Paired Samples t Test

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> ### Descriptive Statistics

> (PairedData) |> describeMmoments()

Summary Statistics for the Data
               N       M      SD    Skew    Kurt
Outcome1   4.000   2.000   2.449   0.544  -2.944
Outcome2   4.000   6.000   2.449   0.544  -2.944

> ### Inferential Statistics

> (PairedData) |> estimateDifference()

Confidence Interval for the Mean Difference
              Diff      SE      df      LL      UL
Comparison   4.000   1.225   3.000   0.102   7.898

> (PairedData) |> testDifference()

Hypothesis Test for the Mean Difference
              Diff      SE      df       t       p
Comparison   4.000   1.225   3.000   3.266   0.047

> (PairedData) |> standardizeDifference()

Confidence Interval for the Standardized Mean Difference
                 d      SE      LL      UL
Comparison   1.633   0.782   0.101   3.165
```

These descriptive statistics are calculated separately for each variable.

The Mean Difference ("Diff") is simply the difference between the two means listed above. However, the "SE" is not determinable from the summary statistics presented here but rather the raw data.

The Std. Deviation of the differences can be determined from this information:

$$SD_D = (SE_D)(\sqrt{N})$$
$$SD_D = (1.225)(\sqrt{4}) = 2.449$$

This confidence interval is centered on the Mean Difference ("Diff") of the two variables. Calculation requires the appropriate critical value. Specifically, the *t* statistic (with 3 *df*) that has a probability of .05 equals 3.182. As a result:

$$CI_D = M_D \pm (t_{CRITICAL})(SE_D)$$
$$CI_D = 4.00 \pm (3.182)(1.225)$$

Thus, the researcher estimates that the true population mean difference is somewhere between 0.1.02 to 7.898 (knowing that the estimate could be incorrect).

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

$$d = \frac{M_D}{SD_D} = \frac{4.000}{2.449}$$
$$d = 1.633$$

Given Cohen's heuristics for interpreting effect sizes, this would be considered an extremely large effect.

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

$$t = \frac{M_D}{SE_D} = \frac{4.000}{1.225} = 3.226$$

The *t* statistic follows a non-normal (studentized or *t*) distribution that depends on degrees of freedom. Here, *df* = *N* – 1 = 4 – 1 = 3. A *t* with 3 *df* that equals 3.226 has a two-tailed probability (*p*) of .047, a statistically significant finding.