USING IBM® SPSS® STATISTICS

SECOND EDITION

James O. Aldrich ■ James B. Cunningham

USING IBM® SPSS® STATISTICS

SECOND EDITION

I dedicate this textbook to my
three children, Sally, James (1965–1996),
and Wendy. The encouragement and support for their
father and his educational pursuits was (and is) above the call of duty.

—James O. Aldrich

I dedicate this book to my son,
Randy Cunningham, and my friend, Glenn Bailey.

—James B. Cunningham

USING IBM® SPSS® STATISTICS

An Interactive Hands-On Approach

SECOND EDITION

James O. Aldrich ■ James B. Cunningham

California State University, Northridge

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SAGE was founded in 1965 by Sara Miller McCune to support the dissemination of usable knowledge by publishing innovative and high-quality research and teaching content. Today, we publish more than 750 journals, including those of more than 300 learned societies, more than 800 new books per year, and a growing range of library products including archives, data, case studies, reports, conference highlights, and video. SAGE remains majority-owned by our founder, and after Sara's lifetime will become owned by a charitable trust that secures our continued independence.

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Preface to the Second Edition

Introduction to the Preface

This second edition was written while using IBM® SPSS® Statistics* Version 22. The first edition was written while using Versions 18 and 20. Although Version 22 is the most recent version available, it is certainly compatible with the earlier releases.

As in the first edition, this book can be used in conjunction with an instructor or as a self-instructional guide. It retains the well-received bulleted points, which inform the reader in exacting terms what has to be done to accomplish certain statistical operations while using the SPSS program. We have improved the self-instructional aspect of the book by adding more SPSS screenshots. The screenshots are complemented with a generous supply of callouts that are used to direct the reader's attention to specific control points.

Reasons for Writing This Book

One of the motivating factors in writing this book was to provide readers with the knowledge to effectively use the power of the SPSS program to analyze data of their choosing. It is the ability to analyze one's own data, see them come to life, that makes data analysis an exciting adventure into the unknown. We felt that many (or most) of the SPSS instructional textbooks utilize existing databases and provide minimal, if any, guidance on how to structure and enter data. In this second edition, we continue with the philosophy that it is wise to know how to enter data into the SPSS

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program. On leaving the academy and finding work in the real world, the ability to analyze data using SPSS can prove extremely useful in advancing one's career. In this edition, we continue to provide the reader with many opportunities for actually entering data, not just opening existing databases. We encourage readers to enter their own personal data as this makes the discovery process that much more exciting. There are few things in research that are more rewarding than making that final click on the mouse and watching your mass of numbers come to life with new meaning and purpose. Whether it's a graph, a prediction equation, or perhaps a statistical test showing a significant difference between groups, the discovery of the unknown that was hidden within the data can be extremely gratifying. The rewards of data analysis can give, and often have given, new meaning to the lives of researchers and to entire societies that benefit from discovery.

△ NEW FEATURES FOR THIS EDITION

Perhaps one of the most important additions to this second edition are the practice exercises at the end of each chapter. Detailed answers and explanations for these *review exercises* are provided in Appendix C at the end of the book. In many cases, these detailed answers (including relevant output screenshots) actually qualify as additional examples in each chapter.

Also new to this edition are the completely revised Chapters 8 and 9 on data graphing. These updated chapters present more complex graphing challenges than those given in the first edition. We feel that the detailed instruction in these new chapters will give the student the ability to produce and edit graphs having a truly professional appearance. These revised chapters present charts showing both *descriptive* univariate and *exploratory* bivariate graphing examples. This edition gives the reader hands-on experience in producing quality graphs by using the SPSS feature known as the *Chart Builder*. Knowledge of the *Chart Builder* will surely enhance one's ability to better understand data through graphing and visualization of summarized databases.

Although our original intent in writing this book was to publish a short "primer," it did grow a little beyond our expectations. Our readers commented positively, and some wanted more depth. Some readers wanted us to expand the coverage in order to make it suitable for graduate students. With that in mind, we added two new chapters to this second edition. Chapter 23 presents *logistic regression*, which serves as a natural extension of our *single* and *multiple regression* chapters. We chose to present the

binary logistic regression method, which is easily understood and nicely handled by SPSS. Chapter 24, also new, is on *factor analysis*. We chose the popular method of *principal component factor analysis* as a way to introduce students to this type of analysis. This particular method of analysis will give the reader new insight into statistical tools that don't fall within the scope of testing for significance or prediction. Furthermore, we have found that the *principal component* approach to factor analysis can be an exciting *descriptive/exploratory* method for the new student/statistician. Discovering new *latent variables* can provide openings for creativity and can actually be fun! Such creativity and fun will be within the reach of anyone reading and practicing our factor analysis chapter.

