

CHAPTER

1

Getting Started

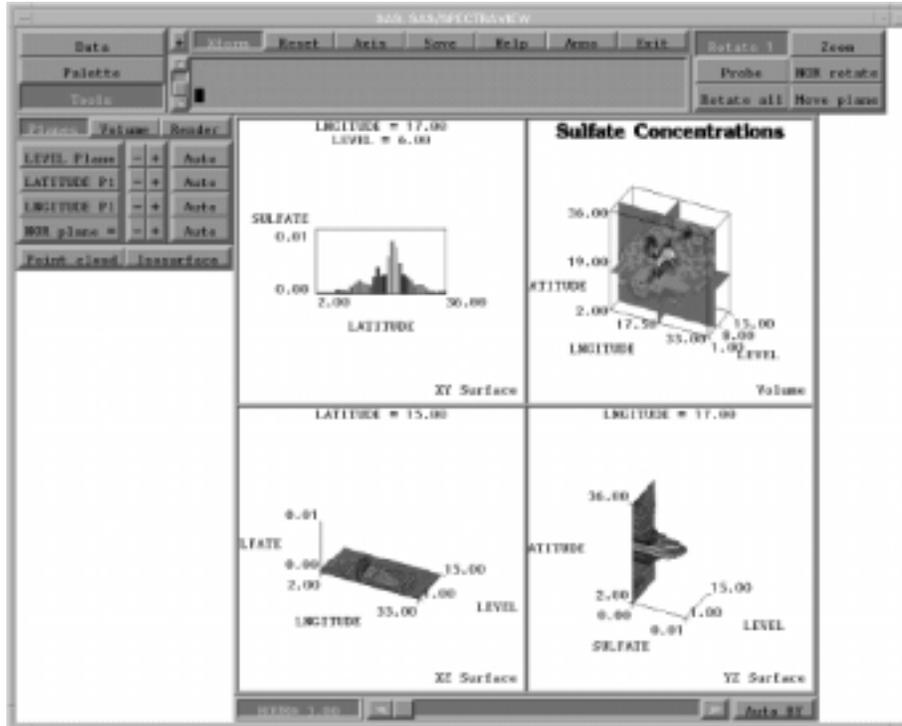
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What is SAS/SPECTRAVIEW Software?

SAS/SPECTRAVIEW software is an interactive visualization product for viewing, exploring, and analyzing data as graphic images. The software reads a SAS data set, then based on your requests, creates two- and three-dimensional graphic images that represent the data. You can then visually explore both surface and interior views of the data to identify and analyze trends and relationships represented by the data.

Display 1.1 on page 4 shows four different images created by SAS/SPECTRAVIEW from a data set containing data about sulfate concentrations in the air. The image in the Volume window (top right window) displays intersecting cutting planes, which produce slices of data perpendicular to each axis. The other three windows show two- and three-dimensional surface views of the data at the position of the cutting planes.

