CHAPTER 6

GRAPHICS

Graphics Window

Opening the Graphics Window

Double-click on the **Graphics** folder in the **Project** window or click the **Graphics** button.

A Graphics window similar to the one shown below will appear.

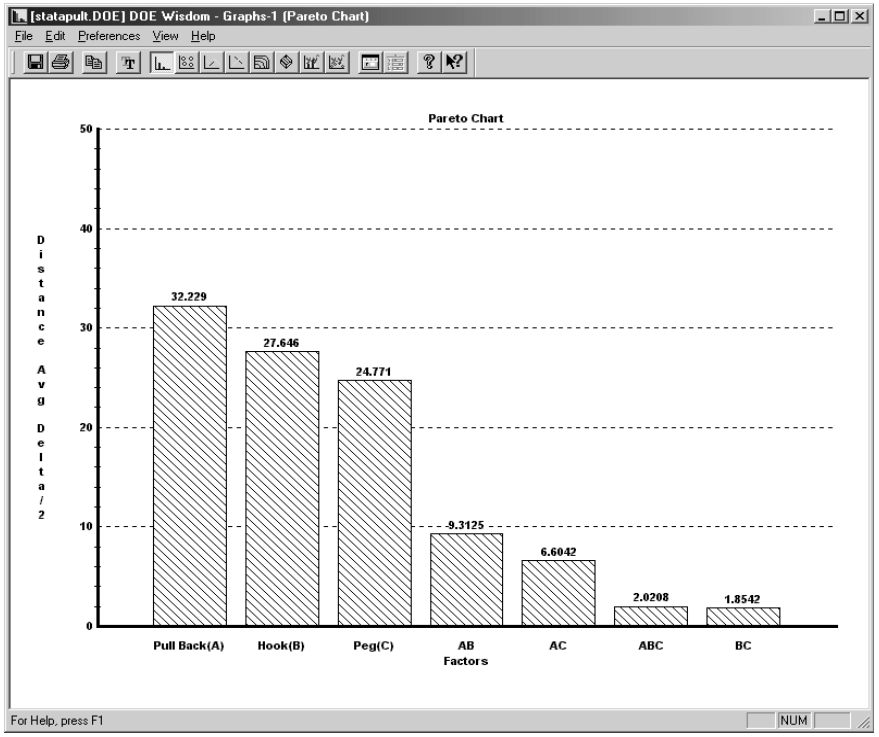


Figure 6-1

The graph that appears is generated according to the default graph selected in the **Properties** section

of the **File** pull-down menu in the **Project** screen. In this example, the Pareto Chart was selected and is the first graph to appear.

Graphics File Menu Commands

The Graphics **File** menu offers the following commands:

Save	Saves a graph for future reference.
Save As	Saves the active graph under a new name for future reference.
Print	Prints a graph. Use this command to print a copy of the graph currently displayed. DOE Wisdom displays the **Print** screen. This screen allows you to select the printer, printer properties, print range, and number of copies. When all selections have been made, choose **OK**. The statistics report will be printed.
Print Setup	Provides setup options for printing. DOE Wisdom displays the **Page Setup** screen. This screen allows you to select the paper size, paper source, portrait or landscape mode, and margin specifications. When all selections have been made, choose **OK**.
Properties	Displays the properties for a graph. When "Properties" is selected, the following window appears. The user can select either the Pareto Chart, Scatter Plot, Main Effects Plot, Interaction Plot, Contour Plot, or Response Surface Plot to be displayed automatically upon entering the Graphics window. The user can also have the edit locations automatically displayed. If this option is selected, edit locations will be surrounded by a "box." Double-clicking within a given box will bring up the editing options for that particular section of the graph.

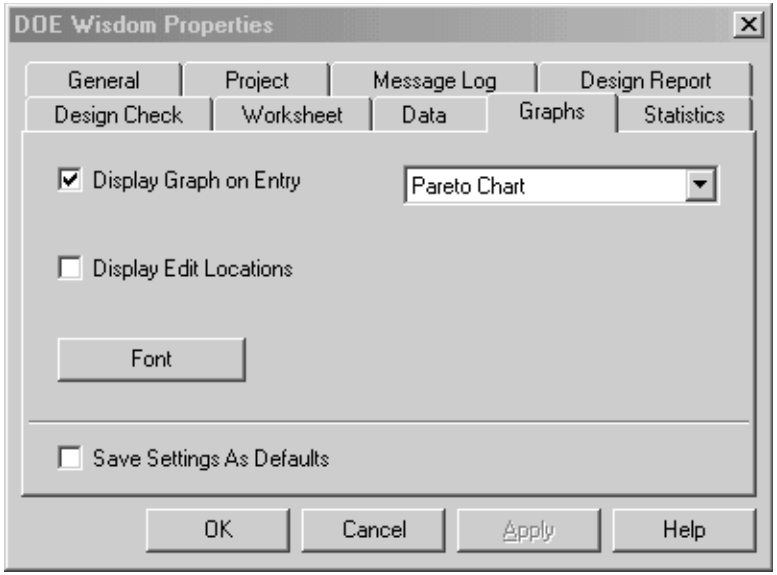


Figure 6-2

Exit	Exits the Graphics window.

Graphics Edit Menu Commands

The Graphics **Edit** menu offers the following commands:

Copy	Copies the graph onto the Clipboard. This allows you to easily copy the graph to other window programs.
Graph	Edits the current graph including factors, responses, axes colors, fonts, etc.
Model	Edits the model being used for the Contour and Response Surface graphs.

Graphics Preferences Menu Commands

The Graphics **Preferences** menu offers the following commands:

Font	Changes the font attributes of the current graph. Font, Font Style, and Font Size may be defined.

Graphics View Menu Commands

The Graphics **View** menu offers the following commands:

Edit Locations	Highlights sections of the graphs that can be modified. Edit locations will be surrounded by a "box." Double-clicking within a given box will bring up the editing options for that particular section of the graph.
Toolbar	Shows or hides the toolbar. The toolbar includes buttons for some of the most common graph commands such as Save, Print, Copy, Font, Pareto Chart, Scatter Plot, Main Effects Plot, Interaction Plot, Contour Plot, Response Surface Plot, Edit Graph, Edit Model, and Graphics Help. The Statistics toolbar is shown in Figure 6-3.

Figure 6-3

Status Bar	Shows or hides the Status Bar. The Status Bar describes the action to be executed by the selected menu item or depressed toolbar button.
Graph Tools	Displays or hides the Graph Tools, which include buttons and other items that perform functions for the particular graph being displayed.
Pareto Chart	Use this command to view the Pareto Chart for the selected experiment.
Scatter Plot	Use this command to view the Scatter Plot for the selected experiment.
Main Effects	Use this command to view the Main Effects Plot for the selected experiment.
Interactions	Use this command to view the Interaction Plot for the selected experiment.
Contour Plot	Use this command to view the Contour Plot for the selected experiment.
Response Surface	Use this command to view the Response Surface Plot for the selected experiment.

Residuals Histogram	Use this command to view the Residuals Histogram for the selected experiment.
Residuals Scatter Plot	Use this command to view the Residuals Scatter Plot for the selected experiment.

Graphics Help Menu Commands

The Graphics **Help** menu offers the following commands:

Graphics Help	This allows the user to display specific graphics help topics.
Help Topics	This allows the user to view Contents, Index, and Find help features.

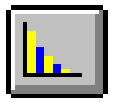
Pareto Chart

Definition

The Pareto Chart shows vertical bars with heights proportional to the average delta or average delta/2 values for each factor and interaction. Pareto analysis is often used to rank order the most important factors and interactions in an experiment.

Pareto Chart Screen

You can select the Pareto Chart by clicking on the **Pareto Chart** button or by selecting **Pareto Chart** from the **View** pull-down menu.



When the Pareto chart is selected, a Pareto chart is displayed for the average delta/2 values. DOE Wisdom displays seven bars. If more than 7 factors/interactions exist, others can be selected and displayed through the **Changes** option. The software allows the user to modify the chart so that only the factors/interactions of interest are displayed. Figure 6-4 shows an example of a Pareto chart.

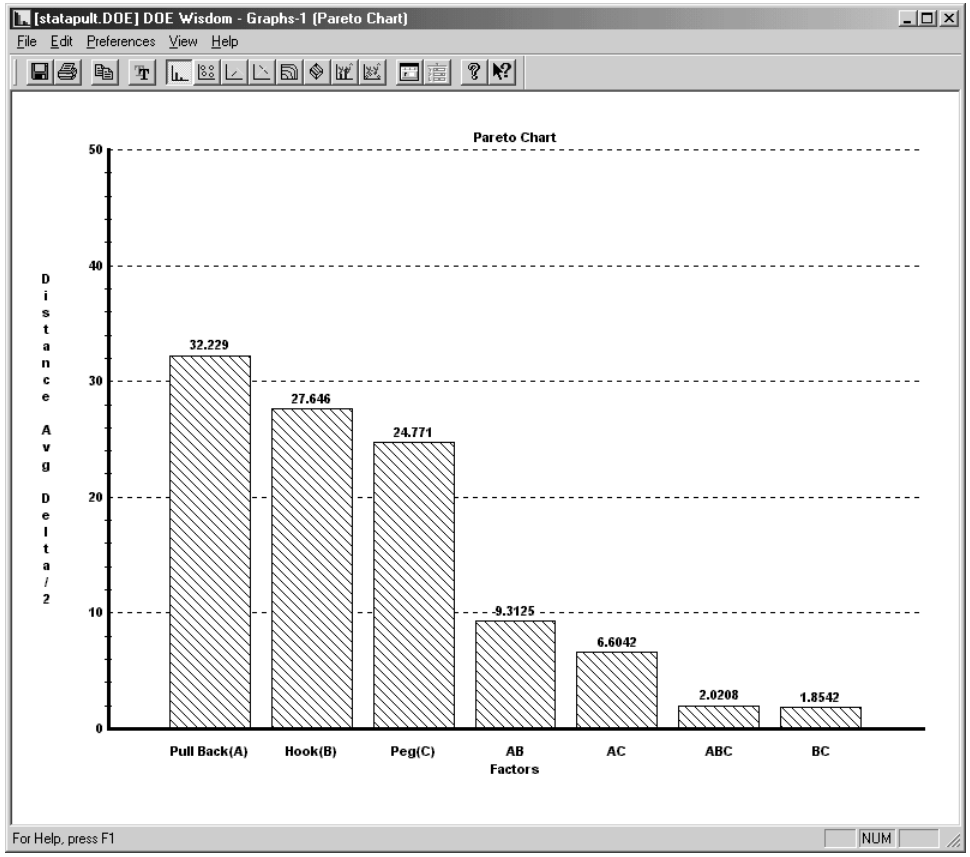


Figure 6-4

General Editing Information

Select the **Graph** option from the **Edit** pull-down menu or click the **Edit Graph** button. A window similar to the one shown in Figure 6-5 will appear.

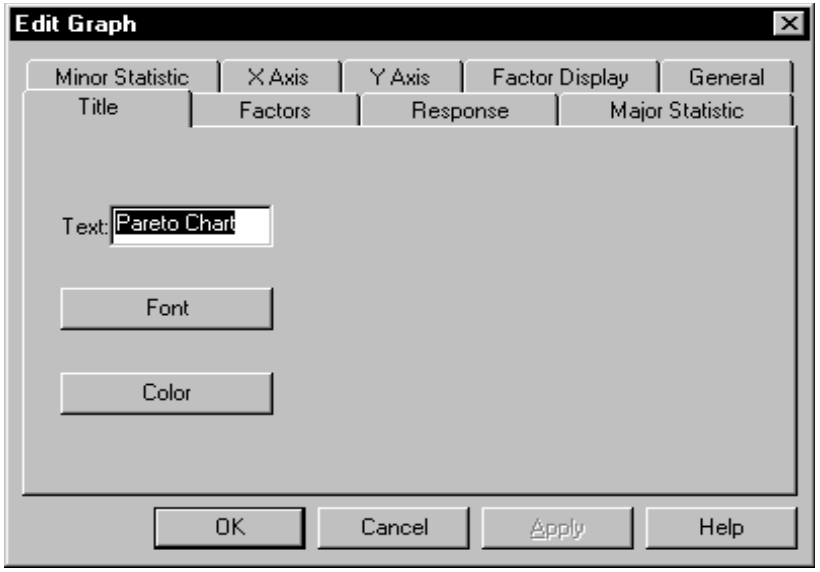


Figure 6-5

Editing the Title

Click the **Title** tab to display the title attributes that can be edited. Pareto chart is now highlighted in the **Text** field. A new title can be entered. The font and color of the title text can also be changed by clicking on the Font and Color buttons. Choose **OK**. The Pareto chart title will now appear with the selected font and color.

Editing the Pareto Chart Factors

Click the **Factors** tab to display the factors that can be added or removed from the Pareto chart. Highlighted factors will remain in the Pareto chart. Use the mouse pointer to select a factor. Click the left mouse button to remove or add the factor. All factors can be selected by clicking the **All** button. If there is a long list of factors and you only want to include a few, it may be easier to select the **None** button and then highlight the desired factors. Click **OK** when all desired changes have been made.

Editing the Pareto Chart Responses

Click the **Response** tab to display all responses for the selected experiment. A Pareto chart will be generated for the highlighted response. Position the mouse pointer over the desired response for the Pareto chart and click the mouse button to select that response. After the response is highlighted, choose **OK**. The new Pareto chart will be generated using the selected response.

Selecting the Major Statistic for the Pareto Chart

Click the **Major Statistic** tab to display all major statistics for the selected experiment. A Pareto chart will be generated for the highlighted statistic. Position the mouse pointer over the statistic desired for the Pareto chart and click the mouse button to select that statistic. After the statistic is highlighted, choose **OK**. A new Pareto chart will be generated using the selected statistic.

Avg, S, and ln s are the typical major statistics shown. If a Taguchi design has been selected, Signal to Noise Ratio options will also be displayed in this window.

