

## PS 211: One-Way ANOVA

We use a one-way between-groups ANOVA when comparing more than two samples in a between-groups (between-subjects) experimental design. In other words, you have more than two groups, with different people in each group.

Example: We conduct a study on the number of hours students studied for a final exam, in an Intro to Psychology course, by their college year.

Group 1: First Year Students:

- Hours studied: 2, 3, 4;  $\sum = 9$

Group 2: Second Year Students

- Hours studied: 4, 4, 6;  $\sum = 14$

Group 3: Third Year Students

- Hours studied: 3, 8, 9;  $\sum = 20$

**Step 1:** Identify populations (groups), the distribution, and assumptions.

Populations: *What are the groups we are comparing?*

Distribution: *What are the distributions that we are comparing?*

Assumptions: *Is the data numeric? Do you have any reason to think these scores wouldn't come from normally distributed populations?*

**Step 2:** State the null and research hypotheses (in words).

**Step 3:** Determine characteristics of the comparison distribution. Remember, because we are conducting a one-way ANOVA, we want to use the *F* distribution, which tells us the distribution of *F* statistics we would expect to find under the null hypothesis. But we need to know *which* *F* distribution to use.

*What is our numerator degrees of freedom?*

*What is our denominator degrees of freedom?*

**Step 4:** Determine critical values, or cutoffs. We *~could~* determine the  $F$  value we need to find to exceed our alpha threshold of .05 via an  $F$  table, but normally we will just compute our  $F$  statistic and find the associated  $p$  value. For the purposes of this worksheet, I will tell you that the critical value is **5.14**.

**Step 5:** Calculate the test statistic, using the following equations

$$F = MS_{\text{Between}} / MS_{\text{Within}}$$

Remember:

$$MS_{\text{Between}} = SS_{\text{Between}} / df_{\text{Between}}$$

$$MS_{\text{Within}} = SS_{\text{Within}} / df_{\text{Within}}$$

**Step 5a: Compute  $SS_{\text{Between}}$ :**

To compute  $SS_{\text{Between}}$ , we want to know, on average, how much each group mean differs from the grand mean.

First, we compute the grand mean, by taking the average of all the scores: **4.78**

Next, we compute  $SS_{\text{Between}}$ :

$$SS_{\text{Between}} = 3 \times (3 - 4.78)^2 + 3 \times (4.67 - 4.78)^2 + 3 \times (6.67 - 4.78)^2 = \mathbf{20.2}$$

*Where do the numbers 3, 4.67, and 6.67 inside the parentheses come from?*

*Why is each term multiplied by 3?*

**Step 5b: Compute  $SS_{\text{Within}}$ :**

To compute  $SS_{\text{Within}}$ , we compute all the squared deviations of each person's score from their group's mean, and then add them up:

$$\begin{aligned} SS_{\text{Within}} = & (2-3)^2 + (3-3)^2 + (4-3)^2 + \\ & (4-4.67)^2 + (4-4.67)^2 + (6-4.67)^2 + \\ & (3-6.67)^2 + (8-6.67)^2 + (8-6.67)^2 = \mathbf{25.33} \end{aligned}$$

*Why are we adding up 9 different terms?*

*If we had an additional group with 3 scores, how many more terms would we add to this equation?*

**Step 5c: Compute the  $F$  statistic:**

*Given the equations written and values computed above, what is the value of  $F$ ?*

**Step 6: Make a decision.** Compare your calculated  $F$  statistic to your critical value.

*Should you reject the null hypothesis? Why or why not? What is your interpretation of this finding in words?*

**Calculate the appropriate effect size for this study.**

Write out the effect size formula for an  $F$  test.

Plug in your numbers to the effect size formula:

Interpret the effect size. Is this a small, medium, or large effect?

Should you run post-hoc tests? Why or why not?

Report your findings in APA format: