Statistics

Lecture 25

Feb 19-8:47 AM

SG 24-27

Testing Claims:

Claim could be about

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

I claim that 5% of all students are left-handed $p = .05$

I claim that the mean age of all students is at most 30 yrs. $\mu \leq 30$

I claim that Standard deviation of scores of all math exams is at least 10. $\sigma \geq 10$

Dec 5-7:21 AM

Why do we need to test a claim?

It is simply to determine its validity.

If claim is valid ⇒ we support it.

If claim is invalid ⇒ we reject it.

Possible errors:

1) We reject a valid claim.

2) We support an invalid claim.

Dec 5-7:28 AM

Testing Methods:

1) Traditional Method
2) P-value Method

we only use these two methods.

3) Confidence Interval Method

Regardless of the method, final conclusion should be the same.

Final Conclusion:

1) must be made about the claim

2) Reject the claim "when claim is invalid" OR Fail-to-Reject the claim "when claim is valid" Support

Action \ claim	Valid	Invalid
Reject	Error	Not error
Support	not error	Error

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Testing Types:

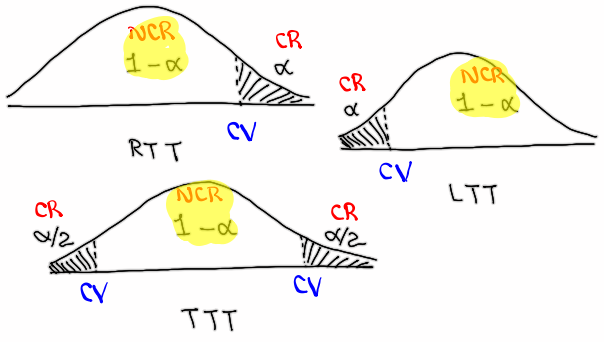
1) Right - Tail Test (RTT)

2) Left - Tail Test (LTT)

3) Two - Tail Test (TTT)

with every testing, we use a Significance level α, $0<\alpha<1$

when α not given $\Rightarrow$ use .05



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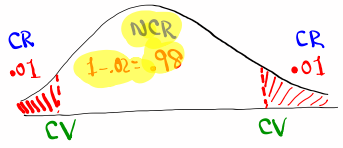
Let's do Complete drawing for TTT with $\alpha=.02$

$\alpha/2 = .02/2 = .01$



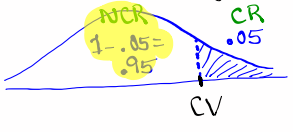
Do a Complete drawing for a LTT with $\alpha=.1$

CR is on the left-Side

Do Complete drawing for a RTT with no α given.

$\alpha=.05$

CR is on the right side



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Testing Process:

1) Set-Up H_0 and H_1.
   - H_0: Null Hypothesis
   - H_1: Alternative Hypothesis, H_a

2) Find all Critical Values.
   Drawing, labeling, shading, Full TI command required.

3) Find Computed Test Statistic (CTS) and P-value (P).
   Full TI Command or formula required

4) use Testing Chart to determine the validity of H_0 and H_1.
   H_0 valid $\Leftrightarrow$ H_1 invalid
   H_0 invalid $\Leftrightarrow$ H_1 valid

5) Draw Final Conclusion about the claim
   Reject the claim when claim is invalid
   OR
   FTR (Fail-to-Reject) the claim when claim is valid

Dec 5-8:15 AM

More on H_0 & H_1:

H_0 must contain = Sign. $\Rightarrow$ $=, \geq, \leq$

H_1 Cannot contain = Sign. $\Rightarrow$ $\neq, <, >$

Keywords:

H_0 $\Rightarrow$ is, equal, Same, at least, at most, not different, ...

H_1 $\Rightarrow$ is not, not equal, not Same, different, more than, less than, above, below, exceed, ...

Claim could be H_0 or H_1, but not both at the Same time.

Always identify the claim and Type of Testing.

- $H_1: \neq \Rightarrow$ TTT
- $H_1: < \Rightarrow$ LTT
- $H_1: > \Rightarrow$ RTT

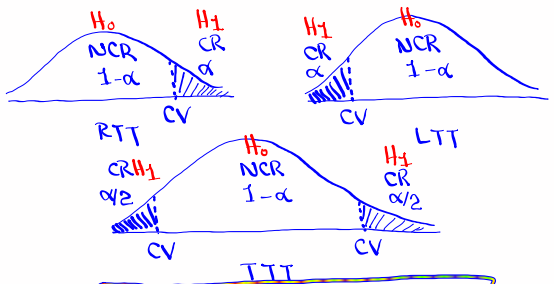
we learn the testing Type from H_1.

Dec 5-8:26 AM

H_0: $=$ | H_0: $\geq$ | H_0: $\leq$

H_1: $\neq$ | H_1: $<$ | H_1: $>$

TTT | LTT | RTT



$P(H_0 \text{ valid}) = 1-\alpha = P(H_1 \text{ invalid})$

$P(H_0 \text{ invalid}) = \alpha = P(H_1 \text{ valid})$

Four – Possible outcomes for H_0:

Conclusion \ Reality	H_0 valid	H_0 invalid
Support H_0	Right Decision	wrong Decision Type II error
Reject H_0	wrong Decision Type I error	Right Decision

Dec 5-8:36 AM

I claim that 5% of all students are left-handed.

$P = .05$ ← H_0

H_0: $P = .05$ claim

H_1: $P \neq .05$ TTT

I claim the mean age of all students is below 30 yrs.

