

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

$$F = \text{MS}_{\text{Between}} / \text{MS}_{\text{Within}}$$

Remember:

$$\text{MS}_{\text{Between}} = \text{SS}_{\text{Between}} / \text{df}_{\text{Between}}$$

$$\text{MS}_{\text{Within}} = \text{SS}_{\text{Within}} / \text{df}_{\text{Within}}$$

Step 5a: Compute $\text{SS}_{\text{Between}}$:

To compute $\text{SS}_{\text{Between}}$, 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 $\text{SS}_{\text{Between}}$:

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

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 $\text{SS}_{\text{Within}}$:

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

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

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: