Statistics

Lecture 13

Feb 19-8:47 AM

SG 23

Testing claims

A claim could be made about a parameter, and we test the claim to determine its validity.

Claim could be about

1) Population Proportion P
2) Population Mean μ
3) Population standard deviation σ

Why do we need to test?

To determine the validity of the claim

If claim is valid $\Rightarrow$ we support it.
Fail-to-Reject

If claim is invalid $\Rightarrow$ we reject it.

May 23-8:07 AM

Possible errors:

If claim is valid but we reject it.

If claim is invalid but we support it.

The final conclusion of testing a claim must be about the claim.

Reject the claim (claim is invalid) **OR FTR the claim** (claim is valid)

May 23-8:13 AM

Testing Methods:

1) Traditional Method

2) P-Value Method

3) Confidence interval Method

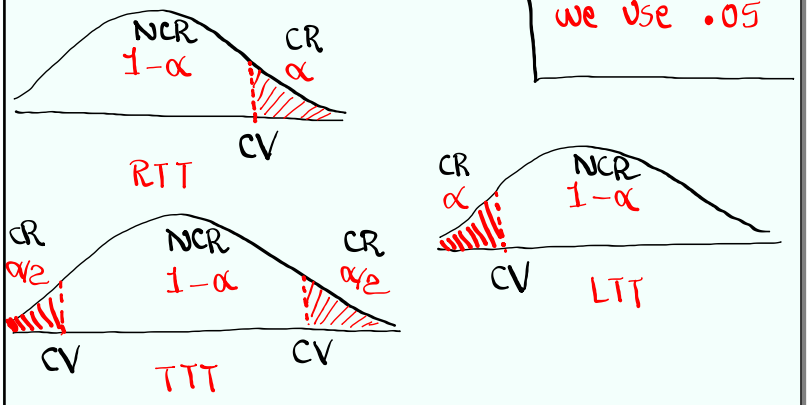
Regardless of the method, final conclusion must be the same.

May 23-8:17 AM

Testing Types:

1) Right-Tail Test RTT
2) Left-Tail Test LTT
3) Two-Tail Test TTT

With every testing, there is a level of Significance α.
$0 < \alpha < 1$
If α not given, we use .05



May 23-8:20 AM

Testing Process:

1) Set-Up H_0 & H_1 (Alternative Hypothesis, H_a)
   H_0: Null Hypothesis
2) Find Critical Value(s)
   Drawing, labeling, Shading, full TI command required.
3) Find Computed Test Statistics CTS and P-Value P.
   Formula or full TI command required.
4) Use the testing chart to determine the validity of H_0 & H_1.
   H_0 valid $\Leftrightarrow$ H_1 invalid
   H_0 invalid $\Leftrightarrow$ H_1 valid
5) Draw Final Conclusion about the claim

Always identify the claim & Testing Type.

May 23-8:28 AM

More on H_0 & H_1:

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

H_1 cannot contain equal Sign. $\neq, <, >$

Key words for H_0:

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

Keywords for H_1:

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

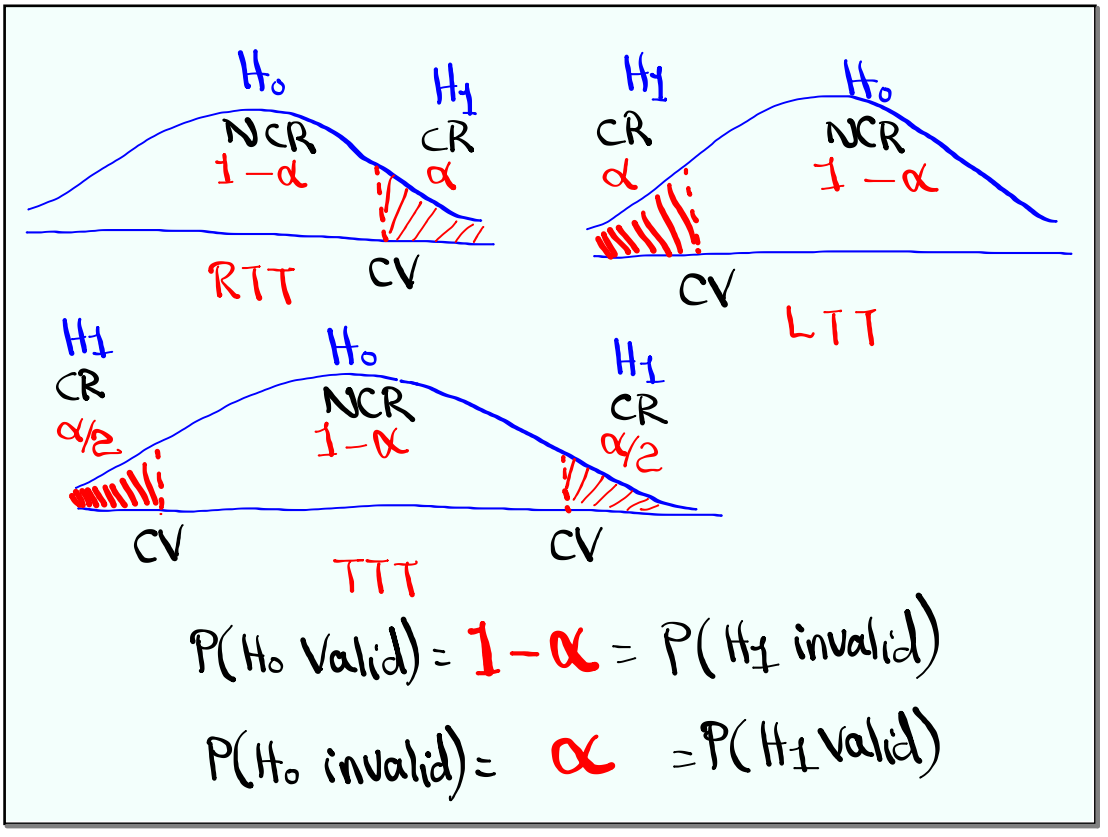
H_0: $=$	H_0: $\geq$	H_0: $\leq$
H_1: $\neq$	H_1: $<$	H_1: $>$
TTT	LTT	RTT

