Statistics

Lecture 14

Feb 19-8:47 AM

SG 23

Testing claims:

A claim is made, and we want to test it to determine its validity.

If claim is valid ⇒ we Support it. (Fail-to-reject)

If claim is invalid ⇒ we reject it.

A claim could be about

1) Population Proportion p
2) Population Mean μ
3) Population Standard deviation σ

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I claim 10% of all college students smoke.

$P = .1$ claim

I claim the mean age of all students is below 32 Yrs.

$\mu < 32$ claim

I claim the standard deviation of all exam scores is at least 10.

$\sigma \geq 10$ claim

Feb 5-4:51 PM

Why do we test a claim?

To determine its validity.

Valid claim $\Leftrightarrow$ we fail-to-reject.

Invalid claim $\Leftrightarrow$ we reject it.

Possible Errors:

Valid claim but we reject it.

Invalid claim but we support it.

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Testing Method:

1) Traditional Method

2) P-Value Method

3) Confidence Interval Method

Regardless of the method, Final Conclusion must be the Same.

Reject the claim (Invalid claim), **FTR the claim** (Valid claim)

Conclusion \ claim	Valid	Invalid
Support	Good Decision	Error
Reject	Error	Good Decision

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Testing Types:

1) Right-Tail Test **RTT**

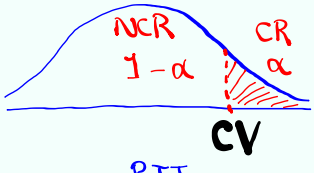
2) Left-Tail Test **LTT**

3) Two-Tail Test **TTT**

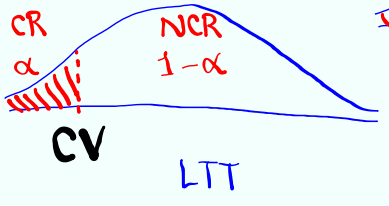
with every test, there is a Significance level α (Alpha)

$0 < \alpha < 1$

If α not given, use .05



RTT



LTT

TTT

Feb 5-5:05 PM

Testing Process:

1) Set-up H_0 & H_1

H_0: Null Hypothesis

H_1: Alternative Hypothesis

2) Find all critical values.

Drawing, labeling, shading, and TI command required.

3) Find Computed Test Statistic CTS and P-Value P.

Formula or TI command required.

4) use testing chart to determine the validity of H_0 & H_1.

5) Draw final conclusion about the claim, claim could be H_0 or H_1.

Final Conclusion

Reject the claim | FTR the claim

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More on H_0 & H_1:

H_0 must contain the equal sign $\Rightarrow =, \geq, \leq$

H_1 cannot contain the equal sign $\Rightarrow \neq, <, >$

Keywords for H_0:

is, equal, not different, at least, at most, ...

Keywords for H_1:

is not, not equal, different, more than, less than, exceed, below, above, ...

when H_1: $>$ Right-Tail Test

when H_1: $<$ Left-Tail Test

when H_1: $\neq$ Two-Tail Test

H_1 helps us to determine the testing type.

Always identify claim and testing type.

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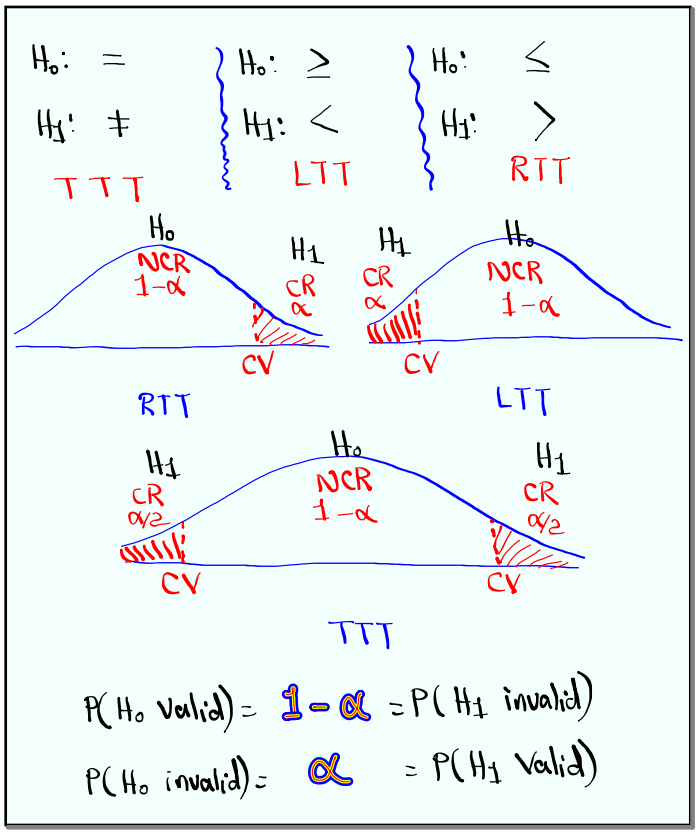

Feb 5-5:27 PM

I claim 10% of all students smoke.

$P = .1$ ← H_0

H_0: $P = .1$ claim

H_1: $P \neq .1$ TTT

I claim the mean age of all students is below 32 yrs.

$\mu < 32$ ← H_1

H_0: $\mu \geq 32$

H_1: $\mu < 32$ claim, LTT

I claim standard deviation of all exams scores is at most 10.

$\sigma \leq 10$ ← H_0

H_0: $\sigma \leq 10$ claim

H_1: $\sigma > 10$ RTT

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Type I & II Errors

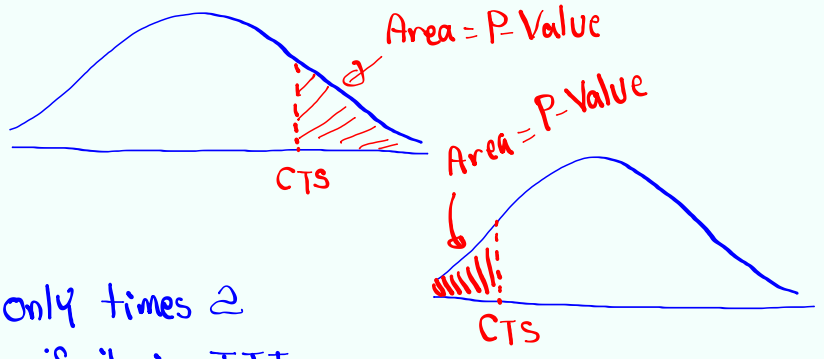
Action \ Reality	H_0 valid	H_0 invalid
Support H_0	Good Decision	Type II error
Reject H_0	Type I error	Good Decision

Feb 5-5:39 PM

CTS → Computed Test Statistic

P-Value is the area of the tail marked by CTS.

If it is TTT, Multiply that area by 2.

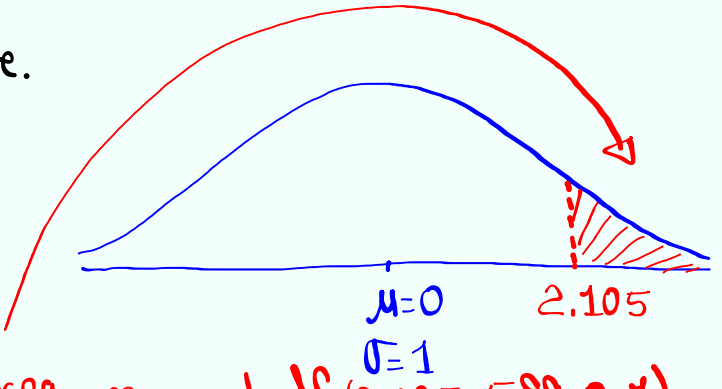


only times 2 if it is TTT.

Feb 5-6:05 PM

Given CTS $Z = 2.105$, RTT

Find P-Value.



