

## Chapter 171

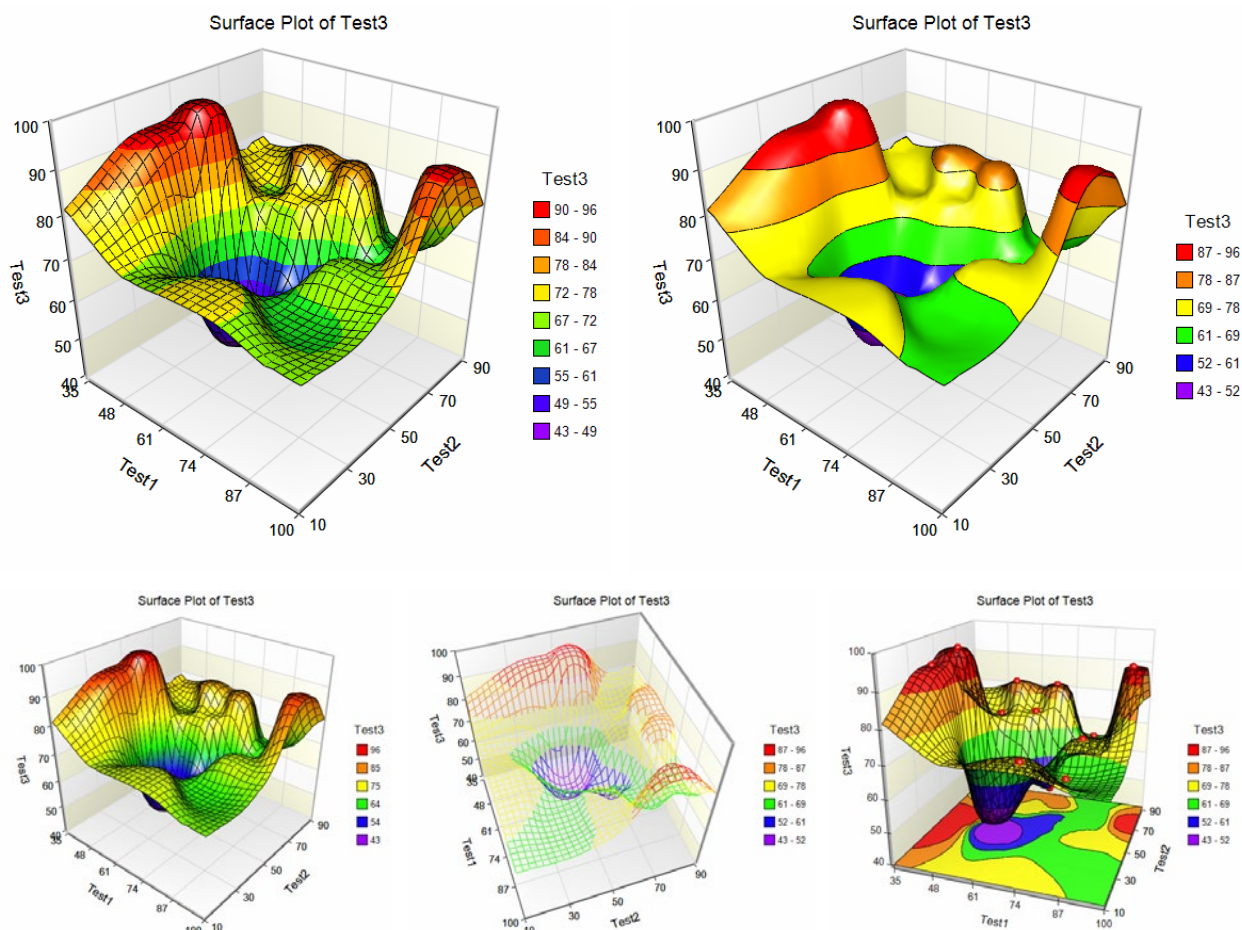
# 3D Surface Plots

## Introduction

Surface plots are diagrams of three-dimensional data. Rather than showing the individual data points, surface plots show a functional relationship between a designated dependent variable (Y), and two independent variables (X and Z). The plot is a companion plot to the contour plot.

It is important to understand how these plots are constructed. A two-dimensional grid of X and Z is constructed. The range of this grid is equal to the range of the data. Next, a Y value is calculated for each grid point. This Y value is a weighted average of all data values that are “near” this grid point. (The number of points averaged is specified by the user.) The three-dimensional surface is constructed using these averaged values. Hence, the surface plot does not show the variation at each grid point.

These plots are useful in regression analysis for viewing the relationship among a dependent and two independent variables. Remember that multiple regression assumes that this surface is a perfectly flat surface. Hence, the surface plot lets you visually determine if multiple regression is appropriate.



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## Data Structure

A surface plot is constructed from three variables. The X and Z (independent) variables are shown on the horizontal axes. The Y variable is shown along the vertical axis. Note that all three variables must be numeric.

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## Procedure Options

This section describes the options available in the 3D Surface Plot procedure.

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### Variables Tab

This panel specifies which variables are in the 3D surface plot.

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#### Variables

##### Variable (X, Y, Z)

Each box specifies a numeric variable that will be used to construct the plot. The X variable is displayed along the horizontal axis, the Y variable is displayed along the vertical axis, and the Z variable is displayed on the depth axis.

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#### Format Options

##### Variable Names

This option selects whether to display only variable's name, label, or both.

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#### 3D Surface Plot Format

##### Format

Click the format button to change the plot settings (see 3D Surface Plot Format Window Options below).

##### Edit During Run

Checking this option will cause the 3D Surface Plot Format window to appear when the procedure is run. This allows you to modify the format of the graph with the actual data.

## 3D Surface Plot Format Window Options

This section describes the specific options available on the 3D Surface Plot window, which is displayed when the 3D Surface Plot format button is clicked. Common options, such as axes, labels, legends, and titles are documented in the Graphics Components chapter.

### 3D Surface Plot Tab

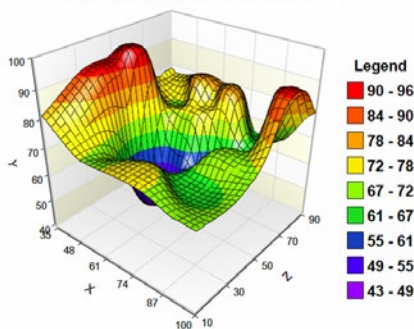
#### Appearance Section

This section contains options that control the colors and shading of interior plot items.

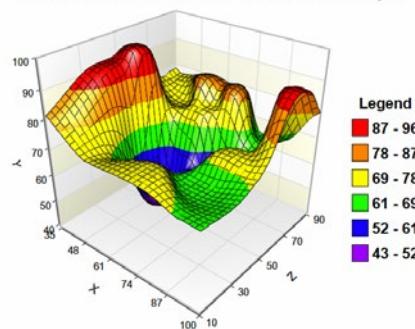
#### Y (Vertical) Zones

Specify how the vertical zones will be assigned. This option affects the coloring of the plot in the Y direction.

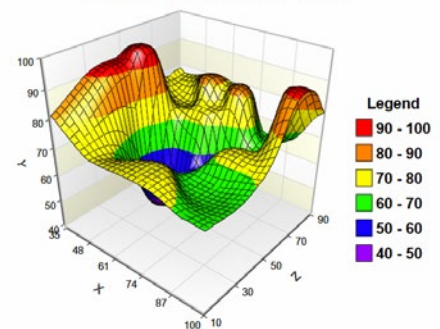
Fixed Number of Zones = 9



Zones from Surface Gradient Stops



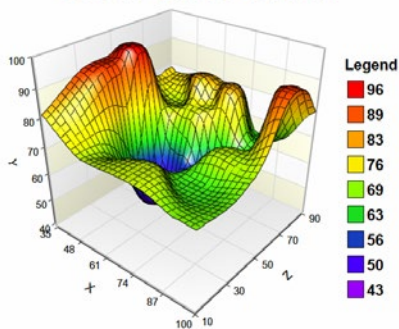
Zones from Y Axis Ticks



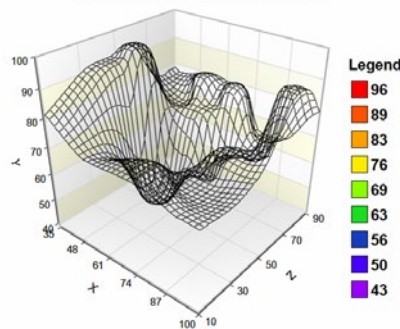
#### Surface Gradient

Check this option to fill the Y (Vertical) Zones with the corresponding colors from the gradient.

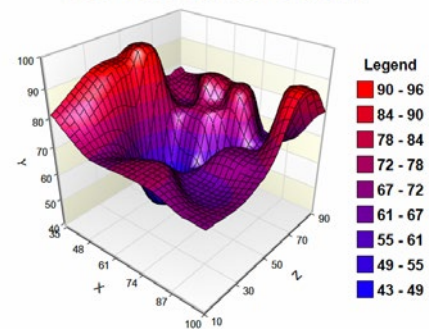
Smooth Surface Gradient



No Surface Gradient Fill



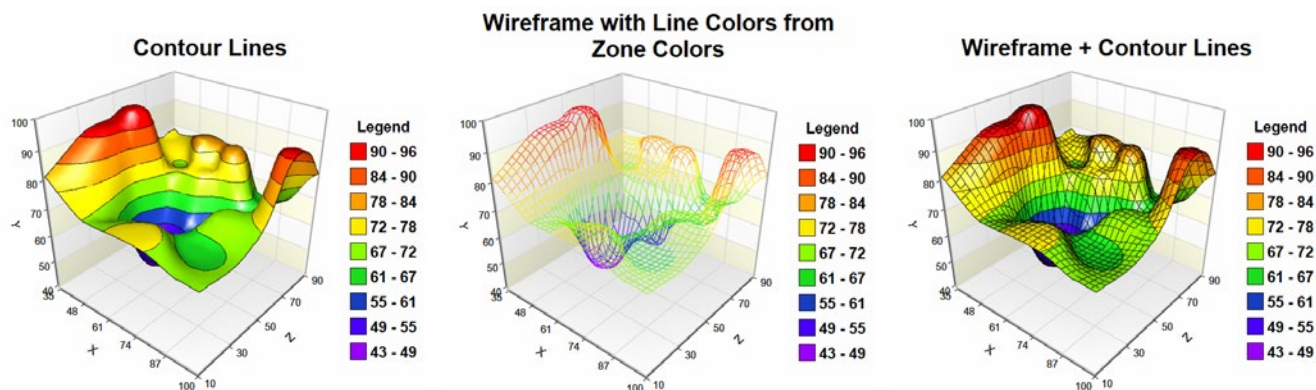
Two-Color Surface Gradient



## 3D Surface Plots

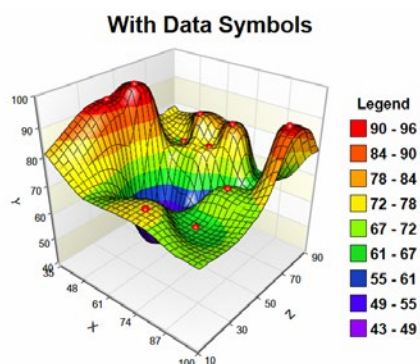
### Surface Lines

Check this option to fill the Y (Vertical) Zones with the corresponding colors from the gradient.



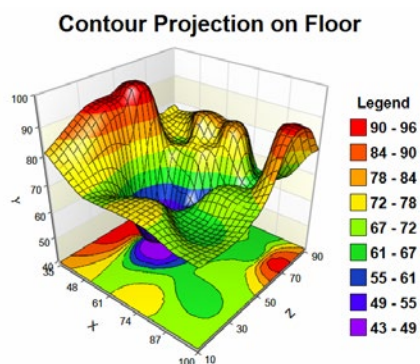
### Data Symbols

Check this option to display symbols for each data point used to generate the surface.



### Show Contour Projection on Floor

Check this option to show a contour projection on the floor. This contour plot is the 2D projection for the surface.

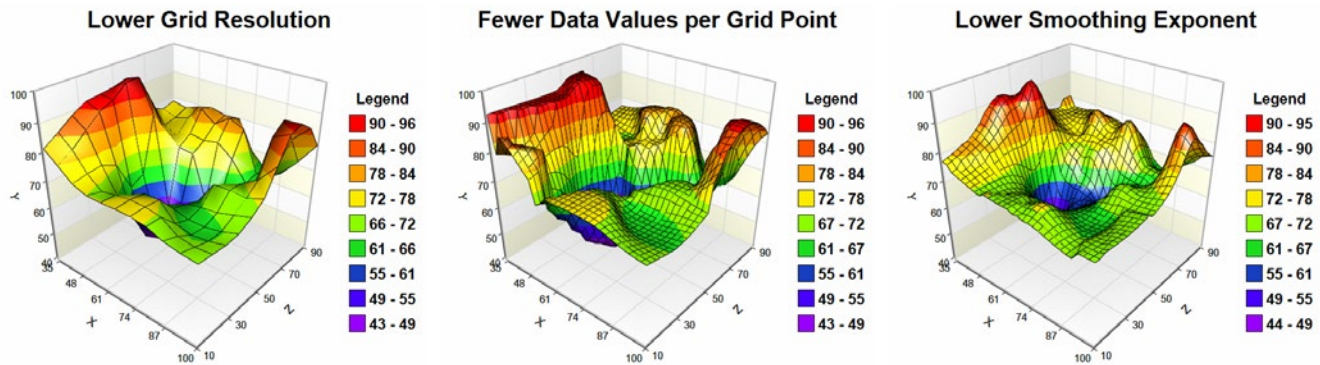




## 3D Surface Plots

### Estimation Section

This section contains options that control how the plot surface Y values are calculated from the X and Z grid values.



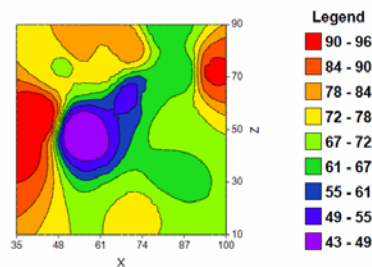
### 3D Layout Tab

Use this tab to control the 3D viewing aspects of the plot. Click on **Show in New Window** beneath the 3D Plot Preview display to show the plot in a separate window where you can auto-spin the plot and interact with the 3D orientation on the fly. All of the options on this tab are also available on the 3D Plot Preview window.

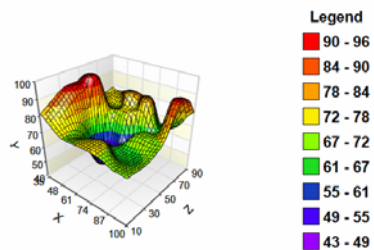
### Display Section

Control the display of the plot. Make the plot 2D or 3D using these options, as well as the zoom and the perspective angle. When using 2D, only the X and Z axes are displayed; the Y axis is not displayed.

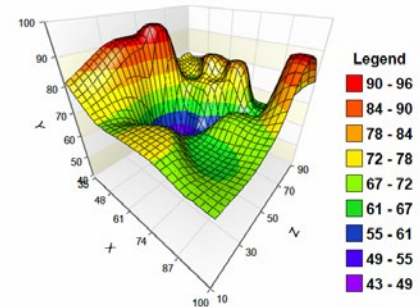
**2D Display (Contour Plot)**



**No Autofit, Zoom = 50%**



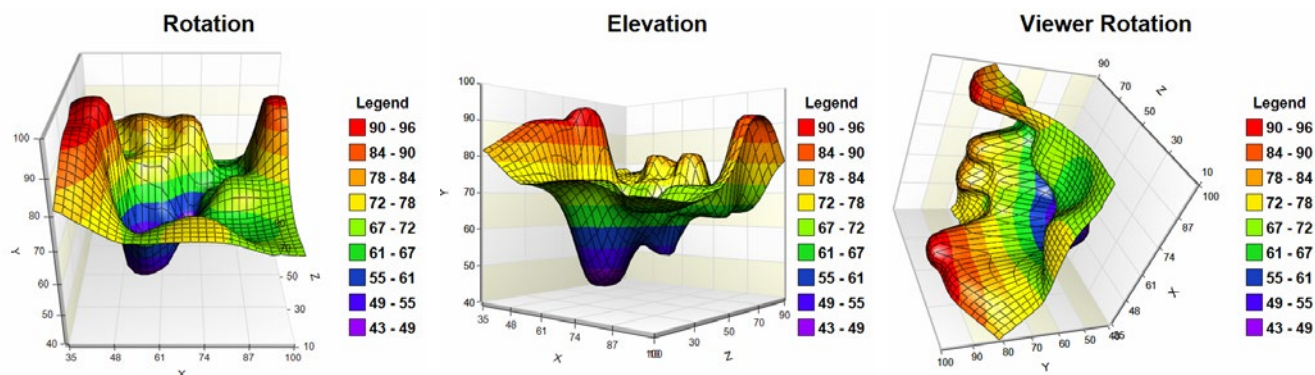
**Perspective Angle**



## 3D Surface Plots

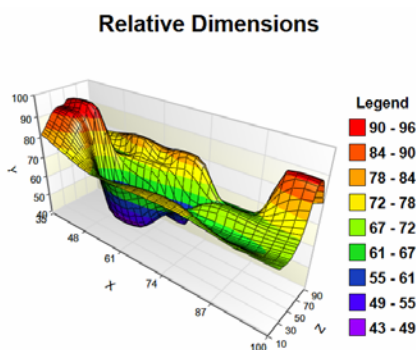
### 3D Orientation Section

Control rotation, elevation, and viewer rotation of the 3D plot. You can modify the rotation and elevation interactively by left-clicking on the plot in the 3D Plot Preview display and dragging your mouse.



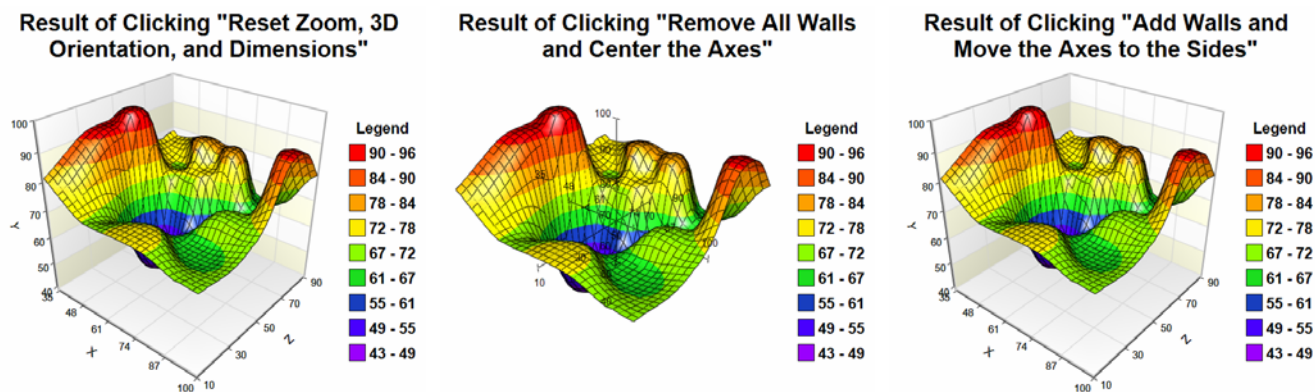
### Relative Dimensions Section

Control the relative display dimensions for the X, Y, and Z axes of the plot.



### Quick Layout Tools Section

Use these tools to quickly change multiple plot settings simultaneously to achieve a 3D display result.



### Load the Interactive 3D Plot Preview Window

Click this button to show the plot in a separate window where you can auto-spin the plot and interact with the 3D orientation on the fly. All of the options on this tab are also available on the 3D Plot Preview window.

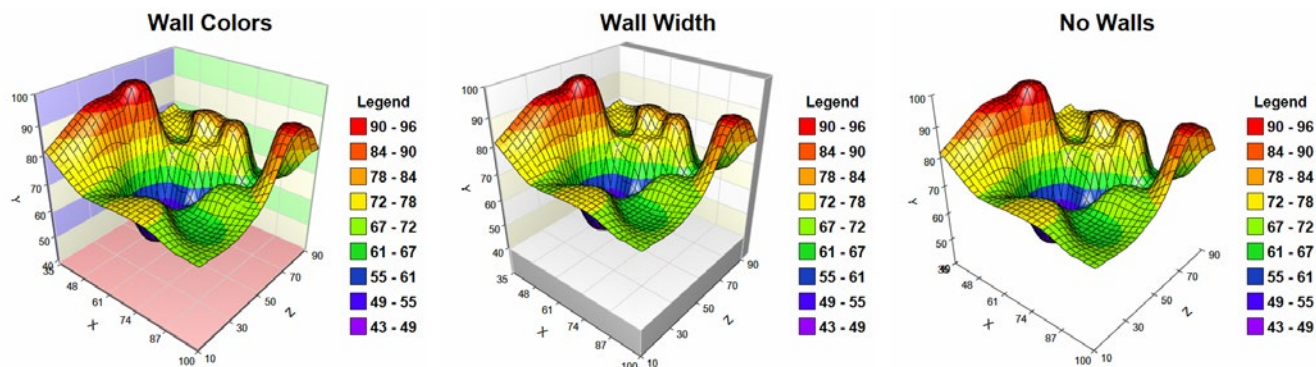
## 3D Surface Plots

## Walls Tab

Use this tab to control the display of walls on the plot.

### XY Walls, YZ Walls, and XZ Walls Section

Control how walls are displayed on the plot.

