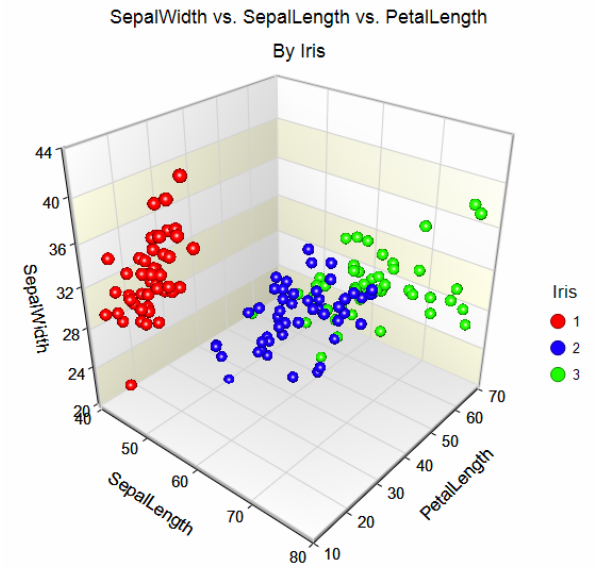
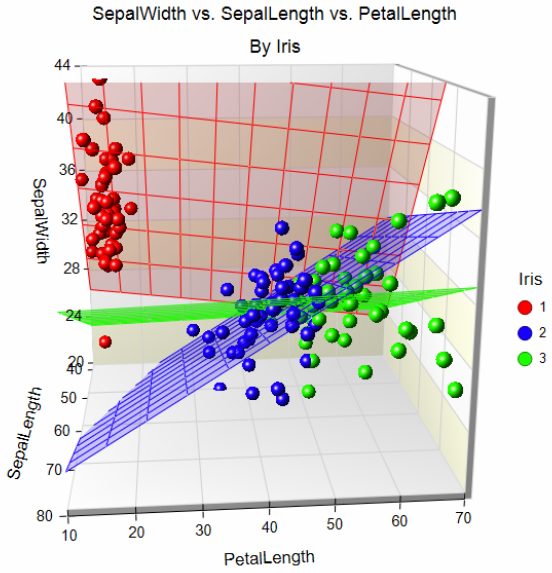
Chapter 170

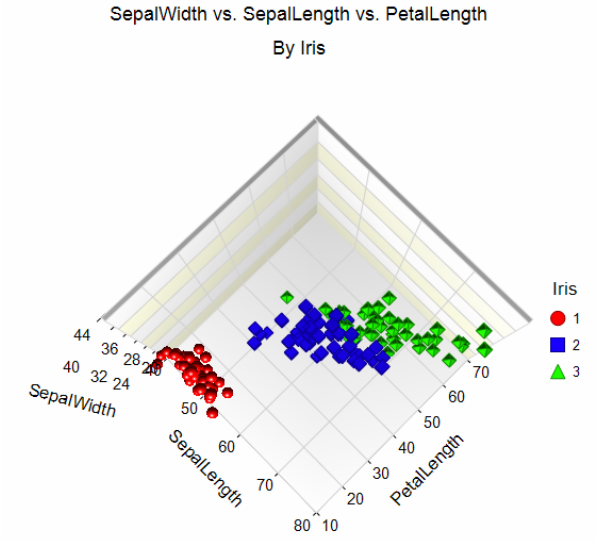
3D Scatter Plots

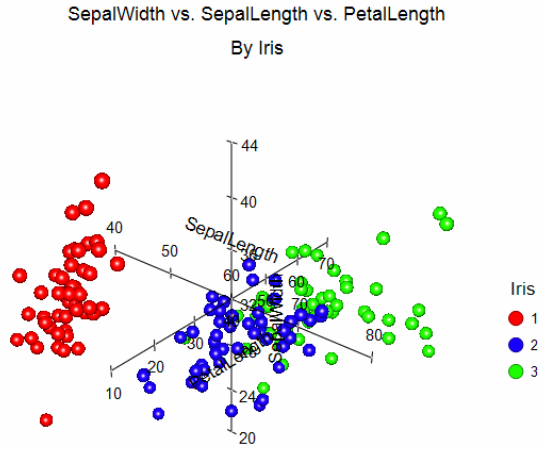
Introduction

The 3D scatter plot displays trivariate points plotted in an X-Y-Z grid. It is particularly useful for investigating the relationships among these variables. The influence of a categorical variable may be investigated by using a different plotting symbol for each value of this variable. Hence, up to four variables (three numeric and one categorical) may be displayed on a single graph. This procedure has the ability to rotate the data so that you can investigate the data from different angles and the ability to plot the multiple regression surface when regressing Y on X and Z using up to two-way multiple regression models.









Data Structure

The data are entered in three numeric variables: X, Y, and Z. A fourth categorical variable may be used to define the plotting symbol and color. You may also include a data label variable to label individual points on the plot.

