analyses answer the research question, it is unnecessary to reverse the order of the two sets of variables and to reanalyze the data.

Using SPSS Graphs to Display the Results

Scatterplots can be used to display the relationships between variables. To look at the relationship between two variables, a bivariate scatterplot (as demonstrated in Lesson 33) can be created for each pair of variables. The matrix scatterplot described in Lesson 31 can be used to look at the relationships between all pairs of variables. To look at relationships among three variables, the 3-D scatterplots described in Lesson 32 can be created.

Other types of graphs are used to evaluate the assumptions of multiple linear regression. They are quite complex and beyond the scope of this book.

Three APA Results Sections

Results sections were written for each of the three applications.
Results for One Set of Predictors

A multiple regression analysis was conducted to evaluate how well the strength measures predicted physical injury level. The predictors were the five strength indices, while the criterion variable was the overall injury index. The linear combination of strength measures was significantly related to the injury index, $F(5, 94) = 4.18, p < .01$. The sample multiple correlation coefficient was .43, indicating that approximately 18% of the variance of the injury index in the sample can be accounted for by the linear combination of strength measures.

In Table 41, we present indices to indicate the relative strength of the individual predictors. All the bivariate correlations between the strength measures and the injury index were negative, as expected, and three of the five indices were statistically significant ($p < .05$). Only the partial correlation between the strength measure for the gluteus/hamstring muscles and the injury index was significant. On the basis of these correlational analyses, it is tempting to conclude that the only useful predictor is the strength measure for the gluteus/hamstring muscles. It alone accounted for 15% (-.392 = .15) of the variance of the injury index, while the other variables contributed only an additional 3% (18% - 15% = 3%). However, judgments about the relative importance of these predictors are difficult because they are correlated. The correlations among the strength measures, except grip, ranged from .37 to .52.

Table 41
The Bivariate and Partial Correlations of the Predictors with Injury Index

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Correlation between each predictor and the injury index</th>
<th>Correlation between each predictor and the injury index controlling for all other predictors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadriceps</td>
<td>-.16</td>
<td>.10</td>
</tr>
<tr>
<td>Gluteus/ Hamstrings</td>
<td>-.39**</td>
<td>-.31**</td>
</tr>
<tr>
<td>Abdominals/Lower back</td>
<td>-.23*</td>
<td>-.09</td>
</tr>
<tr>
<td>Arms/Shoulder</td>
<td>-.24*</td>
<td>-.16</td>
</tr>
<tr>
<td>Grip</td>
<td>-.10</td>
<td>.08</td>
</tr>
</tbody>
</table>

* $p < .05$, ** $p < .01$

Results for Two Unordered Sets of Predictors

Two multiple regression analyses were conducted to predict the overall injury index. One analysis included the three lower-body strength measures as predictors (quadriceps, gluteus/hamstrings, and the abdominal/lower back), while the second analysis included the two upper-body strength measures (arms/shoulders and grip strength). The regression equation with the lower-body measures was significant, $R^2 = .16$, adjusted $R^2 = .13$, $F(3, 96) = 6.07, p < .01$. However, the regression equation with the upper-body measures was not significant, $R^2 = .06$, adjusted $R^2 = .04$, $F(2, 97) = 3.06, p = .051$. Based on these results, the lower-body measures appear to be better predictors of the injury index.

Next, a multiple regression analysis was conducted with all five strength measures as predictors. The linear combination of the five strength measures was significantly related to the injury index, $R^2 = .18$, adjusted $R^2 = .14$, $F(5, 94) = 4.18, p < .01$. The lower-body strength measures predicted significantly over and above the upper-body measures, $R^2$ change = .12, $F(3, 94) = 4.69, p < .01$, but the upper-body strength measures did not predict significantly over and above the lower-body measures, $R^2$ change = .02, $F(2, 94) = 1.29, p = .28$. Based on these results, the upper-body measures appear to offer little additional predictive power beyond that contributed by a knowledge of lower-body measures.

Of the lower-body strength measures, the strength measure for the gluteus/hamstring muscles was most strongly related to the injury index. Supporting this conclusion is the strength of the bivariate correlation between the gluteus/hamstring measure and the injury index, which was

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-.39, \( p < .01 \), as well as the comparable correlation partialling out the effects of the other two lower-body measures, which was \(-.33, p < .01\).

Results for Two Ordered Sets of Predictors

A multiple regression analysis was conducted to predict the overall injury index from previous medical difficulties and age. The results of this analysis indicated that medical difficulties and age accounted for a significant amount of the injury variability, \( R^2 = .16, F(2, 97) = 9.35, p < .01 \), indicating that older women who had more medical problems tended to have higher scores on the overall injury index.

