9.4: Practice! Movies and Mood

Dr. Foster was interested in whether the type of movie someone sees at the theater affects their mood when they leave. He decide to ask people about their mood as they leave one of two movies: a comedy (group 1, N_C = 35) or a horror film (group 2, N_H = 29). The data are coded so that higher scores indicate a more positive mood.

Step 1: State the Hypotheses

As always, we start with hypotheses:

- Research Hypothesis: The average mood for the sample who watched a comedy will be higher than the average mood for the sample who watched a horror film.
  - Symbols: $\bar{X}_C > \bar{X}_H$
- Null Hypothesis: The average mood for the sample who watched a comedy will be similar to the average mood for the sample who watched a horror film. In order words, there will be no difference between the means.
  - Symbols: $\bar{X}_C = \bar{X}_H$

One thing to notice about the research hypothesis is that we put the mean of the comedy first. And since we think that mean will be bigger, our calculated t-score should be positive because we will have a larger number minus a smaller number. Be sure to pay attention to which group is which and how your data are coded (higher is almost always used as better outcomes) to make sure your hypothesis makes sense!

Step 2: Find the Critical Values

Just like before, we will need critical values, which come from out of the same t-table that we used for one-sample t-tests (and found in the Common Critical Value Tables page at the back of this book). In this example, we have a one-tailed test at α = 0.05. Our degrees of freedom for our independent samples t-test is just the degrees of freedom from each group added together:

$$df = N_1 + N_2 - 2 = 35 + 29 - 2 = 62$$

OR

$$df = (N_1 - 1) + (N_2 - 1) = (35 - 1) + (29 - 1) = 34 + 28 = 62$$

From our t-table, we find that our the closest Degrees of Freedom to 62 that is listed is $df = 60$, with a critical value of$t*$ = 1.671. Note that just because we use the $df = 60$ row in the table doesn't mean that the Degrees of Freedom is 60. The table doesn't have all critical t-scores, so we're using the closes Degrees of Freedom to find a critical value that is close to what we need for our two samples.

Step 3: Compute the Test Statistic

The descriptive statistics for both groups are provided in Table $9.4.1$ so that you can focus on the independent samples t-test equation in Example $9.4.1$, and not get caught up in other calculations right now.

Table 9.4.1 - Descriptive Statistics for Mood by Type of Movie

Group	N	Mean	Standard Deviation
Group 1: Comedy	35	24.00	12.20
Group 2: Horror Movie	29	16.50	11.80

Take a deep breath!

Example $9.4.1$

Calculate an independent t-test using the descriptive statistics from Table $9.4.1$.

After your deep breath, copy down the independent samples t-test formula:

$$t=\frac{(\bar{X}_C-\bar{X}_H)}{\sqrt{\left[\frac{(N_C-1)*s_C^2+(N_H-1)*s_H^2}{N_C+N_H-2}\right]*\left(\frac{1}{N_C}+\frac{1}{N_H}\right)}}$$

And then fill in all of the numbers from Table 9.4.1 into the formula:

$$t=\frac{(24.00-16.50)}{\sqrt{\left[\frac{(35-1)*(12.20)^2+(29-1)*(11.80)^2}{35+29-2}\right]*\left(\frac{1}{35}+\frac{1}{29}\right)}}$$

At this point, you do the calculations by following the order of operations (PEMDAS from the Math Refresher in chapter 3!).

Solution

I like to start at the top right and work my way left and down because that's how reading goes in English. Let's try that by doing a few of the easy calculations first. As long as you follow the rules of the order of operations, you can do this in whatever order you'd like, though.

$$\begin{aligned}
t &= \frac{(24.00-16.50)}{\sqrt{\left[\frac{(35-1)*(12.20)^2+(29-1)*(11.80)^2}{35+29-2}\right]*\left(\frac{1}{35}+\frac{1}{29}\right)}}\\
t_{Add/Subtract} &= \frac{7.50}{\sqrt{\left[\frac{(34)*(12.20)^2+(28)*(11.80)^2}{62}\right]*\left(\frac{1}{35}+\frac{1}{29}\right)}}\\
t_{Square} &= \frac{7.50}{\sqrt{\left[\frac{(34*148.84)+(28*139.24)}{62}\right]*\left(\frac{1}{35}+\frac{1}{29}\right)}}\\
t_{Multiply} &= \frac{7.50}{\sqrt{\left[\frac{(5060.56)+(3898.72)}{62}\right]*\left(\frac{1}{35}+\frac{1}{29}\right)}}\\
t_{AddAgain} &= \frac{7.50}{\sqrt{\left(\frac{8959.28}{62}\right)*\left(\frac{1}{35}+\frac{1}{29}\right)}}\\
t_{Divide} &= \frac{7.50}{\sqrt{(144.50)*(0.03+0.03)}}\\
t_{AddAgain\,Again} &= \frac{7.50}{\sqrt{(144.50)*(0.06)}}\\
t_{MultiplyAgain} &= \frac{7.50}{\sqrt{8.67}}\\
t_{SquareRoot} &= \frac{7.50}{2.94}\\
t_{TheEnd!} &= 2.55
\end{aligned}$$