Selecting the Minor Statistic for the Pareto Chart

Click the **Minor Statistic** tab to display all minor statistics for the selected experiment. A Pareto chart will be generated for the highlighted statistic. Position the mouse pointer over the statistic desired for the Pareto chart and click the mouse button to select that statistic. After the statistic is highlighted, choose **OK**. A new Pareto chart will be generated using the selected statistic. Delta and Delta/2 are the minor statistic options.

Editing the X axis

Click the **X Axis** tab to display X axis attributes that can be edited. The X axis label is now highlighted in the **Text** field. A new label can be entered. The font and color of the label text can also be changed by clicking on the Font and Color buttons. Choose **OK**. The Pareto chart X axis label will now appear with the selected font and color.

Editing the Y axis

Click the **Y Axis** tab to display Y axis attributes that can be edited. A screen similar to the one shown in Figure 6-6 will appear.

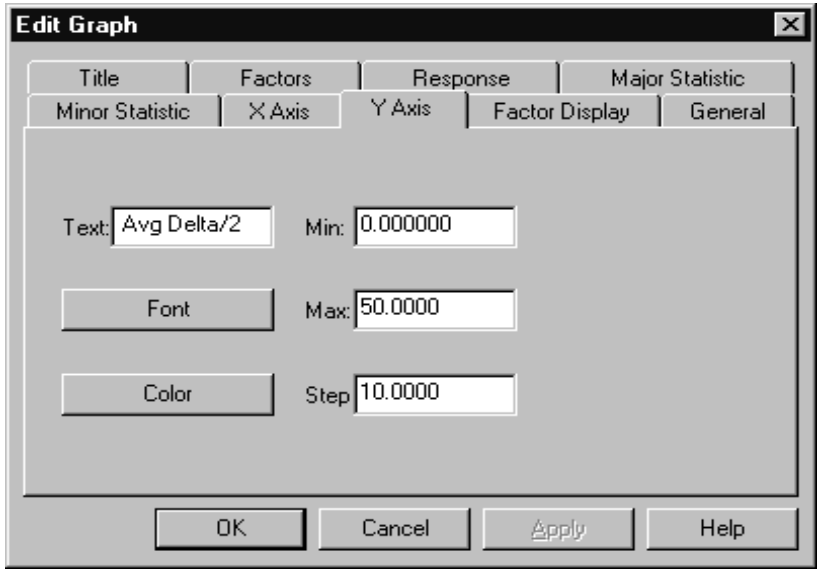


Figure 6-6

The Y axis label text, the font for the label, and the color for the label can be edited. Additionally, the minimum and maximum values for the Y axis can be defined. Tab to the **Step** section. Enter the desired stepsize for the tick marks on the Y axis. After all desired Y Axis information has been entered, choose **OK** to accept the changes.

Editing the Factor Display

Click the **Factor Display** tab to show what factor display attributes can be edited. A screen similar to the one show in Figure 6-7 will appear.

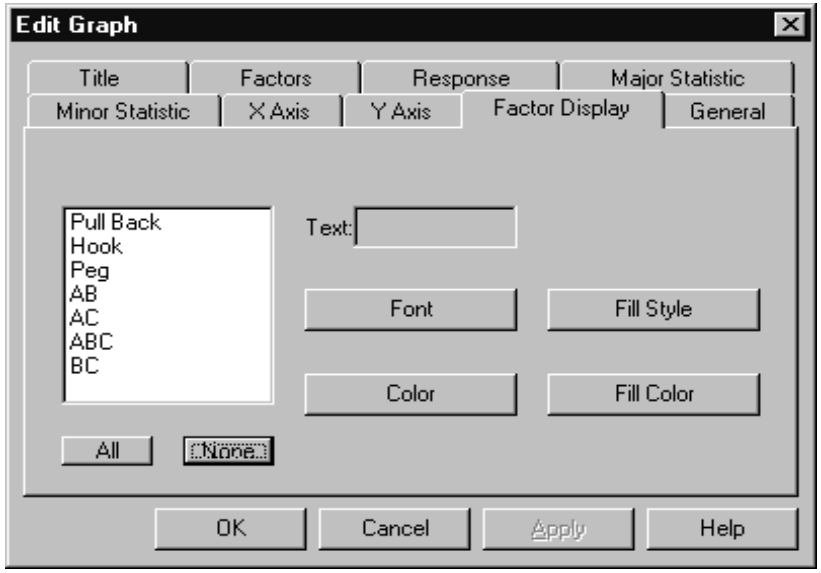


Figure 6-7

Position the mouse pointer over the factor you would like to edit. Click the left mouse button to highlight this factor. If you would like the pareto bars to appear the same for all the factors, click on the **All** button. All factors will now appear highlighted on the screen. Tab to the **Text** section and enter the desired text for the selected factor. Click on the **Font** button to select the desired font for the factor label. Click on the **Color** button to select the desired color for the factor label. Click on the **Fill Style** button to select the desired fill style for the factor pareto bar. Click on the **Fill Color** button to select the desired fill color for the factor pareto bar. Click on **OK** when all the factor display information has been modified. The Pareto chart factors will now appear with the selected font, fill style, and colors.

General Pareto Chart Editing Features

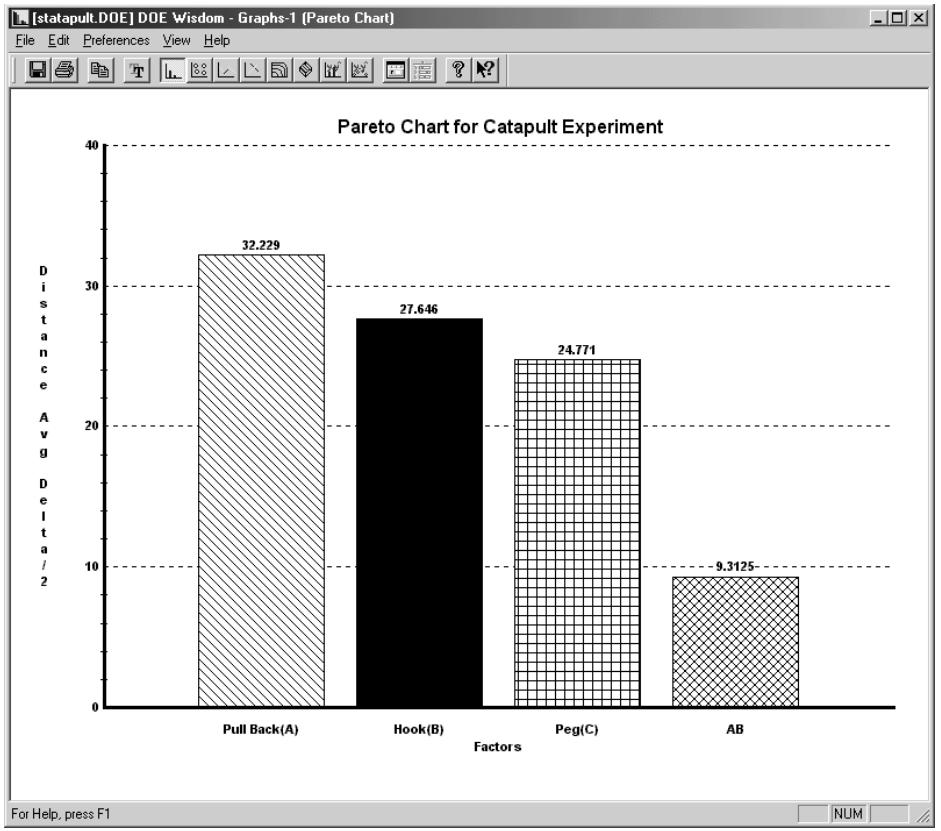
Click on the **General** tab to display the general Pareto chart features that can be edited. Click on the **Axis Color** button to edit the color of the Pareto chart axes. Click on the **Background Color** button to edit the color of the Pareto chart background. Click on **OK** when all color information has been selected. The Pareto chart will now appear with the selected colors.

Editing Qualitative Factors (D-optimal designs only)

If a D-optimal design with qualitative factors has been generated, a **Qualitative Factors** tab also appears. Click on this tab to display the qualitative factor features that can be edited. DOE Wisdom allows the user to select different levels for the - and + values. The Pareto Chart will be generated comparing the new - and + levels.

Pareto Chart Summary

Using DOE Wisdom's powerful editing capabilities, the Pareto chart shown in Figure 6-1 can be modified to appear as shown in Figure 6-8.

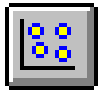


Scatter Plot

Definition

A Scatter Plot is a plot of the raw data. The graph simply plots all individual data points. Scatter Plots provide a graphical representation of the data and can be used to detect individual data points that are outliers. These outliers can then be investigated. Various trends in the data can also be detected using Scatter Plots.

Scatter Plot Screen

You can select the Scatter Plot by clicking on the **Scatter Plot**  button or by selecting **Scatter Plot** from the **View** pull-down menu.

When the Scatter Plot is selected, a Scatter Plot is displayed for the first factor. Other factors can be displayed by using the Scatter Plot editing features. DOE Wisdom allows the user to modify the graph so that only the factors of interest are displayed. Figure 6-9 shows an example of a Scatter Plot.

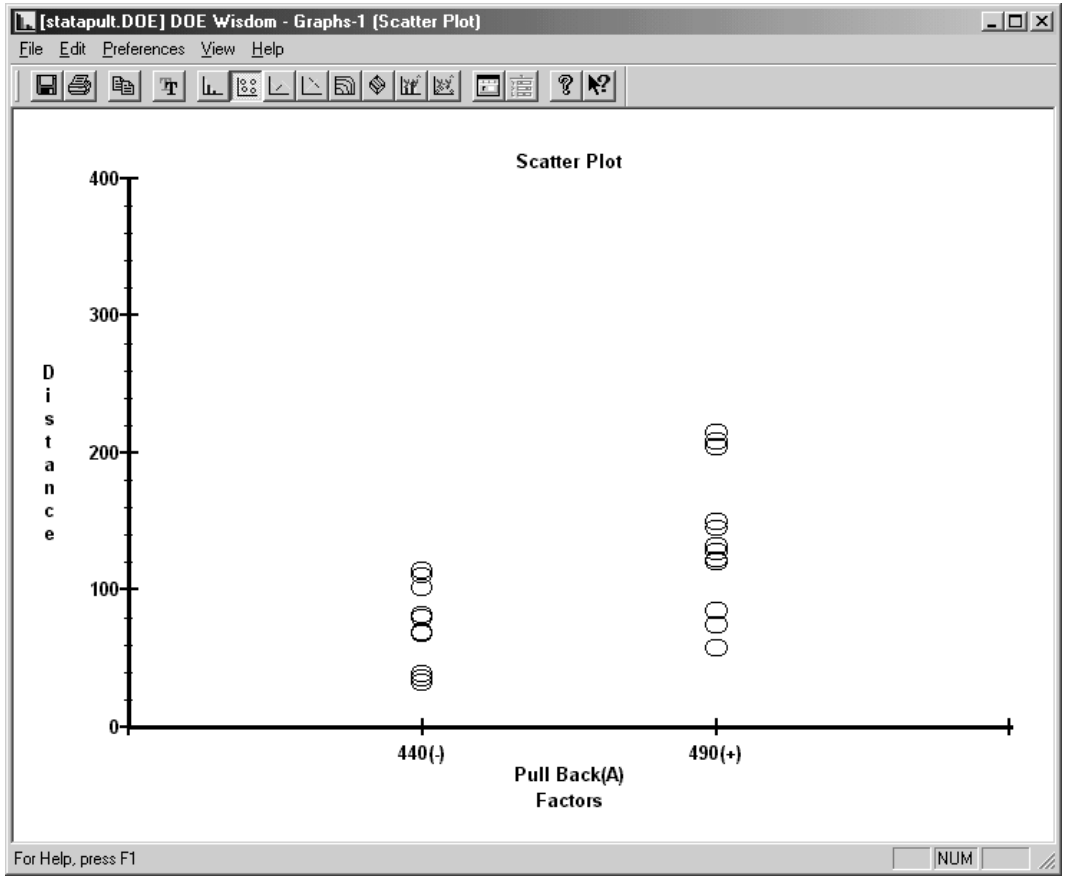


Figure 6-9

General Editing Information

Select the **Graph** option from the **Edit** pull-down menu or click the **Edit Graph** button. A window similar to the one shown in Figure 6-10 will appear.

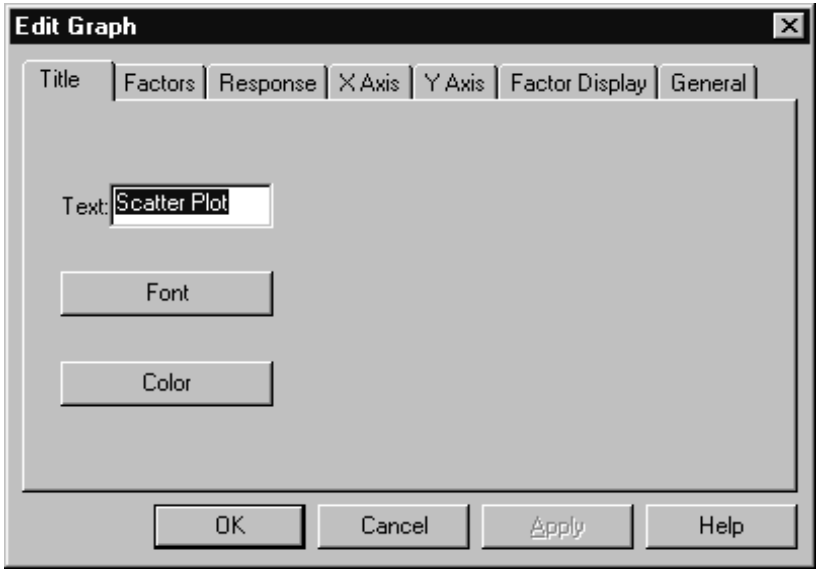


Figure 6-10

Editing the Title

Click the **Title** tab to display the title attributes that can be edited. Scatter Plot is now highlighted in the **Text** field. A new title can be entered. The font and color of the title text can also be changed by clicking on the **Font** and **Color** buttons. Choose **OK**. The Scatter Plot will now appear with the selected font and color.