A second analysis was conducted to evaluate whether the strength measures predicted injury over and above previous medical difficulties and age. The five strength measures accounted for a significant proportion of the injury variance after controlling for the effects of medical history and age, \( R^2 \) change = .15, \( F(5, 92) = 3.97, p < .01 \). These results suggest that women who have similar medical histories and are the same age are less likely to have injuries if they are stronger.

**Tips for Writing an APA Results Section for Multiple Regression**

Here are some guidelines for writing a Results section for multiple regression analyses.

1. It may be appropriate to include an initial description of the analytic strategy used to answer the research questions. This general description is necessary to the degree that the analyses include a number of multiple regression analyses and are unconventional.

2. Report descriptive statistics (e.g., means, standard deviations, and bivariate correlations). These statistics may be reported prior to the presentation of the multiple regression analyses or in conjunction with them.
   - If you are reporting only a few correlations, report them in the text (e.g., \( r(98) = .39, p < .01 \)).
   - For regression analyses, there are often many bivariate correlations. These statistics can be summarized in tabular form. Typically, you would present the lower triangle of a correlation matrix. Means and standard deviations for the variables also can be reported in the table.

3. When presenting the results of a particular regression analysis, describe the variables. For example: “A multiple regression analysis was conducted to predict the overall injury index from previous medical difficulties and age.”
   - Describe the independent or predictor variables. If the variables can be divided into conceptually distinct sets, describe the predictors in each set. In addition, indicate whether the sets are ordered or nonordered.
   - Describe what the criterion variable is.

4. Report the overall strength of the relationship between the predictors and the criterion as well as the results of the overall significance test. If several analyses have been conducted, report the results for each one separately.
   - Besides the \( R^2 \), consider reporting the adjusted \( R^2 \).
   - Report the standard error of estimate if the dependent variable has a meaningful metric.

5. If multiple sets of predictors are evaluated, report the changes in \( R^2 \) and the significance tests associated with those changes in \( R^2 \).

6. Report the contributions of the individual predictors.
   - Consider relevant statistics to evaluate the relative importance of each predictor. The bivariate correlations, the partial correlations, and the standardized regression coefficients might be presented.
   - Report whether the individual variables make a significant contribution to the prediction equation (e.g., \( r(98) = -3.13, p < .01 \)).
7. Describe the specific research conclusions that should be drawn from the regression analyses. For example: “The multiple regression results suggest that women who have similar medical histories and are the same age are less likely to have injuries if they are stronger.”

8. Consider presenting relevant scatterplots.

Exercises

Exercises 1 through 5 are based on the data set named Lesson 34 Exercise File 1 on the Web at http://www.pearsonhighered.com/greensalkindSPSS. The data are from the following research study.

Jenna is interested in understanding who does well and who does poorly in statistics courses. Jenna collects data from the 100 students in her statistics course. Besides their performance on her exams in the course, she obtains students’ scores on math and English aptitude tests that students took in their senior year of high school and their high school grade point averages in math, English, and all other courses. The variables in the data set are shown in Table 42.

Table 42
Variables in Lesson 34 Exercise File 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>mathtest</td>
<td>Score on a math aptitude test taken senior year of high school</td>
</tr>
<tr>
<td>engtest</td>
<td>Score on an English aptitude test taken senior year of high school</td>
</tr>
<tr>
<td>eng_gpa</td>
<td>High school GPA in English courses</td>
</tr>
<tr>
<td>math_gpa</td>
<td>High school GPA in math courses</td>
</tr>
<tr>
<td>othr_gpa</td>
<td>High school GPA in courses other than English and math</td>
</tr>
<tr>
<td>stateXam</td>
<td>Average percentage correct on exams in a college statistics course</td>
</tr>
</tbody>
</table>

Jenna wants to address the following research questions: (a) How well do high school test scores and grade point averages predict test performance in a statistics course? (b) Is it necessary to have both high school test scores and grade point averages as predictors of exams scores in statistics? Conduct the appropriate regression analysis to answer these questions.

1. Should the predictor variables be divided into sets and, if so, what variables should be included in each set? What is the criterion variable? If you divided the predictors into sets, do you think that they should be ordered?
2. What is the regression equation for all predictors?
3. What is the contribution of high school test scores over and above high school grade point averages? Report the appropriate statistic from the output.
4. What is the contribution of high school grade point averages over and above high school test scores? Report the appropriate statistic from the output.
5. Write a Results section based on your analyses that addresses the two research questions.

Exercises 6 through 10 are based on the data set named Lesson 34 Exercise File 2 on the Web at http://www.pearsonhighered.com/greensalkindSPSS. The data are from the following research study.

Sally is interested in predicting the number of relapses that occur after participation in an intensive inpatient substance abuse program. She has data from 120 women who are at least five years beyond their initial admission to the program. Upon entry into the treatment program, the women were evaluated with respect to their psychological state and, in particular, on depression, propensity for substance abuse, and daily life stress. In addition, they completed two measures of social support—amount of social support available to them (number of close relationships) and