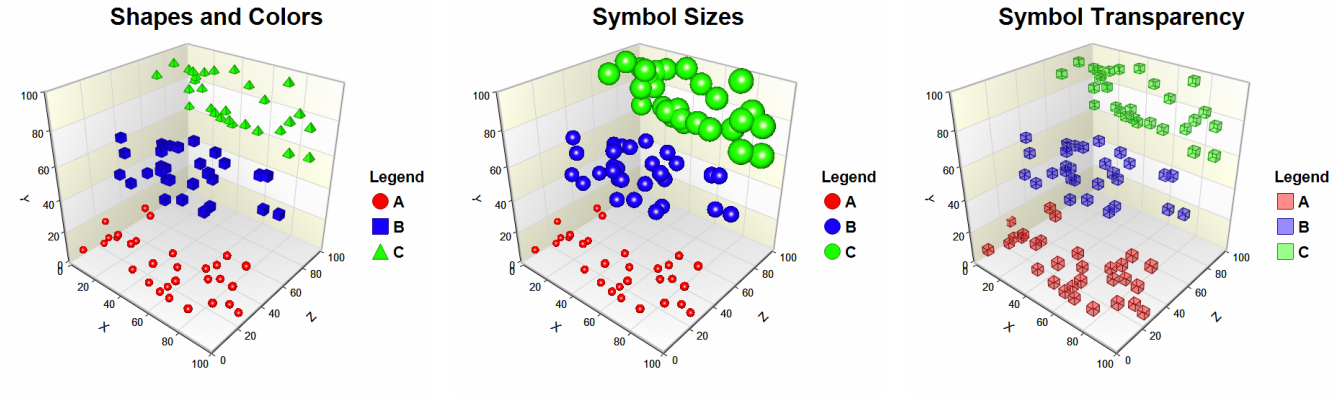
3D Scatter Plot Format Window Options

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

3D Scatter Plot Tab

Symbols Section

You can modify the shape, color, and size of the plot symbols. To change them, click the Symbol Format button to display the Symbol Format window. Here are some of the graphics effects that can easily be achieved.



Multiple Regression Section

You can include the multiple regression surface on the plot. The *Y* variable is always used as the response or dependent variable. *X* and *Z* are always the predictor or independent variables. The regression equation involving only main effects is of the form

$$Y = \beta_0 + \beta_1 X + \beta_2 Z.$$

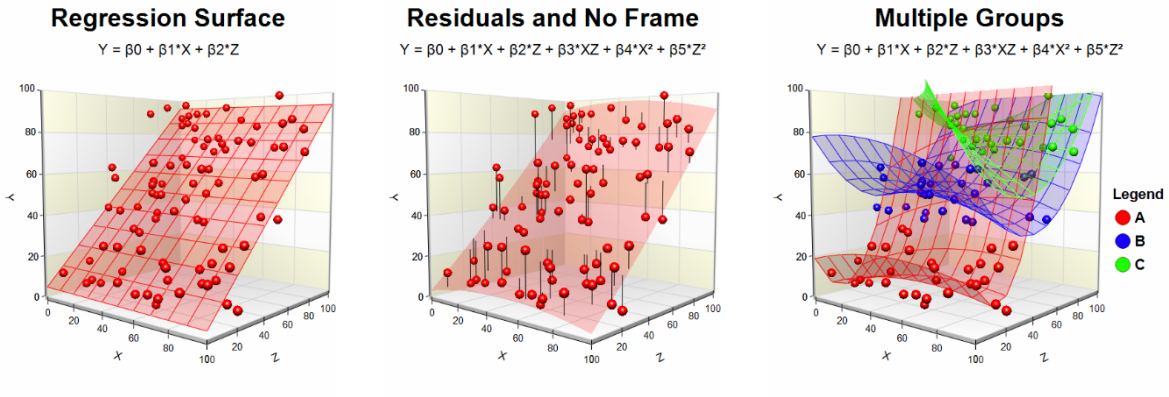
This is the default model. The largest regression model that can be plotted is of the form

$$Y = \beta_0 + \beta_1 X + \beta_2 Z + \beta_3 XZ + \beta_4 X^2 + \beta_5 Z^2.$$

You can select any subset of terms for inclusion in the plotted model. Regression models involving only main effects (*X* and *Z*) result in a plane. When the cross-product (*XZ*) and/or squared terms (X^2 and Z^2) are included, the surface will usually be curved. For more information about the multiple regression calculation formulas and details see the chapter on *Multiple Regression*.

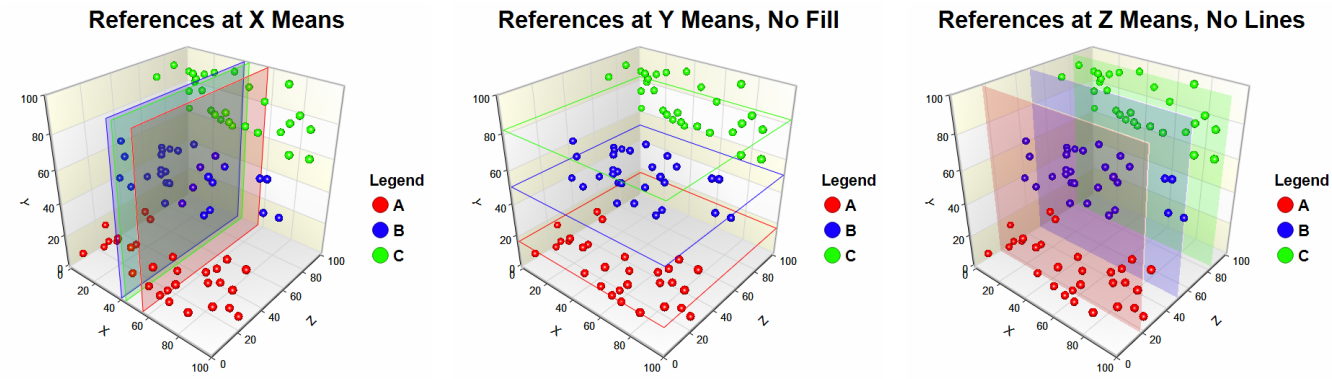
To display the fitted model equation(s) and R^2 value(s) on the graph, click on the Titles tab and change the entry for one of the titles to "Model: {Model}" or "R^2 = {R}". Click the title dropdowns for additional suggestions.