We have also expanded and completely revised our two chapters on *chi-square analysis* with the idea of adding depth to our illustrations. We also did this to illustrate the different ways to input the frequency and proportional data to get SPSS to successfully do the chi-square test. We retained the two separate chapters for *goodness of fit* and *test of independence*, but each chapter now shows multiple ways for structuring and entering data for the chi-square analysis.

Some minor changes that should prove useful include a new section in Chapter 4 that shows how SPSS can provide assistance by suggesting the *level of measurement* for your variables. The *data transformation* information was moved from an appendix to Chapter 6. Also added to Chapter 6 is a handy feature that allows one to split cases into groups for independent analysis. Chapter 18, on *analysis of covariance*, was also revised to directly include the test for the *homogeneity of regression slopes* (moved from the appendix).

DATA USED IN THIS BOOK

As in any book concerned with data analysis, a large amount of data and many databases are required. In some cases, we used real data, such as the database listed in Appendix A1 and Appendix A2, called *class survey*. However, in many instances, especially in the Review Exercises, the data were manufactured for the purpose of demonstrating a particular statistical technique. The results of the demonstrated analysis should be considered as only a demonstration of a statistical process—not as research facts. You will also notice that many databases from the SPSS samples files are used—these are also the result of data manufactured by SPSS for instructional purposes. We encourage readers to use their own data to duplicate some of the techniques illustrated in this book.

OVERVIEW OF THE BOOK'S STRUCTURE

The book is unique in that it encourages the reader to interact with SPSS on the computer as he or she works through the examples in each chapter. This approach to learning may be novel to the reader, but we feel that the best way to learn a subject is to interact with it in a meaningful manner. We have made every effort to ensure that the book is "user-friendly" as we guide the reader through the interactive learning process. Bulleted phrases provide step-by-step procedures to be followed by the reader when completing the exercises.

Another novel approach taken in this book is the inclusion of parametric and nonparametric statistical tests in the same chapters. Other books describe parametric and nonparametric tests in separate chapters, which we feel is inefficient because it forces the reader to continually move from one section of a book to another in search of the rationale justifying the use of either type of test.

This second edition of *Using IBM® SPSS® Statistics: An Interactive Hands-On Approach* not only can be a useful resource for readers who may have some background in statistics but will also provide basic information to those individuals who know little or nothing about statistics. The book is for those who want SPSS to do the actual statistical and analytical work for them. They want to know how to get their data into SPSS and how to organize and code the data so SPSS can make sense of them. Once this is accomplished, they want to know how to ask SPSS to analyze the data and report out with tables and charts in a manner understood by the user. In short, they want SPSS to do the tedious work!

OVERVIEW OF THE BOOK'S CHAPTER AND APPENDIX CONTENT

All chapters include screenshots showing the reader exactly how and where to enter data. The material covered in Chapters 1 through 4 provides basic but essential information regarding navigating in SPSS, getting data in and out of SPSS, and determining the appropriate level of measurement required for a statistical test. Chapters 5 and 6 describe additional methods for entering data, entering variable information, computing new variables, recoding variables, and data transformation. In Chapter 5, you will enter data from an important database (*class_survey1.sav*) found in Appendix A.

This database will be used in many of the subsequent chapters. Chapter 7 describes and explains the Help Menu available in SPSS and how to find information on various statistical tests and procedures. Chapters 8 and 9 provide hands-on experience in creating and editing graphs and charts. Chapter 10 provides explicit directions for printing files, the output from statistical analysis, and graphs. Chapter 11 describes and explains basic descriptive statistics. Finally, Chapters 12 through 25 provide hands-on experience in employing the various statistical procedures and tests available in SPSS, including both parametric and nonparametric tests. Appendix A contains an essential database that is entered in Chapter 5 by the reader and then used and modified throughout the book. Appendix B provides the reader with a "one-stop" shopping spot for many of the important basic concepts of inferential statistical methods. Appendix C gives the answers and detailed explanations for the review exercises that are provided at the end of each chapter.