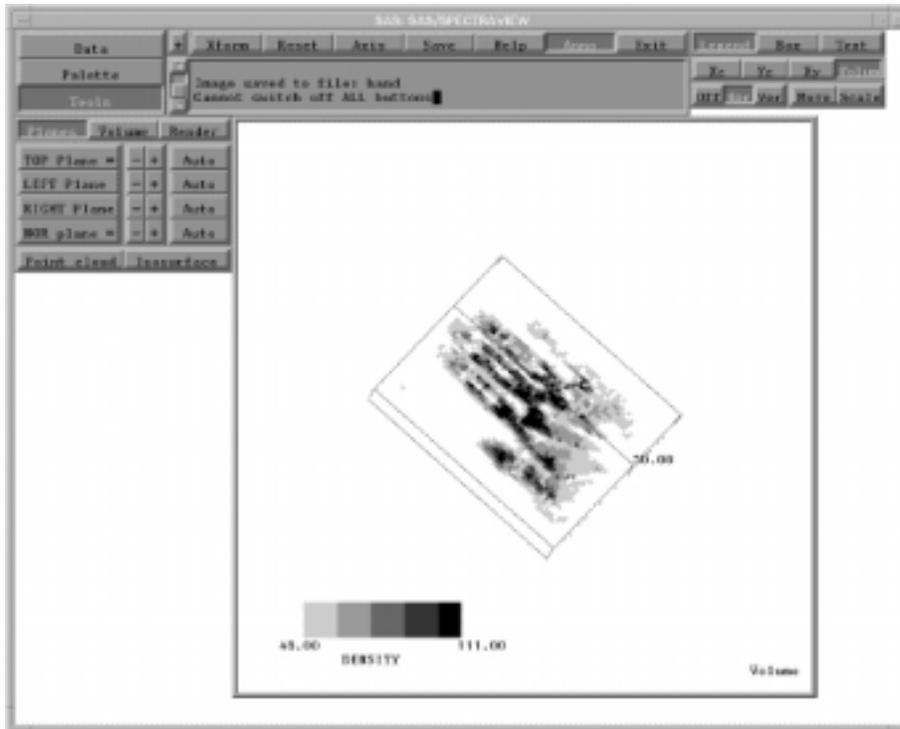
Display 1.1 SAS/SPECTRAVIEW Interface Displaying Images



The software's capabilities apply well to a variety of applications, including oil exploration, environmental sciences, chemical analysis, pharmaceutical studies, financial analysis, and medical imaging.

For example, medical professionals might perform a CT scan of a patient's hand to determine the severity of a fracture. Then, using various SAS/SPECTRAVIEW tools, data from the scan can be explored from several angles, resulting in more information than static two-dimensional images. Display 1.2 on page 5 shows a SAS/SPECTRAVIEW image of a hand created by requesting a cutting plane, which slices perpendicular along its axis. By probing the image, the software displays a density reading at a specific location.

Display 1.2 Multidimensional Medical Image



Using SAS/SPECTRAVIEW Software

Data Set Requirements

To use SAS/SPECTRAVIEW, your data must be stored in a SAS data set, which consists of variables and observations. A *variable* is a column in the data set, such as quantities or characteristics being measured, that has attributes such as a name and a type (character or numeric). An *observation* is the horizontal component of the data set, such as collections of values associated with a single entity; each observation contains one value for each variable in the data set.

The SAS data set that you use must have at least four variables:

- three variables, which can be character or numeric, to be the *axis variables*, that is, the X variable, Y variable, and Z variable. Each axis variable must contain at least two unique values. For best results, the axis variables should contain *discrete data*, which consists of distinct values (noncontinuous) containing natural gaps, like patient IDs and years.
- a fourth variable, which must be numeric, to be the *response variable*. The response variable must contain at least two unique values. For best results, the response variable should contain measured or modeled response values (like sales or population) that are related in some way to the axis values.

You can specify an optional fifth variable, which can be character or numeric, as a *BY variable*. A BY variable allows you to animate an image so that you can see how response values change according to some grouping, like over time.

How the Software Displays Data

When you load a SAS data set into SAS/SPECTRAVIEW, the software does the following:

- 1 The software reads each observation from the data set and creates a three-dimensional *volume grid* by plotting the values for the axis variables, which creates the x,y,z coordinates. That is, for each observation, the following occurs:
 - The value for the X variable is plotted on the X axis, which is the horizontal axis.
 - The value for the Y variable is plotted on the Y axis, which is the vertical axis.
 - The value for the Z variable is plotted on the Z axis, which is the depth axis.

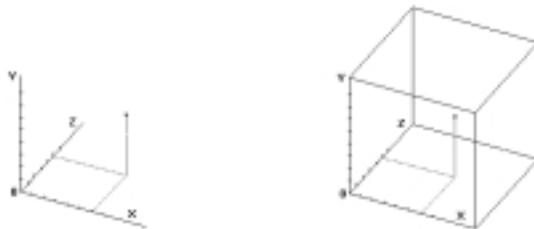
The volume grid is actually an invisible network of lines that intersect in three-dimensional space. Each intersection of an x,y,z coordinate is a location in three-dimensional space, referred to as a *data point*. The shape and size of the volume grid is determined by the number of unique X, Y, and Z values and is displayed with a *bounding box*, which is a set of lines that outline the three-dimensional volume grid.

