Repeated Measures ANOVA

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> ### Descriptive Statistics

> (RepeatedData) |> describeMoments()

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

> (RepeatedData) |> describeEffect()

Source Table for the Model
                SS      df      MS
Subjects    27.000   3.000   9.000
Measures    32.000   1.000  32.000
Error        9.000   3.000   3.000

> (RepeatedData) |> testEffect()

Hypothesis Test for the Model
                 F     df1     df2       p
Measures    10.667   1.000   3.000   0.047

> (RepeatedData) |> estimateEffect()

Proportion of Variance Accounted For by the Model
               Est      LL      UL
Measures     0.780   0.011   0.870
```

These descriptive statistics are calculated separately for each level or condition. Because sample sizes are equal, a grand mean can be determined by averaging these two level means:

$$M_{TOTAL} = (M_{LEVEL} + M_{LEVEL})/2 = (2.000 + 6.000)/2 = 4.000$$

Between-subjects error refers to the average differences across the participants of the study. This Sum of Squares is not easily determined from the summary statistics output, but rather from the data (and the calculations are therefore not shown here). However:

$$df_{SUBJECTS} = \#subjects - 1 = 3$$

The “Mean Square” is the usual ratio of the Sum of Squares to the degrees of freedom.

The statistics for the effect (“Measures”) are functions of the means of the levels or conditions and the sample sizes:

$$SS_{EFFECT} = \sum n_{LEVEL}(M_{LEVEL} - M_{TOTAL})^2$$
$$SS_{EFFECT} = 4(2.0 - 4.0)^2 + 4(6.0 - 4.0)^2 = 32.000$$
$$df_{EFFECT} = \#levels - 1 = 1$$

The “Mean Square” is the usual ratio of the Sum of Squares to the degrees of freedom.

$$MS_{EFFECT} = \frac{SS_{EFFECT}}{df_{EFFECT}} = \frac{32.000}{1} = 32.000$$

The within-subjects “Error” is a function of variabilities of the separate levels or conditions of the factor and the “between-subjects error” given above. Because SS for each level can be determined ($SS = SD^2 \times df$, which equals 18.000 for each of the two outcomes):

$$SS_{ERROR} = SS_1 + SS_2 - SS_{SUBJECTS}$$
$$SS_{ERROR} = 18.000 + 18.000 - 27.000 = 9.000$$
$$df_{ERROR} = df_1 + df_2 - df_{SUBJECTS} = 3 + 3 - 3 = 3.000$$

The “Mean Square” is the usual ratio of the Sum of Squares to the degrees of freedom.

The partial “η^2” statistic is a ratio of the effect and the total group variability (“Sum of Squares”) estimates:

$$Partial\ \eta^2 = \frac{SS_{EFFECT}}{SS_{EFFECT} + SS_{ERROR}}$$
$$Partial\ \eta^2 = \frac{32.000}{32.000 + 9.000} = 0.780$$

Thus, 78.0% of the variability in Outcome scores (after removing individual differences) is accounted for by the repeated measures.

The “F” statistic is a ratio of the effect and within-subjects error variance estimates:

$$F = \frac{MS_{EFFECT}}{MS_{ERROR}} = \frac{32.000}{3.000} = 10.667$$

An *F* with 1 and 3 *df* that equals 10.667 has a two-tailed probability of .047, a statistically significant finding.