OneWay ANOVA

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> ### Descriptive Statistics

> by(Outcome,Factor,sd)

> mean(Outcome)

[1] 5

> tapply(Outcome, Factor, function(x) c(length(x), mean(x), sd(x)))

$`1`
[1] 4.00000 2.00000 2.44949

$`2`
[1] 4.00000 6.00000 2.44949

$`3`
[1] 4.00000 7.00000 2.44949

> ### Inferential Statistics

> summary(Results)

          Df Sum Sq Mean Sq F value Pr(>F)
Factor     2     56      28   4.667 0.0407 *
Residuals  9     54       6
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

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:

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

"Factor" 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":

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

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

$$\begin{aligned} SS_{WITHIN} &= SS_1 + SS_2 + SS_3 \\ &= 18.000 + 18.000 + 18.000 \\ &= 54.000 \end{aligned}$$

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":

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

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.

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

$$\eta^2 = \frac{SS_{BETWEEN}}{SS_{TOTAL}} = \frac{SS_{BETWEEN}}{SS_{BETWEEN} + SS_{WITHIN}} = \frac{56.000}{56.000 + 54.000} = 0.509$$

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