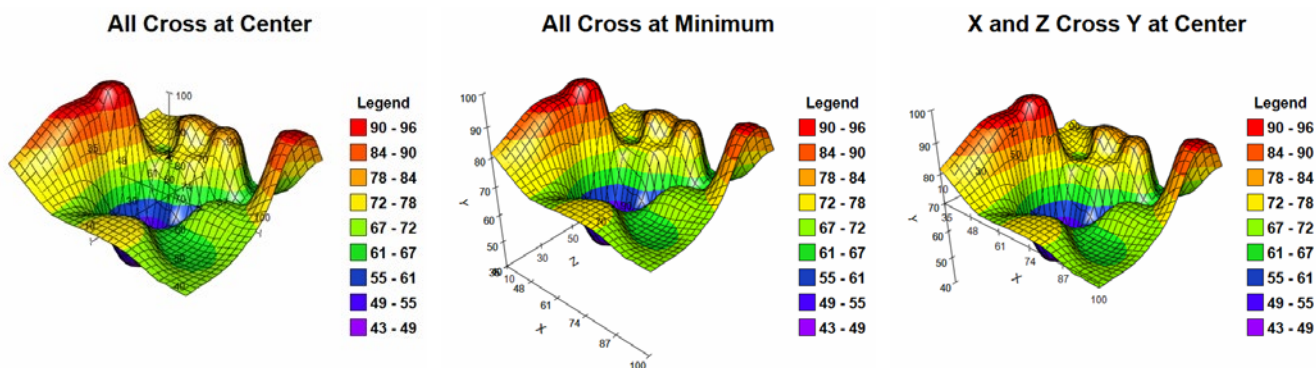


## Titles, Legend, X Axis, Y Axis, Z Axis, Grid Lines, and Background Tabs

Details on setting the options in these tabs are given in the Graphics Components chapter. A few specific options are described below.

### Crosses Axis At (on X, Y, and Z Axis Tabs)

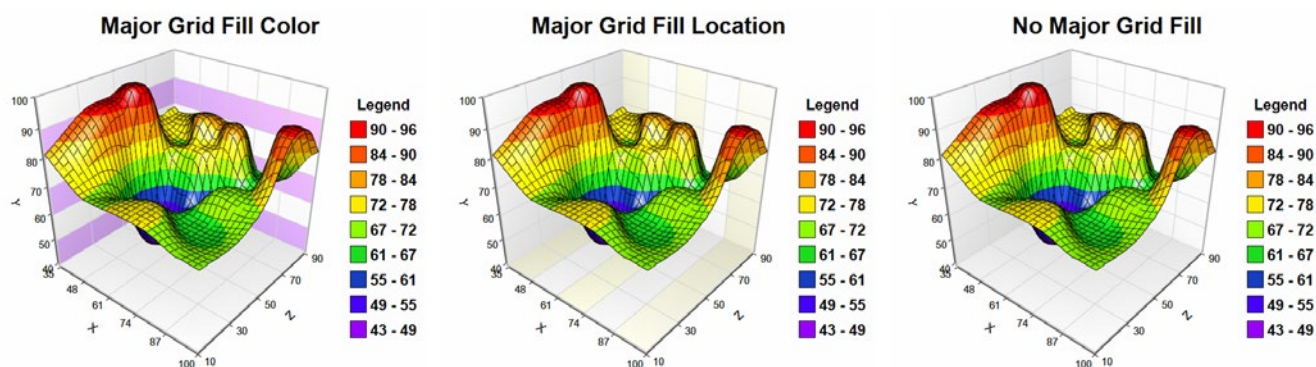
Control where the axes cross in relation to each other.