If a grouping variable is specified, a separate regression surface is drawn for each group. The calculations for each group are performed independently of the other groups.



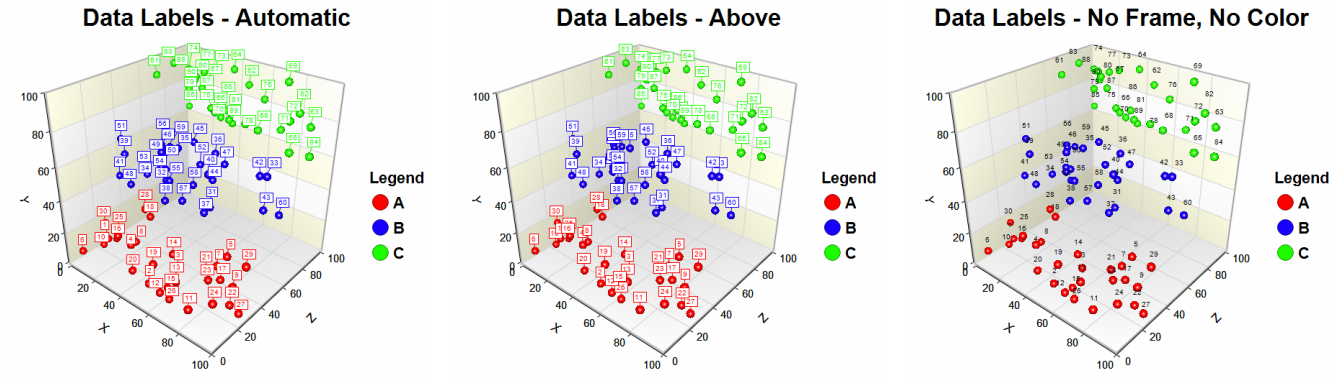
References at Means Section

You can display reference planes on the plot at the means of each group.



Data Point Labels Section

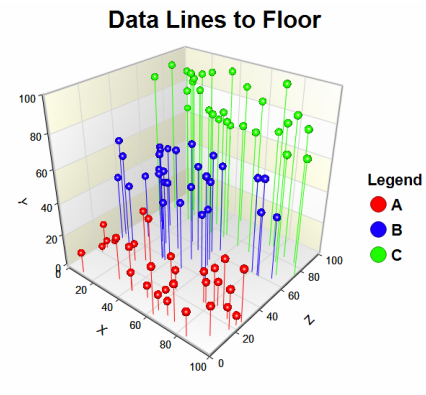
You can display data labels next to the symbols.



Points to Walls Tab

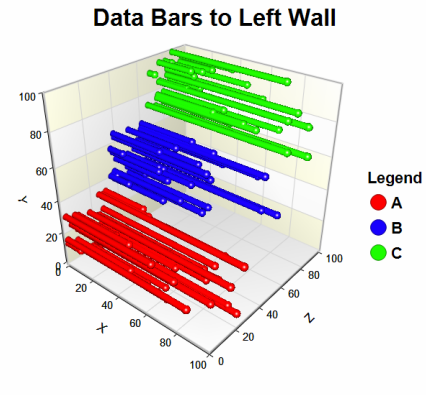
Lines from each Data Point Section

You can display a line between the data point and any wall.



Bars from each Data Point Section

You can display bars between data points and any wall.



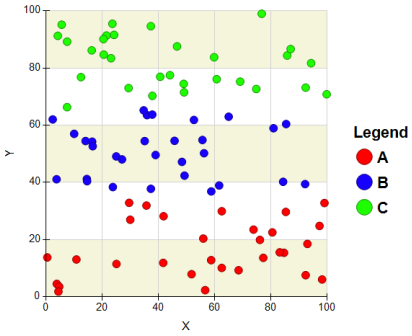
3D Layout Tab

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.

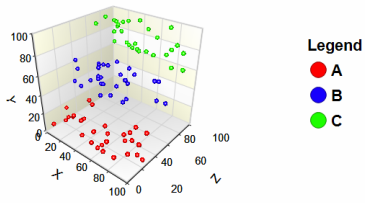
Display Section

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 Y axes are displayed; the Z axis is not displayed.

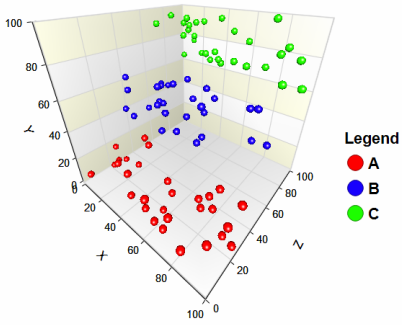
2D Display



No Autofit, Zoom = 50%



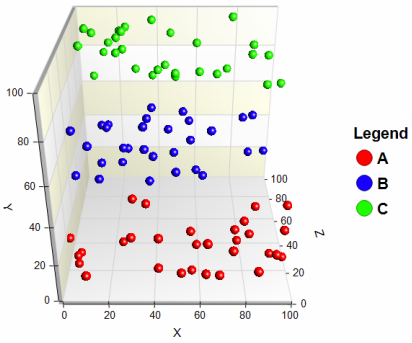
Perspective Angle



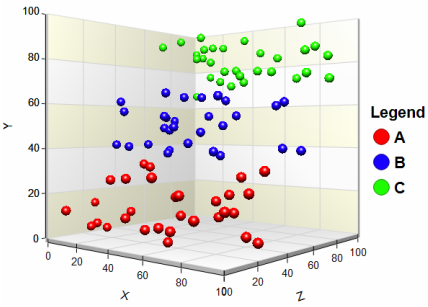
3D Orientation Section

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.

