# Statistics
# Summer 2023
# Lecture 18

Feb 19-8:47 AM

Testing One Population standard deviation:

$H_0: \sigma = \sigma_0$ — $H_1: \sigma \neq \sigma_0$ — TTT

$H_0: \sigma \leq \sigma_0$ — $H_1: \sigma > \sigma_0$ — RTT

$H_0: \sigma \geq \sigma_0$ — $H_1: \sigma < \sigma_0$ — 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

LA Times has reported that standard deviation of ages of all nurses is 10 Years. $\sigma = 10$ $H_0$

In a Survey of 15 randomly Selected nurses, Standard deviation of their ages was 5 Yrs. $n = 15$, $S = 5$

No $\alpha$ → Use .05

Test the validity of the report by LA Times.

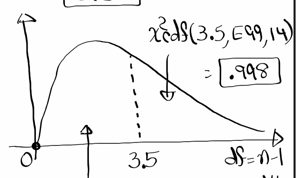
$H_0: \sigma = 10$ Report

$H_1: \sigma \neq 10$ TTT

CTS

$$\chi^2 = \frac{(n-1) \cdot S^2}{\sigma^2} = \frac{(15-1) \cdot 5^2}{10^2}$$

$= \boxed{3.5}$




$\chi^2cdf(3.5, E99, 14) = \boxed{.998}$

$\chi^2cdf(0, 3.5, 14) = \boxed{.002}$

P-value $\leq \alpha$

.004 .05

$H_0$ invalid

$H_1$ valid

Invalid Report

**Reject the report**

P-value = 2 * Smaller area

$= 2(.002) = \boxed{.004}$

Jul 13-7:32 AM

Comparing Two Population Standard deviations:

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

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

TTT RTT LTT

**Always identify the claim**

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

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 |
|---|---|
| $n_1 = 10$ | $n_2 = 15$ |
| $S_1 = 12$ | $S_2 = 5$ |

1) verify $S_1 > S_2$ ✓

2) $Ndf = n_1 - 1 = 9$

$Ddf = n_2 - 1 = 14$

3) CTS $F = \frac{S_1^2}{S_2^2} = \frac{12^2}{5^2} = 5.76$

4) use $\alpha = .1$ to test the claim $\sigma_1 > \sigma_2$.

$H_0: \sigma_1 \leq \sigma_2$

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

| CTS $F = 5.76$ |
|---|
| P-Value $P = .002$ ✓ |

2-Samp F Test

Inpt: STATS

$S_1$: 12

$n_1$: 10

$S_2$: 5

$n_2$: 15

$\sigma_1 > \sigma_2$ $H_1$

P-value $\leq \alpha$

.002 .1

$H_0$ invalid

$H_1$ valid → valid claim

FTR the claim

Jul 13-7:45 AM

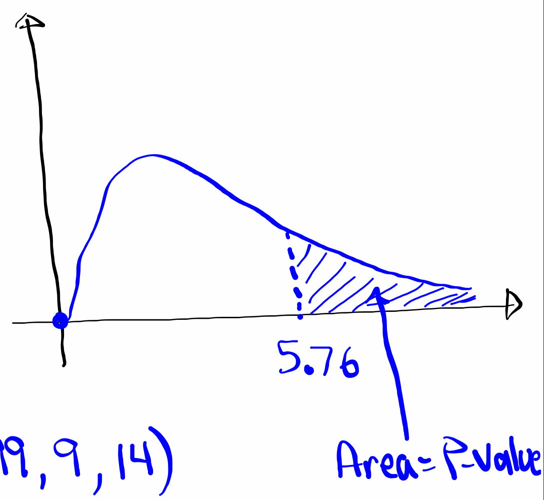
Given CTS $F = 5.76$

$Ndf = 9$

$Ddf = 14$

RTT

Find P-value




P-value = Fcdf(5.76, E99, 9, 14)

= .002

Jul 13-7:55 AM

Morning class : 8 exams, S=12

Afternoon class : 10 exams, S=9

NO α → .05

Test the claim that two population standard deviations are the same.

| Sample 1 | Sample 2 |
| --- | --- |
| $n_1=8$ | $n_2=10$ |
| $S_1=12$ | $S_2=9$ |

Ndf=7 Ddf=9

$S_1 > S_2$

$H_0: \sigma_1 = \sigma_2$ claim

$H_1: \sigma_1 \neq \sigma_2$ TTT

CTS F= 1.778

P_value P= .414 ✓

2-Samp F Test

P_value > α

.414 .05

$H_0$ valid → Valid claim → FTR the claim

$H_1$ invalid

Jul 13-7:57 AM

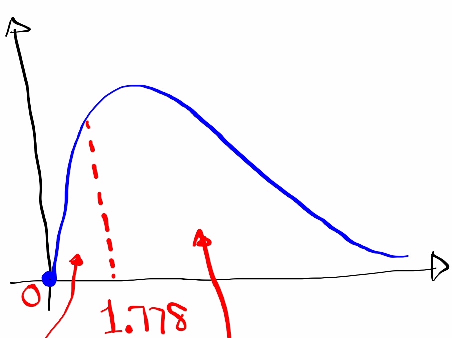
Given: CTS F=1.778

Ndf=7

Ddf=9

TTT

Find P_Value




fcdf(0,1.778,7,9) = .793

fcdf(1.778,E99,7,9) = .207

P_value = 2 * Smaller area

= 2(.207)

= .414

Jul 13-8:04 AM

Comparing at least 3 population means: (SG 35)

$H_0: \mu_1 = \mu_2 = \mu_3 = \cdots = \mu_K$

$H_1$: At least one mean is different. RTT

Name of method: ANOVA

Analysis of Variance

K → # of groups ⇒ Ndf = K − 1

n → Total Sample Size ⇒ Ddf = n − K

P-Value Method only    CTS F

Store data in L1, L2, L3, ... P-Value P

[STAT] [TESTS] → ANOVA(L1, L2, L3, ...

