Statistics

Lecture 15

Feb 19-8:47 AM

Testing one Population standard deviation (SG 27)

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

use p_value Method

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

use χ^2cdf with $df = n-1$

we proceed with testing chart

Draw final Conclusion for the claim.

Dec 5-6:50 PM

Given $\boxed{n=12}$, $\bar{x}=85$, $\boxed{S=8}$

$\boxed{H_0: \sigma \ge 10}$ $\boxed{H_0 \text{ claim}}$ $\boxed{\alpha = .02}$

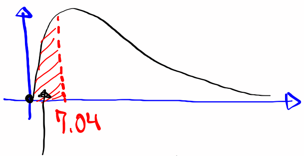
Test the claim

$H_0: \sigma \ge 10$ claim

$H_1: \sigma < 10$ LTT

CTS $\chi^2 = \dfrac{(n-1)\cdot S^2}{\sigma^2} = \dfrac{(12-1)\cdot 8^2}{10^2} = \boxed{7.04}$

$df = n-1 = 11$



P-value = $\chi^2cdf(0, 7.04, 11) = \boxed{.204}$

P-Value > α
.204 .02

H_0 Valid → Valid claim

H_1 invalid

FTR the claim

Dec 5-6:54 PM

I claim that Standard deviation of all math exams is more than 12. $\sigma > 12$ H_1

A Sample of 10 exams, Standard deviation of their Scores was 15. $n=10$ $S=15$

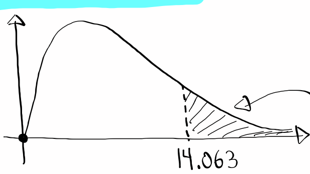
Test the claim. No α → use .05

$H_0: \sigma \le 12$

$H_1: \sigma > 12$ claim, RTT

CTS $\chi^2 = \dfrac{(n-1)\cdot S^2}{\sigma^2} = \dfrac{(10-1)\cdot 15^2}{12^2} = 14.0625 = 14.063$

$df = n-1 = 9$



Area = P-Value = $\chi^2cdf(14.063, E99, 9) = \boxed{.120}$

P-value > α
.120 .05

H_0 Valid

H_1 invalid → Invalid claim

Reject the claim

Dec 5-7:02 PM

LA Times claim that standard deviation of Salaries of all nurses is \$500 $\sigma = 500$ H_0

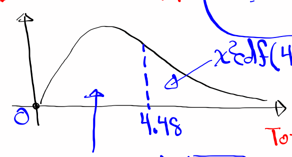
I randomly selected 8 nurses, standard deviation of their salaries was \$400. $n=8$, $S=400$

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

H_0: $\sigma = 500$ claim

H_1: $\sigma \neq 500$ TTT

CTS $\chi^2 = \frac{(n-1) \cdot S^2}{\sigma^2} = \frac{(8-1) \cdot 400^2}{500^2} = 4.48$



$\chi^2cdf(4.48, E99, 7)$ $\boxed{.723}$

Total Area $= .723 + .277 = 1$

$\chi^2cdf(0, 4.48, 7) = \boxed{.277}$

P-value $= 2 * $ Smaller area
$= 2(.277) = \boxed{.554}$

P-value $>$ α
.554 .1

H_0 valid → valid claim
H_1 invalid

FTR the claim

SG 27

Dec 5-7:11 PM

Comparing Two Population Standard deviations σ_1 & σ_2:

SG 31

TTT	RTT	LTT
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: $\sigma_1 < \sigma_2$

Make a table

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

$S_1 > S_2$

$NdF = n_1 - 1$

$DdF = n_2 - 1$

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

CTS F & P-value P

STAT TESTS 2-SampFTest

Set up H_0 & H_1

Use Testing chart to determine the validity of H_0 & H_1 using P-value Method.

Draw Final conclusion about the claim

Dec 5-7:21 PM

Use the chart below

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

1) Verify that $S_1 > S_2$

$12 > 5$ ✓

2) $Ndf = n_1 - 1 = 9$

$Ddf = n_2 - 1 = 7$

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

4) Use $\boxed{\alpha = .02}$ to test the claim that $\sigma_1 = \sigma_2$.

