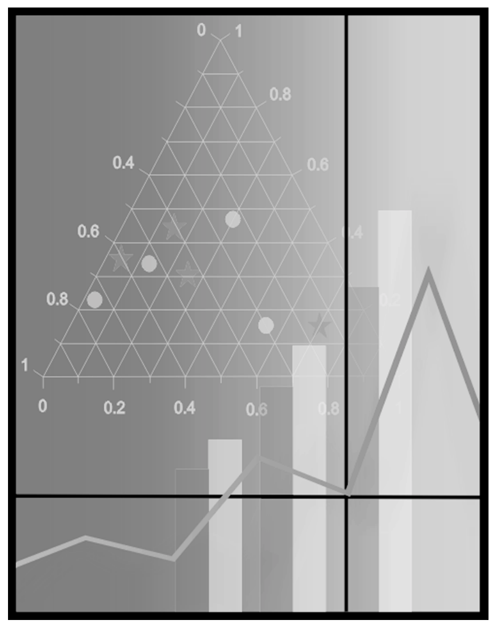
Grapher™

User's Guide

Graphing Software for
Scientists and Engineers



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Chapter 1

Introducing Grapher

About Grapher

Welcome to **Grapher**™, the easy-to-use technical graphics package for scientists, engineers, business professionals, or anyone who needs to generate graphs quickly and easily. With **Grapher**, you can create the following types of plots:

- Line/Symbol Graphs
- Bubble Plots
- Floating Bar Charts
- Function Graphs
- Polar Plots
- Histograms
- Ternary Diagrams
- Step Plots
- Bar Charts
- Hi-Low-Close Graphs
- Pie Charts
- Rose Diagrams
- Box-Whisker Plots

With **Grapher**, creating a graph is as easy as choosing the graph type, selecting the data file, and clicking the *OK* button. **Grapher** automatically selects reasonable default settings for each new graph, though all of the graph settings can be modified. For example, you can change tick mark spacing, tick labels, axis labels, axis length, grid lines, line colors, symbol styles, and more. You can even add legends, bitmaps, fit curves, and drawing objects to the graph. To apply the same custom settings to several graphs, you can create a **Grapher** template containing the desired styles. Advanced automation can be incorporated using Golden Software's Scripter™ program or any Active X automation program. Once your graph is complete, export it in a variety of formats for use in presentations and publications.

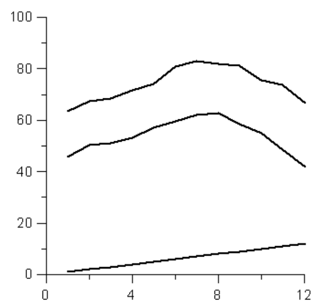
What's New in Grapher 3

The most important change in **Grapher 3** is the addition of several new graph styles, listed below. However, many subtle improvements have been made throughout the entire interface. The following list displays some of the new features in this version of **Grapher**.

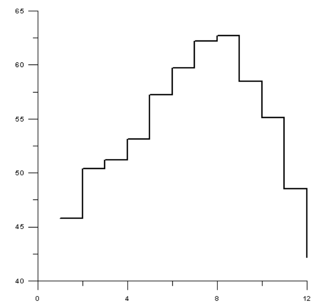
- Create Step Plots
- Create Floating Bar Graphs
- Create Ternary Diagrams
- Step-by-step plot creation using the Graph Wizard
- Make changes to multiple plots at once
- Define custom date formats for use in axis date labels
- Lock cursor to plot line when digitizing
- Choose fill direction for plots
- List all worksheets used by a plot
- Export fit data values to a worksheet
- Create Bubble Plots
- Create Rose Diagrams
- Create Box Whisker Plots
- Convert metafiles to enhanced metafile format
- Customized rulers
- Represent exponential tick mark labels as superscripts (e.g. 2E009 $\rightarrow$ $2x10^9$)
- Add opaque background to text
- Enhanced automation model
- Digitize bitmaps
- Display bar charts either horizontally or vertically

Overview of Graph Types

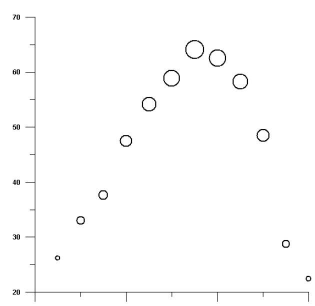
Here are some examples of the different types of plots, charts, and graphs that you can create using **Grapher 3**:



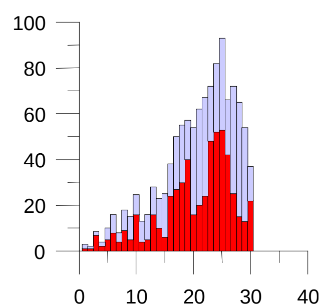
Line/Symbol Graphs



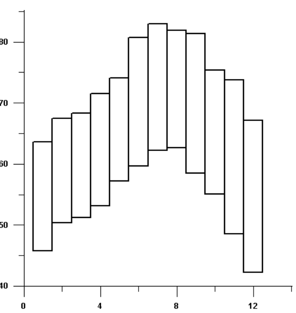
Step Plots



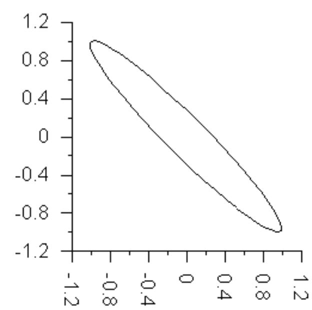
Bubble Plots



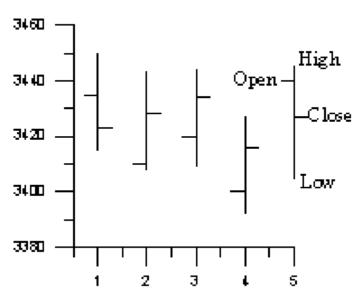
Bar Charts



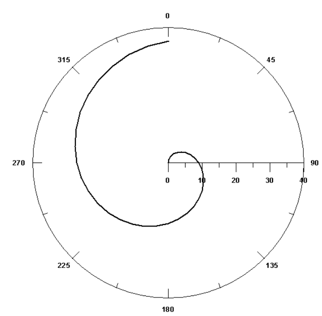
Floating Bar Graph



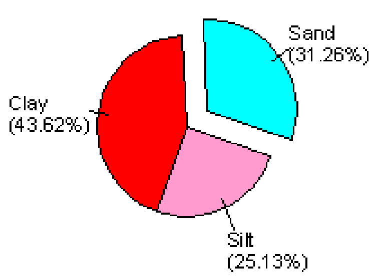
Function Graphs



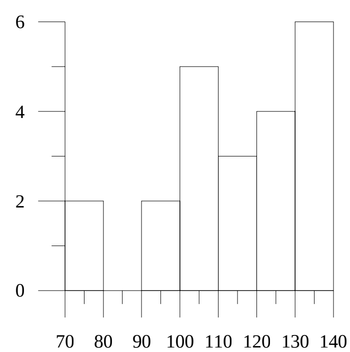
Hi-Low-Close Graphs



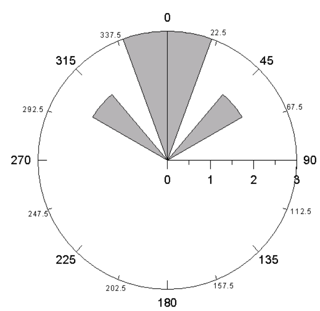
Polar Plots



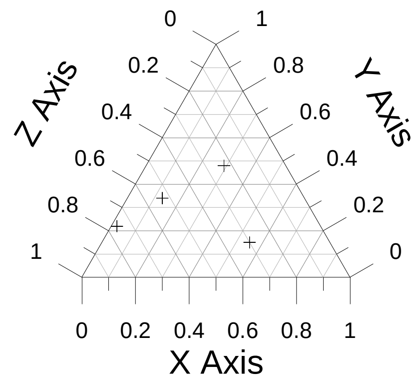
Pie Charts



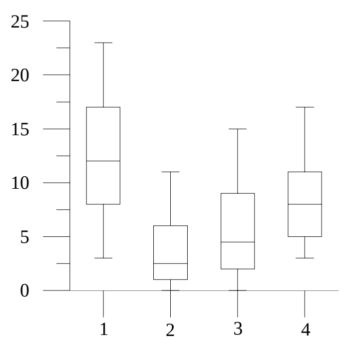
Histograms



Rose Diagrams



Ternary Diagrams



Box-Whisker Plots

About the Grapher Documentation

This section shows you how to get the most out of your **Grapher** documentation. It explains the styles used in the User's Guide and the differences between the User's Guide and the online help.

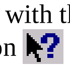
USER'S GUIDE STYLES

The **Grapher** User's Guide has several font styles used to represent different items in the **Grapher** program.

- **Bold text** indicates menu commands, dialog box names, and tab names. For example: Select the **Fill Properties** tab on the **Polygon** dialog box.
- *Italicized text* indicates items or options on a dialog box, such as group box names, options, buttons, and field names. For example: Choose the desired option from the *Look in* drop-down list in the **Open** dialog box.
- UPPERCASE text is used to show the names of files. For example: Run the SETUP.EXE file from the default directory. File extensions are also uppercase and are placed in square brackets. For example: The file is saved with a [.GRF] extension.
- `Courier New` font is used to identify Scripter commands and variables. For example: `Add the line [Dim` **`Grapher`** `as Object] to the script`.
- The process of selecting a menu item from the menu bar is represented by a bar. For example, the action of opening the **File** menu and selecting the **New** command is depicted as: **File | New**.

ONLINE HELP

Most of the information in the User's Guide can also be accessed through **Grapher's** online help system. In some cases, the help system may include more current or complete information than the User's Guide, so it is always worth checking. To access **Grapher's** online help system, select **Help | Help Topics**. Use the **Contents**, **Index**, or **Find** tabs to navigate through the help system and find the desired information.

Whenever you need help with a particular dialog box or item on the screen, you can use **Grapher's** context-sensitive help to quickly open an associated help topic. This brings you directly to a related help topic without having to go through the **Help** menu. For example, to find out what a particular command does on the menu bar, open the menu, highlight that command, and press the F1 key. The help window opens with the appropriate description displayed. You can also achieve this by clicking the help button  on the standard toolbar and then selecting the command from the menu bar.

Technical Support

Golden Software's technical support is free to registered users. Our technical support staff is trained to help you find answers to your questions quickly and accurately. We are happy to answer any of your questions about any of our products, both before and after your purchase. We also welcome suggestions for improvements to our software and encourage you to contact us with any ideas you may have for adding new features or capabilities to any of our programs.

Technical support is available Monday through Friday 8:00 AM to 5:00 PM Mountain Time, excluding major United States holidays. We respond to e-mail and fax technical questions within one business day. When contacting us with your question please have the following information available:

- Your **Grapher** serial number. This is printed in the front cover of the User's Guide.
- Your **Grapher** version number. This can be found by selecting **Help | About**.
- The operating system you are using (Windows 95, Windows 98, Windows NT, Windows 2000).
- The exact wording of the first error message that appears (if any).

Help may be found in the User's Guide, in **Grapher's** online help system, or on our web page in the form of FAQs.

<u>How to Contact Technical Support</u>

Telephone: 303-279-1021

Fax: 303-279-0909

E-mail: graphersupport@goldensoftware.com

Web: http://www.goldensoftware.com

Mail: Golden Software, Inc.

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USA

Installing Grapher

Follow the instructions in this section to install the **Grapher** software on your computer or network.

SYSTEM REQUIREMENTS

In order to install and run **Grapher** on your computer, the system must meet or exceed the following requirements.

Operating System

- Windows 2000
- Windows NT4
- Windows 95/98

Hard Drive

- At least 13 MB of free disk space
- At least 8 MB of free disk space in the Windows drive
- At least 32 MB RAM

Display

- 800 X 600 or higher video resolution

HOW TO INSTALL GRAPHER

Use the appropriate instruction set below to install **Grapher** on a single PC or on a network server and its workstations.

Single PC Installation

Use the following procedure to install **Grapher** onto the local hard drive of a stand-alone workstation.

1. Insert the CD-ROM in the CD-ROM drive.

   The install program automatically begins on most computers. Choose *Install Grapher* from the **Grapher Auto Setup** window to begin installing **Grapher**.

   If the installation program does not start, follow steps a - f below.

   a. Click on the Windows *Start* menu and select *Run.*

- b. Click the *Browse* button on the **Run** dialog.
- c. In the **Browse** window, choose the CD-ROM drive from the drop-down list.
- d. Select the AUTORUN.EXE file and click the *Open* button.
- e. In the **Run** dialog, click *OK*.
- f. Click on the words *Install Grapher* to begin the installation program.

2. Follow the on-screen instructions to complete the rest of this installation.

You must log on with administrator rights in order to install **Grapher** on Windows NT or Windows 2000.

Network Installation

Grapher may be installed on a network as long as the number of concurrent **Grapher** users does not exceed the number of legal packages (i.e. licenses) that have been purchased. Use the following procedure to install **Grapher** on the network:

1. Log on to the file server with administrator rights.
2. Locate the setup program on the CD-ROM and enter the path to the SETUP.EXE file followed by -GSERVER -SMS into the command line. For example: R:\SETUP.EXE -GSERVER -SMS

   The setup title should read "Grapher Server Setup."
3. When setup asks for a destination directory, choose one located on the file server.

   Setup copies all **Grapher** files plus the setup program and the associated files to the file server drive. A **Grapher** setup icon is placed in the specified program folder.

   It is highly recommended you now flag the server directory as read-only.
4. Log on to the file server from each workstation that runs **Grapher** and perform the following procedure:

   a. Start Windows, and then run the copy of setup (SETUP.EXE) located on the server directory. <u>Do not run setup from the CD-ROM</u>!

   b. Enter the path to the server SETUP.EXE file followed by -SMS into the command line. For example: "R:\SETUP.EXE -SMS." The setup title should read "Grapher Workstation Setup."

   c. When setup asks for a destination directory, choose one on the local hard drive.

   A few small **Grapher** files are copied from the server to the workstation, while the bulk of the **Grapher** files stay on the server. This allows many workstations to share a single copy of **Grapher** without having the files duplicated on each computer.

Note: Grapher must be installed directly at each workstation. It cannot be installed from a remote computer over the network because the installation involves editing the computer's registry. Certain parts of the registry cannot be edited from a remote computer.

Registering Grapher

When you reach the end of the **Grapher** installation, you have the option to register the software online.

- If your computer is actively connected to the Internet, choose *Register Grapher 3 online now* and click *Next*. You are connected to the Golden Software web site where you can enter the required information. A confirmation message is displayed when you successfully register the product.
- If your computer does not have Internet access or is not actively connected to the Internet, choose *Register Grapher 3 later* and click *Next*. While the **Grapher** installation finishes, take a minute to fill out the registration card included in the software package, then fax it to: 303-279-0909, or mail it to: Golden Software, Inc., 809 14th St., Golden, CO 80401.
- If you would like to register online later, please use your Internet browser to go to **http://www.goldensoftware.com/frames/registerframe.htm** and complete the online registration form. A confirmation message is displayed after you have successfully registered the product.

IMPORTANT! You must register your software in order to receive free technical support from Golden Software, Inc. Registered users receive the Golden Software newsletter and free information about future releases of **Grapher**.

Chapter 2

Tutorial

This tutorial introduces you to a few of **Grapher's** features and guides you through some common processes, including creating a basic graph, viewing its data file, adding a second plot to the graph, and editing tick marks and axis labels. This tutorial helps previous **Grapher** users learn some of the new features in **Grapher 3**. The tutorial should take approximately 45 minutes to complete.

You should be able to find the answers to any program-related questions in the User's Guide and the online help. In addition, Golden Software also provides FAQs on our web page at **http://www.goldensoftware.com**. Technical support is available by phone (303-279-1021), fax (303-279-0909), and e-mail (graphersupport@goldensoftware.com).

Creating a Graph

Grapher lets you create thirteen different plot types: Line/Symbol Plots, Step Plots, Bubble Plots, Bar Charts, Floating Bar Charts, Function Plots, Hi-Low-Close Plots, Polar Plots, Pie Charts, Histograms, Rose Diagrams, Ternary Diagrams, and Box-Whisker Plots. Each plot requires a data file, with the exception of the function plot, which requires an equation. Plots can be combined to create complex graphs. Add features such as grid lines, legends, and drawing objects to enhance any graph.

The most common action performed in **Grapher** is to generate a graph from an existing data set. This is demonstrated by creating a basic line plot from the TUTORIAL.DAT data file in **Grapher's** Samples folder.

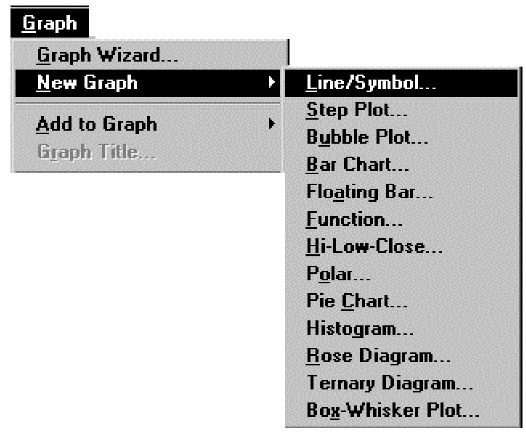
1. Open **Grapher**. (**Start | Programs | Golden Software Grapher 3**)

2. From the menu bar, select **Graph | New Graph**. The menu that appears lists the thirteen types of plots available in **Grapher**.

3. Select **Line/Symbol** from the top of the list.

   The **Open Worksheet** dialog box opens. Use this dialog box to specify the location of the file containing the data you want to graph.

4. In the *Look In* field, browse to the **Grapher** directory and select the Samples folder.



Select the type of graph to create.

5. Double-click on the TUTORIAL.DAT file in the Samples folder.

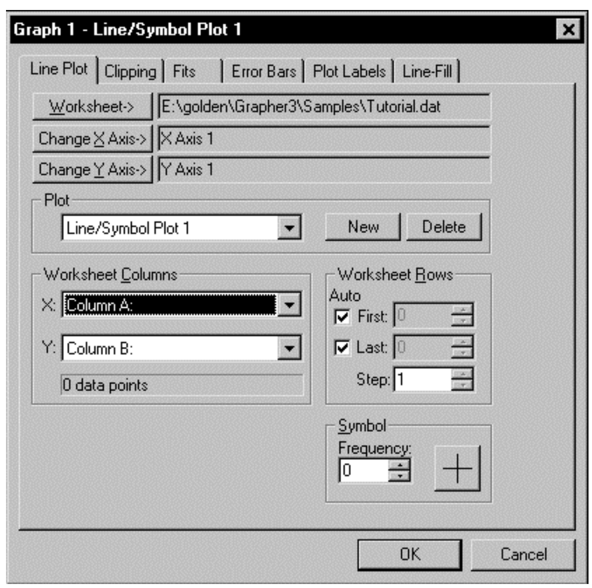
   This selects TUTORIAL.DAT as the data file and opens the **Line/Symbol Plot 1** dialog box.

6. Select the **Line Plot** tab and look at the *Worksheet Columns* group box. This is where you select the data columns to plot on each axis. The defaults are:

   X: Column A

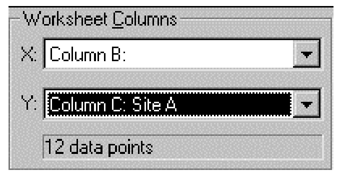
   Y: Column B

   Note that it says, "*0 data points*" under the column fields. This indicates that one or both of the selected columns do not contain valid numeric data.



*The **Line/Symbol Plot** dialog box*

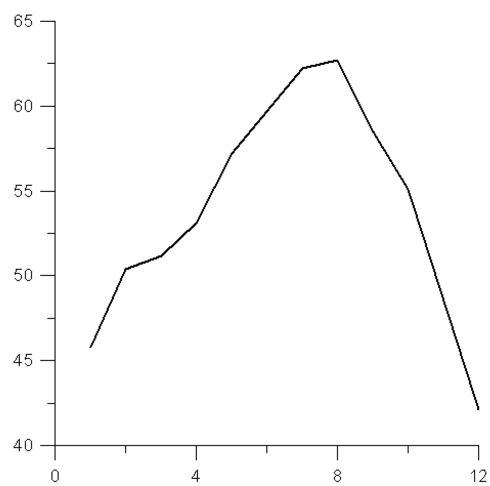
7. Change the worksheet columns from their default setting by clicking on the down arrow button in each field and choosing the following options from the drop-down list:
    - *X: Column B*
    - *Y: Column C: Site A*
    - Note that it now says "*12 data points*" under the columns.



Choose the data to plot on each axis.

Now that you have selected the columns, the graph is ready to view.

8. Click the *OK* button to save your graph settings, close the dialog box, and view the graph.



The finished line plot based on the TUTORIAL.DAT file.

WHAT IS VALID DATA?

Grapher can only use numeric values to create a graph. Two numbers, an X value and a Y value, are necessary to plot each point. If one or both of the worksheet columns do not contain numeric data, the message "*0 data points*" displays under the *Worksheet Columns* field. If any symbols, such as dashes and hyphens are used in a number, the number is read as text, not a number. This means that a date such as 7/23/99 is not a number, and cannot be plotted.

If you see the "*0 data points*" message and do not know why, you should view the data file in the **Grapher** worksheet window so that you can examine the contents of each data column.

Displaying the Data File

Grapher provides three different ways to view data files without leaving the program.

To View the Data for the Current Plot

1. Select the plot whose data you want to view.

   To select the plot, click on only the line curve plot. A selection box (a dashed line with eight black squares) appears around the plot.

2. Select **Graph | Display Worksheet** or right-click on the plot and select **Display Worksheet** from the menu.

To View the Data and the Graph Simultaneously:

1. Select **View | Style**.
2. Choose **Window w/ Worksheets**. The worksheet is displayed on the right portion of the screen and the graph on the left portion of the screen.

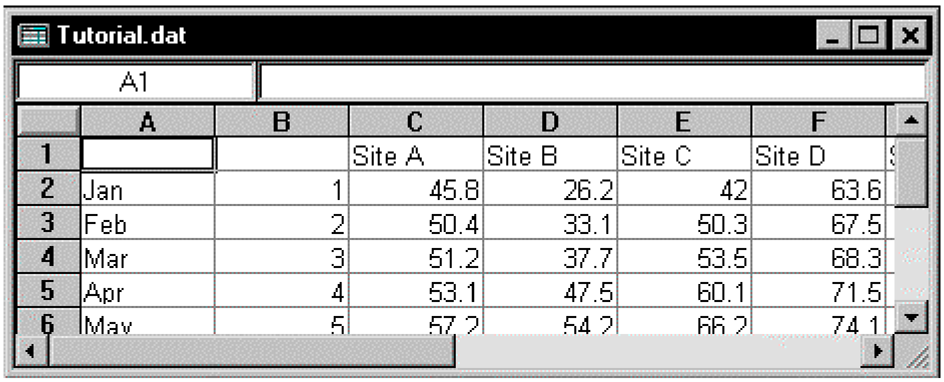
To View the Data in Any Data File:

1. Select **File | Open.**
2. In the **Open** dialog box, choose the data file you wish to view.
3. Click the *Open* button.

Reviewing the TUTORIAL.DAT File

Knowing and understanding your data helps prevent unexpected graphing results. To better understand the graph you just created in the previous section, look at the TUTORIAL.DAT file.

1. Click on the plot once to select it.
2. Select **Graph | Display Worksheet**. The data displays in the TUTORIAL.DAT window.



	A	B	C	D	E	F
1			Site A	Site B	Site C	Site D
2	Jan	1	45.8	26.2	42	63.6
3	Feb	2	50.4	33.1	50.3	67.5
4	Mar	3	51.2	37.7	53.5	68.3
5	Apr	4	53.1	47.5	60.1	71.5
6	May	5	57.2	54.2	66.2	74.1

The first few rows of the TUTORIAL.DAT file are displayed.

In the data file, note the following:

- Column A contains text, not numeric data. This explains why the message "*0 data points*" displayed when this column was selected in step 6 of the *Creating a Graph* procedure on page 12.
- Row 1 contains headers for each column (*Site A*, *Site B*, etc.) When you select the *Worksheet Columns*, **Grapher** appends the header to the column name, so they appear as *Column C: Site A*, *Column D: Site B*, etc. This makes it easier to select the right data column.

Adding a Plot from the Same Worksheet

To create multiple curves from the same worksheet is easy in **Grapher**. In the TUTORIAL.DAT file, the data are in adjacent columns. Follow these steps to add a second curve to the graph.

1. Bring the original plot back into view by selecting **Window | Plot1 ***.
2. Double-click on the curve to open the **Line/Symbol Plot 1** dialog box.
3. In the *Plot* group box, click the *New* button to create a curve from the next data column.
4. The dialog box changes to show the **Line/Symbol Plot 2**.

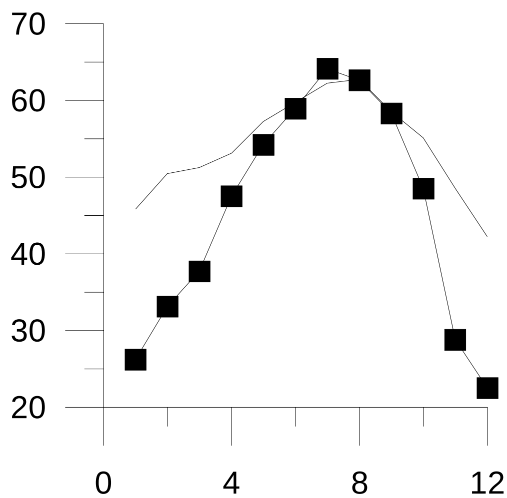
   In the *Worksheet Columns* group box, the columns automatically change to:

   - *X: Column B*
   - *Y: Column D: Site B*

To help differentiate between the plots, add symbols to the second curve.

5. Click the symbol button in the *Symbol* group box to open the **Curve Symbol** dialog box and select a symbol. (A square was chosen in this example.) Click *OK* to return to the **Line Plot** tab.

6. In the *Symbol* group box on the **Line Plot** tab, change the symbol *Frequency* to one. If this number is set to zero, symbols do not plot. Click *OK* to close this dialog box and plot the second curve.

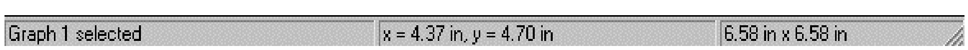


Curve 2 (shown with square symbols) is plotted on the same set of axes as curve 1.

Adding a Plot from a Different Worksheet

Grapher makes it easy to add multiple plots to a single graph from different worksheets, too. The previous case showed how to add a plot from the same worksheet. In this case, two files are used to create multiple curves on the same graph.

1. Select the entire graph by opening the **Object Manager** (**Edit | Object Manager**) and click on the graph item (i.e. Graph 1). Click *Close*. The status bar at the bottom of the screen should display "*Graph 1 selected*."



The status bar shows that Graph 1 is selected.

2. Select **Graph | Add to Graph**.

There are four options in this menu: **Axis**, **Plot**, **Legend**, and **Duplicate Axis**. If these commands appear grayed out, go back to step 1 and select the graph again. (**Duplicate Axis** is only available when an axis is selected by itself.)

3. Select **Plot**. The **Select Plot Type** dialog box opens.

4. Choose *Line/Symbol Plot* and then click *OK*. The **Choose Axes** dialog box opens.

   This dialog box allows you specify whether to graph the new plot on the existing axes, or to graph it on a new set of axes. For this example, choose the existing axes (i.e. *X Axis 1* and *Y Axis 1*), and click *OK*.

   The **Open Worksheet** dialog box opens so you can select the data file for the third curve.

5. Select the TUTORIA2.DAT file and click the *Open* button.

   The **Line/Symbol Plot 3** dialog box opens.

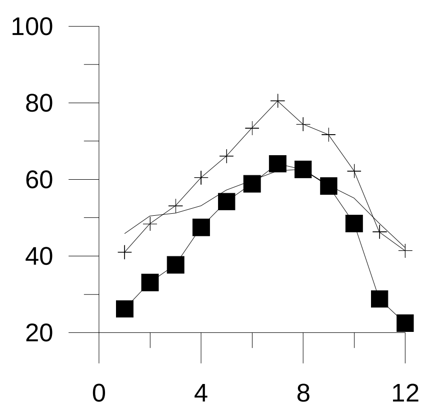
6. Select the data columns for the third plot.

   In the *Worksheet Columns* group box, change the columns to:

   - *X: Column B*
   - *Y: Column C: Site I*

7. Click the symbol button in the *Symbol* group box to open the **Curve Symbol** dialog box and select a symbol. (A cross was chosen in this example.) Click *OK* to return to the **Line Plot** tab.

8. In the *Symbol* group box on the **Line Plot** tab, change the symbol *Frequency* to one. Click *OK* to close this dialog box and plot the third curve.



Curve 3 (shown with cross symbols) is plotted on the same set of axes as curves 1 and 2.

SELECTING A PLOT WITH THE OBJECT MANAGER

When only one plot is displayed, it is easy to select the graph or plot that you want. However, once you have multiple plots, use **Grapher's Object Manager** to select items. In this next procedure, use the **Object Manager** to select one of the plots.

1. Make sure that there are no objects selected on the graph. The status bar at the bottom of the screen should read, "*Nothing selected*." Click outside the graph area to deselect any objects, or choose **Edit | Deselect All**.

2. Select **Edit | Object Manager** to open the **Object Manager** dialog box (or double-click in the white space outside the graph area).

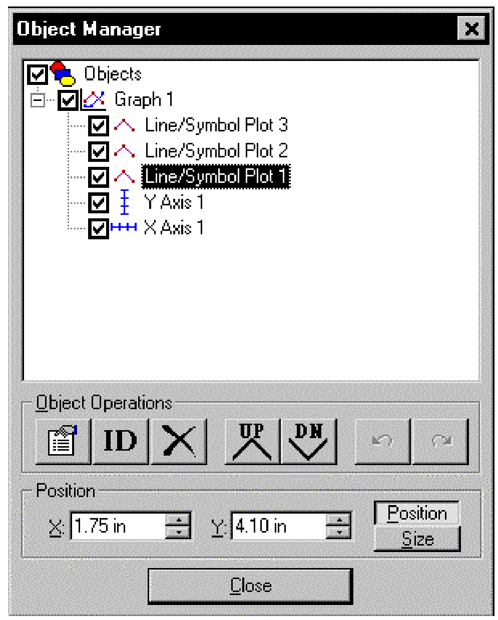
   When the **Object Manager** dialog box is open, one graph object appears in the list with a small cross next to it.

3. Click on the cross next to *Graph 1* to expand the list. This displays the five objects that make up Graph 1:

   - Line/Symbol Plot 3
   - Line/Symbol Plot 2
   - Line/Symbol Plot 1
   - Y Axis 1
   - X Axis 1

3. Select *Line/Symbol Plot 1* from the list and click the *Close* button.

   The **Grapher** status bar now reads "*Line/Symbol Plot 1 selected*."



*The **Object Manager** dialog box*

RENAMING OBJECTS

It is always easier to distinguish the data curves when they have descriptive names. The default names for the curves are "*Line/Symbol Plot 1*", "*Line/Symbol Plot 2*", and "*Line/Symbol Plot 3.*" In this exercise, these names are changed to "Site A," "Site B," and "Site I" respectively.

1. Open the **Object Manager** by double-clicking anywhere in the white space around the graph, or by choosing **Edit | Object Manager**.

2. Expand the *Graph 1* list by single-clicking on the plus sign, if necessary.

3. Click once on *Line/Symbol Plot 1* to select it, and then click the *ID* button. (This makes the object name editable.)
4. Enter *Site A* as the new name.
5. Click one time on *Line/Symbol Plot 2* to select it, and then click the *ID* button.
6. Enter *Site B* as the new name.
7. Click once on *Line/Symbol Plot 3* to select it. Click the *ID* button.
8. Enter *Site I* as the new name.
9. Click the *Close* button.

   The status bar now reads "*Site I selected.*"

Axes

Grapher's axes can be modified to fit any design needs. The axis scale, axis length, tick spacing, tick mark labels, axis titles, colors, etc., can all be modified. The following section shows how to modify the axes of the graph previously created in the tutorial.

Adding Titles to Each Axis

Axis titles let you identify the quantity or units represented by each axis of the graph. Titles can be added easily by editing the properties of each axis object.

1. Open the **Object Manager** by double-clicking in the white space, or choosing **Edit | Object Manager**.
2. If the two axis objects are not shown, expand the *Graph 1* list by single -clicking on the plus sign.
3. Select *Y Axis 1*.
4. Click the properties button . The **Y Axis** dialog box opens.
5. Enter the word "Temperature" in the edit box in the *Title* group box on the **Axis** tab.

   Do not click *OK* yet. The title is too small for the axis, so the font size needs to be increased.
6. Change the text size by clicking on the *Editor* button in the *Title* group box. The **Text Editor** dialog box opens. Highlight the word "Temperature" in the **Text Editor** dialog (or press CTRL + A) and change the font size to 20 points. **Note:** Only the highlighted text changes size.
7. Click the *OK* button to close the **Text Editor** dialog box.

Let the program automatically position the axis label by selecting the *Automatic* option.

8. Click *OK* on the **Y Axis** dialog box. Note that the word “Temperature” now appears along the Y axis.

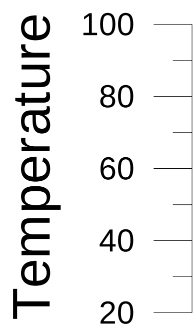
Use this same procedure to add the title “Month” to the X axis, and then click the *Close* button in the **Object Manager.**

Tick Marks

Tick marks are the lines that protrude perpendicularly from an axis. Tick marks indicate units of measure, and are normally equally spaced like the lines on a ruler. In this graph, the longer tick marks are the major ticks while the shorter ones between them are the minor tick marks.

In this sample graph, the major tick mark spacing on the Y axis is 20 units (i.e. 20, 40, 60, 80, 100). In the following exercise, the tick spacing is changed to ten units so tick marks appear at the intervals 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100.

This is done using the options on the **Tick Marks** tab in the **Y Axis** dialog box.



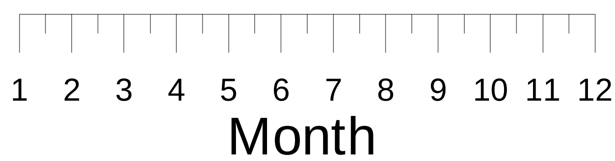
In this sample graph, the major tick mark spacing on the Y axis defaults to 20 units.

Changing Tick Mark Settings on the Y Axis

1. Open the **Y Axis** dialog box by double-clicking on the Y axis. (This is an alternative method to using the *Properties* button in the **Object Manager**.)
2. Select the **Tick Marks** tab.
3. In the *Major* group box, clear the *Auto* check box.
4. In the *Spacing* drop-down list, change the number 20 to the number 10.
5. Click *OK*. Note that the tick marks now appear at ten unit intervals.

Apply this same procedure to edit the X axis and change the tick mark spacing from 4 to 1.

The finished X axis should look like this:



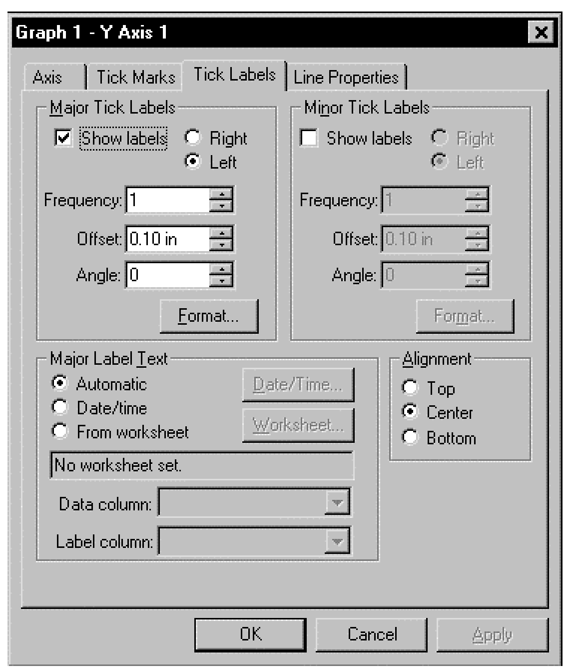
Here the X axis is shown with a tick mark spacing of one.

Tick Labels

Tick labels are the numbers (units) that appear next to the tick marks. In **Grapher**, you can configure these labels to appear at certain intervals.

Changing Tick Labels

1. Open an **Axis** dialog box by double-clicking on the axis you want to edit.
2. Click on the **Tick Labels** tab.
3. In the *Major Tick Labels* group box, try the following settings:
    - Select *Above* or *Below* (if editing a horizontal axis) or *Right* or *Left* (if editing a vertical axis) to indicate which side of the axis you want the labels to appear.
    - To keep labels from displaying at all, remove the check mark from the *Show labels* check box.
    - The *Frequency* setting determines which tick marks receive labels. For example, a setting of 2 would display a label on every other tick mark.



*The **Tick Labels** tab*

- The *Offset* field sets the distance between the tick mark and the label.

- The *Angle* field sets the angle of the label. Setting this to 45 would turn the label 45 degrees counter-clockwise.
- To change the format or font size of a label, click the *Format* button to access those settings.

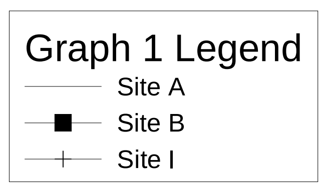
4. Click *OK* to return to the plot window.

   Note: *Chapter 5, Axes* includes detailed examples for including tick mark labels from the worksheet and using date/time labels.

Legends

A legend is a key that helps you identify what the different lines and symbols on the graph represent. In this exercise, the legend shown here is added to the sample graph.

There are two types of legends in **Grapher**: Those attached to a graph (**Graph | Add to Graph**) and those not attached to a particular graph (**Graph | New Top-Level Legend**).



Top-level legends help identify multiple plots in a document.

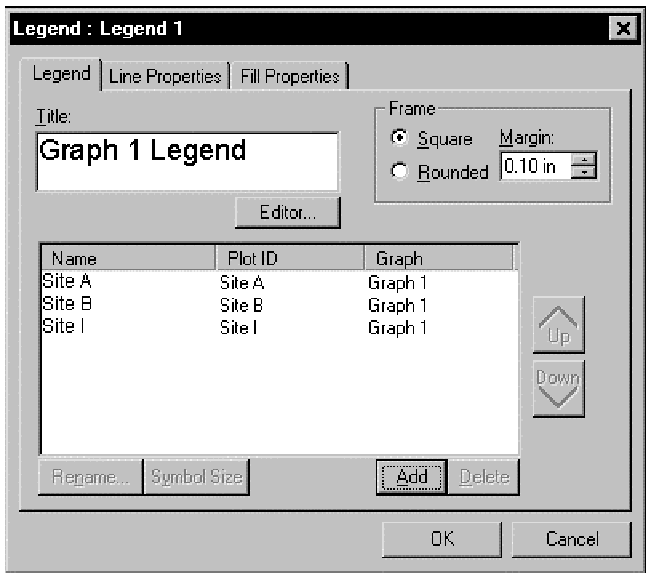
A top-level legend, like the one shown above, is particularly useful when there are multiple graphs in the document.

Adding a Legend

1. Select **Graph | New Top-Level Legend**.

   The **Legend** dialog box opens.

2. In the *Title* box, enter “Graph 1 Legend.”
3. Increase the text size of the title as so:
   - Click on the *Editor* button to open the **Text Editor** dialog box.
   - Press the CTRL + A keys to select the text.
   - Change the font size from 12 to 18 points.
   - Click *OK*.



*Configure a legend in the **Legend** dialog box.*

4. Select the plots you want to include in the legend:
   - Click the *Add* button to open the **Select Plot** dialog box.
   - Click on the words *Site A, Site B,* and *Site I* to select all three plots.
   - Click *OK.*

   Note:

   - If a plot contains symbols, as the Site B and Site I plots do, the symbol size in the legend can be edited by selecting the name of the plot on the **Legend** tab. Then, click the *Symbol Size* button.
   - If you want to change a plot's name or edit the font size used to display it in the legend, select the name of the plot and click the *Rename* button. Use the **Text Editor** dialog box to change the name or set new font properties, then click *OK.*

5. Click *OK* to create the legend. You can position the legend simply by dragging it to the desired location or by specifying a location in the **Object Manager**.

Templates

A template file saves all of the document settings for future use with other data files. Templates do not save actual data file information, but they do retain information such as which data columns are used for each plot, placement of plot legends, and text properties. In this exercise, the sample graph is saved as a template and then used to create a new graph.

Saving the Sample Document as a Template

1. Select **File | Save As**. The **Save As** dialog box opens.
2. In the *Save as type* field, choose *Plot Template (*.grt)*.
3. Delete any text in the *File name* field and enter the word “Tutorial.” (**Grapher** automatically adds the [.GRT] extension.)
4. Click the *Save* button.
5. Select **File | Close All**.

Using a Template File

Once a template is created, it can be used with multiple data files. Here the TUTORIAL.GRT template that you just created is used with a new data file.

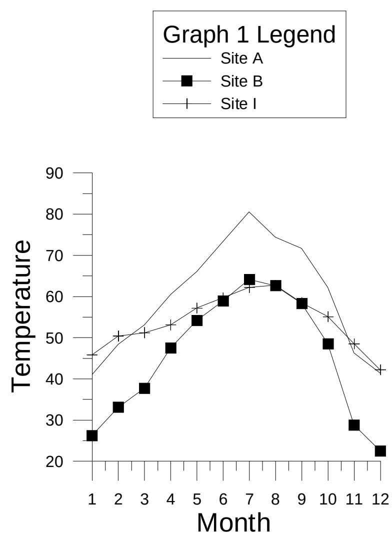
1. Click on **File | New**.
2. Choose *Plot* from the list in the **New** dialog box and check the *Prompt for template* check box at the bottom.
3. Click *OK*. The **Open** dialog box appears.
4. Select TUTORIAL.GRT and click *Open*.

   Since there are two Line/Symbol plots in the template, **Grapher** prompts you to select a data file for each plot. Because the plot data does not need to be from the same data file, you are prompted to specify a data file for each plot. To keep things simple, assign the TUTORIAL2.DAT file to all three plots.
5. In the **Graph 1 - Site A** dialog box, select the TUTORIA2.DAT file from **Grapher’s** Samples folder and click *Open.*
6. In the **Graph 1 - Site B** dialog box, select the TUTORIAL.DAT file from **Grapher’s** Samples folder. At the bottom of the dialog box, place a check mark in front of *Use this worksheet for remaining items* and click *Open*.

   This option allows all of the remaining plots to be created from the same worksheet. If this option were not selected, you would be prompted for another worksheet for **Graph 1 - Site I**.

If the *Set Columns* check box is selected, you can override the default columns defined by the template file and choose whichever columns you decide for the plot.

The new plot, based on the template, is displayed in a new plot window.



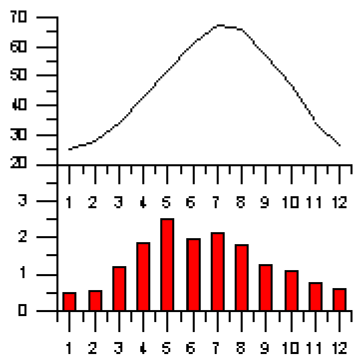
When a template is used to create a plot, the new plot assumes the physical characteristics specified by the template.

7. Select **File | Save As** and name this graph TUTORIAL2.GRF.

   In the *File name* box, if you include the extension [.GRF], the file is saved as a graph. Alternatively, you can type TUTORIAL2 in the *File name* box and select *Grapher File (*.GRF)* in the *Save as type* box.

Graphing with Multiple Axes

Sometimes it is necessary to show multiple variables on one graph. For example, in the following graph, the variables share the same X values, but have different Y values. In this exercise, this graph is created to demonstrate how to use duplicate axes and how to create new axes. It is assumed that you have completed the previous sections in this tutorial and are familiar with using the **Object Manager** and performing basic actions in **Grapher**.



This is the final graph after adding the duplicate X axis, second Y axis, and the line/symbol plot.

Create the bar chart:

1. Select **File | New** and choose *Plot* in the **New** dialog box to open a new plot window. Click *OK*.
2. Select **Graph | New Graph | Bar Chart**. The **Open Worksheet** dialog box appears.
3. From **Grapher's** Samples folder, choose TUTORIA3.DAT and click the *Open* button.

   The **Bar Chart** dialog box opens.
4. To change the width of the bars, click on the **Bar Chart** tab and change the *Width* field to 50 percent by either clicking on the down arrow or by typing in 50.
5. Click *OK*. Notice that the bar chart is drawn with the properties you just specified.

Change the Y axis:

1. Double-click on the Y axis to open the **Y Axis** dialog box.
2. On the **Axis** tab, make the following changes:
   - Set the length of the Y axis to three inches by typing in 3.0 into the *Length* box. This reduces the height of the bar chart to allow room for the second plot.
   - In the *Axis Limits* group box, remove the *Auto* check mark next to the *Axis max* field.
   - Change the *Axis max* to 4 to set the maximum range of the Y axis to four units.

3. Click on the **Tick Marks** tab and make the following changes:
   - In the **Tick Range** group box, open the *Last* drop-down list and choose *Custom*.
   - In the corresponding *Value* field, change the value from 4 to 3.5. (This removes all tick marks and labels on the Y axis above 3.5 units.)

Change the X axis:

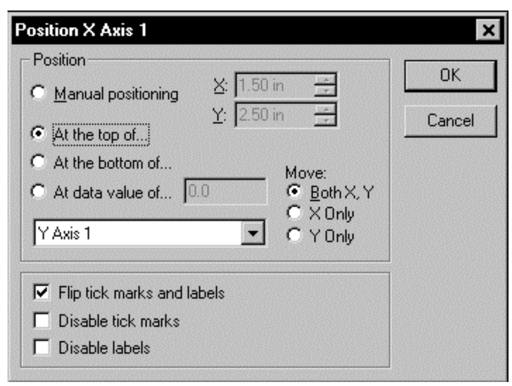
1. Open the **X Axis** dialog box by clicking on the **Axis** tab and selecting *X Axis 1* from the drop-down list where *Y Axis 1* is selected.
2. On the **Axis** tab, make the following changes to adjust how much of the X axis is visible:
   - In the *Axis Limits* group box, remove the check in the *Auto* check box to the right of the *Axis min* field and enter the value 0.5 for *Axis min*.
   - Remove the check mark in the *Auto* check box next to the *Axis max* field and enter the value 12.5 for *Axis max*.
3. Click on the **Tick Marks** tab. For the major tick marks, remove the check mark from the *Auto* check box next to the *Spacing* field, change the tick mark *Spacing* from 4 to 1, and click *OK*. (This assigns a major tick mark spacing of one unit.)

Add a Duplicate X Axis:

The X axis should still be selected. If it is not, select it now.

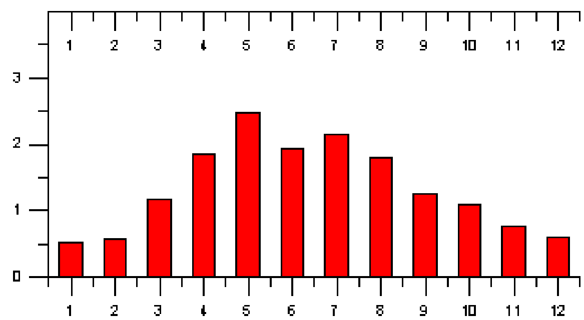
1. Add a duplicate X axis by selecting **Graph | Add to Graph | Duplicate Axis**. (If **Duplicate Axis** is grayed out, the axis is not selected.)
2. In the **Position X Axis 1** dialog box, uncheck the *Flip tick marks and labels* option. The duplicate axis position should default to *At the top of* Y Axis 1.

   When setting a *Position* option, the *Move* radio buttons determine whether the selected axis can move in the X direction (*X Only*), the Y direction (*Y Only*), or in both directions (*Both X, Y*). Make sure that the *Both X, Y* is selected.
3. Click *OK*.



The ***Position Axis*** *dialog box*

Your plot should now look like this:



Plot update after adding the duplicate X axis

Create a Second Y Axis:

1. Select the entire graph using the **Object Manager**.
2. Select **Graph | Add to Graph | Axis.** In the **Axis Type** dialog box, choose *Y Axis* and click *OK*.
3. In the **Y Axis 2** dialog box, click the *Position* button to set the position for the new axis.
4. In the **Position Y Axis 2** dialog box, select *Y Axis 1* from the drop-down list and the position changes to *At the top of.* Click *OK*
5. Change the *Length* of the axis to 3.0 inches by typing the value 3.0 in the *Length* box. Click *OK* and the graph is drawn with the new Y axis.

Add a Line/Symbol Plot:

1. Select the entire graph using the **Object Manager**.
2. Select **Graph | Add to Graph | Plot.** In the **Select Plot Type** dialog box, choose *Line/Symbol Plot* and click *OK.*
3. In the **Choose Axes** dialog box, select *X Axis 2* and *Y Axis 2.*
4. In the **Open Worksheet** dialog box, select TUTORIA4.DAT from the **Grapher's** Samples folder.
5. Accept all of the default options by clicking the *OK* button in the **Line/Symbol Plot 2** dialog box.

Your graph should now look like the one pictured on page 26.

Beyond the Tutorial

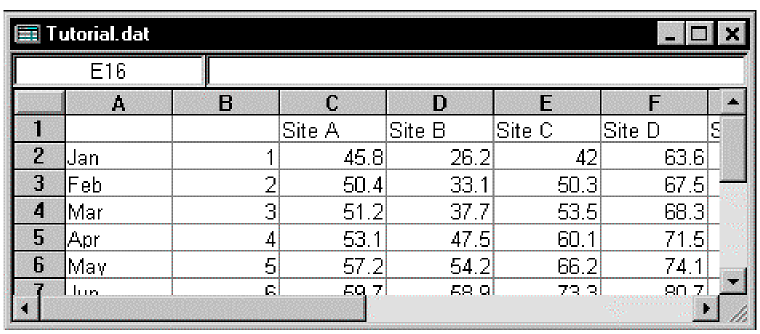
This tutorial has demonstrated how to make a simple graph, and how you can use **Grapher's** advanced customizing features to create graphs that are more complex. You should now have the basic skills necessary to create graphs on your own. Use the rest of the User's Guide and the online help system for information on topics not discussed in the tutorial. Refer to *Chapter 4, Creating Graphs* for more information on the various types of plots available.

Chapter 3

Working with Data Files

Overview of the Grapher Worksheet

The **Grapher** worksheet window provides a simple spreadsheet interface that lets you view the contents of a data file, edit its data, or enter new data for your graph.



The TUTORIAL.DAT file is displayed in ***Grapher's*** *worksheet window.*

When you open most types of data files in **Grapher**, the file automatically opens in the worksheet window. Once the information is opened in the worksheet, it is ready to be used by **Grapher**. Data can be accessed directly by **Grapher** and does not need to be opened in the worksheet before creating a graph.

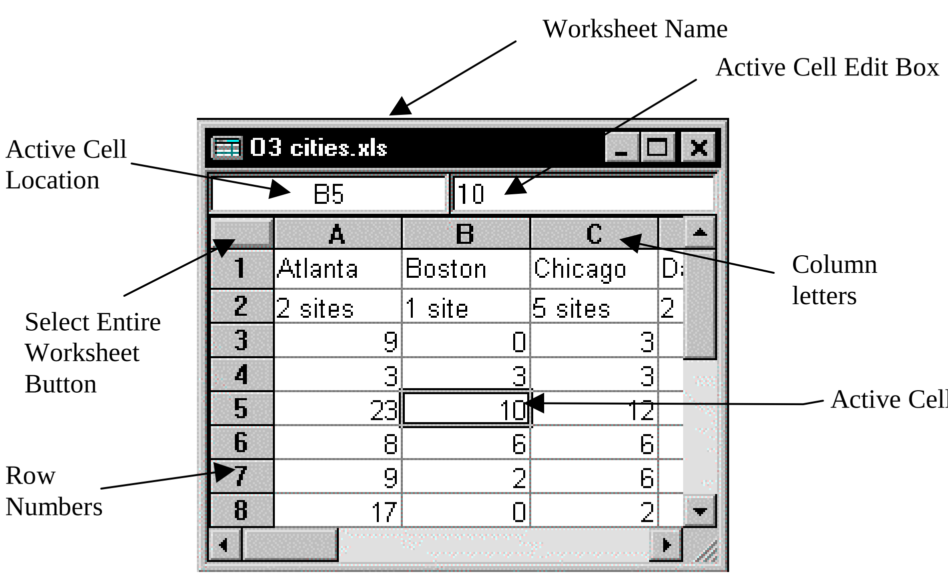
ACCESSING THE WORKSHEET WINDOW

Grapher's worksheet window can be accessed in the following ways:

1. Open a data file using the **File | Open** command. The data displays in the worksheet window.
2. Select a **Grapher** plot and choose **Graph | Display Worksheet**. The data for the selected plot displays in the worksheet window.
3. Right-click on a selected plot and choose the **Display Worksheet** command from the menu. The data for the selected plot displays in the worksheet window.

PARTS OF THE WORKSHEET WINDOW

The parts of the worksheet window are identified below.



Components of a worksheet window

Active Cell Location	The location of the active cell, specified by column letter and row number.
Worksheet Name	The name of the data file displayed in the worksheet.
Active Cell Edit Box	The box displaying the data or text contained in the active cell. Data typed into an empty cell appears in both the active cell edit box and in the active cell.
Column Letters	The letter that identifies a column of the worksheet.
Active Cell	The cell highlighted with a bold outline. The active cell receives data input (numeric values or text strings) from the keyboard. Only one cell is active at a time.
Row Numbers	The number that identifies a row of the worksheet.
Select Entire Worksheet Button	The button used to select all cells in the worksheet.

Working with Worksheets

This section shows you how to perform common operations with your data files, including opening data files, selecting, copying and pasting cells, and importing data from data files.

OPENING DATA FILES

1. Select **File | Open** to display the **Open** dialog box.

   From this dialog box, you can select data files, as well as other **Grapher** documents, including graph and template files.

2. Select the file(s) that you want to open. To select multiple files, hold down the CTRL key while clicking on each file name.

3. Click the *Open* button.

   Each file opens in its own window. Data files open in a worksheet window, graph files [.GRF] and template files [.GRT] open in a plot window.

Importing Data Files

When you import a data file, you merge the entire contents of that file into the active worksheet window. This is very useful when you want to combine the data from several individual files into a single data file.