How to Use This Book

As the reader will note in the first lesson in Chapter 1, we use a simple format to allow the reader to respond to requests. The reader will be moving the mouse around the computer screen and clicking and dragging items. The reader will also use the mouse to hover over various items in order to learn what these items do and how to make them respond by clicking on them. Things the reader should click on or select are in **boldface**. Other important terms in the book are in *italics*. Still other items, such as variable names, are enclosed in double quotes.

The reader will often be requested to enter information and data while working through the examples and exercises in this book. To help in this procedure, we often present figures that show SPSS windows and then show exactly, step-by-step, where to enter this information or data from the keyboard. And, at times, we use callouts in combination with screenshots to clearly show control points and where to click or unclick specific items.

In Summary

The IBM SPSS Statistics program is an outstanding, powerful, and intuitive statistical package. A primary reason for our writing this book was to make the benefits of the SPSS program available not only to the novice but also

to the more experienced user of statistics. We feel this second edition is appropriate for lower-division and upper-division courses in statistics and research methods. We also feel that it will benefit students at the master's and doctoral levels as an introduction to some of the more complex statistical methods and how they are handled by the SPSS statistical package.

Acknowledgments

I first thank my students, who for many years followed my often hastily written instructions on how to get SPSS to do what it was supposed to do. Second, I thank my coauthor, who had the idea for the book and invited me to participate in writing the first edition. I also thank my teaching assistant Hilda Maricela Rodriguez for her careful and tireless review of all the SPSS steps and screenshots presented in the book.

—James O. Aldrich

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—James B. Cunningham

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Chapter 1

First Encounters

1.1 Introduction and Objectives

Hi, and welcome to IBM SPSS Statistics. We assume you know little about variables, values, constants, statistics, and those other tedious things. But we do assume you know how to use a mouse to move around the computer screen and how to click an item, select an item, or drag (move) an item.

We have adopted an easy mouse-using and -typing convention for you to respond to our requests. For example, if you are requested to open an existing file from the SPSS *Menu*, you will see click **File**, select **Open**, and then click **Data**. In general, we will simply ask you to click an item, select (position the pointer over) an item, drag an item, or enter data from the keyboard. Note that in SPSS, the columns in the spreadsheets run vertically and the rows run horizontally, as in a typical spreadsheet such as Excel.

OBJECTIVES

After completing this chapter, you will be able to

- Enter variables into the Variable View screen
- Enter data into the Data View screen
- Generate a table of statistics
- Generate a graph summarizing your statistics
- Save your data

1.2 ENTERING, ANALYZING, AND GRAPHING DATA

We are going to walk you through your first encounter with SPSS and show you how to enter some data, analyze those data, and generate a graph. Just follow these steps:

If you see the IBM SPSS icon anywhere on the screen, simply click it; otherwise, locate your computer's program files, and open SPSS from there. Once the SPSS starts, a screen will appear, which can take different forms depending on the SPSS version you are using. There are some useful shortcuts in these SPSS opening windows, but for now click the **white "x" in the red box** in the upper right-hand corner to close the window. When the window closes, you will see the Data Editor spreadsheet on the screen. This screen can appear in two different ways depending on which tab is clicked at the bottom of the Data Editor screen. These two tabs, Data View and Variable View, are together called the SPSS Data Editor. When you wish to enter or view variable information, you click the Variable View tab, and when you wish to enter or view data, you simply click the Data View tab. Figures 1.1 through 1.4 provide pictures of these screens.

Let's get started with the bullet point part of this introduction to SPSS. We will insert various figures into the text when we wish to clarify certain actions required on your part.

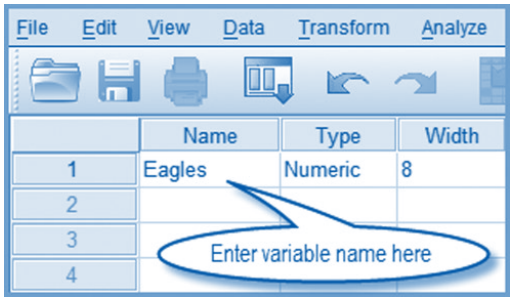
- Start SPSS, close the opening window as discussed above.
- At the bottom of the Data Editor spreadsheet screen, there are two tabs; click **Variable View** (see Figures 1.1 and 1.2).

Figure 1.1 Upper-Left Portion of the Variable View Screen of the SPSS Data Editor

Figure 1.2 Lower Portion of the Variable View Screen of the SPSS Data Editor

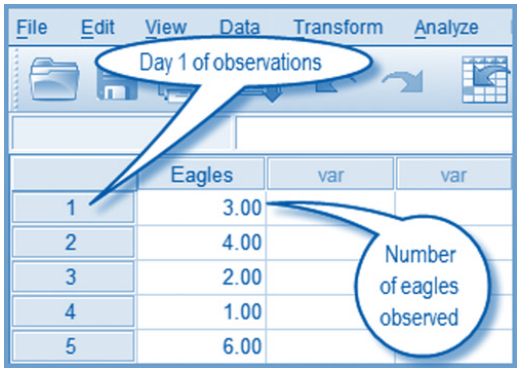
- At the top of the screen, type the word *Eagles* in the cell (this is the cell below *Name* and to the right of Row 1). The callout (balloon) shown in Figure 1.3 points to the cell in which you are to enter the variable name "Eagles." Cells are the little boxes at the intersection of *columns* and *rows*.

Figure 1.3 Small Portion of the Variable View Screen



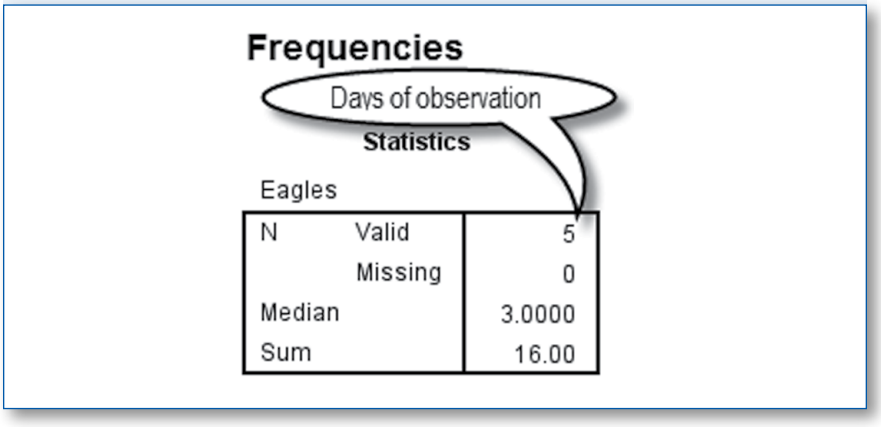
- At the bottom of the screen, click **Data View** (note that the screen's appearance changes slightly).
- You will now enter the number of eagles observed on five consecutive days at the top of Holcomb Mountain. The callout in Figure 1.4 shows exactly where to type the number 3 (Row 1 and Column 1); for now, don't worry about the decimal points.
- Click in Row 2, and type *4*; click in Row 3, and type *2*; click in Row 4, and type *1*; and finally click in Row 5, and type *6*. Your screen should now look as shown in Figure 1.4. If you make a mistake in entering the numbers, just click the cell and reenter the correct number.

Figure 1.4 Small Portion of the Data View Screen



- After you have entered the five pieces of data, check carefully to see if the entries are correct. If they are, save your work as follows: Click **File**, and then click **Save As**.
- A window titled *Save Data As* will open, in which you will enter a name for your work (project). You could enter any name you wish, but for this exercise, enter the name *chapter1* in the *File Name* box. The *Look in* box (located in the middle of the window), showing where the file will be saved, should have an entry titled *Documents*. Click **Save**. Your data have been saved in the *Documents* section of your computer.
- An *Output* window opens; close this by clicking the **white "x" in the red box**. Another dialog box may open asking if you wish to save the output; click **No**.
- Let's continue with the exercise. On the SPSS *Menu* at the top of the screen, click **Analyze**, select **Descriptive Statistics**, and then click **Frequencies**. A window will appear titled *Frequencies*. Drag **Eagles** to the *Variable(s)* box, or click **Eagles** and then click the right arrow to place *Eagles* in the *Variable(s)* box (both methods work equally well).
- Click the **Statistics** button (the *Frequencies: Statistics* window opens). In the *Central Tendency* panel, click **Median** and **Sum**, then click **Continue**.
- Click **OK** (another screen opens, titled *Output IBM SPSS Statistics Viewer*, which shows the results of the analysis just requested). Look at Figure 1.5 for these results.

