Post Hoc Comparisons

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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
Level3   4.000   7.000   2.449  -0.544   -2.944

> ### Inferential Statistics

> (Outcome ~ Factor) |> estimatePosthoc()

Confidence Intervals for the Posthoc Mean Differences
                  Diff      SE      df      LL      UL
Level1 v Level2   4.000   1.732   9.000  -0.836   8.836
Level1 v Level3   5.000   1.732   9.000   0.164   9.836
Level2 v Level3   1.000   1.732   9.000  -3.836   5.836

> (Outcome ~ Factor) |> testPosthoc()

Hypothesis Tests for the Posthoc Mean Differences
                  Diff      SE      df       t       p
Level1 v Level2   4.000   1.732   9.000   2.309   0.106
Level1 v Level3   5.000   1.732   9.000   2.887   0.043
Level2 v Level3   1.000   1.732   9.000   0.577   0.835

> (Outcome ~ Factor) |> standardizePosthoc()

Confidence Intervals for the Posthoc Standardized Mean Difference
                  d      SE      LL      UL
Level1 v Level2   1.633   0.943  -0.215   3.481
Level1 v Level3   2.041   1.007   0.068   4.015
Level2 v Level3   0.408   0.825  -1.209   2.025
```

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.

Mean Difference ("Diff") is the difference between the means for the two listed groups.

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

$$SE_{DIFF} = \sqrt{\left(\frac{MS_{WITHIN}}{n_{GROUP}}\right) + \left(\frac{MS_{WITHIN}}{n_{GROUP}}\right)}$$

$$SE_{DIFF} = \sqrt{\left(\frac{6}{4}\right) + \left(\frac{6}{4}\right)} = 1.732$$

In this case, because all groups are of the same size, the standard error for each comparison is the same.

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 9 df_{WITHIN}) that has a probability of .05 equals 3.068. For the first comparison in the example:

$$CI_{DIFF} = M_{DIFF} \pm (HSD_{CRITICAL})(SE_{DIFF})$$
$$CI_{DIFF} = 4.000 \pm (2.792)(1.732)$$

Thus, the estimates that the true population mean difference is somewhere between -8.836 and 0.836 (knowing that the estimate could be incorrect).

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

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

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" column provides an HSD value that is conceptually similar to a *t* statistic in that it is a function of the "Diff" and the "SE". For the first comparison in the example:

$$HSD = \frac{M_2 - M_1}{SE_{DIFF}} = \frac{4.000}{1.732} = 2.309$$

The "p" column provides the probability of the HSD statistic. An HSD of -2.309 (with 2 $df_{BETWEEN}$ and 9 df_{WITHIN} like in the ANOVA source table) has a two-tailed