H_1 tells us the testing type.

Claim could be H_0 or H_1 (Not both at the same time)

Always identify the claim and testing type.

May 23-8:38 AM



May 23-8:47 AM

College claims that 10% of all students smoke.

$P = .1$ claim

H_0

$H_0: P = .1$ claim

$H_1: P \neq .1$ TTT

College claims the mean age of all students is less than 32.5 yrs.

$\mu < 32.5$ claim

H_1

$H_0: \mu \geq 32.5$

$H_1: \mu < 32.5$ claim, LTT

May 23-8:52 AM

College claims that standard deviation of all math exams is at most 10.

$\sigma \leq 10$ claim

H_0

$H_0: \sigma \leq 10$ claim

$H_1: \sigma > 10$ RTT

May 23-8:57 AM

Four - Possible outcomes for H_0:

Reality / Action	H_0 Valid	H_0 invalid
Support H_0	Good Decision	Type II Error
Reject H_0	Type I Error	Good Decision

May 23-9:01 AM

More on P-Value:

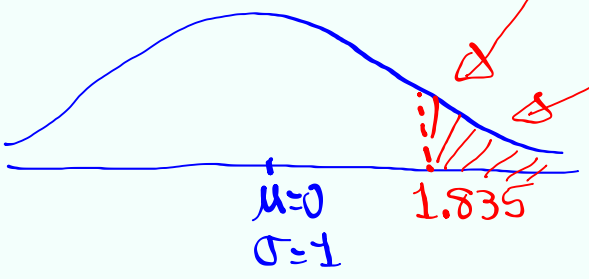
P-Value is the Smallest Significance level for which H_0 will be supported and H_1 " " rejected.

P-Value is the area under the Curve marked by CTS.

Multiply that area by 2 only when Performing TTT.

May 23-9:06 AM

CTS $Z = 1.835$, RTT, find p-Value.



normalcdf(1.835, E99, 0, 1)

$= .033$

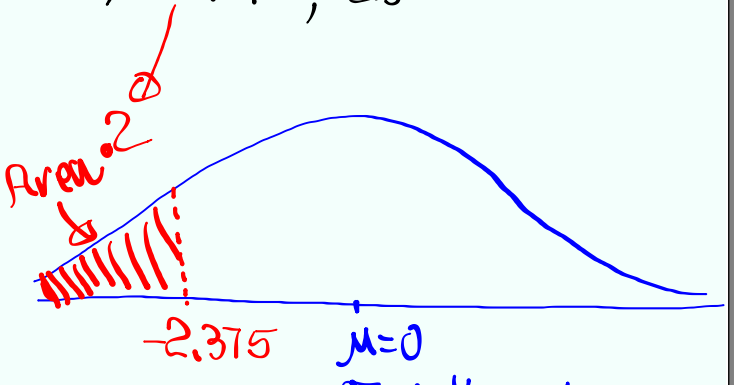
If it was TTT

P-Value $= 2(.033) = .066$

May 23-9:09 AM

CTS $t = -2.375$, TTT, $df = 9$.

find P-Value.