- 2 The software divides the values for the response variable (the response values) into ranges, then color codes them using default ranges and preset colors. According to the response value (and its associated response value range color), the software then maps an appropriate color to each data point that has an associated response value. *Note that you can customize the ranges and colors as explained in Chapter 4, "Setting Response Value Colors for Images," on page 47.*

Spatial Data

The variables that you specify for the axes frequently (but not always) represent dimensions of spatial data. For example, in a spatial diagram like the following cubic volume, the x,y,z coordinate 6,5,5 represents a location that is 6 ticks along the X axis, 5 ticks along the Y axis, and 5 ticks along the Z axis (counting from an origination point shown as 0 in this figure):

Figure 1.1 Coordinate 6,5,5 in Three-Dimensional Space



To illustrate the relationship among the axis values and the response values, consider the following spatial data example:

To determine the age of someone sitting in a specific seat in a stadium, you need to know the section, the row, and the seat number to locate that person. The three values

are x,y,z coordinates that identify a specific location in space, which in this case is a stadium. Once located, the person can be asked his age; that number becomes the fourth value...the response value. You could collect the same information for everyone in the stadium. That is, you could attach an age response value to each location identified by section, row, and seat.

If you created a data set of the seating information and loaded it into SAS/SPECTRAVIEW, the following would occur:

- The resulting data points would form a volume grid displayed within a bounding box.
- The data points would represent the seat holders.
- The response value for each data point would be the age of the occupant.

You could then explore the data visually and determine, for example, whether age groupings occur in various locations in the stadium. You could also display any empty seats, which have no response value at that location.

Locations in three-dimensional space are similar to stadium seat locations. For example, if you want to test the amount of sulphur in the air at various locations, you would need three coordinates similar to section, row, and seat. These might be 20 km east, 10 km north, and 200 meters up. The coordinates describe a specific location in space where a sulphur sample can be taken and recorded. When you display the data, a color is mapped to each response value, representing ranges of values, for example, values between 0.0 and 0.5 could be red, values between 0.51 and 1.0 could be yellow, and so on.

Non-Spatial Data

Since the axis variables represent different dimensions of data, you can use SAS/SPECTRAVIEW to explore non-spatial data as well.

For example, the sample data set MORTGAGE (which contains mortgage payments for various numbers of years, interest rates, and loan amounts) can be represented several ways. The axis variables could be principal amount, percentage rate, and term of loan; it does not matter which variable you assign to X, which to Y, and which to Z. This presumes that the PAYMENT variable is the response you want to explore. Or you could assign the variables so that AMOUNT is the response to explore, with axes of term, rate, and affordable payment range.

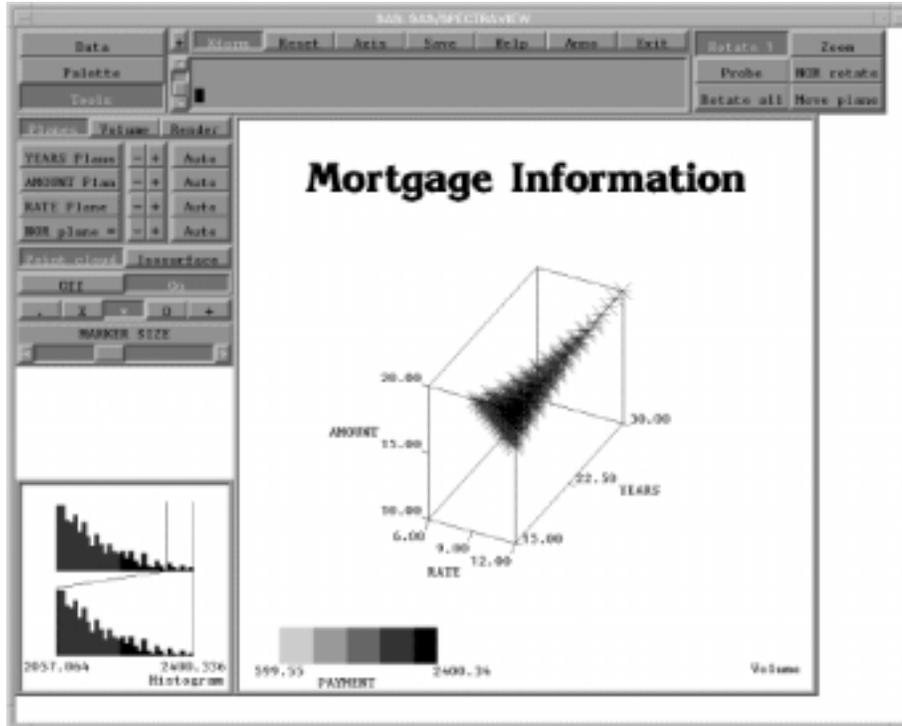
Assume the following variables for SAS/SPECTRAVIEW:

RATE	as the X variable, which is the loan interest percentage rate.
AMOUNT	as the Y variable, which is the loan amount.
YEARS	as the Z variable, which is the number of years for the loan.
PAYMENT	as the response variable, which is the monthly payment amount.

SAS/SPECTRAVIEW reads the data and generates the horizontal X axis (representing the loan interest rate), the vertical Y axis (representing the loan amounts), and the depth Z axis (representing the number of years for the loan). Each resulting data point is applied a color representing a response value, which is a monthly payment amount.

Display 1.3 on page 8 examines the data using a point cloud (which is one of the SAS/SPECTRAVIEW visualization techniques), showing the relationship of the monthly payments to percentage rate, loan amount, and length of the loan. This point cloud displays a subset of the data points, showing only the higher loan payments (response values). With this point cloud, you can determine that most of the higher loan payments are for a shorter number of years.

Display 1.3 MORTGAGE Data Set Displayed as a Point Cloud

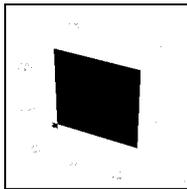


Summary of Software Tools

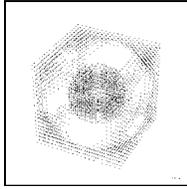
SAS/SPECTRAVIEW provides the following tools that you use to create and analyze images.

Visualization Techniques

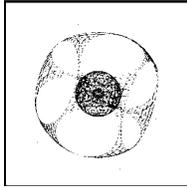
Visualization techniques create images representing your data.



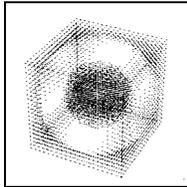
Cutting planes produce slices of data, either perpendicular to an axis or not perpendicular to any axis. In addition to the axis cutting planes, you can request two- and three-dimensional surface views (surfaces, charts, stacks, and plots) at a specific cutting plane's location.



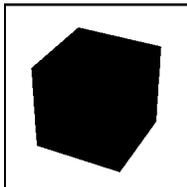
Direct volume rendering creates a two-dimensional image of the entire volume of data points with transparency.



Isosurface produces a three-dimensional surface by connecting all the data points with one response value.



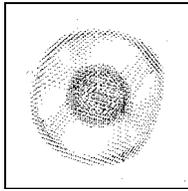
Point cloud displays response values with colored markers, showing individual data points.



Solid-volume image produces a colored, three-dimensional solid-block image of the data points, providing a surface view of the data at the volume's borders.

Customization Options

SAS/SPECTRAVIEW provides a variety of options that you can use with visualization techniques to aid in data exploration and analysis:



Probe analysis displays the response value for a specific data point in an image.



Bounding box displays a set of lines that outline the three-dimensional volume representing the data in the Volume window. By default, the bounding box is on, but you can turn it off.

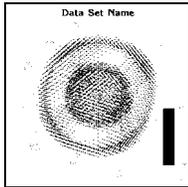


Image annotation allows you to add the following to two- and three-dimensional images: axis labels that name the variables associated with the axes, major and minor tick marks along the axes, text, and a response legend (a visual key to the colored data points).