1. Open the data file into which you want to import the data. If you want to import the file into a new worksheet, select **File | New | Worksheet**. A new worksheet window is created.
2. Select the cell where you want the imported data to be placed. For example, if you select cell B3, the top left cell of the imported file is placed in cell B3 with all other data placed accordingly.

   By default, importing overwrites any existing data unless you first select a cell that is outside the bounds of the existing data block.
3. Select **File | Import**. The **Merge** dialog box opens.
4. Select the data file that you want to import.
5. Click the *Open* button. The data is merged into the new file beginning at the active cell.

   Note: Multiple files can be merged at one time into the same worksheet with the **File | Import** command by using the SHIFT or CTRL keys while selecting files in the **Merge** dialog box. However, you have more control over the physical placement of each file if you import them separately.

Viewing or Modifying Data in a Worksheet

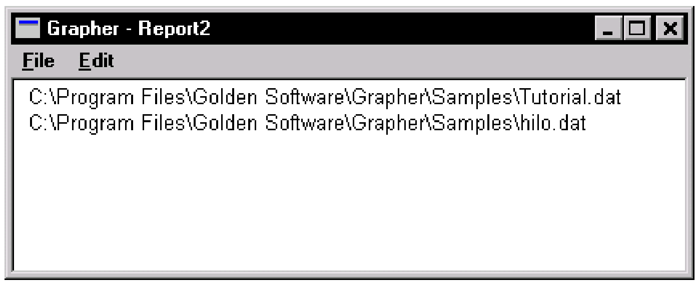
Sometimes it is necessary to view or modify a data set used to create a plot. To open the worksheet that was used to create a plot, use the **Graph | Display Worksheet** command or right-click on the selected plot and choose **Display Worksheet** from the menu. If a plot is not selected, the **Display Worksheet** command is grayed out.

If any modifications are necessary in the worksheet, make the changes in the worksheet, and then save the data file. If **View | Auto Track Worksheets** is enabled (indicated by a check mark next to the menu command) then any changes made in the worksheet are reflected in the graph.

Note: Only one plot can be selected at a time for the **Display Worksheet** command to be active. If any other objects such as axes, titles, drawing objects, etc., are selected the menu command is grayed out.

Listing the Worksheets in Use

To view the path name of all worksheets used in a **Grapher** document, select **Graph | List Worksheets**. The results display in a report window.



*The **Graph | List Worksheets** command shows the full path name to all worksheets used in the current **Grapher** document.*

The **File** menu commands in the report window allow you to save the report to a text file, print the contents of the report window, or close the report window.

The **Edit** menu commands let you copy and paste the contents to another application, or perform a search of the report's content.

Data File Formats

The following file types can be opened or imported into a worksheet:

ASCII [.DAT], [.TXT], and [.CSV] Data Files

There are three common ASCII Data Formats: [.DAT], [.CSV], and [.TXT]. ASCII files are generic format files that can be read or produced by most applications. These files can also be imported into most applications, including word processors, spreadsheets, and ASCII editors.

ASCII files do not contain worksheet formatting information (row heights, column widths, or cell format). When ASCII files are loaded into the worksheet, the default column formatting parameters are applied to the data. This does not result in changes to the data, but might result in the rounding of values in the data display. There are no limitations on the number of rows or columns in an ASCII format. ASCII formats save and load slowly because there is a conversion from binary numbers to character representation.

Golden Software Blanking [.BLN] and Atlas Boundary [.BNA] Formats

You can open Golden Software Blanking [.BLN] files and Atlas Boundary [.BNA] files in the worksheet by selecting **File | Open**. These boundary files are ASCII files that can be edited in the worksheet. If these files are imported into the plot window using the **File | Import** command, they are imported as vector boundary files. For more information on these formats, refer to the online help.

SYLK [.SLK] Files

Microsoft SYLK files contain data and worksheet formatting information, except for background color. If a SYLK file is created in another application and loaded into the worksheet, there might be special formatting information in the file that the worksheet cannot use. In these cases, the data file is loaded without the special formatting.

Technically, the SYLK specification has a 65,536-row limit and a 256-column limit. The Golden Software SYLK Import/Export filters allow limits greater than the specifications indicate; so larger worksheets can be saved in SYLK format. However, other spreadsheet programs may be unable to load these large SYLK files.

Lotus [.WKx] Data Files

[.WKx] files are produced from Lotus programs including 1-2-3 and Symphony. The worksheet can import these files but cannot save in any Lotus format. [.WKS], [.WK1], [.WK2], [.WK3], [.WK4], [.WR1], and [.WRK] files can be read into the worksheet. The Lotus import filter does not import formatting information or formulas. In addition, the newer Lotus file formats cannot be imported into the worksheet.

Excel [.XLS] Data Files

Excel [.XLS] files are Microsoft Excel documents. Worksheet cell data and some cell formatting are retained with this format. Other types of information, such as formulas, are ignored. Excel [.XLS] format files can preserve all formatting information available in the Golden Software worksheet. Excel 97 and Excel 2000 have a 65,536-row limit and a 256-column limit.

Excel files can contain numeric cell formatting (codes like "#,###.00", for example). When an Excel file is imported, the worksheet stores the Excel number formatting internally so that the same formats are preserved when the file is saved. The **Grapher** worksheet only understands a subset of the codes. When the worksheet finds an undefined character, it prints the literal format character. The worksheet displays a reasonable representation of the unsupported Excel characters so the value displayed in the cell looks similar to what was displayed in Excel. Refer to the online help system topic, *Special XLS Characters*, for more information.

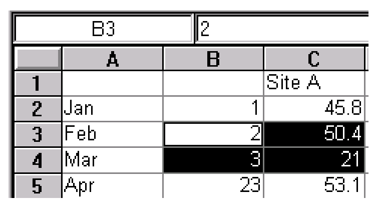
Note: Grapher does not allow for saving multiple worksheets in a single Excel document. If a multiple worksheet file is opened and saved as an [.XLS] file in **Grapher**, only the single worksheet is saved in the document. All other worksheets are deleted from the [.XLS] file. A warning dialog is displayed that makes you aware of this before you save.

Selecting Cells in a Worksheet

Most worksheet operations, (such as formatting, editing, and calculating statistics) require that you select one or more cells before performing the operation. The most common method is to use the mouse to select a block of cells, rows, or columns, though the keyboard can also be used. This section provides you with several techniques for selecting cells in a worksheet.

IDENTIFYING THE ACTIVE CELL

Although many cells can be highlighted at once, only one cell can be edited at a time. The cell that has the focus is referred to as the *active cell*. The active cell is easily identified because it has a box around it and its coordinates display in the **Active Cell Location** box (see illustration on page 32). The active cell is never shaded.



You can select (highlight) multiple cells, but only one cell can be active at a time. Here, the active cell is B3.

Active Cell Notes:

- When you select and highlight a group of cells, the first cell you click on becomes the active cell.
- When you select an entire row or column, the first cell in the row or column becomes the active cell.

MOUSE TIPS FOR SELECTING CELLS

- Clicking the small box directly above the first row header selects the entire worksheet.
- To deselect all selected cells, click the left mouse button anywhere within the worksheet, or change the active cell using an ARROW key or some other movement key.
- To rapidly select a large block, first select one corner of the block, and then use the scroll bars to scroll to the opposite corner. Hold down the SHIFT key and click on the cell at the opposite corner.
- To select all cells in a column or row, click the column header or the row header. To select several adjacent columns or rows, click and hold the left mouse button and drag the pointer on the column letters or row numbers.
- While holding down the CTRL key, you can select multiple non-adjacent cells or blocks of cells.
- If an operation, such as statistics, takes a great deal of time, try to use as few selected blocks as possible. For example, instead of selecting entire columns, just select the block of cells containing the data.

KEYBOARD TIPS FOR SELECTING CELLS

You can always make any cell active by clicking on it with the mouse. The following keystrokes provide a variety of alternate ways to change which cell is active.

- ARROW keys (<Up>, <Down>, <Left>, <Right>) move the active cell to an adjacent cell.
- PAGE UP/PAGE DOWN moves the active cell up or down by the number of rows visible in the window.
- HOME moves the active cell to the first-used row. Pressing HOME again moves the active cell to the first row in the worksheet.
- END moves active cell to the last-used row. Pressing END again moves active cell to the last row of the worksheet.
- ENTER moves active cell down one row and ends the “edit mode” if data is being typed into the worksheet.
- TAB moves active cell right one column and ends the “edit mode” if data is being typed into the worksheet.
- SHIFT + ENTER moves active cell up one row and ends the “edit mode” if data is being typed into the worksheet.

- SHIFT + TAB moves active cell left one column and ends the "edit mode" if data is being typed into the worksheet.
- CTRL + HOME moves the active cell to the first cell in the worksheet (A1).
- CTRL + END moves the active cell to the last-used cell in the worksheet.
- The CTRL + LEFT ARROW behavior depends on the position of the active cell. If the active cell is right of the last-used column, it moves the active cell to the last-used column. If the active cell is right of the first-used column, and within the columns that contain data, it moves the active cell to the first-used column. Otherwise, CTRL + LEFT ARROW moves the active cell to the first column in the worksheet.
- The CTRL + RIGHT ARROW behavior depends on the position of the active cell. If the active cell is left of the first-used column, it moves the active cell to the first-used column. If the active cell is left of the last-used column and within the columns that contain data, it moves the active cell to the last-used column. Otherwise, CTRL + RIGHT ARROW moves the active cell to the last column in the worksheet.
- The CTRL + UP ARROW behavior depends on the position of the active cell. If the active cell is below the last-used row, it moves the active cell to the last-used row. If the active cell is below the first-used row and within the rows that contain data, it moves the active cell to the first-used row. Otherwise, CTRL + UP ARROW moves the active cell to the first row in the worksheet.
- The CTRL + DOWN ARROW behavior depends on the position of the active cell. If the active cell is above the first-used row, it moves the active cell to first-used row. If the active cell is above the last-used row and within the rows that contain data, it moves the active cell to the last-used row. Otherwise, CTRL + DOWN ARROW moves the active cell to the last row in the worksheet.
- If a block of cells is selected, the ENTER, TAB, SHIFT + ENTER, and SHIFT + TAB keys move the active cell within a group of selected cells without canceling the selection.

Entering Data in a Worksheet

When editing data in the worksheet window, you can either type information directly into each cell, or paste information from another cell or data file. This section describes how to perform these common procedures.

MANUALLY ENTERING DATA

To type information into a cell, the cell must first be selected (i.e. made active), usually by clicking in the cell with the mouse. When a cell is active, a box surrounds the cell in the worksheet, and its coordinates display in the **Active Cell Location** box in the upper left of the worksheet window. (See illustration on page 32.) This section shows you many different ways to select cells and manually enter data.

To enter data in an empty cell:	Click once in the cell you want to add to and then type the new value.
To edit the contents of a cell:	Click once in the cell whose value you want to edit. In the active cell edit box, make the desired changes to the value.
To overwrite the contents of a cell:	Click once in the cell whose value you want to overwrite and then type the new value.
	Double-click in the cell whose value you want to overwrite and then type the new value in the active cell edit box.
	Click once in the cell and press the F2 key, then type the new value into the active cell edit box.

Controlling Which Cell Gets the Focus after Editing

When editing a series of adjacent cells, use the following keystrokes to automatically activate the next cell in the series. In this way, you can just type the new values without having to manually select each cell.

Keystroke	**Action**
ENTER	Activates the cell directly below the one you are editing.
SHIFT + ENTER	Activates the cell directly above the one you are editing.
TAB	Activates the cell directly to the right of the one you are editing.
SHIFT + TAB	Activates the cell directly to the left of the one you are editing.

PASTING DATA BETWEEN DOCUMENTS

Data can easily be copied from another worksheet window or another spreadsheet program and pasted into a **Grapher** worksheet.

How to Copy and Paste Data:

1. In the document you are copying from, select the cell(s) containing the data that you want to copy.
    - To select an entire column, click on the column heading (i.e. click on the B for column B).
    - To select an entire row of cells, click on the row heading (i.e. click on the 2 for row 2).
    - To select a block of cells, click on one of the corner cells and drag the mouse until the desired block of cells are highlighted. Alternately, you can click on the corner cell of the block, hold down the SHIFT key, and click on the opposite corner of the block.

    Note: Non-adjacent cells, rows, or columns cannot be copied in a single operation. You must copy and paste each item separately.
2. Select **Edit | Copy**, or press CTRL + C.
3. In the target worksheet, select the cell where you want to paste the contents. Pasting overwrites any existing information in the cells.
    - When pasting multiple cells, the cell you select defines where the first (i.e. top left) cell is pasted.
    - If you copied an entire row and want to paste into a new row, select the row by clicking on its header cell.
    - If you want to paste into a new column, select that column by clicking on its header cell.
4. Select **Edit | Paste**, or press CTRL + V.

Editing a Worksheet

Grapher's Edit menu contains several standard edit options such as **Undo**, **Redo**, **Cut**, **Copy**, and **Paste**. See *Chapter 6, **Creating and Editing Objects*** for more details on these commands. Some of the edit commands have functions specific to the worksheet.

HOW TO UNDO / REDO EDITS

Use the **Edit | Undo** command to reverse any editing action (cut, copy, paste, delete, or clear) that you perform. **Grapher** has a multi-level undo, so you can select the command repeatedly to reverse your previous actions. The default number of times you can use the undo command is 10. To change this, go to **File | Preferences** from a plot window and change the *Number of Undo Levels*. The maximum undo level is 25.

Use the **Edit | Redo** command to reverse the effects of the last **Undo** command.

CUT, COPY, PASTE, CLEAR, AND DELETE

The **Edit** menu's **Cut**, **Copy**, **Paste,** and **Paste Special** commands allow you to move and copy information between documents.

Cut	Removes data from the selected cells and stores it in the Windows clipboard.
Copy	Copies data from the selected cells and stores it in the Windows clipboard.
Paste	Copies the contents of the Windows clipboard to the desired location on the Worksheet, determined by the active cell.
Paste Special	Similar to the Paste command, but this command allows you to choose the format of the pasted information.

For instructions on how these commands are used, see *Pasting Data Between Documents* in this chapter.

Clearing Data

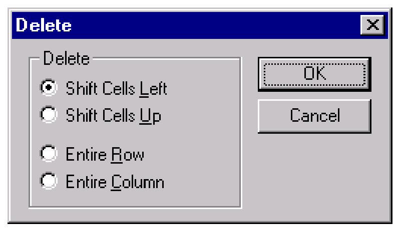
Use the **Edit | Clear** command to delete data from all of the selected worksheet cells. The **Clear** command does not delete the cells, just the data. If you want to delete the cells too, use the **Edit | Delete** command.

ADDING AND REMOVING CELLS

Deleting Cells from a Worksheet

Use the **Edit | Delete** command to delete entire cells, rows, or columns from a worksheet. This is different from the DEL key or the **Clear** command, which removes the data but leaves the cells empty. When an entire row or column is selected, this command removes the entire row/column, and the adjacent rows and columns are shifted to fill in the gap. When one or more cells are selected, the **Delete** dialog box opens, which gives options as to how the surrounding cells should be shifted.

Click either the *Shift Cells Up* or the *Shift Cells Left* option button and then click *OK*. The selected cells are deleted and the contents of cells below or to the right are moved to fill the deleted block. Click *Entire Row* or *Entire Column* to delete the entire row or column that contains highlighted cells. To leave the selected cells empty when the data are removed, use the **Edit | Clear** command, press the DEL key, or use the **Edit | Cut** command.

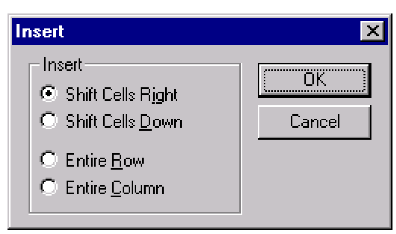


Removing cells from a worksheet

Adding Cells to a Worksheet

Use the **Edit | Insert** command to add new rows, new columns, or any number of blank cells to a worksheet.

- To add a new column: Select the column located where you want the new one to be placed, and then select the **Edit | Insert** command. The highlighted column is shifted to the right, and a new blank column appears. You can select multiple adjacent columns to insert the same number of new blank columns.
- To add a new row: Select the row located where you want the new row to be placed, and then select the **Edit | Insert** command. The highlighted row is shifted down and a new blank row appears. You can select multiple adjacent rows to insert the same number of new blank rows.
- To add a group of cells to a worksheet instead of either columns or rows: Select the area where you want the new blank cells to be placed, and then select **Edit | Insert**. Use the **Insert** dialog box to indicate how the selected cells are to be relocated, then click *OK*.



Adding cells to a worksheet

- The *Shift Cells Down* option moves the selected cells below the new ones you are inserting.

- The *Shift Cells Right* option moves the selected cells to the right of those you are adding.
- Click *Entire Row* or *Entire Column* to insert an entire row or column in the area that contains highlighted cells.

Formatting a Worksheet

The **Format** menu contains several options for changing the display of the worksheet information. Modify cell width and height, set cell background color, align text within cells, and format the number display with **Format** menu commands.

SETTING ROW HEIGHT AND COLUMN WIDTH

Column Width

If a cell number is too long to fit within the cell, a series of pound signs (####) are shown in the cell. Increase the column width to show the number rather than the pound signs. Change the **Column Width** of selected cells by typing a value into the *Column Width* edit box, or by using the mouse to resize the column. The Excel [.XLS] or SYLK [.SLK] file format must be used to save the column width with the file, since ASCII files ([.CSV], [.TXT], [.DAT], [.BLN], and [.BNA]) do not save format information.

To set column widths or to hide columns, select either the entire column or individual cells within the column, and select **Format | Column Width**. For information on selecting columns, see *Mouse Tips for Selecting Cells* in this chapter. Enter the width for the selected column or cells in the **Column Width** dialog box. Columns can range from 0 to 512 characters wide. The value zero (0) hides the column.

Alternatively, you can change the column width with the mouse. When the cursor is moved to the line that defines the right boundary of the column to be resized, the cursor changes to a line with two arrows. Click and hold the left mouse button and move the cursor to the left or right to change the width of the column. Hide a column by moving the cursor to the left until the next dividing line is reached. To display hidden columns, click and hold the left mouse button at the right edge of the hidden column. Move the cursor to the right to widen the column.

Row Height

Change the **Row Height** of selected cells by typing a value into the *Row Height* box, or by using the mouse to resize the row. The Excel [.XLS] or SYLK [.SLK] file format must be used to save the row height information with the file, since ASCII files ([.CSV], [.TXT], [.DAT], [.BLN], and [.BNA]) do not save format information.

To set row heights or to hide rows, select the entire row (or the individual cells in the rows), then select **Format | Row Height**. For information on selecting rows, see *Mouse Tips for Selecting Cells* in this chapter. Enter the height for the selected row in the **Row Height** dialog box. Rows can range from 0 to 512 characters in height. A value of zero hides the row.

The row height can also be changed with the mouse. When the cursor is moved to the line that defines the lower boundary of the row to be resized, the cursor changes to a line with two arrows. Click and hold the left mouse button, move the cursor up or down to change the height of the row. Hide a row by moving the cursor up until the next dividing line is reached. To display hidden rows, click and hold the left mouse button at the bottom of the hidden row and drag the cursor down to increase the row height.

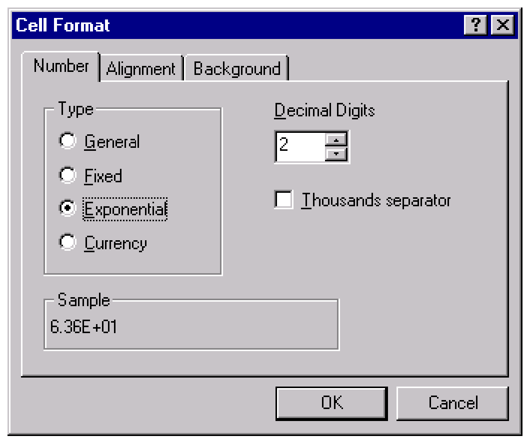
Setting Cell Properties

Use **Grapher's Cell Format** dialog box to change the way that information displays in the worksheet window. For instance, you can change the format used to display numbers (exponential, currency, etc.), the way characters are aligned in the column, and the background color of the cells. You can access the **Cell Format** dialog box by first highlighting the cell or group of cells. Then, go to **Format | Cell Properties,** right-click on the cells and choose **Format Cells**, or by pressing ALT + ENTER.

Numeric Formats

To change the format used to display numeric data in the worksheet, select the cells you want to edit (or an entire row/column) and choose **Format | Cell Properties**. On the **Number** tab, select the type of numeric format you desire. Number formatting has no effect on a numeric text string (numbers entered as text). For example, an ASCII data file might contain the numbers "8123" (numbers surrounded by quotes) which are read as text and not as a number.

The following options are on the **Number** tab:



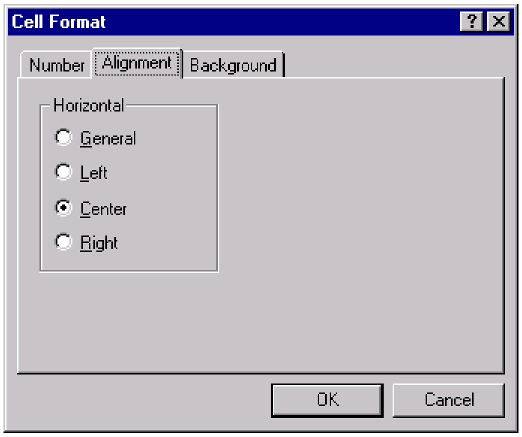
Set the numeric format in the worksheet.

- *General* displays numbers with as many digits as possible within the available cell width.
- *Fixed* displays numbers as d.ddd. The number of digits to the left of the decimal can vary. Set the number of digits to the right of the decimal in the *Decimal Digits* edit box.
- *Exponential* displays numbers as d.ddde+ddd. Set the number of digits to the right of the decimal in the *Decimal Digits* edit box.
- *Currency* displays fixed numbers with a dollar sign. Set the number of digits to the right of the decimal in the *Decimal Digits* edit box.
- If the *Thousands separator* box is checked, a comma appears every three digits to the left of the decimal point.

Click *OK* to apply the new numeric format setting to the selected cells.

Character Alignment

To change the alignment of characters within the cell, select the cells you want to edit (or an entire row or column), then select **Format | Cell Properties** and click on the **Alignment** tab to view the various options.



Align data in a cell.

Entries in a cell can be aligned in one of the following four ways:

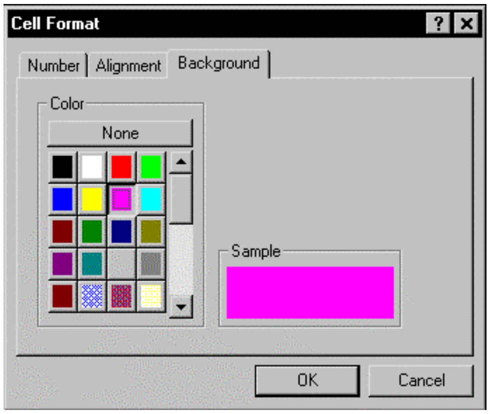
- *General* aligns text on the left side of the cell and numbers on the right side.
- *Left* aligns text and numbers on the left side of the cell.
- *Center* centers text and numbers in the cell.
- *Right* aligns text and numbers on the right side of the cell.

Imported ASCII files automatically use the *General* option, aligning numbers to the right and text to the left.

Click *OK* to apply the new alignment settings.

Background Color

You can make your worksheets easier to work with by changing the background color of the cells to identify particular types of data.



Add background color to the worksheet.

To change the background color, select the cells you want to be affected (or an entire row or column), select **Format | Cell Properties**, and then choose **Background** to view the color palette.

From the *Color* group box, click on the color that you want to apply to the cell backgrounds. The selected color appears in the *Sample* box.

To remove all background colors, click on the *None* button at the top of the palette.

Click *OK* to apply the color to the cells.

Sorting and Transforming Data

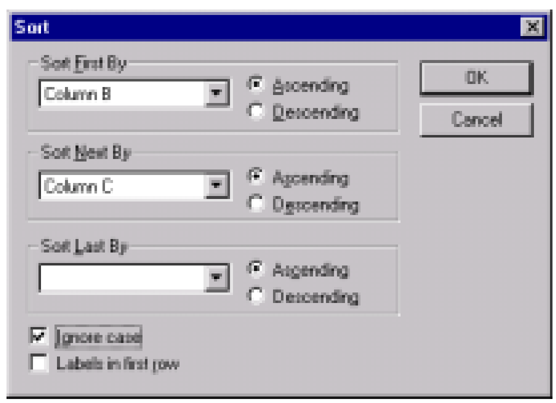
Selected cells of data can be sorted or transformed using the commands on the **Data** menu.

SORTING DATA

You can easily sort data in a **Grapher** worksheet, regardless of whether the cells contain numbers, text, or a mixed column of both text and numbers. To perform a sort, highlight the cells or columns that you want to include in the sort, then select **Data | Sort** to open the **Sort** dialog box.

IMPORTANT: Sorting a single column only affects that column. If your data consists of several columns that are inherently related, you must select all columns when doing a sort. This is true even if you are only sorting on one of the columns. For example, consider two columns containing X and Y coordinates, respectively. Since each X value has a corresponding Y value, you want to make sure that each (X, Y) pair stays together, regardless of which column is sorted. This is achieved by highlighting both columns before using the **Data | Sort** command.

The following options are available in the **Sort** dialog box:



Set the sort order of data columns.

- *Sort First By:* This option specifies the primary column on which the rows are sorted. The *Ascending* or *Descending* rank in the *Sort First By* column determines the positions of the sorted rows.
- *Sort Next By:* When two or more rows have identical entries in the *Sort First By* column, the *Sort Next By* column further organizes the data set. Duplicates in the *Sort First By* column are then sorted according to the rank in the *Sort Next By* column.
- *Sort Last By:* In the event that the *Sort First By* and *Sort Next By* columns contain the same value, use this field to set another level of search criteria to organize the order.

About the Sort Order

Sorting rank is based on numbers, ASCII characters, and punctuation.

The sort order in an *Ascending* sort is based on the dictionary sort order. Numeric values are placed first, followed in order by cells starting with a space character, punctuation characters, numeric text (numbers entered as text), letters, and blank cells. *Descending* sort order is the opposite of *Ascending* sort order.

Lower case letters are normally sorted before upper case letters. When *Ignore case* is activated, “A” is considered identical to “a” in the sorting rank.

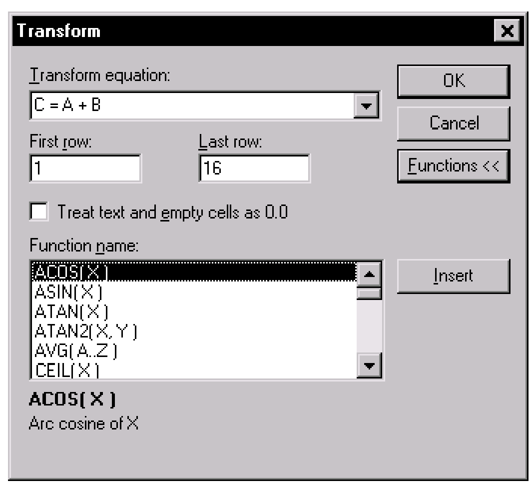
The data set may contain text identifying the data in the column (header information) in row 1. In this case, click the *Labels in first row* option to exclude the label row from the sort process.

DATA TRANSFORMS

Grapher allows you to assign a mathematical transformation to a column. This means that the values in the column are automatically generated by an equation. Transform equations typically use the data from other columns, connected by mathematical operators, such as +, -, *, and /. A large library of advanced mathematical functions is also available. (See *Appendix A, Mathematical Functions* for a list of mathematical functions.)

Constructing a Data Transform

1. Select **Data | Transform**. The **Transform** dialog box opens.
2. In the *Transform equation* field, type the formula using the appropriate column labels on each side of the equation. (If you already entered this equation once before, you can click the down arrow key and select it from the drop-down list.)
3. You can edit which rows to apply the equation by specifying the range in the *First row* and *Last row* fields.
4. Type OK when the equation is complete.



*Use the **Transform** dialog box to build a transform equation in **Grapher**.*

Example

An example of a formula is C = A + B. Set the *First row* option to 1 and the *Last row* option to 25. The formula adds the value in column A and column B and enters the result in column C for each of the rows 1 through 25.

Tips for Building Equations

Use the following guidelines when typing an equation into the **Transform** dialog box.

- Formulas always consist of a destination column on the left side of the equation and a mathematical formula on the right side of the equation. In general, you should have column label letters on both sides of the equation. For example: D = (A + B)/C
- The math operators that can be used in a formula include addition (+), subtraction (-), multiplication (*), and division (/), plus the predefined library of mathematical functions.
- When constructing formulas, use parentheses to set or override the order in which calculations are performed. For example: E = ((A + B)/C) - 2*D
- If a cell contains text or is empty, the formula is not calculated for that row unless you have placed a check mark in *Treat text and empty cells as 0.0*.
- To insert a predefined math function into the equation, click the *Functions* button, select the desired function from the list, and click *Insert*.
- When using predefined functions, change the default variable (X) in the function to the appropriate column letter in the transformation equation.

Data Statistics

Grapher allows you to generate a statistical analysis of your worksheet data. The default statistics report performs common statistical operations on the data in each column and reports such values as the sum, minimum value, maximum value, the mean, median, and standard deviation.

Grapher lets you view the statistics report in a separate window (where it can be viewed or copied and pasted to another document), or you can have it added directly to your worksheet.

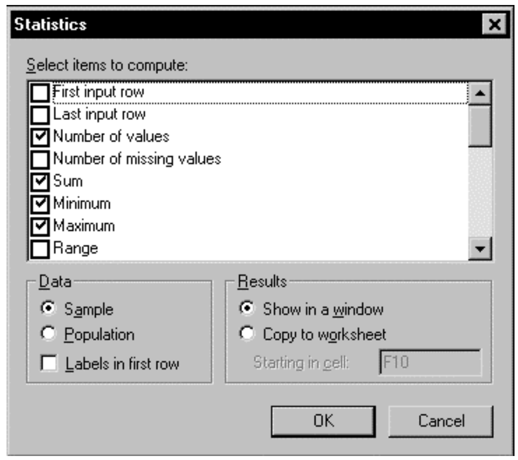
	Column B	Column C	
Number of values	2	2	
Sum	116.9	113.1	
Minimum	57.2	54.2	
Maximum	59.7	58.9	
Mean	58.45	56.55	
Standard deviation	1.768	3.323	

A statistics report can appear in a separate window or in the worksheet window.

CREATING A STATISTICS REPORT

1. Select the columns or the block of cells that you want included in the report. Non-numeric cell entries (empty cells or text) are excluded in statistics calculations.
2. Select **Data | Statistics**. The **Statistics** dialog box opens.
3. In the *Select items to compute* window, check each type of statistical value that you want to include in the report.

   See *Statistics Report Options* on the next page for descriptions of each item.
4. In the *Data* group box, select *Sample* or *Population* depending on whether the data represent a statistical sample or the complete set of all possible members of a group.



Setting up a statistics report

   If the first row of the selection contains descriptive labels and you want to include the labels in the report, check the *Labels in first row* box.
5. In the *Results* group box, select the desired option:
   - *Show in a window* writes the statistics results to a separate window. The results in this window can be copied to the clipboard.
   - *Copy to worksheet* writes the data to part of the current worksheet. Use the *Starting in cell* text box to specify the cell for the upper left corner of the statistics report. If the specified destination cells contain data, a warning is displayed that data will be overwritten. Click *OK* to overwrite the data or click *Cancel* to select a new *Starting in cell* location.
6. Click *OK* to generate the statistics report.

STATISTICS REPORT OPTIONS:

First Input Row	Reports the first row number in the selection. If the *Labels in First Row* option is checked, the *First Input Row* is the second row in the selection.
Last Input Row	Reports the last row number containing data in the column.
Number of Values	Indicates the number of numeric cells in the column.
Number of Missing Values	Indicates the number of non-numeric cells in the selection. If columns are selected by clicking the column letters, the number of missing values includes blank values up to the last used row in the worksheet, which may be different from the last-used row in the selected column. If cells are selected by highlighting specific cells, then only the blank cells within the selection are counted.
Sum	The sum of all numeric cells in the column.
Minimum	Indicates the minimum value in the column.
Maximum	Indicates the maximum value in the column.
Range	Indicates the range of the numeric values in the column (Maximum – Minimum).

Mean

The arithmetic average of the data values. It is the sum of the data values divided by the number of data values.

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

where:

n = number of data values
x_i = i-th data value

Median

The middle value among the data values. Half of the data values are larger than the median and half are smaller than the median. When there is an even number of data values, the median is the average of the two middle values.

First Quartile

(25th percentile)

The values such that one-fourth of the data values are smaller than the quartile and three-fourths of the data values are larger than the first quartile.

Third Quartile

(75th percentile)

The value such that three-fourths of the data values are smaller than the quartile and one-fourth of the data values are larger than the third quartile.

Standard Error of the Mean

This is an estimate of the standard deviation of means that would be found if many samples of *n* items were repeatedly collected from the same population.

Suppose many samples of size *n* were repeatedly collected from the same population and the means of these many samples were calculated. The means of the samples would themselves form a data set. The standard error of the mean is an estimate of the standard deviation of this theoretical sample of means.

$$SE = s / \sqrt{n}$$

where:

s = sample standard deviation
n = number of data values (for a sample)

95% Confidence Interval for the Mean

and

99% Confidence Interval for the Mean

If CI is the value of the confidence interval reported by the worksheet, the range of values between the mean minus CI and the mean plus CI is expected to include the true mean of the underlying population 95% of the time (for the 95% confidence interval) or 99% of the time (for 99% confidence interval). This formula assumes that the data set is sufficiently large for the central limit theorem to apply.

95% Confidence Interval for the Mean

$$\pm t_{(n-1),\alpha=.05}(SE)$$

99% Confidence Interval for the Mean

$$\pm t_{(n-1),\alpha=.01}(SE)$$

where:

t_v,α = the value of the Student's t distribution with v degrees of freedom such that difference between the cumulative probability function evaluated at t (v, α) and -t (v, α) is equal to 1-α

SE = standard error of the mean

Variance

The population variance is the average of the squared deviations from the mean. The sample variance is the sum of the squared deviations from the mean divided by one less than the number of data values.

Population Variance

$$\sigma^2 = \frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2$$

Sample Variance

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \overline{x})^2$$

where:

μ = population mean

$\overline{x}$ = sample mean

N = number of data values (for a population)

n = number of data values (for a sample)

x_i = i-th data value

Average Deviation

The average of the difference between the absolute values of data points and the mean.

Population Mean Deviation

$$MD = \frac{1}{N}\sum |(x_i - \mu)|$$

Sample Mean Deviation (MD)

$$MD = \frac{1}{N}\sum |(x_i - \overline{x})|$$

where:

μ = population mean

$\overline{x}$ = sample mean

N = number of data values (for a population)

x_i = i-th data value

Standard Deviation

The square root of the variance.

Population Standard Deviation

$$\sigma = \sqrt{\sigma^2}$$

Sample Standard Deviation

$$s = \sqrt{s^2}$$

where:

σ^2 population variance
s^2 sample variance

Coefficient of Variation

This is the standard deviation divided by the mean. The worksheet reports the quotient; it does not convert the value to a percentage. The coefficient of variation is a dimensionless measure of variation. This statistic is not defined for the case of a zero mean. This measure is only useful when dealing with strictly positive data.

Population Coefficient of Variation

$$V = \sigma / \mu$$

Sample Coefficient of Variation

$$V = s / \overline{x}$$

where:

σ = population standard deviation
s = sample standard deviation
μ = population mean
$\overline{x}$ = sample mean

Coefficient of Skewness

This is a measure of asymmetry in the distribution. A positive skew indicates a longer tail to the right, while a negative skew indicates a longer tail to the left. A perfectly symmetrical distribution, like the normal distribution, has a skew equal to 0. For small data sets, this measure is unreliable.

Population Skew

$$\gamma_1 = \frac{1}{N\sigma^3}\sum_{i=1}^{N}(x_i - \mu)^3$$

Sample Skew

$$g_1 = \frac{1}{ns^3}\sum_{i=1}^{n}(x_i - \bar{x})^3$$

where:

σ = population standard deviation
s = sample standard deviation
μ = population mean
$\bar{x}$ = sample mean
N = number of data values (for a population)
n = number of data values (for a sample)
x_i = i-th data value

Coefficient of Kurtosis

This is a measure of how sharp the data peak is. Traditionally the value of this coefficient is compared to a value of 0.0, which is the coefficient of kurtosis for a normal distribution (i.e. the bell-shaped curve). A value greater than 0 indicates a peaked distribution and a value less than 0 indicates a flat distribution. Without a very large sample size, the use of this coefficient is of questionable value.

Population Kurtosis

$$\gamma_2 = \left(\frac{1}{N\sigma^4} \sum_{i=1}^{N} (x_i - \mu)^4 \right) - 3$$

Sample Kurtosis

$$g_2 = \left(\frac{1}{ns^4} \sum_{i=1}^{n} (x_i - \bar{x})^4 \right) - 3$$

where:

σ = population standard deviation
s = sample standard deviation
μ = population mean
$\bar{x}$ = sample mean
N = number of data values (for a population)
n = number of data values (for a sample)
x_i = i-th data value

Kolmogorov-Smirnov Goodness of Fit Statistic

This measures how well the data match a normal probability distribution. The K-S statistic is the largest difference between a normal distribution (with a mean equal to the sample mean, $\bar{x}$, and a standard deviation equal to the sample standard deviation, s) and the actual frequency distribution of the data.

Critical Value of Kolmogorov-Smirnov Statistic at 90%/95%/99% Confidence Level

The critical values of the Kolmogorov-Smirnov statistic are the values such that if a sample is collected from a population, with a normal frequency distribution, then the K-S statistic for that sample is less than the critical value 90, 95, or 99 percent of the time. If the K-S statistic is larger than the critical value, then the hypothesis that the underlying population is distributed normally with a mean of $\bar{x}$ and a standard deviation of *s* should be rejected.

Saving Data Files

To save any file, select **File | Save**, or click on the icon in the toolbar.

If the file has not been saved before, the **Save As** dialog opens so you can enter a name and location for the file.

Select the file format for the file in the *Save as type* drop-down list box. You can save as [.XLS], [.SLK], [.CSV], [.TXT], [.DAT], [.BNA], and [.BLN] formats in the worksheet.

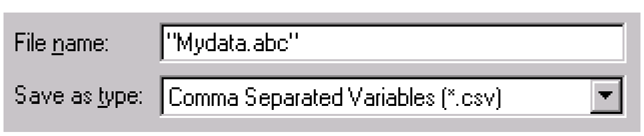
SAVING EXCEL FILES

Grapher does not allow for saving multiple worksheets in a single Excel document. If a multi-worksheet Excel document is opened and saved as an [.XLS] file from **Grapher**, be aware that only the single worksheet is saved in the document. All other worksheets are deleted from the file. In this case, a warning message is issued before the file is saved.

FILE NAMES, FORMATS, AND FILE EXTENSIONS

When a worksheet file is saved, the file format is specified by entering the appropriate extension on the file name. If the needed file is an ASCII [.DAT] file, enter a file name such as MYDATA.DAT. The [.DAT] extension tells the worksheet to save the file in the ASCII [.DAT] file format.

If the extension is not included in the file name, the format is determined by the *Save as type* field. For example, if the name MYDATA is entered into the *File name* field and the *Save as type* field is set to *Excel Spreadsheet (*.xls)*, the file is saved as MYDATA.XLS in the Excel format.



The MYDATA.ABC file is saved in [.CSV] format with the [.ABC] extension by surrounding the File name with quotes.

The file can be saved with any extension by enclosing the file name in double quotes. The file is saved with the name and extension entered into the *File name* box, but saved in the format specified in the *Save as type* field. For example, enter the name (with quotes) “MYDATA.ABC” in the *File name* box. If the *Save as type* field is set to *Comma Separated Variables (*.csv)*, the file is saved as MYDATA.ABC in the [.CSV] format.

SAVING ASCII DATA FILES

There are some distinctions in formatting of ASCII files. Delimiters control the separation between cell entries in a file. Spaces, tabs, semi-colons, or commas can be used to separate cells. If cell entries contain spaces within text, comma or semi-colon delimiters are necessary if quotes are not used to qualify the text. Otherwise, the text string would be interpreted as multiple cell entries rather than a single entry.

There are two types of entries in an ASCII file: values and text. Values are actual numbers, while text can be any type of alphanumeric character, including punctuation characters. Single or double quotes can be placed around text strings when saving the file. If a number should be interpreted as text, surround it with double quotes. When text strings contain spaces, it is recommended to use single or double quotes around text cell entries. When saving an ASCII file, text is separated by the *Text Qualifier*. A *Text Qualifier* can be double-quotes or single-quotes. For example, if double-quotes are chosen, all non-numeric or mixed alpha numeric cell entries are surrounded by double-quotes in the file.

When a file is saved in the [.DAT] format, the **GSI Data Export Options** dialog box is displayed with the following options:

- *Delimiter* is the character used between cells in a single row (fields in a record), and can be commas, spaces, semicolons, or tabs.
- *Text Qualifier* is the character used to denote that the next entry is text. With a [.DAT] file, double-quotes, or single-quotes can be used, or you can choose to use none. For example, if double-quotes are chosen all non-numeric or mixed alpha numeric cell entries are surrounded by double-quotes in the file.

[.TXT] files are tab delimited ASCII text files with no quotes around the text strings. [.CSV] (comma separated variables) files are comma delimited with double-quotes around text strings (non-numeric or mixed alpha numeric).

Using Commas or Semicolons in Addition to Quotes

Although quotes are not required around text strings, they are useful when creating a space-delimited file that contains text. Often there are text strings that contain spaces, as in a date containing month, day, and year. With space delimited files this single entry is interpreted as three cells when loading this file into the worksheet. The safest way to eliminate this problem is to place double quotes around all text strings and use comma or semicolon delimiting between variables.

Creating Data Files from Function Plots and Fit Curves

There are several instances in **Grapher** where plots are created directly from known functions or equations, such as function plots and fit curves. These plots are not generated from data files; however, you can use the **Graph | Export Plot Data** command to create a data file from these functions.

This process works for function plots and fit curves for line/symbol plots, step plots, polar plots, and histograms.

1. Select just the plot (without axes) of either a function plot or a fit curve. Use the **Object Manager** to make sure you select the right plot.
2. Select **Graph | Export Plot Data**.
3. A worksheet window opens, showing the data for the selected plot. To save the data file, select **File | Save** and choose the desired file format.

   Note: For histograms, the worksheet shows the number of points in each bin, the upper limit of the bin, and the cumulative frequency. The cumulative frequency is the current count plus the previous bin's counts.

Creating a Data File from a Graph

When viewing a plot window, the **Graph | Digitize** command can be used to create a data file from a graph. Use the **Digitize** command to collect points in the graph's X, Y coordinates. The **Digitize** command is used to collect coordinates from the graph, not to add drawing objects to the graph. However, a [.BLN] or [.BNA] file can be created from the coordinate file, and then imported into the graph. Please see the online help system for more information on [.BLN] and [.BNA] file formats. Alternately, a [.DAT] file could be created. This new data file can be used to create a new graph or to add a curve to an existing graph. Only a plot can be selected to activate the command. If any other objects are selected (i.e. entire graphs, axes, titles, or drawing objects) the **Digitize** command is not available. This process works only for plots.

Use the **Graph | Digitize Fixed** command to digitize points directly on the plot. This command "locks" the crosshair cursor to the selected plot so that you can only digitize points on the plot.

1. Select a plot.
2. Select **Graph | Digitize** or **Graph | Digitize Fixed**. The arrow pointer changes to a crosshair.
3. Digitize points by clicking with the left mouse button on the graph. The digitized points appear as small red crosses on the screen. The digitized point coordinates appear as text in a report window.
4. Save the contents of the report window by selecting **File | Save** from that window.

Printing Worksheets

Grapher adheres to the standard Windows print dialogs and options.

To Print the Current Worksheet Document:

1. Make sure your printer is powered on.
2. Select **File | Print** or click on the  icon in the toolbar. The **Print** dialog box opens.
3. Select the desired printer, print range and number of copies. If you need to configure your printer settings, click the *Properties* button.

   Note: If you have questions about any of the options in the **Print** dialog box, press the F1 key to view the online help.
4. Click *OK* to send the job to the printer.
   - Depending on how the page setup options are specified, **Grapher** prints as many columns or rows as possible on the first page, then resumes printing on a new page until all of the data has been printed.
   - The worksheet values are printed exactly as they appear on-screen, so any numbers cropped on-screen are cropped on the print-out.

Page Setup Options

Before printing a worksheet you can adjust the page format, including page orientation, headers and footers, centering the data on the page, showing gridlines, and more. These options are available on the **Page Setup** dialog box (**File | Page Setup**). This dialog has three tabs, described below.

Page Tab

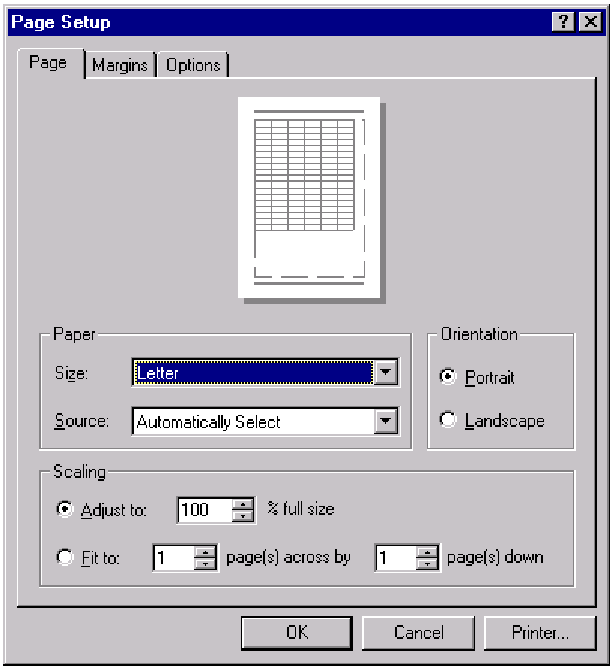
The options in the *Paper* group box specify the paper *Size* and *Source* for the active printer.

The *Orientation* group box lets you decide whether to print on the page in *Portrait* or in *Landscape* mode.

The options in the *Scaling* group box control the print size for the worksheet, so you can fit more information on each page. There are two options with *Scaling:*

- The *Adjust to ___ % full size* option specifies the percent of full size that the worksheet prints. The arrow buttons can be used to scroll up or down from 100% (full size), or a value can be typed into the edit box. The amount of data in the worksheet determines how many pages are required to print the worksheet. This is independent of the *Fit to* option described below.

  The % can be greater than 100% to print at a larger scale than what is on the page. It can be less than 100% to print at a smaller scale. Setting the scale to 50% produces a print-out that is half the size of the original. Setting the scale to 200% produces a print-out that is twice the size of the original.



Setting paper size, print orientation, and scaling options

- The *Fit to __ page(s) across by __ page(s) down* option tells the program to print the worksheet at 100% scale or less. This option does not automatically scale the printed worksheet at greater than 100%. This is most useful when the worksheet is large and the number of printed pages needs to be limited.

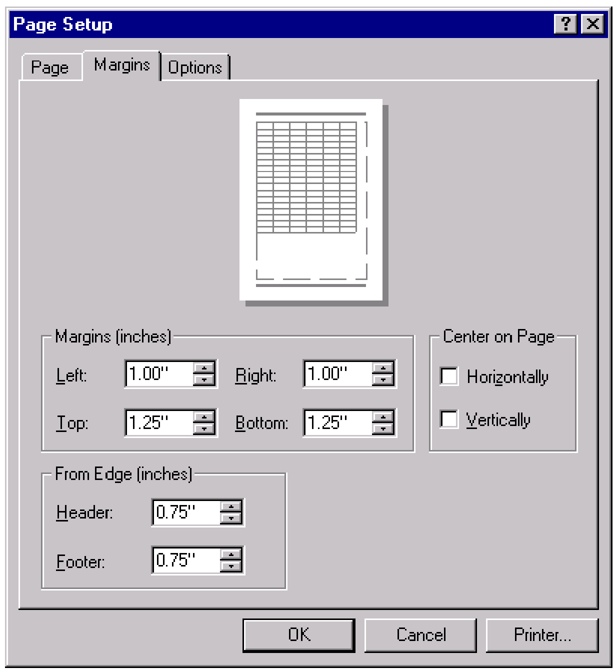
Margins Tab

Use the *Margins* group box options to set the page margins on each edge of the printed page. Set the *Left*, *Right*, *Top*, and *Bottom* values in inches to the desired limits. If you exceed the allowable margin limits of your printer, an error message tells you to change the margins. The margin settings are independent of the settings used for *Headers* or *Footers*, which print outside of the margins.

The *Center on Page* group box options center the printout *Horizontally* and/or *Vertically*. If neither option is selected the worksheet begins printing in the upper left corner of the page.

The *From Edge* options control how far the *Header* or *Footer* is printed from the edge of the page. *Headers* and *Footers* are the only items that print outside the page margins.

If the values in the *From Edge* group box are greater than the values in the *Top* and *Bottom Margins* group box, the worksheet data may print over the header or footer. The text printed for the header and footer is set on the **Options** tab.



*The **Margins** tab of the **Page Setup** dialog box*

Options Tab

The options in the *Print* group box control which parts of the worksheet are printed.

Check the *Gridlines* check box to draw gridlines separating each column and row on the printout.

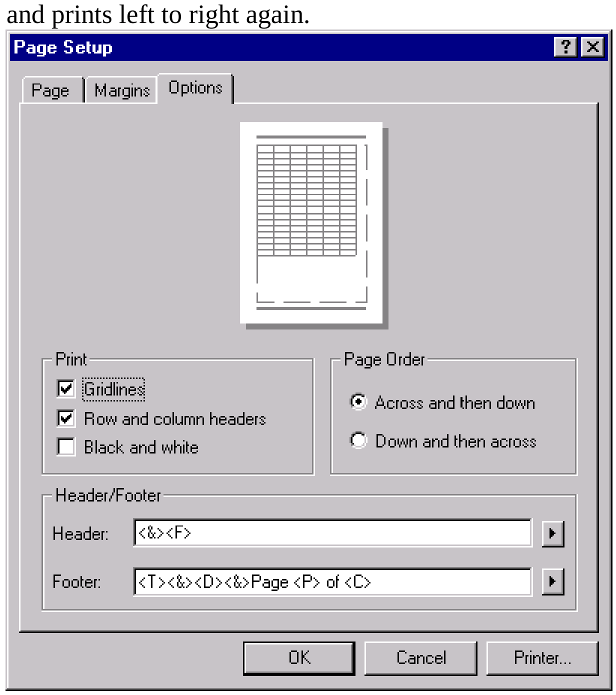
Check the *Row and column headers* option to print the column letters and row numbers of the worksheet on the print-out.

If the cells contain color backgrounds (set from the **Format | Cell Properties** command), use the *Black and white* option to print the worksheet in black-and-white. If the *Black and white* option is not checked, colors print as shades of gray on a black and white printer.

The *Page Order* group box options control the order in which multiple pages are printed.

- The *Across and then down* option prints from left to right until it reaches the far right edge of the worksheet, and then moves down and prints left to right again.
- The *Down and then across* option prints the worksheet from top to bottom until it reaches the bottom edge of the worksheet, and then moves to the right and prints top to bottom again.

The *Header/Footer* group box options control the type of information included in the worksheet headers and footers. The *Header* appears at the top of the page, and the *Footer* appears at the bottom of the page. The *Header* and *Footer* are spaced from the edge of the page based on the *From Edge* option of the **Margins** tab. Descriptive text can be typed in the *Header* and *Footer* boxes, or click the arrows to the right of the boxes and select automatic options from the list.



Setting print, page order, and header/footer options.

Automatic Header/Footer Codes:

File Name	<F>	Prints the name of the active file. The drive and path are not included.
Page Number	<P>	Prints the page number for each page. When several pages are printed, the order of printing is controlled from the *Page Order* group box.
Total Page Count	<C>	Prints the total number of pages required to print out the worksheet.
Current Date	<D>	Prints the current date.
Current Time	<T>	Prints the current time.
Left/Center/Right Separator	<&>	Separates the header and footer text. Too many separators can push text off the page. If this happens, remove the <&> separator and use spaces instead.

Examples:

For a six page document, <&><&>Page <P> of <C> would print the current page number of total pages right justified:

Page 1 of 6

Enter Joe Smith<&><F><&><D> to print out a name, file name, and date:

Joe Smith   COLORADO.DAT   9/11/97

Technical Limits of Worksheets

WORKSHEET SIZE AND MEMORY REQUIREMENTS

The maximum number of rows and columns in a worksheet is 5,000,000 (5 million) each. The approximate memory requirements for unformatted numeric data are 10.5 bytes per cell and 24 bytes per column. Based on that, the following are examples of memory requirements:

Example 1: 10,000 rows of numbers in three columns

30,000 cells x 10.5 bytes/cell = 315,000 bytes (308 Kbytes)

3 columns x 24 bytes/column = 72 bytes

TOTAL MEMORY NEEDED (in addition to memory needed to run the program): 380 Kbytes

Example 2: Three rows of numbers in 10,000 columns

30,000 cells x 10.5 bytes/cell = 315,000 bytes (308 Kbytes)

10,000 columns x 24 bytes/column = 240,000 bytes (234 Kbytes)

TOTAL MEMORY NEEDED (in addition to memory needed to run the program): 542 Kbytes

NUMERIC VALUE LIMITS

The maximum numeric precision is 15 digits. This number includes the digits before and after the decimal place. The maximum numeric resolution is 2.22E-16. Numeric resolution is the smallest detectable difference between two numbers. The maximum absolute value is 1.79769E+308. The maximum absolute value is the largest value that can be represented. The minimum absolute value is 2.22507E-308. The minimum absolute value is the smallest value different from zero.

Chapter 4

Creating Graphs

Creating Graphs

There are thirteen different types of plots available in **Grapher**:

- Line/Symbol Plot
- Step Plot
- Bubble Plot
- Bar Chart
- Floating Bar Chart
- Hi-Low-Close Graph
- Function Graph
- Pie Chart
- Polar Graph
- Rose Diagram
- Histogram
- Box-Whisker Plot
- Ternary Diagram

Multiple graphs can be created in a single document, and in some cases different plot types can be combined in one graph. For example, a bar chart and a line/symbol plot can share the same axes. Many properties of a graph can be changed including line style, line color, symbols or labels for data points, and whether a fit curve or error bars should be included. Most of these general properties are the same for each type of graph and are discussed in detail at the end of this chapter.

