OneWay ANO

These values of the group statistics are calculated separately for each group. They are not identical to the values obtained from analyzing the variable as a whole.

These are the standard errors for each mean separately. For example, for the first group.

$$SE_M = \frac{SD}{\sqrt{N}} = \frac{2.449}{\sqrt{4}} = 1.225$$

Outcome

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Level 1	4	2.0000	2.44949	1.22474	-1.8977	5.8977	.00	5.00
Level 2	4	6.0000	2.44949	1.22474	2.1023	9.8977	4.00	9.00
Level 3	4	7.0000	2.44949	1.22474	3.1023	10.8977	4.00	9.00
Total	12	5.0000	3.16228	.91287	2.9908	7.0092	.00	9.00

"Minimum" and "Maximum" values are the lowest and highest scores in each group.

These "Total" values are all calculated for the set of data as a whole (i.e., not separately for each group). Because the mean and standard deviation are the same for each of the group values, the SE and CI will also be the same:

$$SE_M = \frac{SD}{\sqrt{N}} = \frac{3.162}{\sqrt{12}} = 0.913$$

$$CI_M = M \pm (t_{CRITICAL})(SE_M) = 5.000 \pm (2.179)(0.913)$$

Thus, the researcher estimates that the true population grand (or overall) mean is somewhere between 2.991 and 7.009 (knowing it may not).

This section provides a confidence interval around (centered on) each mean separately. Calculation requires the appropriate critical value. Specifically, the *t* statistic (with 3 *df*) that has a probability of .05 equals 3.182. For example, for the first group:

$$CI_M = M \pm (t_{CRITICAL})(SE_M) = 2.000 \pm (3.182)(1.225)$$

Thus, the researcher estimates that the true population mean is somewhere between -1.898 and 5.898 (knowing it may not).

ANOVA

Outcome

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	56.000	2	28.000	4.667	.041
Within Groups	54.000	9	6.000		
Total	110.000	11			

"Mean Squares" are estimates of the variance for each source. For each in turn:

$$MS_{BETWEEN} = \frac{SS_{BETWEEN}}{df_{BETWEEN}} = \frac{56.000}{2} = 28.000$$

$$MS_{WTIHIN} = \frac{SS_{WITHIN}}{df_{WITHIN}} = \frac{54.000}{9} = 6.000$$

"Within Groups" statistics are a function of the group variabilities. Because SS for each group is calculable (*SS = SD² x df*):

$$SS_{WITHIN} = SS_1 + SS_2 + SS_3$$
$$SS_{WITHIN} = 18 + 18 + 18 = 54.0$$
$$df_{WITHIN} = df_1 + df_2 + df_3 = 9$$

"Between Groups" statistics are a function of the group means and sample sizes:

$$SS_{BETWEEN} = \sum n_{GROUP}(M_{GROUP} - M_{TOTAL})^2$$
$$SS_{BETWEEN} = 4(2-5)^2 + 4(6-5)^2 + 4(7-5)^2$$
$$SS_{BETWEEN} = 56.000$$
$$df_{BETWEEN} = \#groups - 1 = 2$$

The "F" statistic is a ratio of the between and within group variance estimates:

$$F = \frac{MS_{BETWEEN}}{MS_{WITHIN}} = \frac{28.000}{6.000} = 4.667$$

An *F* with 2 and 9 *df* that equals 4.667 has a two-tailed probability (*p*) of .041, a statistically significant finding.