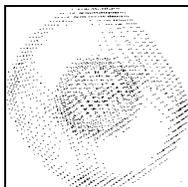
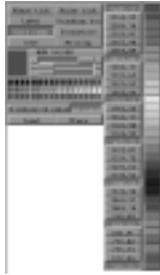


Image transformations let you view a three-dimensional image from any angle or in a different size. That is, you can rotate, move, and zoom an image.



Color palette lets you customize colors for the response value ranges, missing values, an isosurface, and image annotations (such as tick marks, axes labels, text, and the bounding box). You can also save and recall user-defined color palette files.

Processing Options

These options let you modify your view of the data:

BY variable

is a variable specification whose values define groups of observations, such as hour, month, or year. Specifying a BY variable allows you to animate an image so that you can see how response values change according to some grouping, like over time.

Categorizing data

groups numeric data to create discrete ranges for the X, Y, and Z axes, which results in reducing the number of data points created for the volume grid.

WHERE clause

allows you to specify a subset of data to be read into the software.

Data filtering

smooths or sharpens data to deemphasize or highlight variations in response values. The software provides several predefined filters, or you can create your own.

Data saving

lets you save all or part of the original data values to a SAS data set.

Image saving

lets you save a displayed image as a TIFF (Tagged Image File Format) file or a PostScript file.

Getting Acquainted with the Interface

The SAS/SPECTRAVIEW interface is a point-and-click, button-driven interface that provides the functionality to visually explore data.

Invoking SAS/SPECTRAVIEW Software

- 1 First, bring up the SAS System. *For information on bringing up the SAS System, see your SAS Installation Representative.*

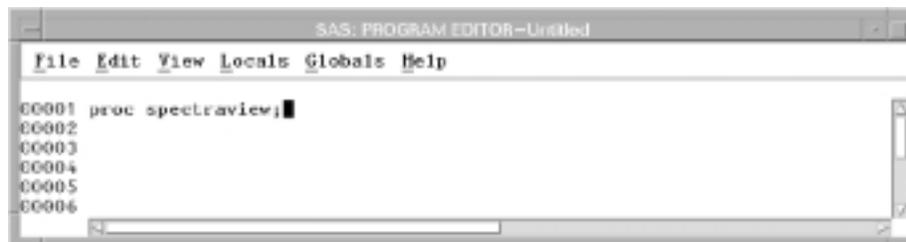
- 2 Issue one or more LIBNAME statements to assign a libref to each data library containing data sets that you want to use in the session. For example, **libname mylib 'mypath'**;. Details are provided in “Assigning Librefs to Data” on page 24.
- 3 Then, invoke SAS/SPECTRAVIEW with a command or as a SAS procedure. On a command line, issue the command **spectrview**; acceptable abbreviations include **spectrav** and **sview**.

Display 1.4 Invoking SAS/SPECTRAVIEW with a Command



Or issue the SPECTRAVIEW procedure, which can be abbreviated to **proc spectrav**; or **proc sview**;. *Note that you do not need to include a RUN statement.*