H_0

$H_0: \sigma_1 = \sigma_2$ claim

$H_1: \sigma_1 \neq \sigma_2$ TTT

CTS F

P-Value P

$\boxed{\text{STAT}}$ TESTS ↓ $\boxed{\text{2-SampF Test}}$

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

$S_1 = 12$

$n_1 = 10$

$S_2 = 5$

$n_2 = 8$

$\sigma_1 \neq \sigma_2$

$\boxed{\text{Calculate}}$

CTS $F = 5.76$

P-Value $P = .031$ ✓

P-Value $>$ α

.031 .02

H_0 valid → valid claim

H_1 invalid

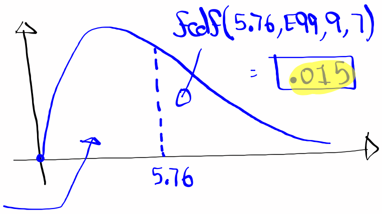
FTR the claim

Dec 5-7:28 PM

Doing Reverse

CTS $F = 5.76$ $Ndf = 9$, $Ddf = 7$, TTT

Find P-Value



Fcdf(5.76, E99, 9, 7) $= \boxed{.015}$

Fcdf(0, 5.76, 9, 7) $= \boxed{.985}$

P-Value = 2 * Smaller area

$= 2(.015) = \boxed{.030}$

Dec 5-7:37 PM

10 female students had a mean age of 26 and stand. dev. of 8.

10 Male Students had a mean age of 30 and stand. dev. of 5.

Use $\boxed{\alpha = .1}$ to test the claim that two Pop. standard deviations are the same.

Females	Males
$n_1 = 10$	$n_2 = 10$
$\bar{x}_1 = 26$	$\bar{x}_2 = 30$
$s_1 = 8$	$s_2 = 5$

1) Verify $s_1 > s_2$ ✓

2) $Ndf = n_1 - 1 = 9$

$Ddf = n_2 - 1 = 9$

$H_0: \sigma_1 = \sigma_2$ claim

CTS $F = \frac{s_1^2}{s_2^2} = 2.56$

$H_1: \sigma_1 \neq \sigma_2$ TTT

$\boxed{\text{CTS } F = 2.56 \quad \text{P-value } P = .178}$ ✓

P-value $>$ α

.178 $>$ .1

2-Samp F Test

inpt: $\boxed{\text{STATS}}$

$s_1 = 8$

$n_1 = 10$

$s_2 = 5$

$n_2 = 10$

$\sigma_1 \neq \sigma_2$

H_0 valid → valid claim

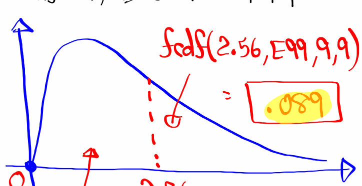
H_1 invalid

FTR the claim

Dec 5-7:41 PM

CTS $F = 2.56$ $Ndf = 9$, $Ddf = 9$ TTT

Find P-value



fcdf(2.56,E99,9,9) = $\boxed{.089}$

fcdf(0,2.56,9,9) = $\boxed{.911}$

Total Area = .911 + .089 = 1 ✓

P-Value = 2 * Smaller area

= 2(.089) = $\boxed{.178}$

Dec 5-7:51 PM

Standard deviation of Salaries of 8 female nurses was \$400. $n=8$, $S=400$

Standard deviation of Salaries of 10 male nurses was \$250. $n=10$ $S=250$

No α → use .05

Test the claim that stand. dev. of Salaries of all female nurses $\boxed{\text{is greater than}}$ the stand. dev. of Salaries of all male nurses

Sample 1	Sample 2
Females	Males
$n_1=8$	$n_2=10$
$S_1=400$	$S_2=250$

$S_1 > S_2$

$H_0: \sigma_1 \le \sigma_2$

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

2-Samp F Test

CTS $F=2.56$

P-Value $P=.095$

P-Value > α

.095 .05

H_0 valid

H_1 invalid → Invalid claim → Reject the claim

If we change α to .1,

P-Value $\le \alpha$ ⇒ H_0 invalid

.09 $\le$ .1

H_1 valid → Valid claim

FTR the claim

SG 31 ✓

Dec 5-7:55 PM

SG 35

Comparing at least 3 pop. means

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

H_1: At least one mean is different. RTT

K → # of groups

n → Total Sample Size

⇒ N df $= K-1$

D df $= n-K$

Name of the method: ANOVA

Analysis of Variance

Store data in L1, L2, L3, ...