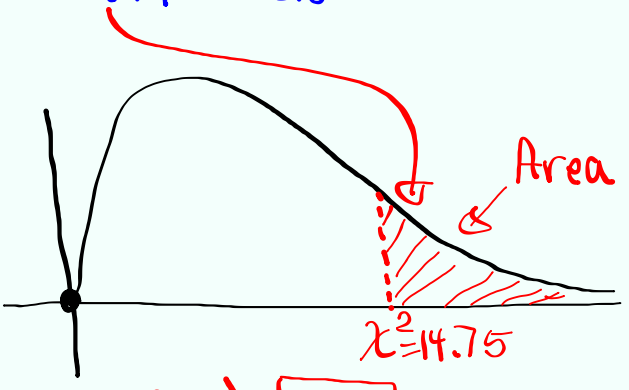


2·tcdf(−E99, −2.375, 9) $= .042$

May 23-9:13 AM

CTS $\chi^2 = 14.75$ RTT $df = 5$

Find p-Value



P-Value $= \chi^2cdf(14.75, E99, 5) = .011$

Redo with $df = 2$

P-Value $= \chi^2cdf(14.75, E99, 2) = 6.3 \times 10^{-4}$

May 23-9:16 AM

S6.24

Testing one population Proportion P:

$H_0: P = P_0$	$H_0: P \geq P_0$	$H_0: P \leq P_0$
$H_1: P \neq P_0$	$H_1: P < P_0$	$H_1: P > P_0$
TTT	LTT	RTT

Critical Value z use invNorm

Drawing, Labeling, Shading, Full TI command required.

Computed Test Statistics CTS and P-Value P.

Formula or TI command → 1-PropZTest

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

Final Conclusion must be about the Claim

May 23-9:33 AM

College claims that 10% of all students smoke

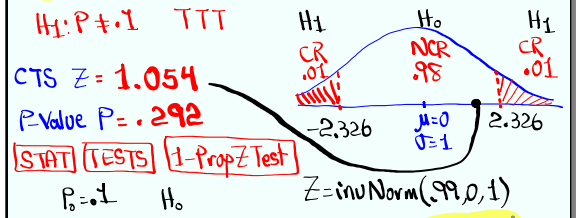
I surveyed 250 students and 30 of them were smokers. $n=250$ $x=30$

Test the claim using $\alpha=.02$.

$H_0: P=.1$ claim

$H_1: P\neq.1$ TTT

CV Z TTT $\alpha=.02$



CTS $Z=1.054$

P-Value $P=.292$

STAT TESTS 1-PropZTest

$P_0=.1$ H_0

$x=30$

$n=250$

Prop $\neq P_0$ H_1

Calculate

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

CTS is in NCR

P-Value $>\alpha$

H_0 Valid

H_1 invalid

Valid claim

Support the claim

FTR the claim

May 23-9:40 AM

CNN claims that at most 40% of all voters are in support of abortion. $P\leq.4$ H_0

LA Times surveyed 500 voters and 45% of them were in support of abortion $n=500$ $\hat{P}=.45$

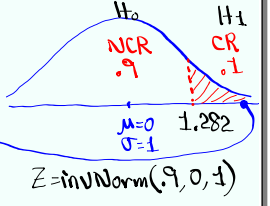
$x=n\hat{P}=500(.45)=225$

Use $\alpha=.1$ to test the claim.

$H_0: P\leq.4$ claim

$H_1: P>.4$ RTT

CV Z RTT $\alpha=.1$



CTS $Z=2.282$

P-Value $P=.011$

1-PropZTest

$P_0:.4$ H_0

$x=225$

$n=500$

Prop $>P_0$ H_1

$Z=$invNorm(.9,0,1)

CTS is in CR

P-Value $\leq\alpha$ ⇒ H_0 invalid, H_1 Valid

Invalid claim

Reject the claim

If we change α to .01,

P-Value $>\alpha$ ⇒ H_0 Valid, H_1 Invalid

Valid claim

FTR the claim

May 23-9:52 AM

College claims that less than 10% of all students carpool to campus. $P < .1$ H_1

$n = 125$, $\hat{P} = .07$ $\Rightarrow x = n\hat{p} = 125(.07) = 8.75 \rightarrow x = 9$

I surveyed 125 students, 7% of them were carpooling to campus. 7% → .07

CV Z LTT

Test the claim.

No α → use .05

H_0: $P \geq .1$

H_1: $P < .1$ claim, LTT

H_1 CR .05 | H_0 NCR .95

−1.645 $\mu = 0$ $\sigma = 1$

CTS $Z = -1.043$

P-Value $P = .148$

1-PropZTest

$P_0 : .1$ H_0

$x = 9$

$n = 125$

Prop < P_0 H_1

$Z = \text{invNorm}(.05, 0, 1)$

CTS is in NCR ⇒ H_0 valid, H_1 invalid

P-Value > α (.148 > .05)

Invalid claim

Reject the claim

If we change α to .15,

P-Value ≤ α (.148 ≤ .15)

H_0 invalid

H_1 valid

valid claim → FTR the claim

May 23-10:08 AM

Testing one population Mean μ:

SG: 24 & 25

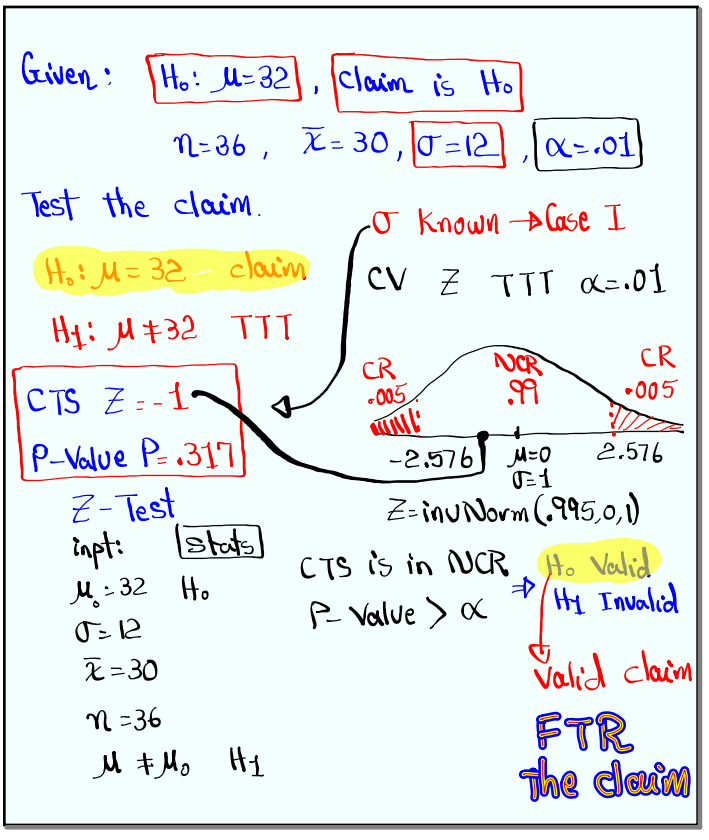
$H_0: \mu = \mu_0$	$H_0: \mu \geq \mu_0$	$H_0: \mu \leq \mu_0$
$H_1: \mu \neq \mu_0$	$H_1: \mu < \mu_0$	$H_1: \mu > \mu_0$
TTT	LTT	RTT

Case I: σ Known	Case II: σ Unknown
CV → invNorm	CV → invT → df = n − 1
CTS Z P-Value P → Z-Test inpt: Stats	CTS t P-Value P → T-Test inpt: Stats

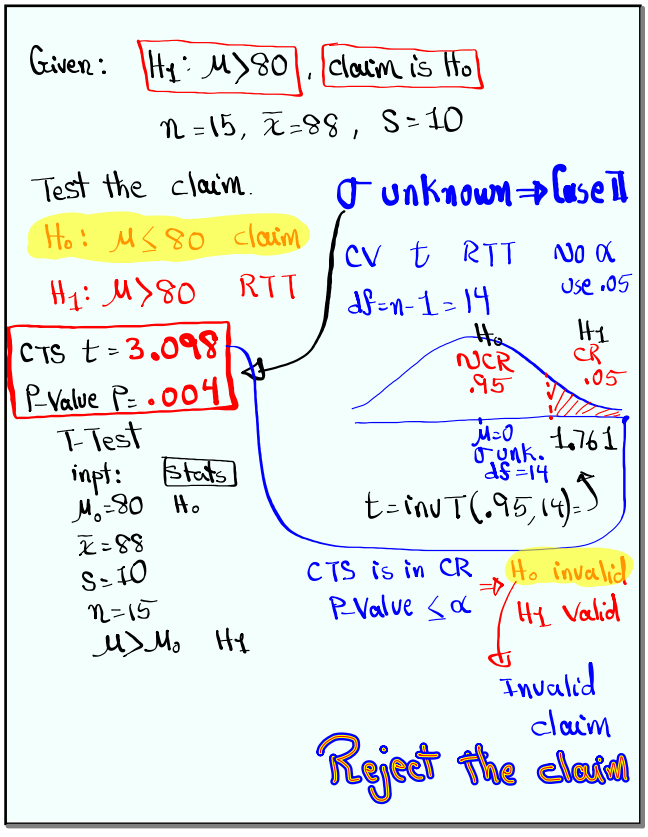
Proceed with testing chart

Draw final Conclusion about the claim

May 23-10:37 AM



May 23-10:43 AM



May 23-10:53 AM