Display 1.5 Invoking SAS/SPECTRAVIEW as a Procedure

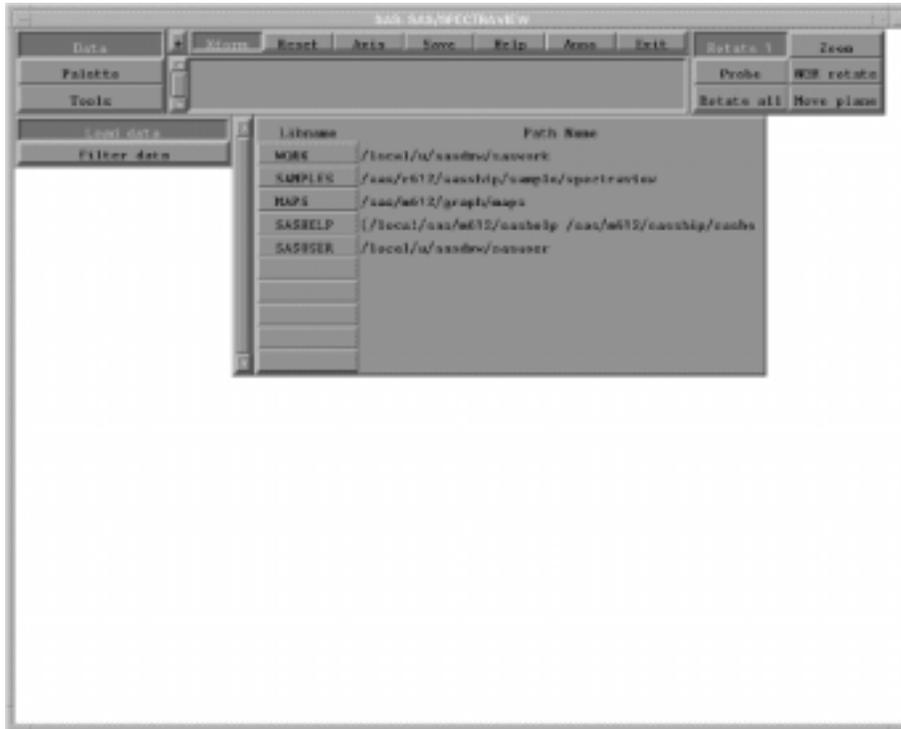


Looking at the Initial Display

Once you invoke the software, the initial interface display appears. By default, the interface is ready for you to load data; that is, **Data** and **Load data** are already selected. From the initial display, you can do the following:

- Load a SAS data set, which you must do before you can do anything else. That is, you cannot select any other buttons until you have loaded a data set. Details are provided in Chapter 2, “Loading Data,” on page 19.
- Apply data filtering, which is explained in Chapter 3, “Adjusting Data with Filters,” on page 39.
- Customize colors for your images with the color palette. From the color palette, you can define response value ranges and specify colors for those ranges. You can also specify colors for image customizations like text, axis tick marks, and so on. Of course, you can simply use the software defaults. Details are provided in Chapter 4, “Setting Response Value Colors for Images,” on page 47.
- Request the various visualization techniques that produce the images such as cutting planes, point clouds, isosurfaces, a solid-volume display, and direct volume rendering. Details are provided in Chapter 5, “Exploring Data with Visualization Techniques,” on page 55.

Display 1.6 SAS/SPECTRAVIEW Initial Display



Selecting Buttons

You interact with the software by selecting buttons with your graphics input device, which can be a mouse, a pick, or a stylus. SAS/SPECTRAVIEW treats all graphics input devices the same. For simplicity, this document refers to the graphics input device as a mouse.

To select a button, position the cursor on it, and click the left mouse button. Once selected, the button becomes shaded, and in many cases, additional buttons appear. *Note that in some situations, the software will select a button for you by default.*