$\boxed{\text{STAT}}$ TESTS $\boxed{\uparrow}$ ANOVA(L1 , L2 , L3, ...

$\boxed{\text{Enter}}$

CTS F

P-Value P

Use Testing chart to determine the Validity of H_0 & H_1.

Draw Final Conclusion about the claim.

Dec 5-8:20 PM

Morning			Afternoon			Evening		
72	85	70	75	84	92	98	88	78
80	90	88	98	85	70	68	100	95
	100						90	

3 groups $\rightarrow$ $K=3$ $\Rightarrow$ $NdF = K-1 = 2$

$n = 7+6+7$ $\rightarrow$ $n=20$ $\quad DdF = n-K = 17$

$\boxed{\text{Test the claim}}$ that all means are the same. $\rightarrow$ NO α $\Rightarrow .05$

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

H_1: At least one mean is different. RTT

Morning $\rightarrow$ L1   STAT   TESTS   ANOVA(L1, L2, L3) $\boxed{\text{Enter}}$

Afternoon $\rightarrow$ L2 $\Rightarrow$

Evening $\rightarrow$ L3

CTS $F = .373$
P-Value $P = .694$

P-Value $>$ α H_0 Valid $\rightarrow$ Valid claim

$.694$ $.05$ H_1 invalid

FTR the claim

Dec 5-8:26 PM

I randomly selected students from 4 schools. Ages are given below:

ELAC			Mt. SAC		Glendale			UCLA		
23	28	18	19	25	18	27	30	34	28	42
30	32	25	28	20	21	33	25	25	45	38
24	34		30	38		35		50	40	36
				40						

4 groups $\rightarrow K=4$ $NdF = K-1 = 3$

$n = 8+7+7+9 = 31$ $\Rightarrow$ $DdF = n-K = 27$

Use $\boxed{\alpha = .01}$ to test the claim that all means are equal.

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

H_1: At least one mean is different. RTT

Use ANOVA $\rightarrow$ Comparing at least 3 pop. means.

ELAC $\rightarrow$ L1 $\boxed{\text{STAT}}$

Mt.SAC $\rightarrow$ L2   TESTS

Glendale $\rightarrow$ L3 $\boxed{\text{ANOVA(}}$ L1, L2, L3, L4 $\boxed{\text{Enter}}$

UCLA $\rightarrow$ L4

CTS $F = 4.568$
P-Value $P = .0103$ ✓

P-Value $>$ α $\rightarrow$ H_0 Valid $\rightarrow$ Valid claim

$.0103$ $.01$ H_1 invalid

FTR the claim

If we change α to $.02, .03, .04, \ldots$

P-Value $\leq \alpha$ $\rightarrow$ H_0 invalid $\rightarrow$ Invalid claim

H_1 Valid   Reject it.

Dec 5-8:39 PM

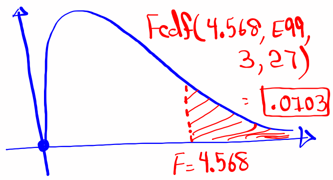
CTS F = 4.568

Comparing 4 means → K = 4 → Ndf = K-1 = 3

Total Sample Size 31 → n = 31   Ddf = n-K = 27

Find P-value

Always RTT



Fcdf(4.568, E99, 3, 27) = $\boxed{.0103}$

F = 4.568

Dec 5-8:53 PM

L1			L2		L3		
70	80	90	68	78	56	65	85
100	85	95	88	98	75	95	100
	75		90	100		80	
			75				

K = 3

n = 21

Ndf = 2

Ddf = 18

No α → .05

$\boxed{\text{Test the claim}}$ that not all means are equal.

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

H_1: At least one mean is different. RTT claim

Use ANOVA → Comparing at least 3 pop. means

ANOVA(L1, L2, L3)

CTS F = .468

P-Value P = .634

P-value > α

.634 > .05

H_0 valid

H_1 invalid

Invalid claim

Reject the claim

SG 35 ✓

Dec 5-8:58 PM