P-Value = Area = normalcdf(2.105, E99, 0, 1)

= .018

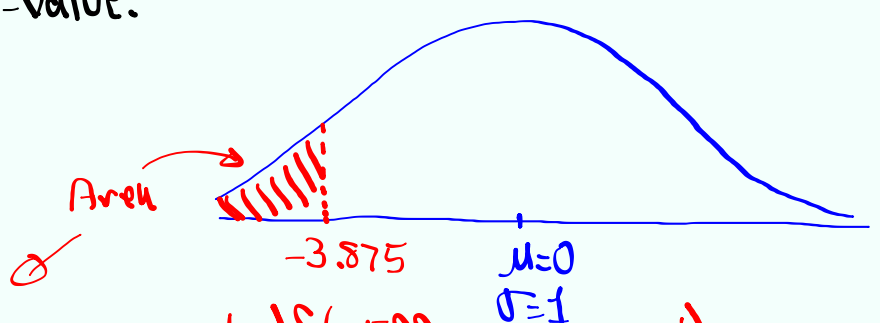
If it was TTT

P-Value = 2(.018) = .036

Feb 5-6:08 PM

Given CTS $Z = -3.875$ LTT

Find p-value.



P-Value = normalcdf(-E99, -3.875, 0, 1)

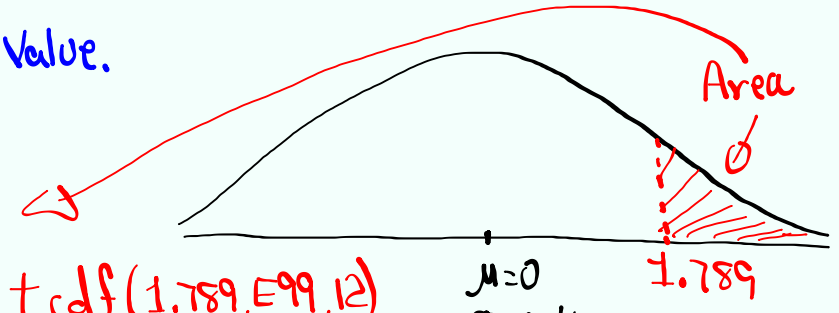
$= 5.3 \times 10^{-5}$

If TTT ⇒ P-Value $= 2(5.3 \times 10^{-5}) = 1.1 \times 10^{-4}$

Feb 5-6:10 PM

Given CTS $t = 1.789$ $df = 12$ RTT

Find P-Value.



P-Value = tcdf(1.789, E99, 12)

= .049

For TTT ⇒ P-Value = 2(.049) = .098

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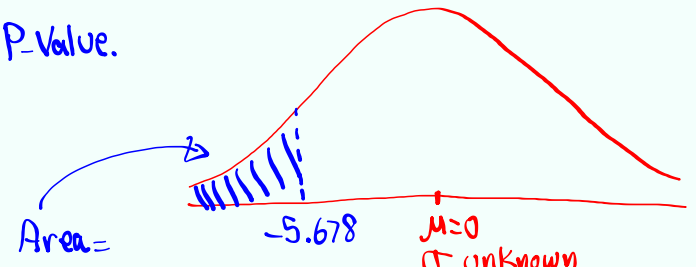
Given CTS $t = -5.678$, $df = 19$, LTT

Find P-Value.



P-Value = tcdf(-E99, -5.678, 19)

= 9.0×10^{-6}

If it was TTT ⇒ P-Value = $2(9.0 \times 10^{-6})$

= 1.8×10^{-5}

Feb 5-6:17 PM

Testing One Population Proportion P:

$H_0: P = P_0$ $H_0: P \leq P_0$ $H_0: P \geq P_0$

$H_1: P \neq P_0$ $H_1: P > P_0$ $H_1: P < P_0$

TTT RTT LTT

CV Z invNorm

CTS Z 1-PropZTest

P-Value P

Use Testing chart to determine the validity of H_0 & H_1.

Draw final conclusion about the claim.

