Chapter 37
# Rotating Plot

## Chapter Table of Contents

**VARIABLES** . . . . . 512
**METHOD** . . . . . 513
**OUTPUT** . . . . . 514
**REFERENCES** . . . . . 517

# Chapter 37
# Rotating Plot

A *rotating plot* is a graphic representation of the relationships among three variables. Rotating plots enable you to see structure in the data that is not apparent in two-dimensional scatter plots. Surface characteristics and general dependencies of one variable on the other two variables can be brought out by the three-dimensional representation (Becker, Cleveland, and Weil 1989).

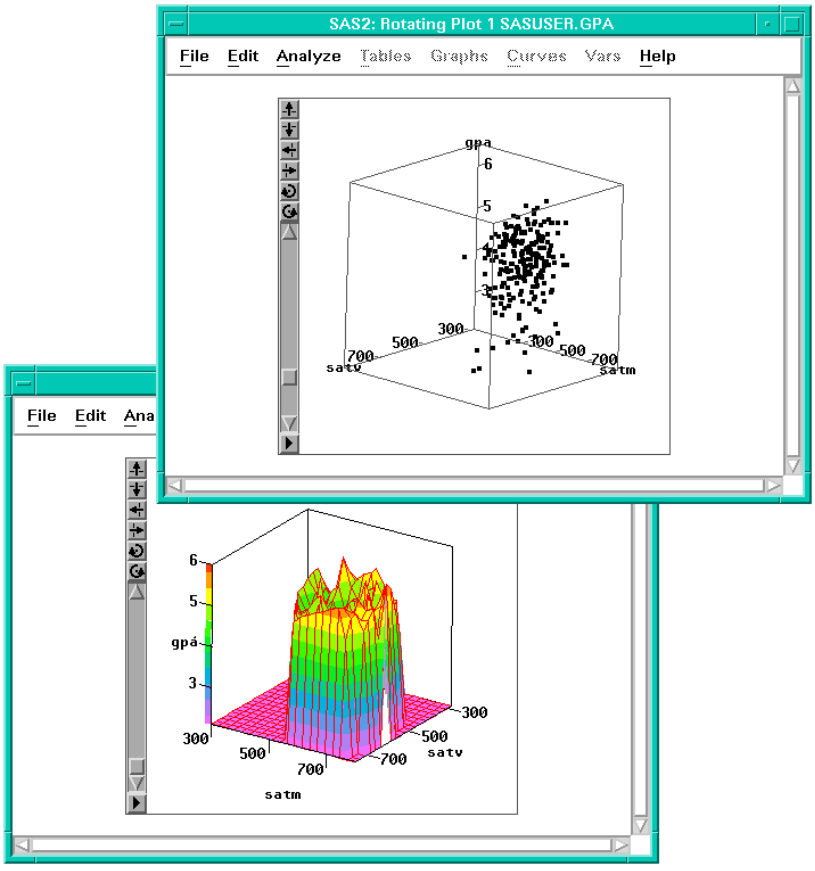


**Figure 37.1.** Rotating Plot

A surface plot is a rotating plot with a fit surface. It is a graphic representation of the relationships among three or four variables. A fourth variable can be used to color surface contours along **Z** direction in three-dimensional space. You can use linear interpolation or a thin-plate smoothing spline to fit surface functions.

Various drawing modes are provided to view a surface. For example, you can interactively color contour levels, and you can control the resolution of the rectangular grid used to compute a fitted surface.

You can toggle the display of axes and rays in any rotating plot. You can add a bounding cube to the display to show the range of the data and to provide perspective to the axes. You can adjust parameters that control depth cueing, the use of color, and the algorithm used for rotation.

# Variables

To create a rotating plot, choose **Analyze:Rotating Plot ( Z Y X )**. If you have already selected three or more variables, a rotating plot for each unique triplet of variables appears. If you have not selected any variables, a variables dialog appears.

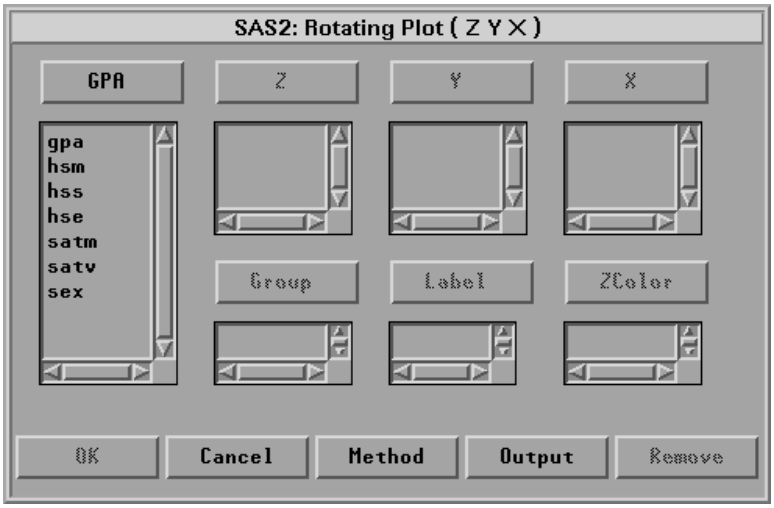


**Figure 37.2.** Rotating Plot Variables Dialog

In the dialog, select at least one **Z, Y, X** variable. If you select more than three variables, you obtain a matrix of rotating plots.