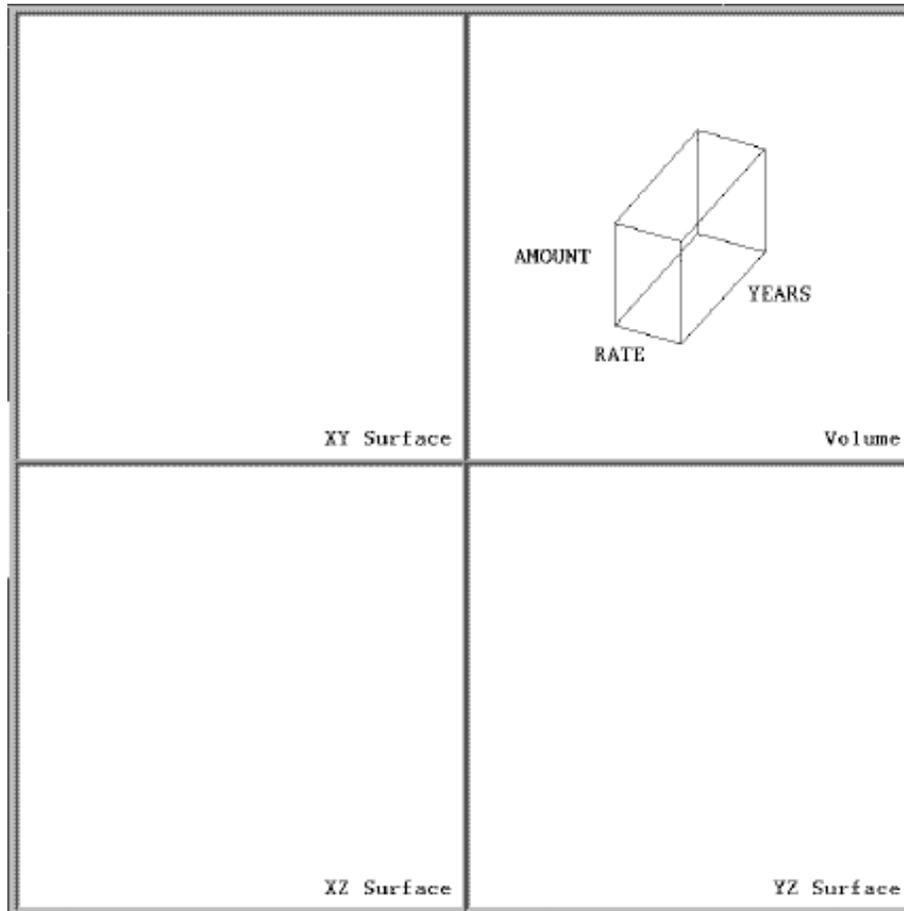
Using the Windows

You view and manipulate images in display windows, and you communicate with the software in the text window.

Display Windows

There are four *display windows*, which provide different views of an image:

- The top right window, labeled Volume, displays the three-dimensional image or images, according to the technique(s) and options that you specify. For example, by requesting a point cloud, you can view all the data points in this window.
- The other three windows, labeled XY Surface, XZ Surface, and YZ Surface, display two- and three-dimensional images of your data. These are linked to the Volume window and show a single "slice" of your data.

Display 1.7 Display Windows

Instructions to resize the display windows are in “Resizing the Display Windows” on page 86.

Text Window

Using the *text window*, which is located to the right of the three basic function buttons (that is, **Data**, **Palette**, and **Tools**), you can enter text and receive messages from the software.

For example, when you position the cursor on a button, a one-line help message, which is usually a description or instruction, displays in the text window. In response, you usually select a button, enter a value, or use the cursor in a window. You also use the text window to enter specifications, such as for a WHERE clause or to enter text to be added to an image.

Display 1.8 Text Window

Instructions to resize the text window are in “Resizing the Text Window” on page 87.

Using Global Buttons

Global buttons, located at the top middle of the interface above the text window, display at all times. Global buttons provide the following capabilities:

Display 1.9 Global Buttons



Xform	To transform an image by rotating and zooming, to probe for a response value, or to manually move a cutting plane through the volume grid.
Reset	To reset the display window's orientation, the color palette, or the entire software.
Axis	To define axis labels.
Save	To save an image as a PostScript file or a TIFF file or to save data values to a SAS data set.
Help	To display the online help.
Anno	To add annotation to an image by defining text, displaying the response legend, or displaying the bounding box.
Exit	To terminate SAS/SPECTRAVIEW software.

Accessing Online Help

SAS/SPECTRAVIEW provides online help for the interface buttons and sliders. By default, when you position the cursor on a button, a one-line help message displays in the text window. To display more detailed online help, you use the **Help** global button.