H_0: $\mu \geq 30$

$\mu < 30$ ← NO = Sign → H_1: $\mu < 30$ claim, LTT

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

H_0: $\sigma \leq 10$ claim

H_1: $\sigma > 10$ RTT

$\sigma \leq 10$ ← because of $=$ Sign ← H_0

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P-Value:

Assuming H_0 is valid, P-value is the Prob. of getting a value of Computed Test Statistic that is at least as extreme as the one obtained from Sample.

P-value is the Prob that H_0 would be rejected and H_1 would be supported.

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P-value is the area of tail marked by CTS. If it is a Two-Tail Test, multiply that area by 2.

Right-Tail Test

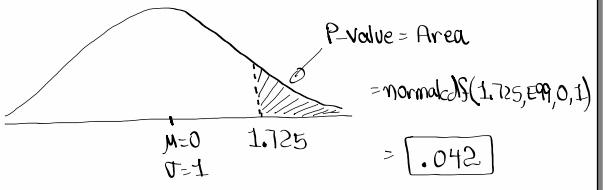
For Two-Tail Test

Find the area of the tail

Multiply by 2.

Dec 5-9:19 AM

CTS $Z = 1.725$ RTT Find P-value.

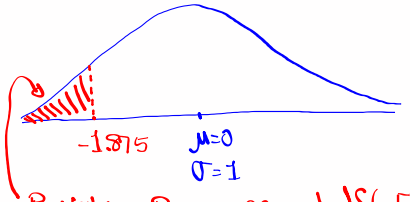


$= \text{normalcdf}(1.725, E99, 0, 1)$

$= \boxed{.042}$

Dec 5-9:23 AM

CTS $Z = -1.875$, Left-Tail Test



P-value = Area = normalcdf(-E99, -1.875, 0, 1)

$= \boxed{.030}$

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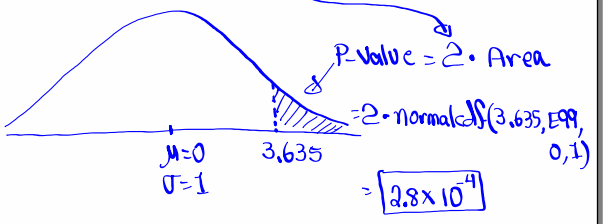
CTS $Z = 3.635$ TTT Find P-value.

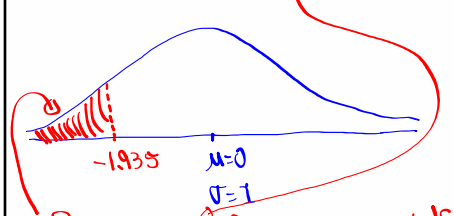


$= 2 \cdot \text{normalcdf}(3.635, E99, 0, 1)$

$= \boxed{2.8 \times 10^{-4}}$

Dec 5-9:28 AM

CTS $Z = -1.935$, TTT, Find p-value.



P-value $= 2 \cdot$ Area $= 2 \cdot \text{normalcdf}(-E99, -1.935, 0, 1)$

$= \boxed{.053}$

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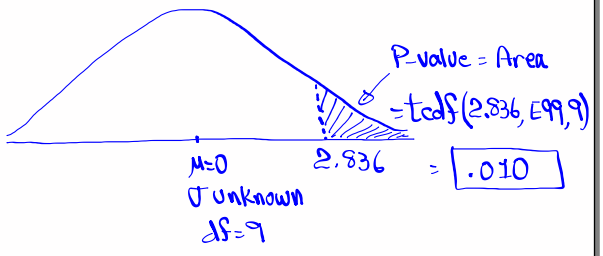
CTS $t = 2.836$, $df = 9$, RTT, find P-value

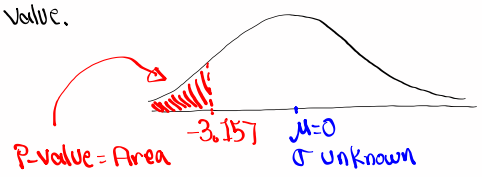


$= tcdf(2.836, E99, 9)$

$= .010$

CTS $t = -3.157$ $df = 14$ LTT

Find P-value.



$= tcdf(-E99, -3.157, 14)$ $df = 14$

$= .003$

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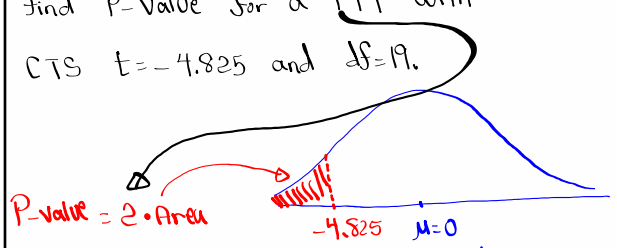
Find P-value for a TTT with CTS $t = -4.825$ and $df = 19$.



$= 2 \cdot tcdf(-E99, -4.825, 19)$

$= 1.177 \times 10^{-4}$

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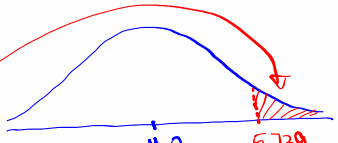
Find P-value for TTT with CTS $t=5.739$ and $df=24$.

P-Value $= 2 \cdot$ Area



σ unknown

$df=24$

$=2 \cdot tcdf(5.739, E99, 24)$

$= 6.495 \times 10^{-6}$

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Dec 5-9:42 AM