Editing the Scatter Plot Factors

Click the **Factors** tab to display the factors that can be added or removed from the Scatter Plot. Highlighted factors will remain in the Scatter Plot. Use the mouse pointer to select a factor. Click the left mouse button to remove or add the factor. All factors can be selected by clicking the **All** button. If there is a long list of factors and you only want to include a few, it may be easier to select the **None** button and then highlight the desired factors. Click **OK** when all desired changes have been made.

Editing the Scatter Plot Responses

Click the **Response** tab to display all responses for the selected experiment. A Scatter Plot will be

generated for the highlighted response. Position the mouse pointer over the desired response for the Scatter plot and click the mouse button to select that response. After the response is highlighted, choose **OK**. The new Scatter Plot will be generated using the selected response.

Editing the X axis

Click the **X Axis** tab to display the X axis attributes that can be edited. The X axis label is now highlighted in the **Text** field. A new label can be entered. The font and color of the label text can also be changed by clicking on the **Font** and **Color** buttons. Choose **OK**. The Scatter Plot X axis label will now appear with the selected font and color.

Editing the Y axis

Click the **Y Axis** tab to display the Y axis attributes that can be edited. A screen similar to the one shown in Figure 6-11 will appear.

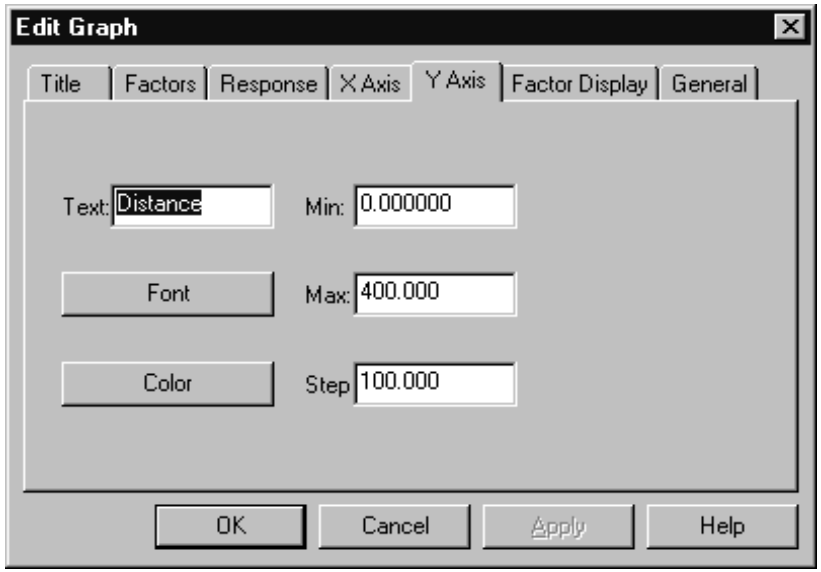


Figure 6-11

The Y axis label text, the font for the label, and the color for the label can be edited. Additionally, the

minimum and maximum values for the Y axis can be defined. The **Step** field allows the user to define the desired stepsize for the tick marks on the Y axis. After all desired Y Axis information has been entered, choose **OK** to accept the changes.

Editing the Factor Display

Click the **Factor Display** tab to show what factor display attributes can be edited. A screen similar to the one shown in Figure 6-12 will appear.

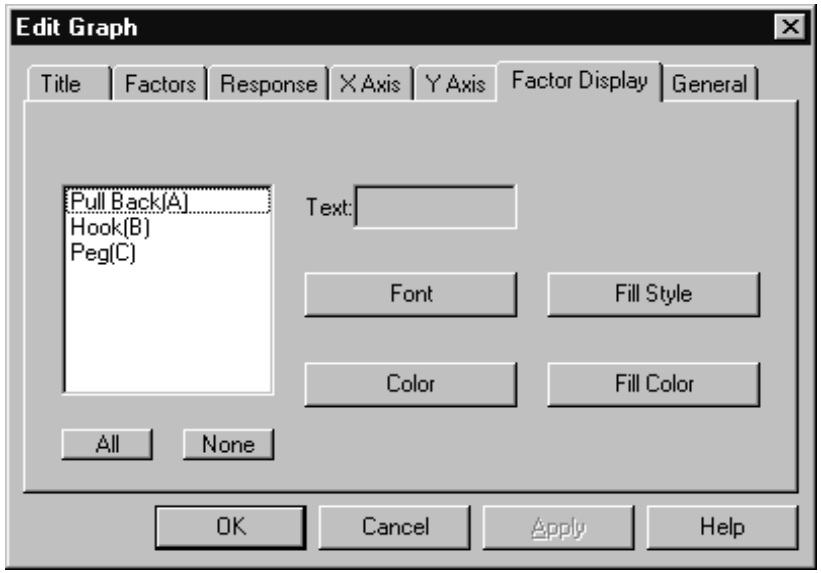


Figure 6-12

Position the mouse pointer over the factor you would like to edit. Click the left mouse button to highlight this factor. If you would like the Scatter plots to appear the same for all factors, click on the **All** button. All factors will now appear highlighted on the screen. Tab to the **Text** section and enter the desired text for the selected factor. Click on the **Font** button to select the desired font for the factor label. Click on the **Color** button to select the desired color for the factor label. Click on the **Fill Style** button to select the desired fill style for the factor scatter plot. Click on the **Fill Color** button to select the desired fill color for the factor Scatter Plot. Click on **OK** when all the factor display information has been modified. The Scatter Plot factors will now appear with the selected font, fill style, and colors.

General Scatter Plot Editing Features

Click on the **General** tab to display the general Scatter plot features that can be edited. Click on the **Axis Color** button to edit the color of the Scatter Plot axes. Click on the **Background Color** button to edit the color of the Scatter Plot background. Select either "Show labels for qualitative factors" or " Show (-,+) for qualitative factors". Click on the **Show Data Points** button and the **Show Average Points** button to see the graph with the points *and* the average bar. Click on the **Show Average Points** button to see a plot of just the averages. Click on **OK** when all color information has been selected. The Scatter Plot will now appear with the selected colors.

Scatter Plot Summary

Using DOE Wisdom's powerful editing capabilities, the Scatter Plot shown in Figure 6-9 can be modified to appear as shown in Figure 6-13. This Scatter Plot has the "average bars" shown.

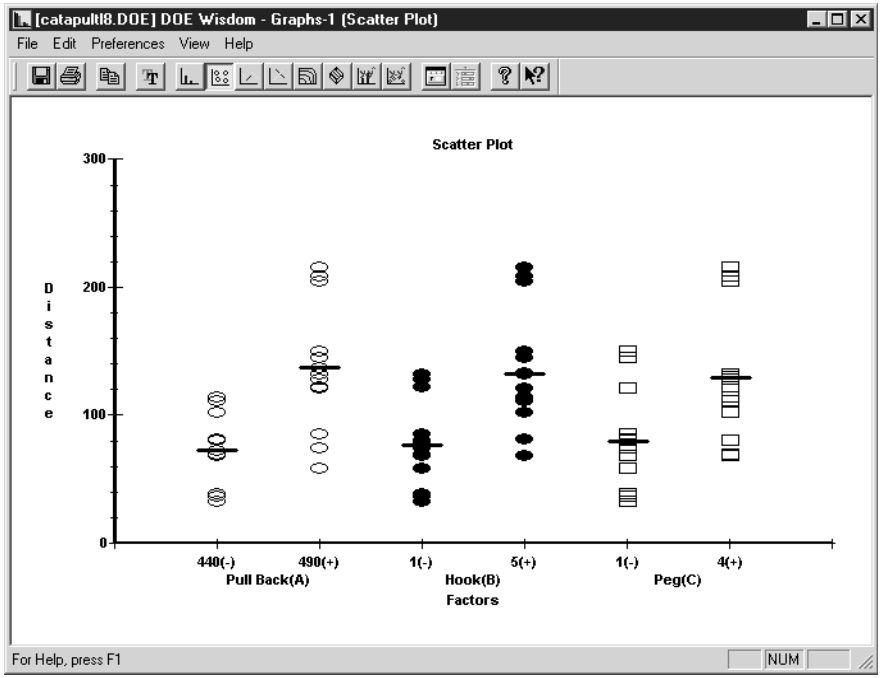


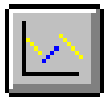
Figure 6-13

Main Effects

Definition

The Main Effects Plot is a plot of the average of the data points at the low factor setting and the average of the data points at the high factor setting. The greater the slope, the more significant the effect.

Main Effects Screen

You can select the Main Effects Plot by clicking the **Main Effects Plot**  button or by selecting **Main Effects** from the **View** pull-down menu.

When the Main Effects Plot is selected, a Main Effects plot is displayed for seven of the factors. Other factors can be displayed by using the Main Effects Plot editing features. DOE Wisdom allows the user to modify the graph so that only the factors of interest are displayed. Figure 6-14 shows an example of a Main Effects Plot.

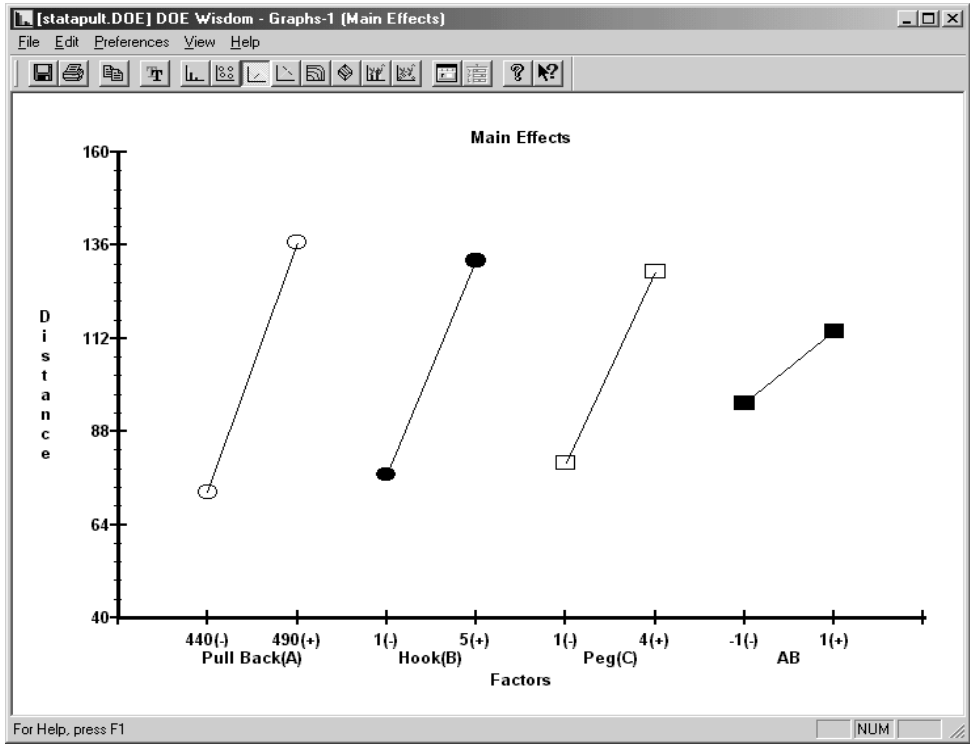


Figure 6-14

General Editing Information

Select the **Graph** option from the **Edit** pull-down menu or click the **Edit Graph** button. A window similar to the one shown in Figure 6-15 will appear.

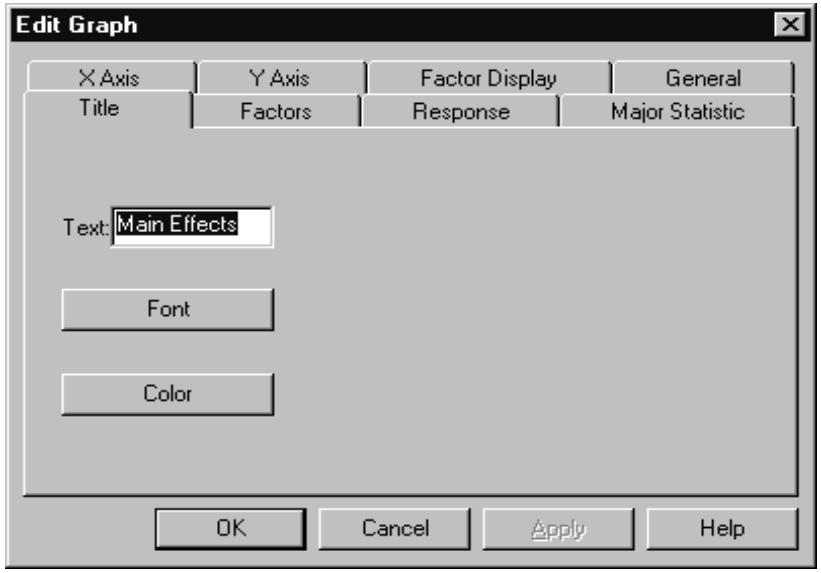


Figure 6-15

Editing the Title

Click the **Title** tab to display the title attributes that can be edited. Main Effects is now highlighted in the **Text** field. A new title can be entered. The font and color of the title text can also be changed by clicking on the **Font** and **Color** buttons. Choose **OK**. The Main Effects Plot will now appear with the selected font and color.

Editing the Main Effects Factors

Click the **Factors** tab to display the factors that can be added or removed from the Main Effects Plot. Highlighted factors will remain in the Main Effects Plot. Use the mouse pointer to select a factor. Click the left mouse button to remove or add the factor. All factors can be selected by clicking the **All** button. If there is a long list of factors and you only want to include a few, it may be easier to select the **None** button and then highlight the desired factors. Click **OK** when all desired changes have been made.

