As soon as you are done looking at your LCQ 9.2 and you have turned it, and the solutions, back in, then...

Pick Up the half-sheet Warm Up

1. A school superintendent must make a decision whether or not to cancel school because of a threatening snow storm. What would the results be of Type I and Type II errors for the null hypothesis: The weather will remain dry?

a) Type I error: don't cancel school, but the snow storm hits.
Type II error: weather remains dry, but school is needlessly canceled.

b) Type I error: weather remains dry, but school is needlessly canceled.
Type II error: don't cancel school, but the snow storm hits.

c) Type I error: cancel school, and the storm hits.
Type II error: don't cancel school, and weather remains dry.

d) Type I error: don't cancel school, and snow storm hits.
Type II error: don't cancel school, and weather remains dry.

e) Type I error: don't cancel school, but the snow storm hits.
Type II error: cancel school, and the storm hits.

Notes from class today **January 28, 2020**

Type I error Rejecting H_0 when H_0 is true

Type II error Not rejecting H_0 when H_0 is false

Type I error Rejecting H_0 when H_0 is true

H_0: weather dry

H_a: not dry

thinking it's bad weather

when the weather is dry

Type II error Not rejecting H_0 when H_0 is false

Type I error — Rejecting H_0 when H_0 is true

thinking it's bad weather — cancel school

when the weather is dry — weather remains dry

H_0: weather dry

H_a: not dry

Type II error — Not rejecting H_0 when H_0 is false

thinking weather is fine

when it's actually bad

Type I error — Rejecting H_0 when H_0 is true

thinking it's bad weather — cancel school

when the weather is dry — weather remains dry

H_0: weather dry

H_a: not dry

Type II error — Not rejecting H_0 when H_0 is false

thinking weather is fine

when it's actually bad

don't cancel school

but a storm hits

1) A school superintendent must make a decision whether or not to cancel school because of a threatening snow storm. What would the results be of Type I and Type II errors for the null hypothesis: The weather will remain dry?

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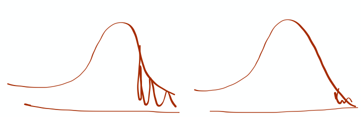
Type II error: cancel school, and the storm hits.

2) Choosing a smaller level of significance, that is, a smaller α-risk, results in

a) a lower risk of Type II error and lower power.
b) a lower risk of Type II error and higher power.
c) a higher risk of Type II error and lower power.
d) a higher risk of Type II error and higher power.
e) no change in risk of Type II error or in power.

Smaller α $\Rightarrow$ harder to reject H_0 $\Rightarrow$ Power $\downarrow$ $\Rightarrow$ Type II error $\uparrow$



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Smaller α $\Rightarrow$ harder to reject H_0 $\Rightarrow$ Power $\downarrow$

$\Downarrow$

Type II error $\uparrow$

We need to "fix" our notes from yesterday.

Power of a Si

Important ideas:

Interpretation

If the true mean cold length is $\mu = 7$ days, there is a .59 probability of finding convincing evividence for $H_a: \mu < 10$

altern Value

H_0

Ty er

A

---

tablet that will lower a child's risk for ADHD. Researchers will administer the vitamin tablet to 200 volunteer children under the age of 4 (with parental consent). The subjects will be tracked through childhood, and the researchers will record the proportion of the subjects who develop ADHD. The researchers will perform a test at the $\alpha = 0.05$ significance level of

$$H_0: p = 0.11$$

$$H_a: p < 0.11$$

where p = the true proportion of all children like those in the study who would develop ADHD when given the new vitamin tablet. The new vitamin tablet is expensive to produce, so researchers would like to be convinced that it really does reduce the risk of ADHD. The power of the test to detect that $p = 0.05$ is 0.937.

1. Interpret this value in context.

If the true proportion of all children like those in the study who would develop ADHD when given the new vitamin is $p = .05$, there's a .937 probab. that the company will find convincing evidence for $H_a: p < 0.11$

Warm Up II

try not to use any notes
if you can.

WARM UP Ch. 9 Review Day

Study the solution details for part a. Then do parts b, c, d, and e.

The Environmental Protection Agency has determined that safe drinking water should have an average pH of 7 moles per liter. You are testing water from a new source, and take 30 vials of water. Water is unsafe if it deviates too far from 7 moles per liter in either direction. The mean pH level in your sample is 6.4 moles per liter, which is slightly acidic. The standard deviation of the sample is 0.5 moles per liter.

(a) Do the data provide convincing evidence at the $\alpha = 0.05$ level that the true mean pH of water from this source differs from 7 moles per liter?

STATE

$H_0: \mu = 7$

$H_a: \mu \neq 7$

μ = true mean pH level (moles/liter) of the water.

$\alpha = 0.05$

$\bar{x} = 6.4$ moles/liter

evidence for H_a

PLAN One sample t test for μ

Random - random sample of 30 vials. ✓

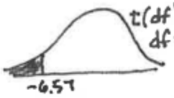
10% - not needed because of the infinite sources of water

Normal/Large Sample : $n = 30 \geq 30$ CLT ✓

$\boxed{\text{DO}}$ $\bar{x} = 6.4$ $S_x = 0.5$ ← from GDC

Standard statistic $= \frac{\text{Stat} - \text{Parameter}}{SD}$

$$t = \frac{\bar{x} - \mu}{\frac{S_x}{\sqrt{n}}} = \frac{6.4 - 7}{\frac{.5}{\sqrt{30}}} = -6.57$$



$df = 30 - 1 = 29$

P-value $2 \cdot tcdf\left[\underset{\text{lower}}{-1000}, \underset{\text{upper}}{-6.57}, \underset{df}{29}\right] \approx 0$

or TABLE A $P(t < -6.57) = 2(.0005) = 0.001$

$\boxed{\text{CONCLUDE}}$

Because the P-value of approximately 0 $< \alpha = 0.05$, we reject H_0.

∴ There is convincing evidence that the true mean pH level for this water source differs from 7.

$\boxed{\text{DO}}$ $\bar{x} = 6.4$ $S_x = 0.5$ ← from GDC

Standard statistic $= \frac{\text{Stat} - \text{Parameter}}{SD}$

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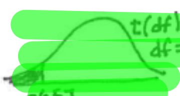

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$\boxed{\text{CONCLUDE}}$

Because the P-value of approximately 0 $< \alpha = 0.05$, we reject H_0.

∴ There is convincing evidence that the true mean pH level for this water source differs from 7.

(b) A 95% confidence interval for the true mean pH level of the water is $(6.21, 6.59)$. Interpret this interval.

We are 95% confident that the interval from 6.21 to 6.59 moles/liter captures the true mean pH level of the water.

(c) Explain why the interval in part (b) is consistent with the result of the test in part (a).

The confidence interval does not include null value, $\mu = 7$, as a plausible value for the true mean pH level μ.

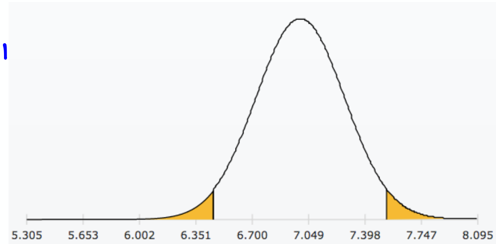
$\therefore$ We would reject H_0 like we did in part a.

alternative μ

(d) The power of the test to detect $\mu = 6.8$ is 0.59. Interpret this value.

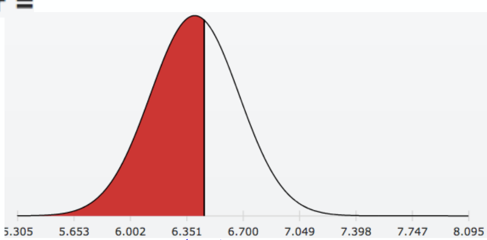
If the true mean pH level for this water source is $\mu = 6.8$, there is a 0.59 probability that the reseachers will find evidence for $H_a: \mu \neq 7$

part "d"



7

Power =



6.8

If the true mean pH level for this source is μ=6.8, there is a 0.59 probability that the researchers will find H_a: μ≠7

(e) Give one way to increase the power of this test.

- Can increase Power by increasing α or by increasing the sample size.

- Power can also increase by enlarging the difference between the H_0 value an an alternative H_A value. Normally this is something researches can't control.

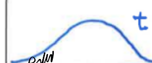
AP Stats Chapter 9 Formula Study Sheet
for Significance Tests

Lesson	9.2 – Significance Test for a Proportion	9.3 – Significance Test for a Mean
Symbol for statistic (sample)		
Symbol for parameter (population)		
Name the procedure		
RANDOM condition		
10% condition		
NORMAL condition		
Formula for mean of the sampling distribution		
Formula for standard deviation of the sampling distribution		
General formula for test statistic		

random : "~~random sample~~"

Lesson	9.2 – Significance Test for a Proportion	9.3 – Significance Test for a Mean
Symbol for statistic (sample)	$\hat{p}$	$\bar{x}$
Symbol for parameter (population)	p	μ
Name the procedure	One sample z test for p	One sample t test for μ
RANDOM condition	check for random sample	check for random sample
10% condition	$n < \frac{1}{10}(N)$	$n < \frac{1}{10}(N)$
NORMAL condition	LARGE COUNTS $np_0 \geq 10$ $n(1-p_0) \geq 10$	Normal/Large Sample - Pop. is approx Normal or... - $n \geq 30$ CLT or.... - No strong skew or outliers

Formula for mean of the sampling distribution	$\mu_{\hat{p}} = p$	$\mu_{\bar{x}} = \mu$
Formula for standard deviation of the sampling distribution	$\sigma_{\hat{p}} = \sqrt{\frac{p_0(1-p_0)}{n}}$	$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} \approx \frac{s_x}{\sqrt{n}} = SE_{\bar{x}}$
General formula for test statistic	$\text{Test stat.} = \frac{\text{Statistic} - \text{Param.}}{\text{SD.}}$	$\text{Test stat} = \frac{\text{stat} - \text{Param}}{\text{SD}}$
Specific formula for test statistic	$z = \frac{\hat{p} - p}{\sqrt{\frac{p_0(1-p_0)}{n}}}$	$t = \frac{\bar{x} - \mu}{s_x/\sqrt{n}}$

Specific formula for test statistic	$z = \frac{\hat{p} - p}{\sqrt{\frac{p_0(1-p_0)}{n}}}$	$t = \frac{\bar{x} - \mu}{s_x/\sqrt{n}}$
Picture	 $N(0,1)$	 $t(df)$
How to find P-value	Table A or Normal cdf	Table B or t_{cdf}

If using techonology to check "DO" 1-PropZ Test T-test

On chapter 9 and 10 tests, only use for checking your work and for m/c

For significance tests

4 STEP PROCESS

STATE: Parameter, statistic, hypotheses, and significance level.
PLAN: Name the appropriate inference method and check conditions.
DO: If the conditions are met, perform the calculations.
General formula, specific formula, work, test statistic, picture, P-value.

CONCLUDE: Make a conclusion about the hypotheses in the context of the problem.

Tips

When reading free response questions ask yourself "Is this context about a mean or a proportion?"

When reading free response questions ask yourself "Is this context about a mean or a proportion? "

quantitative variables

categorical

Frappy!

Ch 9 Review Problems

or Ch. 9 Practice test

Strive for a 5