TI–83 Lab 12 for Statistics 503

Topics: pairwise comparisons from data/stats, CIs and PIs for contrasts

Dataset(s): "cotton.dat" The tensile strength of fibers with varying amounts of cotton content is investigated.

5% cotton	7	7	15	11	9	10
10% cotton	12	17	12	18	18	16
15% cotton	14	18	18	19	19	17
20% cotton	19	25	22	19	23	24
25% cotton	7	10	11	15	11	14

Pairwise Comparisons From Data. For "cotton.dat", use Fisher's LSD test, Bonferroni's LSD test, Scheffe's LSD test and Tukey's LSD test, to decide if there are any significant differences in the i–th mean tensile strength of fiber and the j–th mean tensile strength of fiber, for all i and j, at $\alpha = 0.05$.

- Type the five sets of data into $L_1, \ldots, L_5$.
- Type PRGM PAIRWISE ENTER
- Type 5 ENTER for the number of treatments (T).
- Type 4.17 ENTER for the value of the studentized range (Q).
- Type 0.05 for α.
- Type {1,1,1,1} for {F,B,S,T}? to choose all four the LSD tests.
- The output for the Fisher LSD gives (by pressing ENTER appropriately):

I	J	MI−MJ	LSD	S?
(2)	(1)	1.5	3.1	N
(3)	(1)	5.7	3.1	S
(4)	(1)	7.7	3.1	S
(5)	(1)	12.2	3.1	S
(3)	(2)	4.2	3.1	S
(4)	(2)	6.2	3.1	S
(5)	(2)	10.7	3.1	S
(4)	(3)	2	3.1	N
(5)	(3)	6.5	3.1	S
(5)	(4)	4.5	3.1	S

and

UNOR	ORD		
9.8	9.8	I	
15.5	11.3	I	
17.5	15.5		I
22	17.5		I
11.3	22		

where, in the first table, I is the i–the treatment and J is the j–th observation, and MI−MI is the difference in the means and S? means "significant"?. In the second table, UNOR is the unordered set of treatment means, and ORD is the ordered set of treatment means and where the "I"s indicate which treatments are not significant.

- For the Bonferroni LSD, the program returns the following information:

I	J	MI−MJ	LSD	S?
(2)	(1)	1.5	4.7	N
(3)	(1)	5.7	4.7	S
(4)	(1)	7.7	4.7	S
(5)	(1)	12.2	4.7	S
(3)	(2)	4.2	4.7	N
(4)	(2)	6.2	4.7	S
(5)	(2)	10.7	4.7	S
(4)	(3)	2	4.7	N
(5)	(3)	6.5	4.7	S
(5)	(4)	4.5	4.7	S

and

UNOR	ORD				
9.8	9.8	I			
15.5	11.3	I	I		
17.5	15.5		I	I	
22	17.5			I	I
11.3	22				I

- For the Scheffe LSD, the program returns the following information:

I	J	MI−MJ	LSD	S?
(2)	(1)	1.5	5.1	N
(3)	(1)	5.7	5.1	S
(4)	(1)	7.7	5.1	S
(5)	(1)	12.2	5.1	S
(3)	(2)	4.2	5.1	N
(4)	(2)	6.2	5.1	S
(5)	(2)	10.7	5.1	S
(4)	(3)	2	5.1	N
(5)	(3)	6.5	5.1	S
(5)	(4)	4.5	5.1	S

and

UNOR	ORD				
9.8	9.8	I			
15.5	11.3	I	I		
17.5	15.5		I	I	
22	17.5			I	I
11.3	22				I

- For the Tukey LSD, the program returns the following information:

I	J	MI−MJ	LSD	S?
(2)	(1)	1.5	4.5	N
(3)	(1)	5.7	4.5	S
(4)	(1)	7.7	4.5	S
(5)	(1)	12.2	4.5	S
(3)	(2)	4.2	4.5	N
(4)	(2)	6.2	4.5	S
(5)	(2)	10.7	4.5	S
(4)	(3)	2	4.5	N
(5)	(3)	6.5	4.5	S
(5)	(4)	4.5	4.5	S

and

UNOR	ORD				
9.8	9.8	I			
15.5	11.3	I	I		
17.5	15.5		I	I	
22	17.5			I	I
11.3	22				I

Pairwise Comparisons From Summary Statistics. For $t = 4$ treatment means, $\{4.2, 5.1, 7.5, 2.5\}$ of sample sizes $\{4, 5, 4, 6\}$ and standard deviation of $s = 0.25$ use Fisher's LSD test to decide if there are any significant differences in the i–th mean tensile strength of fiber and the j–th mean tensile strength of fiber, for all i and j, at $\alpha = 0.05$.

- Type the five sets of data into $L_1, \ldots, L_5$.
- Type PRGM PAIRSTAT ENTER
- Type 4 ENTER for the number of treatments (T).
- Type {4,5,4,6} ENTER for the sample sizes of the data sets.
- Type {4.2, 5.1, 7.5, 2.5} ENTER for the treatment means.
- Type 0.25 ENTER for the standard deviation.
- Type 4.17 ENTER for the value of the studentized range (Q).
- Type 0.05 for α.
- Type {1,0,0,0} for {F,B,S,T}? to choose the Fisher LSD test.
- The output for the Fisher LSD gives (by pressing ENTER appropriately):

I	J	MI−MJ	LSD	S?
(2)	(1)	1.7	0.4	S
(3)	(1)	2.6	0.4	S
(4)	(1)	5	0.3	S
(3)	(2)	0.9	0.4	S
(4)	(2)	3.3	0.3	S
(4)	(3)	2.4	0.3	S

and

UNOR	ORD
4.2	2.5
5.1	4.2
7.5	5.1
2.5	7.5

where, in the first table, I is the i–the treatment and J is the j–th observation, and MI−MI is the difference in the means and S? means "significant"? and, in the second table, UNOR is the unordered set of treatment means, and ORD is the ordered set of treatment means.

Confidence Intervals For Contrasts From Data. Given the "cotton.dat", calculate four confidence intervals (Fisher, Bonferroni Scheffe and Tukey) for the contrast $\theta = \frac{1}{2}(-\mu_1 + \mu_2 + \mu_3 - \mu_4) + (0)\mu_5$ (one of $k = 4$ CIs) where the studentized range statistic is $q = 4.17$ and where $\alpha = 0.05$.

- Type the five sets of data into $L_1, \ldots, L_5$.
- Type PRGM CSTCI ENTER
- Type 5 ENTER for the number of treatments (T).
- Type 4 ENTER for the number of contrasts (K).
- Type 4.17 ENTER for the value of the studentized range (Q).
- Type 0.05 for the value of α.
- Type $\{-.5, .5, .5, -.5, 0\}$ ENTER for the coefficients of the contrast θ considered ({CONTRAST}?)
- The program returns the following 95% CIs:

FI	-1.65	2.81
BF	-2.33	3.49
SH	-3.01	4.17
TK	-2.61	3.77

where FI is Fisher, BF is Bonferroni, SH is Scheffe and TK is Tukey.

Confidence Intervals For Contrasts From Summary Statistics. Given $t = 5$ treatments, where the means are $\{2.5, 3.1, 4.5, 1.2, 6.5\}$ and the sample sizes are $\{5, 5, 5, 5, 5\}$ and the standard deviation is $s = 0.45$, calculate four confidence intervals (Fisher, Bonferroni Scheffe and Tukey) for the contrast $\theta = \frac{1}{2}(-\mu_1 + \mu_2 + \mu_3 - \mu_4) + (0)\mu_5$ (one of $k = 4$ CIs) where the studentized range statistic is $q = 4.17$ and where $\alpha = 0.05$.

