Statistics
Summer 2023
Lecture 17

Feb 19-8:47 AM

Testing One Population standard deviation:

$H_0: \sigma = \sigma_0$ $\quad H_0: \sigma \leq \sigma_0$ $\quad H_0: \sigma \geq \sigma_0$

$H_1: \sigma \neq \sigma_0$ $\quad H_1: \sigma > \sigma_0$ $\quad H_1: \sigma < \sigma_0$

TTT $\quad$ RTT $\quad$ LTT

Always identify the claim

Use P-Value method only

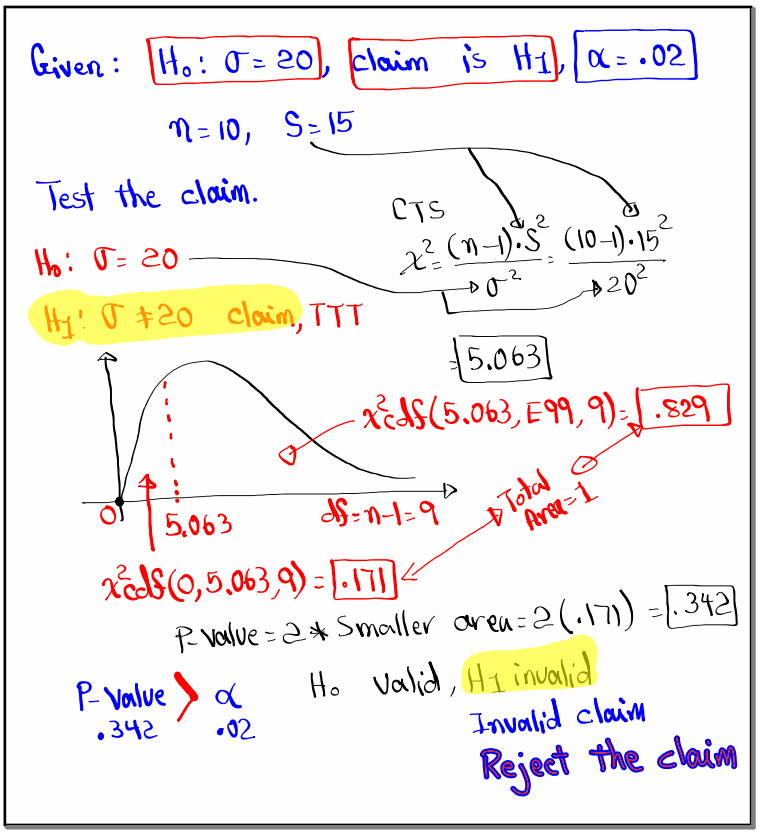
CTS Formula $\chi^2 = \frac{(n-1)\cdot s^2}{\sigma^2}$

Use $\chi^2 cdf$ with $df = n-1$ to find P-value

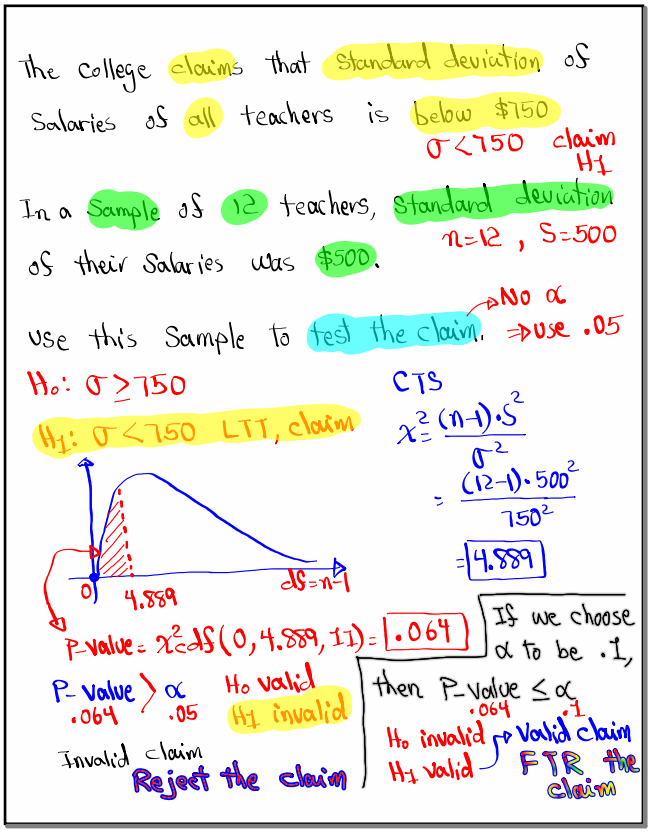
Proceed with testing chart

Draw final conclusion about the claim

Jul 11-9:56 AM



Jul 12-7:33 AM



Jul 12-7:42 AM

Given $H_0: \sigma \leq 5$, claim is H_1, $\alpha = .1$

$n = 10$, $S = 8$

Test the claim.