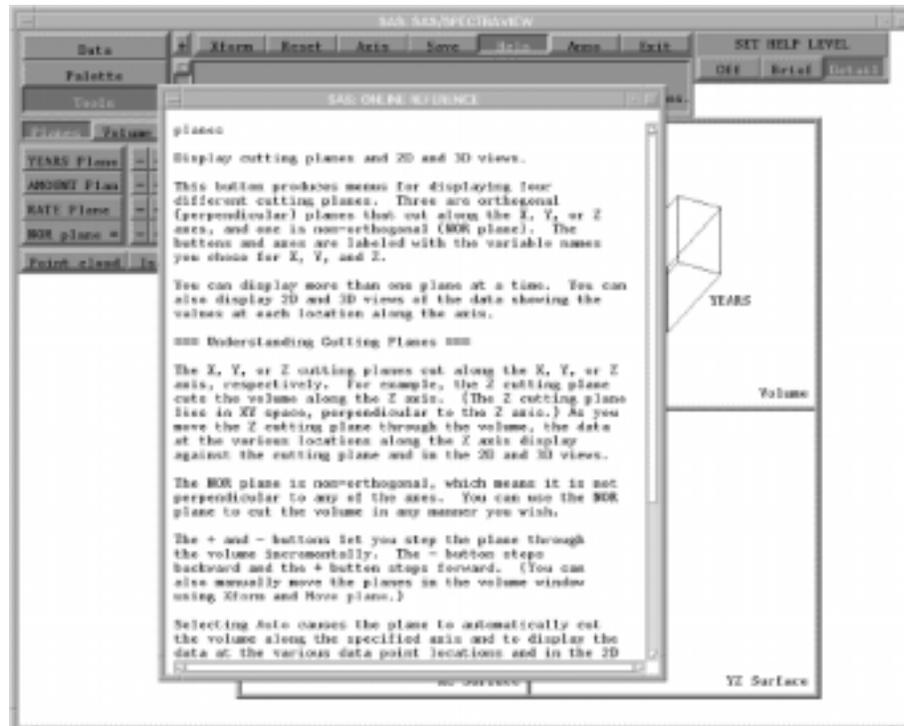
To access the detailed online help:

- 1 Select **Help**, then **Detail**. The software opens the Online Reference window.
- 2 Move the window to a position so that you can view both it and the SAS/SPECTRAVIEW interface window. You can move the window by dragging it to any location. You can also pop it behind the interface.

In order for the Online Reference window to be visible, the SAS/SPECTRAVIEW interface should be set to pop-to-top only when you select its window border. If the Online Reference window does not stay on top, you need to modify your window manager files as explained in "Controlling the Online Reference Window" on page 88.

- 3 Click the SAS/SPECTRAVIEW interface window to make it the active window.
- 4 Position the cursor on a button or slider and wait a moment. *Note that to display online help, you only have to position the cursor on a button; you do not have to select it.*

Display 1.10 Online Reference Window



- 5 If the text is longer than the window, shift the text vertically with the scroll bar on the right. Clicking the up arrow shifts the text up; clicking the down arrow shifts the text down. You can also drag the scroll bar itself up or down.

To remove the Online Reference window and continue the one-line help message in the text window, select **[Help]**, then **[Brief]**. To turn off both, select **[Off]**. *Note that you cannot close the Online Reference window from the window itself.*

Using the Detailed Online Help

The text for each button follows a top-down structure. Information that you need frequently appears at the top. Concepts and other information that you may read only once appears lower down. Each button's information

- starts with a general description of that button's function
- describes subsequent button choices next (if applicable)
- ends with more detailed information, such as, information on understanding a tool.

Recognizing and Using Cursors

As you use the interface, you will notice several cursors presented as symbols. These symbols represent different actions to help you perform an activity. The default cursor is an arrow. The default cursor will change for some activities. For example:

- When the software is waiting for you to enter a response, such as for a filename when saving an image, the default cursor changes to an input cursor, which is a standard I-beam (eye-beam) symbol.
- When you request to rotate an image, the cursor changes to a directional symbol, indicating the directions for dragging the mouse.

- When you are deleting text, a hand symbol displays so that you can point to the text line to be deleted. The hand symbol also lets you indicate where you want axis labels to appear.

Exiting the Software

You exit SAS/SPECTRAVIEW with the **Exit** global button, which is located at the top right of the interface. Exiting SAS/SPECTRAVIEW returns you to the SAS System.

- 1 Select **Exit**. The button becomes highlighted, indicating that you need to confirm the request.
- 2 To confirm the request, select **Exit** again.

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