THREE WAYS TO CREATE A GRAPH

There are three ways to create a graph in **Grapher**. The details of each plot type are discussed in their respective sections in this chapter.

1. Use the **Graph Wizard**. The **Graph Wizard** steps you through the graph making process. This is often the simplest way to make the graph if you are not familiar with **Grapher**. The **Graph Wizard** is available in the plot window under the **Graph** menu. The default graph parameters are used to create the graph.
2. If you are in the plot window, you can choose any graph type from the **Graph | New Graph** menu. You are prompted for a data file and then a graph properties dialog box appears, allowing you to adjust the graph.
3. If you are working with the data in the worksheet, you can create a graph by selecting the columns you wish to plot, and then choosing the graph you would like to make from the **New Graph** menu. The default graph parameters are used to create the graph.

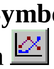
For information on changing the default graph properties, refer to *Editing Existing Plots* in *Chapter 7, Modifying Graphs*.

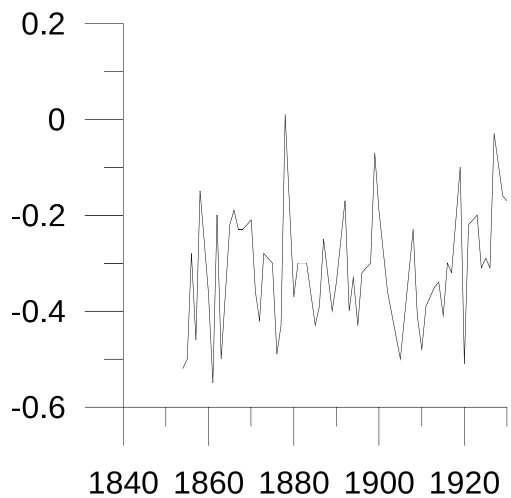
Line/Symbol Plots

Use the **Graph | New Graph | Line/Symbol** command to display your data as a traditional line plot, a scatter plot, or a combined line and symbol plot. A line plot shows lines connecting the data points in the order that they appear in the data file. Scatter plots show the same data with symbols at each data point and without the connecting line. A line/symbol plot shows the line connecting the points and symbols at each data point.

Error bars, data point labels, and fit curves can be added to a line/symbol plot. These options and others are contained in the **Line/Symbol Plot** dialog box.

CREATING A LINE/SYMBOL PLOT

1. Select **Graph | New Graph | Line/Symbol** or click the line/symbol graph button  on the toolbar.
2. Select a data file from the **Open Worksheet** dialog box and click *Open*.
3. In the **Line/Symbol Plot** dialog box, set the desired plot options. By default, a line plot is created.



A line plot made with data from Sample1.dat.

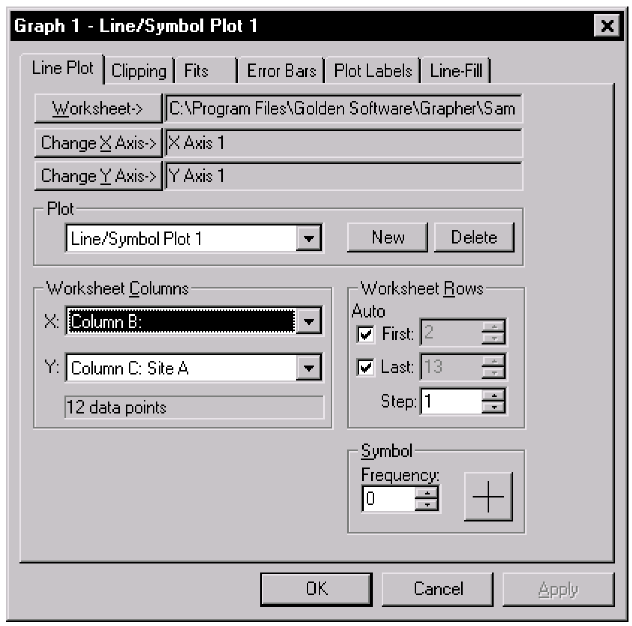
- Use the **Line Plot** tab to select the worksheet and axes, assign which worksheet columns to plot, specify the range of data, assign symbols to the data points, and add new plots or delete existing plots.
- To truncate (i.e. "clip") your plot within a fixed range of values or assign null values to your data set, use the options on the **Clipping** tab. See *Clipping a Plot* on page 133 in this chapter.
- You can compare your plot to known mathematical curves by adding a predefined fit curve to your graph. This is done using the options on the **Fits** tab. In addition to the ten predefined fit curves, you can also create custom curve functions. See *Fit Curves* on page 139 of this chapter.
- You can graphically represent the uncertainty in your data points by adding error bars to your plot. This is done using the options on the **Error Bars** tab. See *Adding Error Bars to a Line/Symbol Plot* on page 76.
- You can add labels to your data points using the options on the **Plot Labels** tab. A label can show the X or Y value of a data point, or it can show some other value or text label stored in the current worksheet. See *Plot Labels* on page 150.
- To change the line style (solid, dashed, thick, thin, etc.), change line color, add "heads" to the ends of the line, or shade the area above or below the line, use the settings on the **Line-Fill** tab. See *Line and Fill Properties* on page 156.

THE LINE PLOT TAB

Use the **Line Plot** tab to change the worksheet or axes used in the plot, select data for the curve, add symbols to the curve, and to add additional curves or delete selected curves from the graph.

Worksheet button

Use the *Worksheet* button to change which data file is used for the current plot, or any other plot in this graph. To change the worksheet, click the *Worksheet* button. In the **Select Plots** dialog box, choose which plots you want to use the new worksheet and click *OK*. In the **Open Worksheet** dialog box, select the new data file and click *Open*. The plot(s) are redrawn using the new worksheet data. You may need to edit the *Worksheet Column* assignments for the data to plot correctly.



*Configure plots in the **Line/Symbol Plot** dialog box.*

Change X Axis **and** ***Change Y Axis*** **buttons**

The fields next to these buttons show the name of the X and Y axes used by the current plot. To change the X or Y axis used by this plot or any other plot in this graph, click the appropriate *Change Axis* button. In the **Select Plots** dialog box, choose which plot(s) you want to assign to a new axis and click *OK*. In the **Select Axis** dialog box, choose the new axis to use and click *OK*. The plot(s) are redrawn using the new axis.

> **Note**: If there is only one axis for the type selected, you are not able to change to a new axis. First, you need to create the axis and then use the appropriate *Change Axis* button. For more information on creating new axes, please refer *Adding Additional Axes to a Graph* in *Chapter 5, Axes*.

Plot **group box**

The *Plot* drop-down list shows you the selected plot. Changes you make on any tab of this dialog are applied to this plot. The drop-down list contains the names of the other plots in this graph that share the same worksheet and are the same plot type. To edit another plot, select its name from the list to make it the active plot. The **Plot** dialog box updates itself to show the properties of the newly activated plot.

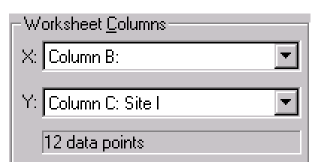
> **Note:** If your graph contains plots that use different worksheets, you cannot switch between them using the *Plot* field. You must manually close the current **Plot** dialog box, select the other plot, and re-open the **Plot** dialog box.

The *New* button creates a new plot based on the same worksheet as the active plot. By clicking the *New* button, a new plot is created that uses the same X column and the next column for Y values. For instance, if your current plot uses column B for X and column C for Y, the new plot uses column B for X and column D for Y. Edit the *Worksheet Columns* assignment and other properties to configure the new plot.

The *Delete* button removes the active plot from the graph. You are not prompted to confirm this decision, so use this button cautiously.

Worksheet Columns **group box**

Use these fields to designate which data columns are plotted on which axis. In the *X* drop-down list, select the column you want plotted along the X axis. In the *Y* drop-down list, select the column you want plotted along the Y axis.

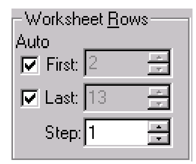


The Worksheet Columns are where you assign the data column to be plotted on each axis.

The column names are designated as *Column A, Column B,* etc. If the first row of the column contains text, this text is appended to the column name (e.g. *Column C: Site I*).

***Worksheet Rows* group box**

Use these options to specify the range of data included in the plot. By default, **Grapher** includes all numeric data in the plot and plots every point. Using these options, you can specify a smaller range of data, or use every n^{th} point.



The Worksheet Rows options let you select the range of data to plot.

The *First* field designates the first row of data that is plotted. If the *Auto* check box is marked, the *First* field is grayed out and **Grapher** uses the first row containing valid numeric data. To use a different value, remove the check mark, highlight the current value and type in the new first row value or click on the up and down arrows to change the value.

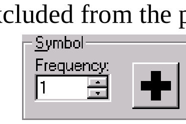
The *Last* field sets the last row of data that is plotted. If the *Auto* check box is marked, the *Last* field is grayed out and **Grapher** uses the last row in the column that contains valid numeric data. To use a different value, remove the check mark, highlight the current value and type in the new last row value or click on the up and down arrows to change the value.

By default, **Grapher** plots every point in the range (*Step* = 1). If you do not want to plot every point, increase the *Step* value accordingly. For example, when *Step* = 2, **Grapher** plots every other point (rows 1, 3, 5, etc,). When *Step* = 3, **Grapher** plots every third point (rows 1, 4, 7, etc.)

Note: Rows that do not contain data (blanks or text) are automatically excluded from the plot.

***Symbol* group box**

Use this option to place a symbol at each of the data points in the plot.



The Symbol Frequency determines how many data points are represented by symbols.

The *Frequency* field indicates how many points are assigned symbols. For example:

> *Frequency* = 0 shows no symbols (default).
>
> *Frequency* = 1 shows every point with a symbol.
>
> *Frequency* = 2 shows every other point with a symbol.

The active symbol displays as an icon button to the right of the *Frequency* field. To change the symbol, click on this button to open the **Curve Symbol** dialog box. Click on a different symbol to change from the default symbol. Click the down arrow next to the *Color* box to change from the default black color to a different color. Click the up and down arrows to change from the default symbol *Size* to a larger or smaller size. Click on *OK* when all changes have been made to the display of the symbol to return to the **Line/Symbol Plot** dialog box.

LINE PLOTS

A line plot is one in which all of the data points are connected by a line, but the actual data points cannot be seen (i.e. no symbols are present at the data points). By default, **Grapher** initially creates all line/symbol plots as line plots.

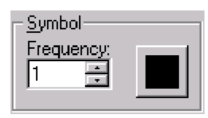
- If the line cannot be seen, click on the **Line-Fill** tab. In the *Line Properties* group box, change the line *Style* from *Invisible* to a visible style (i.e. *Solid*) by clicking on the down arrow next to the *Style* drop-down box. If the line still cannot be seen, click on the **Line Plot** tab to verify that the correct columns are selected.
- To remove the symbols from a plot, click on the **Line Plot** tab and change the *Frequency* in the *Symbol* group box to zero.

SCATTER PLOTS

A scatter plot displays only the data points and does not have a line connecting them. To create a scatter plot:

1. Create a line/symbol plot as discussed in *Creating a Line/Symbol Plot* on page 71.
2. Then, set the *Frequency* in the *Symbol* group box to a number greater than zero.

   If you want to change the current symbol, click on the symbol icon and select a new one from the **Curve Symbol** dialog box.
3. Remove the line by clicking on the **Line-Fill** tab. In the *Line Properties* group box, change the line *Style* to *Invisible* by clicking on the down arrow button next to the *Style* drop-down box.



Set the Symbol Frequency to a number greater than zero to display symbols on the plot.

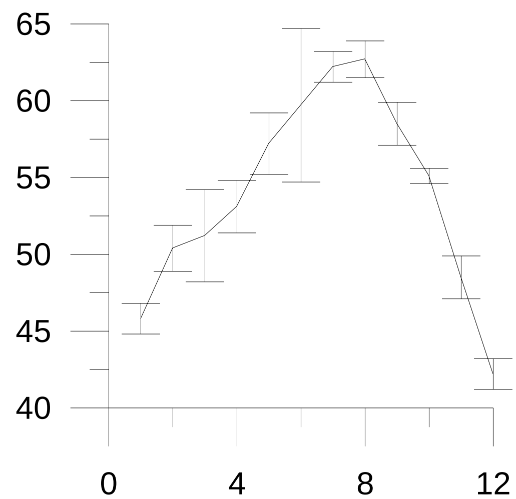
ERROR BARS

Error bars let you graphically represent the average value, sample standard deviation, population standard deviation, or standard error of the mean for each of the data points. Error bars can also be based on calculated custom data that is stored in a data column.

Error bars can be oriented vertically or horizontally.

- Use *Vertical Error Bars* when multiple Y values are recorded for each X value.
- Use *Horizontal Error Bars* when multiple X values are recorded for each Y value.

It is often a good idea to display the original data as a scatter plot. Otherwise, the graph may be difficult to read. For more information on creating a scatter plot, See *Scatter Plots* on page 75.



Vertical error bars displayed on a line plot.

Adding Error Bars to a Line/Symbol Plot

Use the following procedure to add error bars to your plot. For details about particular fields, refer to *The Error Bars Tab* on page 77.

1. In the **Line/Symbol Plot** dialog box, click on the **Error Bars** tab.
2. Use the appropriate group box to configure the error bars:
   - To insert vertical error bars, set the desired options from the *Vertical Error Bars* group box.
   - To insert horizontal error bars, set the desired options from the *Horizontal Error Bars* group box.
3. Choose a line style for the error bars from the *Line Style* group box.
4. To display average values, represented by symbols, bars, or both, choose the desired options from the *Average Indicator* group box.
5. Click *OK* to save your changes.

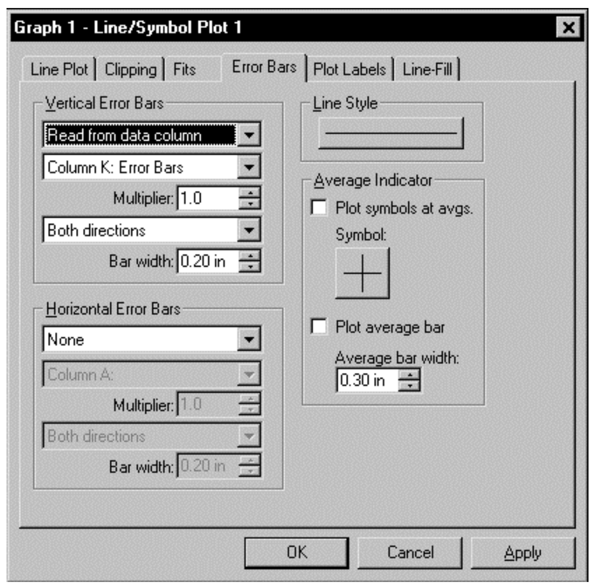
Adding Error Bars to Other Types of Plots

Error bars can only be created on line/symbol plots. If you want to display error bars on another type of plot, add a line/symbol plot to the graph. Make the line *Style* for the line/symbol plot *Invisible* to show only the other plot and the error bars. Refer to *Chapter 2, Tutorial* for information on how to combine multiple plot types on the same graph.

THE ERROR BARS TAB

***Vertical Error Bars* group box and *Horizontal Error Bars* group box**

After deciding which type of error bar is needed, select the value from the first drop-down box that you want the error bars to represent. The options are: *None*, *Read from data column*, *Average value only*, *Sample Std Dev* (standard deviation of the sample), *Population Std Dev* (population standard deviation), or *Standard Error Mean.* If *Read from data column* is chosen as the error bar type, you must select the data column in the second drop-down list. This box is otherwise gray.



*Use the **Error Bars** tab to plot the uncertainty in the data.*

The *Multiplier* multiplies the length of the error bar.

For example, if a standard deviation error bar is multiplied by two, two standard deviations are displayed on the error bar. You can display error bars in *Both directions*, in only the *Positive direction*, *Negative direction*, *Away from reference*, or *Towards reference*.

- *Both directions* displays the error bars in the positive and negative directions. For example, if the error bar is a sample standard deviation error bar, selecting *Both directions* shows the standard deviation on both sides of the mean.
- *Positive direction* displays the error bar in the increasing direction only.
- *Negative direction* displays the error bar in the decreasing direction only.
- *Away from reference* plots error bars pointing away from zero. These error bars can be positive or negative.

- *Towards reference* plots error bars pointing toward zero. These error bars can also be positive or negative.

Changing the *Bar width* changes the width of the bar caps.

***Line Style* group box**

These options let you change the *Style, Color,* and *Width* used to draw the error bars. For example, the error bars can appear as thick dashed red lines instead of thin solid black lines. Click the line sample box to open the **Error Bars Line Style** dialog box. This box allows you to change from the existing parameters.

***Average Indicator* group box**

These options let you display average data values on the plot. Average data values can be represented with symbols or with bars. Average bars can also be displayed by selecting *Average value only* in the *Vertical Error Bars* or *Horizontal Error Bars* group boxes.

When checked, the *Plot symbol at avgs.* option displays a symbol at the average data value. Click the *Symbol* button to change the symbol properties.

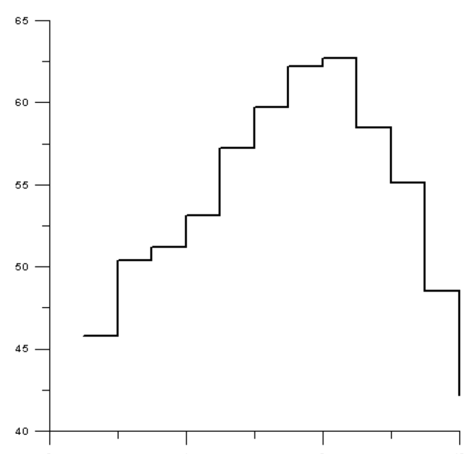
When checked, the *Plot average bar* option displays a bar at the average data value.

Change the *Average bar width* value to change the length of the bar at the average value.

Step Plots

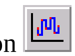
Step plots are very similar to line/symbol plots. In line/symbol plots, the connecting line is drawn directly between adjacent points, using the shortest path. In a step plot, the connecting line is always parallel or perpendicular to the axes.

To understand how this line is created, imagine drawing a horizontal line through each data point, then go back and draw a vertical line through each data point. The intersecting lines form the step plot. Of course, you could also start by drawing the vertical lines first, which creates a different step path. **Grapher** makes it easy to create plots with either horizontal or vertical step lines.



In a step plot, the plot line is always parallel or perpendicular to the axes.

CREATING A STEP PLOT

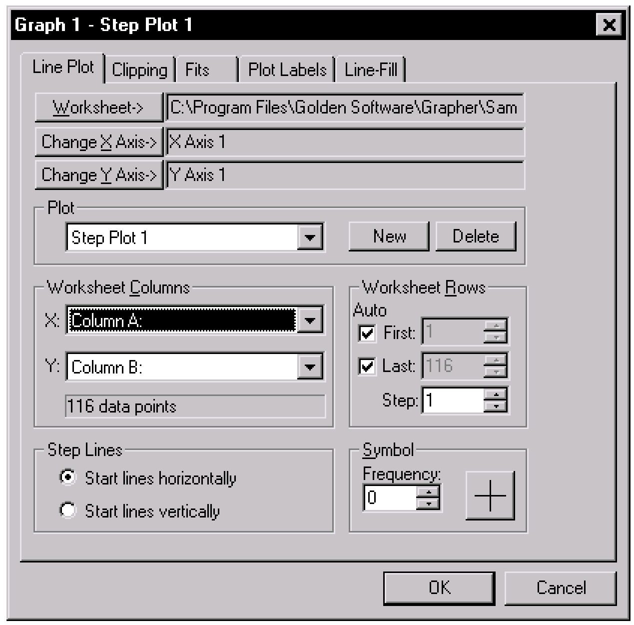
1. Select **Graph | New Graph | Step Plot** or click the step plot button  on the toolbar.
2. Select a data file from the **Open Worksheet** dialog box and click *Open*.
3. In the **Step Plot** dialog box, set the desired plot options.
   - Use the **Step Plot** tab to select the worksheet, set axis options, assign which worksheet columns to plot, specify the range of data, and set the step line properties. The options on this tab are described below.
   - To truncate (i.e. "clip") your plot within a fixed range of values, use the options on the **Clipping** tab. See *Clipping a Plot* on page 133 for additional information on clipping a curve.
   - You can compare your plot to known mathematical curves by adding a predefined fit curve to your graph. This is done using the options on the **Fits** tab. In addition to the ten predefined fit curves, you can also create your own custom curve functions. See *Fit Curves* on page 139 of this chapter for more information.
   - You can add labels to your data points using the options on the **Plot Labels** tab. A label can show the X or Y value of a data point, or it can show another value or text label stored in a column in the current worksheet. See *Plot Labels* on page 150 for information on changing these parameters.
   - To customize the line style (solid, dashed, thick, thin, etc.), change line color, add "heads" to the ends of the line, or shade the area above or below the line, use the settings on the **Line-Fill** tab. See *Line and Fill Properties* on page 156.

THE STEP PLOT TAB

Use the **Step Plot** tab to change the worksheet or axes used in the plot, select worksheet columns for the plot, and set the step direction. You can also add symbols for the data points, add a new plot, or delete the current plot.

Worksheet button

Use the *Worksheet* button to change which data file is used for the current plot, or any other plot in this graph. To change the worksheet, click the *Worksheet* button. In the **Select Plots** dialog box, choose all of the plots you want to use the new worksheet and click *OK*. In the **Open Worksheet** dialog box, select the new data file and click *Open*. The plot(s) are redrawn using the new worksheet. You may need to edit the *Worksheet Columns* assignments for the data to plot correctly.



Configuring a new step plot.

Change X Axis and *Change Y Axis* buttons

The fields next to these buttons show the name of the X axis and Y axis used by the current plot. To change the X axis or the Y axis used by this plot or any other plot in this graph, click the appropriate *Change Axis* button. In the **Select Plots** dialog box, choose all of the plots you want to assign to the new axis and click *OK*. In the **Select Axis** dialog box, choose the new axis to use and click *OK*. The plot(s) are redrawn using the new axis.

Note: If there is only one axis for the type selected, you are not able to change to a new axis. First, you need to create the axis and then use the appropriate *Change Axis* button. For more information on creating new axes, please refer to *Adding Additional Axes to a Graph* in *Chapter 5, Axes*.

Plot group box

The *Plot* drop-down list shows you the active plot. This drop-down list contains the names of all of the other plots in this graph that use this same worksheet and are the same plot type. To edit another plot, select its name from the list to make it the active plot. The **Plot** dialog box updates itself to show the properties of the newly active plot.

> **Note:** If your graph contains plots that use different worksheets, you cannot switch between them using the *Plot* field. You must manually close the current **Plot** dialog box, and double-click on the new plot to edit it.

The *New* button creates a new plot based on the same worksheet as the active plot. Edit the *Worksheet Columns* assignment and other properties to configure the new plot. The default worksheet column is the same X column as the current plot and the next Y column. For example, if your existing plot uses column A for the X axis and column B for the Y axis, clicking on the *New* button creates a new plot that uses column A for the X axis and column C for the Y axis.

The *Delete* button removes the active plot from the graph. You are not prompted to confirm this decision, so use this button cautiously.

***Worksheet Columns* group box**

Use these fields to designate which data columns are plotted on which axis. In the *X* drop-down list, select the column you want plotted along the X axis. In the *Y* drop-down list, select the column you want plotted along the Y axis.

The column names are designated as *Column A*, *Column B*, etc. If the first row of the column contains text, this text is appended to the column name (e.g. *Column B: First Quarter*, *Column C: Second Quarter*, etc.).

***Worksheet Rows* group box**

Use these options to specify the range of data included in the plot. By default, **Grapher** includes all numeric data in the plot and plots every point. Using these options, you can specify a smaller range of data, or plot every n^{th} point.

The *First* field designates the first row of data that is plotted. If the *Auto* check box is marked, the *First* field is grayed out and **Grapher** uses the first row containing valid numeric data. To use a different value, remove the check mark next to the *First* field, highlight the current value and type in the new first row value or click on the up and down arrows to change the existing first row.

The *Last* field sets the last row of data that is plotted. If the *Auto* check box is marked, the *Last* field is grayed out and **Grapher** uses the last row in the column that contains valid numeric data. To use a different value, remove the check mark next to the *Last* field, highlight the current value and type in the new last row value or click on the up and down arrows to change the existing last row.

By default, **Grapher** plots every point in the range (*Step* = 1). If you do not want to plot every point, increase the *Step* value accordingly. For example, when *Step* = 2, **Grapher** plots every other point (rows 1, 3, 5, etc,). When *Step* = 3, **Grapher** plots every third point (rows 1, 4, 7, etc.)

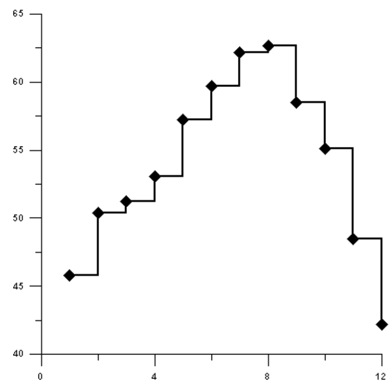
> **Note:** Rows that do not contain data (blanks or text) are automatically excluded from the plot.

***Step Lines* group box**

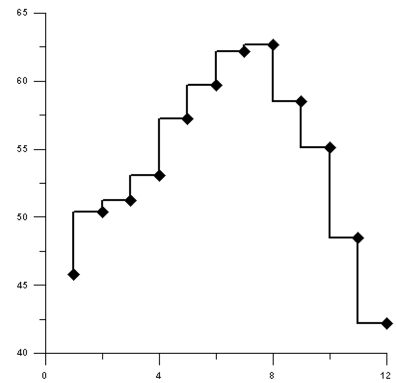
These options determine how the step line is drawn between any two adjacent points.

- When *Start lines horizontally* is selected, the step lines leave each data point parallel to the X axis.
- When *Start lines vertically* is selected, the step lines leave each point parallel to the Y axis.

Examples of *Step Lines* options:



Start lines horizontally



Start lines vertically

The two step plots above use the same set of data but different Step Lines options. Symbols are shown so you can see the difference in how the line leaves and enters each data point.

Symbol group box

Use these options to show a symbol at each of the data points in the plot.

The *Frequency* field indicates how many points are assigned symbols. For example:

Frequency = 0 shows no symbols (default).

Frequency = 1 shows a symbol at every point.

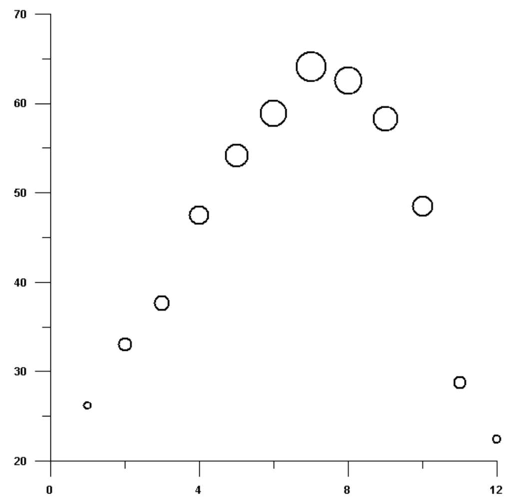
Frequency = 2 shows a symbol at every other point.

The active symbol displays as an icon button to the right of the *Frequency* field. To change the symbol, click on this button to open the **Curve Symbol** dialog box. Click on the desired *Symbol Set*, *Color*, and *Size* to change from the existing parameters and click *OK* to return to the **Step Plot** dialog box.

Bubble Plots

Bubble plots are similar to scatter plots, with one major exception: in a bubble plot, the diameter of each bubble can vary in size, providing a way to represent an additional dimension of data. This effectively makes the bubble plot a three dimensional graph, allowing you to display two Y variables simultaneously.

For example, consider a traditional scatter plot that shows the number of new automobile sales in the U.S. over a period of time. Using a bubble plot, you could include a third dimension of data that shows the average U.S. household income over the same time span. **Grapher** lets you set the minimum and maximum size of the bubbles and proportionally adjusts the other bubbles.



A bubble plot conveys information in two ways, by the position of the bubble and by its relative size.

CREATING A BUBBLE PLOT

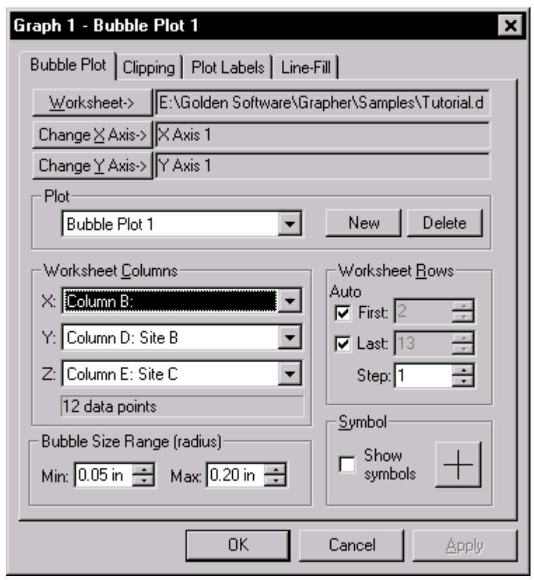
1. Select **Graph | New Graph | Bubble Plot** or click the bubble plot button on the toolbar.
2. Select a data file from the **Open Worksheet** dialog box and click *Open*.
3. In the **Bubble Plot** dialog box, set the desired plot options.
   - Use the **Bubble Plot** tab to select the worksheet and axes, assign which worksheet columns to plot, specify the range of data, and set the bubble size range. The options on this tab are described in this section.
   - To truncate (i.e. "clip") your plot within a fixed range of values, use the options on the **Clipping** tab. See *Clipping a Plot* on page 133.
   - You can add labels to your data points using the options in the **Plot Labels** tab. A label can show the value of a data point (X axis or Y axis), or it can show some other value or text label stored in a column in the current worksheet. See *Plot Labels* on page 150.
   - To customize the line style (solid, dashed, thick, thin, etc.), change line color, or shade the bubbles, use the settings on the **Line-Fill** tab. See *Line and Fill Properties* on page 156.

THE BUBBLE PLOT TAB

Use the **Bubble Plot** tab to change the worksheet or axes used in the plot, select worksheet columns, change the worksheet rows used, add a new plot or delete the existing plot, and set the bubble size range.

Worksheet button

Use the *Worksheet* button to change which data file is used for the current plot, or any other plot in this graph. To change the worksheet, click the *Worksheet* button. In the **Select Plots** dialog box, choose all of the plots that you want to use the new worksheet and click *OK*. In the **Open Worksheet** dialog box, select the new data file and click *Open*. The plot(s) are redrawn using the new worksheet data. You may need to edit the *Worksheet Columns* assignments for the data to plot correctly.



*The **Bubble Plot** dialog box*

Change X Axis and *Change Y Axis* buttons

The fields next to these buttons show the name of the X and Y axes used by the current plot. To change the X or Y axis used by this plot or any other plot in this graph, click the appropriate *Change Axis* button. In the **Select Plots** dialog box, choose which plot(s) you want to assign to a new axis and click *OK*. In the **Select Axis** dialog box, choose the new axis to use and click *OK*. The plot(s) are redrawn using the new axis.

> **Note**: If there is only one axis for the type selected, you are not able to change to a new axis. First, you need to create the axis and then use the appropriate *Change Axis* button. For more information on creating new axes, please refer to *Adding Additional Axes to a Graph* in *Chapter 5, Axes*.

Plot group box

The *Plot* drop-down list shows the active plot. The drop-down list contains the names the other plots in this graph that use the same worksheet and are the same plot type. To edit another plot, select its name from the list to make it the active plot. The **Plot** dialog box updates itself to show the properties of the newly active plot.

> **Note:** If your graph contains plots that use different worksheets, you cannot switch between them using the *Plot* field. You must manually close the current **Plot** dialog box and double-click on the other plot to edit it.

The *New* button creates a new plot based on the same worksheet as the active plot. Edit the *Worksheet Columns* assignment and other properties to configure the new plot. The default worksheet column is the same X and Y columns as the current plot and the next Z column. For example, if your existing plot uses column A for the X axis, column B for the Y axis, and column C for the Z axis, clicking on the *New* button creates a new plot that uses column A for the X axis, column B for the Y axis, and column D for the Z axis.

The *Delete* button removes the active plot from the graph. You are not prompted to confirm this decision, so use this button cautiously.

Worksheet Columns group box

These fields designate how the data columns display on the bubble plot. In the *X* drop-down list, select the data column to plot along the X axis. In the *Y* drop-down list, select the data column to plot along the Y axis. In the *Z* drop-down list, select the data column you want represented by the bubble's diameter. Proportionally larger bubbles represent larger values.

The column names are designated as *Column A*, *Column B*, etc. If the first row of the column contains text, this text is appended to the column name (e.g. *Column B: First Quarter*, *Column C: Second Quarter*, etc.).

Worksheet Rows group box

Use these options to specify the range of data included in the plot. By default, **Grapher** includes all numeric data in the plot and plots every point. Using these options, you can specify a smaller range of data, or plot every n^{th} point.

The *First* field designates the first row of data that is plotted. If the *Auto* check box is marked, the *First* field is grayed out and **Grapher** uses the first row containing valid numeric data. To use a different value, remove the check mark next to the *First* field, highlight the current value and type in the new first row value or click on the up and down arrows to change the existing first row.

The *Last* field sets the last row of data that is plotted. If the *Auto* check box is marked, the *Last* field is grayed out and **Grapher** uses the last row in the column that contains valid numeric data. To use a different value, remove the check mark next to the *Last* field, highlight the current value and type in the new last row value or click on the up and down arrows to change the existing last row.

By default, **Grapher** plots every point in the range (*Step* = 1). If you do not want to plot every point, increase the *Step* value accordingly. For example, when *Step* = 2, **Grapher** plots every other point (rows 1, 3, 5, etc,). When *Step* = 3, **Grapher** plots every third point (rows 1, 4, 7, etc.)

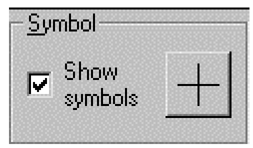
> **Note:** Rows that do not contain data (blanks or text) are automatically excluded from the plot.

***Bubble Size Range* group box**

The *Min* and *Max* fields let you set the range of the bubble's radius in page units. The smallest value in the *Z* worksheet column is displayed as a bubble with the *Min* value radius. The largest value in the *Z* worksheet column is displayed as a bubble with the *Max* value radius. Intermediate values are displayed proportionally.

***Symbol* group box**

Use these options to show a symbol, in addition to the bubble, at each of the data points in the plot.



The Symbol group box controls whether symbols are displayed on the bubble plot.

To plot a symbol in addition to the bubble at each data point, place a check mark in front of the *Show symbols* check box. This does not replace the bubble, but rather adds a symbol inside the bubble. This may be useful with large bubble sizes to determine exactly where the data point is.

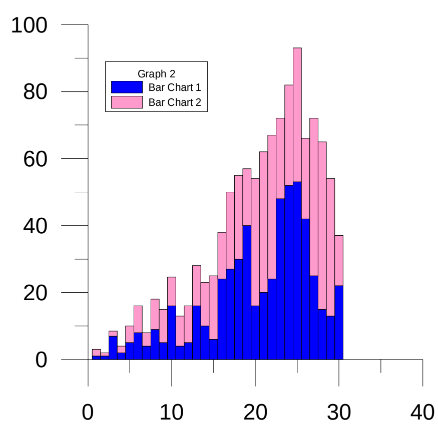
The active symbol displays as an icon button to the right of the *Show symbols* field. To change the symbol, click on this button to open the **Curve Symbol** dialog box. Click on the desired *Symbol Set*, *Color*, and *Size* to change from the existing parameters and click *OK* to return to the **Bubble Plot** dialog box.

Bar Charts

Bar charts display data by drawing a rectangle between a base Y value and the Y data value. The rectangle is centered on the associated X value. If more than one variable is used (multiple Y values for each X value), the bars can either be stacked on top of one another, as shown to the right, or they can be adjacent to each other.

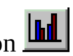
When stacked bars are used, the total height of the stacked bars is equal to the sum of the Y values.

Bar charts can be drawn either vertically, as shown here, or horizontally.



A bar chart shown with a legend.

CREATING A BAR CHART

1. Select **Graph | New Graph | Bar Chart** or click the bar chart button  on the toolbar.
2. Select a data file from the **Open Worksheet** dialog box and click *Open*.
3. In the **Bar Chart** dialog box, set the desired plot options.
    - Use the **Bar Chart** tab to select the worksheet and axes, assign which worksheet columns to plot, specify the range of data, set style options for the plot and add or delete a plot. The options on this tab are described in this section.
    - To truncate (i.e. "clip") your plot within a fixed range of values, use the options on the **Clipping** tab. See *Clipping a Plot* on page 133.
    - You can add labels to your data points using the options in the **Plot Labels** tab. A label can show the value of a data point (X axis or Y axis), or it can show some other value or text label stored in the current worksheet. See *Plot Labels* on page 150.
    - To change the line style (solid, dashed, thick, thin, etc.), change the line color, or shade the area inside the bars, use the settings on the **Line-Fill** tab. See *Line and Fill Properties* on page 156.

THE BAR CHART TAB

Use the **Bar Chart** tab to change the worksheet or axes used in the chart, select which worksheet columns to plot, or select a subset of data to plot. You can also set the base value for the bars, choose adjacent or stacked bars, choose vertical or horizontal bars, and adjust bar width and overlap. New bar charts can also be added using the *New* button or the existing plot can be deleted using the *Delete* button.

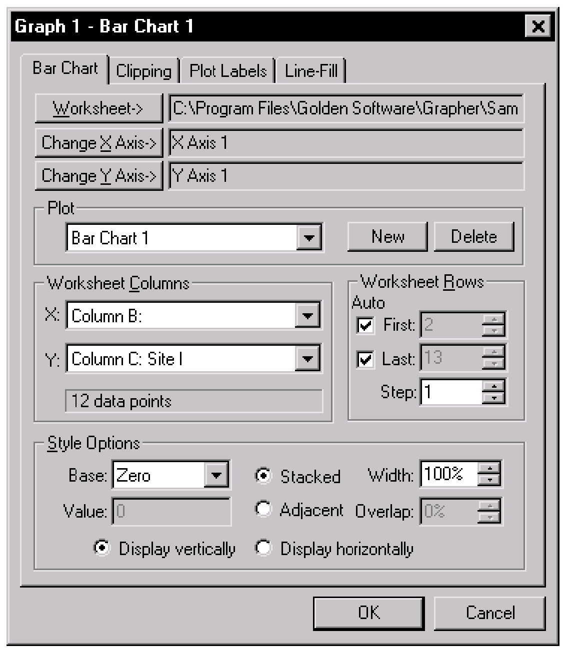
Worksheet button

Use the *Worksheet* button to change which data file is used for the current plot, or any other plot in this graph. To change the worksheet, click the *Worksheet* button. In the **Select Plots** dialog box, choose which plots you want to use the new worksheet and click *OK*. In the **Open Worksheet** dialog box, select the new data file and click *Open*. The plot(s) are redrawn using the new worksheet data. You may need to edit the *Worksheet Columns* assignments for the bars to plot correctly.

Change X Axis **and** ***Change Y Axis*** **buttons**

The fields next to these buttons show the name of the X and Y axes used by the current plot. To change the X or Y axis used by this plot or any other plot in this graph, click the appropriate *Change Axis* button. In the **Select Plots** dialog box, choose which plot(s) you want to assign to a new axis and click *OK*. In the **Select Axis** dialog box, choose the new axis to use and click *OK*. The plot(s) are redrawn using the new axis.

> **Note**: If there is only one axis for the type selected, you are not able to change to a new axis. First, you need to create the axis and then use the appropriate *Change Axis* button. For more information on creating new axes, please refer to *Adding Additional Axes to a Graph* in *Chapter 5, Axes*.



*The **Bar Chart** dialog box*

Plot **group box**

The *Plot* drop-down list shows you the active plot. The drop-down list contains the names of the other plots in this graph that use the same worksheet and are the same plot type. To edit another plot, select its name from the list to make it the active plot. The **Plot** dialog box updates itself to show the properties of the newly active plot.

> **Note:** If your graph contains plots that use different worksheets, you cannot switch between them using the *Plot* field. You must manually close the current **Plot** dialog box, and double-click on the new plot to view its properties.

The *New* button creates a new plot based on the same worksheet as the active plot. Edit the *Worksheet Columns* assignment and other properties to configure the new plot if necessary. The default worksheet column is the same X column as the current plot and the next Y column. For example, if your existing plot uses column A for the X axis, and column B for the Y axis, clicking on the *New* button creates a new plot that uses column A for the X axis, and column C for the Y axis.

The *Delete* button removes the active plot from the graph. You are not prompted to confirm this decision, so use this button cautiously.

***Worksheet Columns* group box**

Use these fields to designate which data columns are plotted on which axis. In the *X* drop-down list, select the column you want plotted along the X axis. In the *Y* drop-down list, select the column you want plotted along the Y axis.

The column names are designated as *Column A*, *Column B*, etc. If the first row of the column contains text, this text is appended to the column name (e.g. *Column B: First Quarter*, *Column C: Second Quarter*, etc.).

Changing the *X* column for one bar chart changes the *X* column for all bar charts in a graph. To create multiple bar charts with different *X* columns, separate graphs need to be created. This can be accomplished with the **Graph | New Graph | Bar Chart** command.

***Worksheet Rows* group box**

Use these options to specify the range of data included in the plot. By default, **Grapher** includes all numeric data in the plot and plots every point. Using these options, you can specify a smaller range of data, or plot every n^{th} point.

The *First* field designates the first row of data that is plotted. If the *Auto* check box is marked, the *First* field is grayed out and **Grapher** uses the first row containing valid numeric data. To change from the default row to another, click on the check mark to remove it and type in a value in the *First* box.

The *Last* field sets the last row of data that is plotted. If the *Auto* check box is marked, the *Last* field is grayed out and **Grapher** uses the last row in the column that contains valid (numeric) data. To change from the default row to another, click on the check mark to remove it and type in a value in the *Last* box.

Changing the *First* and *Last* fields for a bar chart changes the *First* and *Last* fields for all bar charts in the graph. To create multiple bar charts with different *First* and *Last* values for each bar chart, separate graphs need to be created. This can be accomplished with the **Graph | New Graph | Bar Chart** command.

By default, **Grapher** plots every point in the range (*Step* = 1). If you do not want to plot every point, increase the *Step* value accordingly. For example, when *Step* = 2, **Grapher** plots every other point (rows 1, 3, 5, etc,). When *Step* = 3, **Grapher** plots every third point (rows 1, 4, 7, etc.)

Changing the *Step* field for a bar chart changes the *Step* field for all bar charts in the graph. To create multiple bar charts with different *Step* values for each bar chart, separate graphs need to be created. This can be accomplished with the **Graph | New Graph | Bar Chart** command.

> **Note:** Rows that contain blank data or text are automatically excluded from the plot.

Style Options **group box**

The *Style Options* group box allows control over the display of the bars. Bars are drawn from the base value to the Y value of the data point. The *Base* value can be set to the data minimum, the data maximum, zero, or to a custom defined value.

Setting the *Base* value to *Zero* results in all bars originating at zero on the Y axis. Positive data values are drawn upward and negative data values are drawn downward from zero.

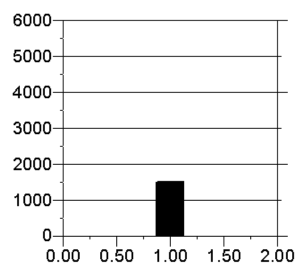
Setting the *Base* value to *Data min* draws all bars from the minimum Y value in the data column to the Y data value of the point. All bars are drawn up to the data point from the data minimum.

Setting the *Base* value to *Data max* draws all bars from the maximum Y value in the data column to the Y data value. All bars are drawn down to the data point from the data maximum.

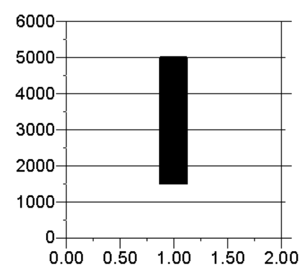
Setting the *Base* value to *Custom* allows you to set the value at which to plot the base. Input the Y value in the *Value* box. The bars are drawn upward or downward depending on the data values and the custom base number.

Custom Base Example:

If the *Base* of a bar chart is set to *Zero* and the Y value is 1500, the bar is drawn from zero to 1500 on the Y axis. If the *Base* is set to *Custom* with a value of 5000, the bar is drawn from 5000 to 1500.



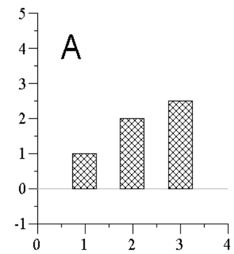
The Y value is 1500 and the base is zero.



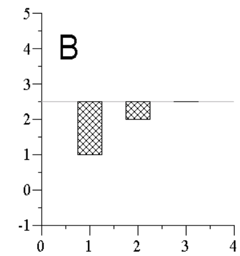
The Y value is 1500 and the base is 5000.

Base Options Example:

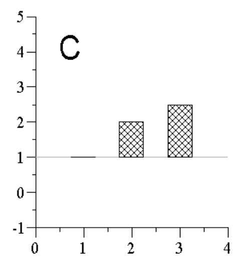
Four plots of the same data set shown using different *Base* options.



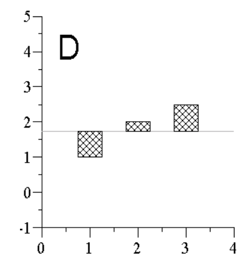
Base = Zero



Base = Data max (2.5)

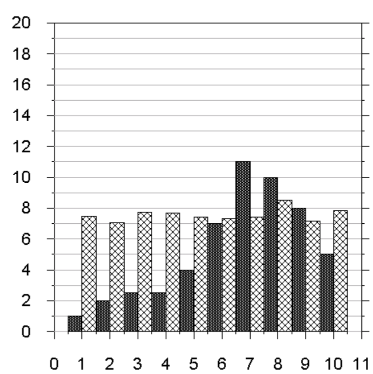


Base = Data min (1)

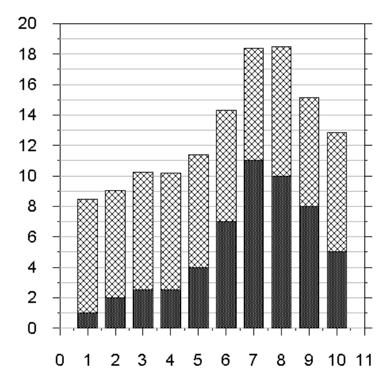


Base = Custom (1.75)

If multiple variables are plotted, the *Adjacent* option draws variables as a group of bars. The group of bars for each X value is centered on the X data value. If the *Stacked* option is selected, the variables are drawn stacked on top of one another. The base for each additional variable is the top of the previous variable's bar. The total height of a stacked bar is the sum of all variables (Y values) for each X value.



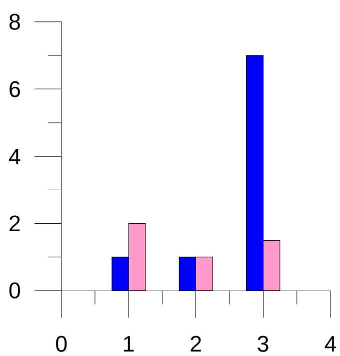
Bar chart with Adjacent bars



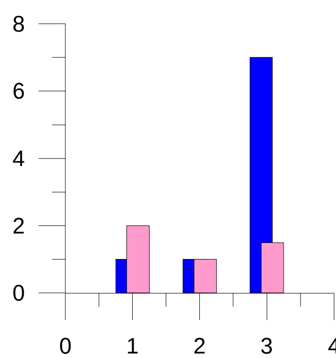
Bar chart with Stacked bars

The *Width* of the bar can be set from 1 to 5000 percent. The default width is 100 percent. The range of the X axis determines how wide the 100 percent width is. For example, if the X axis is 6 inches long and there are three bars, each bar is 2 inches wide. If the same axis has six bars, each bar is only 1 inch wide. If 50% width is chosen, the bars cover 50% of the axis. For example, if the X axis is 6 inches long and there are three bars, each bar is 1 inch wide with a 1 inch space between bars. If the same axis has six bars, each bar is only 0.5 inch wide with a 0.5 inch space between bars.

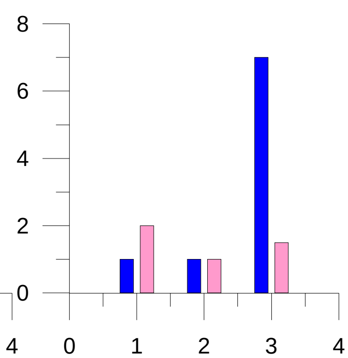
The *Overlap* option sets the amount of overlap in *Adjacent* bars. An overlap of zero means the bars in the same X value are touching. An overlap of greater than 0 means that the bars are overlapping. In the example below, notice in the middle graph, the second set of bars is partially on top of the first set. Using negative numbers in the *Overlap* field creates gaps between the bars within an X value. In the example graph on the right, notice that there are gaps between the bars in each group.



Adjacent bar chart with 50% Width and 0% Overlap

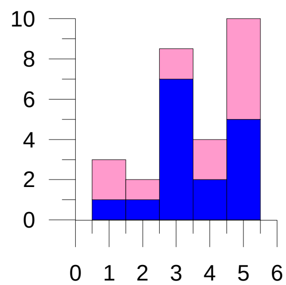


Adjacent bar chart with 50% Width and 50% Overlap

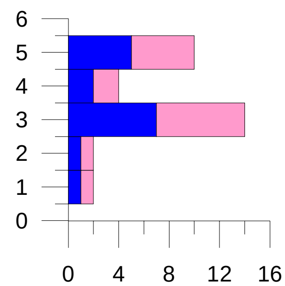


Adjacent bar chart with 50% Width and -50% Overlap

The *Display vertically* and *Display horizontally* radio buttons let you change the orientation of the axes. The default setting is *Display vertically*, which plots the Y data on the vertical axis. The *Display horizontally* option rotates the graph by 90°, showing the Y axis data on the horizontal (X) axis. This results in a bar graph where the bars protrude horizontally from the vertical axis.



This stacked bar chart is displayed vertically.



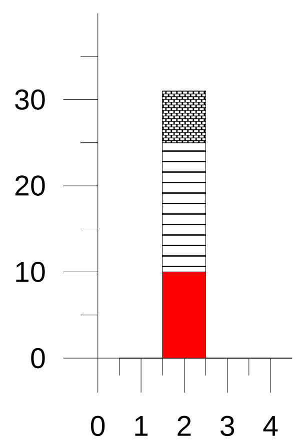
The same stacked bar chart is displayed horizontally.

Multi-Variable Example:

Consider three variables (Y values) associated with the single value, X = 2. The Y values are 10, 15, and 6. When these Y values are plotted individually on the same graph using the *Stacked* option, the first bar is drawn from zero to 10. The next bar is drawn from 10 to 25, and the final bar is drawn from 25 to 31.

	A	B	C	D
1	0	0	0	0
2	1	0	0	0
3	2	10	15	6
4	3	0	0	0
5	4	0	0	0
6	5	0	0	0

To stack bar graph values on top of each other, each bar's data must be in its own data column. Each column must then be added to the graph as a separate plot, and the Stacked option must be selected.



A stacked multi-variable bar graph representing the three values: Y = 10, Y = 15, Y = 6. The base of the stacked bar is set to zero. The base of each stacked bar is the top of the previous bar.

CREATING A BAR CHART WITH MULTIPLE Y VARIABLES

1. Create the first bar chart using the directions provided in *Creating a Bar Chart* on page 87.
2. Double-click on the bar chart to open the **Bar Chart 1** dialog box.
3. Click on the *New* button to add a second plot.
4. Set the new bar chart properties in the **Bar Chart 2** dialog box.

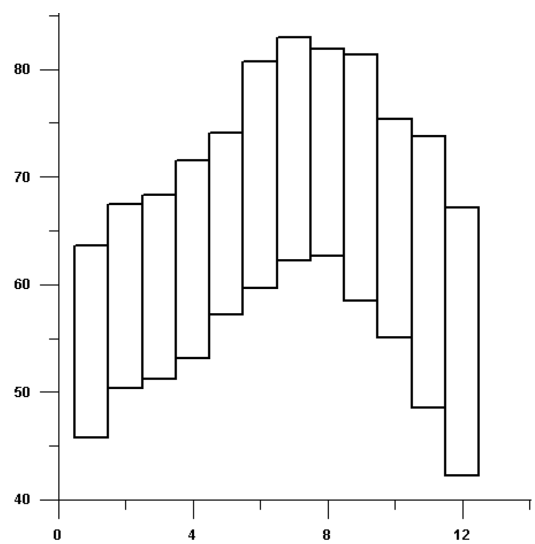
   Settings in the *Style Options* group box and the *Worksheet Rows* group box on the **Bar Chart** tab affect <u>all</u> bars in the graph that use the same worksheet. If the selected bar is set to *Adjacent*, all bars are set to *Adjacent*. Line styles and fill patterns apply only to the selected bar chart.

   Note: In order for bars to stack correctly or to appear adjacent correctly, they need to use the same worksheet for each data set. In addition, changing the X axis column for one bar chart changes the X axis column for all bar charts.

Floating Bar Charts

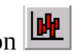
Floating bar charts provide a unique way of viewing the differences between two sets of data as the X value varies over a common range. The length of each floating bar is drawn from the minimum Y value and rises to the maximum Y value. The Y values are read from two different data columns in the active worksheet.

The length of a floating bar represents the absolute difference between two sets of Y data values for the same X variable. By plotting labels, you can show the minimum and maximum values for each bar.



An example of a floating bar chart

CREATING A FLOATING BAR CHART

1. Select **Graph | New Graph | Floating Bar** or click the floating bar button  on the toolbar.
2. Select a data file from the **Open Worksheet** dialog box and click *Open*.
3. In the **Floating Bar** dialog box, set the desired plot options.
   - Use the **Floating Bar** tab to select the worksheet and axes, assign which worksheet columns to plot, specify the range of data, and set style options for the plot. The options on this tab are described in this section.
   - To truncate (i.e. "clip") your plot within a fixed range of values, use the options on the **Clipping** tab. See *Clipping a Plot* on page 133.
   - You can add labels to your data points using the options on the **Plot Labels** tab. See *The Plot Labels Tab* topic on page 98.
   - To change the line style (solid, dashed, thick, thin, etc.), line color, or to shade the area inside the bars, use the settings on the **Line-Fill** tab. See *Line and Fill Properties* on page 156.

