

   State appropriate hypotheses for performing a significance test. Be sure to define the parameter of interest.

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H_o :

H_a : lower case "a"

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Belief

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$H_a: p > 0.697$ ← the claim we are trying to find evidence for.

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where p = the true proportion of all last year's graduates at Bernard's school who enroll in college or university.

Argue with Friends

2. **Argue with Friends.** A Gallup poll report revealed that 72% of teens said they seldom or never argue with their friends. Yvonne wonders whether this result holds true in her large high school, so she surveys a random sample of 150 students at her school.
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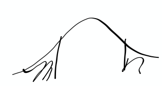
$\neq$?

H_0: $p = 0.72$

H_a: $p \neq 0.72$ ← two sided H_a



where p = ~~the true proportion~~ of teens in Yvonne's school who rarely or never argue with their friends.

CAUTION:

The hypotheses should express the belief or suspicion we have before we see the data.

AP® Exam Tip

Hypotheses always refer to a population, not to a sample. Be sure to state H_0 and H_a in terms of population parameters. It is never correct to write a hypothesis about a sample statistic, such as H_0: $\hat{p} = 0.80$ or H_a: $\bar{x} = 31$.

$\cancel{H_0: \hat{p} = 0.80}$

$p = 0.8$

Ch. 9

9.1 Hypothesis testing in general (No formulas)

9.2 Testing claims re: proportions

9.3 Testing claims re: means

Chapter 9: Testing a Claim

9.1 Significance Tests: The Basics	2 Days
9.2 Tests about a Population Proportion	2 Days
9.3 Tests about a Population Mean	2 Days
Review, FRAPPY!, and Test	2 Days

Next Test: Wed Jan 29th

Learning Targets:

- ✓STATE appropriate hypotheses for a significance test about a population parameter.
- ✓INTERPRET a P-value in context.
- ✓MAKE an appropriate conclusion for a significance test.

Interpreting P-Values

We'll read page 556 together

Pick Up the handout

The ***P*-value** of a test is the probability of getting evidence for the alternative hypothesis H_a as strong or stronger than the observed evidence when the null hypothesis H_0 is true.

Are you college bound? Part 2

The U.S. Bureau of Labor Statistics estimates that 69.7% of high school graduates enroll in a college or university. Bernard thinks the proportion of college-bound students is greater for last year's graduates from his large high school. He decides to perform a test of

$$H_0 : p = 0.697 \qquad H_a : p > 0.697$$

where p = the true proportion of all last year's graduates at Bernard's school who enroll in a college or university. Bernard asks a random sample of 40 of last year's graduates from his high school if they are enrolled in a college or university, and 34 say "Yes." The sample proportion enrolled in a college or university is

$\hat{p} = \frac{34}{40} = 0.85.$ Bernard performed a significance test and obtained a P-value of 0.018.

(a) Explain what it would mean for the null hypothesis to be true in this setting.

(b) Interpret the P-value.

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If $H_0: p = 0.697$ is true, then the proportion of last year's graduates at Bernard's school who enroll in a college is 0.697 (same as national proportion)

(b) Interpret the P-value.

Assuming that the proportion of last year's grads who enroll in a college is 0.697, there is a of

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If $H_0: p = 0.697$ is true, then the proportion of last year's graduates at Bernard's school who enroll in a college is 0.697 (same as national proportion)

(b) Interpret the P-value.

Assuming that the proportion of last year's grads who enroll in a college is 0.697, there is a 0.018 probability of getting a sample proportion of 0.85 or greater just by chance in a SRS of 40 graduates.

Making Conclusions

just watch
for a moment

Making Conclusions

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- If the observed result is **not unlikely to occur by chance alone** when H_0 is true (**large *P*-value**), we will "**fail to reject H_0**."

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How to Make a Conclusion in a Significance Test

- If the *P*-value is small, reject H_0 and conclude that there is convincing evidence for H_a (in context).
- If the *P*-value is not small, fail to reject H_0 and conclude that there is not convincing evidence for H_a (in context).

Making Conclusions

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That is equivalent to saying, “View a *P*-value less than 0.05 as small.”

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In Chapter 4 , we suggested that you use a boundary of 5% when determining whether a result is statistically significant.