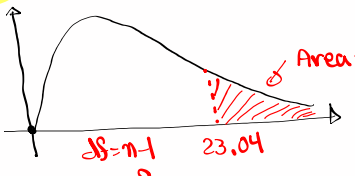
$H_0: \sigma \leq 5$

$H_1: \sigma > 5$ RTT, claim

CTS

$$\chi^2 = \frac{(n-1)\cdot S^2}{\sigma^2} = \frac{(10-1)\cdot 8^2}{5^2}$$

$$= 23.04$$



$= \chi^2 cdf(23.04, E99, 9)$

$= .006$

P-value $\leq \alpha$

$.006 \quad .1$

H_0 invalid

H_1 valid → valid claim → FTR the claim

If we choose $\alpha = .005$

P-value $> \alpha$

$.006 \quad .005$

$\Rightarrow H_0$ valid

H_1 invalid → Invalid claim

Reject the claim

Jul 12-7:53 AM

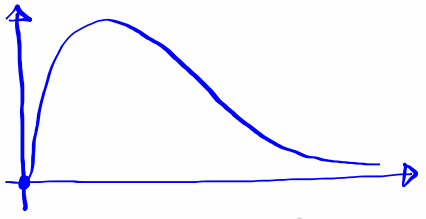
F - Dist:

1) Graph is Similar to χ^2-Dist.

Starts at 0.

Skewed to the right

Total area = 1



2) It comes with two degrees of freedom

Numerator df → Ndf

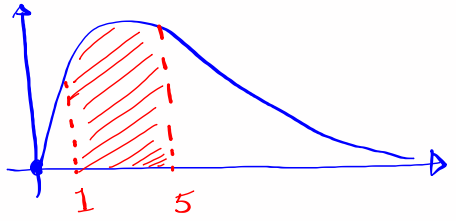
Denominator df → Ddf

3) We use Fcdf to find prob.

Fcdf(L , U, Ndf, Ddf)

Jul 12-8:31 AM

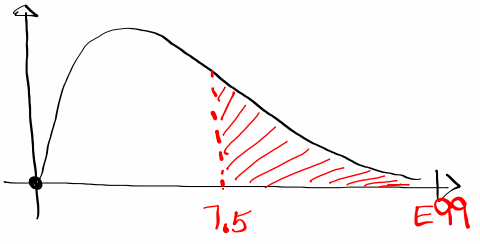
Find $P(1 < F < 5)$ with Ndf=4, Ddf=20.



2nd VARS

fcdf(1, 5, 4, 20) = .425

Find $P(F > 7.5)$ with Ndf=3 & Ddf=24.



fcdf(7.5, E99, 3, 24) = .001

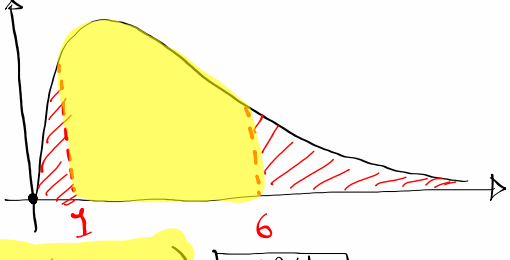
Jul 12-8:34 AM

Find $P(F < .5)$ with Ndf=5 & Ddf=30.

fcdf(0, .5, 5, 30) = .226

Find $P(F < 1$ OR $F > 6)$ with Ndf=2 & Ddf=22

Total Area



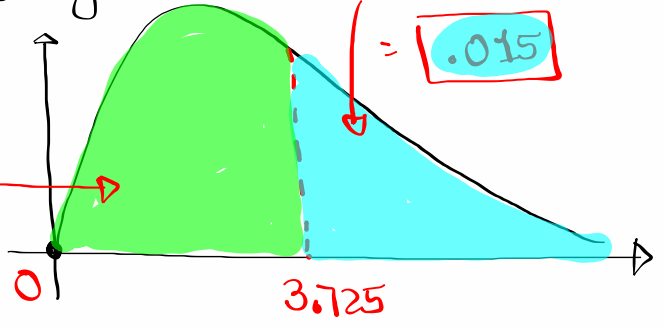
= 1 − fcdf(1, 6, 2, 22) = .624

Jul 12-8:39 AM

Find the area on each side of F=3.725 with Ndf=4 & Ddf=28, then multiply the smaller area by 2.