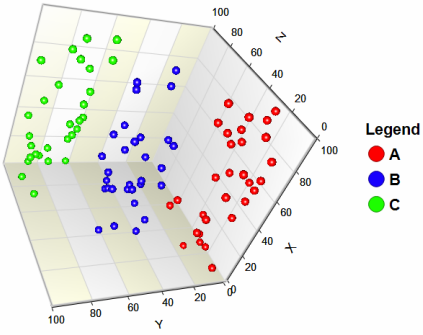
Rotation



Elevation

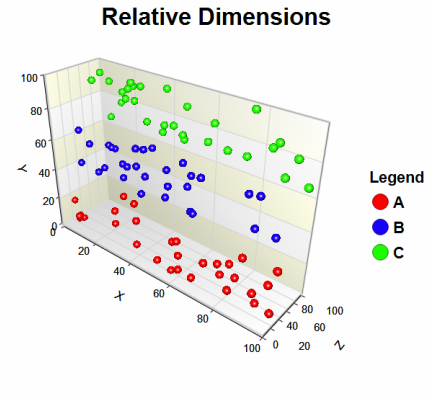


Viewer Rotation



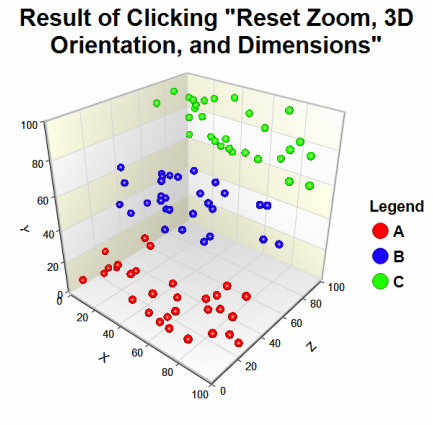
Relative Dimensions Section

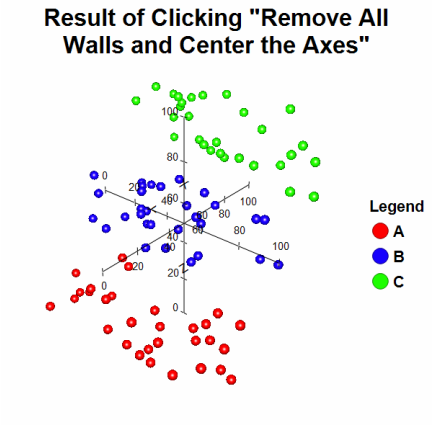
Control the relative display dimensions for the X, Y, and Z axes of the plot.

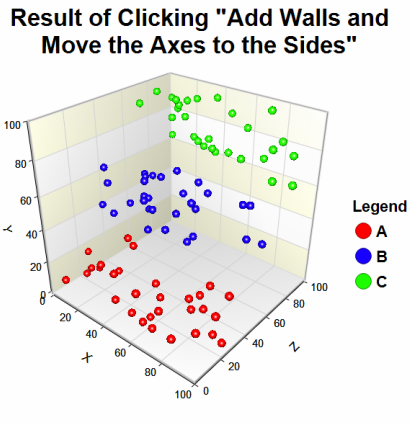


Quick Layout Tools Section

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







Load the Interactive 3D Plot Preview Window

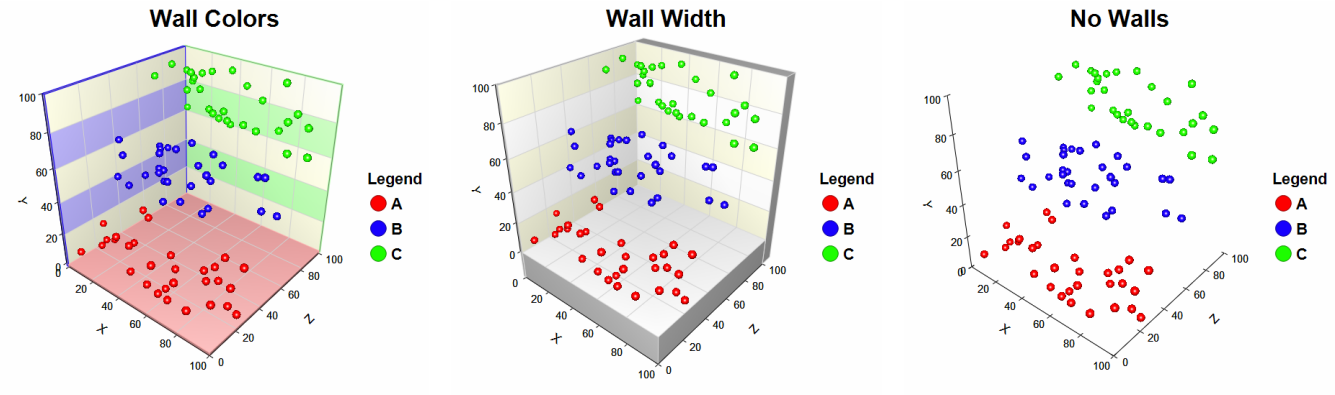
Click this button to show the plot in a separate window where you can auto-spin the plot and interact with the 3D orientation on the fly. All of the options on this tab are also available on the 3D Plot Preview window.

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.