That is equivalent to saying, "View a *P*-value less than 0.05 as small."

Sometimes it may be preferable to use a different boundary value—like 0.01 or 0.10—when drawing a conclusion in a significance test.

Making Conclusions

The **significance level α** is the value that we use as a boundary for deciding whether an observed result is unlikely to happen by chance alone when the null hypothesis is true.

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If the *P*-value is less than α, we say that the result is "statistically significant at the α = .05 level."

$\alpha =$

Making Conclusions

The **significance level α** is the value that we use as a boundary for deciding whether an observed result is unlikely to happen by chance alone when the null hypothesis is true.

If the *P*-value is less than α, we say that the result is "statistically significant at the α = ____ level."

CAUTION:

α should be stated before the data are produced.

Significance Tests: The Basics

Hypotheses	P-Value	Conclusions

Significance Tests: The Basics

Hypotheses	P-Value	Conclusions
Null		
Alternative		

Significance Tests: The Basics

Hypotheses	P-Value	Conclusions
Null $H_0: \mu = \text{Null Value}$ Alternative $H_a: \mu <, >, \neq \text{Null Value}$		

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Significance Tests: The Basics

Hypotheses	P-Value	Conclusions
Null $H_0: \mu =$ Null Value or p Alternative $H_a: \mu <, >, \neq$ Null Value or p	The probability of getting the results or more extreme results purely by chance if the null is true	Based on our P-Value of ___, we reject/do not reject H_0. We do/do not have convincing evidence against the null α = significance level P-Value $< \alpha$ is significant

if P-Value $< .05$, then reject H_0

H_0 ~~Ho~~

Check Your Understanding

Calcium is a vital nutrient for healthy bones and teeth. The National Institutes of Health (NIH) recommends a calcium intake of 1300 milligrams (mg) per day for teenagers. The NIH is concerned that teenagers are not getting enough calcium, on average. Is this true?

1. State appropriate hypotheses for performing a significance test. Be sure to define the parameter of interest.

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1. State appropriate hypotheses for performing a significance test. Be sure to define the parameter of interest.

$H_0: \mu = 1300$ mg

$H_a: \mu < 1300$ mg

μ = true mean daily calcium intake of teens.

Researchers decide to perform a test using the hypotheses stated in #1. They ask a random sample of 20 teens to record their food and drink consumption for 1 day. The researchers then compute the calcium intake for each student. Data analysis reveals that $\bar{x} = 1198$ mg and $s_x = 411$ mg. Researchers performed a significance test and obtained a P-value of 0.1404.

2. Explain what it would mean for the null hypothesis to be true in this setting.

3. Interpret the P-value.

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2. Explain what it would mean for the null hypothesis to be true in this setting.

If $H_0: \mu = 1300$ is true, the mean daily calcium intake in the population of teens is 1300 mg.

3. Interpret the P-value.

Researchers decide to perform a test using the hypotheses stated in #1. They ask a random sample of 20 teens to record their food and drink consumption for 1 day. The researchers then compute the calcium intake for each student. Data analysis reveals that $\bar{x} = 1198$ mg and $s_x = 411$ mg. Researchers performed a significance test and obtained a P-value of 0.1404.

2. Explain what it would mean for the null hypothesis to be true in this setting.

If $H_0: \mu = 1300$ is true, the mean daily calcium intake in the population of teens is 1300 mg.

3. Interpret the P-value.

Assuming the mean daily intake is 1300 mg, there is a 0.1404 probability of getting a sample mean of 1198 mg or less purely by chance.

4. What conclusion would you make at the $\alpha = 0.05$ level?

- Because the P-Value of $0.1404 > \alpha = .05$, we fail to reject H_0.
- We don't have convincing evidence that the true mean daily calcium intake is < 1300 mg.

Next Test : Wed Jan 29th

PPC - Unit 4

MCQ A
MCQ B
MCQ C

→ due by Sunday Feb 2nd

FRQ 1 and 2

Take your time

1. Use formula sheet
2. Use notes
3. Use textbook

all before your friends

What's going to help you with recall later?

9.1 ..... 1-9 (odds), 13-15, 19

study pp. 554-560