Editing the Main Effects Responses

Click the **Response** tab to display all responses for the selected experiment. A Main Effects Plot will be generated for the highlighted response. Position the mouse pointer over the desired response for the Main Effects Plot and click the mouse button to select that response. After the response is highlighted, choose **OK**. The new Main Effects Plot will be generated using the selected response.

Selecting the Major Statistic for the Main Effects Plot

Click the **Major Statistic** tab to display all major statistics for the selected experiment. A Main Effects Plot will be generated for the highlighted statistic. Position the mouse pointer over the statistic desired for the Main Effects Plot and click the mouse button to select that statistic. After the statistic is highlighted, choose **OK**. A new Main Effects Plot will be generated using the selected statistic.

Avg, S, and ln s are the typical major statistics shown. If a Taguchi design has been selected, Signal to Noise Ratio options will also be displayed in this window.

Editing the X Axis

Click the **X Axis** tab to display the X axis attributes that can be edited. The X axis label is now highlighted in the **Text** field. A new label can be entered. The font and color of the label text can also be changed by clicking on the **Font** and **Color** buttons. Choose **OK**. The Main Effects Plot X axis label will now appear with the selected font and color.

Editing the Y Axis

Click the **Y Axis** tab to display the Y axis attributes that can be edited. A screen similar to the one shown in Figure 6-11 will appear. The Y axis label text, the font for the label, and the color for the label can be edited. Additionally, the minimum and maximum values for the Y axis can be defined. The **Step** field allows the user to define the desired stepsize for the tick marks on the Y axis. After all desired Y Axis information has been entered, choose **OK** to accept the changes.

Editing the Factor Display

Click the **Factor Display** tab to show what factor display attributes can be edited. A screen similar to the one shown in Figure 6-12 will appear. Position the mouse pointer over the factor you would like to edit. Click the left mouse button to highlight this factor. If you would like the Main Effects Plots to appear the

same for all factors, click the **All** button. All factors will now appear highlighted on the screen. Tab to the **Text** section and enter the desired text for the selected factor. Click on the **Font** button to select the desired font for the factor label. Click on the **Color** button to select the desired color for the factor label. Click on the **Fill Style** button to select the desired fill style for the factor Main Effects Plot. Click on the **Fill Color** button to select the desired fill color for the factor Main Effects Plot. Click on **OK** when all the factor display information has been modified. The Main Effects Plot factors will now appear with the selected font, fill style and colors.

General Main Effects Plot Editing Features

Click on the **General** tab to display the general Main Effects Plot features that can be edited. A screen similar to the one shown in Figure 6-16 will appear.

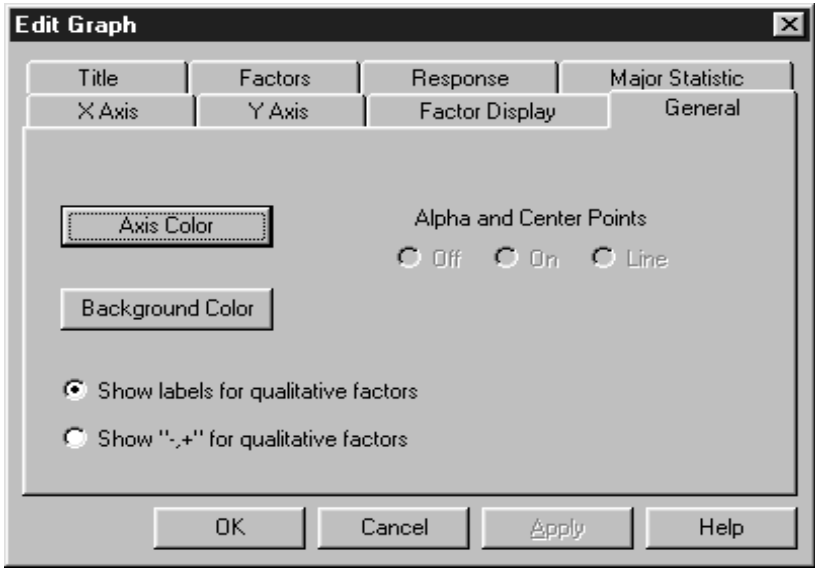


Figure 6-16

Click on the **Axis Color** button to edit the color of the Main Effects Plot axes. Click on the **Background Color** button to edit the color of the Main Effects Plot background. DOE Wisdom also provides the option of including alpha and center points on the Main Effects Plot. Select **On** if you wish to include these points on your plot. If you select **Line**, a line will connect each of the points.

Select how you would like the qualitative factor labels to be displayed. Click on **OK** when all information has been selected. The Main Effects Plot will now appear with the selected colors, labels and points.

Editing Qualitative Factors (D-optimal designs only)

If a D-optimal design with qualitative factors has been generated, a **Qualitative Factors** tab also appears. Click on this tab to display the qualitative factor features that can be edited. DOE Wisdom allows the user to select different levels for the - and + values. The Main Effects Plot will be generated comparing the new - and + levels.

Main Effects Plot Summary

Using DOE Wisdom's powerful editing capabilities, the Main Effects Plot shown in Figure 6-14 can be modified to appear as shown in Figure 6-17.

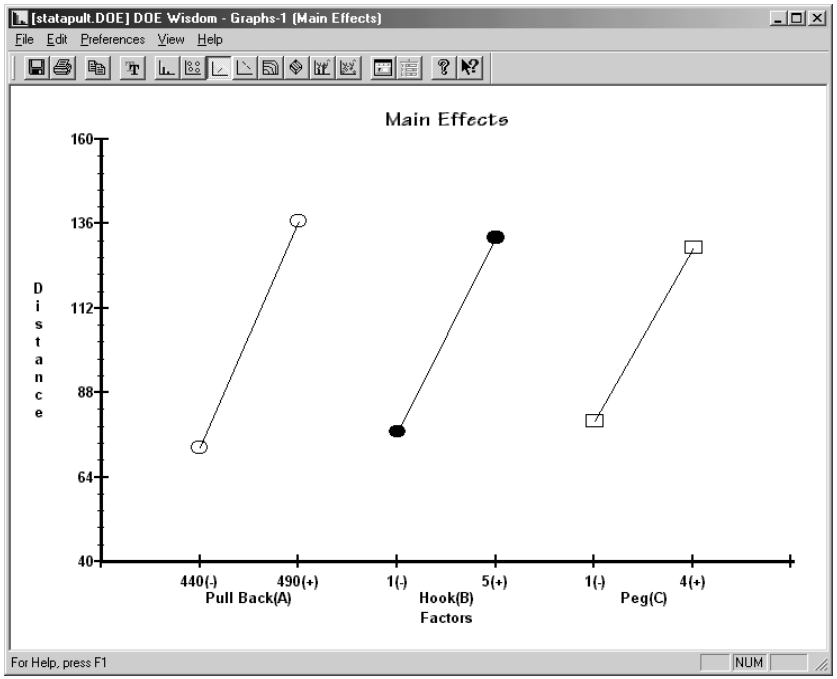


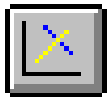
Figure 6-17

Interactions

Definition

An interaction occurs when the difference in the response between the levels of one factor is not the same at all levels of the other factors. The result produced by the individual factor is different than the result produced by the combination of two or more factors. If the slopes of the lines on the interaction plot are not equal, there may be some interaction.

Interactions Screen

You can select the Interaction Plot by clicking on the **Interactions**  button or by selecting **Interactions** from the **View** pull-down menu.

When the Interaction Plot is selected, an Interaction Plot is displayed for the first interaction. Other interactions can be displayed by using the Interaction Plot editing features. DOE Wisdom allows the user to modify the graph so that only the factors of interest are displayed. Figure 6-18 shows an example of an Interaction Plot.

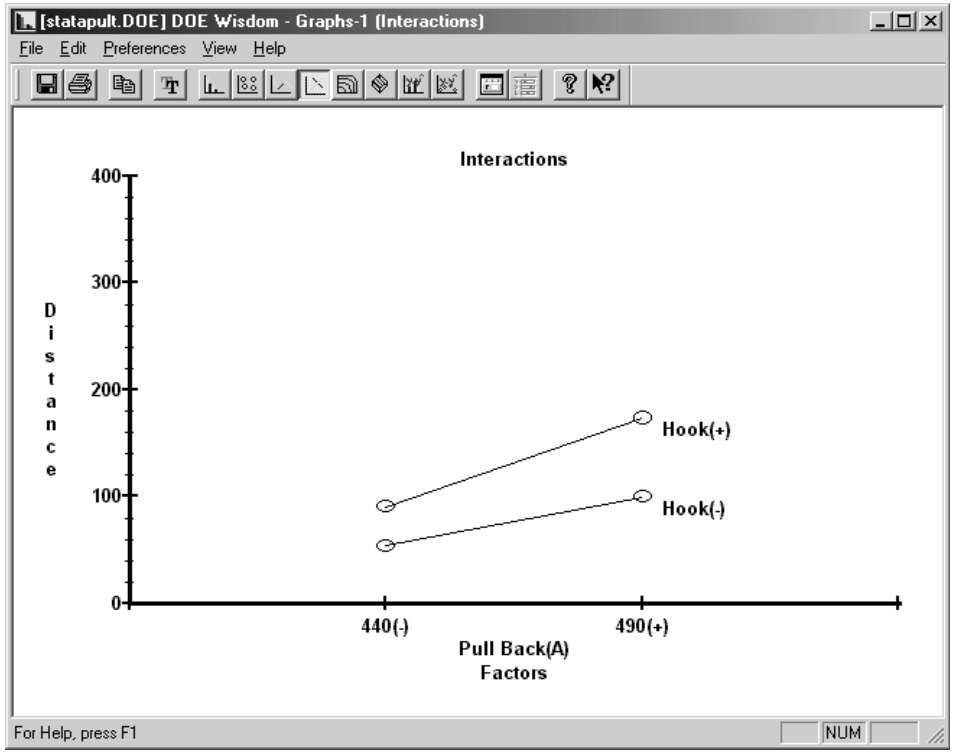


Figure 6-18

General Editing Information

Select the **Graph** option from the **Edit** pull-down menu or click the **Edit Graph** button. A window similar to the one shown in Figure 6-19 will appear.

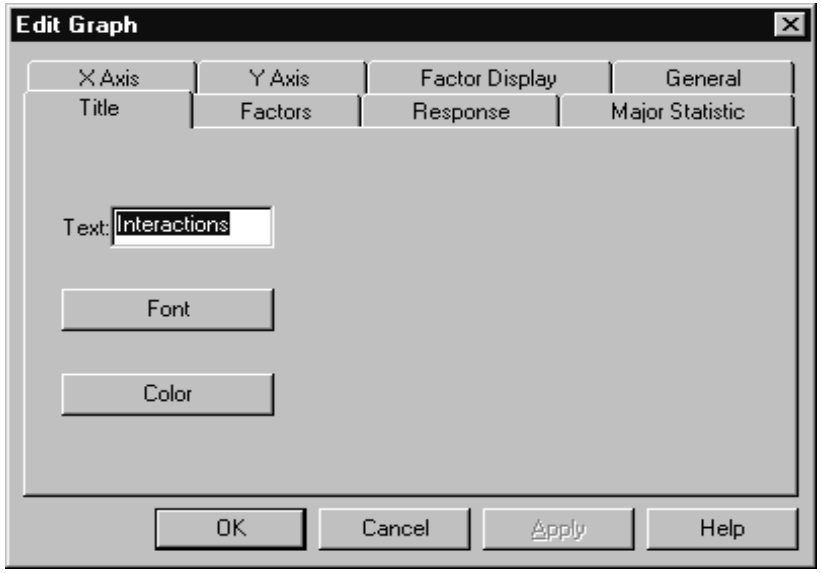


Figure 6-19

Editing the Title

Click the **Title** tab to display the title attributes that can be edited. Interaction Plot is now highlighted in the **Text** field. A new title can be entered. The font and color of the title text can also be changed by clicking on the **Font** and **Color** buttons. Choose **OK**. The Interaction Plot will now appear with the selected font and color.

Editing the Interactions

Click the **Factors** tab to display the interactions that can be added or removed from the Interaction Plot. Highlighted interactions will remain in the Interaction Plot. Use the mouse pointer to select an interaction. Click the left mouse button to remove or add the interaction. All interactions can be selected by clicking the **All** button. If there is a long list of interactions and you only want to include a few, it may be easier to select the **None** button and then highlight the desired interactions. Click **OK** when all desired changes have been made.

Editing the Interaction Plot Responses

Click the **Response** tab to display all responses for the selected experiment. An Interaction Plot will be generated for the highlighted response. Position the mouse pointer over the desired response for the Interaction Plot and click the mouse button to select that response. After the response is highlighted, choose **OK**. The new Interaction Plot will be generated using the selected response.

Selecting the Major Statistic for the Interaction Plot

Click the **Major Statistic** tab to display all major statistics for the selected experiment. An Interaction Plot will be generated for the highlighted statistic. Position the mouse pointer over the statistic desired for the Interaction Plot and click the mouse button to select that statistic. After the statistic is highlighted, choose **OK**. A new Interaction Plot will be generated using the selected statistic.
Avg, S, and ln s are the typical major statistics shown. If a Taguchi design has been selected, Signal to Noise Ratio options will also be displayed in this window.

Editing the X Axis

Click the **X Axis** tab to display the X axis attributes that can be edited. The X axis label is now highlighted in the **Text** field. A new label can be entered. The font and color of the label text can also be changed by clicking on the **Font** and **Color** buttons. Choose **OK**. The Interaction Plot X axis label will now appear with the selected font and color.

Editing the Y Axis

Click the **Y Axis** tab to display the Y axis attributes that can be edited. A screen similar to the one shown in Figure 6-11 will appear. The Y axis label text, the font for the label, and the color for the label can be edited. Additionally, the minimum and maximum values for the Y axis can be defined. The **Step** field allows the user to define the desired stepsize for the tick marks on the Y axis. After all desired Y axis information has been entered, choose **OK** to accept the changes.