Figure 1.5 Frequency Statistics for 5-Day Eagle Observation



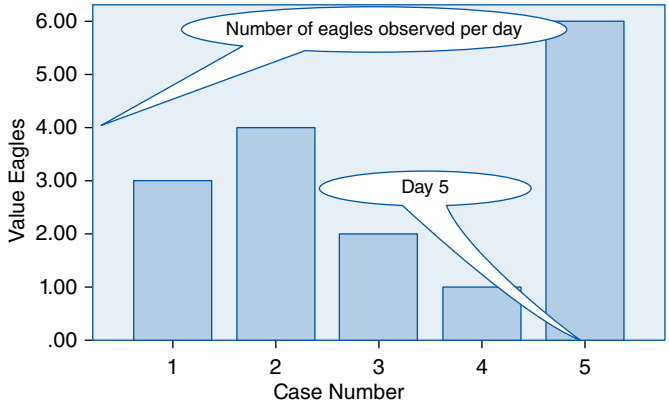
- On the Main Menu, click **Graphs**, select **Legacy Dialogs**, and then click **Bar**.
- The *Bar Charts* window opens; click **Simple**, and then click **Values of Individual Cases**. Click **Define**.
- The *Define Simple Bar: Values of Individual Cases* window opens. Click **Eagles** and drag it to the *Bars Represent* box, or click the right arrow to place *Eagles* in that box. Click **OK**. A simple bar graph will appear in the same Output IBM SPSS Statistics Viewer screen below the table, as shown in Figure 1.6.

After you have reviewed the graph, you will save the Output IBM SPSS Statistics Viewer screen, which contains the results of your analysis and the graph. Note that in the future we will often refer to this screen simply as the Output Viewer.

- In the screen, click **File**, and then click **Save As**.
- A window titled *Save Output As* will appear. In the *File name* box, type *chapter1*. Note that the file name is all lowercase and does not include any embedded spaces (blanks). The *Look in* box indicates the location where your file will be saved and should have an entry titled *Documents*. Click **Save**.
- After saving your work, your Output Viewer screen will remain. Click the **white "x" in the red box** found in the top right corner to make it go away.

Congratulations! You have just used SPSS (perhaps for the first time) to analyze some data and provide some statistical results and a graph.

Figure 1.6 Bar Graph for 5 Days of Eagle Observation



Looking at the *Frequencies* table shown in Figure 1.5, we see that 16 eagles were observed over a period of 5 days with the median number per day of 3. The bar graph seen in Figure 1.6 provides the details regarding each day's observations. For example, we see that Day 5 yielded the most eagle sightings at 6, while the fewest were observed on Day 4, when only 1 was seen.

Admittedly, the statistical analysis and graph are not that exciting. But they do show you that SPSS is not difficult to use. Of course, you could have used a handheld calculator to do the same analysis in less than a minute. But suppose you had 50 different variables, such as height, weight, eye color, and so on, and thousands of cases for each of the variables! Using a calculator to analyze these data would be a monumental task. But SPSS can do it easily.

- If you wish to exit (quit using SPSS) at this time, click **File**, and then click **Exit**.

1.3 SUMMARY

In this chapter, you learned how to enter variable names and data. You also learned how to generate a table of statistics and a graph summarizing those statistics. In the next chapter, you will learn to navigate in SPSS. You will be

introduced to the Main Menu, the Toolbar editor, and the options available for these. Finally, you will be introduced to the various dialog boxes and windows in SPSS that allow you to enter information regarding your variables.

1.4 REVIEW EXERCISES

1.1 You have classified the size of several fish that were caught in a "catch and release" fishing contest for children as small, medium, and large. The number of fish caught by the children are 32 small, 21 medium, and 11 large. *Note:* When inputting these data and information, you are *not* required to enter the names for the categories of the fish (small, medium, large). SPSS calls these categories *Labels* and *Label Values*. You will learn to input this information in a later chapter. Input the variable information and data, and build a frequency table and a bar graph. Name and save the database in the *Documents* section of your computer.