You can select one or more **Group** variables if you have grouped data. This creates rotating plots for each group.

You can select a **Label** variable for labeling observations in the plots.

To create a surface plot, select the **Fit Surface** option in the **Output** dialog as shown in Figure 37.3. If the **X** variable and **Y** variable are the same, you get a rotating plot without surface.

You can select one or more **ZColor** variables to color surfaces. This creates surface plots for each color variable. The hues in the multiple colors button in the tools

window are applied to the surface, according to interpolated values of the **ZColor** variable.

# Method

Observations with missing values for **Z, Y, X** variables are not used.

If there are observations that all share the same values for the X and Y variables, then the mean Z value of the set is used for the purpose of fitting a surface to the data set.

Clicking on the **Method** button in the variables dialog displays the dialog in Figure 37.3.

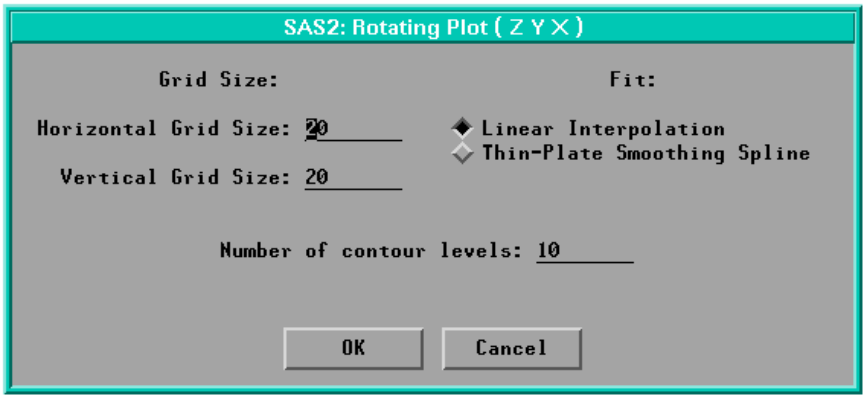


**Figure 37.3.** Rotating Plot Methods Dialog

**Grid Size: Horizontal Size** specifies the horizontal resolution of the rectangular grid over which surface and **ZColor** functions are evaluated.

**Grid Size: Vertical Size** specifies the vertical resolution of the rectangular grid over which surface and **ZColor** functions are evaluated.

**Fit:Linear Interpolation** linearly interpolates surface and **ZColor** functions across rectangular grid cells.

**Fit:Thin-Plate Smoothing Spline** fits surface and **ZColor** functions over the rectangular grid using thin-plate smoothing spline fitting. The process may be much slower than linear interpolation. It usually produces very smooth surfaces and colors.

**Number of Contour Levels** specifies the number of contour levels to be drawn on the surface. The contour levels are spaced evenly within the range of the **ZColor** variable, or the range of the Z variable if no **ZColor** variable is specified.

# Output

To view or modify output options associated with your rotating plot, click on the **Output** button of the rotating plot variables dialog. This displays the options dialog in Figure 37.4.

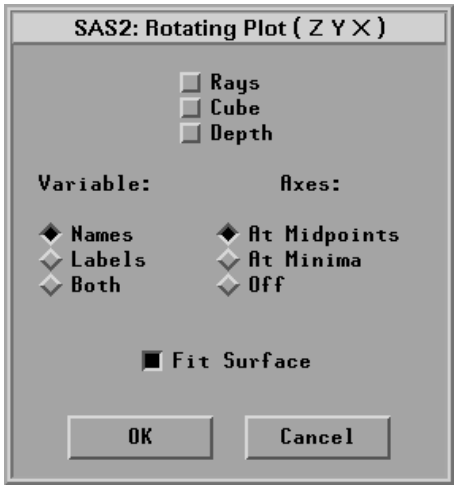


**Figure 37.4.** Rotating Plot Output Options Dialog

**Rays** draws a line segment from the center of the plot to each observation. These segments may help show the structure of the data.

**Cube** displays a perspective cube around the observations to show the range of the data.

**Depth** displays observations in two sizes (larger for near observations and smaller for distant observations) to aid three-dimensional visualization. If the marker size is 1 while **Depth** is in effect, only near observations are displayed.

**Variable:Names** labels the axes with variable names.

**Variable:Labels** labels the axes with variable labels.

**Variable:Both** labels the axes with both names and labels.

**Axes:At Midpoints** positions axes at the midpoints of the data, with no ticks. This is the best position for exploratory data analysis, as it minimizes interference of the axes with the point cloud.

**Axes:At Minima** positions axes at the minima of the data, with ticks. This is the best position for viewing spatial or volumetric data.