Editing the Factor Display

Click the **Factor Display** tab to show what factor display attributes can be edited. A screen similar to the one shown in Figure 6-12 will appear. Position the mouse pointer over the factor you would like to edit. Click the left mouse button to highlight this factor. If you would like the interaction plots to appear the same for all factors, click on the **All** button. All factors will now appear highlighted on the screen. Tab

to the **Text** section and enter the desired text for the selected factor. Click on the **Font** button to select the desired font for the factor label. Click on the **Color** button to select the desired color for the factor label. Click on the **Fill Style** button to select the desired fill style for the factor interaction plot. Click on the **Fill Color** button to select the desired fill color for the factor interaction plot. Click on **OK** when all the factor display information has been modified. The Interaction Plot factors will now appear with the selected font, fill style and colors.

General Interaction Plot Editing Features

Click on the **General** tab to display the general Interaction plot features that can be edited. Click on the **Axis Color** button to edit the color of the Interaction Plot axes. Click on the **Background Color** button to edit the color of the Interaction Plot background. Select how you would like the qualitative factor label to appear. Click on **OK** when all color information has been selected. The Interaction Plot will now appear with the selected colors.

Editing Qualitative Factors (D-optimal designs only)

If a D-optimal design with qualitative factors has been generated, a **Qualitative Factors** tab also appears. Click on this tab to display the qualitative factor features that can be edited. DOE Wisdom allows the user to select different levels for the - and + values. The Interaction Plot will be generated comparing the new - and + levels.

Interaction Plot Summary

Using DOE Wisdom's powerful editing capabilities, the Interaction Plot shown in Figure 6-18 can be modified to appear as shown in Figure 6-20.

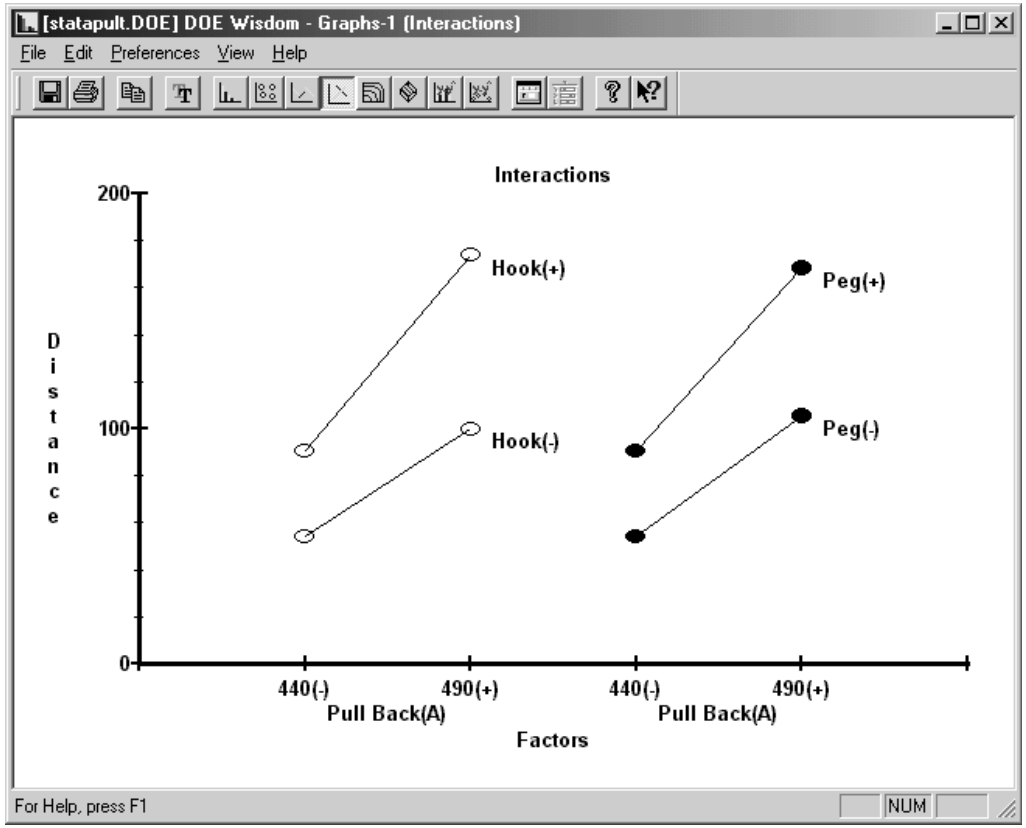


Figure 6-20

Contour Plot

Definition

Contour Plots are projections of lines of constant response from the response surface onto the two dimensional "factor" plane. Contour Plots provide the ability to graphically "see" those factor settings that give a specific response.

Contour Plot Screen

You can select the Contour Plot by clicking on the **Contour Plot**  button or by selecting **Contour Plot** from the **View** pull-down menu.

When the Contour Plot is selected, a Contour Plot is displayed for the first response. Other responses can be displayed by using the Contour Plot editing features. DOE Wisdom allows the user to modify the graph so that only the responses of interest are displayed. Figure 6-21 shows an example of a Contour Plot.

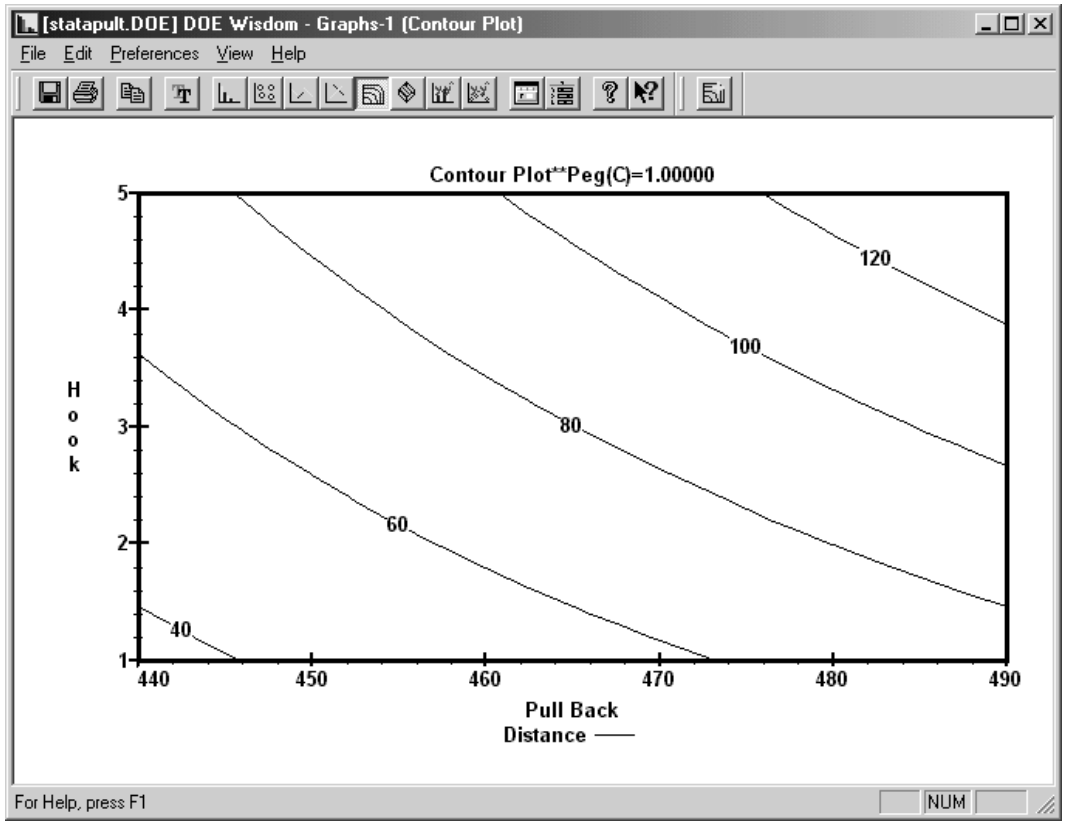


Figure 6-21

General Editing Information

Select the **Graph** option from the **Edit** pull-down menu or click the **Edit Graph** button. A window similar to the one shown in Figure 6-22 will appear.

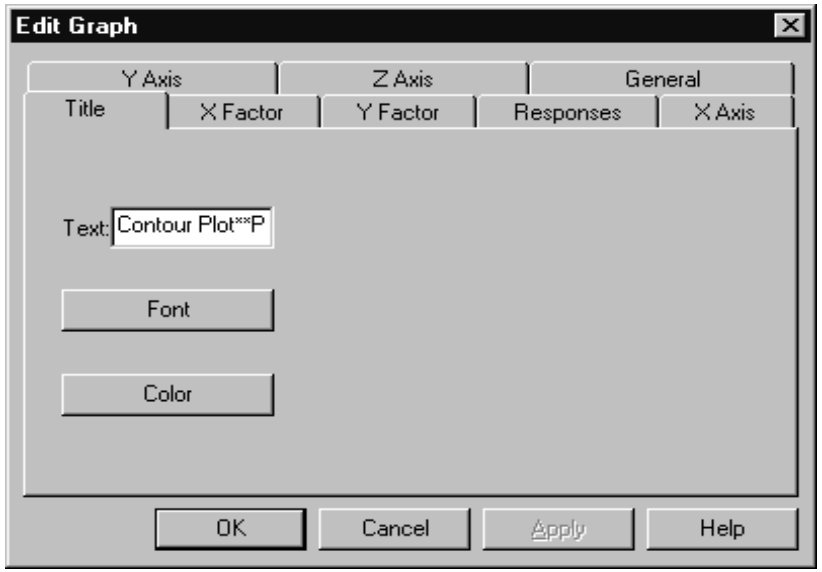


Figure 6-22

Editing the Title

Click the **Title** tab to display the title attributes that can be edited. The Contour Plot title is now highlighted in the **Text** field. A new title can be entered. The font and color of the title text can also be changed by clicking on the **Font** and **Color** buttons. Choose **OK**. The Contour Plot will now appear with the selected font and color.

Editing the X Axis Factor

Click the **X Factor** tab to display the factors that can be selected for the X axis factor. Use the mouse pointer to select the desired factor. Click the left mouse button to select the factor. Click **OK** when the desired factor has been selected.

Editing the Y Axis Factor

Click the **Y Factor** tab to display the factors that can be selected for the Y axis factor. Use the mouse pointer to select the desired factor. Click the left mouse button to select the factor. Click **OK** when the desired factor has been selected.

Editing the Contour Plot Responses

Click the **Responses** tab to display all responses for the selected experiment. A Contour Plot will be generated for the highlighted response. Position the mouse pointer over other responses you would like plotted on the Contour Plot and click the left mouse button to highlight them. One or more responses can be selected. If you would like to include all responses on the Contour Plot, click the **All** button. After the responses are highlighted, choose **OK**. The new Contour Plot will be generated using the selected responses.

Editing the X Axis

Click the **X Axis** tab to display the X axis attributes that can be edited. A screen similar to the one shown in Figure 6-23 will appear.

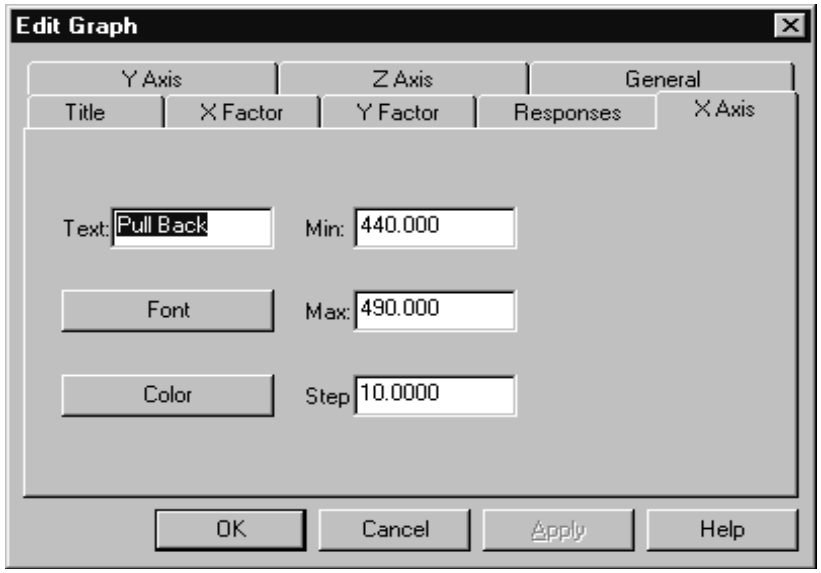


Figure 6-23

The X axis label text, the font for the label, and the color for the label can be edited. Additionally, the minimum and maximum values for the X axis can be defined. DOE Wisdom will allow the user to set these limits outside of the experimental region. If you choose to extrapolate, you must understand that the confidence of the points in this region is reduced.

The **Step** field allows the user to define the desired stepsize for the tick marks on the X axis. After all desired X axis information has been entered, choose **OK** to accept the changes.

Editing the Y Axis

Click the **Y Axis** tab to display the Y axis attributes that can be edited. A screen similar to the one shown in Figure 6-23 will appear. The Y axis label text, the font for the label, and the color for the label can be edited. Additionally, the minimum and maximum values for the Y axis can be defined. DOE Wisdom will allow the user to set these limits outside of the experimental region. If you choose to extrapolate, you must understand that the confidence of the points in this region is reduced.

The **Step** field allows the user to define the desired stepsize for the tick marks on the Y axis. After all desired Y axis information has been entered, choose **OK** to accept the changes.

Editing the Z Axis

Click the **Z Axis** tab to display the Z axis attributes that can be edited. A screen similar to the one shown in Figure 6-24 will appear.