## 3D Surface Plots

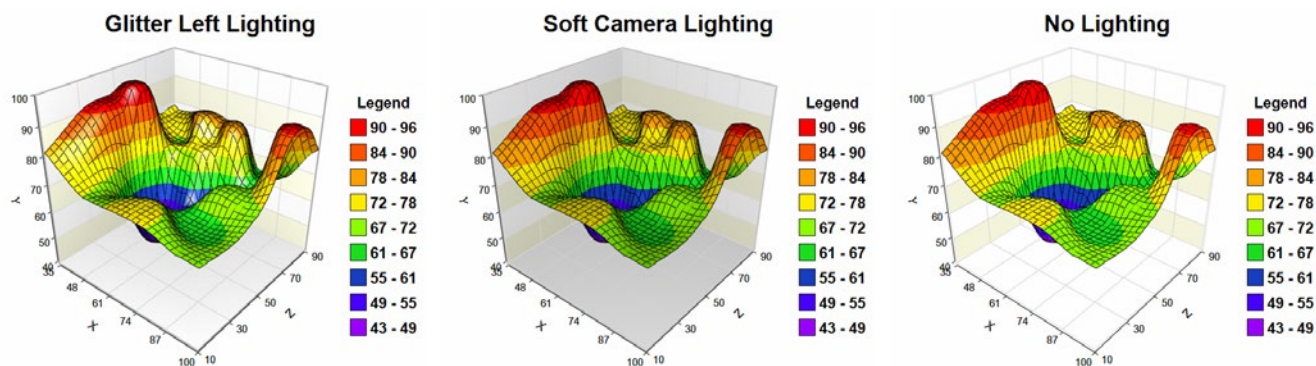
## Fill Between Major Grid Lines (on Grid Lines Tab)

Control the appearance of reference bands on the plot.



## Lighting Scheme (on Background Tab)

Control the ambient lighting on the plot. Choose from a number of present lighting schemes. These schemes change the way colors and 3D items appear in the plot.





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## Example 1 – Creating a 3D Surface Plot

This section presents an example of how to generate a 3D surface plot. The data used are from the Tests dataset.

You may follow along here by making the appropriate entries or load the completed template **Example 1** by clicking on Open Example Template from the File menu of the 3D Surface Plots window.

### 1 Open the Tests dataset.

- From the File menu of the NCSS Data window, select **Open Example Data**.
- Click on the file named **Tests**.
- Click **OK**.

### 2 Open the 3D Surface Plots window.

- Using the Graphics menu or the Procedure Navigator, find and select the **3D Surface Plots** procedure.
- On the menus, select **File**, then **New Template**. This will fill the procedure with the default template.

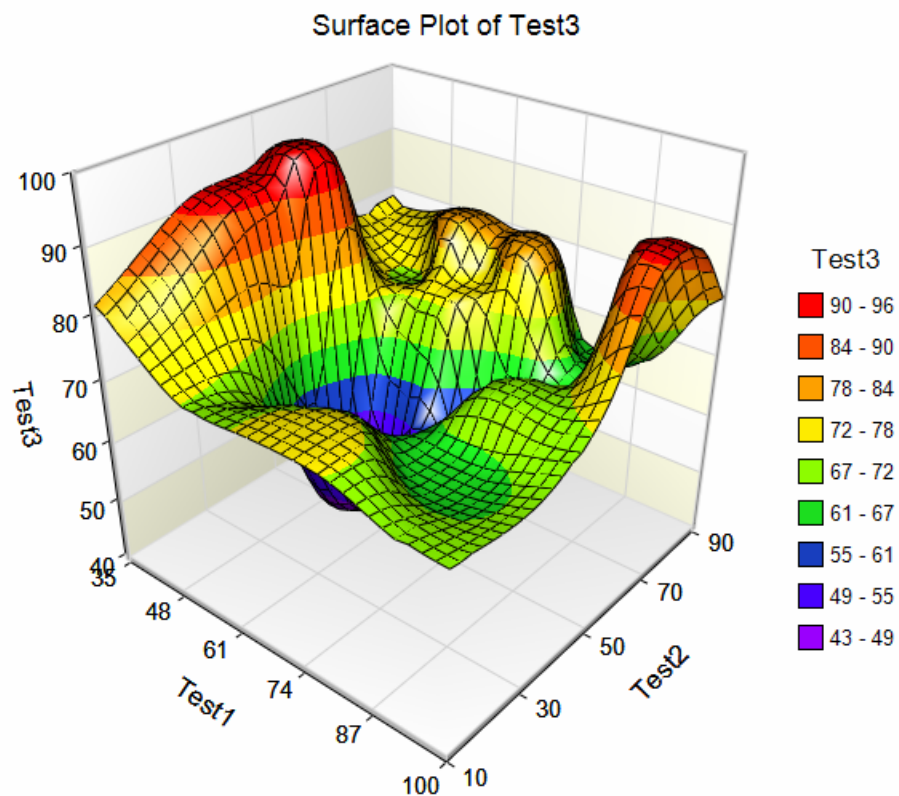
### 3 Specify the variables.

