

Post Hoc Tests

Tukey's HSD procedure is appropriate for post-hoc pairwise comparisons. SPSS lists all possible pairwise comparisons, including those that are redundant.

The "Sig." column provides the probability of the HSD statistic (which is not listed). The HSD statistic is a function of the "Mean Difference" and the "Std. Error". For the first comparison in the example:

$$HSD = \frac{M_1 - M_2}{SE_{HSD}} = \frac{-4.000}{.81650} = 4.899$$

SPSS calculated the probability of a HSD of 4.899 (with 2 $df_{BETWEEN}$ and 6 df_{WITHIN} like in the ANOVA source table) as equaling .006.

This section provides confidence intervals around (centered on) the "Mean Differences." Calculation requires the appropriate critical value. Specifically, the HSD statistic (with 2 $df_{BETWEEN}$ and 6 df_{WITHIN}) that has a probability of .05 would equal 3.068 (see Critical Values of the t Distribution). For the first comparison in the example:

$$CI_D = M_D \pm (CV_{HSD})(SE_{HSD}) \\ = -4 \pm (3.068)(.81650)$$

Thus, the researcher would have 95% confidence that the interval ranging from -6.5052 to -1.4948 covers the true population mean difference.

Dependent Variable: Score on Quiz
Tukey HSD

(I) Lab Group	(J) Lab Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Control	Experimental 1	-4.00000(*)	.81650	.006	-6.5052	-1.4948
	Experimental 2	-5.00000(*)	.81650	.002	-7.5052	-2.4948
Experimental 1	Control	4.00000(*)	.81650	.006	1.4948	6.5052
	Experimental 2	-1.00000	.81650	.483	-3.5052	1.5052
Experimental 2	Control	5.00000(†)	.81650	.002	2.4948	7.5052
	Experimental 1	1.00000	.81650	.483	-1.5052	3.5052

* The mean difference is significant at the .05 level.

"Mean Difference (I-J)" is the difference between the means for the "I" and "J" groups. Even though half of the listed comparisons are redundant, the mean differences will have the opposite signs because of subtraction order. This will also change the signs of the associated confidence intervals.

These "Standard Errors" are for the difference between the two group means. The values are a function of the MS_{WITHIN} (from the ANOVA Source Table) and the group sizes:

$$SE_{HSD} = \sqrt{\frac{MS_{WITHIN}}{n_1} + \frac{MS_{WITHIN}}{n_2}} \\ = \sqrt{\frac{1.000}{3} + \frac{1.000}{3}} = .81650$$

Because all groups are of the same size, the standard error for each comparison is the same.

Homogeneous Subsets

Score on Quiz

Tukey HSD

Lab Group	N	Subset for alpha = .05	
		1	2
Control	3	4.0000	
Experimental 1	3		8.0000
Experimental 2	3		9.0000
Sig.		1.000	.483

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

"Homogeneous Subsets" provide groupings for the means. Means within the same subset are not significantly different from each other (note the "Sig." value at the bottom of the column for the subset). This offers a useful summary of the comparisons as analyzed above.