1.2 One day you are sitting in your professor's office getting help on regression analysis. His phone rings; he apologizes but says that he must take the call. As you wait for him to end his phone call, you scan his bookshelves and make mental notes of the titles. You arrive at the following: 15 books on introductory statistical analysis, 12 on advanced statistics, 3 on factor analysis, 8 on various regression topics, 13 on research methods, and 2 on mathematical statistics. You think to yourself, "Wow! This guy must have an exciting life!" As in the previous problem, don't concern yourself with the category labels for the textbooks. For now, just input the data and variable information, build a bar chart, generate a descriptive table, and name and save the database.

1.3 There was a quarter-mile drag race held at the abandoned airport last week. The makes of the winning cars were recorded by an interested fan. The results of her observations were as follows: Chevrolets won 23 races, Fords won 19 times, Toyota won 3, Hondas won 18, and KIAs won 8 races. As in the previous two problems, don't concern yourself with the categories' labels for the makes of the cars. Your task is to enter these data into SPSS, generate a bar graph and a frequency table, and then name and save the database.

Chapter 2

Navigating in SPSS

2.1 Introduction and Objectives

As with any new software program you may use, it is important that you are able to move around the screen with the mouse and that you understand the meaning and purpose of the various items that appear on the screen. Consequently, we present a tour of the Variable View screen, the Data View screen, the Main Menu, and the Data Editor Toolbar. You will use these often as you complete the chapters in this book.

OBJECTIVES

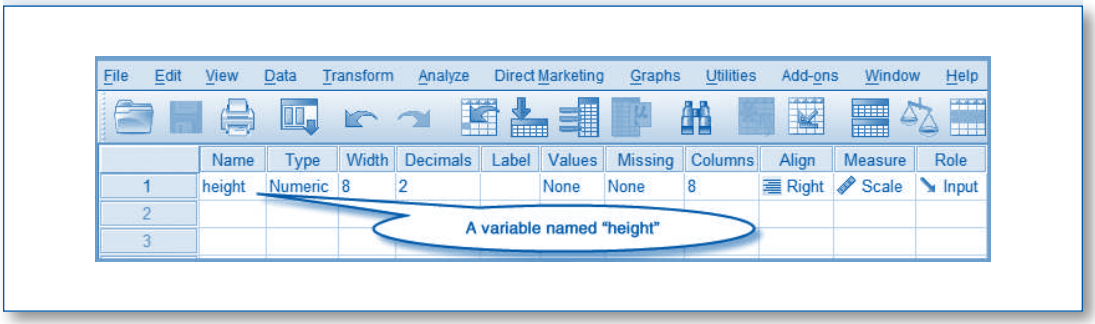
After completing this chapter, you will be able to

- Describe the Variable View screen and its purpose
- Describe the Data View screen and its purpose
- Select items from the Main Menu and the Data Editor Toolbar
- Use the 11 items (*Name, Type, Width, Decimals, Label, Values, Missing, Columns, Align, Measure, and Role*) found in the Variable View screen to describe your variables

2.2 SPSS VARIABLE VIEW SCREEN

Start SPSS, and click the Variable View tab at the bottom of the screen. Figure 2.1 shows a portion of the Variable View screen. We have entered the variable "height" in the first cell.

Figure 2.1 Upper Portion of the Variable View Screen Showing a Variable Named "height"



As you will recall from Chapter 1, you were briefly introduced to the Variable View screen when you entered the variable "Eagles." The *rows* represent variables, and the *columns* represent attributes (properties) and other information that you can enter for each variable. You must provide a name for each variable or SPSS will assign a default name, such as var1, var2, var3, and so on. It is in the Variable View screen that you enter all your variables and their properties. In Section 2.6, you are given all the details needed to properly enter the information on your variables.

Throughout this book, you will often be requested to enter information into a *cell*. Any cell you click is the active cell, displayed in color, indicating that it is ready to receive input from the keyboard. In Figure 2.2, you see an example showing a balloon pointing to the cell in which a variable named "Pre_treatment" has been entered.

2.3 SPSS DATA VIEW SCREEN

A small portion of the Data View screen is shown in Figure 2.3.

Click the Data View tab if you are not already in that screen. It is in the Data View screen that you enter data for each variable. We have entered