THE FLOATING BAR TAB

Use the **Floating Bar** tab to change the worksheet or axes used in the chart, select worksheet columns for the plot, set the range of the data, set the bar style, and adjust the bar width.

Worksheet button

Use the *Worksheet* button to change which data file is used for the current plot, or any other plot in this graph. To change the data, click the *Worksheet* button. In the **Select Plots** dialog box, choose which plots you want to use the new worksheet and click *OK*. In the **Open Worksheet** dialog box, select the new data file and click *Open*. The plot(s) are redrawn using the new worksheet data. You may need to edit the *Worksheet Columns* assignments for the data to plot correctly.

Change X Axis and *Change Y Axis* buttons

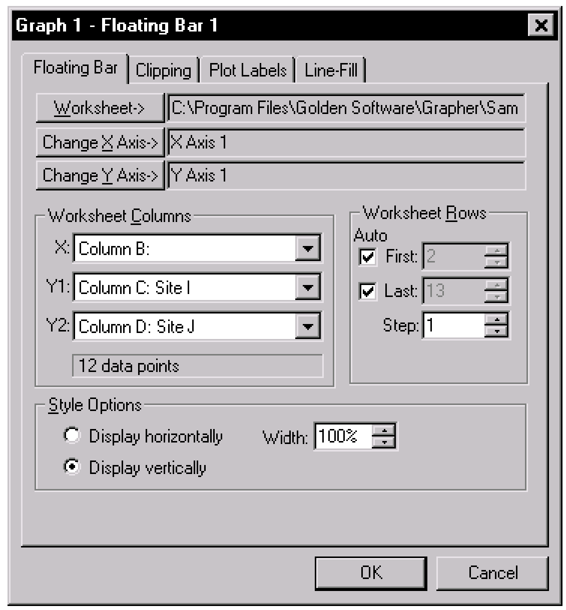
The fields next to these buttons show the name of the X and Y axes used by the current plot. To change the X or Y axis used by this plot or any other plot in this graph, click the appropriate *Change Axis* button. In the **Select Plots** dialog box, choose which plot(s) you want to assign to a new axis and click *OK*. In the **Select Axis** dialog box, choose the new axis to use and click *OK*. The plot(s) are redrawn using the new axis.

> **Note**: If there is only one axis for the type selected, you are be able to change to a new axis. First, you need to create the axis and then use the appropriate *Change Axis* button.

For more information on creating new axes, please refer to *Adding Additional Axes to a Graph* in *Chapter 5, Axes*.

Worksheet Columns group box

Use these fields to designate which data columns are plotted on which axis. In the *X* drop-down list, select the column to plot along the X axis. For a floating bar chart, the X axis is the category axis. In the *Y1* and *Y2* drop-down lists, select the columns you want plotted as the limits for the bar values along the Y axis. For instance, suppose your data set is composed of cities with population for the years 1990 and 2000. *Y1* would be the 1990 population and *Y2* would be the 2000 population.



*The **Floating Bar** dialog box*

Worksheet Rows group box

Use these options to specify the range of data included in the plot. By default, **Grapher** includes all numeric data in the plot and plots every point. Using these options, you can specify a smaller range of data, or just plot every n^{th} point.

The *First* field designates the first row of data that is plotted. If the *Auto* check box is marked, the *First* field is grayed out and **Grapher** uses the first row containing valid numeric data. To use a different *First* row, click on the check mark to remove it and type in the value of the *First* row of data.

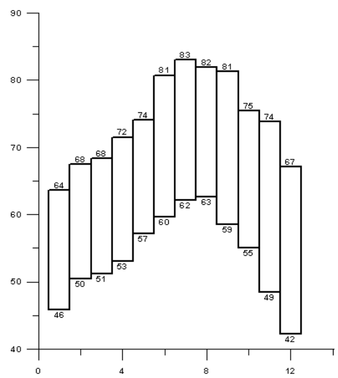
The *Last* field sets the last row of data that is plotted. If the *Auto* check box is marked, the *Last* field is grayed out and **Grapher** uses the last row in the column that contains valid numeric data. To use a different *Last* row, click on the check mark to remove it and type in the value of the *Last* row of data.

By default, **Grapher** plots every point in the range (*Step* = 1). If you do not want to plot every point, increase the *Step* value accordingly. For example, when *Step* = 2, **Grapher** plots every other point (rows 1, 3, 5, etc,). When *Step* = 3, **Grapher** plots every third point (rows 1, 4, 7, etc.)

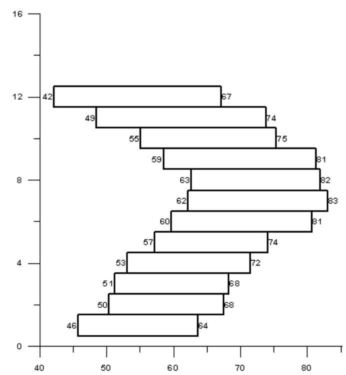
Note: Rows that contain blank data or text are automatically excluded from the plot.

Style Options group box

Display horizontally shows the bars horizontally and plots the Y values against the horizontal axis. *Display vertically* is the default setting. It plots the bars vertically and plots the Y values against the vertical axis.



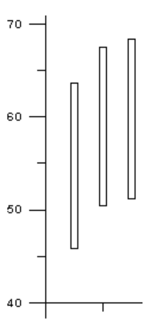
Display Vertically



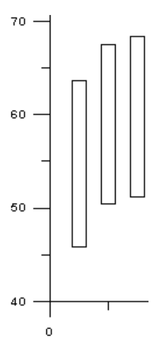
Display Horizontally

The same data set plotted vertically and horizontally.

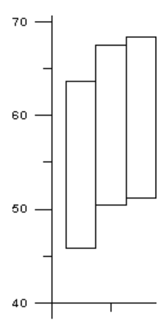
The *Width* field controls the relative width of all floating bars in the graph. This value can be set from 1 to 5000 percent. At 100% (the default setting), adjacent bars are wide enough to touch each other and share common sides. In the following examples, notice how the thickness of the bars vary with the *Width* setting.



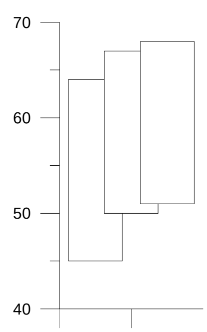
Width = 25%



Width = 50%



Width = 100%



Width = 150%

THE PLOT LABELS TAB

The **Plot Labels** tab in the **Floating Bar** dialog box lets you display the data values associated with each bar graph.

Show labels check box

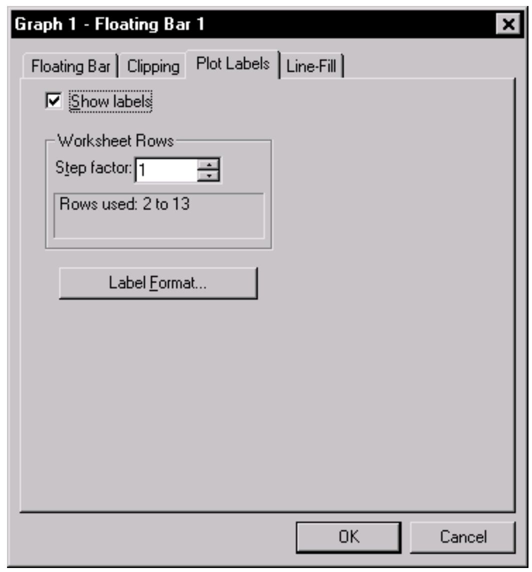
Place a check mark in this box to enable the label feature.

Worksheet Rows group box

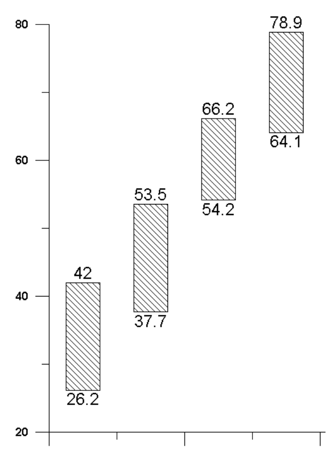
The *Step factor* field sets the frequency of bars that display labels. When this is set to 1 (the default), every bar is labeled. When set to 2, every other bar is labeled.

Label Format button

Click on this button to open the **Plot Labels Format** dialog box, where you can set the format for the label and specify the font properties for the label text. For a detailed description of these label options, see *The Plot Points Label Format Dialog Box* on page 154.



*The **Plot Labels** tab in the **Floating Bar** dialog box*

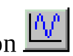


A floating bar graph with labels displayed

Function Plots

Function plots display mathematical functions on a graph. No data files are required for this type of plot. You can plot Y as a function of X, or plot a parametric equation where X and Y are functions of a third variable, T.

CREATING A FUNCTION PLOT

1. Select **Graph | New Graph | Function** or click the function graph button  on the toolbar.
2. In the **Function Plot** dialog box, set the desired plot options.
   - To change the axes used, enter the equation or the function interval, add symbols, or change the increment or number of points used to create the curve, use the option on the **Function** tab. The options on this tab are described in this section.
   - To truncate (i.e. "clip") your plot within a fixed range of values, use the options on the **Clipping** tab. See *Clipping a Plot* on page 133.
   - You can add labels to your data points using the options in the **Plot Labels** tab. A label can show either the X or Y value of a data point. It cannot store information that is contained in a worksheet. See *Plot Labels* on page 150.
   - To change the line style (solid, dashed, thick, thin, etc.) or change the line color, use the settings on the **Line Properties** tab. See *Line and Fill Properties* on page 156.

THE FUNCTION TAB

Use the **Function** tab to enter function equations, change which axes are used, set the function interval, control the number of points on the curve, and add symbols to the function line.

Change X Axis and *Change Y Axis* buttons

The fields next to these buttons show the name of the X and Y axes used by the current plot. To change the X or Y axis used by this plot or any other plot in this graph, click the appropriate *Change Axis* button. In the **Select Plots** dialog box, choose which plot(s) you want to assign to the new axis and click *OK*. In the **Select Axis** dialog box, choose the new axis to use and click *OK*. The plot(s) are redrawn using the new axis.

> **Note**: If there is only one axis for the type selected, you are not able to change to a new axis. First, you need to create the axis and then use the appropriate *Change Axis* button. For more information on creating new axes, please refer to *Adding Additional Axes to a Graph* in *Chapter 5, Axes*.

Equation group box
This field is used to enter the algebraic function that you want to plot.

Select the *Y = F(X) =* radio button to enter an equation where Y is a function of X.

For example, to enter the equation:

$$Y = 3 - x^2$$

into the Y = F(X) equation field, type:

```
3-pow(X,2)
```

Use the *Function* button to open the **Functions** dialog box, where you can select and insert advanced mathematical functions into your equation. For more information about these functions, see *Appendix A, Mathematical Functions*.

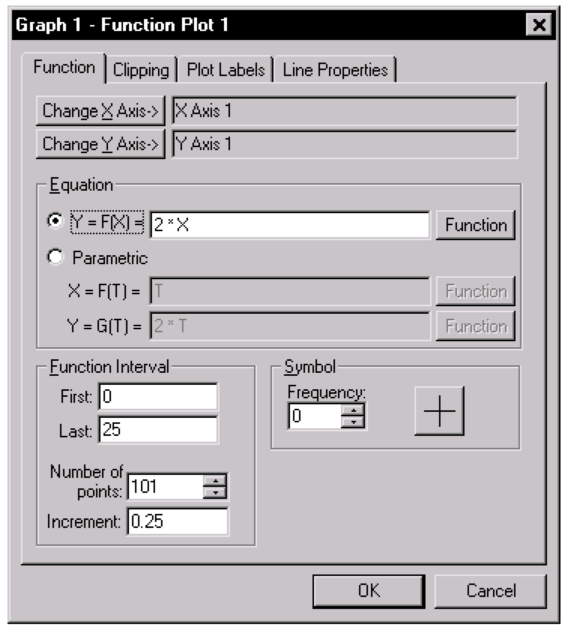
Select *Parametric* to enter expressions where X and Y are functions of T.

For example, to plot the following parametric equations:

X=cos(t-2)

Y=sin(t+3)

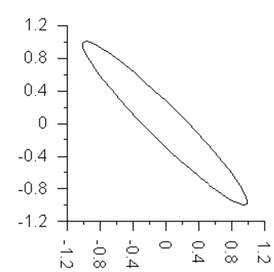
where $1 \le t \le 7.28$



*The **Function** tab*

Do the following:

1. Enter `cos(t-2)` in the *X=F(T)=* field.
2. Enter `sin(t+3)` in the *Y=G(T)=* field.
3. Enter 1 in the *First* field and 7.28 in the *Last* field in the *Function Interval* group box.
4. Click *OK* to view the resulting parametric representation.



Plot of parametric expression:

X = cos (t-2), Y = sin(t+3)

***Function Interval* group box**

Use these options to specify the range and increment of the variable. Enter the first X value or the first T value, if parametric in the function range in the *First* field. Enter the last X value or the last T value in the function range in the *Last* field.

The *Number of points* determines how many times the equation is calculated, and consequently, the number of data points on the function curve. A larger number of points mean that more detail is plotted in the function. This creates smoother looking curves and takes longer to process. If you want a faster initial view, use fewer points. When the *Number of points* is changed, the *Increment* value is automatically adjusted. If you type in a value in the *Increment* field, the *Number of points* field is automatically updated.

***Symbol* group box**

Use these options to represent the data points in the plot with a symbol character. The *Frequency* field indicates how many points are assigned symbols. For example:

Frequency = 0 means that no symbols are plotted. This is the default.

Frequency = 1 means that every point has a symbol.

Frequency = 2 means that every other point has a symbol.

The active symbol displays as an icon button to the right of the *Frequency* field. To change the symbol, click on this button to open the **Plot Point Symbol** dialog box. Specify the desired *Symbol Set*, *Color*, and *Size*. Click *OK* to return to the **Function Plot** dialog box.

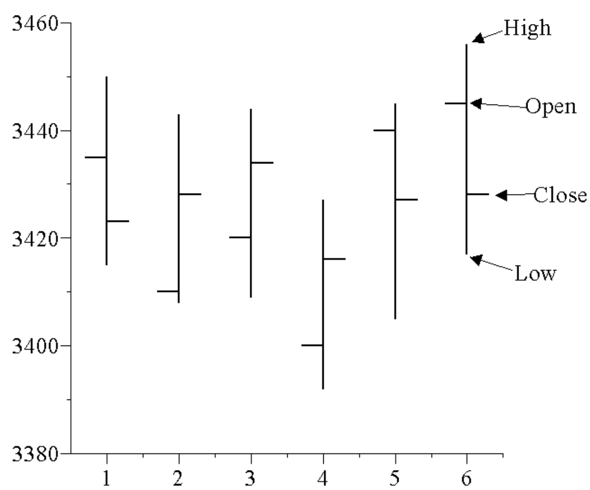
Creating a Function Plot with Multiple Equations

1. Create the first function plot using the directions in *Creating a Function Plot* on page 99.
2. Select the entire graph.
3. Select **Graph | Add to Graph | Plot** or right-click on the graph and choose **Add Plot** from the menu. Select *Function Plot* as the new plot type.
4. Select the appropriate axes in the **Choose Axes** dialog box.
5. Set the new function plot properties in the **Function Plot** dialog box.

Hi-Low-Close Plots

Hi-low-close plots let you display a range of Y values at each X value. This plot is commonly used to display the high, low, opening, and closing stock values, though it can also be used for other data sets. For example, if a data set contains high and low values, such as daily temperatures, it can be used with the hi-low-close plot.

In a hi-low-close plot, a vertical line is drawn between the high and low values, and horizontal lines show the opening and closing values. The high value must be greater than the low value to create a valid graph. The opening value is a horizontal line to the left of the vertical line, and the closing value is a horizontal line to the right of the vertical line.



A hi-low-close graph

Opening and closing values are optional. If no opening or closing value is specified, the resulting graph is a vertical line connecting the high and low values without any horizontal lines.

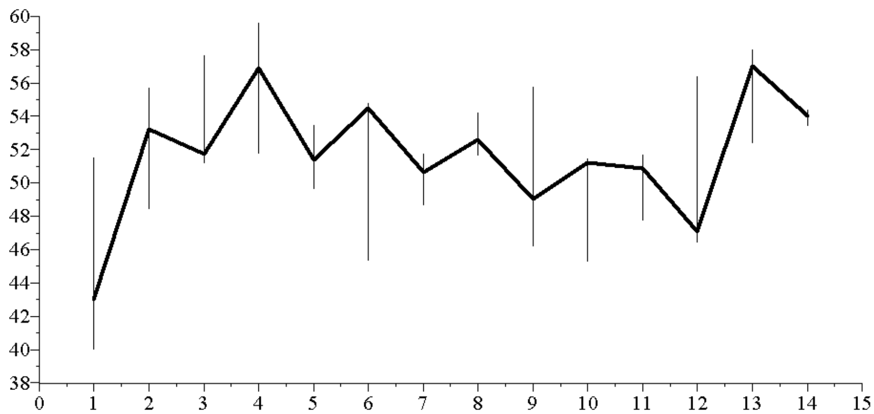
Creating a Hi-Low-Close Plot

1. Select **Graph | New Graph | Hi-Low-Close** or click the hi-low-close graph button on the toolbar.
2. Select a data file from the **Open Worksheet** dialog box and click *Open*.
3. In the **Hi-Low-Close Plot** dialog box, set the desired plot options.
    - Use the **Hi-Low Plot** tab to select the worksheet and axes, assign which worksheet columns to plot, specify the range of data, and set the width of the open and close bars. The options on this tab are described in this section.
    - To truncate (i.e. "clip") your plot within a fixed range of values, use the options on the **Clipping** tab. When clipping is used with hi-low-close plots, the plot does not truncate a bar at a specified value. If any part of the bar exceeds a clipping limit, the bar is not plotted. Also, because there are no lines, there are no *Missing Data* options or a *Draw plot to clipping limit* check box. See *Clipping a Plot* on page 133 for more information.
    - You can add labels to your data points using the options in the **Plot Labels** tab. In a hi-low-close graph, the labels can be the High, Low, Open, or Close values or it can be any combination of the values. See *Adding Labels to Hi-Lo-Close Graphs* later in this section.
    - To customize the type of line (solid, dashed, thick, thin, etc.), or change line color, use the settings on the **Line Properties** tab. See *Line and Fill Properties* on page 156.

Creating a Hi-Low-Close Plot with Connected Bars

1. Create a hi-low-close plot using the directions in *Creating a Hi-Low-Close Plot* above.
2. Select the entire graph.
3. Select **Graph | Add to Graph | Plot** or right-click on the graph and choose **Add Plot** from the menu.
4. Select *Line/Symbol Plot* from the **Select Plot Type** dialog box and click *OK*.
5. Select the appropriate axes in the **Choose Axes** dialog box and click *OK*.
6. Select the data file that was used to create the hi-low-close plot in step 1 in the **Open Worksheet** dialog box and click *Open.*
7. In the **Line/Symbol Plot** dialog box, choose the same X column that was used in the hi-low-close plot, and select the high value, low value, open value, or close value column for the Y column. As a result, a line connects the high, low, open, or close values. Which column you

choose for the Y column determines where on the vertical hi-low plot lines the line/symbol plot connects.



Hi-low-close graph connected by close values.

THE HI-LOW PLOT TAB

Use the options on the **Hi-Low Plot** tab to change the worksheet or axes used by the plot, set the worksheet columns or the range of data that the plot uses. The width of the open and close bars is also set on this tab.

Worksheet button

Use the *Worksheet* button to change which data file is used for the current plot, or any other plot in this graph. To change the data, click the *Worksheet* button. In the **Select Plots** dialog box, choose which plots you want to use the new worksheet and click *OK*. In the **Open Worksheet** dialog box, select the new data file and click *Open*. The plot(s) are redrawn using the new worksheet data. You may need to edit the *Worksheet Columns* assignments for the graphs to display properly.

Change X Axis and *Change Y Axis* buttons

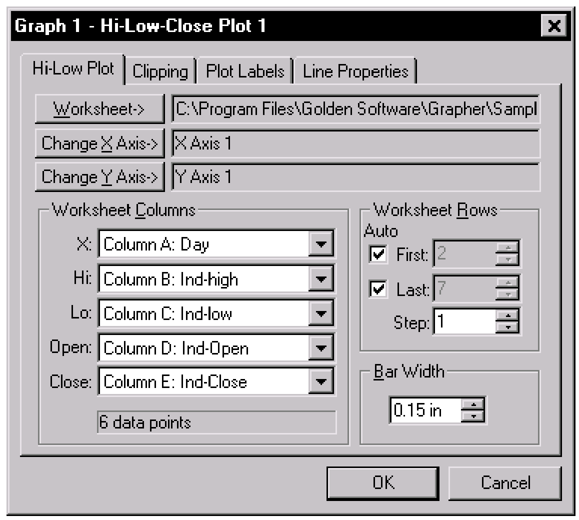
The fields next to these buttons show the name of the X and Y axes used by the current plot. To change the X or Y axis used by this plot or any other plot in this graph, click the appropriate *Change Axis* button. In the **Select Plots** dialog box, choose which plot(s) you want to assign to the new axis and click *OK*. In the **Select Axis** dialog box, choose the new axis to use and click *OK*. The plot(s) are redrawn using the new axis.

> **Note**: If there is only one axis for the type selected, you are not able to change to a new axis. First, you need to create the axis and then use the appropriate *Change Axis* button. For more information on creating new axes, please refer to *Adding Additional Axes to a Graph* in *Chapter 5, Axes*.

Worksheet Columns **group box**

Use these fields to designate which data columns are plotted on which axis.

In the *X* drop-down list, select the column you want to plot along the X axis. In a hi-low-close plot, this is generally your date value column. If you do not have a column of data for the *X* column, you can specify *Row Number* or *Sequence Number*. Use the *Row Number* to assign the row number position from the worksheet as the X axis value. If the first row in the worksheet is row 2, your X data begins with the value 2. If the first row of data in the worksheet is row 20, your X data begins with the value 20. Use the *Sequence Number* if you want your data to begin with the number 1 regardless of where in the worksheet your data is located.



*The **Hi-Low-Close Plot** dialog box*

In the *Hi* and *Lo* drop-down lists, select the columns that contain the high and low data column, respectively.

> **Note:** The column containing *Hi* values must contain values greater than the numbers in the *Lo* value column.

If you want to plot opening and closing data bars, select the appropriate data columns in the *Open* and *Close* drop-down lists. If your plot does not contain this type of data, select *None*.

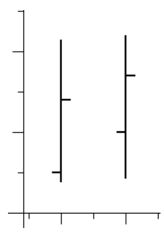
Worksheet Rows **group box**

Select the range of rows to be plotted in the *Worksheet Rows* group box. **Grapher** defaults to using the first and last rows containing data in the worksheet. Rows that do not contain data (blanks or text) are excluded from the plot. To change the range of rows used, uncheck the *Auto* box next to the *First* and/or the *Last* boxes and type or scroll to the new row number. Check the *Auto* box to revert to the default rows.

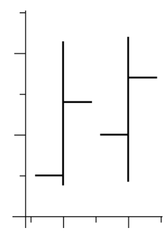
Use the *Step* option to skip rows of data in the plot. When *Step* is set to 1, all of the data between the *First* and *Last* rows are plotted. If *Step* is set to 2, every other data point is plotted on the graph. If *Step* is set to 3, every third point is plotted on the graph.

Bar Width **group box**

This option sets the length of the *Open* and *Close* lines on the graph.



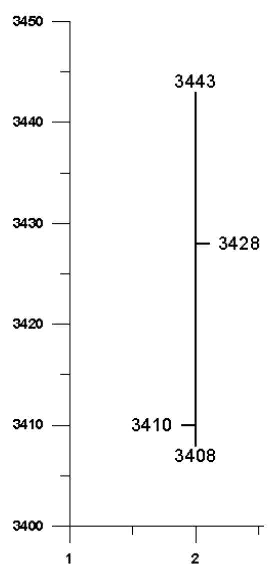
Bar Width = 0.15 in



Bar Width = 0.50 in

ADDING LABELS TO HI-LO-CLOSE GRAPHS

Use the options on the **Plot Labels** tab to show the actual data values next to the hi, low, open, and close bars on the graph. Follow these directions to add labels to an existing hi-low-close plot.



A hi-low-close plot shown with labels.

1. In the **Hi-Low-Close Plot** dialog box, click on the **Plot Labels** tab.

2. Place a check mark in the *Show labels* check box. This activates the *Show Value* options.

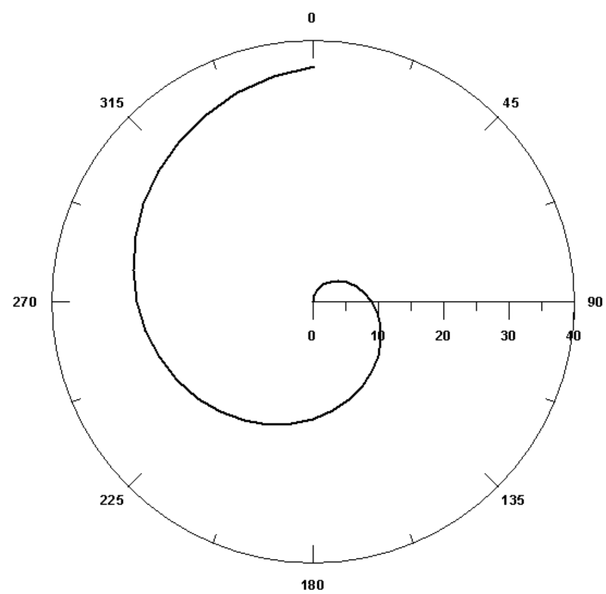
3. In the *Show Value* group box, place a check mark in the check box next to each type of data value to which you want to assign a label. The options are *High*, *Low*, *Open*, and *Close*. To remove a label, clear its check box. Any individual label or any combination of labels can be checked.

4. To change the format of the label or its font properties, click on the *Label Format* button. This opens the **Plot Labels Format** dialog box.

   See *The Plot Points Label Format Dialog Box* on page 154 for a detailed description of these label options.

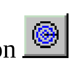
Polar Plots

Use polar plots to display degree, radian, or grad data versus radial distance. The degree, radian, or grad data are displayed on a circular angle axis. The second axis is a radial axis showing the distance from the center of the circle. Refer to the section titled, *Configuring Axes on Polar Plots and Rose Diagrams* on page 180 for more information about radial axes.



A polar plot with the angle axis in degrees

CREATING A POLAR PLOT

1. Select **Graph | New Graph | Polar** or click the polar plot button  on the toolbar.
2. Select a data file from the **Open Worksheet** dialog box and click *Open*.
3. In the **Polar Plot** dialog box, set the desired plot options.
    - Use the **Polar Plot** tab to select the worksheet, assign which worksheet columns to plot, specify the range of data to plot, show symbols, add new plots or delete existing plots. The options on this tab are described in this section.
    - To truncate (i.e. "clip") your plot within a fixed range of values, use the options on the **Clipping** tab. See *Clipping a Plot* on page 133. Note that although the clipping options look the same, the radial and angular axes are used instead of X and Y axes.

- You can compare your plot to known mathematical curves by adding a predefined fit curve to your graph. This is done using the options on the **Fits** tab. In addition to the ten predefined fit curves, you can also create your own custom curve functions. See *Fit Curves* on page 139 of this chapter.
- You can add labels to your data points using the options in the **Plot Labels** tab. A label can show the value of a data point (radius or angle axis), or it can show some other value or text label stored in the current worksheet. See *Plot Labels* on page 150.
- To change the line style (solid, dashed, thick, thin, etc.), change the line color, or add "heads" to the ends of the line, use the settings on the **Line Properties** tab. See *Line and Fill Properties* on page 156.

Creating a Polar Plot with Multiple Data Curves

1. Create the first polar plot using the directions in the *Creating a Polar Plot* section on page 107.
2. Select the entire graph.
3. Select **Graph | Add to Graph | Plot** or right-click on the graph and choose **Add Plot** from the menu. You can only add a polar plot or a rose diagram to an existing polar plot.
4. In the **Select Plot Type** dialog box, choose *Polar Plot* and click *OK.*
5. Select a data file in the **Open Worksheet** dialog box and click *Open*.
6. Set the new polar plot properties in the **Polar Plot** dialog box.

Polar plots can also be added by clicking the *New* button in the **Polar Plot** dialog box. Use this button instead of the **Graph | Add to Graph | Plot** command if the data is in the same worksheet as the original data.

THE POLAR PLOT TAB

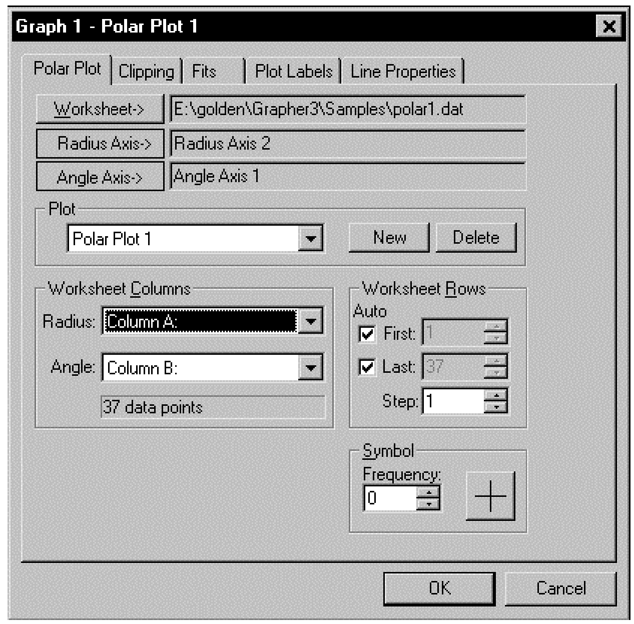
Use the **Polar Plot** tab to change the worksheet, choose which columns to display, choose the data range to display, add symbols, add a new plot or delete an existing plot.

Worksheet button

Use the *Worksheet* button to change which data file is used for the current plot, or any other plot in this graph. To change the data, click the *Worksheet* button. In the **Select Plots** dialog box, choose which plots you want to use the new worksheet and click *OK*. In the **Open Worksheet** dialog box, select the new data file and click *Open*. The plot(s) are redrawn using the new worksheet data. You may need to edit the *Worksheet Columns* assignments for the data to plot correctly.

Radius Axis and *Angle Axis* fields

These fields show the name of the radius and angle axes used by the current plot.



*The **Polar Plot** dialog box*

Plot group box

This drop-down list shows you the active plot. The list contains the names of any other plots in this graph that share the same worksheet and are the same plot type.

Note: If your graph contains plots that use different worksheets, you cannot switch between them using the *Plot* field. You must manually close the current **Polar Plot** dialog box, and double-click on the new plot to edit its properties.

The *New* button creates a new plot based on the same worksheet as the active plot. By clicking the *New* button, a new plot is created that uses the same *Radius* column and the next column for the *Angle* values. For instance, if your current plot uses column B for *Radius* and column C for *Angle*, the new line uses column B for the *Radius* and column D for *Angle*. Edit the *Worksheet Columns* assignment and other properties to configure the new plot.

The *Delete* button removes the active plot from the graph. You are not prompted to confirm this decision, so use this button cautiously.

Worksheet Columns group box

Select which data column to plot on each axis. The *Radius* column should contain data that shows how far the data point is from the center of the plot. The *Angle* column data can be in radians, degrees, or grads. Specify the units for the *Angle* column in the **Angle Axis** dialog box. If the first worksheet row contains header information, the header information appears next to the column letter, as in *Column A: Distance* or *Column B: Direction*.

In addition to the columns containing data, there are two other options, *Row Number* and *Sequence Number*. *Row Number* plots the data with the row number position in the worksheet. The data are plotted according to the rows selected in the *Worksheet Rows* group box. If the first row is number two, the first axis position is two. If the first data row is row number 50, the first axis position is 50. *Sequence Number* uses the data position in the worksheet to plot the data. The

Sequence Number position always begins with the number one regardless of what rows are selected in the *Worksheet Rows* group box.

***Worksheet Rows* group box**

Use these options to specify the range of data included in the plot. By default, **Grapher** includes all numeric data in the plot and plots every point. Using these options, you can specify a smaller range of data, or plot every n^{th} point.

The *First* field designates the first row of data that is plotted. If the *Auto* check box is marked, the *First* field is grayed out and **Grapher** uses the first row containing valid numeric data. To use a custom *First* row, click on the check mark to remove it and type in the value of the *First* row of data.

The *Last* field sets the last row of data that is plotted. If the *Auto* check box is marked, the *Last* field is grayed out and **Grapher** uses the last row in the column that contains valid numeric data. To use a custom *Last* row, click on the check mark to remove it and type in the value of the *Last* row of data.

By default, **Grapher** plots every point in the range (*Step* = 1). If you do not want to plot every point, increase the *Step* value accordingly. For example, when *Step* = 2, **Grapher** plots every other point (rows 1, 3, 5, etc,). When *Step* = 3, **Grapher** plots every third point (rows 1, 4, 7, etc.)

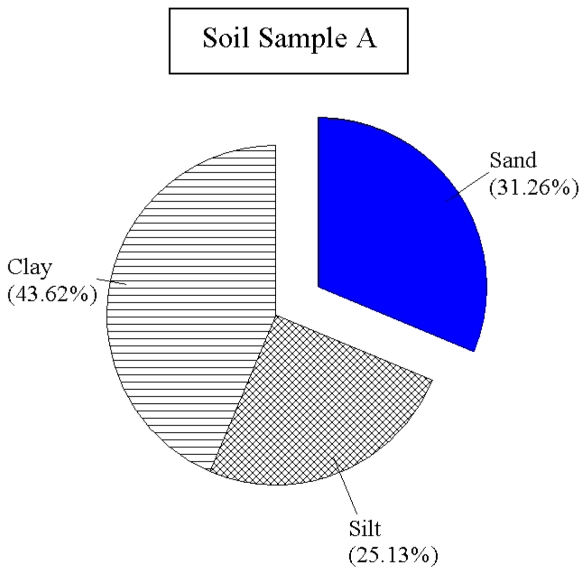
> **Note:** Rows that do not contain data (blanks or text) are automatically excluded from the plot.

***Symbol* group box**

You can display symbols at the data points by setting the *Frequency* of the symbols to a number greater than zero. Setting the *Frequency* to 0 shows no symbols. This is the default behavior. Setting the *Frequency* to 1 shows a symbol at every data point. Setting the *Frequency* to 2 shows a symbol at every other data point. The current symbol displays as a button next to the *Frequency* group. Click on this symbol to open the **Curve Symbol** dialog box. Click on the desired *Symbol Set*, *Color*, or *Size* to change the current symbol properties. Click *OK* to return to the **Polar Plot** dialog box.

Pie Charts

A pie chart shows data values as proportional slices of a circle. Each data value is divided by the sum of the data to determine its percentage of the whole, which determines the size of the slice. The data with the largest number in the data column has the largest slice in the pie chart.



Pie chart with one "exploded" slice (Sand) and two line labels (soil type and percentage)

Creating a Pie Chart

1. Select **Graph | New Graph | Pie Chart** or click the pie chart button  on the toolbar.
2. Select a data file from the **Open Worksheet** dialog box and click *Open*.
3. In the **Pie Chart** dialog box, set the desired plot options.
   - Use the **Pie Chart** tab to select the worksheet, assign which worksheet columns to plot, specify the range of data to plot, and access the properties of each slice. The options on this tab are described in this section.
   - You can add labels to your pie chart to identify the various slices using the options in the **Labels** tab. These options are described in this section.

The Pie Chart Tab

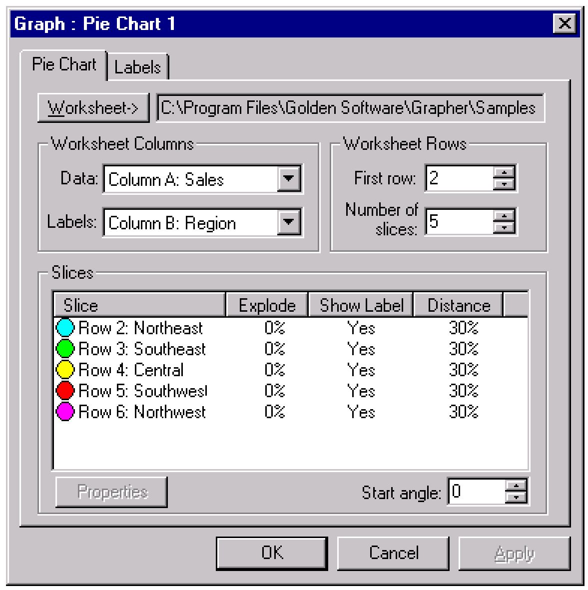
Use the **Pie Chart** tab to change the worksheet, select the data column, select the label column, change the range of data, and access the properties of all slices.

Worksheet button

Click this button to change the worksheet used in this plot. In the **Open Worksheet** dialog box, select the new data file and click *Open*. The plot is redrawn using the new worksheet data. You may need to edit the *Worksheet Columns* assignments for the data to plot correctly.

Worksheet Columns group box

In the *Data* column, choose the column containing the data values to plot as percentages of the pie chart. In the *Labels* column, choose the column containing the data labels. The labels can be text, numeric, or a combination of both.



*The **Pie Chart** dialog box*

Worksheet Rows group box

Use these options to plot only a portion of the data. The default *First row* is the topmost row in the worksheet that contains valid data. Rows that contain text or blanks are excluded from the chart.

In pie charts, a slice represents each data row. The *Number of slices* field determines how many data rows are plotted, starting from the first valid row. For example, setting this field to 5 would plot the first five data rows in the pie chart. By default, all valid rows are included in the pie chart. The *Number of slices* cannot be greater than the number of data rows in the data set.

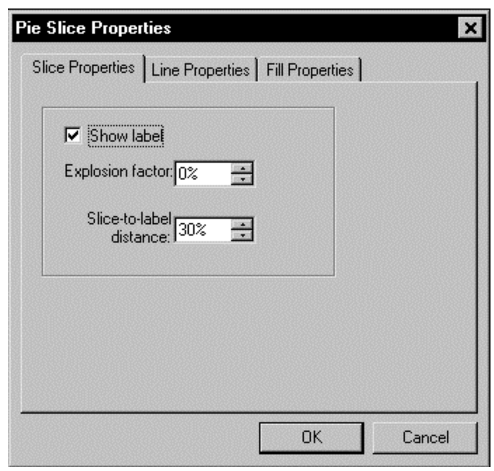
Start angle field

This option lets you rotate the pie chart by a fixed number of degrees. Zero is at the 12:00 position on the pie. The first data value is drawn with the left edge of the slice on the 12:00 vertical line and the right edge is drawn clockwise from this line. Entering positive numbers rotates the pie clockwise. Negative numbers rotate the pie counter-clockwise.

Slices group box

This box lists information about each pie slice. To change the properties of all slices simultaneously, click the *Slice*, *Explode*, *Show Label*, or *Distance* buttons at the top of the *Slices* group box. Clicking one of these buttons opens a dialog box so you can make the desired setting changes.

To edit an individual slice, double-click on the slice in the *Slices* list, or highlight the slice and click the *Properties* button. The **Pie Slice Properties** dialog box opens so you can make the desired **Slice Properties**, **Line Properties**, and **Fill Properties** changes.



*The **Pie Slice Properties** dialog box*

- The **Slice Properties** tab contains the options to show labels, explode the piece of pie, and change the slice to label distance. The *Show label* check box determines whether the slice's label is visible. Remove the check mark to remove the label for this piece of pie. The *Explosion factor* determines how far out the slice is placed from the center of the pie. The allowable range is 0% to 100%. A value of 0% places the tip of the pie piece at the center of the circle. A value of 100% places the tip of the pie at the outer edge of the original circle. The *Slice-to-label distance* determines the distance between the slice and the label. The allowable range is from – 100% to 100%. A value of – 100% places the label at the tip of the pie slice. A value of 0% places the label on the edge of the circle. A value of 100% places the label the same distance away from the pie slice as the radius of the pie.
- The **Line Properties** tab contains options to let you change the line *Style*, *Color*, and *Width*. These options affect the perimeter of the slice only. See *Line Properties* on page 157 for more information about changing line properties.
- The **Fill Properties** tab contains options to let you assign a fill pattern to the slice and change the foreground and background colors used by the pattern. See *Fill Properties* on page 158 for more information about changing fill properties.

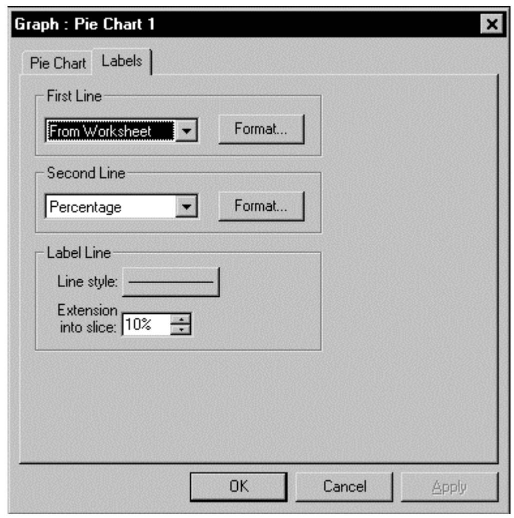
The Labels Tab

Use this tab to set the label properties for a pie chart.

First Line and *Second Line* group boxes

Each label has two lines. These drop-down lists determine the data source used for each line. The following options are available:

- *None* leaves the label blank. If the *First Line* is set to *None*, no labels are allowed on the *Second Line*.
- *From Worksheet* displays the data from the *Labels* column specified on the **Pie Chart** tab.
- *Data Value* displays the numeric value from the *Data* column on the **Pie Chart** tab.
- *Percentage* displays how much of the total pie each slice occupies as a percent value.



*The **Labels** tab of the **Pie Chart** dialog box*

Clicking the *Format* button in the *First Line* or *Second Line* group boxes opens the **First Line Format** or **Second Line Format** dialog box, respectively. You can set the numeric format, active format, character format, and text properties for the labels in this dialog box. See *The Plot Points Label Format Dialog Box* on page 154.

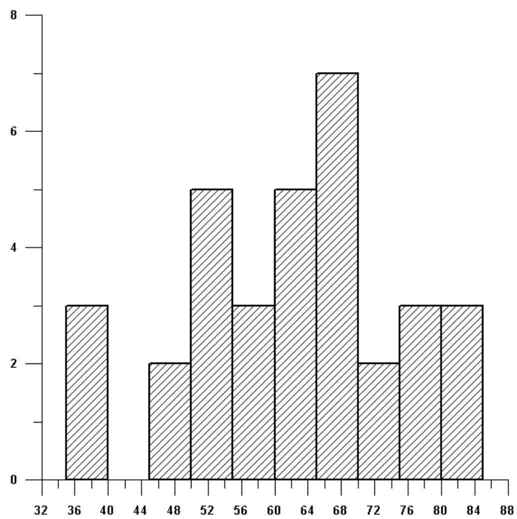
Label Line group box

Click the *Line style* button to open the **Extension Line** dialog box. In this dialog box, you can change the line's *Style, Color, Width*, and *End Styles*. See *Line and Fill Properties* on page 156 for more details on how to change these properties.

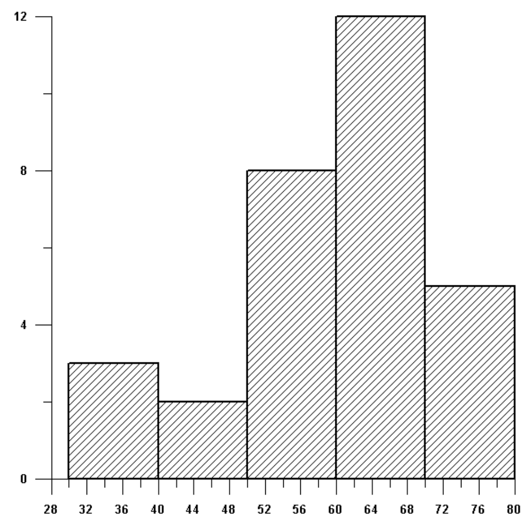
Change the number in the *Extension into slice* box to change the distance the line extends into the slice. This must be a value between 0 and 100%. A value of 0% stops the line at the edge of the pie slice. A value of 50% extends the line halfway into the slice. A value of 100% extends the line to the center of the circle.

Histograms

Histograms display data as a series of groups, called bins. Each bin represents a range of values on the X axis. The height of a bin represents the number of data points that fall within that bin's range. You can manually set the number of bins and the bin size, or let **Grapher** determine a bin range automatically. You can display the number of data points as a total count of the number of Y values that fall within the bin or as a relative frequency. If you have only a single Y value for each X value, to use the bar chart instead of the histogram.



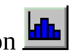
Histogram with Number of bins = 10, Bin size = 5.



Histogram with Number of bins = 5, Bin size = 10.

The two histograms above show the same data set represented using two different bin models. Smaller bin sizes provide more detailed information about a range of data. For example, the histogram on the right shows us only that there are two data points in the range 40 - 50. The histogram on the left clarifies this further and shows that the two data points occur between the range 45 - 50.

CREATING A HISTOGRAM

1. Select **Graph | New Graph | Histogram** or click the histogram button  on the toolbar.
2. Select a data file from the **Open Worksheet** dialog box and click *Open*.
3. In the **Histogram** dialog box, set the desired plot options.
    - Use the **Histogram** tab to select the data and axes, assign which data column to plot, specify the range of data to plot, set the number of bins, bin width, and base value for the bins. The options on this tab are described in this section.
    - Use the **Bins** tab to create custom bin sizes. This tab is discussed in this section.
    - You can compare your plot to known mathematical curves by adding a predefined fit curve to your graph. This is done using the options on the **Fits** tab. With the histogram, there is only one fit available – the Normal Distribution (Gaussian) fit. All of the other options on this tab are described in the section titled *Fit Curves* on page 139 of this chapter.
    - You can add labels to your data points using the options on the **Plot Labels** tab. A label shows the number of values that fall within the given bin. The options on this tab are discussed in this section.
    - To change the line style (solid, dashed, thick, thin, etc.), change the line color, or shade the area inside the bar, use the settings on the **Line-Fill** tab. See *Line and Fill Properties* on page 156.

ADDING A LINE PLOT TO A HISTOGRAM

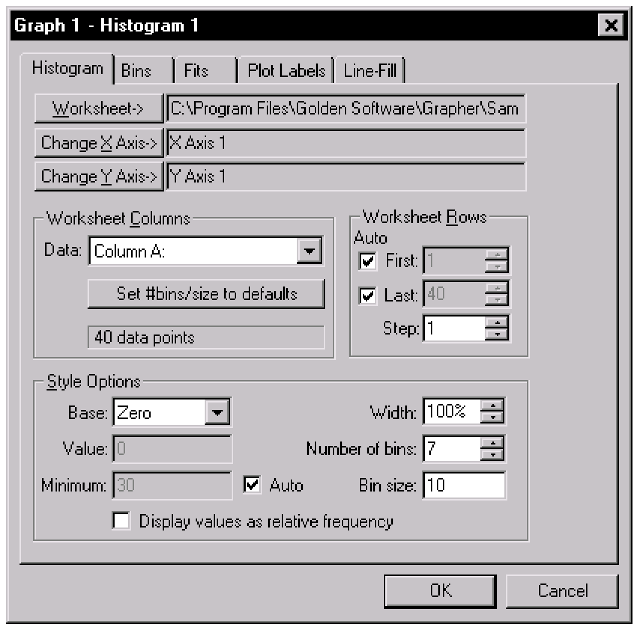
1. Create a histogram using the above directions.
2. Select the entire graph.
3. Select **Graph | Add to Graph | Plot** or right-click on the graph and choose **Add Plot** from the menu.
4. Select *Line/Symbol Plot* in the **Select Plot Type** dialog box and click *OK*.
5. Select the appropriate axes in the **Choose Axes** dialog box and click *OK*.
6. Click *OK* in the **Line/Symbol Plot** to see the line plot drawn onto the histogram. Adjust the order of the graphs by using the up and down arrows in the **Object Manager**, or by using the **Arrange** menu commands after a graph has been selected.

THE HISTOGRAM TAB

Use the **Histogram** tab to set histogram options such as changing the worksheet and axes, choosing a base value, selecting a data column to use in the histogram, and limiting the number of rows used. The automatic binning options are also included on this page. To set custom bins, use the options on the **Bins** tab.

Worksheet button

Use the *Worksheet* button to change which data file is used for the current plot, or any other plot in this graph. To change the worksheet, click the *Worksheet* button. In the **Select Plots** dialog box, choose which plots you want to use the new worksheet and click *OK*. In the **Open Worksheet** dialog box, select the new data file and click *Open*. The plot(s) are redrawn using the new worksheet data. You may need to edit the *Worksheet Columns* assignments for the data to plot correctly.



The ***Histogram*** *dialog box*

Change X Axis and *Change Y Axis* buttons

The fields next to these buttons show the name of the X and Y axes used by the current plot.

To change the X or Y axis used by this plot or any other plot in this graph, click the appropriate *Change Axis* button. In the **Select Plots** dialog box, choose which plot(s) you want to assign to a new axis and click *OK*. In the **Select Axis** dialog box, choose the new axis to use and click *OK*. The plot(s) are redrawn using the new axis.

> **Note**: If there is only one axis for the type selected, you are not able to change to a new axis. First, you need to create the axis and then use the appropriate *Change Axis* button. For more information on creating new axes, please refer to *Adding Additional Axes to a Graph* in *Chapter 5, Axes*.

***Worksheet Columns* group box**

In the *Data* column, select the data column that you want to plot as a histogram. If the first worksheet row contains header information, the header information appears next to the column letter. This would be displayed as *Column A: My Data*. The total number of data points used in the plot is displayed beneath the *Set #bins/size to defaults* button.

If you make changes to the default bin settings on this page, either the number of bins or the bin size, click the *Set #bins/size to defaults* button to restore **Grapher's** default bin settings for this plot.

***Worksheet Rows* group box**

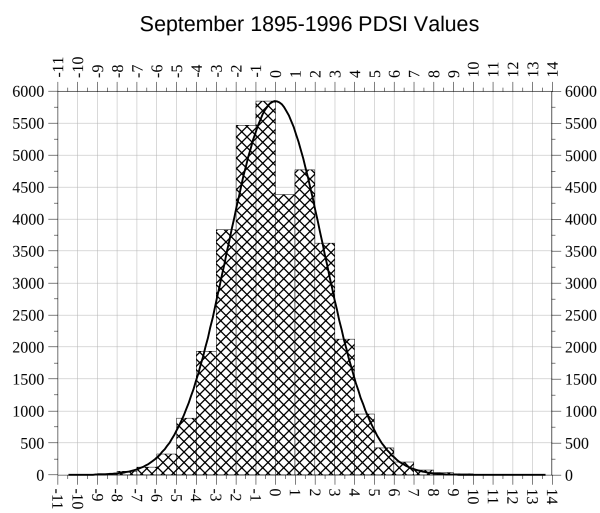
Use these options to set the range of data you want to include in the histogram. The default rows are the first and last rows containing data in the worksheet. Rows that contain blanks or text are excluded from the plot. To change the range of rows used, uncheck the *Auto* box next to the *First* and/or *Last* boxes and type or scroll to the row number. Check the *Auto* box to revert to the default rows.

Use the *Step* option to limit the number of data points shown in the plot. For example, if *Step* is set to five, every fifth data point is plotted on the graph. When *Step* is set to 1, all data points are plotted on the graph.

***Style Options* group box**

Set the *Base* of the bins to the data minimum, to the data maximum, to zero, or to a custom defined value.

- *Zero* causes all bins to originate at the zero point on the Y axis.
- *Data min* draws all bins from the minimum data value to the Y data value.
- *Data max* draws all bins from the data maximum to the Y data value.
- *Custom* lets you set the number at which to plot the base. Enter this number in the *Value* box. The bins are drawn upward or downward depending on the data in the bins and the custom setting.



Histogram with a Normal Distribution (Gaussian) fit

Enter the beginning bin value in the *Minimum* box, or check the *Auto* box to have **Grapher** automatically set the starting value to the minimum data value. This item is not part of the *Base*. This is the X axis value on which the first bin starts. Therefore, if you set *Minimum* to 30, your bins start at 30. If you change the *Minimum* box to 25, the bins start at 25.

Set the *Width* of the automatic bins from 1 to 5000%. At 100%, there is no space between adjacent bins. If the *Bin size* is 10, a value of 100% results in a bin that is 10 units wide on the graph. If you set the *Width* to 200%, the bin is 20 units wide. At 50%, the same bin is five units wide.

Use the *Number of bins* field to change the number of bins drawn on the plot.

The *Bin size* field is the number of X values included in a single bin.

> **Note:** When changing the number of bins and bin size, **Grapher** automatically adjusts the range of data to accommodate the settings.

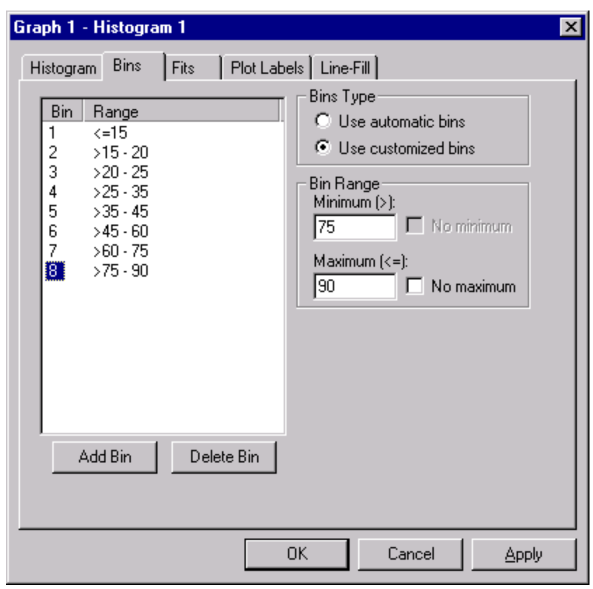
When there is a check mark in the *Display values as relative frequency* check box, the histogram shows the relative frequency (i.e. percentage) of the data values along the Y axis rather than the number of observations in each bin.

The Bins Tab

You can use the **Bins** tab to custom define bins when creating or editing a histogram. By default, the *Use automatic bins* option is selected, which uses the automatic bin settings defined on the **Histogram** tab.

