Independent Samples t Test

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.

Group Statistics

	Lab Group	N	Mean	Std. Deviation	Std. Error Mean
Outcome	Level 1	4	2.0000	2.44949	1.22474
	Level 2	4	6.0000	2.44949	1.22474

These are the standard errors for each mean separately.

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

Notice that the standard errors are equal because both groups have the same standard deviation and sample size.

"Levene's Test" determines whether the variability from the two groups is significantly different. If this were significant, one might consider using the t-test for unequal variances.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Outcome	Equal variances assumed	.000	1.000	-2.309	6	.060	-4.00000	1.73205	-8.23818	.23818
	Equal variances not assumed			-2.309	6.000	.060	-4.00000	1.73205	-8.23818	.23818

The "t", "df", and "Sig." columns provide the results of the statistical significance test. First, *t* provides the standardized statistic for the mean difference:

$$t = \frac{M_1 - M_2}{SE_{DIFF}}$$

$$t = \frac{-4.000}{1.732} = -2.309$$

The *t* statistic follows a non-normal (studentized or *t*) distribution that depends on degrees of freedom. Here, *df* = N – 2 = 8 – 2 = 6. A *t* with 6 df that equals -2.309 has a two-tailed probability (*p*) of .060, a finding that is not statistically significant.

The "Mean Difference" is the difference between the two group means. For the example, group one's mean was 4 points lower.

The "Standard Error of the Difference" is a function of the two groups' individual standard errors. When sample sizes are equal:

$$SE_{DIFF} = \sqrt{SE_1^2 + SE_2^2}$$

$$SE_{DIFF} = \sqrt{1.225^2 + 1.225^2} = 1.732$$

This value is important for both the significance test and the confidence interval. [Importantly, the computation of the standard error of the difference is more complex for unequal sample sizes.]

This section provides a confidence interval around (centered on) the "Mean Difference." Calculation requires the appropriate critical value. Specifically, the *t* statistic (with 6 *df*) that has a probability of .05 equals 2.447. As a result:

$$CI_{DIFF} = M_{DIFF} \pm (t_{CRITICAL})(SE_{DIFF})$$
$$CI_{DIFF} = -4 \pm (2.447)(1.732)$$

Thus, the researcher estimates that the true population mean difference is somewhere between -8.238 and 0.238 (knowing that the estimate could be incorrect).