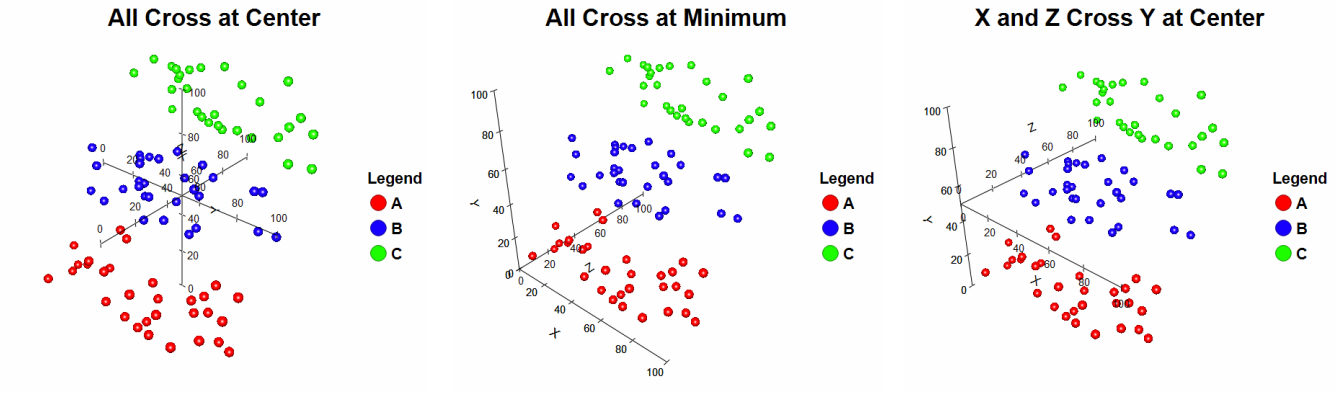


Titles, Legend, X Axis, Y Axis, Z Axis, Grid Lines, and Background Tabs

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

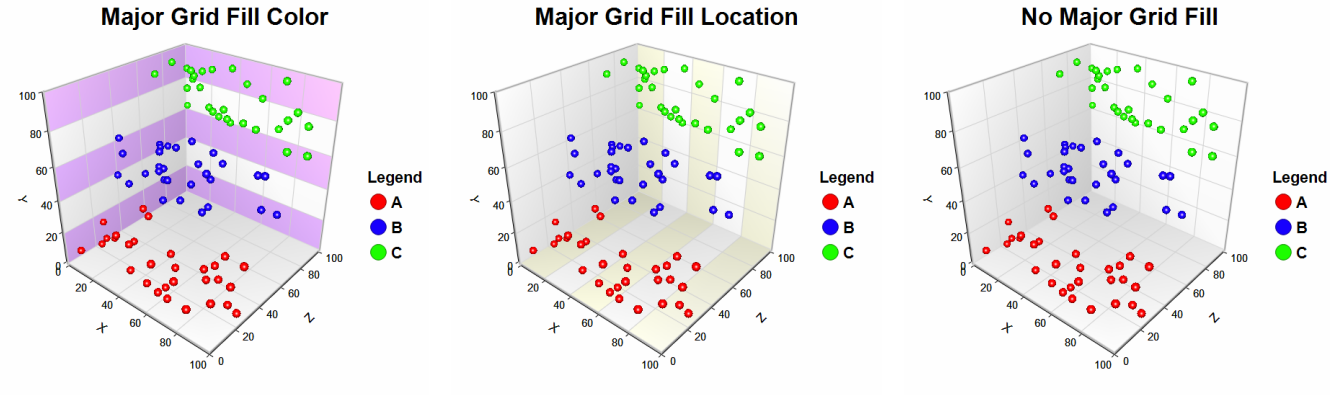
Crosses Axis At (on X, Y, and Z Axis Tabs)

Control where the axes cross in relation to each other.



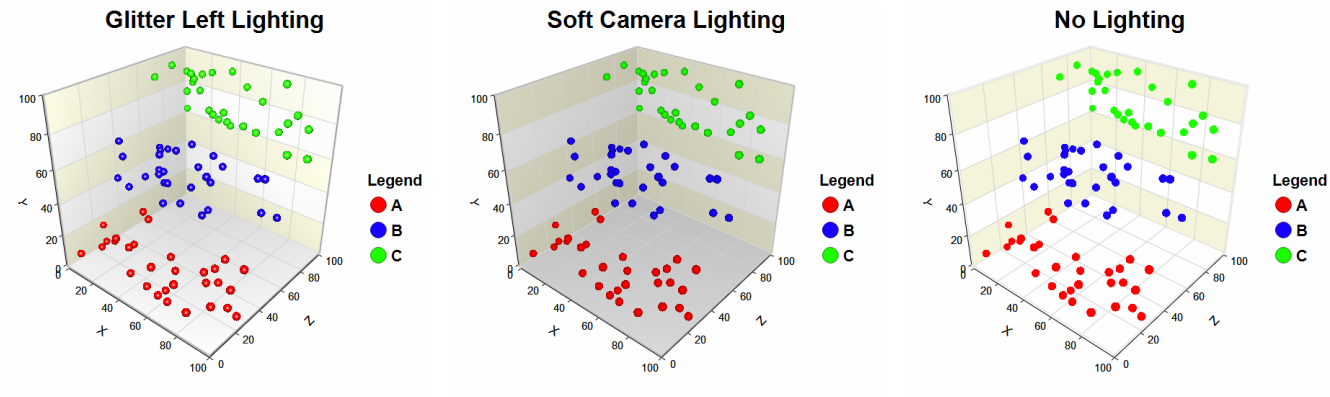
Fill Between Major Grid Lines (on Grid Lines Tab)

Controls 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.