- Double-click in the **X (Horizontal) Variable(s)** text box. This will bring up the variable selection window.
- Select **Test1** from the list of variables and then click **Ok**. “Test1” will appear in the X (Horizontal) Variable(s) box.
- Double-click in the **Y (Vertical) Variable(s)** text box. This will bring up the variable selection window.
- Select **Test3** from the list of variables and then click **Ok**. “Test3” will appear in the Y (Vertical) Variable(s) box.
- Double-click in the **Z (Depth) Variable(s)** text box. This will bring up the variable selection window.
- Select **Test2** from the list of variables and then click **Ok**. “Test2” will appear in the Z (Depth) Variable(s) box.

### 4 Run the procedure.

- From the Run menu, select **Run Procedure**. Alternatively, just click the green Run button.

## 3D Surface Plot Output



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## Example 2 – Interactive 3D Rotation

This section presents an example of real-time rotation of a 3D surface plot. The data used are from the Tests dataset.

You may follow along here by making the appropriate entries or load the completed template **Example 2** by clicking on Open Example Template from the File menu of the 3D Surface Plots window.

### 1 Open the Tests dataset.

- From the File menu of the NCSS Data window, select **Open Example Data**.
- Click on the file named **Tests**.
- Click **OK**.

### 2 Open the 3D Surface Plots window.

- Using the Graphics menu or the Procedure Navigator, find and select the **3D Surface Plots** procedure.
- On the menus, select **File**, then **New Template**. This will fill the procedure with the default template.

### 3 Specify the variables.

- Double-click in the **X (Horizontal) Variable(s)** text box. This will bring up the variable selection window.
- Select **Test1** from the list of variables and then click **Ok**. “Test1” will appear in the X (Horizontal) Variable(s) box.
- Double-click in the **Y (Vertical) Variable(s)** text box. This will bring up the variable selection window.
- Select **Test3** from the list of variables and then click **Ok**. “Test3” will appear in the Y (Vertical) Variable(s) box.
- Double-click in the **Z (Depth) Variable(s)** text box. This will bring up the variable selection window.
- Select **Test2** from the list of variables and then click **Ok**. “Test2” will appear in the Z (Depth) Variable(s) box.
- Check the **Edit During Run** box.

### 4 Run the procedure.

- From the Run menu, select **Run Procedure**. Alternatively, just click the green Run button. Once you run the procedure, the 3D Surface Plot Format window will appear with your actual data loaded.

### 5 Load the 3D Plot Preview window.

- On the 3D Surface Plot Format window, click **Show in New Window**. This will load the plot into the 3D Plot Preview window.

### 6 Edit the 3D Layout interactively.

- On the 3D Plot Preview window. Click on the **3D Orientation** tab.
- Check **Auto Spin** across from Rotation. This will cause the plot to start rotating horizontally.
- Increase the value for **Speed** across from Rotation. This will cause the plot to rotate faster.
- Set **Direction** to “Reverse” across from Rotation. This will cause the plot to rotate in the opposite direction.
- Uncheck **Auto Spin**. This will cause the plot to stop rotating and remain at the last orientation.
- Repeat the previous steps with Elevation and Viewer Rotation. Alternatively, left-click on the plot in the viewer and drag your mouse to change the rotation and elevation of the plot.
- On the 3D Plot Preview window. Click on the **Display** tab.
- Check **Hide Titles** and **Hide Legend**. This will hide the indicated items in the 3D plot viewer without deactivating the actual settings. This allows you to see the full plot.
- Uncheck **Autofit Plot in Bounds**. This will keep the plot from resizing as the plot rotates.
- Decrease **Zoom** to 80.
- On the 3D Plot Preview window. Click on the **3D Orientation** tab.

### 3D Surface Plots

- Decrease **Elevation** to 0.
- Check **Auto Spin** across from Rotation. This will cause the plot to start rotating horizontally again.
- On the 3D Plot Preview window. Click on the **Quick Layout Tools** tab.
- Click **Remove All Walls and Center the Axes**. This will cause the plot to be displayed with the axes centered and without any walls. This makes it easy to see the points from all vantage points as the plot rotates.
- As the plot continues to rotate, go back to the 3D Surface Plot Format window and change any of the various plot settings (symbol colors, titles, axes, etc.). These changes will immediately be displayed on both preview windows.

#### 7 Generate the plot in the output.

- On the 3D Surface Plot Format window. Click **OK**.

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### 3D Surface Plot Output

Below is an example of what the final result might look like after running through the interactive steps of this example. Of course, the plot you generate might look different, depending on your final rotation value. The plot below was generated with Rotation = -36 and Elevation = 0.