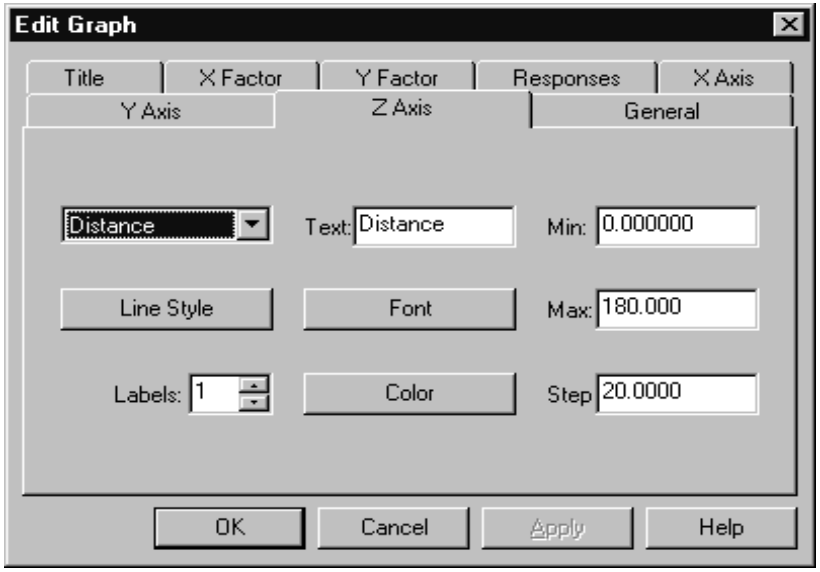


Figure 6-24

The Z axis response that is being edited is now highlighted. Click the arrow to the right of this display to select the response you would like to edit. If you want to change the text for the Z axis label, move to the **Text** field and enter the desired text. The font for the label and the color for the line and label can be edited. Additionally, the minimum and maximum values for the Y axis can be defined. The **Step** field allows the user to define the desired stepsize for the response contour lines. The **Labels** field allows the user to define the number of labels per line. The user can also define the line style for each response by selecting the **Line Style** button.

General Contour Plot Editing Features

Click on the **General** tab to display the general Contour Plot features that can be edited. Click on the **Axis Color** button to edit the color of the Contour Plot axes. Click on the **Background Color** button to edit the color of the Contour Plot background. Click on **OK** when all color information has been selected. The Contour Plot will now appear with the selected colors.

Contour Plot Graphical Summary

Using DOE Wisdom's powerful editing capabilities, the Contour Plot shown in Figure 6-21 can be modified to appear as shown in Figure 6-25.

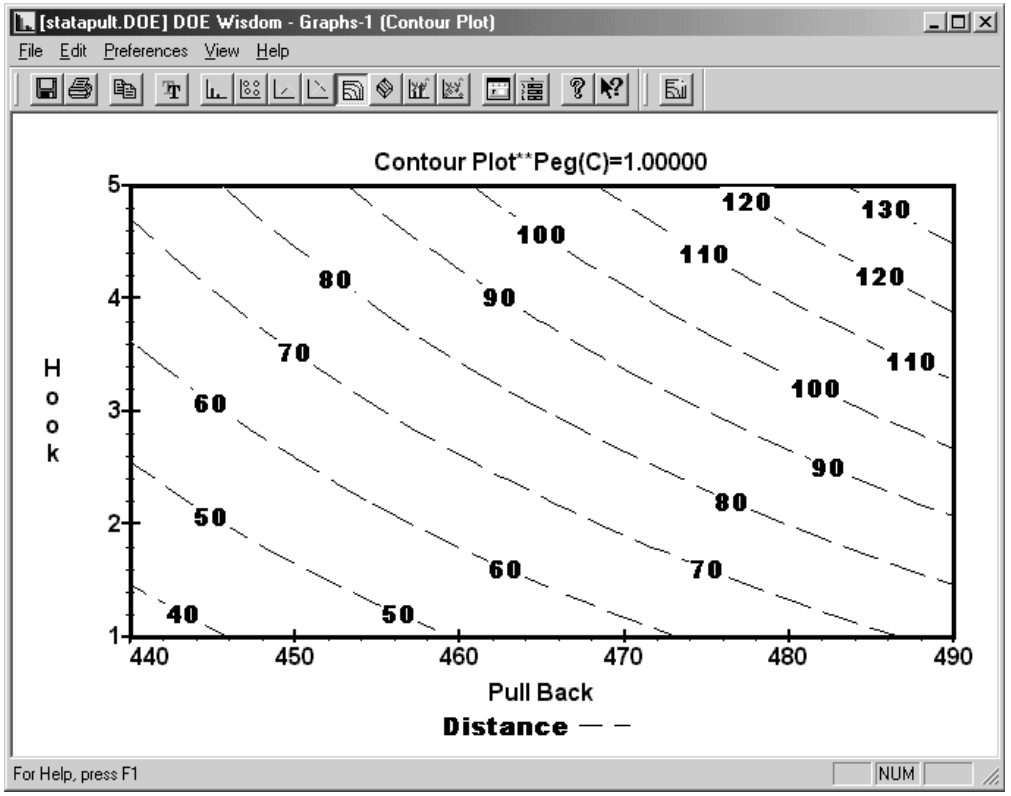


Figure 6-25

Contour Plot Prediction Equation

You can select the Contour Plot Prediction Equation by clicking on the **Prediction Equation** button or by selecting **Model** from the **Edit** pull-down menu. When Prediction Equation is selected, a screen similar to the one shown in Figure 6-26 will appear.

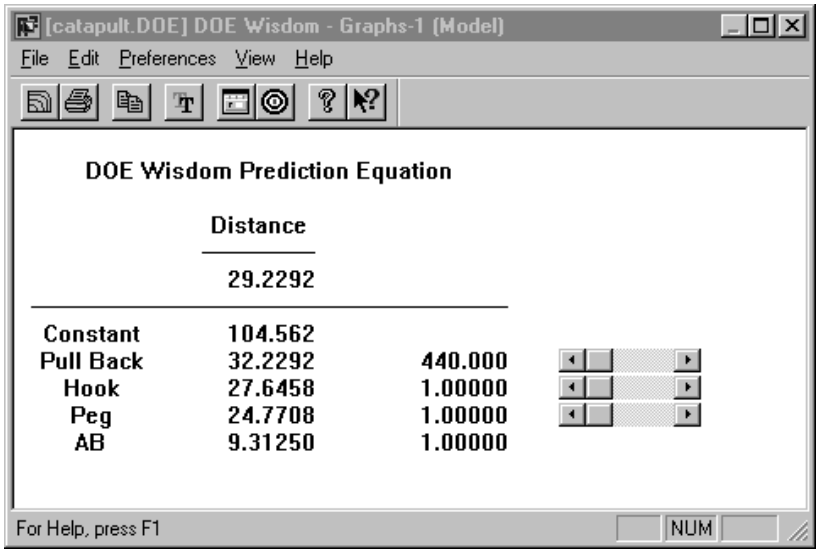


Figure 6-26

The Contour Plot shown in Figure 6-25 was based on a peg setting of 1. To change the Peg setting, use the horizontal scroll bar to the right of "Peg" to increment to the proper factor setting. For our example, let's change peg to 4.

After all desired changes have been made, click on the **Contour Plot** button.

DOE Wisdom will now display the new Contour Plot. Figure 6-27 represents the new plot with the peg set at 4 instead of 1. Compare this plot to the one shown in Figure 6-25.

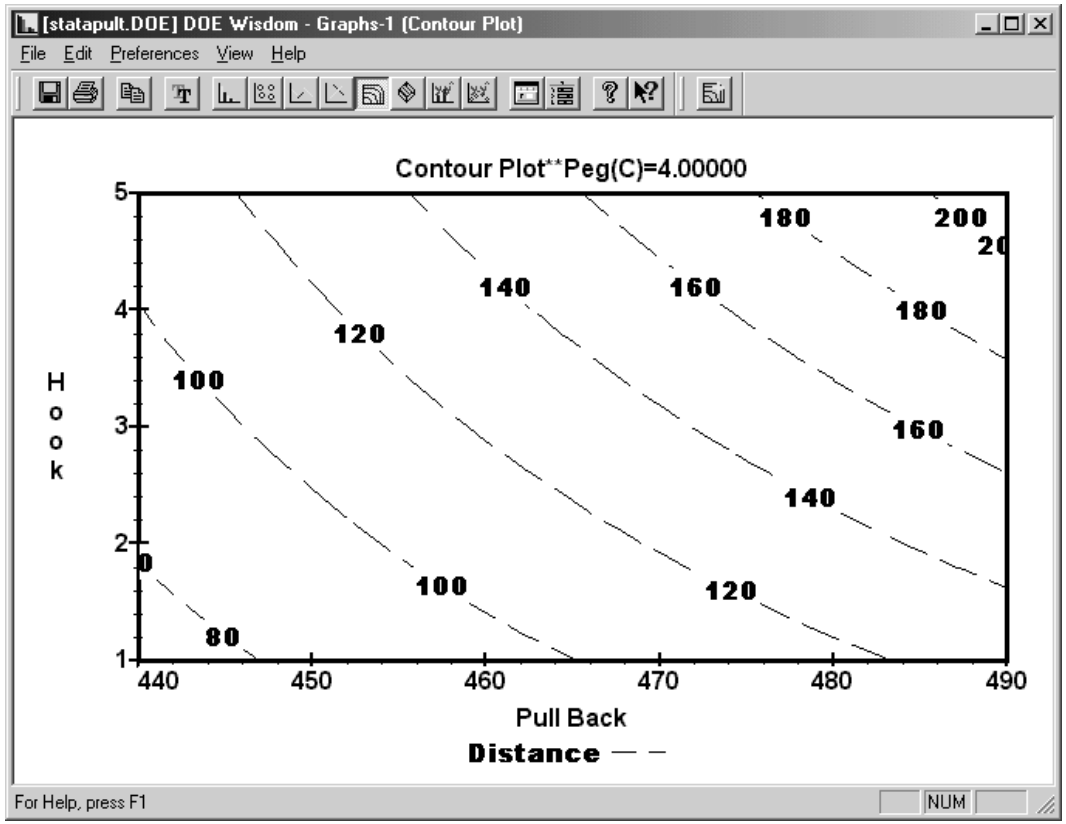


Figure 6-27

Viewing Model for Points on the Contour Plot

You can select the View Model for Points by clicking on the **View Points Model** button.

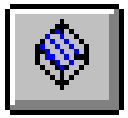
This will allow you to view the model for individual points on the Contour Plot. Click on the **View Points Model** button. Position the mouse pointer anywhere in the Contour Plot and click the left mouse button. A point now appears on the graph and the Prediction Equation Screen shows up for that point.

Size the Contour Plot window and PredictionEquation window so that both are easy to view on the screen. Position the mouse pointer anywhere in the Contour Plot and click the left mouse button. A crosshair now appears. Drag the crosshair across the graph and you will see that the Prediction Equation Screen changes for the new points.

Response Surface

Definition

Response Surface Plots are similar to Contour Plots except on a three dimensional plane. Response Surface Plots provide the ability to graphically "see", on a three dimensional plane, those factor settings that give a specific response.



Response Surface Screen

You can select the Response Surface Plot by clicking on the **Response Surface** button or by selecting **Response Surface** from the **View** pull-down menu.

When the Response Surface Plot is selected, a Response Surface Plot is displayed for the first response. Other responses can be displayed by using the Response Surface Plot editing features. Figure 6-28 shows an example of a Response Surface Plot.

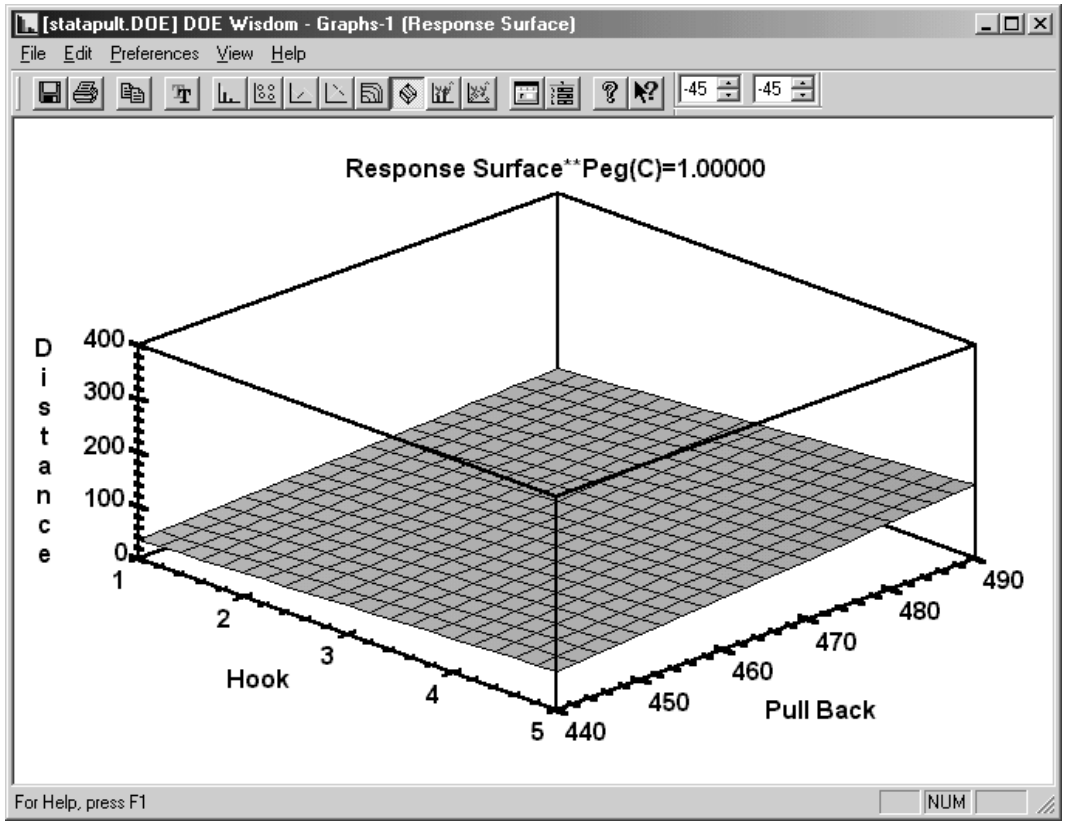


Figure 6-28

General Editing Information

Select the **Graph** option from the **Edit** pull-down menu or click the **Edit Graph** button. A window similar to the one shown in Figure 6-22 will appear.

Editing the Title

Click the **Title** tab to display the title attributes that can be edited. The Response Surface Plot title is now highlighted in the **Text** field. A new title can be entered. The font and color of the title text can also be

changed by clicking on the **Font** and **Color** buttons. Choose **OK**. The Response Surface Plot will now appear with the selected font and color.

Editing the X Axis Factor

Click the **X Factor** tab to display the factors that can be selected for the X axis factor. Use the mouse pointer to select the desired factor. Click the left mouse button to select the factor. Click **OK** when the desired factor has been selected.

Editing the Y Axis Factor

Click the **Y Factor** tab to display the factors that can be selected for the Y axis factor. Use the mouse pointer to select the desired factor. Click the left mouse button to select the factor. Click **OK** when the desired factor has been selected.

Editing the Response Surface Plot Response

Click the **Response** tab to display all responses for the selected experiment. A Response Surface Plot will be generated for the highlighted response. Position the mouse pointer over the desired response for the Response Surface Plot and click the mouse button to select that response. After the response is highlighted, choose **OK**. The new Response Surface Plot will be generated using the selected response.

Editing the X Axis

Click the **X Axis** tab to display the X axis attributes that can be edited. A screen similar to the one shown in Figure 6-23 will appear. The X axis label text, the font for the label, and the color for the label can be edited. Additionally, the minimum and maximum values for the X axis can be defined. The **Step** field allows the user to define the desired stepsize for the tick marks on the X axis. After all desired X axis information has been entered, choose **OK** to accept the changes.

Editing the Y Axis

Click the **Y Axis** tab to display the Y axis attributes that can be edited. A screen similar to the one shown in Figure 6-23 will appear. The Y axis label text, the font for the label, and the color for the label can be edited. Additionally, the minimum and maximum values for the Y axis can be defined. The **Step** field allows the user to define the desired stepsize for the tick marks on the Y axis. After all desired Y axis information has been entered, choose **OK** to accept the changes.

Editing the Z Axis

Click the **Z Axis** tab to display the Z axis attributes that can be edited. A screen similar to the one shown in Figure 6-23 will appear. The Z axis label text, the font for the label, and the color for the label can be edited. Additionally, the minimum and maximum values for the Z axis can be defined. The **Step** field allows the user to define the desired stepsize for the tick marks on the Z axis. After all desired Z axis information has been entered, choose **OK** to accept the changes.

General Response Surface Plot Editing Features

Click on the **General** tab to display the general Response Surface Plot features that can be edited. A screen similar to the one shown in Figure 6-29 will appear.

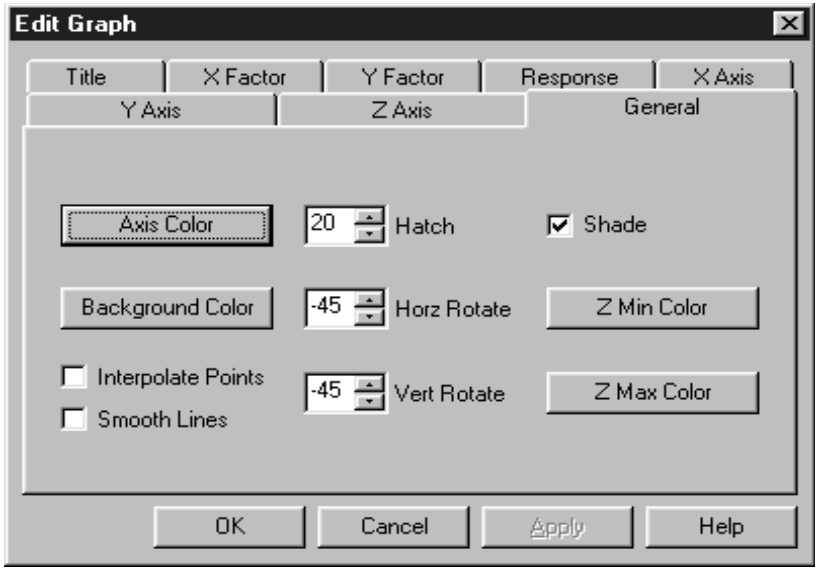


Figure 6-29

Click on the **Axis Color** button to edit the color of the Response Surface Plot axes. Click on the **Background Color** button to edit the color of the Response Surface Plot background. The **Hatch** field allows the user to select the number of hatch marks for the graph. The **Horz Rotate** field allows the user to rotate the graph horizontally. The **Vert Rotate** field allows the user to rotate the graph vertically. The

Interpolate Points field allows the user to turn on or off the interpolate feature. When this feature is turned on, the software will generate a more accurate Response Surface Plot; however, this plot typically takes longer to generate. The "Shade" feature allows the user to select 3-D graphical shading. The Z Minimum color and Maximum Color can also be defined.

Response Surface Plot Prediction Equation

You can select the Response Surface Plot Prediction Equation by clicking on the **Prediction Equation** button or by selecting **Model** from the **Edit** pull-down menu.

When Prediction Equation is selected, a screen similar to the one shown in Figure 6-26 will appear. The Response Surface Plot shown in Figure 6-28 was based on a peg setting of 1. To change the Peg setting, use the horizontal scroll bar to the right of "peg" to increment to the proper factor setting. For our example, let's change peg to 4. After all desired changes have been made, select **Refresh Graph** from the **File** pull-down menu. DOE Wisdom will now display the new Response Surface Plot with the peg set at 4 instead of 1.

Response Surface Plot Summary

Using DOE Wisdom's powerful editing capabilities, the Response Surface Plot shown in Figure 6-28 can be modified to appear as shown in Figure 6-30.

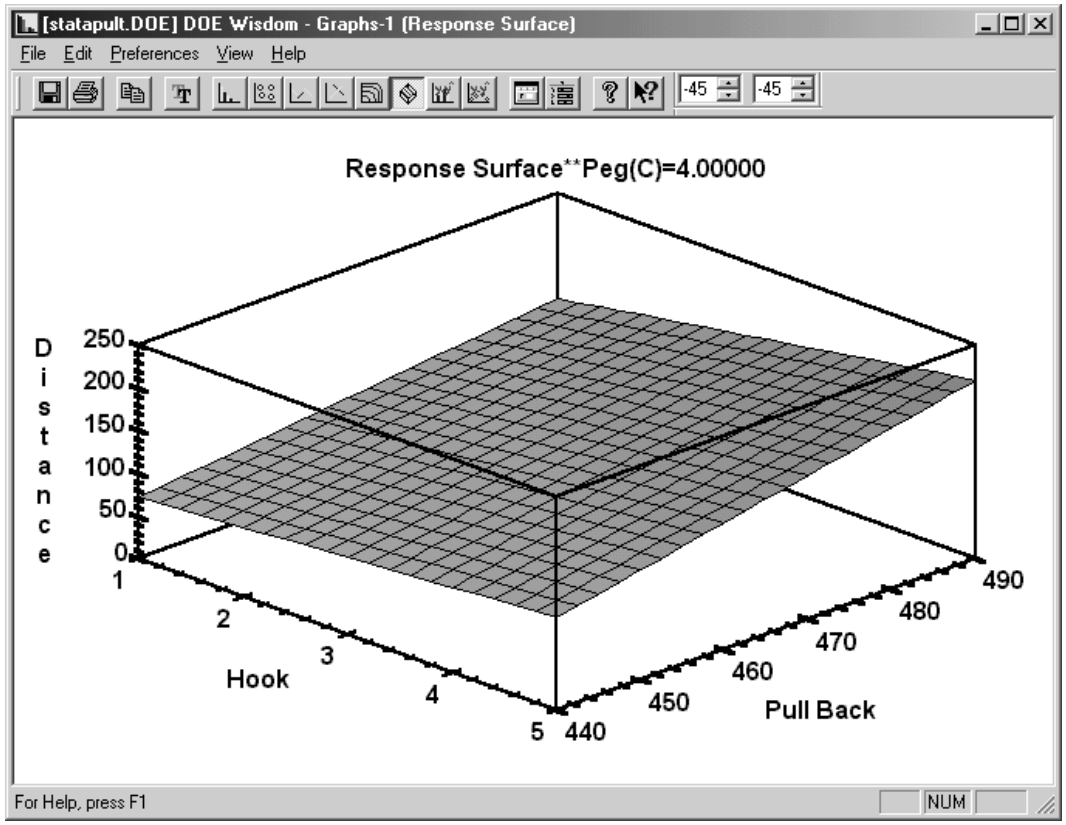


Figure 6-30

Residual Plots

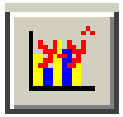
Definition

The difference between the observed response value and the value predicted by our model is the residual. Information about the linear relationship between our response and our factors is in the equation. The residuals contain all of the remaining (or residual information) in the data. Residuals can give valuable information about time trends, data entry errors and random variation. The residuals are very important. If our model properly describes the data, then the residuals should just be random variation about the regression line. It is always wise to examine the residuals before accepting your model.

Since the residuals from a regression will generally not be independently or identically distributed (even if the disturbances in the regression model are), it is advisable to weight the residuals by their standard deviations (this is what is meant by *studentization*).

The studentized residuals have an approximate *t*-distribution with n-p-1 degrees of freedom. This means we can assess the significance of any single studentized residual using a *t*-table.

Residuals Histogram Screen



You can select the Residual Histogram screen by clicking on the **Residual Histogram** button or by selecting **Residuals Histogram** from the **View** pull-down menu.

When Residuals Histogram is selected, a Residuals Histogram is displayed for the first response. Other responses can be displayed by using the Residuals Histogram editing features. Figure 6-31 shows an example of a Residuals Histogram.

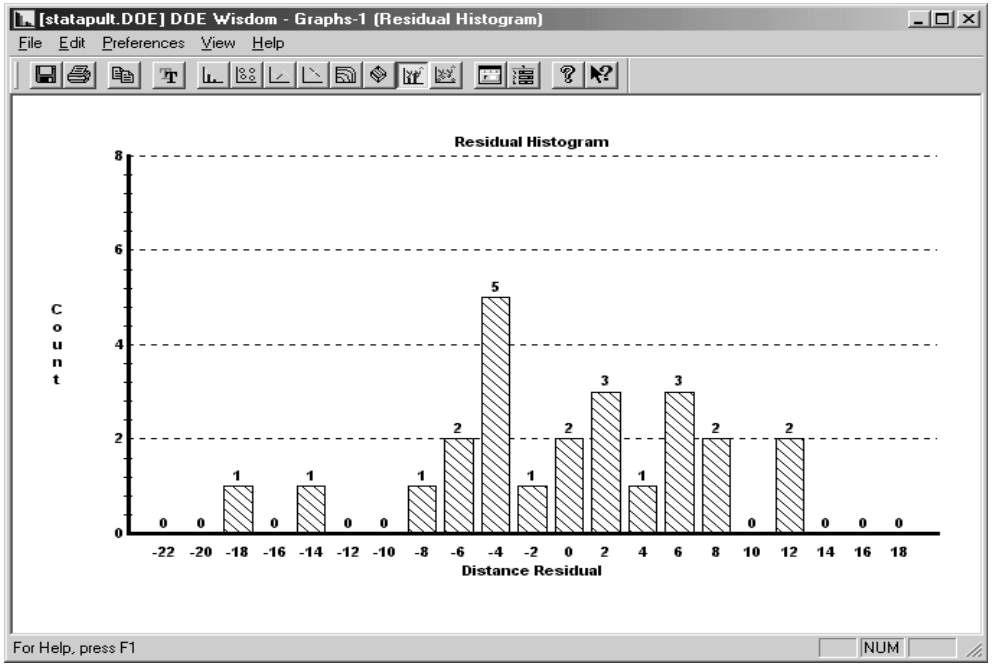


Figure 6-31

General Editing Information

Select the **Graph** option from the **Edit** pull-down menu or click the **Edit Graph** button. A window similar to the one shown in Figure 6-32 will appear.

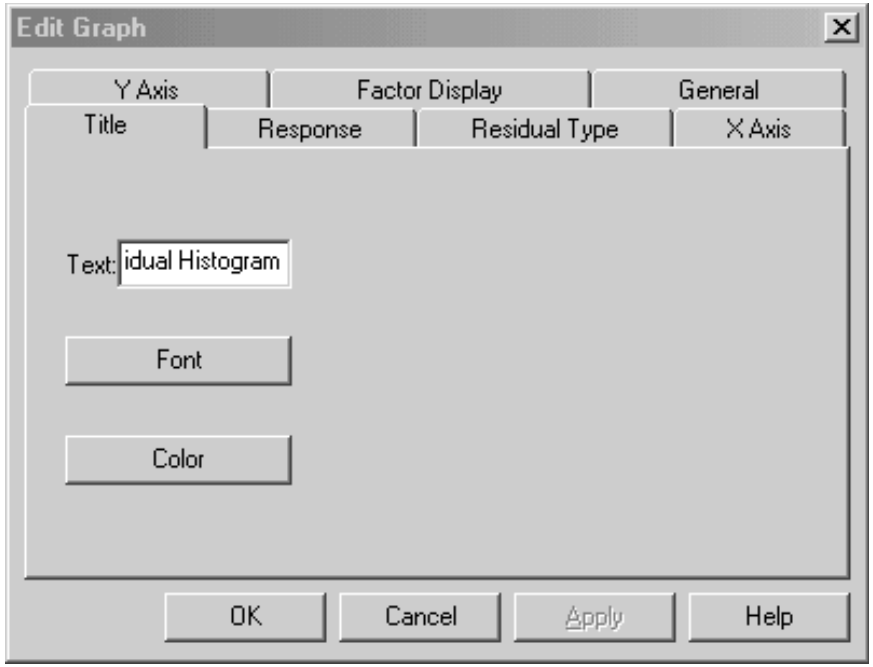


Figure 6-32

Editing the Title

Click the **Title** tab to display the title attributes that can be edited. The Residuals Histogram title is now highlighted in the **Text** field. A new title can be entered. The font and color of the title text can also be changed by clicking on the **Font** and **Color** buttons. Choose **OK**. The Residuals Histogram will now appear with the selected font and color.