Feb 5-6:21 PM

Given $H_0: P = .1$, claim is H_0

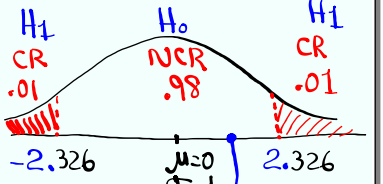
$n = 250$, $x = 32$, $\alpha = .02$

Test the claim

$H_0: P = .1$ claim

$H_1: P \neq .1$ TTT

CV Z $\alpha = .02$ TTT



CTS Z = 1.476

P-Value P = .140

1-PropZTest

$P_0: .1$ H_0

$x = 32$

$n = 250$

Prop ≠ P_0 H_1

Calculate

CV Z = invNorm(.99, 0, 1)

CTS is in NCR

H_0 valid

H_1 invalid

P-Value > α

.140 .02

Valid claim

FTR the claim

Feb 5-6:26 PM

College claims that about 35% of all students use the tutoring services.

$H_0: P = .35$ claim

$H_1: P \neq .35$ TTT

I took a sample of 425 students and 136 of them were using the tutoring services.

$n = 425$ $x = 136$

Test the claim.

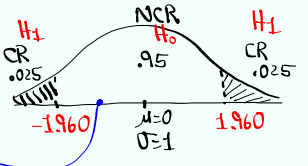
No α

use .05

CV Z TTT $\alpha = .05$

$H_0: P = .35$ claim

$H_1: P \neq .35$ TTT



CTS $Z = -1.297$

P-Value $P = .195$

$Z = \text{invNorm}(.975, 0, 1)$

1-PropZTest

$P_0: .35$ H_0

$x = 136$

$n = 425$

Prop $\neq P_0$ H_1

Calculate

CTS is in NCR

P-Value $> \alpha$

.195 .05

H_0 valid

H_1 invalid

Valid claim

FTR the claim

Feb 5-6:38 PM

College claims that at most 25% of all students are STEM majors.

$P \leq .25$ (H_0)

$H_0: P \leq .25$ claim

$H_1: P > .25$ RTT

I took a sample of 300 students, and 28% of them were STEM majors.

$n = 300$

$\hat{P} = .28$

Use $\alpha = .02$ to test the claim.

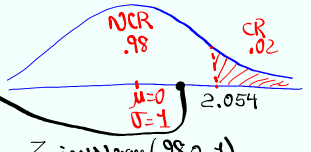
$x = n\hat{P} = 300(.28) =$ if decimal 84

$\Rightarrow$ Round-up

$H_0: P \leq .25$ claim

$H_1: P > .25$ RTT

CV Z RTT $\alpha = .02$



CTS $Z = 1.2$

P-Value $P = .115$

$Z = \text{invNorm}(.98, 0, 1)$

1-PropZTest

$P_0: .25$

$x = 84$

$n = 300$

Prop $> P_0$ H_1

Calculate

CTS is in NCR

P-Value $> \alpha$

.115 .02

H_0 valid

H_1 invalid

Valid claim

FTR the claim

Feb 5-6:50 PM

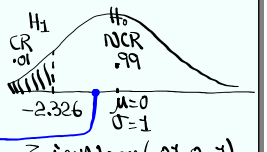
College claims that less than 10% of all students smoke. $P < .1$

I took a Sample of 175 students and 8.2% of them were smokers. $n = 175$, $\hat{P} = .082$, $x = n\hat{P} = 175(.082)$, $x = 15$

Use $\alpha = .01$ to test the claim.

$H_0: P \geq .1$ CV Z $\alpha = .01$ LTT

$H_1: P < .1$ claim, LTT



CTS $Z = -.630$

P-Value $P = .264$

$Z = \text{invNorm}(.01, 0, 1)$

1-Prop Z Test

$P_0: .1$

$x = 15$

$n = 175$

Prop $< P_0$ H_1

CTS is in NCR H_0 valid

P-Value $> \alpha$

H_1 invalid

Invalid claim

Reject the claim

Sb 24

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