Example 1 – Creating a 3D Scatter Plot

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

Setup

To run this example, complete the following steps:

1 Open the Fisher example dataset

- From the File menu of the NCSS Data window, select **Open Example Data**.
- Select **Fisher** and click **OK**.

2 Specify the 3D Scatter Plots procedure options

- Find and open the **3D Scatter Plots** procedure using the menus or the Procedure Navigator.
- The settings for this example are listed below and are stored in the **Example 1** settings file. To load these settings to the procedure window, click **Open Example Settings File** in the Help Center or File menu.

Variables Tab	
X (Horizontal) Variable	**SepalLength**
Y (Vertical) Variable	**SepalWidth**
Z (Depth) Variable	**PetalLength**
Grouping (Symbol) Variable	**Iris**

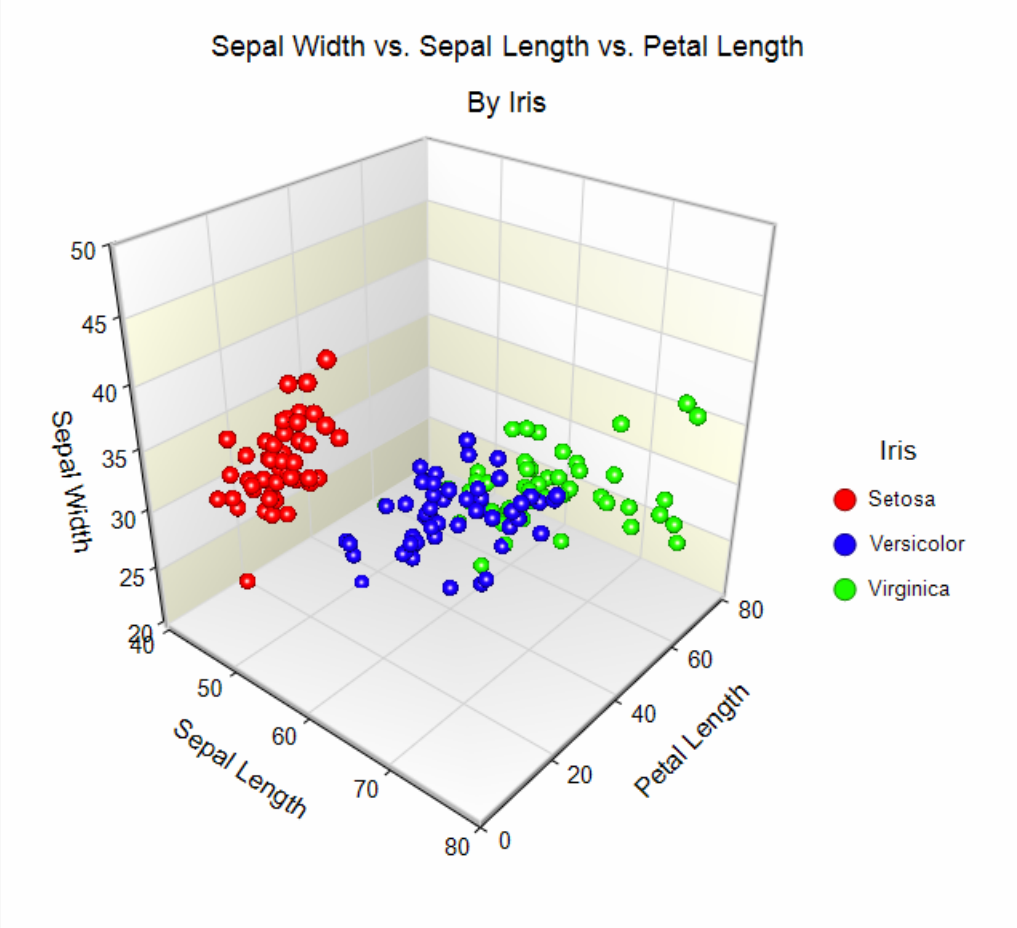
Report Options (*in the Toolbar*)	
Variable Labels	**Column Labels**
Data Labels	**Value Labels**

3 Run the procedure

- Click the **Run** button to perform the calculations and generate the output.

3D Scatter Plot Output

3D Scatter Plot



Example 2 – Interactive 3D Rotation

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

Setup

To run this example, complete the following steps:

1 Open the Fisher example dataset

- From the File menu of the NCSS Data window, select **Open Example Data**.
- Select **Fisher** and click **OK**.

2 Specify the 3D Scatter Plots procedure options

- Find and open the **3D Scatter Plots** procedure using the menus or the Procedure Navigator.
- The settings for this example are listed below and are stored in the **Example 2** settings file. To load these settings to the procedure window, click **Open Example Settings File** in the Help Center or File menu.

Variables Tab	
X (Horizontal) Variable	**SepalLength**
Y (Vertical) Variable	**SepalWidth**
Z (Depth) Variable	**PetalLength**
Grouping (Symbol) Variable	**Iris**
Edit During Run (*on the Plot Format button*)	**Checked**
Report Options (*in the Toolbar*)	
Variable Labels	**Column Labels**
Data Labels	**Value Labels**

3 Run the procedure

- Click the **Run** button to perform the calculations and generate the plot preview. The 3D Scatter Plot Format window will appear with your actual data loaded.

4 Load the 3D Plot Preview window

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

5 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.
- 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 Scatter 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.

