We created a boxplot to show the distributions of the changes in number of days with cold symptoms for the three vitamin C treatment groups. Figure 154 shows the distributions of the three groups.

An APA Results Section

A one-way analysis of variance was conducted to evaluate the relationship between vitamin C and the change in the number of days with cold symptoms from the first year to the second year of the study. The independent variable, the vitamin C factor, included three levels: placebo, low doses of vitamin C, and high doses of vitamin C. The dependent variable was the change in the number of days of cold symptoms from the first year to the second year. The ANOVA was significant, $F(2, 27) = 4.84, p = .02$. The strength of relationship between the vitamin C treatment and the change in the number of days with cold symptoms, as assessed by $\eta^2$, was strong, with the vitamin C factor accounting for 26% of the variance of the dependent variable.

Follow-up tests were conducted to evaluate pairwise differences among the means. Because the variances among the three groups ranged from 16.54 to 30.00, we chose not to assume that the variances were homogeneous and conducted post hoc comparisons with the use of the Dunnett's C test, a test that does not assume equal variances among the three groups. There was a significant difference in the means between the group that received a low dose of vitamin C and the placebo group, but no significant differences between the two vitamin C groups and between the high dose and placebo groups. The group that received a low dose of vitamin C showed a greater decrease in number of days with cold symptoms in comparison to the placebo group. The 95% confidence intervals for the pairwise differences, as well as the means and standard deviations for the three vitamin C groups, are reported in Table 19.

Table 19
95% Confidence Intervals of Pairwise Differences in Mean Changes in Number of Days of Cold Symptoms

<table>
<thead>
<tr>
<th>Vitamin C group</th>
<th>M</th>
<th>SD</th>
<th>Placebo</th>
<th>Low dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placebo</td>
<td>3.50</td>
<td>4.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low dose</td>
<td>-2.10</td>
<td>4.07</td>
<td>[0.47, 10.73*]</td>
<td></td>
</tr>
<tr>
<td>High dose</td>
<td>-2.00</td>
<td>5.48</td>
<td>[-0.56, 11.56]</td>
<td>[-6.12, 5.92]</td>
</tr>
</tbody>
</table>

Note: An asterisk indicates that the 95% confidence interval does not contain zero, and therefore the difference in means is significant at the .05 significance level using Dunnett's C procedure.
Writing an APA Results Section

We present some guidelines for writing a Results section for statistical procedures that may require follow-up tests, such as one-way ANOVA and MANOVA in Unit 7, or the Friedman test in Unit 10. Consequently, it may be necessary to reread this material after you have read the other lessons in Unit 7 and the lessons in Unit 10.

Some researchers initially provide a description of the general overall analytic strategy that includes the omnibus tests and the follow-up tests. This general description is necessary to the degree that the analyses are unconventional or complex.

The steps required to write a Results section are as follows:

1. Describe the statistical test(s), the variables, and the purpose of the statistical test(s). For example, “A one-way analysis of variance was conducted to evaluate the relationship between vitamin C and the change in the number of days with cold symptoms from the first year to the second year of the study.”
   - Describe the factor or factors. If a factor is a within-subjects factor, be sure to label it as such. Otherwise the reader may assume that it is a between-subjects factor. If a multifactorial design has one or more within-subjects factors, describe each factor as a between-subjects or a within-subjects factor.
   - Indicate the number of levels of each factor. It may also be informative to the reader to have a description of each level if the levels are different treatments. However, it is not necessary to report the number of levels and what the levels are for factors with obvious levels such as gender.
   - Describe what the dependent variable(s) are.

2. Report the results of the overall test(s).
   - Describe any decisions about which test was chosen based on assumptions. For example, for a one-way within-subjects ANOVA, justify the choice of using a traditional univariate test instead of a multivariate test.
   - Report the test value and significance level (for the one-way ANOVA, F(2, 27) = 4.84, p = .02). For p values of .000, report them as p < .01 or p < .001. For multifactor designs, report the statistic for each of the main and interaction effects. Tell the reader whether the test(s) are significant or not.
   - Report statistics that allow the reader to make a judgment about the magnitude of the effect for each overall test (e.g., for the one-way ANOVA, η² = .45).
   - Statistical notation consisting of Greek letters and abbreviations that are not variables, as well as subscripts and superscripts that are not variables, should be in standard type. Vectors and matrices should be in boldface. All other statistical symbols should be in italics.

3. Report the descriptive statistics. Refer the reader to a table or figure that presents the relevant descriptive statistics (e.g., means and standard deviations for ANOVA designs). A table or figure may not be necessary for simpler designs, such as a one-way ANOVA with three groups. For these simple designs, the descriptive statistics may be presented in the text.

4. Describe and summarize the general conclusions of the analysis. For example, “The results of the one-way ANOVA supported the hypothesis that different types of vitamin C treatment had a differential effect on the reduction of cold symptoms in individuals.”

5. Report the results of the follow-up tests.
   - Describe the procedures used to conduct the follow-up tests. Explain any decisions you made about choice of tests based on their assumptions.
   - Report the method used to control for Type I error across the multiple tests.
   - Summarize the results of the follow-up procedures. It may be useful to present the results of the significance tests among pairwise comparisons with a table of means and standard deviations. When possible, report confidence intervals for pairwise comparisons.
Describe and summarize the general conclusions of the follow-up analyses. Make sure to include in your description the directionality of the test. For example, the mean for one treatment group is higher or lower than the mean for another group.

6. Report the distributions of the dependent variable for levels of the factor(s) in a graph, if space is available. The graph should be inserted in the text where appropriate. For example, if the graph pertains to assumptions, you would insert it in the section where assumptions are discussed. Likewise, if the graph reflects the means and standard deviations, it should be presented with the discussion of the descriptive statistics.

Alternative Analyses

Data for a one-way ANOVA can also be analyzed by using the Kruskal-Wallis nonparametric procedure (see K independent-samples tests in Lesson 43). If the assumptions of a one-way ANOVA are met, ANOVA is more powerful than the nonparametric alternatives. However, if the assumptions are not met, nonparametric alternatives may be more powerful.

Exercises

The data for Exercises 1 through 3 are in the data set named Lesson 25 Exercise File 1 on the Web at http://www.pearsonhighered.com/greensalkindSPSS. The data are from the following research problem.

Marvin is interested in whether blonds, brunets, and redheads differ with respect to their extroversion. He randomly samples 18 men from his local college campus: six blonds, six brunets, and six redheads. He then administers a measure of social extroversion to each individual.

1. Conduct a one-way ANOVA to investigate the relationship between hair color and social extroversion. Be sure to conduct appropriate post hoc tests. On the output, identify the following:
   a. $F$ ratio for the group effect
   b. Sums of squares for the hair color effect
   c. Mean for redheads
   d. $p$ value for the hair color effect
2. What is the effect size for the overall effect of hair color on extroversion?
3. Create a boxplot to display the differences among the distributions for the three hair color groups.

The data for Exercises 4 through 6 are in the data set named Lesson 25 Exercise File 2 on the Web at http://www.pearsonhighered.com/greensalkindSPSS. The data are from Karin’s research problem, described earlier in this lesson, involving students with behavior problems and different teaching styles. Karin’s SPSS data file has 40 cases with a factor distinguishing among the three types of teachers and a dependent variable, the number of disciplinary actions for students in a class. Conduct a one-way ANOVA to answer Karin’s question.

4. What does the Levene’s test tell us about our data?
5. Which follow-up tests would you choose and why?
6. Write a Results section based on the analyses you have conducted.