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.

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

Rejecting H_0 → thinking it's bad weather

when H_0 is true → 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

H_0: weather dry

H_a: not dry

Rejecting H_0 → thinking it's bad weather, cancel school

when H_0 is true → when the weather is dry, weather remains dry

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thinking weather is fine

when it's actually bad

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don't cancel school

but a storm hits

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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.

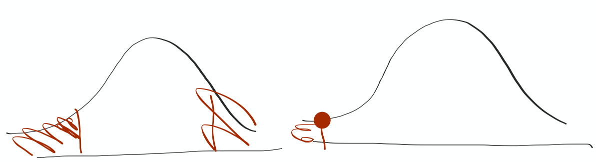
d) a higher risk of Type II error and higher power.

e) no change in risk of Type II error or in power.

Smaller α → harder to reject H_0 → Power ↓

↓

Type II error ↑



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Power is a probability...

that you are doing the right thing when H_0 is not true

(and the right thing in that case is to reject H_0)

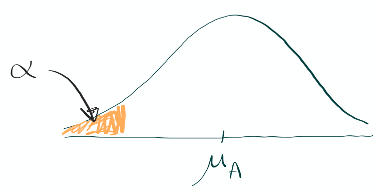
NOTE: A Type I error is not rejecting when you should so...

POWER = 1 − P(Type II error)

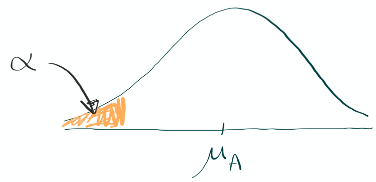
Two Sampling Distributions

- one where we assume H_0 is true
- the other where some alternative value is true

H_0: true



H_0: true



test a sample $\bar{x}$

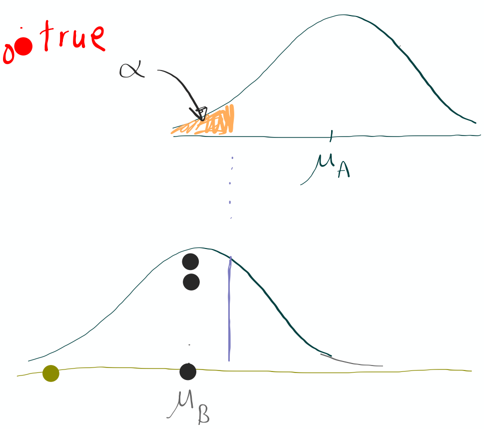
std. test statistic

↓

see if statistic is below threshold

but... what if some other parater is true (H_0 false)?

H_0: true



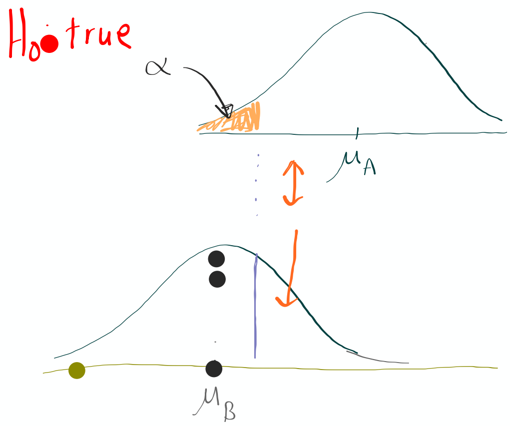
test a sample $\bar{x}$

std. test statistic

↓

see if statistic is below threshold

Where are the samples that lead us to the wrong conclusion if H_a is true?



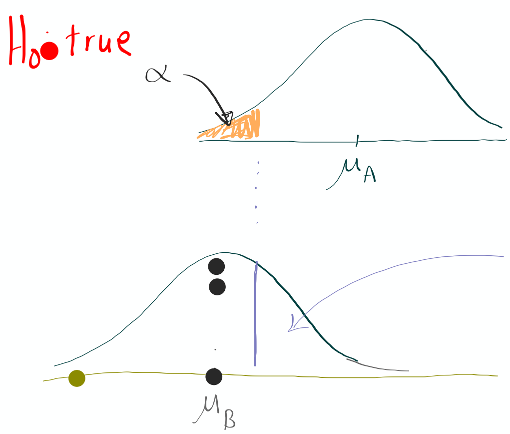
test a sample $\bar{x}$

std. test statistic

↓

See if statistic is below threshold

Where are the samples that lead us to the wrong conclusion if Ha is true?



test a sample $\bar{x}$

std. test statistic

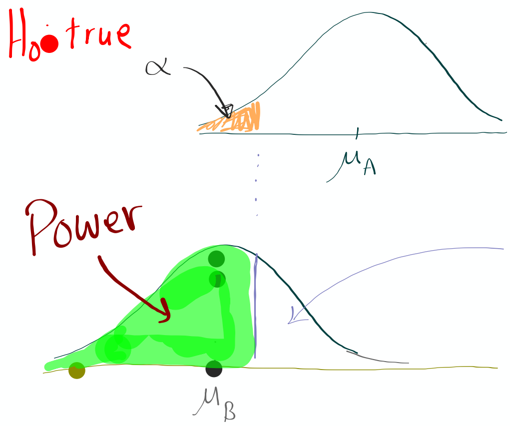
↓

See if statistic is below threshold

Type II error (not rejecting when Ha is true)

↑

alternative value is true.



test a sample $\bar{x}$

Std. test statistic
↓
See if statistic is below threshold

Type II error
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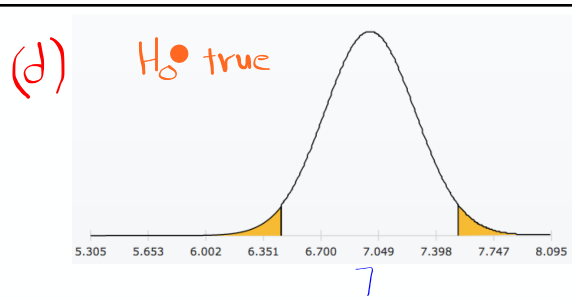
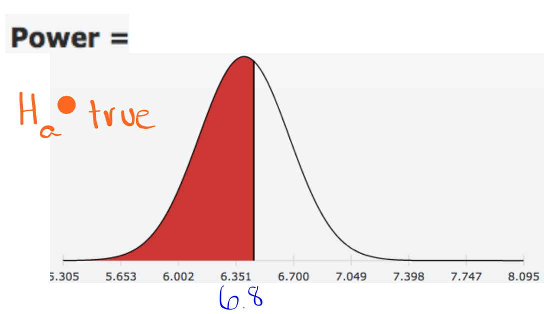




<u>Power:</u>

= *P(avoiding Type II error)*

Power is good.

If the alternative <u>IS</u> true, we want to maximize the prob. of finding convincing evidence that it is true.

Warm Up
2

(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).

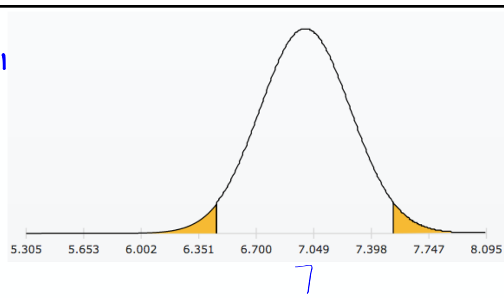
The confidence interval does not include null value, $\mu = 7$, as a plausible value for the true mean pH level μ.

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

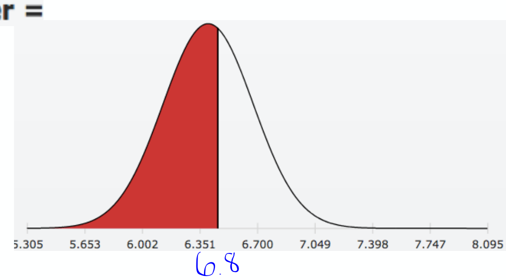
(d) The power of the test to detect $\mu = 6.8$ is 0.59. Interpret this value.

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

part "d"



Power =

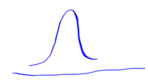


If the true mean pH level for this source is μ=6.8, there is a 0.59 probability that the researchers will find H_a: μ≠7

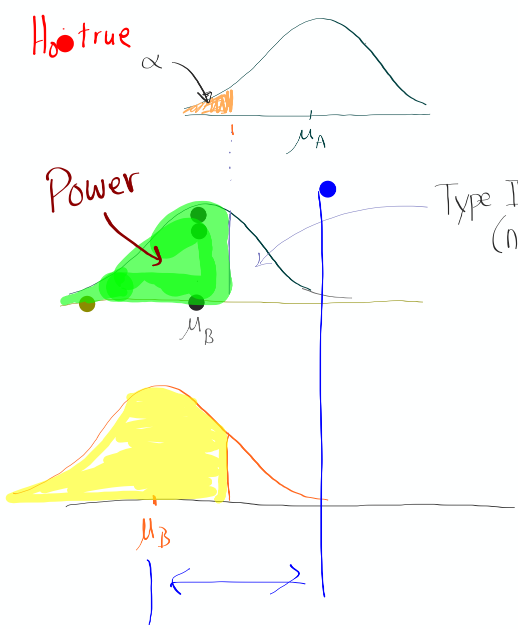
$\alpha = .05$ $\alpha = .10$

(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.



Std. test statistic
↓
See if statistic is below threshold

Type II error (not rejecting when Ha is true)
↑
alternative value is true.

AP Stats Chapter 9 Formula Study Sheet

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		

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 $n p_0 \geq 10$ $n(1-p_0) \geq 10$	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	$\mu_{\hat{p}} = P_0$	$\mu_{\bar{x}} = \mu$
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	St. Test Stat. $= \frac{\text{Statistic} - \text{Param.}}{\text{SD.}}$	St. 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	 $N(P_0, \sigma_{\hat{p}})$	 $t(df)$
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

from
Stat Medic

Frappy!

Ch 9 Review Problems

or Ch. 9 Practice test