OneWay ANOVA

```
> ### 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
```

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.

A grand mean can be determined by taking the weighted average of all of the group means:

$$M_{TOTAL} = \frac{\sum n(M_{GROUP})}{N} = \frac{4(2) + 4(6) + 4(7)}{4 + 4 + 4} = 5.000$$

```
> ### Inferential Statistics

> (Outcome ~ Factor) |> describeEffect()

Source Table for the Model
              SS       df       MS
Between   56.000    2.000   28.000
Within    54.000    9.000    6.000
```

"Between" statistics are a function of the differences among the groups:

$$SS_{BETWEEN} = \sum n(M_{GROUP} - M_{TOTAL})^2$$

$$SS_{BETWEEN} = 4(2-5)^2 + 4(6-5)^2 + 4(7-5)^2 = 56.000$$

The degrees of freedom ("df") are a function of the number of groups:

$$df_{BETWEEN} = \#groups - 1 = 2$$

The "Mean Square" is the ratio of the "Sum of Squares" to the "df":

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

"Within" statistics are a function of the within group variabilities. Because SS for each group equals 2.00 (*SS* = *SD*² x *df*):

$$SS_{WITHIN} = SS_1 + SS_2 + SS_3 = 18.000 + 18.000 + 18.000 = 54.000$$

The degrees of freedom ("df") are a function of the number of people in each group:

$$df_{WITHIN} = df_1 + df_2 + df_3 = 9$$

The "Mean Square" is the ratio of the "Sum of Squares" to the "df":

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

```
> (Outcome ~ Factor) |> testEffect()

Hypothesis Test for the Model
               F      df1      df2        p
Factor     4.667    2.000    9.000    0.041
```

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.

```
> (Outcome ~ Factor) |> estimateEffect()

Proportion of Variance Accounted For by the Model
             Est       LL       UL
Factor     0.509    0.016    0.665
```

The "η^2" statistic is a ratio of the between group and the total group variability ("Sum of Squares") estimates:

$$\eta^2 = \frac{SS_{BETWEEN}}{SS_{TOTAL}} = \frac{SS_{BETWEEN}}{SS_{BETWEEN} + SS_{WITHIN}}$$

$$\eta^2 = \frac{56.000}{56.000 + 54.000} = 0.509$$

Thus, 50.9% of the total variability among all of the scores in the study is accounted for by group membership.