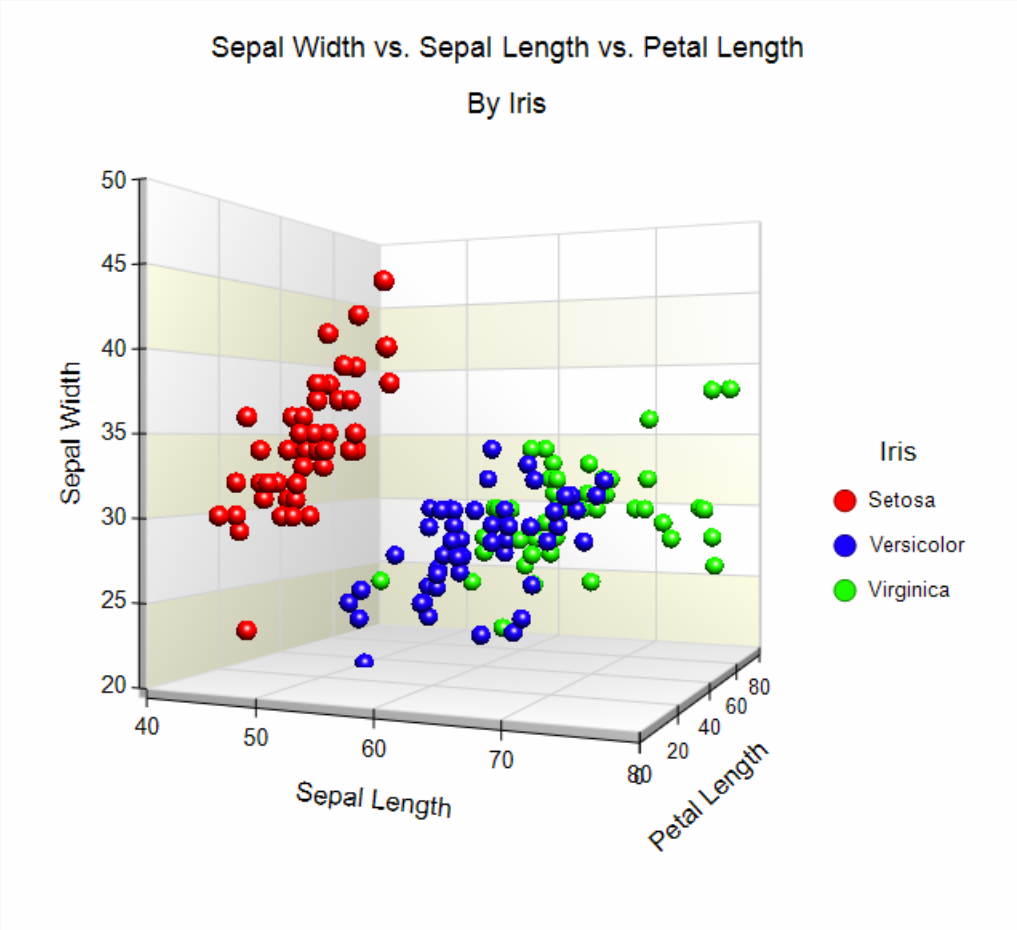
6 Generate the plot in the output

- On the 3D Scatter Plot Format window, click **OK** to generate the output.

3D Scatter 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 = -23 and Elevation = 0.

3D Scatter Plot



Example 3 – 3D Regression Surface for a Main Effects Model

This section presents an example of how to include a main-effects model multiple regression surface on a 3D scatter plot and display the regression equation and R^2 value on the graph. The data used are from the IQ dataset.

Setup

To run this example, complete the following steps:

1 Open the IQ example dataset

- From the File menu of the NCSS Data window, select **Open Example Data**.
- Select **IQ** and click **OK**.

2 Specify the 3D Scatter Plots procedure options

- Find and open the **3D Scatter Plots** procedure using the menus or the Procedure Navigator.
- The settings for this example are listed below and are stored in the **Example 3** settings file. To load these settings to the procedure window, click **Open Example Settings File** in the Help Center or File menu.

Variables Tab

X (Horizontal) Variable **Test1**
Y (Vertical) Variable ..... **IQ**
Z (Depth) Variable **Test2**

3D Scatter Plot Format (*Click the Button*)

3D Scatter Plot Tab
Regression Surface ..... **Checked**
Regression Surface – Fill ..... **Checked**

Titles Tab
Top 2 ..... **Checked**
Top 2 Text ..... **Model: {Model} with R² = {R}**

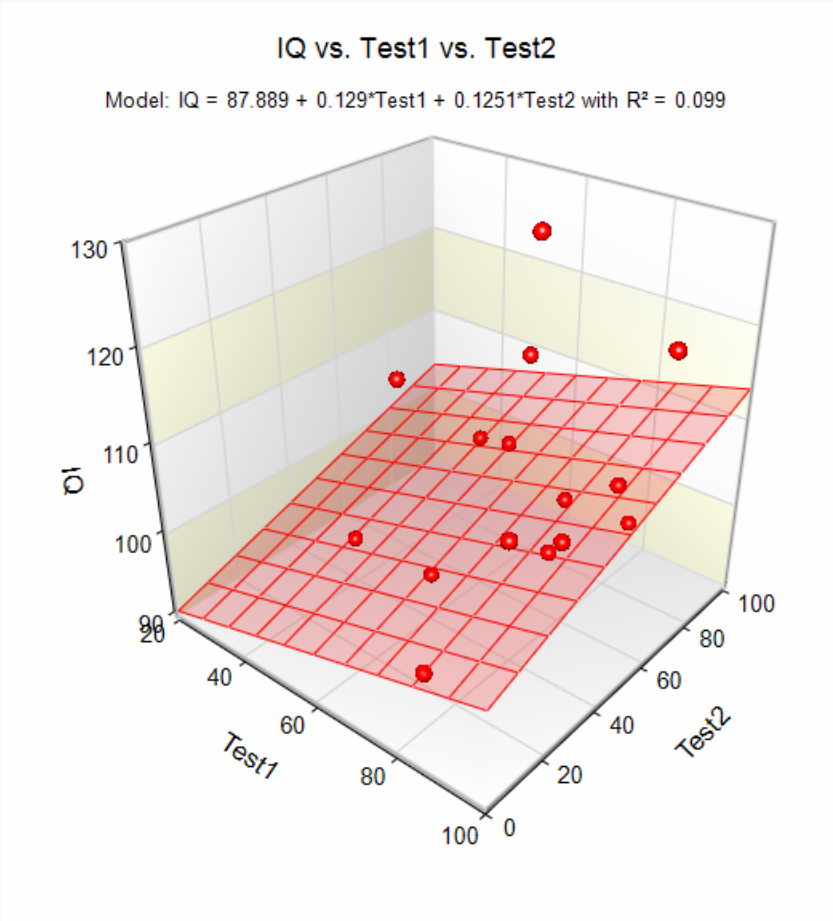
Top 2 Font (*Click the Button*)
Font Size **8**