fcdf(3.725, E99, 4, 28) = .015

fcdf(0, 3.725, 4, 28) = .985



2 * Smaller Area = 2(.015) = .030

Jul 12-8:44 AM

Comparing Two Population Standard deviations:

$H_0: \sigma_1 = \sigma_2$ $H_0: \sigma_1 \le \sigma_2$ $H_0: \sigma_1 \ge \sigma_2$

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

TTT RTT LTT

Always identify the claim

Group 1	Group 2
$n_1 =$	$n_2 =$
$S_1 =$	$S_2 =$

$S_1 > S_2$

$Ndf = n_1 - 1$

$Ddf = n_2 - 1$

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

use 2-Samp F Test to find CTS & P-Value

Using P-Value method

Proceed with testing chart

Draw Final Conclusion about the claim

Jul 12-8:48 AM

Consider the chart below

Group 1	Group 2
$n_1 = 8$	$n_2 = 10$
$S_1 = 5$	$S_2 = 4$

1) Is $S_1 > S_2$? Yes

2) $Ndf = n_1 - 1 = 7$

$Ddf = n_2 - 1 = 9$

3) CTS $F = \frac{S_1^2}{S_2^2} = \frac{5^2}{4^2} = 1.563$

Use $\alpha = .1$ to test the claim $\sigma_1 = \sigma_2$.

H_0: $\sigma_1 = \sigma_2$ claim

H_1: $\sigma_1 \neq \sigma_2$ TTT

CTS $F = 1.563$

P-value $P = .522$

P-value $>$ α

.522 .1

H_0 valid H_1 invalid

Valid claim

FTR the claim

STAT TESTS

2-SampF Test

Inpt: Stats

$S_1 = 5$

$n_1 = 8$

$S_2 = 4$

$n_2 = 10$

$\sigma_1 \neq \sigma_2$ H_1

Calculate

Jul 12-8:55 AM

10 Female students had a stand. dev. of 8 for their ages.

Females: $n = 10$, $S = 8$

12 Male students had a stand. dev. of 5 for their ages.

Males: $n = 12$, $S = 5$

Females	Males
$n_1 = 10$	$n_2 = 12$
$S_1 = 8$	$S_2 = 5$

1) Verify $S_1 > S_2$ ✓

2) $Ndf = n_1 - 1 = 9$

$Ddf = n_2 - 1 = 11$

3) CTS $F = \frac{S_1^2}{S_2^2} = \frac{8^2}{5^2} = 2.56$

Test the claim that $\sigma_1 \neq \sigma_2$.

H_0: $\sigma_1 = \sigma_2$ ↳ two $\alpha \Rightarrow .05$

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

CTS $F = 2.56$

P-value $P = .144$ ✓

P-value $>$ α

.144 .05

H_0 valid H_1 invalid

Invalid claim

Reject the claim

2-SampF Test

Inpt: Stats

$S_1 = 8$

$n_1 = 10$

$S_2 = 5$

$n_2 = 12$

$\sigma_1 \neq \sigma_2$ H_1

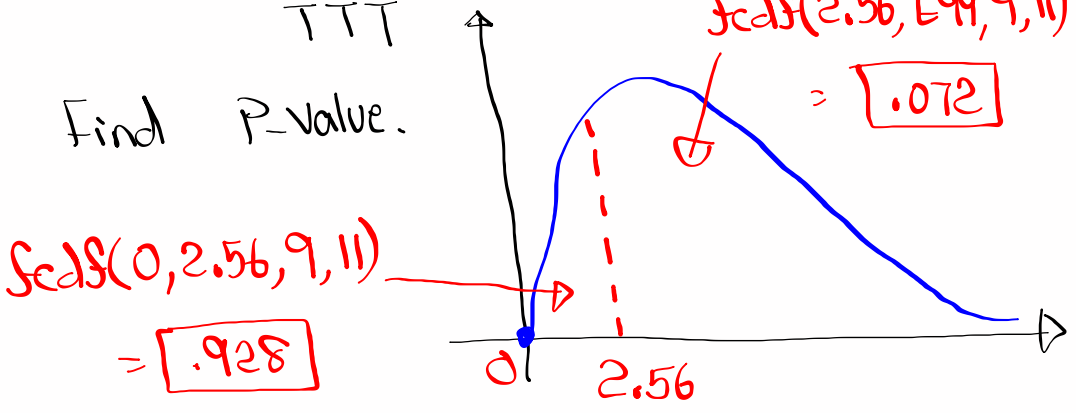
Calculate

Jul 12-9:03 AM

Given Ndf=9, Ddf=11, CTS F=2.56

TTT

Find P-value.