Bins Type group box

To create or use the bins defined on the **Bins** tab, you must first select the *Use customized bins* radio button. If this is not selected, the bin ranges are calculated by **Grapher** using the information on the **Histogram** tab.



*The **Bins** tab of the **Histogram** dialog box*

Add Bin button

After selecting the *Use customized bins* setting, click the *Add Bin* button to create custom bin sizes. The **New Bin Range** dialog box opens so you can enter the *Minimum* and *Maximum* values of the new bin. When finished, click *OK* to return to the **Histogram** dialog box. Continue clicking the *Add Bin* button and inputting bin ranges until all of the bins have been defined.

When categorizing, the maximum value is included in the bin and all values greater than, but not equal to, the minimum value are included in the bin.

Delete Bin button

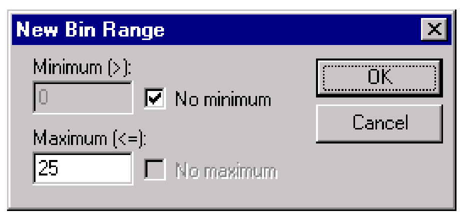
Bins can be deleted by clicking the *Delete Bin* button. You are not warned before the bin is removed, so use this button with caution.

Bin Range group box

The *Bin Range* group box shows the *Minimum* and *Maximum* value for the selected bin. To select a bin, click on the *Bin* number in the bin list. To edit the range, highlight the value in either the *Minimum* or *Maximum* field and type in a new value.

Setting Open Ended Bin Ranges

If you want a bin to include all values below a particular value, enter the *Maximum* value and check the *No minimum* check box. Any values equal to or lower than the maximum value register in this bin.



Creating a bin for all values equal to or less than 25

If you want the bin to include all points above a particular value, enter the *Minimum* value and check the *No maximum* check box. Any values greater than the minimum value register in this bin.

After entering the bin range, click *OK* to add the new bin to the **Bins** tab. A no limit bin can also be set in the *Bin Range* group box after the bin has been created.

A Note about Defining Bins

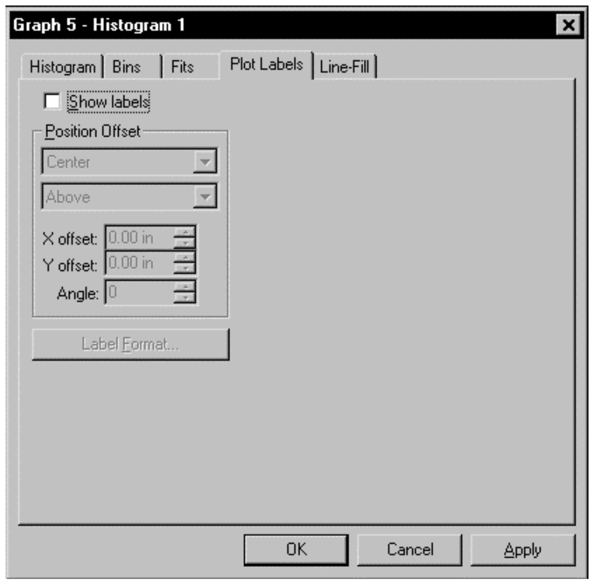
- Histogram bins can be defined automatically or manually in **Grapher**. The bin definition on the **Histogram** tab is automatic. The program decides the bin size, number of bins, and the bin labels. If you need more control over bin sizes, manually define the bins on the **Bins** tab. Customized bins are especially useful when the bins are uneven sizes. If the bins are uneven sizes, the bins vary in width depending on the ranges set for the bins.
- When defining bins, it is a good idea to enter the *Maximum* value of the previous bin into the *Minimum* value box of the next bin. Otherwise, there are gaps in the bin range and some data may be missed on the histogram. Remember that the maximum value is included in the bin, whereas only values greater than but not equal to the minimum value are included. This prevents duplication of data.

THE PLOT LABELS TAB

Labels can be added to a histogram and configured using the options on the **Plot Labels** tab of the **Histogram** dialog box.

Show labels check box

Check the *Show labels* check box on the **Plot Labels** tab of the **Histogram** dialog box. This makes the other options on this tab active.



*The **Plot Labels** tab of the **Histogram** dialog box*

Position Offset group box

In the *Position Offset* group box, set the position where you want the label to appear. The top drop-down list sets the horizontal position of the label (*Left*, *Center*, *Right*) while the lower drop-down list sets the vertical position with respect to the top line of the histogram bar (*Above*, *Center*, *Below*).

Use the *X offset* and *Y offset* fields to manually position the labels a specific distance in the horizontal and vertical directions, respectively. These values may be positive or negative.

The *Angle* field lets you rotate the values by a specific number of degrees. Positive angle values rotate the label counter-clockwise while negative values rotate the label clockwise.

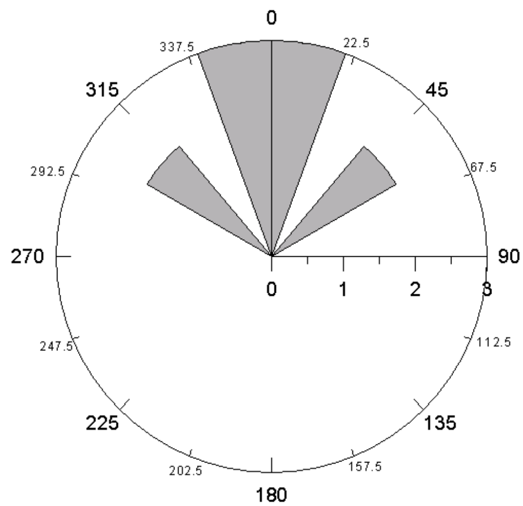
Label Format button

To change the format of the label or its font properties, click on the *Label Format* button. This opens the **Plot Labels Format** dialog box. See *The Plot Points Label Format Dialog Box* on page 154 for a detailed description of these options. Click the *OK* button to return to the **Histogram** dialog box.

Rose Diagrams

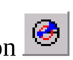
Like histograms, rose diagrams display statistical data. Rose diagrams show the number of occurrences of an event that fall within a specific angular region.

For example, the plot shown here uses a *Bin size* of 20 degrees, which means it divides the entire 360 degree circle into 20 degree slices. The plot indicates that the largest point density occurs in the two regions between 340-360 degrees, and 0-20 degrees. By viewing the radius axis, it can be seen that the average point density in these two regions is 3. In the 40-60 degree bin, the point density drops to 2, as it does in the 300-320 degree bin.



A rose diagram with a 20 degree bin size

Creating a Rose Diagram

1. Select **Graph | New Graph | Rose Diagram** or click the rose diagram button  on the toolbar.
2. Select a data file from the **Open Worksheet** dialog box and click *Open*.
3. In the **Rose Diagram** dialog box, set the desired plot options.
   - Use the **Rose Diagram** tab to select the worksheet, assign which worksheet column to plot, specify the range of data to plot and set the bin options. The options on this tab are described in this section.
   - To change the line style (solid, dashed, thick, thin, etc.), change the line color, or shade the bin areas, use the settings on the **Line-Fill** tab. See *Line and Fill Properties* on page 156.

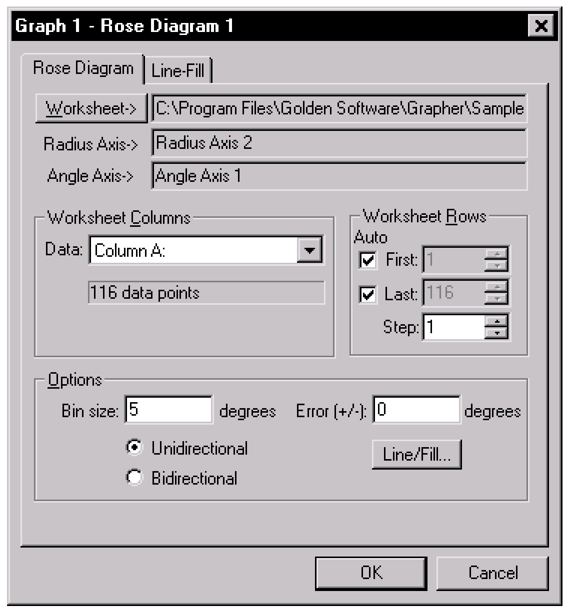
THE ROSE DIAGRAM TAB

Worksheet button

Use the *Worksheet* button to change which data file is used for the current plot, or any other plot in this graph. To change the worksheet, click the *Worksheet* button. In the **Select Plots** dialog box, choose which plots you want to use the new worksheet and click *OK*. In the **Open Worksheet** dialog box, select the new data file and click *Open*. The plot(s) are redrawn using the new worksheet data. You may need to edit the *Worksheet Columns* assignments for the data to plot correctly.

Radius Axis and *Angle Axis* fields

These fields display the axes for the current plot.



The ***Rose Diagram*** *dialog box*

Worksheet Columns group box

In the *Data* list, select the data column that you want to plot on the rose diagram. This column should have data in degrees, radians, or grads.

Example: To have a mark with a length of two displayed at the 45 degree mark, the value “45” would need occur twice in the worksheet *Data* column.

If the first worksheet row contains header information, the header information appears next to the column letter. For example, the data may be in *Column A: Direction.* The total number of data points used in the plot is displayed beneath the *Data* field.

Worksheet Rows group box

Use these options to set the range of rows you want to include in the rose diagram. The default rows are the first and last rows containing data in the worksheet. Rows that contain blanks or text are excluded from the plot. To change the range of rows used, uncheck the *Auto* box next to the *First* and/or *Last* fields and type or scroll to the row number. Place a check mark in the *Auto* box to revert to the default rows.

Use the *Step* option to limit the number of data points shown in the plot. For example, if *Step* is set to five, every fifth data point is plotted on the graph. When *Step* is set to one, all data points are plotted on the graph.

***Options* group box**

The *Bin size* specifies how large the angular sampling region is. For example, if *Bin size* = 45, the plot would be divided into eight equal sections of 45 degrees.

If *Unidirectional* is selected, the information is plotted once. Selecting *Bidirectional* creates a mirror image of the data. To calculate where the data is plotted using *Bidirectional,* add 180 degrees to the data value. Therefore, if you have a bin size of 45 degrees and values in the range of zero to 45, there is a bin at 0-45 degrees and another mirrored at 180-225 degrees.

The *Error (+/-)* field plots an arc with a width that is twice the specified error. This allows the user to set an error bar around the data that has been plotted. This is especially useful when plotting single points with an error distribution. For example, if you put in 5 degrees for your *Error,* a bar that is 10 degrees wide located at the center of all of the bars is created.

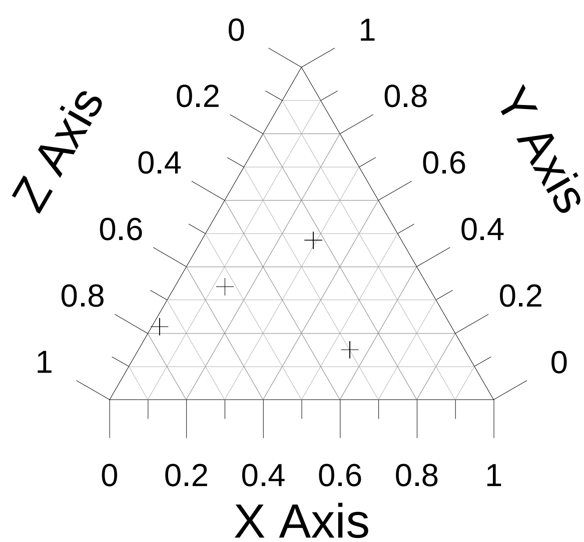
Click the *Line/Fill* button to open the **Error Line/Fill** dialog box. This dialog box sets the line style and color fill for the error bar only. Refer to *Line and Fill Properties* on page 156.

Ternary Diagrams

Ternary diagrams provide a way to represent relative percentages in a three component system. They are frequently used in chemistry and earth sciences to illustrate rock classification schemes and depict chemical compositions on phase diagrams.

For example, if you were analyzing the composition of a soil sample, you could use a ternary diagram to illustrate the relative percentages of three minerals found in the sample.

To plot data on a ternary diagram, the sum of the three data points (X + Y + Z) in any row must equal 100%. If the data does not sum to 100%, **Grapher** normalizes the data before it is plotted. Once this relationship has been established between the data points, you need only know the values of any two data points in order to determine the third.



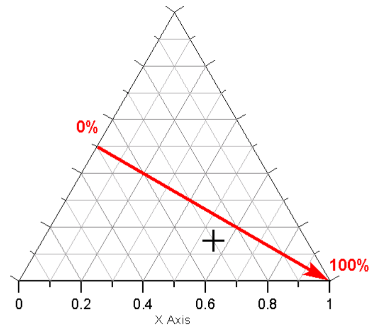
Four data points plotted on a ternary diagram.

How to Read a Ternary Diagram

X Axis

The X axis values in a ternary diagram are read from the zero point, defined along the left side of the triangle, to the 100% point at the lower right vertex.

The sample point (+) on this diagram has an X value of 0.55.

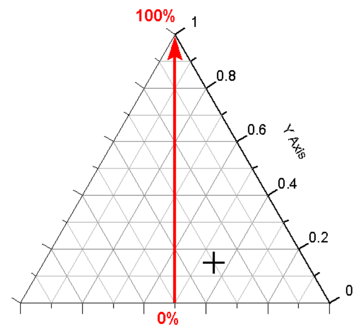


The range of X values in a ternary diagram

Y Axis

The Y axis values in a ternary diagram are read from the zero point, defined along base of the triangle, to the 100% point at the upper vertex.

The sample point (+) on this diagram has a Y value of 0.15.

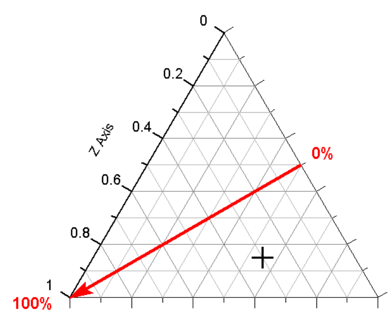


The range of Y values in a ternary diagram

Z Axis

The Z axis values in a ternary diagram are read from the zero point, defined at the right side of the triangle, to the 100% point at the lower left vertex.

The sample point (+) on this diagram has a Z value of 0.30.

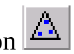


The range of Z values in a ternary diagram

Note in the example above that, as required, the sum of the three values, X + Y + Z is 100%:

$$0.55 + 0.15 + 0.30 = 1.00.$$

CREATING A TERNARY DIAGRAM

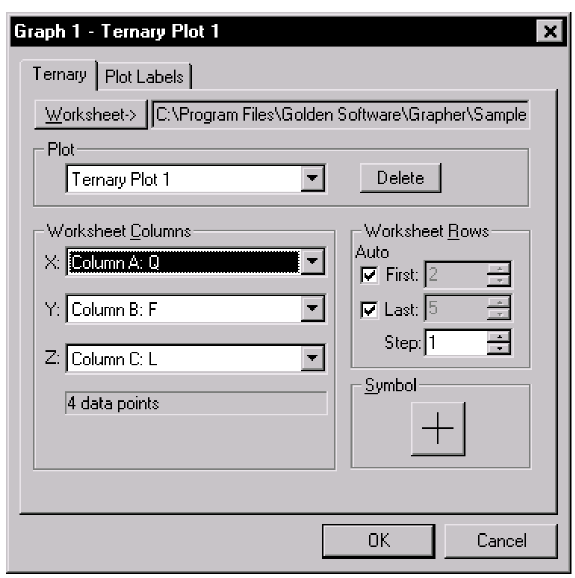
1. Select **Graph | New Graph | Ternary Diagram** or click the ternary diagram button  on the toolbar.
2. Select a data file from the **Open Worksheet** dialog box and click *Open*.
3. In the **Ternary Plot** dialog box, set the desired plot options.
   - Use the options on the **Ternary** tab to change the current worksheet, assign worksheet columns to each axis, specify the range of data to plot, and assign a symbol to each data point. The options on this tab are described below.
   - Use the options on the **Plot Labels** tab to show the values for each data point. You can show the X, Y, or Z value, or any combination thereof. The options on this tab are described below.

THE TERNARY TAB

Use the options on the **Ternary** tab to change the current worksheet, assign worksheet columns to each axis, specify the range of data to plot, and assign a symbol to each data point.

Worksheet button

The *Worksheet* button selects a different worksheet for this or any other plot in this graph. To change the worksheet, click the *Worksheet* button. In the **Select Plots** dialog box, choose which plots you want to use the new worksheet and click *OK*. In the **Open Worksheet** dialog box, select the new data file and click *Open*. The plot(s) are redrawn using the new worksheet data. You may need to edit the *Worksheet Columns* assignments for the data to plot correctly.



*The **Ternary Plot** dialog box*

Plot group box

This drop-down list shows you the active plot. The list contains the names of any other plots created in this graph that share the same worksheet.

The *Delete* button deletes the current graph. There is not a confirmation before the graph is deleted, so use this button with care.

> **Note:** If your graph contains plots that use different worksheets, you cannot switch between them using the *Plot* field. You must manually close the current **Ternary Plot** dialog box, and double-click on the new graph to re-open the **Ternary Plot** dialog box for the other plot.

Worksheet Columns group box

These drop-down lists contain the data columns used for each variable in the current graph. Assign the appropriate worksheet column to each axis. In the *X* drop-down list, select the data column to plot along the X axis (100% at the lower right corner). In the *Y* drop-down list, select the data column to plot along the Y axis (100% at the upper corner). In the *Z* drop-down list, select the data column to plot along the Z axis (100% at the lower left corner).

If the first worksheet row contains header information, the header information appears next to the column letter. For example, *Column A: Q* is displayed. The total number of data points used in the plot is displayed beneath *Z* field.

IMPORTANT! The three worksheet columns you assign to *X*, *Y*, and *Z* must be normalized so that their sum is 1.0 or 100 (i.e. 100%). This is a necessary condition for ternary diagrams. Data that is not normalized to 1 (or 100) is automatically normalized by **Grapher** when it is plotted (e.g., values of 0.50, 0.75 and 0.25 plot as 0.33, 0.50 and 0.17 respectively).

Worksheet Rows group box

Use these controls to determine how many rows of data you want to include in the plot. By default, **Grapher** selects the first and last rows in the worksheet that contain valid data. Rows that do not contain data (blanks or text) are excluded from the plot. To change the range of rows used, uncheck the *Auto* box next to the *First* and/or *Last* boxes and type or scroll to the row number. Check the *Auto* box to revert to the default rows.

Use the *Step* option to skip rows of data in the plot. For example, if *Step* is set to five, every fifth data point is plotted on the graph. If *Step* is set to 1, every data point is plotted on the graph.

Symbol group box

Symbols represent the data points on the plot. Click the symbol button to open the **Curve Symbol** dialog box. In this dialog box, you can change the *Symbol Set*, or to change the symbol *Color* or *Size*. Click *OK* to return to the **Ternary Plot** dialog box.

PLOT LABELS TAB

Labels can be added to the ternary diagram by using the options on the **Plot Labels** tab.

Show labels check box

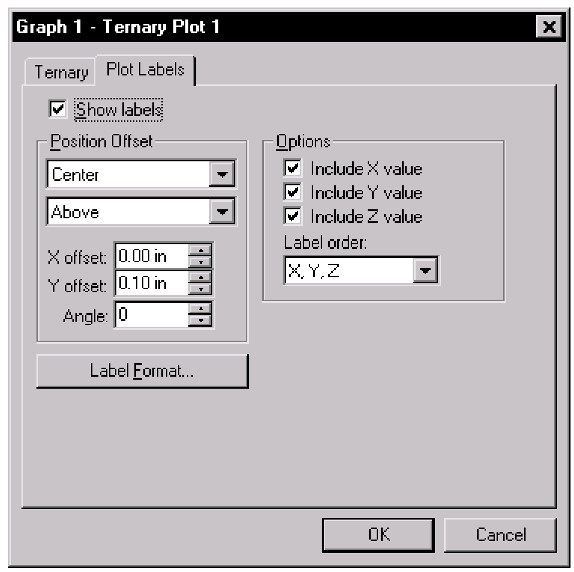
Click on the *Show labels* option to activate the options on this tab. Placing a check mark in this check box places labels on the plot.

Position Offset group box

In the *Position Offset* group box, set the position where you want the label to appear. The top drop-down list sets the horizontal position of the label (*Left*, *Center*, *Right*) while the lower drop-down list sets the vertical position (*Above*, *Center*, *Below*).

Use the *X offset* and *Y offset* fields to manually position the labels a specific distance in the horizontal and vertical directions, respectively. These values may be positive or negative.

The *Angle* field lets you rotate the values by a specific number of degrees. Positive angle values rotate the label counter-clockwise while negative values rotate the label clockwise.



*The **Plot Labels** tab of the **Ternary Plot** dialog box*

Label Format button

To change the format of the label or its font properties, click on the *Label Format* button. This opens the **Plot Labels Format** dialog box. See *The Plot Points Label Format Dialog Box* on page 154 for a detailed description of these options.

Options group box

The *Options* group box specifies which values are included as labels. The *Include X value*, *Include Y value*, and *Include Z value* variables can be set independently. In the *Label order* drop-down list, specify the variable order for the labels by choosing an option from the drop-down list. If a variable is omitted (i.e. not checked in the *Include value* boxes), the remaining values are adjacent to each other. There is not an extra space where the missing variable would be.

NOTE: A common way to portray labels on a ternary diagram is by having the labels surrounded by parentheses. To do this, click on the *Label Format* button. Put a left parenthesis in the *Prefix* box and a right parenthesis in the *Suffix* box. Click OK on the **Plot Labels Format** dialog box. Place a check mark in front of the *Include X value*, *Include Y value*, and *Include Z value* options. Set the *Label order* to *X, Y, Z.* For the data point X=55, Y=15, Z=30, the label appears as:

(0.55, 0.15, 0.30)

To display the values on a 0 to 100 scale instead of 0 to 1, double-click on one of the axes. In the *Axis Limits* group box, place a check mark in front of the *0 to 100 scale* option. The above label then appears as:

(55, 15, 30)

Box-Whisker Plots

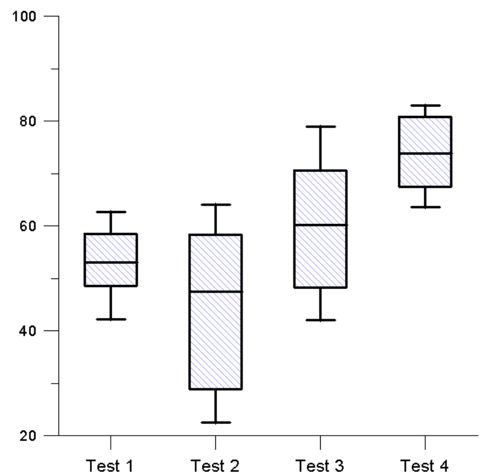
Box-whisker plots are commonly used to show minimum, maximum, median, and lower and upper quartiles for a particular X group. The caps at the end of each box indicate the extreme values (minimum and maximum). The box is defined by the lower and upper quartiles. The line in the center of the box is the median. These terms are defined as so:

Median	The middle value for odd number of data points. For even number points, it is the mean of the middle values.
Lower Quartile	The middle value between the median and the minimum data value. This is rounded to the nearest whole number.
Upper Quartile	The middle value between the median and the maximum data value. This is rounded to the nearest whole number.

The box-whisker options let you display markers for each of the outlier samples in your data group. Data for a box and whiskers plot should be in columns for each category. In the example graph shown below, Test 1, Test 2, Test 3, and Test 4 are the four categories. Box plots are ideal for making comparisons between data sets such as these.

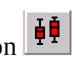
C	D	E	F
Test 1	Test 2	Test 3	Test 4
45.8	26.2	42	63.6
50.4	33.1	50.3	67.5
51.2	37.7	53.5	68.3
53.1	47.5	60.1	71.5
57.2	54.2	66.2	74.1
59.7	58.9	73.3	80.7
62.2	64.1	78.9	83
62.7	62.6	74.7	81.9
58.5	58.3	70.5	81.3
55.1	48.5	61.7	75.4
48.5	28.8	48.3	73.8
42.2	22.5	43.3	67.1

The worksheet shows box-whisker data.



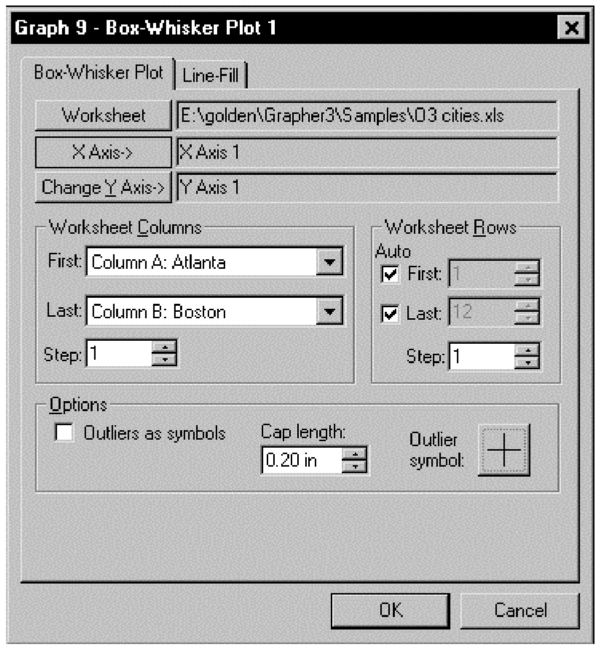
Data are plotted on a box-whisker graph.

CREATING A BOX-WHISKER PLOT

1. Select **Graph | New Graph | Box-Whisker Plot** or click the box-whisker button  on the toolbar.
2. Select a data file from the **Open Worksheet** dialog box and click *Open*.
3. In the **Box-Whisker Plot** dialog box, set the desired plot options.
   - Use the options on the **Box-Whisker Plot** tab to change the current worksheet or axes, assign the range of worksheet columns to be plotted, and specify the range of data to plot. The options on this tab are described below.
   - To change the line style (solid, dashed, thick, thin, etc.), change line color, or shade the boxes, use the settings on the **Line-Fill** tab. See *Line and Fill Properties* on page 156.

THE BOX-WHISKER PLOT TAB

Use the options on the **Box-Whisker Plot** tab to change the current worksheet or axes, assign the range of worksheet columns to be plotted, and specify the range of data to plot.



*The **Box-Whisker Plot** dialog box*

Worksheet button

The *Worksheet* button lets you select a different worksheet for this or any other plot in this graph. To change the worksheet, click the *Worksheet* button. In the **Select Plots** dialog box, choose which plots you want to use the new worksheet and click *OK*. In the **Open Worksheet** dialog box, select the new data file and click *Open*. The plot(s) are redrawn using the new worksheet data. You may need to edit the *Worksheet Columns* assignments for the data to plot correctly.

X Axis button

This field shows the name of the X axis used by the current plot.

Change Y Axis button

This field shows the name of the Y axis used by the current plot. To change the Y axis used, click on the *Change Y Axis* button. In the **Select Plots** dialog, choose which plot(s) you want to assign to a new axis and click *OK*. In the **Select Axis** dialog, choose the new axis to use and click *OK*. The plot(s) are redrawn using the new axis assignment.

> **Note**: If there is only one axis for the type selected, you are not able to change to a new axis. First, you need to create the axis and then use the appropriate *Change Axis* button. For more information on creating new axes, please refer to *Adding Additional Axes to a Graph* in *Chapter 5, Axes*.

***Worksheet Columns* group box**

In the *First* drop-down list, select the first data column that you want to plot. In the *Last* drop-down list, select the final column that you want to plot. By default, all data columns between *First* and *Last* are included in the plot. Each column should contain a different X category.

The *Step* field determines how many of the worksheet columns are included in the plot. For example, when *Step* = 1 (default), all of the data columns between *First* and *Last* are plotted. When *Step* = 2, every second column is skipped.

***Worksheet Rows* group box**

Select the range of rows to be plotted in each column. For example, if you only want to plot the data in rows 10 to 20, uncheck the *Auto* boxes, set the *First* field to 10 and the *Last* field to 20.

Grapher defaults to using the first and last rows containing data in the worksheet. Rows that do not contain data (blanks or text) are excluded from the plot. To change the range of rows used, uncheck the *Auto* box next to the *First* and/or *Last* boxes and type or scroll to the row number. Place a check mark in the *Auto* box to revert to the default rows.

Use the *Step* option to skip rows of data in the plot. For example, if *Step* is set to five, only every fifth row of data is plotted on the graph. If *Step* is set to one, every row of data is plotted.

***Options* group box**

When the *Outliers as symbols* check box is checked, a symbol is placed at the outlying points and the maximum value is recalculated. The following is how to calculate if a point is an outlier. First, the difference between the quartiles is called the interquartile range (IQR). Q_L is the value of the lower quartile (bottom of the box) and Q_U is the value of the upper quartile (top of the box). An outlier is any point that falls below Q_L – 1.5*IQR or above Q_U – 1.5*IQR. If this box is not checked, the maximum is displayed as the upper tick instead of an outlier symbol.

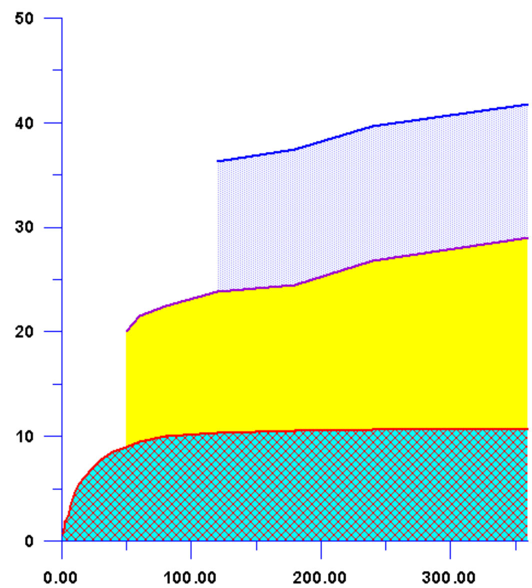
The *Cap length* adjusts the length of the cap lines (whiskers) on either end of the lines. To display the box plot without the whiskers, simply set the value for the *Cap length* to zero.

The *Outlier symbol* button shows the active symbol. Click this button to open the **Curve Symbol** dialog box. Here, you can change the *Symbol Set* or edit the symbol *Size* or *Color*.

Clipping a Plot

Setting clip limits (also called "clipping") truncates a plot at fixed points, so that only the data within the clip limits is displayed.

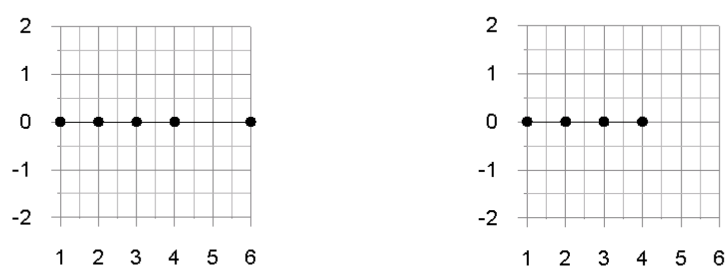
Consider a line plot that extends from 0 to 50 units along the X axis. If you want to display the data in the middle section of the plot, you could set a minimum clip limit at 20 and a maximum clip limit at 40. Now, only the points in the range 20 to 40 would be visible on the plot. The size and range of the plot would remain the same.



Clipping examples: The bottom plot has not been clipped at all. The middle plot has been clipped at Xmin = 50, and the top plot has been clipped at Xmin = 100.

ABOUT CLIPPING LIMITS

Clipping always occurs at the nearest data point that is inside the clipping limit. This means that a line segment is not cut at the specified limit - it is cut at the nearest data point.



Clipping truncates the data to the nearest data point. The graph to the left is the original data set (no clipping). The graph on the right has custom clipping set to a value of X max = 5. Since the last data point before the clipping limit is (4, 0), the line is truncated at X = 4.

DIFFERENCES BETWEEN PLOT TYPES

The following lists the differences between the various plot types and the availability of clipping. The pie chart, histogram, rose diagram, ternary diagram, and box-whisker plots do not have a **Clipping** tab. To exclude data from these types of graphs, the data needs to be removed from the worksheet.

Clipping on Bar Charts, Floating Bar Charts, and Hi-Low-Close Plots

If clipping is used with the bar chart, floating bar chart, or with hi-low-close plots, the plot does not truncate a bar at a specified value. If any part of the bar exceeds a clipping limit, the bar is not plotted.

Clipping on Bubble Plots, Hi-Low-Close Plots, Floating Bar Charts, or Bar Charts

When clipping with bubble plots, bar charts, floating bar charts, and hi-low-close plots, two clipping options are not available. Because these plots do not have traditional lines, there is not a *Missing Data* group box and there is not a *Draw plot to clipping limit* check box.

Clipping on Function Plots

Function plots do not have a *Draw plot to clipping limit* check box or a *Data Criteria* group box.

Clipping on Polar Plots

Polar plots use R (radius) and A (angle) values instead of X and Y coordinates to specify the clip limits. Otherwise, this works the same as traditional clip settings on a line/symbol plot.

CLIPPING TAB

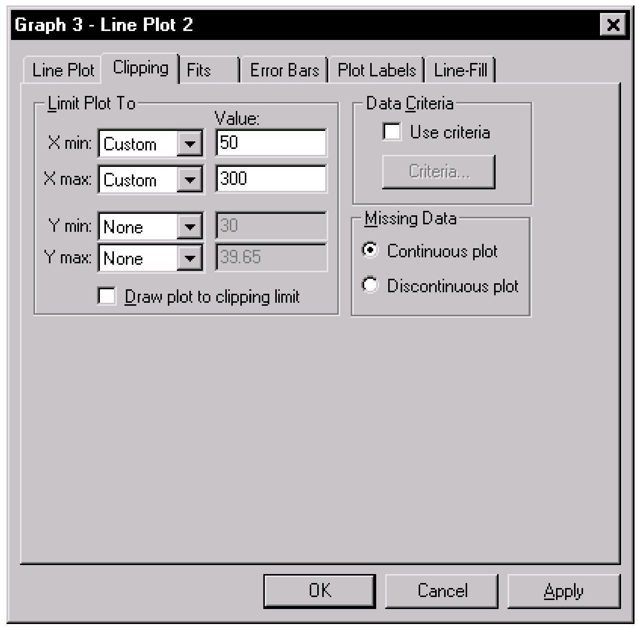
The clipping feature can be accessed through the **Clipping** tab on the following types of plots:

- Line/Symbol Plot
- Step Plot
- Bubble Plot
- Bar Chart
- Function Plot
- Hi-Low-Close Plot
- Polar Plot
- Floating Bar Chart

Limit Plot To **group box**

The following clipping limits can be assigned to the *X min*, *X max*, *Y min*, and *Y max* parameters, or *R min*, *R max*, *A min*, and *A max* on polar plots.

- *None* removes the clipping and displays all of the data.
- *Axis* clips the plot at the current axis limits, so no points beyond the range of the axis are included.
- *Custom* lets you clip the plot at a specified axis value. When you select this option, the *Value* field becomes available so you can enter the axis value where you want the plot to be clipped.

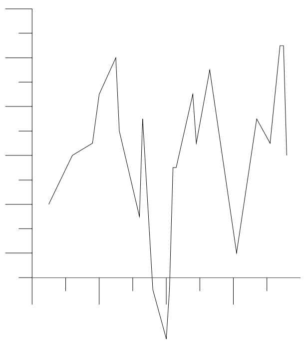


You can truncate the plot at fixed values using the options on the ***Clipping*** *tab. In this dialog box, a line plot is being configured to clip values below X=50 and above X=300.*

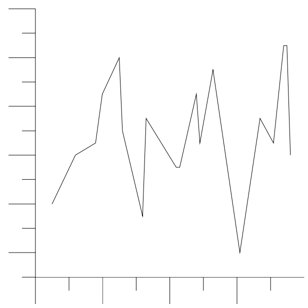
The *Draw plot to clipping limit* check box determines how the rest of the graph is drawn when the data are clipped. By placing a check here, the lines are drawn to the clipping limit as if the data being clipped were still part of the plot. When the check mark is removed, the data outside the clipping limit are not considered part of the data set. Therefore, the line is drawn between the points on either side of the clipped data and the clipped point is ignored.

> **Note:** To display a range that is larger than your data values (outside your clipping limits) on your axes, you must first change the axis minimum and/or axis maximum by editing the axis directly. If the axis values are set to automatic (*Auto* is checked), then the axis automatically adjusts when the clipping limits are changed.

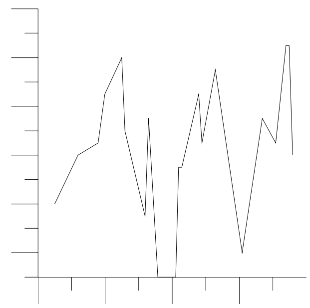
Clipping Limits Example:



Graph with Clip Limits set to None.



Same graph with the Y min clip limit set to Axis. Note that no data points below the Y axis are included.



Same graph with the Y min clip limit set to Axis and the Draw plot to clipping limit checked. Note that the plot goes to the Y axis and stops.

Data Criteria group box

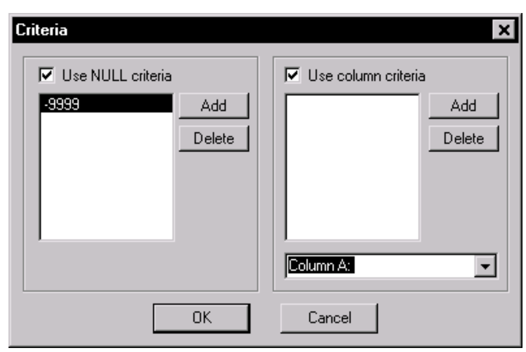
The *Data Criteria* options allow you to specify a NULL criteria and/or a column criteria (described below). Place a check mark in the *Use criteria* box to activate the *Criteria* button. Click the *Criteria* button open the **Criteria** dialog box.

NULL Criteria

A NULL criteria lets you designate values that should be treated as non-values. A good example of this would be to assign the value –9999 wherever there is insufficient data or a missing data point in the worksheet.

In order to take advantage of the null data entry, you must make sure the same null value is used to represent missing data points in the worksheet.

To assign a null value in the **Criteria** dialog box, place a check mark the *Use NULL criteria* check box. Then, click the *Add* button to open the **Enter NULL Value** dialog box. In this box, enter the criteria in the *NULL Value* field. Any value can be specified. After inputting the value, you can click the *OK* button to return to the **Criteria** dialog box.



Assign the value -9999 as a null value to represent missing data.

Column Criteria

You can also use the **Criteria** dialog box to establish a column criteria. A column criteria is a method of including only select data points in a graph. For example, suppose you have just done a statistical analysis of the data in a column and decided that some of the data was not recorded properly and therefore should not be plotted. To do this, open the worksheet containing the data and, in a new column, enter a word in every row whose data you want to include. When this is complete, save and close the worksheet. Then, open the **Criteria** dialog box. Place a check mark in the *Use column criteria* check box and click the *Add* button. In the **Enter Criteria Value** dialog box, enter the word in the *Value* field that you input into the worksheet and click *OK*. In the drop-down list, select the column containing the criteria and click *OK*. When the graph is plotted, only those data points with the specified criteria in the criteria column are used. This is especially handy when you have the same value for good and bad data since the NULL criteria does not work. Any word or text entry can be used for the column criteria.

Note: Both column and null data criteria can be used together in a single graph.

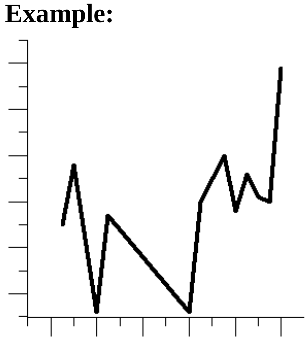
***Missing Data* group box**

These options control how **Grapher** handles missing data in a graph, such as extra spaces between rows. Data clipped based on the null or column entry are not included as missing data.

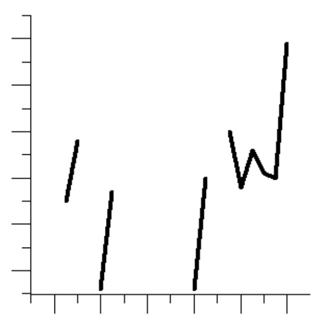
The *Continuous plot* option ignores the missing points and draws a continuous line based on the existing points.

The *Discontinuous plot* option shows the missing points as blank spaces between the existing points, resulting in a discontinuous line.

Missing Data Example:



Continuous plot



Discontinuous plot

For plots that contain missing data (i.e. rows without valid data), the continuous setting automatically skips the missing points and connects the existing ones.

Fit Curves

Fit curves are a collection of predefined mathematical functions that you can add to your graph to compare the behavior of your plot with known functions. In addition to the predefined functions, you can also create your own custom fit curves. Fit curves can be added to the following graph types: line/symbol plots, step plots, polar plots, and histograms.

Adding a Predefined Fit Curve

1. Double-click on the plot to open the **Plot** dialog box. On the **Fits** tab, click on the *Available Fits* drop-down list.

   Note: This tab is only available on the following plot types:

   - Histogram Plot
   - Line/Symbol Plot
   - Polar Plot
   - Step Plot

2. Select the desired fit curve from the list. The available curves include:

   - Linear
   - Log
   - Exponential
   - Power
   - Spline Smoothing
   - Polynomial
   - Orthogonal Polynomial
   - Through Origin
   - Running Average
   - Weighted Average

   Note: On a Histogram, there is only one fit curve available, the *Normal Distribution (Gaussian)* fit.

3. Click the *Add* button. The selected curve is listed in the *Display Following Fits* box.
4. If desired, repeat steps 2 and 3 to add additional fit curves to the graph. The equations for each of the predefined fit curves are listed on page 143.

ADDING A CUSTOM FIT CURVE

1. On the **Fits** tab of the **Plot** dialog box, click on the *Define* button.

   The **Define Fit Equation** dialog box opens.

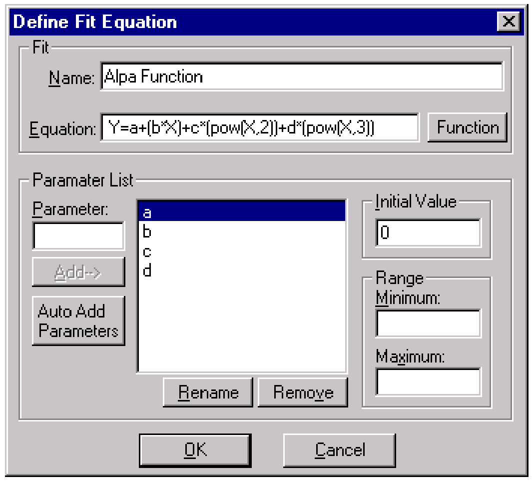
2. Enter a name for this new function in the *Name* field.

3. In the *Equation* field, complete the equation in the form "Y = " to construct the desired function.

   For example, a fourth degree polynomial fit of the form:

   $$Y = a + a_1X + a_2X^2 + a_3X^3$$

   would be entered in the *Equation* field as:



Defining a custom fit equation

```
Y=a+(b*X)+c*(pow(X,2))+d*(pow(X,3))
```

   To add a predefined mathematical function (Cosine, Log10, etc.) to the equation, click the *Function* button and select it from the **Functions** dialog box. A description of these functions can be found in *Appendix A, Mathematical Functions*.

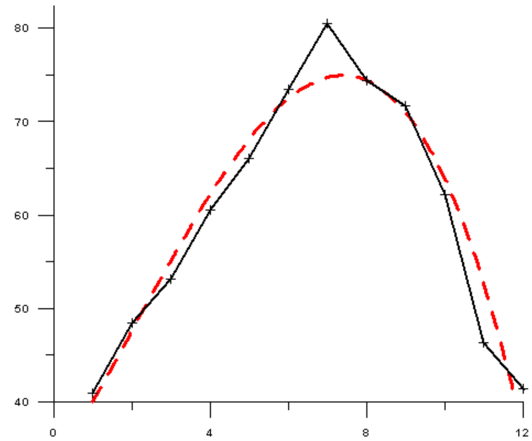
   Note: The ^ symbol is not used to show exponents in **Grapher**. The `pow` function, accessed from the *Function* button, is used instead. Always use an operator between each element For example, multiplication is shown by an asterisk *.

4. In the *Parameter* field, enter the name of any variables you are using in the equation.

   - To add all variables automatically, click on the *Auto Add Parameters* button. This is the preferred way to add variables.
   - To manually add a variable, enter the variable name in the *Parameter* field and click *Add.* If you are adding a parameter after editing an equation, choose this method to add the new variable.

   Note: To rename a parameter, type a new parameter name in the *Parameter* box, select the parameter from the list, and click the *Rename* button. Make sure that you change the variable in the equation, as well.

5. Set the range for each variable by selecting it in the *Parameter List* window and entering the *Initial Value*, *Range Minimum*, and *Maximum*. These values are optional. A fit can be calculated without entering the *Initial Value, Range Minimum* or *Maximum*.
6. Click *OK* to close the **Define Fit Equation** dialog box.
7. Click on the *Add* button on the **Fits** tab to add the custom fit to the *Display Following Fits* list. The new function is added to the *Available Fits* list with the other predefined functions.



A fit curve (dashed line) added to a traditional line plot (one that connects all points in the data file).

Adding Fit Curves to Polar Graphs

All fits that can be added to a line/symbol plot can also be added to a polar plot, but you must account for the polar coordinates. In a polar plot's fit equation, the *X* value is replaced with the *Angle* value, and the *Y* value is replaced with the *Radius* value. Therefore, the linear equation for a line/symbol plot (Y=B*X+A) is written as Radius = B*(Angle) + A in polar coordinates.

The Fits Tab

Fit curves are added to a graph using the options on the **Fits** tab.

***Available Fits* group box**

This drop-down list contains the ten predefined *Available Fits* and any customized fits that have been defined. To add a fit to the plot, select it from the drop-down list and click the *Add* button.

The *Define* button opens the **Define Fit Equation** dialog box, where you can create your own fit equation.

Clicking the *Edit* button allows you to edit the selected custom equation in the *Available Fits* list. Predefined equations cannot be edited.

Clicking the *Copy* button creates a copy of the selected custom equation in the *Available Fits* list. Predefined equations cannot be copied. The copy of the equation is prefixed with the words "*Copy of*." This is a convenient way to create variations of the same custom equation.

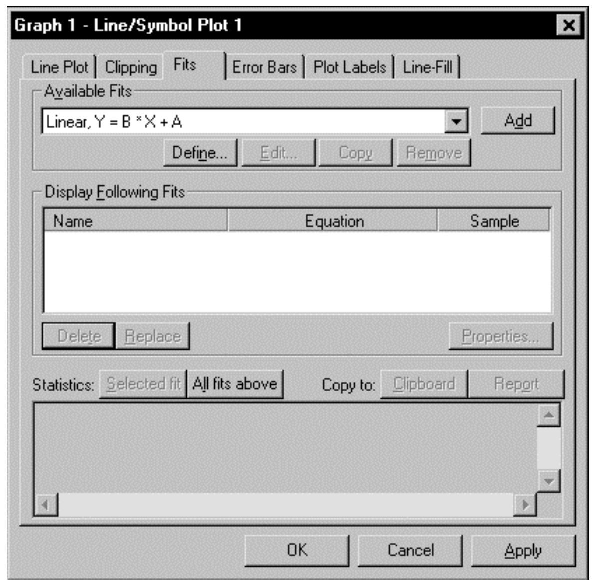
Clicking the *Remove* button deletes the selected custom equation in the *Available Fits* list. You are not prompted to confirm this action, so use this button with caution. Predefined equations cannot be removed.

***Display Following Fits* group box**

This is a list of all the fit curves displayed for the current plot. To access the following buttons, select a curve in the list.

Clicking the *Delete* button removes the selected fit curve from the *Display Following Fits* list and from the plot itself.

The *Replace* button replaces the equation selected in the *Display Following Fits* list with the equation that is selected in the *Available Fits* list. The *Name* of the fit curve is not replaced, just the equation. Therefore, you can have a name of *Fit 1: Linear* with an equation for the exponential equation. You can rename the fit in the **Object Manager**.



*Fit curves can be added and created on the **Fits** tab.*

To replace the equation, select a fit from the *Available Fits* group box and a fit from the *Display Following Fits* list and then click the *Replace* button.

Clicking on the *Properties* button allows you to edit the physical properties of the selected fit curve in the *Display Following Fits* box. A **Fit** dialog box opens with a **Fit Properties** tab and a **Line-Fill** tab. Here, you can customize the fit curve by setting clipping limits, minimum and maximum values, symbols, number of data points, line properties, line colors, and other properties. For more information, refer to *The Fit Dialog Box* on page 147.

***Statistics* group box**

Clicking the *Selected fit* button generates a statistics report for the selected fit curve in the *Display Following Fits* box. The report displays in the *Statistics* box. The equation is given along with the average X and Y values, and the number of data points used. In addition, the residual sum of squares, the regression sum of squares, the coefficient of determination (R squared), and the residual mean square are calculated and displayed. The *Spline smoothing*, *Running average*, and *Weighted average* fits do not have statistics associated with them.

An example of a statistics report is shown here:

```
Fit Results
Fit 1: Linear
Equation Y = 0.102835904 * X + 15.65412164
Number of data points used = 20
Average X = 62.9
Average Y = 22.1225
Residual sum of squares = 1209.93
Regression sum of squares = 1811.07
Coef of determination, R-squared = 0.599493
Residual mean square, sigma-hat-sq'd = 67.2186
```

Clicking the *All fits above* button generates a statistics report for all of the fit curves listed in the *Display Following Fits* box.

***Copy to* group**

Clicking the *Clipboard* button copies the report displayed in the *Statistics* window to the Windows clipboard so it can be pasted into another document or into the plot window. Clicking the *Report* button opens the statistics report in a separate window where it can be saved to a [.TXT] file or to an [.RTF] file.

PREDEFINED FIT CURVE EQUATIONS

The following list shows the equations for each of the predefined fit curves.

Linear fit displays a straight-line fit through the data.

$$Y = bX + a$$

Log fit displays a log fit through the data.

$$Y = b(\ln X) + a$$

Exponential fit displays an exponential fit through the data.

$$\ln Y = bX + a \text{ or } Y = ae^{bX}$$

Power fit displays a power fit through the data.

$$\ln Y = b(\ln X) + a \text{ or } Y = aX^{b}$$

Spline smoothing produces a uniform curve that passes through all the data points. Spline fits do not extrapolate beyond the maximum or minimum data values displayed for the curve. An equation is not given for *Spline smoothing*.

Polynomial fit displays a curve based on the equation below. The polynomial degree can be set from 0 to 10 on the **Fit Properties** tab.

$$Y = a_0 + a_1 X^1 + a_2 X^2 + ... + a_n X^n$$

Orthogonal Polynomial regression is an alternate method for calculating a polynomial regression. The orthogonal polynomial regression equation has been converted to normal polynomial form, so Y can be calculated from a given X with the equation given in the statistics results. Alternatively, Y can be calculated from a given X using the orthogonal factors. For detailed information on orthogonal polynomial regression, please refer to the online help system.

Through origin forces the linear best-fit line through the origin (0,0). The *b* value here is not the same *b* value given in the *Linear* fit.

$$Y = bX$$

Running average fits are generated by taking the average of data within a specified range on either side of a given point. The number of data points on either side is determined by setting the *Window width* in the **Fit** dialog box. The *Running average* is truncated short of the data limits by a factor of (*Window width* - 1)/2 so the fit does not extend to the limits of the plotted data curve, and therefore it cannot extrapolate beyond the data.

Weighted average is similar to *Running average*. Instead of averaging the points in the *Window width* equally, a weight is provided for each of the data points within the window. In a *Running average* fit, all of the weights are 1. Therefore, the weighted average fit provides the same fit as the *Running average* fit if all of the weights (as set on the **Weights** dialog box) are 1. Usually, the weights are set so that points further away have less weight than points closer to the point, or so weights on one side of the fit point being created have more weight than points on the other side.

FIT STATISTICS

Most fit statistics include the following information:

- *Equation Name.* The equation name appears in the *Display Following Fits* section of the **Fits** tab. The equation name can be changed through the **Object Manager** by selecting the fit curve and clicking on the *ID* button or by right-clicking on the selected fit in the plot window and then choosing *Object ID* from the menu.
- *Fit equation.* If a fit has an equation (all fits except *Spline smoothing*, *Running average*, and *Weighted average* have equations), the equation is displayed in the fit statistics.
- *Alternate equation.* Alternate equations are provided for power and exponential fits only.
- *Number of data points used*. This section displays the number of data points used in the fit calculation.

- *Average X.* This is displayed for most fits, though some fits display the average natural log of X (lnX).
- *Average Y.* This is displayed for most fits, though some fits display the average natural log of Y (lnY).
- *Residual sum of squares.* The *Residual sum of squares* (SSe) is the sum of the squares of all the residual values. A residual is the difference between the fit Y value and the actual Y data value at any given X value.
- *Regression sum of squares.* The *Regression sum of squares* (SSr) is the sum of squares of the difference between the average of all Y values and the fit Y values at each X location where a data point occurs.
- *Coefficient of determination, R-squared.* This shows how well the data are explained by the best-fit line.

$$r^2 = \frac{SSe}{SSe + SSr}$$

- *Residual mean square, sigma-hat-sq'd.*

$$\hat{\Sigma}^2 = \frac{SSe}{n-2}$$

where:
n = the number of Y values for the curve on which the fit is based

- *Standard Deviation.* This is only calculated for the normal distribution fit. The normal distribution (Gaussian) fit is only an option for the histogram plot. The standard deviation of a sample is the square root of the variance of the sample.

  Sample Standard Deviation

  $$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2}$$

  where:
  $\bar{x}$ = sample mean
  n = the number of data values (for a sample)
  x_i = the i-th data value

- *Coefficients* for each fit are displayed in the fit equation and displayed in a separate section in the statistics results.

- *Orthogonal Polynomial Factors* include *X Shift*, *Y Shift*, *B[n]*, *Alpha[n]*, and *Beta[n]*. Please see Orthogonal Polynomial Regression in the online help system for more details on the use of these factors.

Statistics References

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Press, William H. et al. 1992. *Numerical Recipes in C.* New York: Cambridge University Press.