3 Run the procedure

- Click the **Run** button to perform the calculations and generate the output.

3D Scatter Plot Output

3D Scatter Plot



The regression surface for the main effects model is included on the plot along with the associated prediction equation and R^2 value in the subtitle. The surface is a tilted plane.

Example 4 – 3D Regression Surface for a Two-Way Model with Residuals

Continuing from Example 3, this example demonstrates how to change the multiple regression model to the full two-way model and include residuals on the plot. The data used are from the IQ dataset.

Setup

To run this example, complete the following steps:

1 Open the IQ example dataset

- From the File menu of the NCSS Data window, select **Open Example Data**.
- Select **IQ** and click **OK**.

2 Specify the 3D Scatter Plots procedure options

- Find and open the **3D Scatter Plots** procedure using the menus or the Procedure Navigator.
- The settings for this example are listed below and are stored in the **Example 4** settings file. To load these settings to the procedure window, click **Open Example Settings File** in the Help Center or File menu.

Variables Tab

X (Horizontal) Variable **Test1**
Y (Vertical) Variable ..... **IQ**
Z (Depth) Variable **Test2**

3D Scatter Plot Format (*Click the Button*)

3D Scatter Plot Tab
All 6 Model Terms (Intercept, X, Z, XZ, X^2, and Z^2) ..... **Checked**
Regression Surface ..... **Checked**
Regression Surface – Fill ..... **Checked**

Titles Tab
Top 2 ..... **Checked**
Top 2 Text ..... **Model: {Model} with R^2 = {R}**

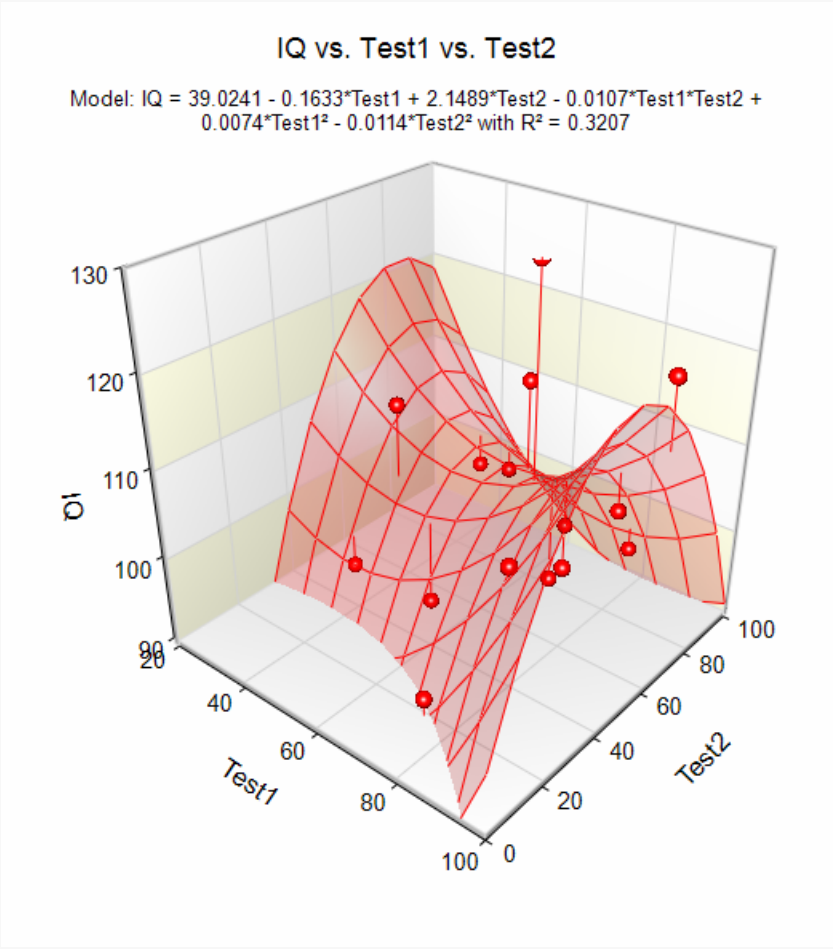
Top 2 Font (*Click the Button*)
Font Size **8**

3 Run the procedure

- Click the **Run** button to perform the calculations and generate the output.

3D Scatter Plot Output

3D Scatter Plot



The regression surface for the main effects model is included on the plot along with the associated prediction equation and R^2 value in the subtitle. The surface is a curved saddle because of the interaction and squared terms in the model. The residuals are also plotted.