Independent Samples t Test

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> ### Descriptive Statistics

> (Outcome ~ Factor) |> describeMoments()

Summary Statistics for the Data
              N        M       SD     Skew     Kurt
Level1    4.000    2.000    2.449    0.544   -2.944
Level2    4.000    6.000    2.449    0.544   -2.944

> ### Inferential Statistics

> (Outcome ~ Factor) |> estimateDifference()

Confidence Interval for the Mean Difference
              Diff       SE       df       LL       UL
Comparison   4.000    1.732    6.000   -0.238    8.238

> (Outcome ~ Factor) |> testDifference()

Hypothesis Test for the Mean Difference
              Diff       SE       df        t        p
Comparison   4.000    1.732    6.000    2.309    0.060

> (Outcome ~ Factor) |> standardizeDifference()

Confidence Interval for the Standardized Mean Difference
                 d       SE       LL       UL
Comparison   1.633    0.943   -0.215    3.481
```

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

The standard errors for each condition can be calculated separately but note that both groups have the same standard deviation and sample size.:

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

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

$$SE_{DIFF} = \sqrt{SE_1^2 + SE_2^2} = \sqrt{1.225^2 + 1.225^2} = 1.732$$

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 ("Diff"). 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 -.238 and 8.238 (knowing that the estimate could be incorrect).

The pooled (or weighted average) Std. Deviation of the groups can be determined from the group descriptive statistics:

$$SD_{WITHIN} = \sqrt{\frac{(SD_1^2)(df_1) + (SD_2^2)(df_2)}{df_1 + df_2}} = \sqrt{\frac{(2.449^2)(3) + (2.449^2)(3)}{3 + 3}} = 2.449$$

Cohen's "d" provides a standardized effect size for the difference between the two means:

$$d = \frac{M_{DIFF}}{SD_{WITHIN}} = \frac{4.000}{2.449} = 1.633$$

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

$$t = \frac{M_{DIFF}}{SE_{DIFF}} = \frac{4.000}{1.732} = 2.309$$

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.