Proceed with testing chart

Draw final Conclusion about claim

Jul 13-8:30 AM

Chart below shows ages of randomly selected students from different schools:

| ELAC | | | Mt. SAC | | | Chaffey | | |
|---|---|---|---|---|---|---|---|---|
| 20 | 24 | 18 | 19 | 23 | 27 | 18 | 24 | 28 |
| 30 | 32 | 25 | 20 | 30 | 35 | 32 | 36 | |
| | 40 | | | | | | | |

3 groups → K = 3 → Ndf = K − 1 = 2

n = 7 + 6 + 5 → n = 18 → Ddf = n − K = 15

Test the claim that all pop. means are the same. → No $\alpha$ → .05

$H_0: \mu_1 = \mu_2 = \mu_3$ claim

$H_1$: At least one mean is different. RTT

Clear all lists

ELAC → L1
Mt. SAC → L2
Chaffey → L3

[STAT] [TESTS] [ANOVA(] L1, L2, L3 [Enter]

CTS F = .113

P-Value P = .894

P-Value > $\alpha$
.894 > .05

$H_0$ Valid $H_1$ invalid

Valid claim

FTR the claim

Jul 13-8:37 AM

Chart below shows ages of randomly selected students from different Schools:

| ELAC | Mt. SAC | Chaffey | UCLA |
|---|---|---|---|
| 24 19 28 | 18 34 36 | 20 27 32 | 25 18 35 40 |
| 25 32 30 | 19 28 20 | 18 25 | 20 45 50 |
| 20 25 | 25 25 | 30 | 60 |

K = 4
n = 8 + 8 + 6 + 8 = 30

NdF = K - 1 = 3
DdF = n - K = 26

Use $\alpha = .1$ to test the claim that all means are the same.

$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4$ claim

$H_1$: At least one mean is different. RTT

Clear all lists

ELAC → L1
Mt.SAC → L2
Chaffey → L3
UCLA → L4

STAT
TESTS
ANOVA( L1, L2, L3, L4 enter

CTS F = 2.910
P-Value P = .053

P-value ≤ α
.053 .1

$H_0$ invalid
$H_1$ Valid
Invalid claim
Reject the claim

If we choose α = .05, .04, .03, .02, .01

P-value > α
.053

$H_0$ valid, $H_1$ invalid
Valid claim
FTR the claim

Jul 13-8:47 AM

Consider the chart below for scores of randomly selected exams from different classes

| Morning | Afternoon | Evening | weekend | Online |
|---|---|---|---|---|
| 72 85 | 68 76 | 74 83 | 40 65 | 86 92 100 |
| 80 90 | 88 80 | 92 98 | 70 55 | 90 78 88 |
| 70 100 | 92 98 | 70 | 60 | 95 |

NO α → .05

Use these sample to test the claim that not all pop. means are equal.

K = 5
n = 6 + 6 + 5 + 5 + 7 = 29

→ NdF = K - 1 = 4
DdF = n - K = 24

$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$

$H_1$: At least one mean is different. RTT, claim

Morning → L1
Afternoon → L2
Evening → L3
Weekend → L4
Online → L5

STAT
TESTS
ANOVA( L1, L2, L3, L4, L5)
Enter

CTS F = 7.480
P-Value P = $4.63 \times 10^{-4}$

P-value ≤ α
$4.6 \times 10^{-4}$ .05

$H_0$ invalid
$H_1$ valid → VALID claim
FTR the claim

Jul 13-9:29 AM

Given CTS $F = 2.725$

$K = 4$ , $n = 24$

Find the p-value for (comparing 4 pop. means)

ANOVA

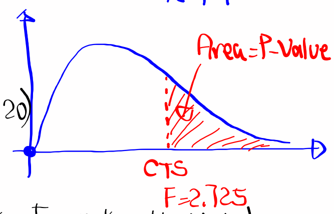
RTT

$K = 4 \rightarrow Ndf = K - 1 = 3$

$n = 24 \rightarrow Ddf = n - K = 20$

P-value = Fcdf(2.725, E99, 3, 20)

= $\boxed{.071}$




Suggest a value for $\alpha$ to make $H_0$ valid.

$H_0$ valid $\rightarrow$ P-Value $> \alpha$

$.071 > \alpha$ $\rightarrow$ choose $\alpha = .07, .06, .05, .04, .03, .02, .01$

Suggest a value for $\alpha$ to make $H_1$ valid.

$H_1$ valid $\rightarrow$ P-Value $\leq \alpha$

$.071 \leq \alpha$ $\rightarrow$ choose $\alpha = .075, .08, .09, .1,$

Jul 13-9:43 AM