P-value = 2* Smaller area

= 2(.072) = .144

Jul 12-9:12 AM

Females: $n_1=5$, $S_1=10$

Males: $n_2=5$ $S_2=5$

Test the claim $\sigma_F > \sigma_M$

Ddf=4

Females	Males
$n_1=5$	$n_2=5$
$S_1=10$	$S_2=5$

Ndf=4

No α ⇒ use .05

H_0: $\sigma_1 \leq \sigma_2$

H_1: $\sigma_1 > \sigma_2$ claim, RTT

CTS F = 4

P-value P = .104 ✓

2-SampFTest

P-value > α

.104 > .05

H_0 valid

H_1 invalid

Invalid claim

Reject the claim

SG 31 ✓

Jul 12-9:16 AM

Consider the chart below for ages of randomly Selected nurses:

Females			Males		
32	40	28	36	40	35
35	45	25	45	48	
50	55				
$\bar{x}=39$			$\bar{x}=41$		
group 1: $s=11$, $n=8$			$s=6$, $n=5$ group 2		

Find $\bar{x}$, s, and n for each group. Round to whole #

No $\alpha \rightarrow .05$

Test the claim that there is no difference between Pop. standard deviations.

$\sigma_1 = \sigma_2$

$H_0: \sigma_1 = \sigma_2$ claim

$H_1: \sigma_1 \neq \sigma_2$ TTT

Ndf = 7

Ddf = 4

CTS F = 3.361

P-value P = .258 ✓

2-Samp F Test

P-value > α

.258 > .05

H_0 valid, H_1 invalid

Valid claim ⇒ FTR the claim

Jul 12-10:05 AM

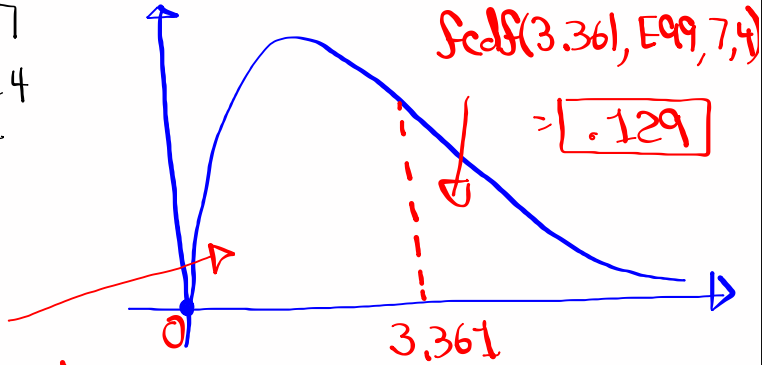
Given CTS F = 3.361

Ndf = 7

Ddf = 4

TTT

Find P-value



fcdf(3.361, E99, 7, 4) = .129

fcdf(0, 3.361, 7, 4) = .871

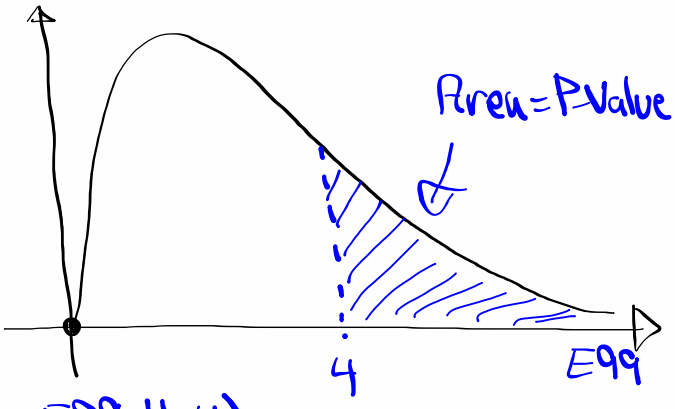
P-value = 2 * Smaller area = 2(.129)

= .258

Jul 12-10:15 AM

Given CTS F=4, RTT, NdF=4, DdF=4

Find P-value.



P-value = fcdf(4, E99, 4, 4) = .104

Jul 12-9:22 AM