# Statistics

# Fall 2022

# Lecture 27

Feb 19-8:47 AM

Testing One Population Standard Deviation:

| | | |
|---|---|---|
| $H_0: \sigma = \sigma_0$ | $H_0: \sigma \le \sigma_0$ | $H_0: \sigma \ge \sigma_0$ |
| $H_1: \sigma \ne \sigma_0$ | $H_1: \sigma > \sigma_0$ | $H_1: \sigma < \sigma_0$ |
| TTT | RTT | LTT |

**Always identify the claim & Testing type.**

P-Value Method only:

CTS $\chi^2 = \dfrac{(n-1)\cdot S^2}{\sigma^2}$

For P-Value : $\chi^2cdf$ command with $df = n-1$

Proceed with testing chart.

Final Conclusion must be about the claim.

**Reject the claim OR FTR the claim**

Dec 12-6:00 AM

Given $\boxed{n=12}$, $\boxed{S=8}$ $\boxed{H_0: \sigma \le 5}$, $\boxed{\text{Claim is } H_0}$

$\boxed{\alpha = .05}$

Test the claim.

$H_0: \sigma \le 5$ claim

$H_1: \sigma > 5$ RTT

CTS $\chi^2 = \dfrac{(n-1)\cdot S^2}{\sigma^2}$ $H_0$

$= \dfrac{(12-1)\cdot 8^2}{5^2} = \boxed{28.16}$

P-value Method

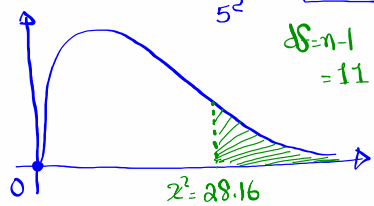
P-value $\le \alpha$

.003 .05

$H_0$ invalid, $H_1$ Valid

Invalid claim

**Reject the claim**




$df = n-1$
$= 11$

P-value $= \chi^2 cdf(28.16, E99, 11)$

$= \boxed{.003}$

If we choose $\alpha = .002$
then P-value $> \alpha$
$H_0$ valid, $H_1$ invalid
Valid claim
FTR the claim.

Dec 12-6:07 AM

Math dept. claims that standard deviation of all Scores of all final exams is below 10.

$\sigma < 10$ $H_1$

I took a Sample of 15 final exams, and standard deviation of their Scores was 7.5.

$n = 15$
$S = 7.5$

Use $\boxed{\alpha = .1}$ to test the claim.

$H_0: \sigma \ge 10$

$H_1: \sigma < 10$ claim, LTT

CTS $\chi^2 = \dfrac{(n-1)\cdot S^2}{\sigma^2}$

$= \dfrac{(15-1)\cdot 7.5^2}{10^2}$

$= 7.875$

P-value = Area

$\chi^2 cdf(0, 7.875, 14) = \boxed{.104}$


$df = n-1$
$= 14$

P-value $> \alpha$
.104 .1

$H_0$ valid, $H_1$ invalid $\rightarrow$ Invalid claim $\Rightarrow$ **Reject the claim**

If we change $\alpha$ to .105, than
P-value $\le \alpha \Rightarrow H_0$ invalid, $H_1$ Valid $\rightarrow$ Valid claim
FTR the claim

Dec 12-6:16 AM

The College claims that Standard deviation of ages of all Students is 12 Yrs. $\sigma = 12$ $H_0$

I took a Sample of 10 Students and Standard deviation of their ages was 9 Yrs. $n = 10$ $S = 9$

No $\alpha \Rightarrow$ use .05

Test the claim

$H_0: \sigma = 12$ claim

$H_1: \sigma \neq 12$ TTT

CTS $\chi^2 = \dfrac{(n-1)\cdot S^2}{\sigma^2}$

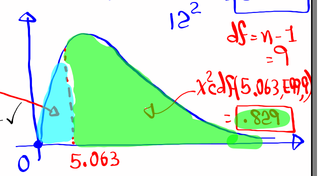
$= \dfrac{(10-1)\cdot 9^2}{12^2} = \boxed{5.063}$

$df = n-1$
$= 9$

$\chi^2cdf(0, 5.063, 9)$

$= \boxed{.171}$

Total = 1 ✓




$\chi^2cdf(5.063, E99, 9)$

$= \boxed{.829}$

P-value $>$ $\alpha$
.342 .05

$H_0$ Valid & $H_1$ invalid

Valid claim $\Rightarrow$ $\boxed{\text{FTR the claim}}$

Find the area on each Side,

P-value $= 2 *$ $\boxed{\text{Smaller area}}$

$= 2 * (.171) = \boxed{.342}$

If we change $\alpha$ to .35, then

P-value $\leq \alpha$ $\Rightarrow$ $H_0$ invalid $\Rightarrow$ Invalid claim
.342 .35 $H_1$ Valid

Reject the claim

Dec 12-6:30 AM

SG 31

Comparing two Population Standard deviations $\sigma_1$ & $\sigma_2$:

| Sample 1 | Sample 2 |
|---|---|
| $n_1 =$ | $n_2 =$ |
| $S_1 =$ | $S_2 =$ |

$\boxed{S_1 > S_2}$

NdF $= n_1 - 1$

DdF $= n_2 - 1$

$H_0: \sigma_1 = \sigma_2$ $H_0: \sigma_1 \leq \sigma_2$ $H_0: \sigma_1 \geq \sigma_2$