**Axes:Off** removes axes from the rotating plot.

**Fit Surface** fits a surface in the rotating plot.

You can modify other aspects of the rotating plot by using the rotating plot pop-up menu. Click the menu button at the lower left corner of the plot to display the pop-up menu.

The pop-up menu for a rotating plot without surface is shown in Figure 37.5.

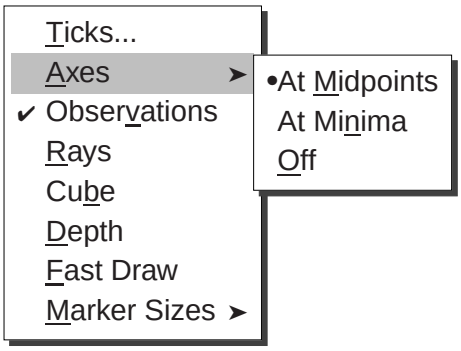


**Figure 37.5.** Rotating Plot without Surface Pop-up Menu

| | |
|---|---|
| **Ticks...** | specifies tick labels on any axis. |
| **Axes, Rays, Cube, Depth** | set the display of axes, observation vectors, perspective cube, and depth cueing as described in the previous section on output options. |
| **Observations** | toggles the display of observations. When this menu item is toggled off, observations are displayed only if selected. |
| **Fast Draw** | toggles the use of drawing algorithms that may be faster, depending on your host. The effect of these algorithms also depends on the size of your data set. On some hosts, this menu improves rotation speed for large data sets. |
| **Marker Sizes** | sets the size of markers used to display observations. |

The pop-up menu of a rotating plot with a fitted surface is shown in Figure 37.6.

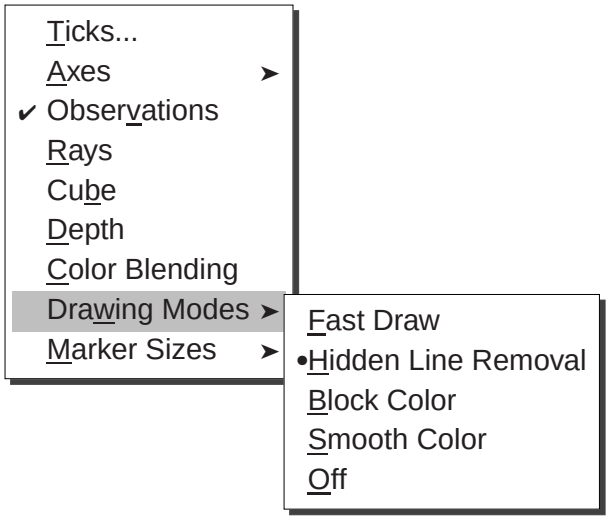


**Figure 37.6.** Rotating Plot with Surface Pop-up Menu

In addition to the menu items shown in Figure 37.5, the following items are specific for the surface plot.

| | |
|---|---|
| **Axes:Three Sections** | positions axes, with ticks, on the edges of a bounding cube surrounding the data and fitted surface. The axes are placed so that the tick labels minimally interfere with viewing the data. |
| **Color Blending** | applies color blending to all contour levels. The color blends in the tools window are used. The surface is colored when the **Block Color** or **Smooth Color** display modes are on. |
| **Drawing Modes: Fast Draw** | toggles the use of drawing algorithms that may be faster, depending on your host. The effect of these algorithms also depends on the size of your data set. On some hosts, this menu improves rotation speed for large data sets. |
| **Drawing Modes: Hidden Line Removal** | draws the surface in wireframe with hidden line removal. The front and back faces are in two different colors. |
| **Drawing Modes: Block Color** | fills each surface grid cell with a color block by using color interpolation at the grid cell level. |
| **Drawing Modes: Smooth Color** | fills the surface by using smooth color interpolation at the screen pixel level. |
| **Drawing Modes: Off** | toggles the display of the fitted surface. |

† **Note:** In color drawing modes, a color legend bar is drawn along the Z axis in 3D space if no **ZColor** variable is specified. Otherwise, a 2D color bar is drawn at the right side of the plot for the **ZColor** variable.

† **Note:** You can create a blended color strip based on the interpolation of up to five colors, as described in Chapter 11, "Coloring Observations."

With large data sets, rotation speed can be slow. The most reliable ways to optimize rotation speed are as follows:

- Use only square observation markers.
- Use only one color for observations.
- Use a small marker size, 1 if possible.
- Use **Fast Draw** or **Hidden Line Removal** drawing modes for surface.

When modeling with two explanatory variables, you may want to display a fitted plane in the rotating plot. You can write SAS statements to add planes and surfaces to the data set and rotate them with the original data. Muenchen (1992) has developed and documented a flexible set of SAS statements for this purpose.

# References

Becker, R.A., Cleveland, W.S., and Weil, G. (1989), "An Interactive System for Multivariate Data Display," *Proceedings of the 11th Conference on Probability and Statistics*, Boston: American Meteorological Society.

Muenchen, R.A. (1992), "INSIGHT into Multiple Regression," *Proceedings of the Seventeenth Annual SAS Users Group International Conference*, 17, 1407–1410.

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