Editing the Response

Click the **Response** tab to display all responses for the selected experiment. A Residual Histogram will be generated for the highlighted response. Position the mouse pointer over the desired response for the Residual Histogram and click the mouse button to select that response. After the response is highlighted, choose **OK**. The new Residual Histogram will be generated using the selected response.

Editing the Residual Type

Click the **Residual Type** tab to display the type of residuals for the selected experiment. Select either "Residual" or "Studentized Residual". A Residual Histogram will be generated for the highlighted type. Position the mouse pointer over the desired residual type for the Residual Histogram and click the mouse button to select that residual type. After the type is highlighted, choose **OK**. The new Residual Histogram will be generated using the selected residual type.

Editing the X Axis

Click the **X Axis** tab to display the X axis attributes that can be edited. A screen similar to the one shown in Figure 6-23 will appear. The X axis label text, the font for the label, and the color for the label can be edited. Additionally, the minimum and maximum values for the X axis can be defined. The **Step** field allows the user to define the desired stepsize for the tick marks on the X axis. After all desired X axis information has been entered, choose **OK** to accept the changes.

Editing the Y Axis

Click the **Y Axis** tab to display the Y axis attributes that can be edited. A screen similar to the one shown in Figure 6-23 will appear. The Y axis label text, the font for the label, and the color for the label can be edited. Additionally, the minimum and maximum values for the Y axis can be defined. The **Step** field allows the user to define the desired stepsize for the tick marks on the Y axis. After all desired Y axis information has been entered, choose **OK** to accept the changes.

Editing the Factor Display

Click the **Factor Display** tab to display the factor display attributes that can be edited. A screen similar to the one shown in Figure 6-33 will appear. Position the mouse pointer over the residual bar label you would like to edit. Click the left mouse button to highlight this bar. If you would like the bars to appear the same, click on the **All** button. Tab to the **Text** section and enter the desired text. Click on the **Font** button to select the desired font for the bar label. Click on the **Color** button to select the desired color for

the bar label. Click on the **Fill Style** button to select the desired fill style for the residual bar. Click on the **Fill Color** button to select the desired fill color for the residual bar. Click on **OK** when all the display information has been modified. The Residual Histogram will now appear with the selected font, fill style and colors.

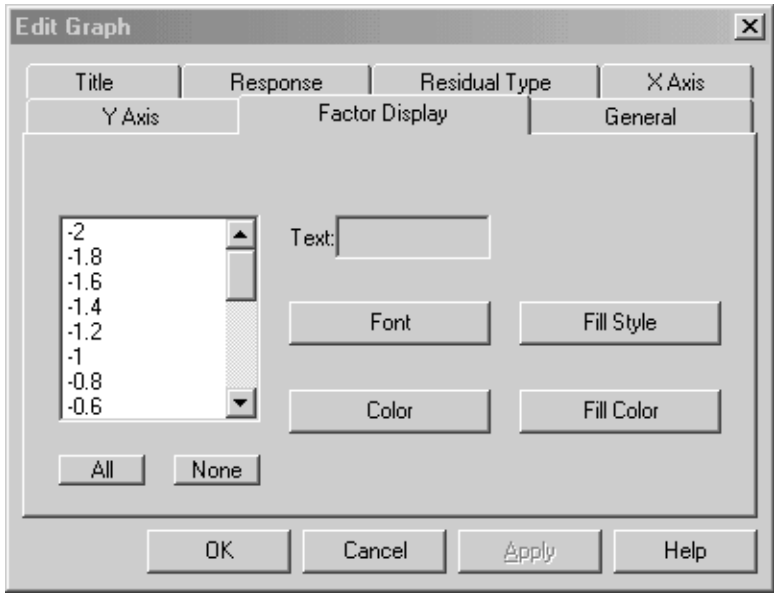
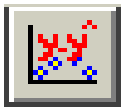


Figure 6-33

General Residual Histogram Editing Features

Click on the **General** tab to display the general Residual Histogram features that can be edited.

Residuals Scatter Plot Screen



You can select the Residual Histogram screen by clicking on the **Residual Scatter Plot** button or by selecting **Residuals Scatter Plot** from the **View** pull-down menu.

Responses can be displayed by using the Residuals Scatter Plot editing features. Figure 6-34 shows an example of a Residuals Scatter Plot.

When Residuals Scatter Plot is selected, a Residuals Scatter Plot is displayed for the first response. Other example of a Residuals Scatter Plot.

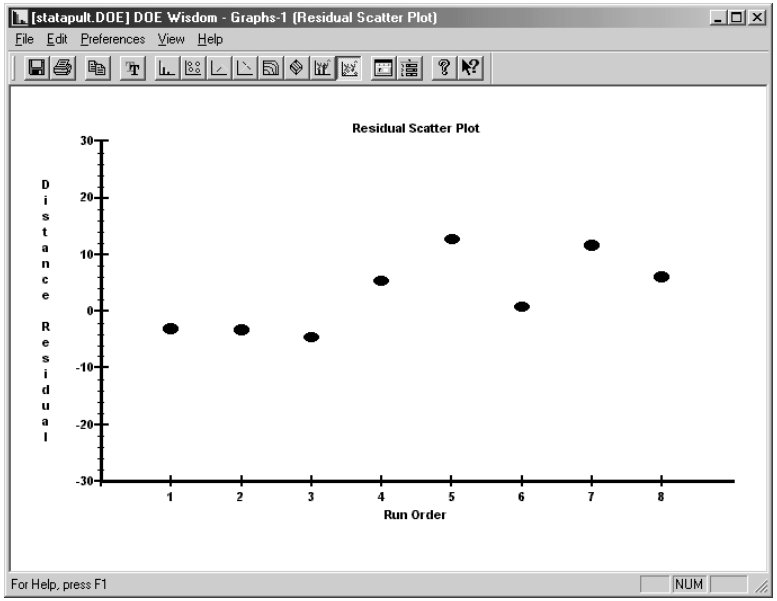


Figure 6-34

General Editing Information

Select the **Graph** option from the **Edit** pull-down menu or click the **Edit Graph** button. A window similar to the one shown in Figure 6-35 will appear.

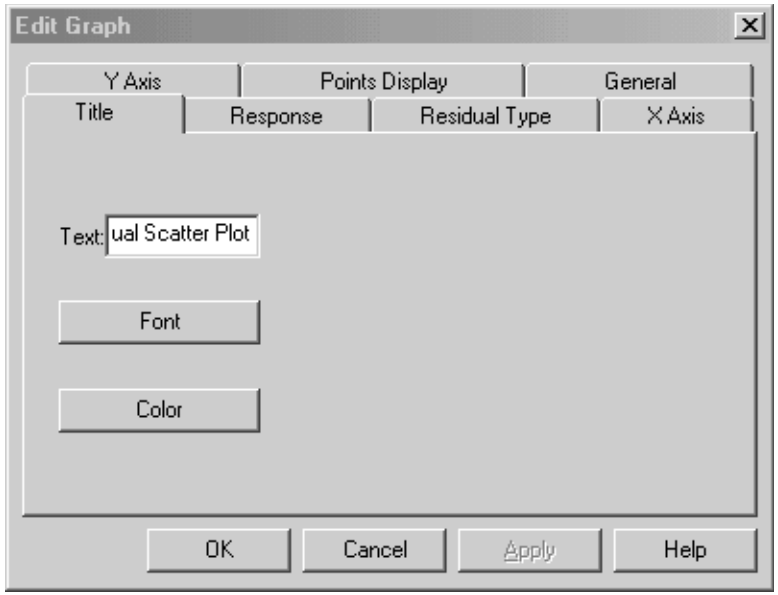


Figure 6-35

Editing the Title

Click the **Title** tab to display the title attributes that can be edited. The Residuals Scatter Plot title is now highlighted in the **Text** field. A new title can be entered. The font and color of the title text can also be changed by clicking on the **Font** and **Color** buttons. Choose **OK**. The Residuals Scatter Plot will now appear with the selected font and color.

Editing the Response

Click the **Response** tab to display all responses for the selected experiment. A Residual Scatter Plot will be generated for the highlighted response. Position the mouse pointer over the desired response for the Residual Scatter Plot and click the mouse button to select that response. After the response is highlighted, choose **OK**. The new Residual Scatter Plot will be generated using the selected response.

Editing the Residual Type

Click the **Residual Type** tab to display the type of residuals for the selected experiment. Select either "Residual" or "Studentized Residual". A Residual Scatter Plot will be generated for the highlighted type. Position the mouse pointer over the desired residual type for the Residual Scatter Plot and click the mouse button to select that residual type. After the type is highlighted, choose **OK**. The new Residual Scatter Plot will be generated using the selected residual type.

Editing the X Axis

Click the **X Axis** tab to display the X axis attributes that can be edited. A screen similar to the one shown in Figure 6-36 will appear. The X axis label text, the font for the label, and the color for the label can be edited. Additionally, the treatment of replicate values can be defined. After all desired X axis information has been entered, choose **OK** to accept the changes.

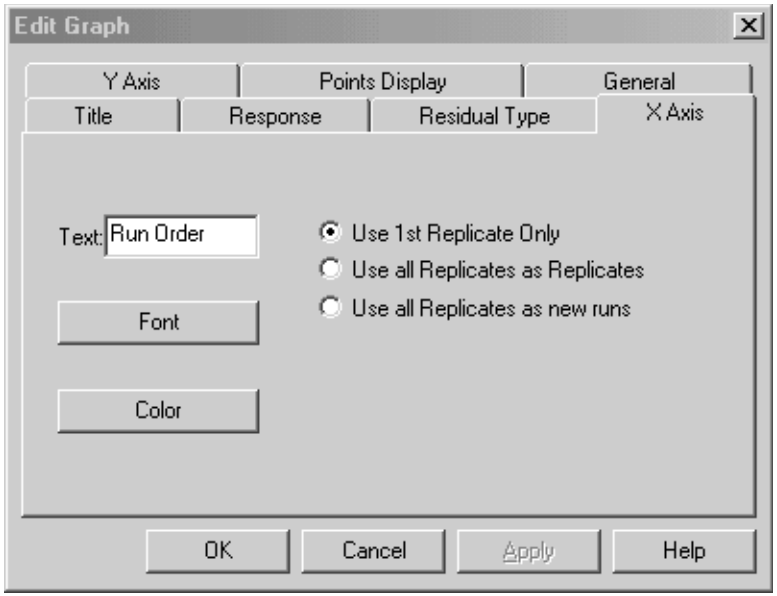


Figure 6-36

Editing the Y Axis

Click the **Y Axis** tab to display the Y axis attributes that can be edited. A screen similar to the one shown in Figure 6-23 will appear. The Y axis label text, the font for the label, and the color for the label can be edited. Additionally, the minimum and maximum values for the Y axis can be defined. The **Step** field allows the user to define the desired stepsize for the tick marks on the Y axis. After all desired Y axis information has been entered, choose **OK** to accept the changes.

Editing the Points Display

Click the **Factor Display** tab to display the factor display attributes that can be edited. A screen similar to the one shown in Figure 6-37 will appear.

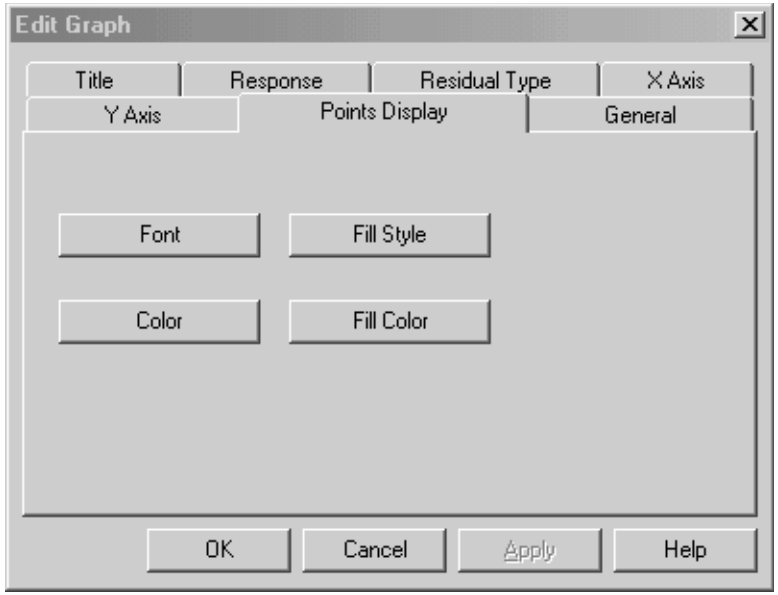


Figure 6-37

Click on the **Font** button to select the desired font for the point labels. Click on the **Color** button to select the desired color for the point labels. Click on the **Fill Style** button to select the desired fill style for the residual point. Click on the **Fill Color** button to select the desired fill color for the residual point.

Click on **OK** when all the display information has been modified. The Residual Scatter will now appear with the selected font, fill style and colors.

General Residual Scatter Plot Editing Features

Click on the **General** tab to display the general Residual Histogram Plot features that can be edited.

Printing Graphics

DOE Wisdom for Windows™ 95 or NT requires that a Windows 95 printer driver be installed on your computer. Your Windows 3.1 driver "may" work for Word and other word processing programs in Windows™ 95 but it will not work for printing graphics in DOE Wisdom. In order to print out the graphics files in DOE Wisdom, the software needs some specific Windows™ 95 printer driver information.

In order to select the Windows™ 95 driver for your printer, perform the following:

1. Select **Settings** from the **Start** menu in Windows™ 95.
2. Select **Control Panel**.
3. Double click on **Printers**.
4. Right click on the printer you are currently using.
5. Select **Properties**.
6. Click on the **Details** tab.
7. Select **New Driver** (answer yes when prompted)
8. Select the **Manufacturer**.
9. Select **Model** or **Have disk**.