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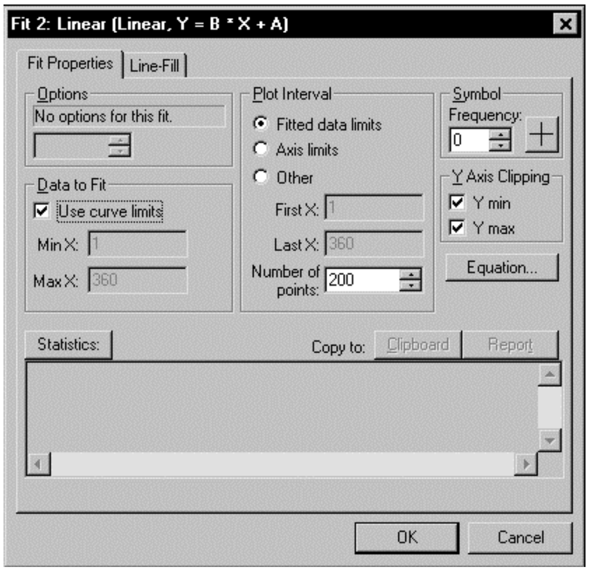


*The **Fit** dialog box*

THE FIT DIALOG BOX

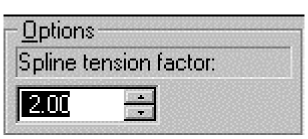
When adding a fit curve to a plot, you can edit the physical and display properties of the curve by selecting it in the *Display Following Fits* box and clicking the *Properties* button. This opens the **Fit** dialog box. Use the **Fit Properties** tab to set fit attributes for the selected fit.

Options group box

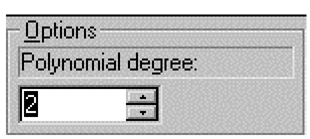
The *Options* group box has options available for select fit curves. The spline smoothing fit has a *Spline tension factor* associated with it. This allows you to control the amount of smoothing available. Tension factors range from 1 to 50. The higher the tension factor, the straighter the line between the data points.

The polynomial and orthogonal polynomial fits have a *Polynomial degree* option. The *Polynomial degree* can be set from 0 to 10. A polynomial degree of zero is the average Y value, degree one is a linear fit, degree two is a quadratic fit, degree three is a cubic fit, and degree four is a quartic fit.

The running average and weighted running average have a *Window width* option. The *Window width* is an odd number between 3 and 1001 that controls the range of data. The default window width of five averages the data point, the two values above the data point, and the two values below the data point. An average of all five values is plotted as part of the fit line. The fit is a line connecting the average points. With the weighted running average, there is also a *Weights* button. Click this button to open the **Weights** dialog box where different weights can be assigned to each point.



Set the Spline tension factor



Set the Polynomial degree

Set the Window width

Data to Fit **group box**

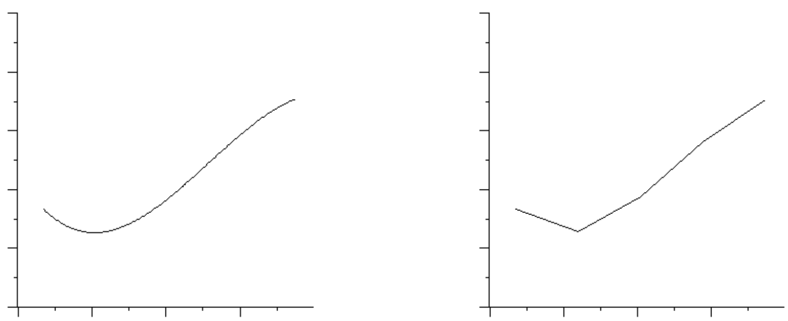
This option sets the range of X values in the fit curve. When the *Use curve limits* check box is marked, the fit is limited to the range set in the *Limit Plot To* group box on the **Clipping** tab of the **Plot** dialog box. To set new limits, uncheck the *Use curve limits* check box and enter the new minimum X and maximum X limits into the *Min X* and *Max X* boxes.

Plot Interval **group box**

These options control the displayed fit limits and the number of points along the fit curve.

- *Fitted data limits* uses the limits in the *Data to Fit* group box.
- *Axis limits* extends the fit to the entire axis range.
- *Other* lets you customize the limits of the fit. If the custom fit range is greater than the axis limits, the axis range changes to match the customized limits. The *Running average, Weighted average,* and *Spline smoothing* fit do not extrapolate the fit beyond the data.

The *Number of points* sets the number of data points used to create the fit curve. A higher number of points result in a smoother fit. The *Number of points* cannot be set for the *Running average* or *Weighted average* fits.



An Orthogonal Polynomial Curve shown with the Number of Points = 200 (left) and the Number of Points = 4 (right).

Symbol **group box**

The *Frequency* field indicates how many points on the fit curve are assigned symbols. For example:

Frequency = 0 means that no symbols are drawn. This is the default behavior.

Frequency = 1 shows every point with a symbol.

Frequency = 2 shows every other point with a symbol.

The active symbol displays as an icon button to the right of the *Frequency* field. To change the symbol, click on this button to open the **Plot Symbol** dialog box. Specify the desired *Symbol Set*, *Color*, and *Size* and click *OK* to return to the **Fit** dialog box.

***Y Axis Clipping* group box**

Use these fields to clip the fit curve at the Y axis limits. The Y axis clipping is on by default. To show parts of the curve outside the axis limits, uncheck the *Y min* and/or *Y max* boxes.

***Equation* button**

Clicking on the *Equation* button opens the **Select Fit** dialog box so you can completely change the selected fit equation. Custom fits have an *Edit Equation* button to edit the selected fit.

***Statistics* button**

Click the *Statistics* button to view statistics for the fit.

***Copy to* group**

Clicking the *Clipboard* button copies the report displayed in the *Statistics* window to the Windows clipboard so it can be pasted into another document or into the plot window. Clicking the *Report* button opens the statistics report in a separate window where it can be saved to a [.TXT] file or to an [.RTF] file.

Changing Line Properties of the Fit Curve

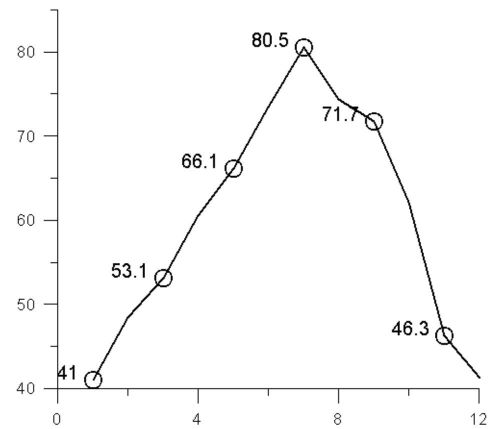
Use the options on the **Line-Fill** tab to change the *Style*, *Color*, and *Width* of the fit line or to add a fill pattern to the fit curve. See *Line and Fill Properties* on page 156 for detailed descriptions of these options.

Plot Labels

Labels let you show worksheet data right on the graph, so you can display exact data values or other supporting information.

The labels can display the values from either axis, or it can show the data from some other column in the worksheet.

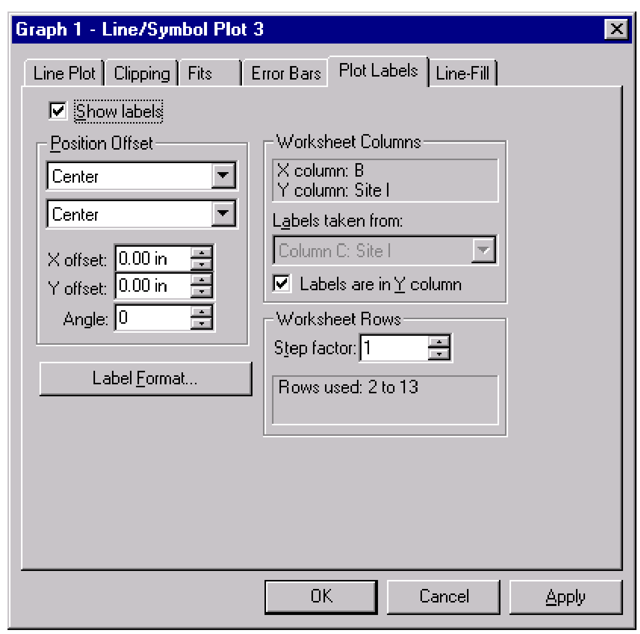
Labels can also be customized to appear in specific locations and can use a variety of formats, fonts, and colors to optimize the look and feel of the graph.



Point labels showing the Y data value.

THE PLOT LABELS TAB

Plot labels are configured using the options on the **Plot Labels** tab.



*Use the **Plot Labels** tab to set label properties.*

Show labels check box

Check this box to enable the labels feature and all of its options.

Position Offset group box

These fields set the position of the label with respect to each data point. These settings are applied to all points.

The top drop-down list sets the horizontal position (*Left*, *Center*, *Right*, *Alternate left-right*).

The bottom drop-down list sets the vertical position (*Above*, *Center*, *Below*, *Alternate top-bottom*).

The *X offset* field lets you fine tune the horizontal position of the labels.

The *Y offset* field lets you fine tune the vertical position of the labels.

To rotate the labels, specify a rotation angle in degrees in the *Angle* field. Positive numbers cause counter-clockwise rotation.

***Label Format* button**

Clicking the *Label Format* button opens the **Plot Points Label Format** dialog box where you can customize the format and text properties of the label. See *The Plot Points Label Format Dialog Box* on page 154.

***Worksheet Columns* group box**

Use this field to select the data column you want to use for the labels.

The *Labels taken from* drop-down list shows all of the columns in the active worksheet. The column you select from this list is used as the source for the labels. You must remove the check mark in the *Labels are in Y column* check box to enable the *Labels taken from* field. When there is a check mark in the *Labels are in Y column* check box, the column assigned to the Y axis is used as the label source.

Above the *Labels taken from* drop-down list is the current plot designations. This shows which worksheet column is assigned to the axes for the current plot.

***Worksheet Rows* group box**

Use the *Step factor* field to indicate the frequency of labels on the plot. Select how many of the points you want labeled by selecting an appropriate value from this field. For example, When *Step factor* = 1, every point is labeled. When *Step factor* = 2, every second point is labeled.

ADDING PLOT LABELS TO A GRAPH

1. Open the **Plot** dialog box for the plot you want to edit by double-clicking on the plot or selecting the plot from the **Object Manager**.
2. Click on the **Plot Labels** tab.
3. Place a check mark in the *Show labels* check box.
4. In the *Worksheet Columns* box, select the data column that you want to display as labels. This box is not present for a function plot, hi-low-close plot, or a ternary diagram.

   By default, the *Labels are in Y column* check box is selected. To use a different column for the labels, remove the check mark in this box and choose the desired column from the *Labels taken from* drop-down list.

5. In the *Worksheet Rows* box, select the frequency for labeling by selecting an appropriate value from the *Step factor* field. For example, When *Step factor* = 1, every point is labeled. When *Step factor* = 2, every second point is labeled.
6. In the *Position Offset* box, choose the location where you want the label to display with respect to its data point.
7. To change the numeric format, text size, font, and color of the labels, click the *Label Format* button and make the desired settings in the **Plot Points Label Format** dialog box. Click *OK* to close this dialog box and return to the **Plot** dialog box.
8. Click the *Apply* button to see how the labels look on the plot. Make any desired adjustments and click *Apply* again until the labels are positioned as you desire.
9. Click *OK* to close the **Plot** dialog box.

ADDING A SECOND SET OF LABELS TO A PLOT

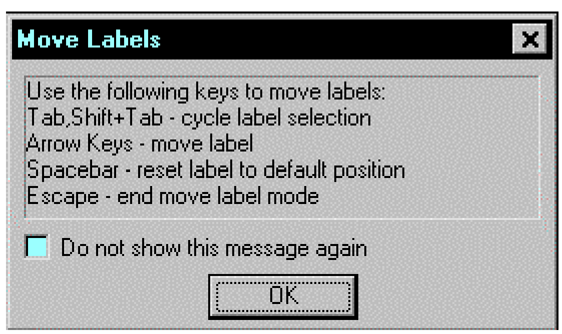
Although **Grapher** can only show one set of labels per plot, you can simulate a second set of labels by adding an identical duplicate plot. Assign an invisible line style the second set of labels to this "invisible" plot. This procedure is outlined below. This procedure does not work with a function plot, hi-low-close plot, or ternary diagram. A second plot needs to be added using the **Graph | Add to Graph | Plot** command for these graph types. After adding the second plot, follow steps 3 through 7 below. Step 3 can be ignored for a ternary diagram.

1. Open the **Plot** dialog box for the plot to which you want to add a second label.
2. Click the *New* button to add a new plot, and then choose the *Worksheet Columns* to match the original plot. The two plots should overlap exactly.

   Make sure the new plot is displayed in the *Plot* field before continuing.
3. Click on the **Line-Fill** tab or the **Line Properties** tab.
4. In the *Line Properties* group box, select an invisible line from the *Style* drop-down list.
5. Click on the **Plot Labels** tab.
6. Add labels to the invisible line. Make sure that the label location is not the same as that used by the first label. Refer to *Adding Plot Labels to a Graph* on page 151.
7. After you have positioned the second set of labels, click *OK* to close the **Plot** dialog box.

MOVING LABELS ON A PLOT

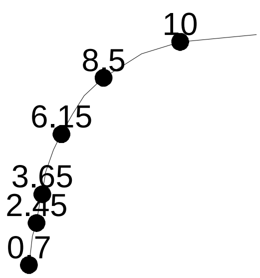
After your labels are displayed on the plot window, you may notice that some labels overlap. To move these labels, select the plot and choose **Graph | Move Plot Labels**. A dialog box opens that provides directions about how to move labels.



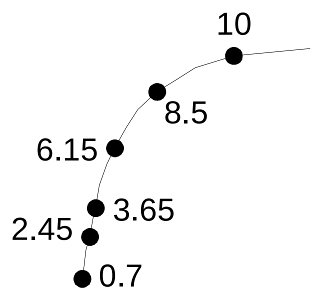
*The **Move Labels** dialog box*

After clicking on the *OK* button, the dialog box closes and allows the user to move each label individually. The first label to be positioned is the first row in the worksheet. You then progress through each row in the worksheet until all labels have been repositioned.

To move the label, press the ARROW keys. The right ARROW key moves the label to the right. The left ARROW key moves the label to the left. The up ARROW key moves the label up. The down ARROW key moves the label down. After positioning the first label, press the TAB key to move to the next label. To skip a label, press the TAB key without pressing the ARROW keys. To place the label in its original position, press the SPACEBAR. To end the move labels mode, press the ESC key.



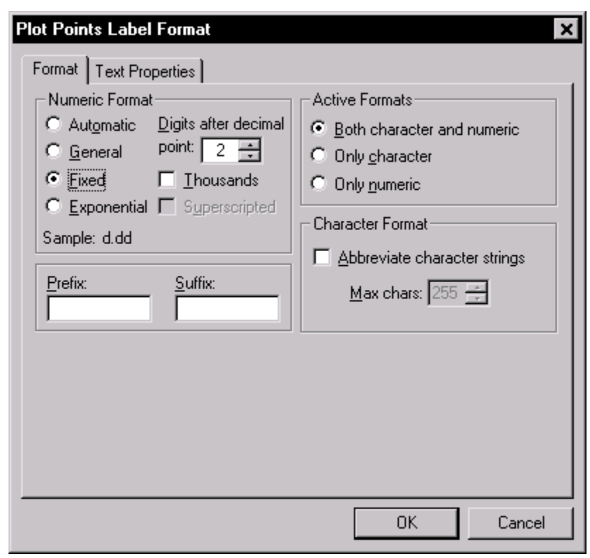
*Labels positioned before using the **Move Plot Labels** command.*



*The **Move Plot Label** command makes all labels visible.*

The Plot Points Label Format Dialog Box

This dialog box is used to customize the numeric format and font properties of data labels. It has two tabs. On the **Format** tab, set the numeric, active, and character formats and the prefix and suffix for the labels.



Configuring the format used to display numeric labels.

***Numeric Format* group box**

There are four numeric format options in the *Numeric Format* group box. *Automatic* displays numbers as fixed or exponential.

General displays numbers as fixed or exponential, depending on the value set in the *Total digits* field. Example: If the *Numeric Format* is set to *General* with two *Total digits*, the number 1998 shows as 1.9e+003 (exponential). If the *Total digits* are set to six, the number 1998 shows as 1998.00 (fixed).

Fixed displays numbers as d.ddd. The number to the left of the decimal can vary. The number to the right of the decimal is set in the *Digits after decimal point* box.

Example: If the *Numeric Format* is set to *Fixed* with three *Digits after the decimal point*, the number 1998 shows as 1998.000.

Exponential displays numbers as d.ddde+ddd. The number to the right of the decimal is set in the *Digits after decimal point* field. Example: If the numeric format is set to *Exponential* with two *Digits after the decimal point*, the number 1998 shows as 1.99e+003.

Superscripted is activated when *Exponential* is selected. When checked, the number 1998 displays as $1.998x10^3$ if three digits are selected in the *Digits after decimal point* field.

If the *Thousands* check box is checked, a comma appears after every three digits to the left of the decimal point. With an *Automatic* format and the *Thousands* checked, the number 1998 would appear as 1,998.

***Prefix* and *Suffix* fields**

Use these fields to enter numbers or letters that precede or follow the labels. For example, if you want to place a dollar sign in front of every label value, type *$* in the *Prefix* field. To include the letters "lbs." after every label, type *lbs*. in the *Suffix* field.

***Active Formats* group box**

The options in the *Active Formats* box control the type of labels displayed.

- *Both character and numeric* displays labels with both text and numbers.
- *Only character* shows text labels only.
- *Only numeric* shows numeric labels only.

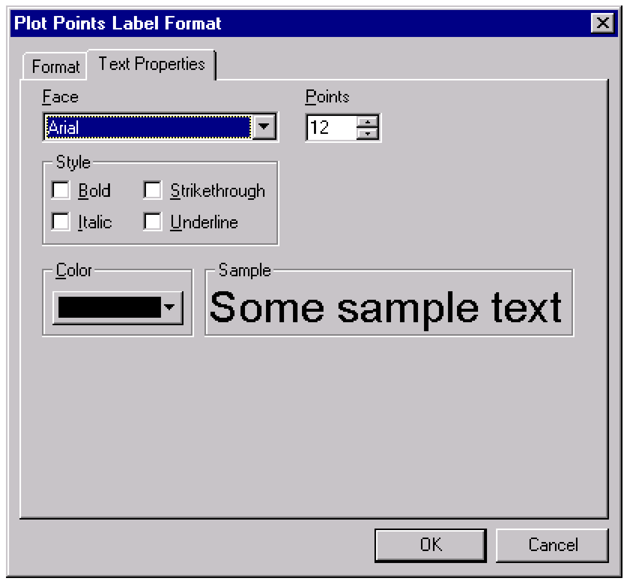
Example: If the label for one point is "Well #2" and for another point is "2" and *Both character and numeric* is selected, both labels are displayed. If *Only character* is selected, the numeric label, 2, is not displayed. If *Only numeric* is selected, the text label, Well #2, is not displayed.

***Character Format* group box**

If the labels are character strings, the length of the character string can be limited to a fixed number of characters. Place a check mark in the *Abbreviate character strings* check box to limit the number of characters that appear in the label. Set the number of maximum characters in the labels in the *Max chars* field.

Example: In the previous example, the *Well #2* label is a character string label. If the *Abbreviate character strings* check box has a check mark in it, this label is truncated. If the *Max chars* is set to 4, the string is truncated as *Well*. If the *Max chars* is set to 2, the label appears as *We*. If the *Max chars* is a value greater than 7, all of the characters in the label appear.

Use the options on the **Text Properties** tab to change the font *Face*, *Style*, *Color*, and *Points* size of the label text.



The ***Text Properties*** *tab*

Face **drop-down list**

Click the down arrow next to the current *Face* to select the typeface you want to use for the labels.

Points **drop-down list**

In the *Points* drop-down list specify the desired point size.

Style **group box**

Apply **Bold**, *Italic*, ~~Strikethrough~~, or Underline styles to the label text by checking the appropriate check boxes in the *Style* group box.

Color **group box**

Click the down arrow next to the current color to open the color palette. Select the desired color from the palette, or click the *Custom* button at the bottom of the palette box to create custom colors.

Sample **group box**

This box demonstrates what the text looks like using the current text property settings.

Line and Fill Properties

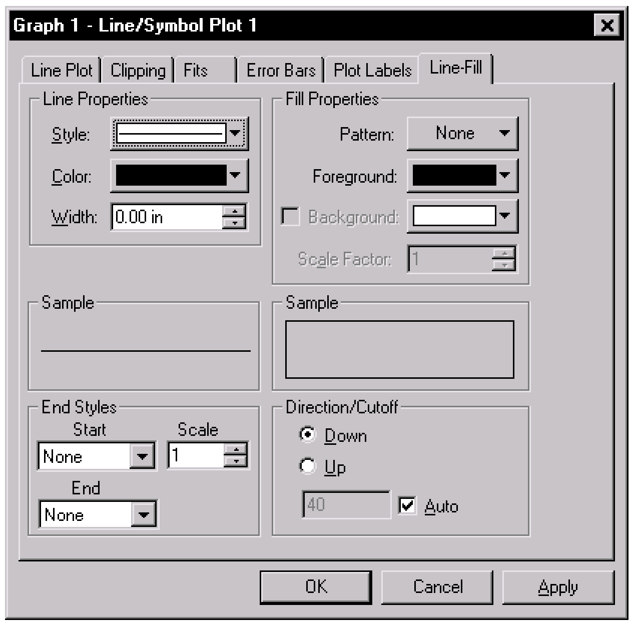
The line and fill options let you customize the appearance of lines, bars, and related objects used to represent data on a plot. For lines, you can change their *Style*, *Width*, *Color*, and *End Styles*. You can create a color fill under the plot, in a closed shape (bubbles, bars, and pie charts) or under a fit curve. The fill *Pattern* (solid, crosshatch), the *Foreground*, and the *Background* colors can be changed. In addition, the *Direction/Cutoff* can be set.

Setting line and fill properties is as simple as selecting the desired options from the **Line-Fill** tab on the **Plot** dialog box. The *Sample* fields on this dialog box show you how the current settings look when applied to your plot.

THE LINE-FILL TAB

Depending on the type of plot you are creating, the fill properties may not be available. Because of this, some dialog boxes have a **Line Properties** tab, while others have a **Line-Fill** tab.

Line Properties



*Set line and fill properties on the **Line-Fill** tab.*

Line Properties group box

When setting line properties, refer to the *Sample* box to see a preview of how the line looks with the current properties.

The *Style* drop-down list shows the current line style. Click the *Style* button to open the line style palette. Click on a line style to apply it to your line. If you want to create a new line style, click the *Custom* button.

The *Color* drop-down list shows the current line color. Click the arrow to the right of the line color to open the color palette. Click on a new color to select it. Create new colors by clicking the *Custom* button at the bottom of the palette box.

Change the line *Width* by typing a new number into the edit box or by scrolling to a new number using the arrow buttons to the right of the box. The line width can be 0.00 to 0.50 inches or 0.00 to 1.27 cm wide. A width of 0.00 is one pixel wide. Select the *Invisible* line style from the *Style* drop-down list if you do not want to display a line.

End Styles group box

Use these options to place arrowheads on the ends of lines. The *Start* style is placed at the first vertex of the line. The *End* style is placed at the last vertex. The *Scale* determines the size of the arrowhead.

Fill Properties

When setting fill properties, refer to the *Sample* box on the right side of the dialog box to see a preview of how an area looks with the current properties.

Fill Properties group box

The *Pattern* defaults to *None* for most plots, indicating that there is no fill under the curve or in the bars. Change the fill pattern by clicking on the down arrow to open the fill palette, and then click on a pattern to select it. To create a new pattern, click the *Custom* button at the bottom of the palette.

When applying a pattern, the *Foreground* color is the color of the pattern lines or pixels. The *Foreground* color is the color of the pattern (bitmap or solid fill color). The *Background* color is the color behind the pattern. To change to a new color, select it from the appropriate color palette by clicking the down arrow and clicking a different color box. To create a new color, click the *Custom* button at the bottom of the palette. With *Vector* and *Stock* pattern styles, the fill pattern can be transparent or opaque. A transparent fill has no *Background* color. To make the style transparent, remove the check mark in the check box in front of the *Background* color box. The *Background* color is then ignored.

The *Scale Factor* is used on vector fill patterns to make the pattern easier to see on paper and on the screen. Changing the value to 2 makes the pattern twice as large as when it is set to 1. The smaller the number you enter here, the tighter (smaller) the pattern is. This value must be between 0.1 and 10.

Direction/Cutoff group box

These options control how a fill is applied to a curve. For example, it can be applied above the curve, below the curve, or in some partial way.

Selecting *Down* fills the area under the curve to the minimum Y axis value.

Selecting *Up* fills the area above the curve to the maximum Y axis value.

If the check mark is removed from the *Auto* field, a value can be typed in the box. The fill then goes up or down to this value. For instance, if you have selected *Up* and unchecked *Auto* and input the value 20, the fill goes above the curve to the Y axis value of 20. Any area above the curve that is greater than the Y axis value of 20 is not filled.

Chapter 5

Axes

This chapter shows you how to modify the attributes of a graph's axes, including tick spacing, label format, and axis scale.

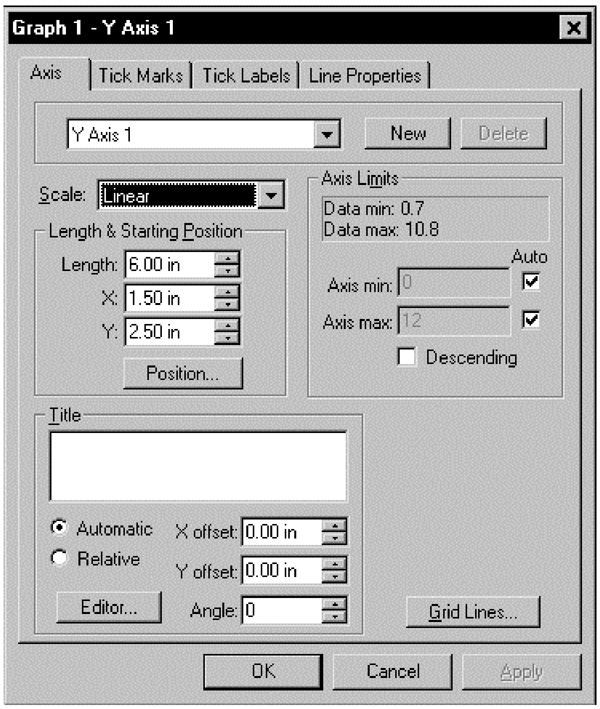
The Axis Dialog Box

Axis properties are edited through an **Axis** dialog box, which can be accessed in any one of the following ways:

- Double-click on the axis you want to edit.
- Right-click on the axis you are editing and choose **Properties** from the menu.
- Select the axis then choose **Edit | Properties**.
- Open the **Object Manager** (**Edit | Object Manager**), select one of the *Axis* objects, and click the *Properties* button.

For orthogonal coordinate systems, the axes are named *X Axis*, *Y Axis*, and *Z Axis* (if applicable). For polar coordinates, the axes are named *Radius Axis* and *Angle Axis*.

The **Axis** dialog box has four tabs where you set the various axis properties **Axis**, **Tick Marks**, **Tick Labels**, and **Line Properties**. The sections that follow describe each of these tabs in detail.



*The **Y Axis** dialog box allows you to set properties of the Y axis. The X axis and Y axis dialogs are similar.*

Axis Tab

The **Axis** tab (shown above) contains options to adjust the axis scale, length, starting position, title, limits, and grid lines.

Axis group box

This drop-down list shows the name of the axis you are editing. If you want to edit a different axis in this graph, you can select it from this list. The title bar on the **Axis** dialog box shows which axis is active.

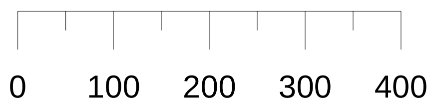
To add a new axis to the graph, click the *New* button and fill out the **Position Axis** dialog box to configure and place the location of the new axis. See the *Position* button on page 162 for details about positioning an axis. Each new axis is assigned a default sequential name. For example, if you created two additional X axes, they would be named: *X Axis 2* and *X Axis 3*, respectively.

You can delete an axis that you have created by selecting the axis in the drop-down list and clicking the *Delete* button. You cannot delete axes that a plot is using.

Scale drop-down list

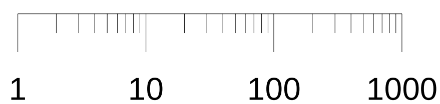
This drop-down list lets you set the axis scale to *Linear*, *Log (base 10)*, or *Probability*.

- *Linear* axes default to a range that covers all of the data. Tick marks are spaced so that the tick mark labels do not overlap.



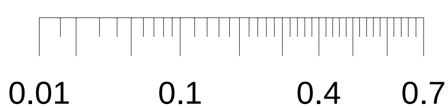
A linear X axis ranging from 0 to 400.

- *Log (base 10)* axes should not contain values equal to or less than zero in the data column defined for this axis. If such values are present, the plot only displays those values greater than zero. A warning message is displayed after selecting *Log (base 10)* if your data does have values less than zero.

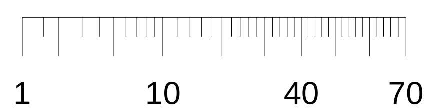


A log (base 10) X axis ranging from 0 to 1000.

- *Probability* axis listings come in two varieties. The difference between *Probability* and *Probability (% Labels)* are how the labels are displayed. The probability data must be percentages, though the axes can be displayed with percent or proportion labels. When using probability axes, negative data values are excluded from the plot. The minimum value for probability axes is 1E-5 (or 0.001%). The maximum value for probability axes is 0.99999 (or 99.999%)



A probability X axis ranging from 0.01 to 0.7.



A probability (% Labels) X axis ranging from 1 to 70.

Length & Starting Position group box

These options control the axis position on the page and the axis length.

To change the length of the axis, enter a new number into the *Length* edit box. When creating a new graph, the axis length defaults to six inches.

Set the horizontal (X) and vertical (Y) starting positions of the axes by typing new numbers into the *X* and *Y* edit boxes. The starting position for the Y axis refers to the bottom of the axis, and the starting position for the X axis refers to the left of the axis.

The position boxes measure the horizontal position from the left edge of the page, and the vertical position from the bottom of the page in page units (inches or centimeters).

***Position* button**

Click the *Position* button in the *Length & Starting Position* group box to position the axis relative to other axes, to place the axis according to data values, or to manually position the axis.

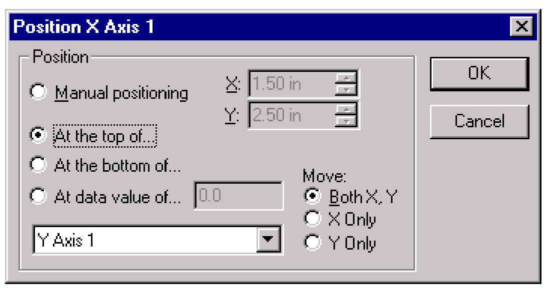
If *Manual positioning* is selected, set the starting position of the axis in page units (inches or centimeters) in the *X* and *Y* boxes.

Positioning a Y Axis

If a Y axis is selected or added, the default position options are either to place the Y axis *At the left of* or *At the right of* an X axis. If the Y axis is to be placed at the top of or at the bottom of another Y axis, select a Y axis from the drop-down list at the bottom of the **Position Axis** dialog box. If a Y axis is selected from the drop-down list, the options change to *At the top of* and *At the bottom of* the selected Y axis.

Positioning an X Axis

If an X axis is selected or added, the default position options are either to place the X axis *At the top* of or *At the bottom of* a Y axis. If the X axis is to be placed to the left of or to the right of another X axis, then select an X axis from the list at the bottom of the **Position Axis** dialog box. If an X axis is selected from the drop-down list, the options change to *At the right of* and *At the left of* the selected X axis.



*The **Position X Axis** dialog box lets you set the relative position of an X axis.*

Positioning an Axis at a Specific Location

To place the axis at a specific data location on another axis, select the *At data value of* option. Select an axis from the drop-down list at the bottom of the **Position Axis** dialog box, and then enter the data value into the edit box.

Axes can be placed by moving the axis vertically, horizontally, or both. Select *Both X, Y* to move an axis in both directions. Select *X Only* to only move the axis horizontally. Select *Y Only* to only move the axis vertically. By using these controls, the axis can be moved with respect to different axes.

Special Options for Duplicate Axes

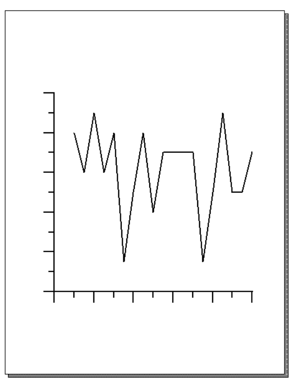
If you encounter the **Position Axis** dialog as part of adding a duplicate axis (**Graph | Add to Graph | Duplicate Axis**), the dialog box contains some additional options:

- Check the *Flip tick marks and labels* box to place the tick marks and labels opposite of the original tick marks and labels.
- Check the *Disable tick marks* box to remove tick marks from the duplicate axis.
- Check the *Disable labels* box to remove the labels from the duplicate axis.

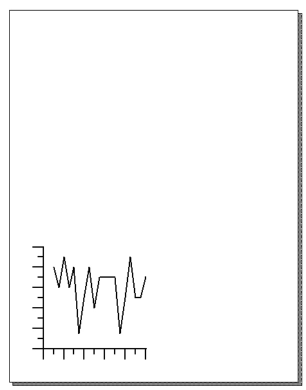
When adding a duplicate axis, these options are included on the ***Position Axis*** *dialog box.*

Axis Position Example:

A graph can be precisely sized and repositioned by changing the axis lengths and starting positions. The example below shows the transition from the original graph where both axes are 6.00 inches long to the final graph where both axes are three inches long. The final graph also shows the axes beginning one inch from the left and bottom edges of the page.



The original graph:
X axis length = 6.00"
Y axis length = 6.00"
X axis starting position:
X: 1.50", Y: 2.50"
Y axis starting position:
X: 1.50", Y: 2.50"



After changes to both axes:
X axis length = 3.00"
Y axis length = 3.00"
X axis starting position:
X: 1.00", Y: 1.00"
Y axis starting position:
X: 1.00", Y: 1.00"

To make changes such as this to a pair of axes, double-click on an axis to open its **Axis** dialog box. Set the *Length* to 3.0 inches. In the *Length & Starting Position* group box, set the *X*, and *Y* values to 1.0 inch. To make changes to the other axis, select it from the drop-down list at the top of the **Axis** dialog box and enter the desired settings in the *Length & Starting Position* group box as described above.

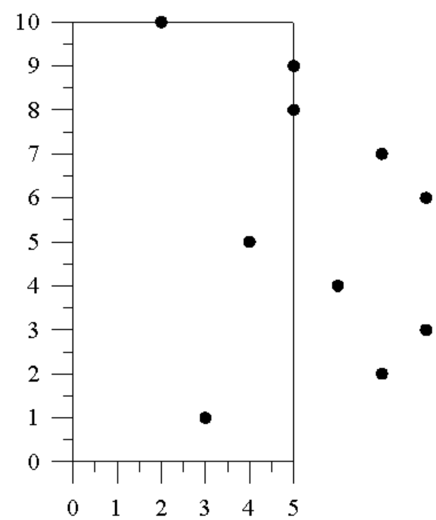
***Axis Limits* group box**

Use these options to expand or condense the axis range. If an axis range is shortened, the data are displayed outside the graph unless clip limits are used. For more information on clipping plots, refer to ***Clipping a Plot*** on page 133.

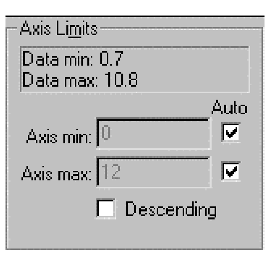
By changing the value on the **Clipping** tab in the **Plot** dialog box, the data are truncated at a specified limit and the axis is appropriately clipped. The only way to manually expand an axis is to change the *Axis Limits* on the **Axis** dialog box. Changing the clip limits beyond the axis limits does not expand the range of an axis.

The data minimum and maximum for the axis are displayed in the *Axis Limits* group box. These values are displayed in the non-editable box just below the *Axis Limits* title as *Data min* and *Data max*.

If the *Auto* option is checked next to the *Axis min* and *Axis max* fields, the axis range is automatically generated based on the data minimum and maximum.



*When you shorten the X axis, the data does not change and will display outside the axis range unless you use **Clip Limits** to limit which data is plotted.*



The Axis Limits group box

To change the axis minimum or axis maximum, click the *Auto* box to deselect the automatic axis range and then type a new number into the *Axis min* box or the *Axis max* box.

If the axis limits are set beyond the data range, the data plot outside the graph. For example, if the data range is 100 to 500, and the *Axis min* is changed to 10,000 and the *Axis max* is changed to 50,000 then it appears that no plot is on the graph. The data plot well outside of the axes, whether or not it can be seen in the program window. Use the **View | Fit to Window** command to see all of the plot and the axes. If the data are plotted far beyond the axes, use the **Object Manager** to delete the plot or reset the axis limits.

If the *Descending* box is checked for the X axis, the values decrease from left to right. If the *Descending* box is checked for the Y axis, the values decrease from bottom to top.

***Title* group box**

You can add a title to the axis by entering text into the *Title* field. These options also give you different ways to fine-tune the position of the axis title.

Select the *Automatic* option to allow the program to position the title on the axis. By default, the program centers the title on the axis and puts the title just beyond the tick marks and tick labels. If the axis attributes are changed, the title position adjusts for these changes. For example, if the X axis labels are rotated to 90 degrees, the title is placed farther from the axis to adjust for the additional space used by the rotated labels. You can fine-tune the automatic position using the *X offset*, *Y offset*, and *Angle* fields.

To place the title directly on the axis line, select the *Relative* option. This option is useful for customizing the location of the axis title using the *X offset* and *Y offset*, though the offsets can also be used with the *Automatic* option. When the *Relative* option is selected, the axis title does not move if the labels are changed. This may cause the title to overwrite the labels in some instances.

Use the *X offset* to move the label horizontally. Negative values move the label to the left, and positive values move the label to the right. Use the *Y offset* to move the label vertically. Negative values move the label down, and positive values move the label up. The label always moves relative to the original *Automatic* or *Relative* title position.

Rotate the axis title by entering a number into the *Angle* box. Negative numbers rotate the axis title clockwise, and positive numbers rotate the title counter-clockwise.

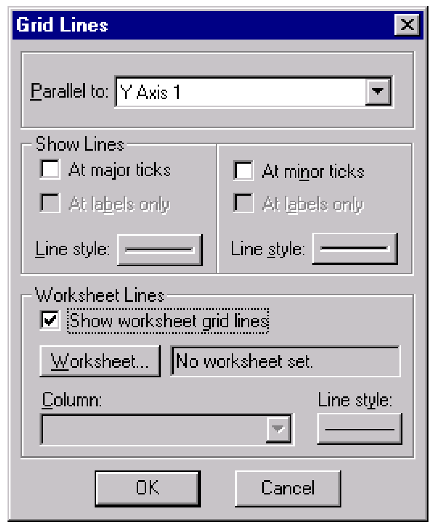
Change the axis title attributes by clicking the *Editor* button. This opens the **Text Editor** dialog box where you can change the font style, size, and color of the title. You must highlight the text that you want to edit before applying the new text attributes. For more information on the **Text Editor** dialog box, see ***Using the Text Editor*** on page 207.

***Grid Lines* button**

Click the *Grid Lines* button to open the **Grid Lines** dialog box, where you can add and configure grid lines. In **Grapher**, horizontal and vertical grid lines are assigned separately. To add horizontal grid lines, you must be editing a Y axis. To add vertical grid lines, you must be editing an X axis.

GRID LINES DIALOG BOX

Clicking on the *Grid Lines* button in the **Axis** dialog box opens the **Grid Lines** dialog box. Here, you can add and configure grid lines for the current axis. In the *Parallel to* drop-down list, choose the axis to which the grid lines are to be parallel. If you are editing an X axis, all of the Y axes in the graph appear in this drop-down list. If you are editing a Y axis, all of the X axes in the graph appear in this drop-down list.



Creating grid lines parallel to the Y axis

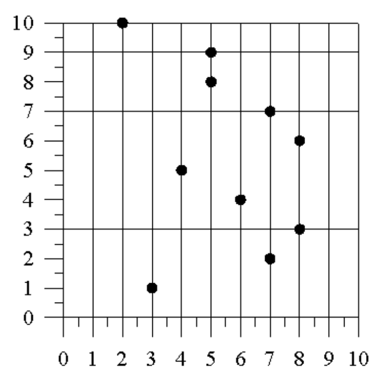
Select the location of the grid lines in the *Show Lines* group box. You can draw grid lines *At major ticks*, and *At minor ticks*. If you do not have tick labels at every tick mark, you may want to select *At labels only* to display a grid line only at those tick marks that have a label. By default, grid lines are placed at all ticks. To change the line properties of grid lines drawn at major and minor ticks, click the appropriate *Line style* button in the *Show Lines* group box.

Adding Custom Grid Lines

You can add custom grid lines to a graph at specific data values by entering those values into a dedicated worksheet column.

X	Y	Grid Lines
3	1	3
7	2	7
8	3	9
6	4	

In this example, the custom grid line values are read from the same worksheet where the X and Y values are stored.



The Y axis grid lines shown at 3, 7, and 9 are custom lines, read from the worksheet. The X axis grid lines are shown at the major ticks.

To setup custom grid lines:

1. In the **Grid Lines** dialog box, click the *Show worksheet grid lines* check box.
2. Click the *Worksheet* button to select the worksheet containing the grid line column.
3. In the **Open Worksheet** dialog box, select the worksheet and click the *Open* button.
4. In the *Column* drop-down list, choose the column containing the custom grid line data. To change the custom grid line properties, click on the *Line style* button next to the *Column* drop-down list.

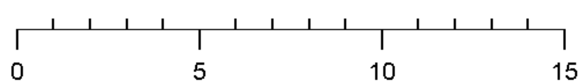
   Note:

   - The worksheet containing the grid line locations does not need to be the same worksheet that contains the plot data.
   - Custom grid lines are displayed in addition to the options selected in the *Show Lines* group box. If you have *At major ticks* selected and *Show worksheet grid lines*, grid lines are placed at all of the custom locations as specified in the worksheet and at each major tick.

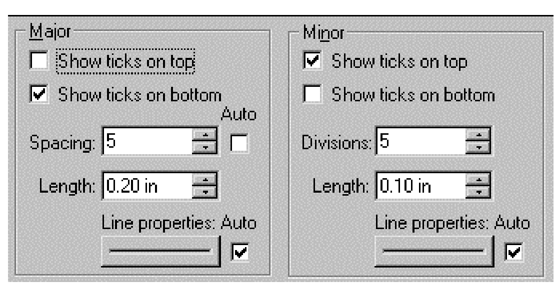
Tick Marks Tab

The **Tick Marks** tab on the **Axis** dialog box is where you set major and minor tick mark spacing, tick length, tick line properties and tick range.

Example of major and minor tick marks on a horizontal axis. Here the major tick marks plot below the axis, and the minor tick marks plot above the axis.

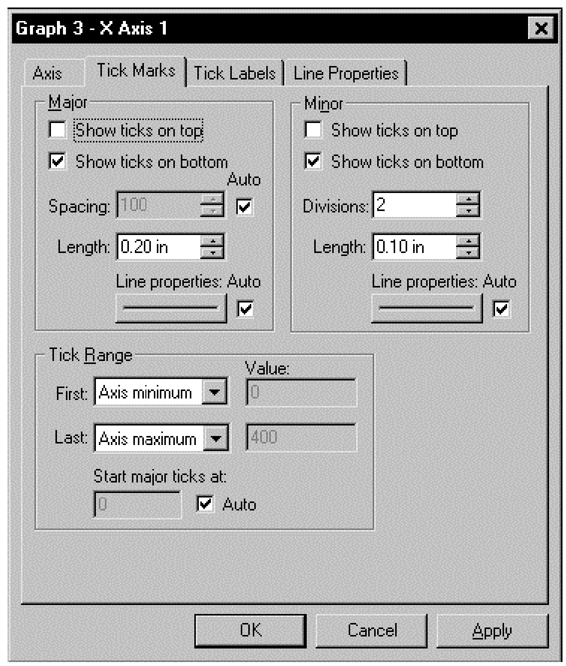


*These options on the **Tick Marks** tab of the **Axis** dialog box show the settings used to create the axis above.*



CONFIGURING MAJOR AND MINOR TICK MARKS

Tick marks come in two general varieties, *Major* and *Minor*. By default, major tick marks are longer than the minor tick marks and are spaced so that they occur at whole-number intervals on the axis. Minor tick marks are traditionally shorter and subdivide the region between the major tick marks.

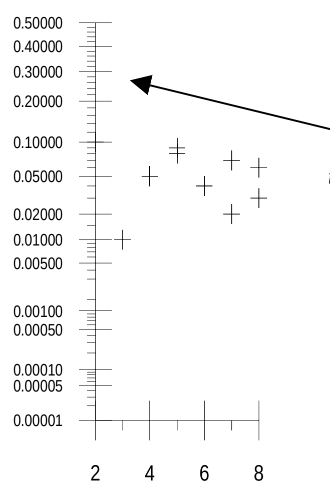


*Tick mark properties are set from the **Tick Marks** tab.*

Major **and** ***Minor*** **group boxes**

Ticks can be shown on either side of an axis line. When editing an X axis, you have the option to *Show ticks on top* or *Show ticks on bottom* of the axis. You can check both of these to place tick marks on both sides of the axis. When editing a Y axis, these options change to *Show ticks on right* and *Show ticks on left*.

For linear axes, the *Spacing* setting determines the number of major tick marks that display along the axis. If you want to change the default spacing, you must uncheck the *Auto* box and enter the desired spacing value. Major tick mark spacing cannot be set for log or probability axes. For log axes, the major interval occurs at 0.01, 0.1, 1, 10, 100, 1000, and so on. The diagram to the right shows the spacing for a probability axis.



On a probability axis (proportional labels), the major tick spacing and the minor tick divisions cannot be changed.

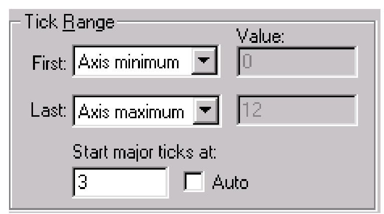
The *Divisions* setting determines how many spaces, not minor tick marks, exist between major tick marks. For example, if ten is typed into the *Divisions* edit box, the axis plots with nine tick marks and ten spaces between each major tick. The *Divisions* option is available for linear scale axes only. Probability axes and log axes have a set number of minor tick divisions that cannot be altered.

The *Length* field sets the physical length of the tick mark. These values can be changed by highlighting the current value and typing in a new value or by clicking the up or down arrows.

By default, tick marks have the same line properties as the axis line. Therefore, changing the axis line properties on the **Line Properties** tab also changes the tick mark line properties. You can override this setting and define a unique line style for the tick marks on the **Tick Marks** tab. Remove the check mark in the *Auto* check box and then click on the *Line properties* button. You can then select the desired options in the **Line Properties** dialog box. The *Line properties* can be set independently for the major and minor tick marks.

Tick Range group box

The options in the *Tick Range* group box let you set the starting and ending tick mark positions. This setting affects the tick marks only. If a tick mark position is outside the tick range, the mark is not displayed. By default, the *Axis min* and *Axis max* settings on the **Axis** tab determine the axis data range.



*The Tick Range group box on the **Tick Marks** tab of the **Axis** dialog box lets you set a range of values where you want tick marks to appear.*

To set the tick range, choose the appropriate settings in the *First* and *Last* fields.

- *Axis minimum* and *Axis maximum* use the minimum and maximum values as set in the *Axis Limits* group box of the **Axis** tab. This is the default setting.
- *Data minimum* and *Data maximum* places the first tick mark at the closest tick to the minimum data point, and the last tick closest to the maximum data point. The spacing of the major tick marks determine how far the first tick is away from the first data point. For example, if the tick spacing is set to five and the data minimum is three, the first tick is five if the *First* tick setting is the *Data minimum*. Changing the value in the *Start major ticks at* box can change the first tick mark to three and retain the 5-unit spacing.
- *Custom* lets you enter specific starting and ending tick mark locations. The custom value must be within the range of the axis minimum and axis maximum. To use a number outside the axis range, reset the axis minimum and maximum on the **Axis** tab.

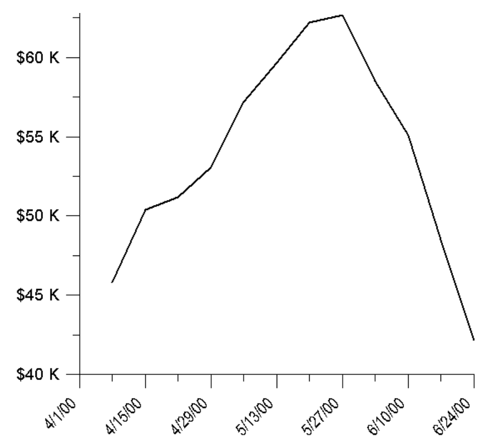
The *Start major ticks at* field lets you begin the major tick marks at a specific number that is not tied to the axis minimum or maximum. To use this option, remove the check mark in the *Auto* check box under the *Start major ticks at* label and enter a number into the edit box to begin the ticks at that value. For example, if the axis minimum is two and the tick spacing is two, the first tick is two if the *Axis minimum* option is selected. If the number three is entered into the *Start* *major ticks at* edit box, the first tick is now three. Subsequent ticks are at 5, 7, 9, and so on. Check the *Auto* check box to revert to the original starting value.

> **Note:** Setting the tick range does not affect the axis line. For example, consider an axis that ranges from 0 to 10. If you assign a *Custom* setting to the *Last* tick and set it to 5, ticks are drawn from 0 to 5. An axis line with no ticks exists in the range 5 to 10.

Tick Labels Tab

Grapher creates default tick labels at all major ticks using the value that is plotted on the graph. However, if you are plotting your data as a function of time (seconds, days, months, years), money (profits, dividends, earnings), or some other unit, you may want to customize the axis labels.

In the plot shown to the right, the Y axis has been modified with $ and K characters to denote thousands of dollars. The X axis data has been replaced with custom dates to show 2-week intervals.



This graph uses custom tick labels on both axes.

Configuring Major and Minor Tick Labels

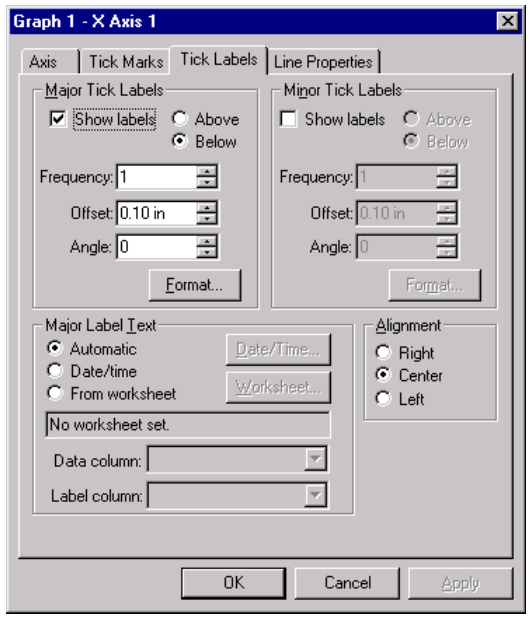
The location and frequency of labels can be set independently for major and minor tick labels. The *Major Tick Labels* group box controls the labels for major tick marks and the *Minor Tick Labels* group box controls the labels for minor tick marks. The options in these groups are the same.

Major Tick Labels and *Minor Tick Labels* group boxes

The *Show labels* check boxes on the **Tick Labels** tab make the labels visible. This option is enabled by default for major tick labels, and disabled for minor tick labels. To add minor labels, place a check mark in the *Show labels* box in the *Minor Tick Labels* group box. To remove labels, remove the check mark in the appropriate group box.

These options determine the position of the label with respect to the axis you are editing. You can position the labels *Above* or *Below* an X axis, or position the labels to the *Right* or *Left* of a Y axis.

The *Frequency* determines how many tick marks have labels. For example on linear and log axes, when *Frequency = 1*, every tick mark has a label. When *Frequency = 2*, every second tick mark has a label.



*The tick label settings are accessed from the **Tick Labels** tab on the **Axis** dialog box.*

On a probability axis, you can set the frequency in the *Major Tick Labels* group box to *Dense*, *Medium*, or *Sparse* by changing the *Labels at* drop-down box. The *Dense* setting labels every major tick. The *Medium* setting labels every other major tick. The *Sparse* setting labels every third major tick.

Setting the *Frequency* in the *Minor Tick Labels* group box is the same as setting the *Frequency* in the *Major tick labels* group box for linear axes. Minor tick labels on a log axis can be displayed on all minor ticks, at the 2^{nd}, 4^{th}, 6^{th}, and 8^{th} minor ticks; at the 2^{nd}, 3^{rd}, and 5^{th} minor ticks; at the 2^{nd} and 5^{th} minor ticks; and at every third minor tick. Minor tick labels are not displayed on probability axes.

The *Offset* field lets you set the distance between the tick marks and the tick labels. By default, this value is 0.10 inches or 0.25 centimeters.

The *Angle* field lets you rotate the labels. This is particularly useful with long labels as it can reduce overlap. This also makes the axis easier to read. Positive angle values rotate the label counter-clockwise, while negative angle values rotate the label clockwise.

Click the *Format* button in the *Major Tick Labels* group box to open the **Major Label Format** dialog box and in the *Minor Tick Labels* group box to open the **Minor Label Format** dialog box. Here you can change the **Format** used by the label and edit the **Text Properties** of the label. See *The Plot Points Label Format Dialog Box* on page 154 for more information about these options.

***Major Label Text* group box**

Major axis labels can be numeric or they can be character strings. There are three label options in the *Major Label Text* group box on the **Tick Labels** tab: *Automatic*, *Date/time*, and *From worksheet*.

- *Automatic* allows **Grapher** to automatically determine numeric labels based on the data used to create the graph.

- *Date/time* shows date/time labels. This option should only be used if the data are organized in evenly spaced increments of time. Click the *Date/Time* button to select the data value and the corresponding date or time. See the *Using Date/Time Labels* section below for more information on using this option.
- The *From worksheet* option lets you read label values directly from a worksheet. Click the *Worksheet* button to select the worksheet that contains the tick marks and labels. After the worksheet is selected, choose the column containing the tick mark locations for the *Data column*, and select the column containing labels for the *Label column*. See *Using Labels from a Worksheet* on page 176 for more information.