If you use Excel your final calculations will be slightly different because Excel keeps all of the numbers after the decimal point. For Excel, the calculation will look like:

$$t = \frac{(24.00 - 16.50)}{\sqrt{\left[\frac{(35-1)*(12.20)^2 + (29-1)*(11.80)^2}{35+29-2}\right]*\left(\frac{1}{35}+\frac{1}{29}\right)}}$$

$$t_{Add/Subtract} = \frac{7.50}{\sqrt{\left[\frac{(34)*(12.20)^2 + (28)*(11.80)^2}{62}\right]*\left(\frac{1}{35}+\frac{1}{29}\right)}}$$

$$t_{Square} = \frac{7.50}{\sqrt{\left[\frac{(34*148.84) + (28*139.24)}{62}\right]*\left(\frac{1}{35}+\frac{1}{29}\right)}}$$

$$t_{Multiply} = \frac{7.50}{\sqrt{\left[\frac{(5060.56) + (3898.72)}{62}\right]*\left(\frac{1}{35}+\frac{1}{29}\right)}}$$

$$t_{AddAgain} = \frac{7.50}{\sqrt{\left(\frac{8959.28}{62}\right)*\left(\frac{1}{35}+\frac{1}{29}\right)}}$$

$$t_{Divide} = \frac{7.50}{\sqrt{(144.50)*(0.03+0.03)}}$$

$$t_{AddAgainAgain} = \frac{7.50}{\sqrt{(144.50)*(0.06)}}$$

$$t_{MultiplyAgain} = \frac{7.50}{\sqrt{9.11}}$$

$$t_{SquareRoot} = \frac{7.50}{3.02}$$

$$t_{TheEnd!} = 2.48$$

Phew!

A few things to notice. I added subscripts inappropriately to indicate what I was doing on each step. Also, on my own, I might have combined a few of these calculations in one step, but I don't encourage too much of that because it's easy to miss a step. Especially when you are re-writing the equation over and over again.

Before we can move on to the final step of the hypothesis testing procedure, take a break and congratulate yourself! That was a scary formula, and you did it! I know that you're not supposed to use food as a reward, so I petted my dog as a reward. But I also had a dark chocolate truffle.

Step 4: Make the Decision

We have good reason to believe that people leaving the comedy will be in a better mood, so we use a one-tailed test at α = 0.05 to test our hypothesis. Our calculated test statistic has a value of t = 2.48, and in step 2 we found that the critical value is $t*$ = 1.671. As 1.671 is smaller than 2.48 (the critical value is smaller than the calculated value), we reject the null hypothesis because:

$$\textbf{(}\boldsymbol{Critical} < |\boldsymbol{Calculated}|\textbf{)} = \textbf{\textit{Reject null}} = \textbf{\textit{means are different}} = \boldsymbol{p < .05}$$
$$\textbf{(}\boldsymbol{Critical} > |\boldsymbol{Calculated}|\textbf{)} = \textbf{\textit{Retain null}} = \textbf{\textit{means are similar}} = \boldsymbol{p > .05}$$

We found that the calculated t-score was more extreme than the critical t-score. The critical t-score was marking the 5% probability, so a calculated score more extreme than that shows that the probability of the calculated t-score being this extreme (the means being this different) is less than 5%.

Let's look back at the research hypothesis:

- Research Hypothesis: The average mood for the sample who watched a comedy will be higher than the average mood for the sample who watched a horror film.
- Symbols: $\bar{X}_C > \bar{X}_H$

Example $9.4.2$

What does the conclusion for a t-test look like?

Solution

Based on our sample data from people who watched different kinds of movies, the average mood for the sample who watched a comedy ($\overline{X_C} = 24.00$) was higher than the average mood for the sample who watched a horror film ($\overline{X_H} = 16.50$), $t(62) = 2.48, p < .05$. This supports our research hypothesis.

For a full report, you would describe what all three of the measures of central tendency tell us about the center of the distribution, what the standard deviation tells us about the shape of the distribution, and we'd look at the graph. After all of that, we'd add the concluding paragraph for our t-test (as show in Example $9.4.2$.

Summary

Let's summarize.

1. First, we made a prediction about which group will have a higher mean, and noted our null hypothesis (that the means will be the same).
2. Second, we looked at the t-table to see what our critical value would be to be able to reject the null hypothesis that the means are the same.
3. Third, we did a complicated equation with numbers provided from a table to find a calculated t-test.
4. Fourth, and finally, we decided that our calculated t-score was so big that it is very unlikely (a difference between means this big would occur less than 5% of the time if the samples were actually from the sample population) that the groups were similar, so we determined that the means were different. We looked at our research hypothesis, and found that the means were different in the direction we said (the group we said would have a bigger mean did have the bigger mean), and supported our research hypothesis.

You're doing great, keep it up!

- Dr. MO (Taft College)