- Type the five sets of data into $L_1, \ldots, L_5$.
- Type PRGM CSTCI ENTER
- Type 5 ENTER for the number of treatments (T).
- Type 4 ENTER for the number of contrasts (K).
- Type 4.17 ENTER for the value of the studentized range (Q).

- Type .45 ENTER for the value of the standard deviation (S).
- Type 0.05 for the value of α.
- Type $\{-.5, .5, .5, -.5, 0\}$ ENTER for the coefficients of the contrast θ considered ({CONTRAST}?)
- Type $\{5, 5, 5, 5, 5\}$ ENTER for the treatment sample sizes, ({SAMPLES SIZES}?)
- Type $\{2.5, 3.1, 4.5, 1.2, 6.5\}$ ENTER for the treatment means, ({MEANS}?)
- The program returns the following 95% CIs:

FI	1.53	2.37
BF	1.4	2.5
SH	1.27	2.63
TK	1.36	2.54

where FI is Fisher, BF is Bonferroni, SH is Scheffe and TK is Tukey.

Prediction Intervals For Contrasts From Data. Given the "cotton.dat", calculate two confidence intervals (Fisher and Bonferroni) for the contrast $\theta = (-1)\mu_1 + (0)\mu_2 + (0)\mu_3 + (1)\mu_4 + (0)\mu_5$ (one of $k = 4$ CIs) where the future sample sizes of the five treatments are $\{1, 1, 1, 1, 1\}$ and where $\alpha = 0.05$.

- Type the five sets of data into $L_1, \ldots, L_5$.
- Type PRGM PI ENTER
- Type 5 ENTER for the number of treatments (T).
- Type 4 ENTER for the number of contrasts (K).
- Type 4.17 ENTER for the value of the studentized range (Q).
- Type 0.05 for the value of α.
- Type $\{0, -1, 0, 0, 1, 0\}$ ENTER for the coefficients of the (augmented) contrast θ considered ({C0,CONTRAST}?)
- Type $\{1, 1, 1, 1, 1\}$ ENTER for the future sample sizes, ({FUTURE SIZES}?)
- The program returns the following 95% PIs:

FI	3.84	20.5
BF	1.29	23.05

where FI is Fisher and BF is Bonferroni.

Prediction Intervals For Contrasts From Summary Statistics. Given $t = 5$ treatments, where the means are $\{2.5, 3.1, 4.5, 1.2, 6.5\}$ and the sample sizes are $\{5, 5, 5, 5, 5\}$, the future sample sizes are $\{1, 1, 1, 1, 1\}$, and the standard deviation is $s = 0.45$, calculate four confidence intervals (Fisher, Bonferroni Scheffe and Tukey) for the contrast $\theta = \frac{1}{2}(-\mu_1 + \mu_2 + \mu_3 - \mu_4) + (0)\mu_5$ (one of $k = 4$ CIs) where the studentized range statistic is $q = 4.17$ and where $\alpha = 0.05$.

- Type the five sets of data into $L_1, \ldots, L_5$.
- Type PRGM CSTCI ENTER
- Type 5 ENTER for the number of treatments (T).
- Type 4 ENTER for the number of contrasts (K).
- Type .45 ENTER for the value of the standard deviation (S).
- Type 0.05 for the value of α.
- Type $\{-.5, .5, .5, -.5, 0\}$ ENTER for the coefficients of the contrast θ considered ({CONTRAST}?)
- Type $\{5, 5, 5, 5, 5\}$ ENTER for the treatment sample sizes, ({SAMPLES SIZES}?)
- Type $\{1, 1, 1, 1, 1\}$ ENTER for the treatment sample sizes, ({SAMPLES SIZES}?)
- Type $\{2.5, 3.1, 4.5, 1.2, 6.5\}$ ENTER for the treatment means, ({MEANS}?)
- The program returns the following 95% PIs:

FI	0.92	2.98
BF	0.6	3.3

where FI is Fisher and BF is Bonferroni.