One-Way ANOVA Demonstration
Program Transcript

MATT JONES: This week we're going to be introducing you to one-way ANOVA. This is a comparisons-of-means test. Let's go to SPSS to see how we'll perform this specific test. To perform the one-way ANOVA in SPSS, we start up at the Analyze tab. If we click that, we get a dropdown menu.

Since one-way ANOVA over is a comparisons-of-means test, we can move our cursor down to Compare Means, scroll across, and we see that one-way ANOVA is down at the bottom. If we click on that, a dialog box is opened up, where we have a Dependent List and a Factor. For one-way ANOVA, our dependent variable needs to be a metric level variable. That is it's an interval or ratio level of measurement. This is important because one one-way ANOVA compares means across a factor.

The factor is our grouping variable. This needs to be a categorical variable. Typically, one-way ANOVA is used with grouping variables that have three or more levels or attributes to them. In this case, let's go ahead and test whether the means of the socioeconomic status index differ across a respondent's highest degree.

To begin with, well, we'll go ahead, and we'll put socioeconomic status index into our Dependent List box. So you can see off to the left are choice of variables. Socioeconomic Status is down towards the bottom of our Variable list. If I place my cursor over it, we'll see it highlighted. You'll also note, again, a little scale ruler off to the left, which indicates that this is an interval-ratio-level variable.

Once I click on that variable, it's highlighted. I can just simply click on the arrow box, which moves that variable over into the Dependent List. Now I need to make sure and enter my factor as well. I'll scroll up till I find Respondents Highest Degree. I can see that it's right here. I can hover over this variable and then highlight it.

Again, click on my arrow that places it into the Factor box. For basic omnibus ANOVA test, we are finished. We can go ahead and click OK and examine our output. This is the SPSS one-way ANOVA omnibus output. You can see here Respondent Socioeconomic Index is our dependent variable.

SPSS provides us with information about between-groups and within-groups variance. The between-groups variance is a squared deviations between the groups. The within-groups variance, also known as unexplained variance, is the variance within the sample. A ratio of the mean square of between groups to within groups is how we obtain the F-value. The F statistic is a critical value that determines the significance of our test.

Here we can see that the significance level is 0.000. This significance level is well below the conventional threshold of 0.5. Therefore we can reject the null hypothesis that there are no differences in socioeconomic status index across respondents highest degree. To find out where possible differences lie, we have to perform a post-hoc test.

To perform a post-hoc test, we once again go back up to our Analyze, Compare Means, One-Way ANOVA. We can click on Post-Hocs, in here you'll see that there are a variety of options provided for you. We have equal variances assumed and equal variances not assumed. At this point, we don't know that whether we have equality of variances, and this is something that we specifically have to test for.

But as you're performing the one-way ANOVA test, you can choose an equal variances assumed test, an equal variances not assumed test, and then on your output, go to the appropriate test after examining the variances. So we can click on a Bonferroni Test for equal variances and also Games-Howell for equal variances not assumed. Click Continue.

If we click our Options box, this is how we determine whether we have homogeneity of variances, or said another way, equality of variances. As you know from your reading, this is an assumption of the one-way ANOVA test. If we click on that and activate this test, going to hit Continue and then click OK. Right away you'll see that we get quite a bit more output than we had before.

Our first piece of output is the test of homogeneity of variances, also known as a Levene's test. This tests the null hypothesis of homogeneity of variances. Here, if you look at the significance level, you'll see that we are at 0.000, which is well below the threshold of 0.05. This means we reject our null hypothesis that variances are equal. Therefore, we have to assume that the variances are not equal in the one-way ANOVA.

As we noted before, the overall test, also sometimes referred to as the omnibus test, is significant. Since the omnibus test is significant, we know that at least one of the means differs from another. Therefore we need to examine our post-hoc tests to determine which means differ. Again, moving with the assumption of inequality of variances, we have to move down to our Games-Howell all Post-Hoc test.

If you remember, we chose Bonferroni as a test for equality of variances, but tested for the equality of variances and found they were not equal. The Games-Howell test performs a pairwise comparison for all levels of our variable. Here you'll see less than high schools compared to high school, less than high school to junior college, less than high school to bachelor, less than high school to graduate, and so forth, until all possible combinations are achieved.

The next column shows us our mean difference. We can see that on the socioeconomic status index, our dependent variable, those with less than high school have a mean score of 10.08 units lower than high school. If we move over to our significance level, we see that, indeed, this pairwise comparison is statistically significant a at the 0.05. Therefore there is a statistically significant difference between those with less than high school and those with a high school degree.

As we move down our output, we can examine all of these pairwise comparisons. Again, less than high school to junior college, there is a difference of 17.38, and it is statistically significant. If we move to a less than high school to bachelor's, we can see that the difference increases. Again, it is statistically significant, and the same is true for less than high school to graduate.

Moving through our output, we can go ahead and examine all of these pairwise comparisons, move over to our significance column, and see that they are indeed all statistically significant. You'll notice on the main difference that SPSS also puts an asterisk next to each mean difference to highlight or flag those differences that are statistically significant. We can conclude from our output and our post-hoc tests that there is indeed a difference in socioeconomic status index across respondents highest degree and that all pairwise comparisons are statistically significant, concluding that the higher a respondent's degree, the higher their socioeconomic status index on average.

And that concludes our SPSS demonstration on one-way ANOVA. As a couple of parting thoughts, be sure and remember that your dependent variable in one-way ANOVA needs to be a metric variable, that is an interval ratio level of measurement. Your independent variable, or your factor, needs to be a categorical variable. This is because one-way ANOVA of is a comparison-of-means test.

Also, it's very important to test the assumption for homogeneity of variances, so be sure and look at that Levene's test. If you have any further questions, be sure and use your textbook. And also, your instructor is a very valuable resource.