$H_1: \sigma_1 \neq \sigma_2$ $H_1: \sigma_1 > \sigma_2$ $H_1: \sigma_1 < \sigma_2$

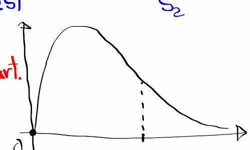
TTT RTT LTT

Always identify the claim & Testing Type

use P-value method only:

CTS F
P-value P $\Rightarrow$ 2-SampF Test

CTS $F = \dfrac{S_1^2}{S_2^2}$




use $Fcdf(L, U, NdF, DdF)$

Proceed with testing chart.

Final Conclusion must be about the claim.

Reject the claim OR FTR the claim

Dec 12-7:05 AM

Use the chart below

| Sample 1 | Sample 2 |
|---|---|
| $n_1 = 10$ | $n_2 = 12$ |
| $S_1 = 8$ | $S_2 = 5$ |

1) Is $S_1 > S_2$? Yes

2) $NdF = n_1 - 1 = 10 - 1 = 9$

$DdF = n_2 - 1 = 12 - 1 = 11$

3) Find CTS F using Formula.

$$F = \frac{S_1^2}{S_2^2} = \frac{8^2}{5^2} = \boxed{2.56}$$

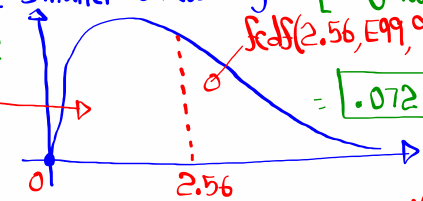
4) Find the area on each side of CTS F, multiply the smaller area by 2

L U Ndf Ddf

Fcdf(0, 2.56, 9, 11) $= \boxed{.928}$

L U Ndf Ddf

Fcdf(2.56, E99, 9, 11) $= \boxed{.072}$




P-value = 2 * Smaller area = 2(.072) = $\boxed{.144}$ ✓✓✓

Dec 12-7:16 AM

5) Test the claim at $\boxed{\alpha = .1}$ that two Pop. standard deviations are the Same.

| Sample 1 | Sample 2 |
|---|---|
| $n_1 = 10$ | $n_2 = 12$ |
| $S_1 = 8$ | $S_2 = 5$ |

$H_0: \sigma_1 = \sigma_2$ claim

$H_1: \sigma_1 \neq \sigma_2$ TTT

CTS $F = 2.56$

P-value $P = .144$

STAT TESTS

2-SampF Test

Inpt: $\boxed{\text{Stats}}$

$\sigma_1 \neq \sigma_2$

P-value > $\alpha$

.144 .1

Ho Valid, H1 Invalid → Valid claim

FTR the claim

If we change $\alpha$ to .15, then

P-value $\leq \alpha$ ⇒ Ho invalid → Invalid claim

.144 .15

Reject the claim

Dec 12-7:23 AM

Standard deviation of ages of 8 Female Students was 8 Yrs.

$n = 8$

$S = 8$

Standard deviation of ages of 10 male Students was 10 Yrs.

$n = 10$

$S = 10$

Group 1 must have larger Standard deviation.

| Males | Females |
|---|---|
| $n_1 = 10$ | $n_2 = 8$ |
| $S_1 = 10$ | $S_2 = 8$ |

1) $Ndf = n_1 - 1 = 9$

$Ddf = n_2 - 1 = 7$

2) CTS $F = \frac{S_1^2}{S_2^2} = \frac{10^2}{8^2} = \boxed{1.563}$ ✓✓✓

3) Find the area on each side of CTS F, then multiply Smaller area by 2.

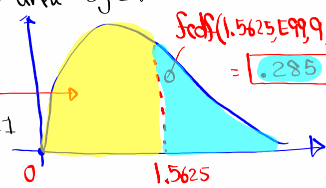
Fcdf(0,1.5625,9,7)

$= \boxed{.715}$

Total = 1

Fcdf(1.5625,E99,9,7)

$= \boxed{.285}$




P-Value = 2 * Smaller area

$= 2 * (.285) = \boxed{.57}$ ✓

Dec 12-7:32 AM

4) Test the claim that there is a difference between two pop. standard deviations.

No $\alpha$ ⇒ $\boxed{.05}$

$H_0: \sigma_1 = \sigma_2$

$H_1: \sigma_1 \neq \sigma_2$ claim, TTT

| Males | Females |
|---|---|
| $n_1 = 10$ | $n_2 = 8$ |
| $S_1 = 10$ | $S_2 = 8$ |

CTS F = 1.5625

P-value P = .569

2-Samp F Test

Inpt: $\boxed{\text{Stats}}$

$\sigma_1 \neq \sigma_2$

P-value > $\alpha$ ⇒ $H_0$ Valid

.569 .05

$H_1$ Invalid ⇒ Invalid claim

**Reject the claim**

SG 31 ✓✓✓

Dec 12-7:42 AM