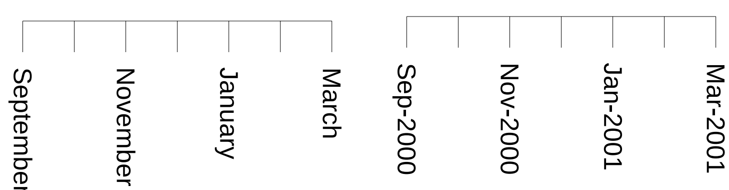
***Alignment* group box**

For X axes, you can set the tick label's *Alignment* to be to the *Right*, *Center*, or *Left* of the tick mark. For Y axes, set the tick label *Alignment* to the *Top*, *Center*, or *Bottom* of the tick marks.

USING DATE/TIME LABELS

Occasionally, time is used as a variable to plot graphs in **Grapher**. **Grapher** recognizes text and numbers. There are no date data types in **Grapher**. Any non-numeric characters (letters, colons, slashes, hyphens, etc.) cause numbers to be read as text. Time values such as 1/1/98, January 1, 1998, or 12:30 cannot be used as variables directly because they include non-numeric characters. All non-numeric data must be converted into numbers before graphing the data in **Grapher**. If a non-numeric column is chosen to create a graph, only axes are displayed on the graph.

Text labels, such as those below, can be displayed as axis labels. **Grapher** can automatically generate *Date/Time* labels if the time increments are evenly spaced. If the time increments are unevenly spaced use the *From worksheet* option to include date/time axis labels.



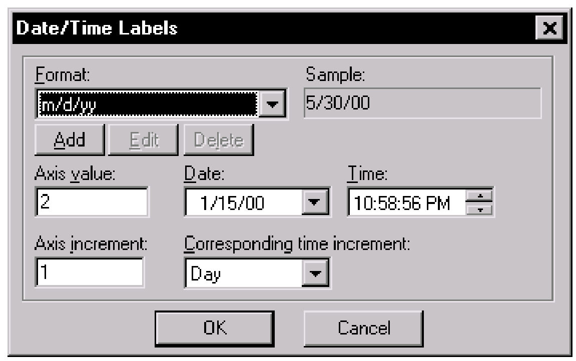
Date/Time labels shown on an X axis.

DATE/TIME LABELS DIALOG BOX

To open the **Date/Time Labels** dialog box, double-click on the axis to open the **Axis** dialog box. Select the **Tick Labels** tab, choose the *Date/time* option in the *Major Label Text* group box, and then click the *Date/Time* button.

Select the format of the label from the *Format* drop-down list. A sample of the selected format appears in the *Sample* box to the right of the *Format* list. New formats can be added by clicking the *Add* button. Custom formats can be edited or deleted by using the *Edit* and *Delete* buttons.

The *Axis value* is the numeric value that equals a specific time.



*The **Date/Time Labels** dialog box is accessed from the **Tick Label** tab.*

Set the axis value *Date* by clicking the down arrow. In the calendar, click on the day that represents the *Axis value.* Values can also be typed directly into the *Date* box. You can highlight the number representing the month, day, or year and type in a new value.

If your value corresponds to a particular time during the day, click the up or down arrows next to the *Time* to change it. If the time does not matter, the field can be left as is.

The *Axis increment* should match the major tick mark spacing, though this is not required. The *Corresponding time increment* is the unit of time applied to the *Axis Increment* value. For example, in the picture of the **Date/Time Labels** dialog box above, every increase of one on the axis is equivalent to an increase of one day.

If *Row Number* is used instead of a worksheet column for the data, enter the first-used row number for the *Axis value*. If *Sequence Number* is used for the axis data, enter 1 in the *Axis value* box. Plotting a graph with *Row Number* or *Sequence Number* plots the data at even increments.

Date/Time Labels - Example 1

Consider the following scenario:

- An observation is recorded once a day for 21 days.
- The data are plotted using the *Row Number* for the X values and the worksheet observation column for the Y values.
- There are headers in row one, so the worksheet rows used in the plot are rows 2 through 22. The worksheet row information is displayed on the **Line Plot** tab of the **Line/Symbol Plot** dialog box.

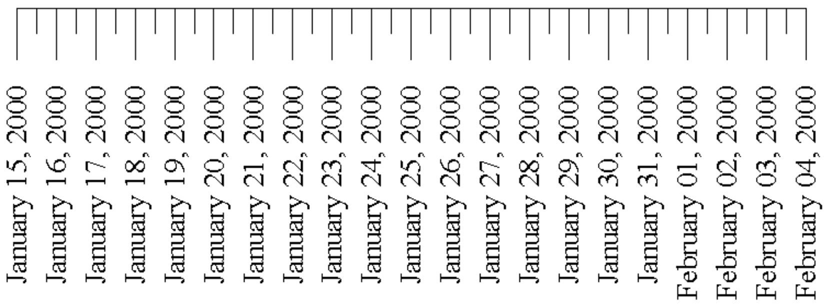
The following steps show you how to plot month-day-year labels for each data point.

1. Double-click on the X axis to open the **X Axis** dialog box.
2. Select the **Tick Marks** tab, clear the *Auto* check box in the *Major* group box and change the *Spacing* to one.
3. Select the **Tick Labels** tab and set the *Angle* in the *Major Tick Labels* group box to 90.
4. Select the *Date/time* option in the *Major Label Text* group box, and click on the *Date/Time* button.
5. In the **Date/Time Labels** dialog box, set the *Format* to *mmmm dd, yyyy*.
6. Since the axis minimum is two, set the *Axis value* to two.
7. The first observation day is January 15, 2000, so set the *Date* to 1/15/00.

   Note: The *Time* does not need to be set to anything in particular since the time increment is days.
8. Set the *Axis increment* to one since there is an observation once a day and the X axis numbers increment by one.
9. Set the *Corresponding time increment* to *Day*.
10. Click *OK* on all open dialog boxes. The axis labels appear once a day with dates beginning at January 15, 2000 and ending on February 4, 2000.

	A
1	Y data
2	0.7
3	0.83
4	0.3
5	0.51
6	0.72
7	0.19
8	0.35
9	0.31
10	0.28
11	0.35
12	0.42
13	0.51
14	0.75
15	0.32
16	0.85
17	0.73
18	0.81
19	0.76
20	0.75
21	1.04
22	0.62

This graph in this example only requires one column of data because the row number is used for the X axis.



Resulting date labels for Example 1

Date/Time Labels - Example 2:

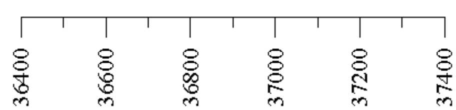
An observation is recorded once a day for 700 days. Dates are entered into column A in the 1/15/00 format, and the date values are recorded in column B. Since the dates contain forward slashes, they are considered text, so the dates must be converted to numbers. Some spreadsheet software can change text dates into serial numbers. In Excel, for example, select column A and change the format from date to number by using the **Format | Cell** command. The dates are converted to five-digit Julian numbers. Plot the serial numbers on the X axis and the observation values on the Y axis.

	A	B	C
1	Date	Serial #	Y value
2	1/1/00	36526	7.48
3	1/2/00	36527	7.03
4	1/3/00	36528	7.73
5	1/4/00	36529	7.67

Part of the worksheet from Example 2 is shown here. Column A contains the original date, column B contains the date converted to a serial number, and column C contains the observations.

Since there are 700 data points, a date/time increment of a day is not legible on the X axis. The following steps show how to plot a date label once a month for daily data.

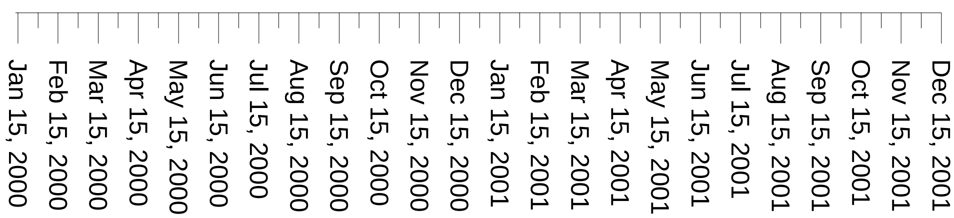
1. Double-click on the X axis to open the **X Axis** dialog box.
2. On the **Axis** tab, remove the tick mark in the *Auto* check box next to the *Axis min* and change the *Axis min* to 36526.



The original X axis for Example 2, before date labels were added.

3. Click the **Tick Marks** tab, remove the check mark in the *Auto* check box in the *Major* group box and set the *Spacing* to 30.44 (365.25 days per year divided by 12 months).
4. Set the *First* tick value in the *Tick Range* group box to *Data minimum*.
5. Click the **Tick Labels** tab and set the *Angle* in the *Major Tick Labels* group box to 270.
6. Select *Date/time* in the *Major Label Text* group box, and then click the *Date/Time* button.
7. Set the *Format* to *mmm dd, yyyy*.

8. Set the *Axis value* to 36526 (the data minimum and first tick).
9. The first day of the observations occurs on January 15, 2000, so set the *Date* to 1/15/00.
10. Set the *Axis increment* to 30.44 (365.25 days per year divided by 12 months).
11. Set the *Corresponding time increment* to *Month*.
12. Click *OK* in all open dialog boxes. The axis labels appear once a month beginning at Jan 15, 2000 and ending at Dec 15, 2001.



The resulting X axis, with monthly date labels

Date/Time Labels - Example 3:

An observation is taken every two to eight hours. Time is entered in column A in a 24-hour format (for example 14:31), and the time values are recorded in column B. Since the data are unevenly spaced (spacing varies from two to eight hours), automatic *Date/time* labels cannot be used. In this case, you must use the *From worksheet* option. The following section shows several examples of how to use labels from a worksheet.

USING LABELS FROM A WORKSHEET

To display text or symbol labels in **Grapher**, use worksheet labels. Enter the labels into a worksheet column and plot the labels using the *From worksheet* option on the **Tick Labels** tab. You can use math text in the worksheet to format the labels. See *Appendix B, Math Text* for more information on using math text.

Text labels from the worksheet require two columns of information. One column must contain tick mark locations. This column can be the same column as the X or Y data. The other column should contain the text for the axis labels. If the labels are dates/times, then **Grapher** can automatically generate date/time labels if the time increments are evenly spaced. If the time increments are unevenly spaced, the *From worksheet* option is necessary.

When using the *From worksheet* option, select the worksheet containing the axis labels by clicking the *Worksheet* button on the **Tick Labels** tab. The worksheet containing labels does not have to be the same worksheet used to create the plot. Select the column with the major tick mark locations for the *Data column*, and select the column with the text labels for the *Label column*. There does not need to be a label for every tick mark. However, it is important to keep in mind that a tick mark is displayed for every value in the *Data column*. If there are too many ticks or labels on the axis, create a new tick mark location column and a new label column with fewer values.

Worksheet Labels - Example 1:

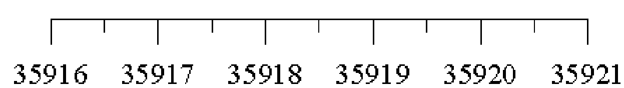
In this example, time is recorded as a date and 24 hour time. Since time is text, the dates were changed to serial numbers in Excel by changing the column format from date to number with the **Format | Cells** command. The time increments of the observations range between two and eight hours, so automatic date/time labels cannot be used.

A	B	C	D	E	F
Time	Serial #	Y values	Labels 2	Ticks	Labels 3
5/1/98 0:00	35916	7.48	5/1/98 0:00	35916	5/1/98 0:00
5/1/98 2:00	35916.083	7.03		35917.292	5/2/98 6:59
5/1/98 8:00	35916.333	7.73		35918.167	5/3/98 3:59
5/1/98 11:0	35916.458	7.67		35919.125	5/4/98 3:00
5/1/98 15:0	35916.625	7.41		35920.167	5/5/98 3:59
5/1/98 23:0	35916.958	7.3			
5/2/98 6:59	35917.292	7.4	5/2/98 6:59		

Label data stored in a worksheet.

Column A contains the original time values. Since text cannot be used as a variable, time was converted to serial numbers and placed in column B.

The serial numbers in column B are used to plot X values and column C is used to plot Y values. Serial numbers are plotted as the X axis labels unless the *From worksheet* option is used.

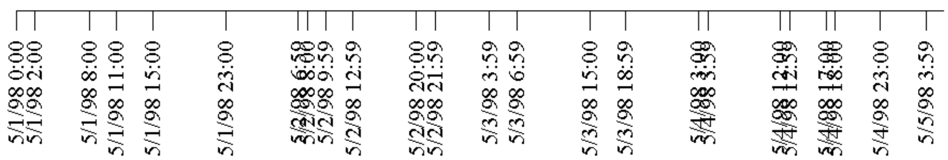


Original X axis labels show serial numbers.

To change the serial number tick mark labels to text tick mark labels:

1. Double-click on the X axis to open the **X Axis** dialog box.
2. Click the **Tick Labels** tab and select the *From worksheet* option in the *Major Label Text* group box.
3. Click the *Worksheet* button to open the **Open Worksheet** dialog box. Select the worksheet containing the tick marks and tick labels. Click *Open* to return to the **X Axis** dialog box.
4. In the *Data column* drop-down list, select *Column B: Serial #*. The *Data column* is the column containing the location of the tick marks.
5. In the *Label column* drop-down list, select *Column A: Time*.

6. Change the *Angle* in the *Major Tick Labels* group box to 90 degrees.
7. Click *OK* and the following X axis labels appear:

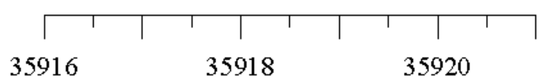


X axis shows all tick marks and labels plotted. Notice that labels are spaced too closely.

The serial numbers in column B was selected for the tick marks and the X axis data column, so there is a tick mark for each data point. Since some of the data points are closely spaced, the labels overlap. To plot a more legible axis, plot fewer labels and/or tick marks.

Worksheet Labels - Example 2:

Another way to show fewer labels by using the original columns is to set the *Frequency* to a value other than 1. By setting the *Frequency* to 2 in Example 1, the following axis would result.



Axis from Example 1 with the label Frequency set to two.

To change the label frequency to 2:

1. Double-click on the X axis to open the **X Axis** dialog box.
2. Click the **Tick Labels** tab.
3. In the *Frequency* field of the *Major Tick Labels* group box, change the value to 2. Click *OK* to view the graph.

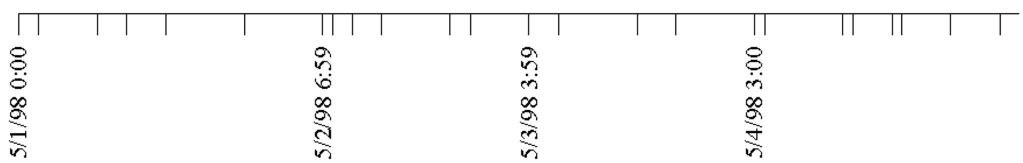
Follow the instructions in *Worksheet Labels – Example 1* to plot every other tick label from the worksheet.

Worksheet Labels - Example 3:

Another method to make the axis labels more legible is to skip some labels. To plot fewer labels create a new label column in the worksheet, and align the tick label at the corresponding serial number location. Compare columns A and D in the worksheet picture in Example 1 on the previous page. New labels were entered into column D at the matching serial numbers. It is important to align the new labels with the existing serial numbers to properly place the labels on the axis.

1. Double-click on the X axis to open the **X Axis** dialog box.

2. Select the **Tick Labels** tab and select the *From Worksheet* option.
3. Click the *Worksheet* button and select the worksheet containing the tick marks and tick labels in the **Open Worksheet** dialog box. Click *OK* to return to the **X Axis** dialog box.
4. In the *Data column* drop-down list, select *Column B: Serial #*.
5. In the *Label column* drop-down list, select *Column D: Labels 2*.
6. Change the *Angle* in the *Major Tick Labels* group box to 90.
7. Click *OK* and the following X axis labels appear:

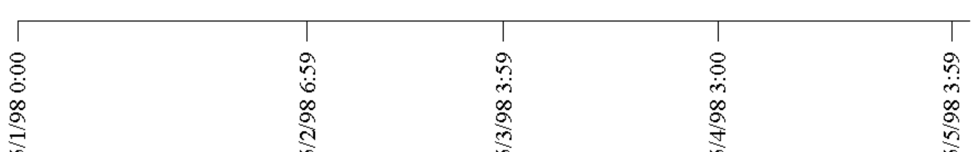


Axis labels plotted on the first observation of each day.

Worksheet Labels - Example 4:

If plotting tick marks for each data point is unnecessary; the ticks can be removed. Since all values in the *Data column* are plotted, create a new data column and a new label column to remove the intermediate tick marks. See columns E and F in the worksheet picture in Example 1. Column E contains the serial number for the first data point of each day. Column F contains the tick label for the first data point of the day.

1. Double-click on the X axis to open the **X Axis** dialog box.
2. Click on the **Tick Labels** tab and select the *From Worksheet* option.
3. Click the *Worksheet* button and select the worksheet containing the tick marks and tick labels.
4. Back on the **Tick Labels** tab, select the *Data column* as *Column E: Ticks*.
5. Select *Column F: Labels 3* for the *Label column*.
6. Change the *Angle* in the *Major Tick Labels* group box to 90.
7. Click *OK* and the following X axis labels appear:



Axis labels and tick marks plotted on the first observation of each day.

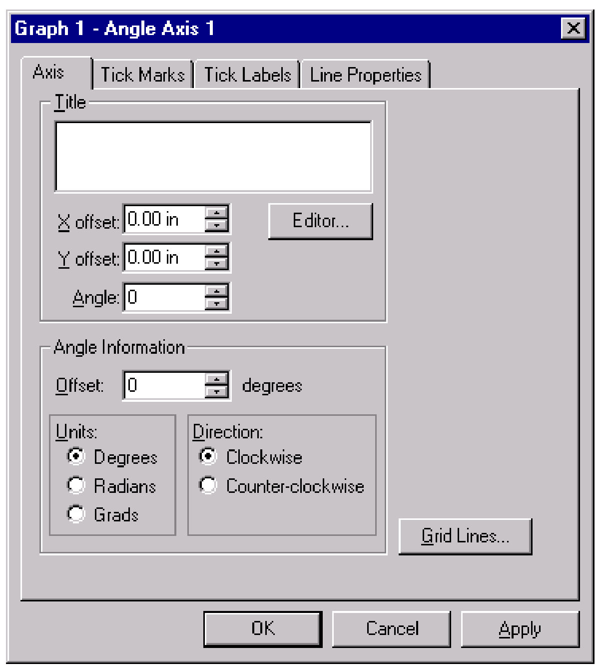
Line Properties Tab

The **Line Properties** tab controls the Line *Color*, *Style* and *Width* of the axis line and tick marks. This tab also allows you to specify any *End Styles* for the line. The tick marks and axis lines are the same color, style, and width by default. Tick mark properties can be set on the **Tick Marks** tab if a style other than the axis line style is desired. Grid line attributes are set in the **Grid Line** dialog box through the **Axis** tab. For more information on setting options on the **Line Properties** tab, refer to the ***Line and Fill Properties*** section on page 156.

Configuring Axes: Special Cases

Configuring Axes on Polar Plots and Rose Diagrams

Polar plots and rose diagrams use an angle axis and a radius axis. The angle axis is the outer circular axis, and the radius axis is the radius of the circle. The angular data can be in units of degrees, radians, or grads. Use the fields on the **Axis** tab to set the *Units* to match the data format of the worksheet and add a *Title* to the axis or change the direction of the axis. The other tabs on the **Angle Axis** dialog box are similar to those used for linear coordinate systems.



*The **Axis** tab on the **Angle Axis** dialog box lets you set the general properties of the axis, including title, units, and angular direction.*

Title group box

Type the axis title in the *Title* box. The title's position defaults to the top center of the angle axis.

Use the *X offset* to move the axis title horizontally. Negative values move the label to the left, and positive values move the label to the right. Use the *Y offset* to move the axis title vertically. Negative values move the label down, and positive values move the label up.

Rotate the title by entering a number in the *Angle* box. Negative values rotate the title clockwise and positive values rotate the title counter-clockwise.

Click the *Editor* button to open the **Text Editor** dialog box. In this dialog box, you can change the properties of the axis title. For more information on the **Text Editor** dialog box, see ***Using the Text Editor*** on page 207.

Angle Information group box

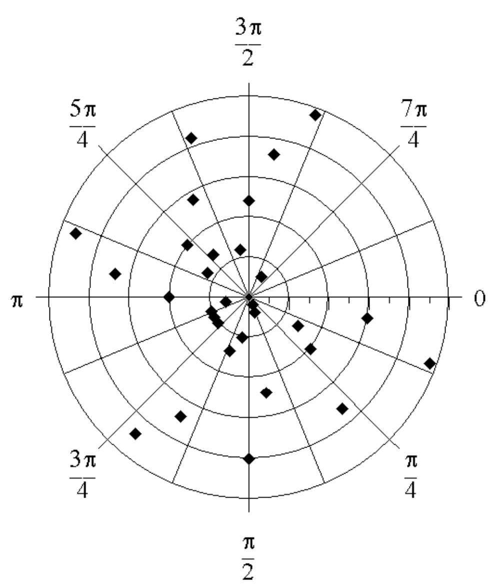
Use the *Angle Information* group box to set the axis units and to rotate the angle axis. Rotate the angle axis by entering a number into the *Offset* box. Zero is placed at the top of the graph by default. Enter 90 degrees into the *Offset* box to change the zero location to horizontal right.

Angle axis *Units* can be *Degrees* (0 to 360), *Radians* (0 to 6.283), or *Grads* (0 to 400). The data should match the angle axis unit type. To display radian axis labels as increments of Pi, enter the labels into the worksheet using *Math Text*. Display the labels using the *From worksheet* option on the **Tick Labels** tab. See *Using Labels from a Worksheet* on page 178 for additional information on using labels from the worksheet.

The Angle Axis *Direction* can increment the axis *Clockwise* or *Counter-clockwise*.

Grid Lines button

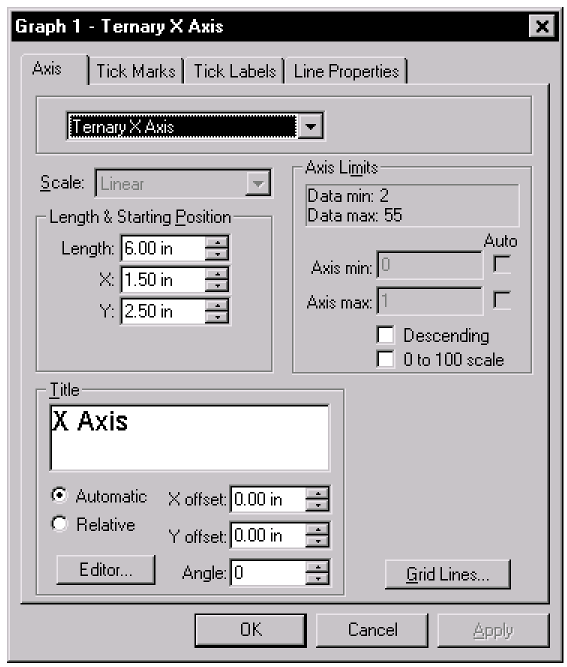
Click the *Grid Lines* button to open the **Grid Lines** dialog box. The options on this dialog box allow you to add grid lines to the graph. See *Grid Lines Dialog Box* on page 166 for more information about this dialog box.



This polar plot contains labels from the worksheet. To create symbols and fractions in labels, use math text. This graph also contains grid lines from the worksheet since worksheet labels are for major tick marks only. The angle axis was rotated 90 degrees to place zero at horizontal right.

CONFIGURING AXES ON TERNARY DIAGRAMS

When working with ternary diagrams, the **Axis** dialog boxes have a few additional options unique to this type of plot.



*The **Axis** tab on the **Ternary X Axis** dialog box*

Ternary Axis drop-down list

This field at the top of the **Axis** tab shows the axis that is being edited. You can choose *Ternary X Axis*, *Ternary Y Axis*, or *Ternary Z Axis* from the drop-down list. The title bar of the **Axis** dialog box updates to correspond with the axis selected.

Length & Starting Position group box

These options control the axis position on the page and the axis length.

To change the length of the axis, enter a new number into the *Length* edit box. When creating a new graph, the axis length defaults to six inches.

Note: Changing the length of one axis changes the length of all three ternary axes.

Set the horizontal (X) and vertical (Y) starting positions of the axes by typing new numbers into the *X* and *Y* edit boxes.

Axis Limits group box

In ternary diagrams you cannot change the *Axis min* and *Axis max* values. Ternary axes always range from zero to one or from zero to 100.

The *Descending* check box reverses the direction of the numbering on the axis. For example, instead of the axis going from 0 to 1, this option makes the axis range from 1 to 0. Enabling this option for one axis reverses the numbering on all three ternary axes.

The *0 to 100 scale* check box changes the axis range from 0 to 1 to 0 to 100. Enabling this option for one axis changes all three ternary axes.

***Title* group box**

Type the axis title in the *Title* box.

When the *Automatic* radio button is selected, the title centers itself along the axes just beyond the labels. This is below the X axis, to the left of the Z axis, and to the right of the Y axis. The title slants along the Y and Z axes to the same angle as the axis. When the *Relative* radio button is selected, the titles are centered, but placed directly on the axis.

Use the *X offset* to move the axis title horizontally. Negative values move the label to the left, and positive values move the label to the right.

Use the *Y offset* to move the axis title vertically. Negative values move the label down, and positive values move the label up.

Rotate the title by entering a number in the *Angle* box. This rotates the title from the original position.

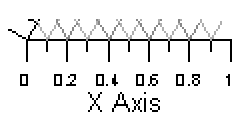
Click the *Editor* button to open the **Text Editor** dialog box. In this dialog box, you can change the properties of the axis title. You must select the text in the **Text Editor** dialog box before changing the font attributes. For more information on the **Text Editor** dialog box, see ***Using the Text Editor*** on page 207.

***Grid Lines* button**

Grid lines can be added to the graph by clicking the *Grid Lines* button. This opens the **Grid Lines** dialog box where you configure the line density. For more information about grid line settings, see *Grid Lines Dialog Box* on page 166.

TICK MARKS ON TERNARY DIAGRAMS

The **Tick Marks** tab of a ternary diagram has the same options available as on a standard plot. See the *Tick Marks Tab* on page 167 for more information on most of the options available on this tab. In addition to the standard options, ternary axes have a unique check box called *Angled marks*. By default, the tick marks on a ternary axis are drawn perpendicular to the axis. When the *Angled marks* check box is enabled, the tick marks are replaced by angled marks.



The default tick marks shown on the ternary X axis.

Angled tick marks shown on the same ternary X axis.

CONFIGURING AXES ON BOX-WHISKERS PLOTS

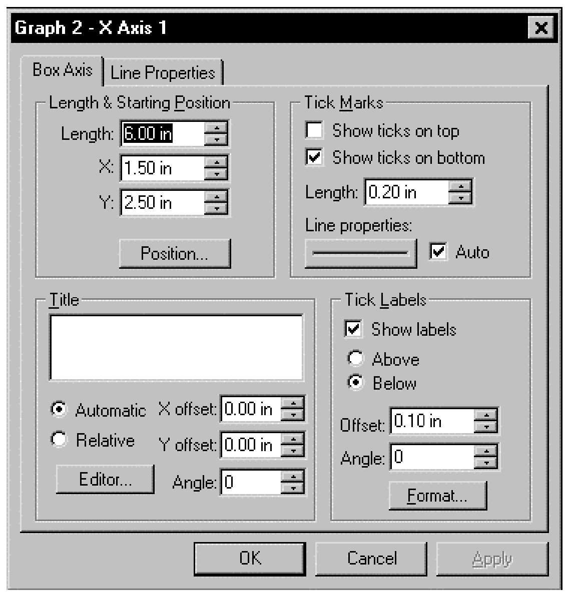
When working with box-whisker plots, the **X Axis** dialog box is different than other **X Axis** dialog boxes. There are two tabs available, the **Box Axis** tab and the **Line Properties** tab. The **Line Properties** tab is the same as for any other X axis. Refer to ***Line Properties*** on page 157for more information on how to change the line properties.

Length & Starting Position group box

These options control the axis position on the page and the axis length.

To change the length of the axis, enter a new number into the *Length* edit box. When creating a new graph, the axis length defaults to six inches.

Set the horizontal (X) and vertical (Y) starting positions of the axes by typing new numbers into the *X* and *Y* edit boxes. The starting position for the Y axis refers to the bottom of the axis, and the starting position for the X axis refers to the left side of the axis. The position boxes measure the horizontal position from the left edge of the page, and the vertical position from the bottom of the page in page units.



*The **X Axis** dialog box of a box-whisker plot*

Click the *Position* button to position the axis relative to other axes, to place the axis according to data values, or to manually position the axis. Refer to *Position button* on page 162 for more information about the options available on this dialog box.

Tick Marks group box

Ticks can be shown on either side of an axis line. For the box-whisker X axis, you have the option to *Show ticks on top* or *Show ticks on bottom* of the axis. You can check both of these to place tick marks on both sides of the axis.

The *Length* field sets the physical length of the tick mark. By default, this value is 0.20 inches. This value can be changed by highlighting it and typing in a new length or by using the up or down arrows to scroll to a new value.

By default, tick marks always take on the same line properties as the axis line. Therefore, changing the axis line properties on the **Line Properties** tab also changes the tick mark line properties. You can override this setting and define a unique line style for the tick marks by clicking the *Line properties* button and selecting the desired options from the **Line Properties** dialog box. You must uncheck the *Auto* check box to enable this button.

***Title* group box**

Type the axis title in the *Title* box.

When the *Automatic* radio button is selected, the title centers itself below the axis labels. When the *Relative* radio button is selected, the titles are centered, but placed directly over the axis.

Use the *X offset* to move the axis title horizontally. Negative values move the label to the left, and positive values move the label to the right.

Use the *Y offset* to move the axis title vertically. Negative values move the label down, and positive values move the label up.

Rotate the title by entering a number in the *Angle* box. Negative values move the label clockwise, and positive values move the label counter-clockwise.

Click the *Editor* button to open the **Text Editor** dialog box. In this dialog box, you can change the properties of the axis title. You must select the text in the **Text Editor** dialog box before changing the font attributes. For more information on the **Text Editor** dialog box, see *Using the Text Editor* on page 207.

***Tick Labels* group box**

Place a check mark in the *Show labels* check box to show the labels for each tick mark. If there is not a check mark in this box, no labels are displayed along the X axis and the options in this group box are disabled.

Select the *Above* radio button to place the labels above the axis and tick marks. Select the *Below* radio button to place the labels below the axis and tick marks.

The *Offset* field lets you set the distance between the tick marks and the tick labels. By default, this value is 0.10 inches or 0.25 centimeters.

The *Angle* field lets you rotate the labels. This is particularly useful with long labels as it can reduce overlap. Positive angle values rotate the label counter-clockwise, while negative angle values rotate the label clockwise.

Click the *Format* button to open the **Label Format** dialog box. Here you can change the **Format** used by the label and edit the **Text Properties** of the label. See *The Plot Points Label Format Dialog Box* on page 154 for more information about these options.

Adding Additional Axes to a Graph

Use the following procedure to add an X or Y axis to your graph. If you want to add a duplicate of an existing axis, follow the instructions in the section *Adding Duplicate Axes to the Graph*.

1. Add an axis to an existing graph using one of the following methods. Note that the entire graph must be selected prior to using these methods.
   - Select the **Graph | Add to Graph | Axis** command.
   - Right-click on a selected graph and choose **Add Axis** from the menu.
   - Select the graph and choose **Edit | Properties** to add an axis through the **Graph Properties** dialog box.

   Note: If there are multiple objects on the page, the easiest way to select the graph is through the **Object Manager**.
2. In the **Axis Type** dialog box, choose the type of axis you want to add (*X Axis* or *Y Axis*) and click *OK*.
3. Set the desired properties for the axis in the **Axis** dialog box and click *OK*.

The new axis is created with the default settings (axis minimum = 0 and axis maximum = 25). To edit these properties, double-click on the axis and change the settings in the **Axis** dialog box.

Adding Duplicate Axes to the Graph

To create an axis identical to an existing axis, select the axis you want to duplicate and use the **Graph | Add to Graph | Duplicate Axis** command. Only an axis can be selected when using the **Add Duplicate Axis** command, otherwise the menu command is grayed out.

The duplicate axis has the same axis range and scale as the original axis. Set the duplicate axis properties in the **Position Axis** dialog box. When creating a duplicate axis, the **Position Axis** dialog box contains options to display the axis with reversed ticks and labels, or to disable the ticks and labels completely. See the *Position button* section on page 162 of this chapter for more information on position options.

Chapter 6

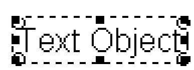
Creating and Editing Objects

Grapher contains several editing and drawing tools. Once an object is selected, it can be edited with the **Edit** menu commands or repositioned with commands in the **Arrange** menu. You can link or embed OLE objects from other applications, or you can link or embed **Grapher** documents into other applications. Graphics can also be imported to enhance the appearance of the graph. For information on modifying graphs, see *Chapter 7, Modifying Graphs*.

Selecting Objects

Before an object can be edited, it must be selected. This section discusses the various ways that objects can be selected in **Grapher**.

When an object is selected, a selection rectangle surrounds the object along with eight small black boxes, called handles. If only one object is selected, the name of that object appears in the left pane of the status bar at the bottom of the application window.

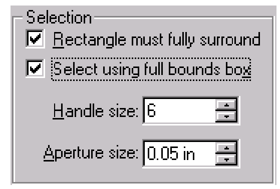


A selected object has a bounding box around it.

The status bar shows the selected object in the left pane.

Two settings in **Grapher** allow you to decide how an object is selected. To access these settings, select **File | Preferences** to open the **Preferences** dialog box and click on the **General** tab.

In the *Selection* group box, there are two selection check box options. The *Select using full bounds box* option controls where you click on an object to select it. When the option is checked, clicking anywhere within the object's bounding box selects the object. The bounding box is the smallest rectangle that can be drawn around an object. If the option is not checked, you must click directly on the object itself to select it.



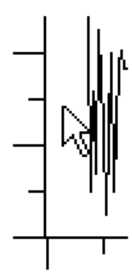
*These options in the **Preferences** dialog box control how objects are selected.*

The *Rectangle must fully surround* option controls the behavior of the **Edit | Block Select** command. When this option is enabled, the selection rectangle created by dragging the cursor must fully surround an object for it to be selected. If unchecked, any object that even intersects the selection rectangle is selected. For more information on these options, see the *Selection group box* in *Chapter 8, **Default Settings***.

SELECTING BY CLICKING

Clicking on an object with the mouse pointer is probably the most common method of selecting an object. The *Select using full bounds box* setting on the **File | Preferences | General** tab controls which part of the object to click on to select it. Refer to the *Selection group box* in *Chapter 8, **Default Settings*** for an example of selecting an object with the *Select using full bounds box* checked and unchecked.

- If there are many objects in the document and you are having trouble selecting an object by clicking on it, try one of the other selection methods.
- If an entire object is selected, deselect the object before attempting to select one part of the object. For example, an axis cannot be selected if the entire graph is already selected. Click in the white space in the plot window to deselect the graph, or use **Edit | Deselect All**. Once the graph is deselected, click on an axis to select it.
- To select an entire graph, click in the area between the plot and the axis or within any white space within the graph. If the *Select using full bounds box* option is checked in **File | Preferences** you must click within the graph but outside of the plot and axes bounding boxes. In some plots, the gap is not big enough to select the graph with this method. When this occurs, use **Block Select** or the **Object Manager** instead.


Click in the area between the plot and the axis to select the entire graph.

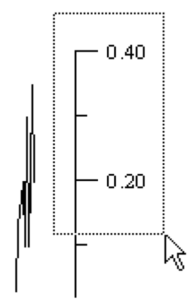
SELECTING WITH CTRL + CLICK

CTRL + Click can be used to select an object when there are several overlapping bounding boxes. If *Select using full bounds box* is checked on the **File | Preferences | General** tab, hold down the CTRL key and click within the object's bounding box until it is selected. The program cycles through all overlapping objects. The status bar at the bottom of the application displays the name of the selected object.

If *Select using full bounds box* is not checked, you can use CTRL + Click directly on the object to select it. CTRL + Click is only necessary if the object overlaps other objects. The graph object overlaps individual components of the graph (axes, plots, titles, and legends), so use CTRL + Click to select one of the overlapping objects.

SELECTING WITH BLOCK SELECT

Use the **Block Select** feature to select one or more objects by dragging a rectangle around them with the mouse pointer. To select a single object, click and hold the left mouse button at one corner of the object and then drag a rectangle around the object. If this causes another object to be selected when the mouse is clicked, choose **Edit | Block Select**. This forces the program into block select mode so other objects are not moved in the process. If the *Rectangle must fully surround* option is selected on the **File | Preferences** dialog box, you must drag the rectangle completely around the object to select it. If the *Rectangle must fully surround* option is not selected, then any object that is partially contained in the rectangle is selected.



To block select, click and hold the left mouse button while dragging a rectangle around the object to select it.

SELECTING OBJECTS WITH THE OBJECT MANAGER

You can select objects with the **Object Manager** by using the **Edit | Object Manager** command. With the **Object Manager** open, click on an object in the *Object List* to select it. The object remains selected after the **Object Manager** is closed. This is the most direct method of selecting an object in a complex document. See the topic *Using Object Manager* on page 190 for more information.

Use the **View | Style | Window w/ Object Manager** command to simultaneously view the **Object Manager** with your plot in a split-window. In this way, when you select an item in the **Object Manager**, you can see which object is selected in the plot window. The **Object Manager** is always available when using this view style. You can use the **Graph Manager** in the same way using the **View | Style | Window w/ Graph Manager** command. For more information on these commands, refer to the *View Style Commands* section in this chapter.

SELECTING MULTIPLE OBJECTS

To select multiple objects, use either the block select method, or hold down the SHIFT key while clicking on the objects you want to select. As you click, all previously selected objects remain selected, and each object you click on also is selected. A selection rectangle surrounds all of the selected objects. To deselect a single object in the selection, hold down the SHIFT key and click on the object that you want to deselect.

Another way of selecting multiple objects is to use the **View | Style | Window w/ Object Manager** command. Objects in this **Object Manager** can be selected using the SHIFT and CTRL keys. To select multiple adjacent objects in the **Object Manager** list, click once on the first object's name, hold down the SHIFT key, and click on the last object's name in the group. To select objects not adjacent in the **Object Manager** list, click on the first object's name, hold down the CTRL key, and click on each additional object's name. To deselect any selected object, hold down the CTRL key and click on the object name again.

Using Object Manager

The **Object Manager** dialog box contains a list of all objects in the current document, so it is an essential editing tool. Objects can be arranged, selected, and edited from here. The **Object Manager** is accessed through the **Edit | Object Manager** command or by double-clicking in the white space of a plot window.

***Object List* group**

In the **Object Manager** dialog box, the *Object List* displays all objects in the current document. Double-click on an object to edit the object properties or click the *Properties* button. If an object cannot be edited, the *Properties* button is grayed out. OLE object properties cannot be edited through the **Object Manager**. To edit OLE objects, close the **Object Manager** and select **Edit | Links** or **Edit | Object**.

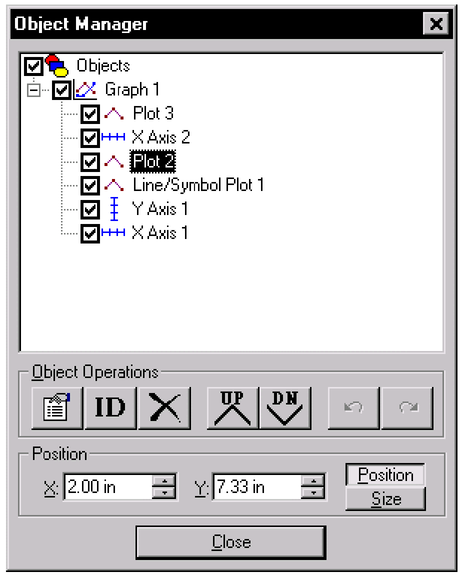
***Object Operations* group box**

The *Object Operations* group box includes the *Properties*, *ID*, *Delete*, *Up*, *Down*, *Undo*, and *Redo* buttons.

- Use the *ID* button **ID** to change the object's name. Any object can be renamed in **Grapher**.
- Click the *Properties* button to access the object's properties dialog box.

- Click the *Delete* button to remove the object from the document.
- Use the *Up* and *Down* buttons to change the drawing order of the objects. The *Up* and *Down* buttons move the object forward or backward one step at a time, similar to the **Arrange | Move Forward** and **Arrange | Move Backward** commands. Objects can also be rearranged by dragging the object to a new location in the *Object List.*

  Moving the order of the objects is important when several objects overlap. For example, in a multi-curve line/symbol graph, the order of the curves can be changed using the *Up* and *Down* arrows in the **Object Manager**. This makes selecting a curve easier (objects on top are selected first).
- Click the *Undo* button to reverse the last action performed in the **Object Manager**.



*Use the **Object Manager** to arrange and edit all objects in the plot window. When the object is selected in the **Object Manager**, it is also selected in the plot window.*

- Click the *Redo* button to redo the previously undone action.

If one of these options is unavailable, the button is grayed out. An example of when a button might be grayed out would be if you have selected the top object in the *Object List.* The *Up* button would be unavailable.

Position/Size group box

Objects can be moved or sized through the *Position/Size* group box. If the *Position* button is selected, the options available in this group box are *X* and *Y*. The *X* position moves an object relative to the left edge of the page. An *X* position of 0.5 inches places the left edge of the object 0.5 inches from the left side of the page. The *Y* position moves an object relative to the bottom of the page. A *Y* position of 5.0 inches places the top edge of the object 5.0 inches from the bottom of the page.

If the *Size* button is selected, the options available are *W* and *H*. The *W* field changes the width of an object, and the *H* field changes the height of the object. Rotated graph objects cannot be sized.

Close button

Click the *Close* button to close the **Object Manager**.

Note: When using the **Object Manager** to select objects, you can use the **View | Style | Window w/ Object Manager** command to simultaneously view the plot in a split-window. This allows you to see the object(s) that you select and keeps the **Object Manager** available.

Edit Menu Commands

Grapher contains the standard Windows editing commands, plus some additional ones to help with object selection.

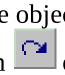
Undo / Redo Commands

Edit | Undo

The **Edit | Undo** command reverses the last action. The undo command is grayed out if there are not any actions to reverse or if the last action cannot be reversed. To access the undo command, go to **Edit | Undo**, click the undo button  on the toolbar, or press CTRL + Z.

Set the number of times undo can be selected in the **Preferences** dialog box (**File | Preferences)**. The default number of undo levels is 10. This can be set from zero to 25.

Edit | Redo

Once an action has been undone, use the **Edit | Redo** command to restore the action. For example, assume an object is deleted from the document. The undo command appears as **Edit | Undo Deletion**. Once **Edit | Undo Deletion** is selected, the object reappears and the **Edit | Redo** command appears as **Edit | Redo Deletion**. If **Redo Deletion** is selected, the object is deleted again. To access the redo command, go to **Edit | Redo**, click the redo button  on the toolbar, or press CTRL + Y.

CUT / COPY / PASTE / PASTE SPECIAL / DELETE COMMANDS

Edit | Cut

The **Edit | Cut** command places the selected item on the clipboard. Use **Edit | Cut** to move objects to a different location in the document or to move the object to another application. Cutting an object deletes the selected object after it is copied to the clipboard. To cut an object from its current location, use the **Edit | Cut** command, click the cut button  on the toolbar, or press CTRL + X.

Edit | Copy

The **Edit | Copy** command copies the selected item to the clipboard. When an object is copied, it remains in the current window. To copy an object to the clipboard, use the **Edit | Copy** command, click the copy button  on the toolbar, or press CTRL + C.

Edit | Paste

The **Edit | Paste** command copies the clipboard contents into a document. The clipboard contents remains on the clipboard until something new is cut or copied to the clipboard. Using the **Edit | Paste** command pastes objects in their native format. For example, if a text block is cut and then the **Edit | Paste** command is used, the object is pasted as text. Most native objects can be edited in **Grapher**. To paste an object from the clipboard, use the **Edit | Paste** command, click the paste button  on the toolbar, or press CTRL + V.

Edit | Paste Special

When objects are cut or copied to the clipboard, some formatting information is also copied. In order to select the format of the pasted information, use the **Edit | Paste Special** command. For more information on inserting OLE objects with **Edit | Paste Special**, see the topic *Creating OLE Objects* on page 199. The normal options under **Edit | Paste Special** include *Picture (Enhanced Metafile)*, *Picture (Metafile)*, and *Device Independent Bitmap*. Other options are available depending on the object type and the program from which the object was copied.

> **Note**: Only one object may be placed on the clipboard at a time. Each time the **Edit | Cut** or **Edit | Copy** command is used, the contents of the clipboard are overwritten. The contents of the clipboard can be inserted into a document with the **Edit | Paste** or **Edit | Paste Special** commands.

Edit | Delete

The **Edit | Delete** command removes an object from the document. You can restore a deleted object through the **Edit | Undo** command.

Selection Commands

In addition to the standard commands listed above, **Grapher** has some selection commands that aid you in selecting groups of objects or individual objects.

Edit | Select All

Use the **Edit | Select All** command, or press the CTRL + A keys, to select all objects in the document.

Edit | Deselect All

Use the **Edit | Deselect All** command to deselect all selected objects. This command is useful when zoomed in on a selected object. All objects can also be deselected by clicking in the white space outside all objects in the plot window.

Edit | Invert Selection

The **Edit | Invert Selection** command selects non-selected objects and deselects selected objects.

Edit | Block Select

Use the **Edit | Block Select** command to select items by dragging a rectangle around them. The block select command is available at all times in the program. Click outside one corner of the object, hold the left mouse button down, and drag the mouse to the opposite corner of the object. To avoid accidentally moving an object when using the block select command, choose **Edit | Block Select**. This forces the program into "block select only" mode where objects cannot be moved. If an object is properly selected, a selection rectangle surrounds the object.

Selection options are set in the **Preferences** dialog box. The **Preferences** dialog box is accessed from the **File | Preferences** command.

Object Commands

The object commands let you embed or link objects from another application to a **Grapher** document.

Edit | Insert New Object

The **Edit | Insert New Object** command opens the **Insert Object** dialog box where you select the type of object you want to create. See *The Insert Object Dialog Box* on page 197 for more information on the **Insert Object** dialog box.

Edit | Links

The **Edit | Links** command opens the **Links** dialog box. Use this option when you have checked the *Link* check box when inserting an object. See *The Links dialog box* on page 198 for more information on the **Links** dialog box.

Edit | Object

After you add any type of object, you can edit, open, or convert that object by selecting it and then choosing the object's name from the **Edit** menu. A submenu displays, showing the different options available for that object. This menu varies with object type.

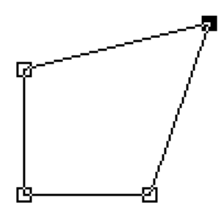
> **Note:** The name of the **Edit | Object** command varies according to the type of object that is selected. For instance, if an AutoCAD drawing object is selected, the command is listed as **Edit | Linked Drawing Object**. For a linked Excel file, the command appears as **Edit | Linked Worksheet Object**. If the Excel file is not linked, it appears as **Edit | Worksheet Object**. Likewise, each different object has unique menu options. However, most objects have the *Edit*, *Open*, and *Convert* commands. Refer to *Editing OLE Objects* on page 200 for additional information on the general options available.

Edit | Reshape

Use the **Edit | Reshape** command to move, delete, or insert vertices in polygons and polylines. Objects such as broken apart metafiles can be edited with the **Edit | Reshape** command. Polygons must have at least three vertices.

To reshape a polyline or polygon:

1. Select the object.
2. Choose the **Edit | Reshape** command.
3. The pointer turns into an arrowhead and all the vertices appear as small hollow squares.
4. To move a vertex, click on the vertex with the mouse and drag it to a new location. To add a vertex, hold down the CTRL key and click the area on the polygon or polyline. To delete a vertex, select it and then press the DEL key.



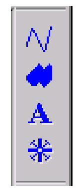
*When **Edit | Reshape** is selected, the vertices that make up the object are shown by small hollow squares. A selected vertex shows as a solid black square.*

5. Press the ENTER key to end the edit mode, or press the ESC key to cancel the changes.

Edit | Properties

Use the **Edit | Properties** command, or press the ALT + ENTER keys, to edit the properties of a selected object. The properties for each object vary depending on what the object is. For example, polygons have line and fill properties, while graphs have axis, plots, and legend properties. Please reference the object type for more information on its properties. There are several ways to open an object's properties:

- Select the object and choose **Edit | Properties**.
- Right-click on the selected object and then choose **Properties** from the context menu.
- Select the object and then click the *Line*, *Fill*, *Text*, or *Symbol* buttons on the properties toolbar.
- Double-click on the object.
- Open the **Object Manager**, highlight the object, and click the *Properties* button.



*The properties toolbar is displayed on the right side of the **Grapher** window.*

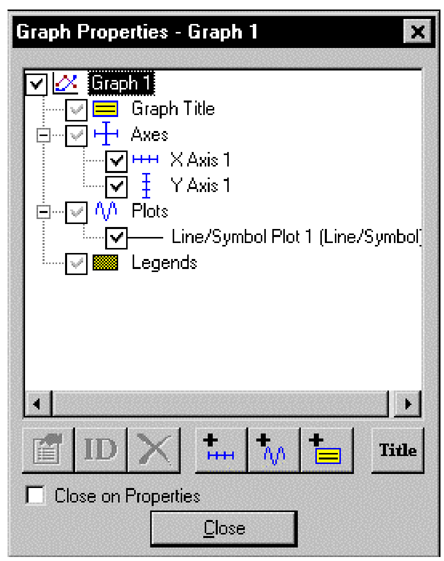
Once the properties dialog box is open, make any necessary changes and click *OK* or *Apply* to accept the changes.

If an entire graph is selected, a **Graph Properties** dialog box appears.

The **Graph Properties** dialog box shows all plots, axes, and legends associated with the graph. Top-level legends do not appear in this dialog box because top-level legends are not tied to a specific graph.

Use the **Graph Properties** dialog box to edit the graph's components, to change the ID of an object, or to delete parts of the graph. You can also add axes, plots, legends, and titles to the graph through the **Graph Properties** dialog box.

See the *Selecting Objects* section on page 187 of this chapter for more information on selecting graphs.



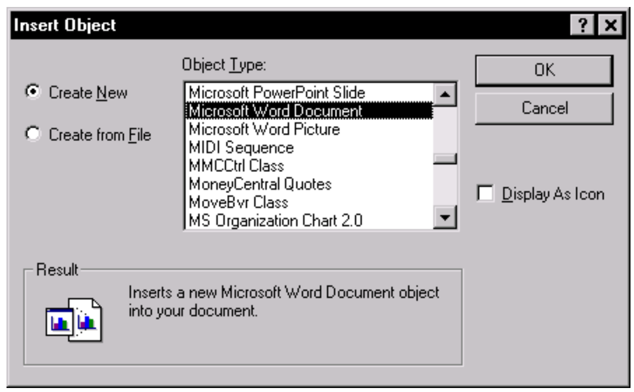
*The **Graph Properties** dialog box displays all of the members of a graph object.*

The Insert Object Dialog Box

The **Insert Object** dialog box is opened by the **Edit | Insert New Object** command. The radio buttons on the left side of this dialog box give you the option to create a new blank document or to create the new object from an existing file.

Create New option

The *Create New* option lets you choose the type of object you want to create. Select an option from the *Object Type* list. This list includes all of the object types that can be created in a **Grapher** document. For example, a *Microsoft Word Document* can be created in **Grapher**. Choose *Microsoft Word Document* from the *Object Type* list, click *OK* and an object box appears. Text can be typed and edited just as in Microsoft Word.



*The **Insert Object** dialog box creates a new blank object.*

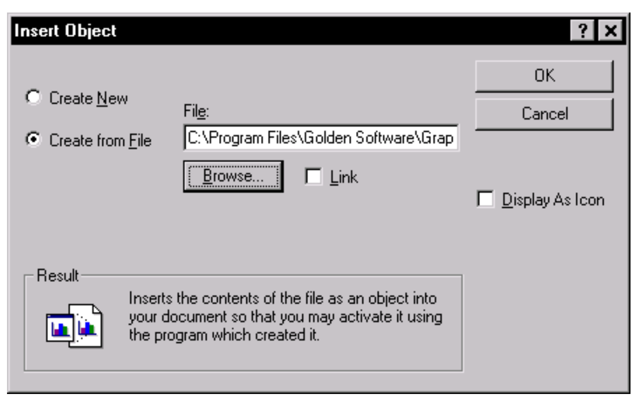
Note: Only OLE compatible programs on your computer appear in this list. For example, if you do not have Microsoft Word installed, the *Microsoft Word Document* option does not appear.

Create from File option

The *Create from File* option lets you create an object from an existing file. Use the *Browse* button to select the file you want to add to the **Grapher** document.

Place a check mark in the *Link* check box if you want to keep the object dynamically linked to the originally file. When an object is linked, edits made in the original file are updated in the **Grapher** document.

When adding an object, the *Result* group box display tells you what the result of creating the object is.

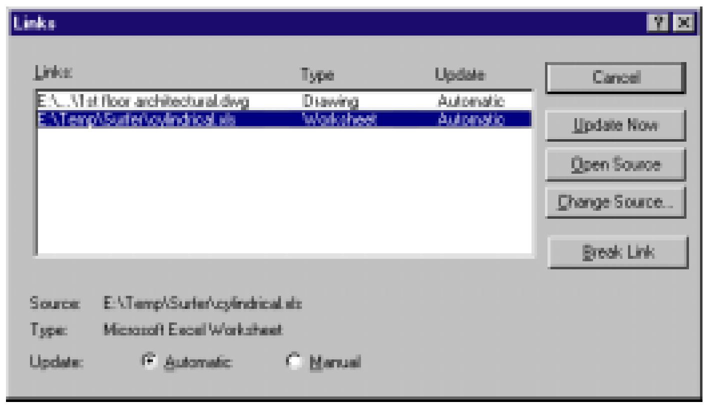


*The **Insert Object** dialog box creates an object from an existing file.*

Check the *Display As Icon* check box to display the new object as an icon instead of displaying the full object. If the *Display As Icon* box is checked, click the *Change Icon* button to edit the displayed icon and title of the object.

