

Problem 11.12 Added Bonferroni and Scheffe Methods

The ANOVA Procedure

Class Level Information

Class	Levels	Values
group	3	1 2 3

Number of Observations Read	12
Number of Observations Used	12

The ANOVA Procedure

Dependent Variable: time

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	170.4500000	85.2250000	5.70	0.0251
Error	9	134.4666667	14.9407407		
Corrected Total	11	304.9166667			

R-Square	Coeff Var	Root MSE	time Mean
0.559005	6.380180	3.865325	60.58333

Source	DF	Anova SS	Mean Square	F Value	Pr > F
group	2	170.4500000	85.2250000	5.70	0.0251

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The ANOVA Procedure

Level of group	N	Mean	Std Dev
1	4	60.5000000	3.10912635
2	3	54.6666667	3.05505046
3	5	64.2000000	4.65832588

The ANOVA Procedure

Scheffe's Test for time

NOTE: This test controls the Type I experimentwise error rate, but it generally has a higher Type II error rate than Tukey's for all pairwise comparisons.

$n_1 =$ _____

$n_2 =$ _____

$n_3 =$ _____

Alpha	0.05
Error Degrees of Freedom	9
Error Mean Square	14.94074
Critical Value of F	4.25649

Comparisons significant at the 0.05 level are indicated by ***.

group Comparison	Difference Between Means	Simultaneous 95% Confidence Limits	
3 - 1	3.700	-3.865	11.265
3 - 2	9.533	1.297	17.770
1 - 3	-3.700	-11.265	3.865
1 - 2	5.833	-2.780	14.447
2 - 3	-9.533	-17.770	-1.297
2 - 1	-5.833	-14.447	2.780

$$3.7 \pm 2.918 \sqrt{14.94 \left(\frac{1}{5} + \frac{1}{4} \right)}$$

$$9.533 \pm 2.918 \sqrt{14.94 \left(\frac{1}{5} + \frac{1}{3} \right)}$$

$$5.833 \pm 2.918 \sqrt{14.94 \left(\frac{1}{4} + \frac{1}{3} \right)}$$

$$S = \sqrt{(3-1)(F(2, 9, .05))}$$

$$= \sqrt{(2)(4.26)}$$

$$= 2.918$$

The ANOVA Procedure

Bonferroni (Dunn) t Tests for time

NOTE: This test controls the Type I experimentwise error rate, but it generally has a higher Type II error rate than Tukey's for all pairwise comparisons.

Alpha	0.06
Error Degrees of Freedom	9
Error Mean Square	14.94074
Critical Value of t	2.82144

$$\alpha = .06$$

$$g = 3$$

$$\alpha^* = \frac{.06}{3} = .02$$

$$t(dfe, \frac{\alpha^*}{2})$$

Comparisons significant at the 0.06 level are indicated by ***.

$$t(9, .01) = 2.821$$

group Comparison	Difference Between Means	Simultaneous 94% Confidence Limits	
3 - 1	3.700	-3.616	11.016
3 - 2	9.533	1.569	17.498
1 - 3	-3.700	-11.016	3.616
1 - 2	5.833	-2.496	14.163
2 - 3	-9.533	-17.498	-1.569
2 - 1	-5.833	-14.163	2.496

$$3.7 \pm 2.821 \sqrt{14.94 \left(\frac{1}{5} + \frac{1}{4} \right)}$$

$$9.533 \pm 2.821 \sqrt{14.94 \left(\frac{1}{5} + \frac{1}{3} \right)}$$

$$5.833 \pm 2.821 \sqrt{14.94 \left(\frac{1}{4} + \frac{1}{3} \right)}$$