The Links dialog box

The **Links** dialog box shows a list of all objects in the current **Grapher** document linked to files.



*The **Links** dialog box displays all objects in the **Grapher** plot linked to existing files.*

Links field

The file name, type of file, and method of updating the file are shown in the *Links* box. The full file name and type of file is listed in the *Source* and *Type* fields below the *Links* box. In the *Update* field, choose *Automatic* or *Manual* updates.

Update Now button

If *Manual* update is selected, you must open the *Links* dialog box and click the *Update Now* button to show any changes made to the object.

Open Source button

Clicking on the *Open Source* button opens the original file in the original application. If a Microsoft Excel file was selected and the *Open Source* button was clicked, Microsoft Excel would open displaying the original file.

Change Source button

Clicking on the *Change Source* button allows you to change the file that is inserted into the **Grapher** document.

Break Link button

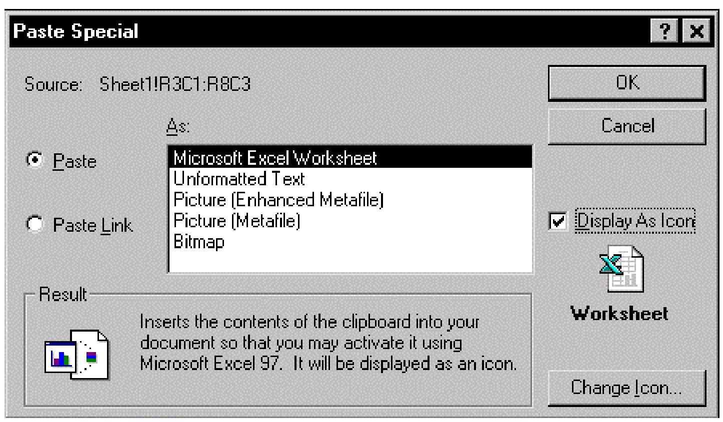
Clicking on the *Break Link* button removes the link between the original file and the object inserted into the **Grapher** document. The object becomes an embedded object.

Adding Objects through OLE

Object Linking and Embedding (OLE) is a feature that allows several software applications to work together. OLE allows the use of an object in another application without losing the functionality of the original application. There are two types of OLE objects, *linked* objects and *embedded* objects. A linked object is stored within the original file, and any changes made to the original file appear in **Grapher's** copy as well. Embedded objects are stored in **Grapher** as a separate copy of the original object. Embedded objects can be edited within **Grapher** using the original application's menu commands, toolbars, etc. Changes made to the object in the original file do not appear in **Grapher's** embedded copy and vice versa.

Creating OLE Objects

You can create an OLE object in **Grapher** by using the **Edit | Paste Special** command or the **Edit | Insert New Object** command.



*The **Paste Special** dialog box shows the options when embedding a Microsoft Excel Worksheet as an icon.*

The **Edit | Paste Special** command copies the object from the Windows clipboard and inserts it into **Grapher**. If an OLE type is specified as the clipboard format, then the object can be embedded or linked. If the *Paste* option is selected in the **Paste Special** dialog box, the object is embedded. Select the *Paste Link* option to paste the object as a linked object. Either type of object can be pasted into **Grapher** as an icon by checking the *Display as Icon* check box.

Use the **Edit | Insert New Object** command to create a new OLE object in the document, or to import an existing object into the document. When creating a new OLE object, a box appears in the **Grapher** window in which to create the object. The menu commands and toolbars change to the original application of the selected object type. For example, to create a Microsoft Word object in **Grapher** choose **Edit | Insert New Object**, select the *Create New* radio button, and choose *Microsoft Word Document* from the *Object Type* list. The **Grapher** menu commands change to the Word menu commands, and the toolbars change to the Word toolbars.

An OLE object can also be inserted from a file. An object created from a file can be linked or embedded. If the application for the selected file type does not support OLE, then the file is inserted as an icon. This icon can be used to open the original application.

See the topic, *The Insert Object Dialog Box* on page 197 for a description of the **Insert Object** dialog box.

EDITING OLE OBJECTS

Double-click on the OLE object to edit it, or use the **Edit |** [*object type*] **Object** command.

- *Embedded* objects are edited directly in the **Grapher** window. When editing an embedded object, all commands in the plot window change to the original application commands.
- *Linked* objects are edited in the original application window. Double-clicking on a linked object opens the original application. The **Edit |** [*object type*] **Object | Open** menu opens the original application for linked or embedded objects. An embedded object appears with diagonal lines across it when it is being edited in the original application window. Choose **File | Save Copy As** in the original application to save changes. Check the original application's **File** menu for **Close and return to *.GRF** to return to the embedded object in **Grapher**.

To convert the OLE object into another type of object, select the **Edit |** [*object type*] **| Convert** command. Converted objects cannot be converted back to the original object type.

IMORTANT! Use *Extreme Caution* with the **Convert** command. Since **Convert** alters the system registry, it converts ALL objects of a given type in every program that recognizes the object type. There is no undo command for this feature. Once an object type is converted it remains converted until the registry is physically edited.

Importing Graphics

Add graphic files, such as bitmaps, to the plot window with the **File | Import** command. Graphics can also be added with OLE commands in the **Edit** menu.

Some imported files have format-specific options. For example, line colors can be changed when importing [.DXF] files. For more information on each import file type, please refer to the online help system. In addition, some imported files can be broken apart (**View | Break Apart**) and edited. Refer to the section, *Edit Menu Commands* on page 192 for more information on each editing feature. Bitmaps cannot be edited, rotated, or broken apart in **Grapher**.

Since the Golden Software Blanking file [.BLN] and the Atlas Boundary files [.BNA] are ASCII formats that can be edited in the worksheet, use **File | Import** to open these files as graphics. **File | Open** opens the files in the worksheet.

Arrange Menu Commands

Objects can be arranged in a **Grapher** document by dragging selected objects to new locations or by setting the exact position in the **Object Manager**. If the objects overlap, the drawing order of the objects can be changed using the **Arrange** menu commands or using the **Object Manager**. Besides translational movement, some **Grapher** objects can also be rotated. Objects can also be combined to create a single composite object.

SETTING THE OVERLAP ORDER OF OBJECTS

When multiple objects overlap each other, you can set which ones you want to appear on top of the others using the **Arrange** menu commands. This is sometimes necessary with opaque items so that other objects are visible.

Arrange | Move to Front

The **Arrange | Move to Front** command moves the selected object to the top of the drawing order. The object appears on top of the other objects. To access this command, select the object, and choose **Arrange | Move to Front** or press the SHIFT + PAGE UP keys.

Arrange | Move to Back

The **Arrange | Move to Back** command moves the selected objects to the bottom of the drawing order. The object appears behind the other objects. To access this command, select the object, and choose **Arrange | Move to Back** or press the SHIFT + PAGE DOWN keys.

Arrange | Move Forward

The **Arrange | Move Forward** command moves the selected object forward one position in the drawing order. To move an object forward, select the object, and choose **Arrange | Move Forward** or press the CTRL + PAGE UP keys. You can also use the *Up* arrow button in the **Object Manager**.

Arrange | Move Backward

The **Arrange | Move Backward** command moves the selected object backward one position in the drawing order. To move an object backward, select the object, and choose **Arrange | Move Backward** or press the CTRL + PAGE DOWN keys. You can also use the *Down* arrow button in the **Object Manager**.

Grouping Objects Together

Grouping objects allows you to combine them together so that multiple objects can be selected, moved, copied, pasted, or otherwise manipulated as if it were a single object. When objects are combined, you can no longer control the individual properties of any individual object in the group. To edit an individual object, you must first break the group apart.

Object grouping is controlled using the following **Arrange** menu commands:

Arrange | Combine

The **Arrange | Combine** command is used to group several independent objects into one composite object. Composite objects can be a combination of several types of objects including other composite objects. Composite objects can be moved or resized as a single object, though individual parts cannot be edited. Break apart the composite object to edit an individual object. To create a composite object, select all the objects to be part of the composite, and chose the **Arrange | Combine** command.

Arrange | Break Apart

The **Arrange | Break Apart** command is used to separate a composite object into its component pieces. Composite objects cannot be edited, so use this command to break apart the composite to edit individual parts of the composite object. The **Arrange | Break Apart** command can also be used with imported files including Golden Software Boundary [.GSB]; Atlas Boundary [.BNA]; USGS [.DLG], [.LGO], [.LGS]; AutoCAD [.DXF]; Golden Software Blanking [.BLN]; and Metafiles [.WMF].

Rotating and Aligning Objects

Use the following **Arrange** menu commands to customize the orientation and alignment of objects.

Arrange | Rotate

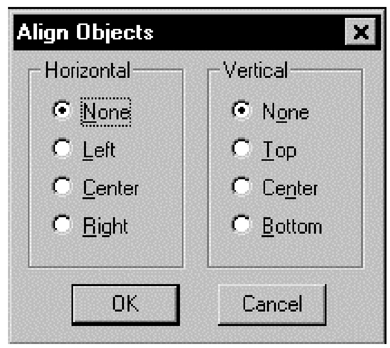
Use the **Arrange | Rotate** command to rotate an object by a specified number of degrees. To rotate an object, select the object and choose the **Arrange | Rotate** command. Enter the number of degrees to rotate the object into the **Rotate object** dialog box. Positive numbers rotate the object in a counter-clockwise direction and negative numbers rotate the object in a clockwise direction. Some objects, such as bitmaps, cannot be rotated. If a graph object is rotated, it cannot be resized. In order to size a rotated graph, clear the graph rotation with the **Graph | Clear Rotation** command, resize the graph, and then rotate the graph again.

Arrange | Free Rotate

Use the **Arrange | Free Rotate** command to rotate an image with the mouse. Select the object, and choose **Arrange | Free Rotate**. The mouse pointer changes to have a small angle symbol next to it. This indicates that the program is in free rotate mode. To rotate an object, click just inside the object's bounding box and hold the left mouse button while dragging the cursor. As the object is rotated, the degrees of rotation are indicated in the status bar. Some objects, such as bitmaps, cannot be rotated. If a graph object is rotated, it cannot be resized. In order to size a rotated graph, clear the graph rotation with the **Graph | Clear Rotation** command, resize the graph, and then rotate the graph again.

Arrange | Align Objects

The **Arrange | Align Objects** command is used to align selected objects relative to the bounding box surrounding the selected objects. You can align the objects both vertically and horizontally.



*The **Align Objects** dialog box shows the Horizontal and Vertical alignment for the selected objects.*

The *Horizontal* group box has four options: *None, Left, Center,* and *Right.* The *Left* option aligns all selected objects along the left side of the group's bounding box. The *Center* option centers all selected objects between the left and right sides of the group's bounding box. The *Right* option aligns all selected objects along the right side of the group's bounding box. The *None* option does not change the individual components horizontal placement.

The *Vertical* group box has four options: *None, Top, Center,* and *Bottom.* The *Top* option aligns all selected objects along the top side of the group's bounding box. The *Center* option centers all selected objects between the top and bottom sides of the group's bounding box. The *Bottom* option aligns all selected objects along the bottom side of the group's bounding box. The *None* option does not change the individual components vertical placement.

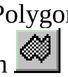
Draw Menu Commands

The **Draw** menu contains several objects that can be added to the plot window. You can add text, polygons, polylines, symbols, rectangles, rounded rectangles, and ellipses through the **Draw** menu, or through the draw toolbar. Drawing object default fill properties, line properties, text properties, and symbol properties can be set through **File | Preferences**. Refer to *Chapter 8, Default Settings* for more information on default settings. Drawing object properties can be changed by clicking on the available tools on the properties toolbar, by double-clicking on the drawing object, by selecting the object and selecting **Edit | Properties**, or by clicking the *Properties* button in the **Object Manager**.

DRAWING SYMBOLS, LINES, AND POLYGONS

Use the following **Draw** menu commands to add your own graphic objects and symbols to your graph.

Draw | Polygon

Use the **Draw | Polygon** command to draw an irregularly shaped area. Polygons must have at least three vertices. Choose **Draw | Polygon**, or click the polygon button  on the toolbar to draw a polygon. Once the **Draw | Polygon** command is selected, the pointer changes into a crosshair to indicate drawing mode.

- Click points on the page to draw a polygon.
- Click and hold the left mouse button and drag the mouse to create a continuous stream of points.
- Click the right mouse button to remove the last drawn point.
- Press the CTRL key while clicking points to constrain the lines to 45-degree angles.
- Double-click the left mouse button or press the ENTER key to close the polygon.
- Press the ESC key to exit drawing mode. To cancel drawing a polygon, press the ESC key before closing the polygon.
- Edit the polygon shape by using the **Edit | Reshape** tool. See the *Edit | Reshape* section on page 195 for more information about reshaping objects.

Draw | Polyline

Use the **Draw | Polyline** command to draw a polyline. Choose the **Draw | Polyline** command, or click the polyline button on the toolbar to draw a polyline. Once the **Draw | Polyline** command is selected, the pointer changes into a crosshair to indicate drawing mode.

- Click only the endpoints of a line to draw a straight line. Observe the cursor position in the status bar to position the endpoints of a line.
- Click several points to create an irregularly shaped line.
- Click the right mouse button to remove the last drawn point.
- Click and hold the left mouse button and drag the mouse to create a continuous stream of points.
- Press the CTRL key while clicking points to constrain the lines to 45-degree angles.
- Double-click the left mouse button or press the ENTER key to end the line.

- Press the ESC key to end drawing mode. To cancel drawing the line, press the ESC key before ending the line.
- Edit the polyline by using the **Edit | Reshape** tool. See the *Edit | Reshape* section on page 195 for more information about reshaping objects.

Draw | Symbol

Use the **Draw | Symbol** command to draw a symbol. Choose the **Draw | Symbol** command, or click the symbol button on the toolbar to draw a symbol. Once the **Draw | Symbol** command is selected, the pointer changes to a crosshair. Click in the document to add a symbol at that location. Press the ESC key to end drawing mode. Double-click the symbol to change the size, color, or symbol font.

Draw | Rectangle

Use the **Rectangle** command to create a rectangle or square in the document. Choose **Draw | Rectangle**, or click the rectangle button on the toolbar. You can hold down the SHIFT key to draw the rectangle outwards from the center rather than from one of the corners.

To draw a rectangle:

1. Select the **Draw | Rectangle** command. The pointer changes to a pencil with a small square to indicate drawing mode.
2. Click and hold the left mouse button at one corner of the rectangle.
3. Drag the mouse to the opposite corner of the rectangle. The size of the rectangle appears in the status bar as it is drawn.

The rightmost column in the status bar shows the dimensions of the rectangle.

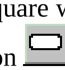
4. Release the left mouse button when the rectangle is the preferred size and shape.
5. Press the ESC key to end drawing mode.

To draw a square:

Hold down the CTRL key while dragging the mouse to draw a square rather than a rectangle.

Draw | Rounded Rect

Use the **Draw | Rounded Rect** command to create a rectangle or square with rounded corners.

Choose **Draw | Rounded Rect,** or click the rounded rectangle button  on the toolbar. You can hold down the SHIFT key to draw the rounded rectangle outwards from the center rather than from one of the corners.

To draw a rounded rectangle:

1. Select the **Draw | Rounded Rect** command. The cursor changes to a pencil with a small rounded rectangle next to it to indicate drawing mode.
2. Click and hold the left mouse button at one corner of the rounded rectangle.
3. Drag the mouse to the opposite corner of the rounded rectangle. The size of the rectangle appears in the status bar as it is drawn.
4. Release the left mouse button when the rectangle is the preferred size and shape.
5. Press the ESC key to end draw mode.

To draw a rounded square:

Hold down the CTRL key while dragging the mouse to draw a square rather than a rectangle.

Draw | Ellipse

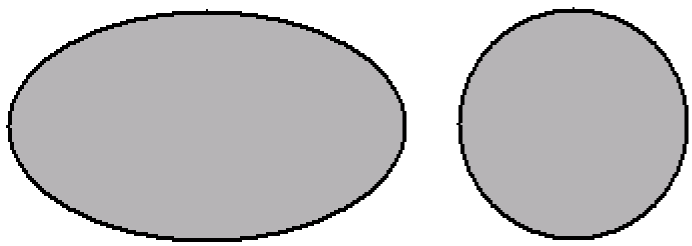
Use the **Ellipse** command to create an ellipse or circle in the document. Choose the **Draw | Ellipse** command, or click the ellipse button  on the toolbar. You can hold down the SHIFT key to draw the ellipse outwards from the center rather than from one of the bounding box corners.

To draw an ellipse:

1. Select the **Draw | Ellipse** command. The cursor changes to a pencil with a small circle next to it to indicate drawing mode.
2. Click and hold the left mouse button at one corner of the bounding box of the ellipse.
3. Drag the mouse to the opposite corner of the ellipse. The size of the ellipse's bounding box appears in the status bar as it is drawn.
4. Release the left mouse button when the ellipse is the preferred size and shape.
5. Press the ESC key to end draw mode.

To draw a circle:

Hold down the CTRL key while dragging the mouse to draw a circle rather than an ellipse.



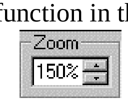
*To draw an ellipse, click on the ellipse tool, or choose **Draw | Ellipse**. To create a circle, hold down the CTRL key while using the **Draw | Ellipse** command.*

Draw | Text

Click the **Text** button  on the toolbar or choose the **Draw | Text** command to add text objects to the document. After selecting the text tool, the cursor turns into a pointer with a small **A** beside it. Click on a location in the document to insert text and then enter the text into the **Text Editor** dialog box. Click *OK* to exit the **Text Editor** and then press the ESC key to end the **Draw | Text** mode. Edit text by double-clicking on the text, by using the **Object Manager**, or by clicking the text properties tool (blue "A") when the text is selected.

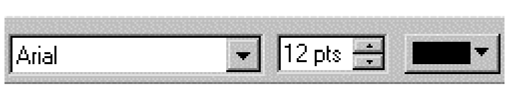
Using the Text Editor

Use the **Text Editor** to create or edit a text object. To easily find a button's function in the **Text Editor**, position the cursor over the button for a description of the function. A text object is one or more lines of text that function as a single entity. You can enter text or change existing text in the text edit box. Text can be magnified in the text edit box by entering a new number in the *Zoom* group box.

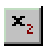
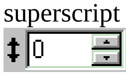


The Zoom group box magnifies text.

Before text is entered, select a typeface from the drop-down list in the upper left corner of the dialog box. Set the size of the typeface in the edit box to the right of the typeface list. Change the color of the text by choosing a new color from the color palette. To change these settings after the text is entered, highlight the text and then change the settings. Only highlighted text is changed.



The font face, font size, and font color drop-down lists show the font properties of the text.

- Create **bold** , *italic* , underline , or ~~strikethrough~~  text by clicking on the appropriate style button.
- The cut, copy, and paste commands work in the same manner that the commands **Edit | Cut**, **Edit | Copy**, and **Edit | Paste** work. See *Edit Menu Commands* on page 192 for more information about these functions.
- Click the  button to add a superscript character.
- Click the  button to add a subscript character.
- Click the reset position button  to return to the default text size and position after adding a superscript or a subscript character. Enter a number into the character position control  to raise or lower text from the midpoint of the existing line.
- **Note:** This does not revert to normal font. It merely changes the appearance of the superscript or subscript font. To exit the super/sub script command, click the appropriate button a second time to deselect it.
- To add a symbol to the text object, click the  button.
- To automatically enter today's date or time, click the  button.
- To add a background color to the text box, click the  button. This opens the **Fill Properties** dialog box. See *Fill Properties* on page 158 for more information about these options.
- To enter equations based on a template, click the  button. Choose a template from the **Template Library** and then click the *Insert* button, or create a new template by clicking the *New* button. Modify an existing template by clicking the *Edit* button.

  Create complex equations by nesting multiple templates together. In the example to the right, *a* divided by *b* is one template. The square root of *a* divided by *b* requires two templates. Once the template is added to the text edit box, highlight a character in the template and use the *Sub Position* controls to position a character in the template. For more information on the *Template Library* dialog box or the *Create/Edit Template* dialog box, and for an example of how to create templates, see the online help system.

$$\frac{a}{b} \qquad \frac{\sqrt{a}}{b}$$

The equation on the left contains one template. The equation on the right contains two templates.

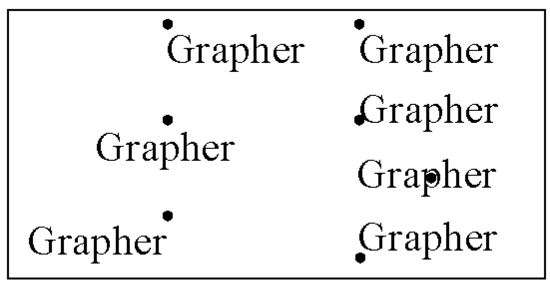
***Alignment* group box**

A text box is an imaginary box that tightly bounds a text object. The lines in a text object can be right justified, left justified, or centered within the text box.

The reference point is the point clicked on in the plot window when the cursor contains an *A* next to it. The text box is horizontally and vertically aligned relative to the reference point. *Right* aligns the text box so that the reference point is to the right of the text box. *Left* aligns the text box so that the reference point is to the left of the text box. *Center* aligns the text box so that the reference point is centered between the left and right sides of the text box.

Bottom aligns the text box so that the reference point is to the below of the text box. *Top* aligns the text box so that the reference point is at the top of the text box. *Center* aligns the text box so that the reference point is centered between the top and bottom sides of the text box. *Baseline* aligns the text box so that the reference point is located at the base of the text. The baseline is the imaginary line along which characters are positioned as they are drawn. Descenders on characters are drawn below the baseline.

The baseline of a text box is at the base of the text above the descenders.



In each case, the dot represents the reference point. On the left side, Horizontal alignment is shown from top to bottom as: Left, Center, and Right. On the right side, Vertical alignment is shown from top to bottom as: Top, Baseline, Center, and Bottom.

View Menu Commands

While editing objects, you can vary the display with the **View** menu commands. The **View** menu allows you to zoom in on objects and change the window style to make editing objects easier. **View** menu commands that allow you to set the screen update, which toolbars are shown, and whether bitmaps are shown in the window.

RESIZING THE VIEW

View | Fit to Window

Use the **View | Fit to Window** command to scale the objects so that they fill the plot window.

View | Page

Use the **View | Page** command to view the extents of the page. The page outline is visible if the *Display page outline* option is checked in **File | Preferences**. You can use this command even if the *Display page outline* option is not checked.

View | Actual Size

The **View | Actual Size** command scales the drawing to the approximate size it is when printed. The size is usually scaled slightly larger on the display to allow an adequate size for displaying text.

View | Full Screen

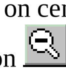
The **View | Full Screen** command scales the image to fit the monitor. The command menus and toolbars are not accessible when viewing at **Full Screen**. Press the ESC key or click a mouse button to return to the normal plot window.

ZOOM COMMANDS

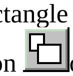
View | Zoom | In

The **View | Zoom | In** command increases the magnification of the image. The command scrolls the window to keep the point that was clicked on centered in the window. To zoom in, select **View | Zoom | In** or click the *Zoom in* button  on the toolbar. Click on the area on which to center the magnified image. Double-click the *Zoom in* button to lock the zoom in tool allowing for zooming in multiple times. Press the ESC key or select another button to end the locked zoom mode.

View | Zoom | Out

The **View | Zoom | Out** command decreases the magnification of the image. The command scrolls the window to keep the point that was clicked on centered in the window. To zoom out, select **View | Zoom | Out** or click the *Zoom out* button  on the toolbar. Click on the area on which to center the magnified image. Double-click the *Zoom out* button to lock the zoom out tool allowing for zooming multiple times. Press the ESC key or select another button to end the locked zoom mode.

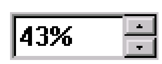
View | Zoom | Rectangle

The **View | Zoom | Rectangle** command allows magnification by drawing a rectangle around the area of interest. Select **Zoom | Rectangle**, or click on the *Zoom rectangle* button  on the toolbar to magnify the image. Hold down the left mouse button and drag a rectangle around the area of interest to magnify it. Double-click the *Zoom rectangle* button to zoom multiple times. Press the ESC key to end the locked zoom mode.

View | Zoom | Selected

The **Zoom Selected** command changes the magnification of the image so that the selected objects are the maximum size possible in the window.

Zoom Percent



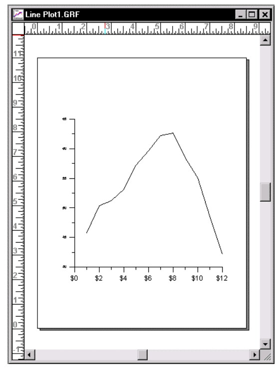
The *Zoom Percent* button allows you to type or scroll to the size that you want to zoom. The graph is redrawn at the specified scale. Setting the percentage to 100% is the same as using the **Zoom | Actual Size** command. This command can only be accessed via the toolbar.

VIEW STYLE COMMANDS

The **View | Style** command lets you select from several different document views. These views combine the standard plot window with either the **Object Manager**, **Graph Manager**, or the data worksheet, so that both can be seen simultaneously.

View | Style | Standard

The **Standard** view is the default document view in **Grapher**. This view contains a single plot window. In order to edit the properties of an object, you need to double-click on an object or open the **Object Manager** using the **Edit | Object Manager** command.



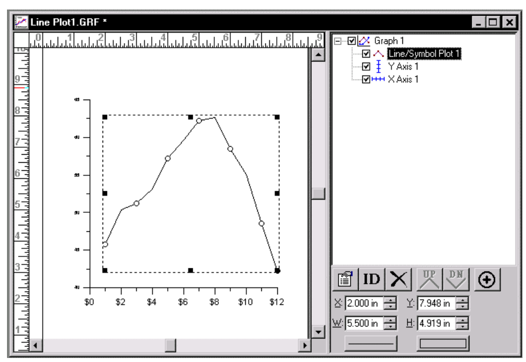
*The **View | Style | Standard** window is shown here.*

View | Style | Window w/Object Manager

The **Window w/Object Manager** view is a split window with the plot on the left and the **Object Manager** on the right.

You can use your mouse to grab the split line between the windows and drag it left or right to change the spacing.

In the **View | Style | Window w/ Object Manager** view, objects can be selected in the **Object Manager** on the right side of the screen. The object is also selected in the plot window on the left side of the screen. Object properties such as line style, fill color, and location can be changed by clicking on the buttons at the bottom of the **Object Manager** view.



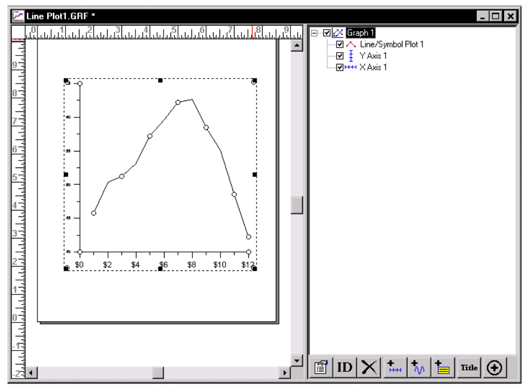
*The **View | Style | Window w/Object Manager** window is shown here.*

View | Style | Window w/Graph Manager

The **Window w/Graph Manager** view is a split window with the plot on the left and the **Graph Manager** on the right.

You can use your mouse to grab the split line between the windows and drag it left or right to change the spacing.

In the **View | Style | Window w/ Graph Manager** view, objects can be selected in the **Graph Manager** on the right side of the screen. The object is then selected in the plot window on the left side of the screen. Axes, plots, legends, and titles can be added by clicking the buttons in the **Graph Manager** view.

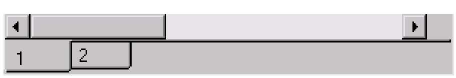


*The **View | Style | Window w/Graph Manager** is shown above.*

View | Style | Window w/Worksheets

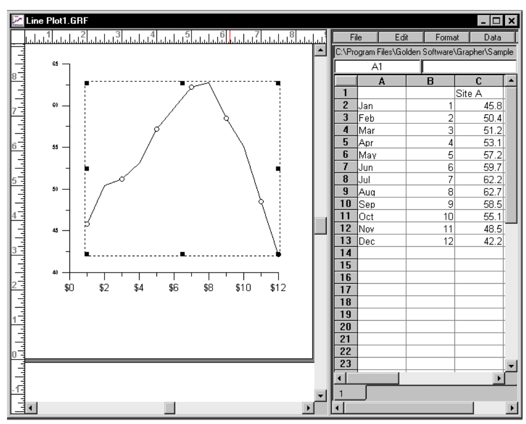
The **Window w/Worksheets** view is a split window with the plot on the left and the worksheet on the right.

If the graphs on the left use more than one data file, the worksheets overlap and are assigned numbered tabs. To view a different worksheet, click on its tab at the bottom of the worksheet window.



When more than one worksheet is present they overlap and are assigned numbered tabs.

The buttons at the top of the worksheet window are the menu commands for the worksheet. See *Chapter 3, Working with Data Files* for more information on the commands available in the worksheet.



*The **View | Style | Window w/Worksheets** view is shown here.*

Redraw Settings

View | Redraw

The **View | Redraw** command redraws all images on the screen. You can also redraw the screen at any time by pressing the F5 key.

View | Auto Redraw

The **View | Auto Redraw** command causes **Grapher** to automatically redraw the image each time the window contents change or the view is changed. The command is enabled if there is a check mark beside it. Click the **View | Auto Redraw** command to toggle the command on and off. If the **View | Auto Redraw** is disabled, use the **View | Redraw** command or press the F5 key to redraw the image.

View | Auto Track Worksheets

The **View | Auto Track Worksheets** command is used to automatically show changes in the worksheet associated with the graph. The command is enabled if there is a check mark beside the command. If **View | Auto Track Worksheets** is disabled, changes made to the worksheet do not show on the graph. Click the **View | Auto Track Worksheets** command to toggle the command on and off. This command only reflects changes made to the worksheet while it is opened in the **Grapher** worksheet window.

Displaying Toolbars and Graphics

Grapher lets you customize the **Grapher** window by letting you view only those toolbars that you use. The status bar can be removed from the program window. The standard toolbar can also be customized to show only those buttons that you wish.

View | Toolbars

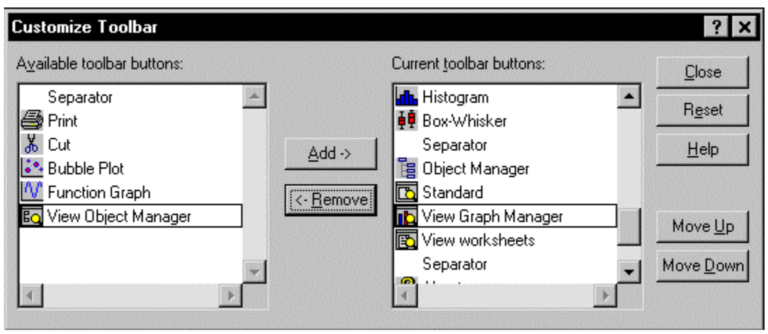
Use **View | Toolbars** command to show or hide the *Standard*, *Drawing Tools*, *Properties* and *Zoom Tools* toolbars. A check mark is displayed next to visible toolbars. Hold the pointer over any button on the toolbar to display the function of the button. **Grapher** toolbars can be moved to any location in the document or they can be displayed as floating tool palettes. To dock the toolbar in a new location, click in the gray area outside the buttons, hold the left mouse button, and then drag the toolbar to a new location. You can drag the toolbar into the window to display it as a palette.

Editing the *Standard* toolbar

The standard toolbar allows you to open or save files. It also allows you to create any new graph type, change the view style, and copy and paste objects.

The standard toolbar allows you to open or save files. It also allows you to create any new graph type, change the view style, and copy and paste objects.

To remove or add buttons to the standard toolbar, right-click anywhere within the toolbar. A **Customize Toolbar** dialog box opens. In the *Available toolbar buttons* box, a list of buttons not currently displayed is shown. Select any of these button names and click the *Add* button. The button is added at the cursor location in the *Current toolbar buttons* box. To remove buttons from the toolbar, select the button name in the *Current toolbar buttons* box and click the *Remove* button. The button is then stored in the *Available toolbar buttons* box. To not accept any changes that you have made, click the *Reset* button. The toolbar returns to its previous layout. Click the *Move Up* button to move the selected button up in the toolbar list. Click the *Move Down* button to move the selected button down in the toolbar list. Click the *Close* button to close the dialog box. All of the changes you have made are shown on the toolbar.



The ***Customize Toolbar*** *dialog box allows you to change which buttons are shown on the standard toolbar.*

View | Status Bar

Click on the **View | Status Bar** command to show or hide the status bar. The status bar displays information about the current command or activity in **Grapher**. A check mark next to status bar indicates that the status bar is displayed. The status bar is divided into three sections. The left section shows the selected object name. If a command is selected a brief description of the command appears here instead of the object name. The middle section shows the pointer coordinates in inches or centimeters. If the **Graph | Digitize** or **Graph | Digitize Fixed** command is selected, this area displays the pointer position in the graph's X and Y coordinate system. The right section shows the dimensions of the selected object. In the worksheet, the status bar displays ToolTips.

The status bar shows the selected object name in the first pane, the cursor position in the second pane, and the selected object dimensions in the third pane.

Arranging Windows in Grapher

The plot windows, template windows, and worksheet windows can be arranged in a number of ways inside the main **Grapher** application window.

WINDOW MENU COMMANDS

The following commands are accessed from the **Window** menu. These commands allow you to rearrange the open windows.

Window | New Window

Use the **Window | New Window** command to create a duplicate window. Use this duplicate window to display different views or different parts of the same graph simultaneously. When you edit objects in either window, the changes appear in both windows.

Window | Cascade

Use **Window | Cascade** to arrange multiple windows in an overlapped fashion.

Window | Tile Vertical

Use **Window | Tile Vertical** to arrange multiple windows side by side.

Window | Tile Horizontal

Use **Window | Tile Horizontal** to arrange multiple windows in an non-overlapped fashion horizontally.

Window | Arrange Icons

Use **Window | Arrange Icons** to arrange the icons for minimized windows at the bottom of the main window. If there is a maximized document window, then some or all of the icons may be located underneath the document window.

Chapter 7

Modifying Graphs

Graphs can be modified by adding objects to them using the **Graph | Add to Graph** commands. Graph objects include axes, plots, and legends. In order to access most of the **Add to Graph** commands, only the graph itself can be selected. If other objects are selected, the **Add to Graph** commands are grayed out. To select just the graph, use the **Object Manager**, the **Edit | Block Select** command, or the CTRL + Click method rather than using **Edit | Select All**. For more information on selecting objects and editing existing objects, refer to *Chapter 6, Creating and Editing Objects*.

Editing Existing Plots

Existing plots can be edited by opening the properties dialog box associated with the plot. There are several methods to open this dialog box.

1. Select the plot and double-click. If any other objects are selected, the plot properties dialog box is not displayed.
2. Select the plot and right-click. Choose **Properties** from the pop-up menu.
3. Select the plot and click on **Edit | Properties**.
4. Open the **Object Manager** by clicking on **Edit | Object Manager** or by double-clicking in the white space on the page. From the list of objects, select the plot and click the *Properties* button .
5. If the window view is set to **View | Style | Window w/Object Manager** or **View | Style | Window w/Graph Manager**, select the plot from the list on the right and click on the *Properties* button .

Changing the Worksheet used by a Plot

Use this procedure to change the data file used by a plot.

1. Select the plot, right-click and select **Properties** from the pop-up menu.
2. In the **Plot** dialog box, click the *Worksheet* button. The **Select Plots** dialog box opens.
3. Choose the plots you want to use the new worksheet and click *OK*. The **Open Worksheet** dialog box opens.
4. Select the new data file and click *Open*.

The plot(s) are redrawn using the new worksheet data. You may need to edit the *Worksheet Columns* assignments for the data to plot correctly.

Changing the Axis used by a Plot

If your graph has multiple X or Y axes, you can reassign which plot(s) are mapped onto which axes by following this procedure.

1. Select the plot, right-click on it and select **Properties** from the pop-up menu.
2. To assign a plot to a different X axis, click the *Change X Axis* button. To assign a plot to a new Y axis, click the *Change Y Axis* button. The **Select Plots** dialog opens.
3. Choose the plots that you want to assign to a new axis and click *OK*. The **Select Axis** dialog opens.
4. Choose the new axis to use and click *OK*. The plot(s) are redrawn using the new axis.

If there is only one axis listed in the **Select Axis** dialog box, you need to add an axis to the graph before changing the axis used by the plot. For more information on how to add axes, refer to *Adding an Axis to a Graph* on page 223.

Adding Grid Lines to a Plot

Grid lines are added by clicking the *Grid Lines* button on the **Axis** dialog box. This opens the **Grid Lines** dialog box where you configure the line density.

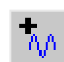
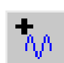
To add horizontal grid lines, you must be editing a Y axis in the **Axis** dialog box. To add vertical grid lines, you must be editing an X axis. For more information on the **Grid Lines** dialog box, refer to *Grid Lines Dialog Box* on page 166.

Manually Positioning Plot Labels

When you add labels to a plot, you are able to set the general position of all the labels with respect to its associated data point. **Grapher** also lets you control the position of each label individually using the **Graph | Move Plot Labels** command. For more information on this command, refer to *Moving Labels on a Plot* on page 153.

Adding New Plots to an Existing Graph

There are several ways to add a new plot to an existing graph.

1. If the data is in the same worksheet as the original data, you can open the **Plot** dialog box and click the *New* button. This button automatically adds a second curve to the existing graph. On most plot types, the new curve uses the same column for the X data and the next column in the worksheet for the Y data. This option is not available with all graph types.
2. You can add a plot to an existing graph by selecting the graph and using the **Graph | Add to Graph | Plot** command.
3. Right-click on a selected graph and choosing the **Add Plot** command from the menu.
4. Open the **Graph Properties** dialog box and click the *Add Plot* button .
5. Click on the *Add Plot* button  while in the **View | Style | Window w/Graph Manager** view.
6. Click **Graph | Graph Wizard** and select the *Add to existing graph* option on the first screen.

   Note: Pie charts cannot have plots added to them.

After adding the plot with methods 2 – 5 above, the **Select Plot Type** dialog box opens. For most existing graphs, the options include: *Line/Symbol Plot, Step Plot, Bubble Plot, Bar Chart, Floating Bar, Function Plot, Hi-Low-Close Plot, Histogram Plot,* or *Box-Whisker Plot.*

For polar plots or rose diagrams, the **Select Plot Type** dialog box contains only two options: *Polar Plot* and *Rose Diagram*. This is because these plots use polar coordinate systems and cannot be combined with the Cartesian coordinate systems.

For ternary plots, the **Select Plot Type** dialog box does not appear. This is because only a ternary plot can be added to an existing ternary plot.

After making a selection in the **Select Plot Type** dialog box, the **Choose Axes** dialog box opens. You can select existing axes or create new axes for the new plot. For more information on adding an axis, see *Chapter 5, Axes*.

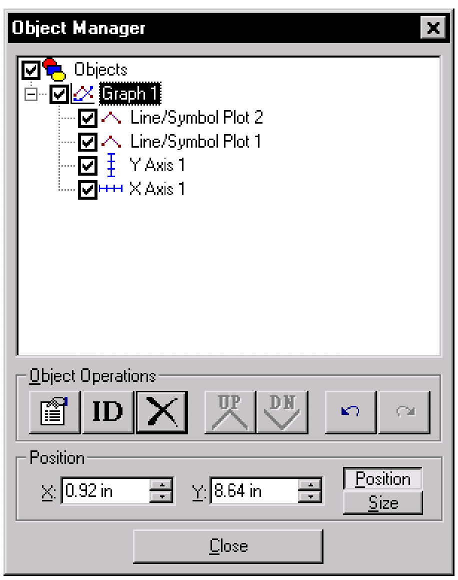
To Add a Plot:

This is one way to add a plot to a graph. The other methods are listed on the previous page.

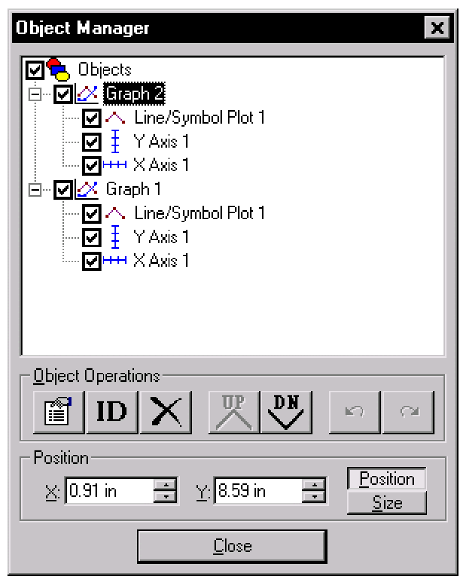
1. Select the graph that you want to add the plot to by using the **Object Manager**.
2. Select the **Graph | Add to Graph | Plot** command.
3. Choose the plot type to add to the graph in the **Select Plot Type** dialog box and click *OK*.
4. Choose the axes for the new graph in the **Choose Axes** dialog box and click *OK*.
5. Choose the data file to use for the new plot in the **Open Worksheet** dialog box and click *Open*.
6. Set the plot properties in the **Plot** dialog box.

Note: If a plot has been added to an existing graph object, the plot is listed under the graph object's name in the **Object Manager**. A graph object can contain multiple axes, multiple plots, and multiple legends.

For an example, see ***Graphing with Multiple Axes*** on page 25. To create a completely separate graph object in the plot window, use the **Graph | New Graph** command. If graphs are created this way each time, they are listed as separate graph objects in the **Object Manager**.



***Object Manager** shown after adding a second plot using the **Graph | Add to Graph | Plot** command.*



***Object Manager** shown after adding a second plot using the **Graph | New Graph** command.*

Adding an Axis to a Graph

There are several methods to use to add an axis to a graph. To use any of the methods, the graph must first be selected. When the entire graph is properly selected, *<Graph ID> selected* appears on the left side of the status bar. The status bar is located at the bottom of the **Grapher** window.

Graph 1 selected appears on the left side of the status bar.

1. Select the entire graph and click on the **Graph | Add to Graph | Axis** command.
2. Right-click on the selected graph and choose **Add Axis** from the pop-up menu.
3. Click on the *Add Axis* button  in the **Graph Properties** dialog box.
4. Click on the *Add Axis* button  in the **View | Style | Window w/Graph Manager** view.

Choose the type of axis to add in the **Axis Type** dialog box. In the **Axis** dialog box, change the settings for the new axis. The default axis range is 0 to 25. The axis properties such as scale, axis range, and tick mark spacing are altered in the **Axis** dialog box. Refer to *Chapter 5, Axes* for more information on the options available in the **Axis** dialog box.

One way to add an axis to the graph:

1. Select the entire graph.
2. Choose **Graph | Add to Graph | Axis**.
3. In the **Axis Type** dialog box, choose the type of axis to add to the graph and click *OK*.
4. In the **Axis** dialog box, change the properties of the axis. Click *OK* to view the changes on the graph.

To make a duplicate of an existing axis:

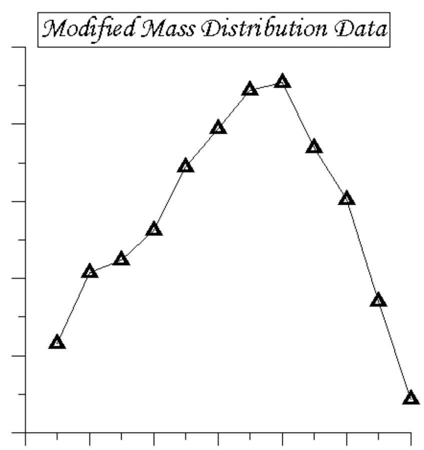
1. Select the axis you want to duplicate.
2. Choose **Graph | Add to Graph | Duplicate Axis**.
3. The **Position Axis** dialog box opens so you can specify the location of the new axis. This can be edited later in the **Axis** dialog box. Click *OK* to create the duplicate axis at the specified location.

Adding a Title to a Graph

There are several methods to access the **Graph Title** dialog box.

1. Select the graph and click on the **Graph | Graph Title** command.
2. Right-click on the selected graph and choose **Title** from the pop-up menu.
3. Click on the *Title* button  in the **Graph Properties** dialog box.
4. Click on the *Title* button  in the **View | Style | Window w/Graph Manager** view.

Use the **Graph Title** dialog box to add and configure a title for your graph. Titles can be configured in a variety of positions and orientations and customized with different line styles and background fill patterns. Each graph object can have only one title.



A simple graph title positioned at the top and center of the graph.

To add a Title to a Graph:

1. Select the entire graph.
2. Select the **Graph | Graph Title** command. The **Graph Title** dialog box opens. In this dialog box, enter the title text. You can also set the desired text properties, position, and display options. See *The Graph Title Dialog Box* on page 225.
3. Click *OK* to add the title to the graph.

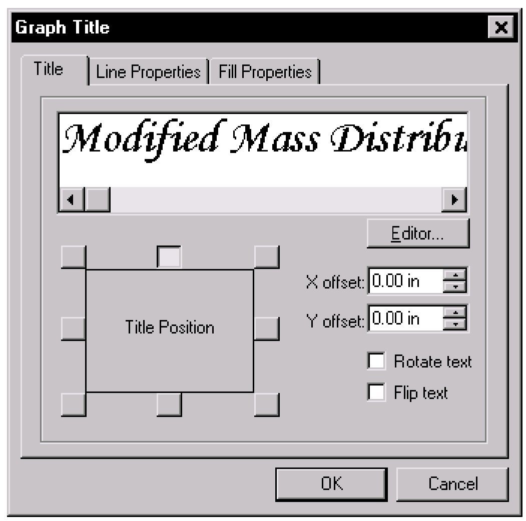
To edit the title, select the entire graph, and then select **Graph | Graph Title** to open the **Graph Title** dialog box.

THE GRAPH TITLE DIALOG BOX

The Title Tab

The **Title** tab of the **Graph Properties** dialog box allows control over the text properties and physical placement of the title with respect to the graph.

Enter the desired title text into the text box. To change the font, font style, font size or to insert symbols, date & time, or equations, click the *Editor* button. This opens the **Text Editor** window. See ***Using the Text Editor*** on page 207.



*The **Title** tab of the **Graph Title** dialog box.*

Set the general position of the title by clicking on the appropriate box in the *Title Position* group. Click *OK* to see where the title is positioned. The title position can be fine-tuned by using the *X offset* and *Y offset* fields. For the *X offset*, positive values move the title to the right and negative values move the title to the left. For the *Y offset*, positive values move the title up and negative values move the title down.

The *Rotate text* check box turns the title 90 degrees counter-clockwise. The *Flip text* check box turns the title 180 degrees from its current position. If *Rotate text* and *Flip text* are used together, the net result is a 90 degree clockwise rotation in the title.

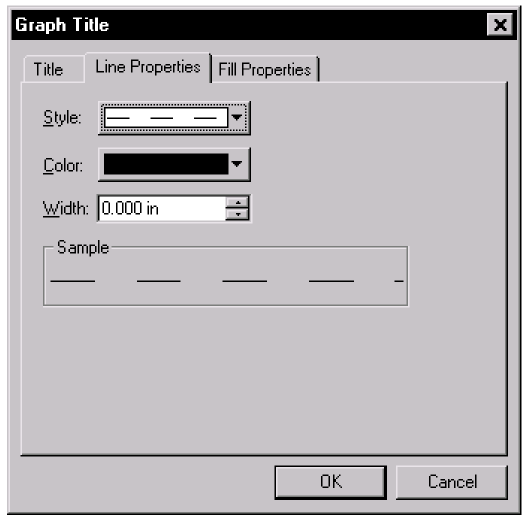
The Line Properties Tab

The **Line Properties** tab controls the style of the bounding box that surrounds the title.

To remove the border from the title, select the *Invisible* style from the *Style* drop-down list.

If you select a visible line style, use the *Color* drop-down list to change the color of the bounding box. Use the *Width* drop-down list to set the thickness of the line.

When selecting a line style, the *Sample* group box shows you what the border looks like with the current settings.



*The **Line Properties** tab of the **Graph Title** dialog box.*

The Fill Properties Tab

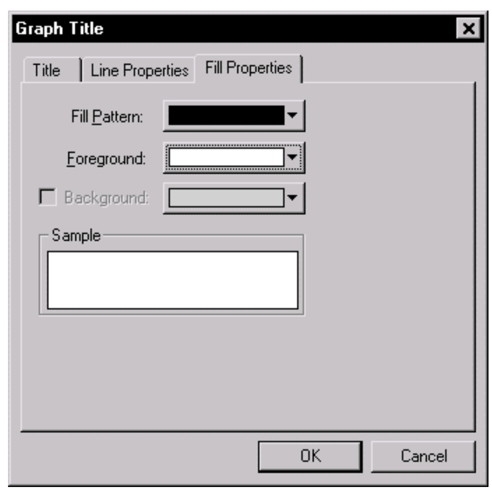
The *Fill Properties* tab controls the fill color and pattern that displays behind the title.

To add a solid background color behind the title, select the solid pattern from the *Fill Pattern* drop-down list, and then select the desired color from the *Foreground* drop-down list.

To add a textured pattern behind the title, select the desired pattern from the *Fill Pattern* drop-down list. Set the color of the lines from the *Foreground* drop-down list and the color behind the lines from the *Background* drop-down list. If you do not want a background color, remove the check mark from the *Background* check box.

To remove the fill pattern entirely, select the blank style from the *Fill Pattern* drop-down list.

The *Sample* group box shows what the fill pattern looks like with the current settings.

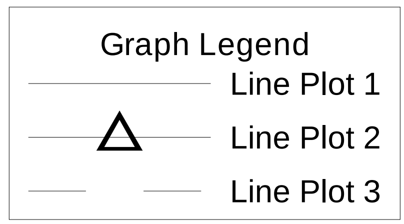


*The **Fill Properties** tab of the **Graph Title** dialog box.*

Legends

Legends in **Grapher** can either be attached to a single graph, or used to represent multiple graphs on one page. Use the **Graph | Add to Graph | Legend** command to attach a legend to a single graph. If there are multiple graphs that use a combined legend, use the **Graph | New Top-Level Legend** command.

If more than one graph is selected or if objects other than the graph are selected the **Graph | Add to Graph | Legend** option is grayed out.



Legends automatically reflect the line and symbol styles applied in the ***Plot*** *dialog box, unless they have been manually detached.*

For more information on how to select the graph, see ***Selecting Objects with the Object*** Manager on page 189. Legend properties, such as legend titles, line styles, and fill patterns can be saved as part of a template. For more information about templates, see ***Creating Template Graphs*** on page 249.

Creating a Legend

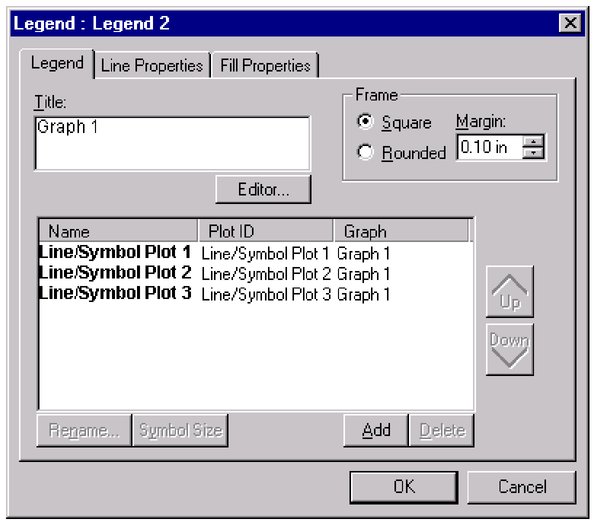
1. Select the graph. The status bar at the bottom of the **Grapher** window should display *<Graph ID> selected* if the graph is properly selected.
2. Select **Graph | Add to Graph | Legend**. The **Legend** dialog box opens.
3. Set legend options in the **Legend**, **Line Properties**, and **Fill Properties** tabs.
4. Click *OK*.

Creating a Top-Level Legend

1. Choose **Graph | New Top-Level Legend**.
2. Set the top-level legend options in the **Legend**, **Line Properties**, and **Fill Properties** tabs. See *The Legend Dialog Box* on page 228 for more information on the **Legend** tab options.
3. Click the **Add** button on the **Legend** tab to select the plots to show in the legend. By default, no plots appear in the top-level legend list box.
4. Click *OK*.

The Legend Dialog Box

The **Legend** dialog box contains a **Legend** tab, a **Line Properties** tab, and a **Fill Properties** tab. If a plot's properties are changed, the legend automatically updates unless the **Graph | Detach Legend** command has been used.



*The **Legend** tab of the **Legend** dialog box.*

The Legend Tab

The **Legend** tab sets the general options, including the legend's title and symbol sizes. This tab also allows you to set the order of entries in the legend.

Type a legend title into the *Title* box, and click the *Editor* button to change the font attributes. This opens the **Text Editor** window. See ***Using the Text Editor*** on page 207 for more information about the **Text Editor**.

The options in the *Frame* group box control the shape of the frame that surrounds the legend. *Square* draws a traditional rectangle with square corners. *Rounded* creates a rectangle with rounded corners. The *Margin* value sets the amount of space between the legend text and the inside of the frame. The default value is 0.10 inches.

The legend list box contains the *Name*, *Plot ID*, and *Graph* ID for each plot object. The text label used within the legend appears in the *Name* column. The *Plot ID* is set in the **Object Manager** or in the **Graph Properties** dialog box. The *Name* and *Plot ID* do not have to be the same. The *Graph* column shows to which graph a plot belongs. If a legend is added to an existing graph by using the **Graph | Add to Graph | Legend** command, only one graph name appears in the *Graph* column. If a top-level legend is created, multiple graph names can appear in the *Graph* column.

Highlight an object in the legend list box and click the *Rename* button to change its *Name* or text attributes in the legend. This opens the **Text Editor** window. See *Using the Text Editor* on page 207 for more information about the **Text Editor**.

If a plot contains symbols, the legend symbol size can be changed. Highlight a plot in the legend list box and click the *Symbol Size* button to change the legend symbol size. *Fixed* symbols are fixed at a reasonable default size. *Plot size* displays legend symbols at the same size used in the graph. If the graphed symbol size changes, the legend symbol size changes as long as the **Graph | Detach Legend** command is not used. Use the *Custom* option to select a custom-sized legend symbol.

*Open the **Symbol Size** dialog box by pressing the Symbol Size button on the **Legend** tab.*

Click the *Add* button to add plots to the legend. If a legend is created through **Graph | Add to Graph | Legend**, all objects appear in the legend list box by default. If a top-level legend is created, click the *Add* button to add plots to the legend list box.

Click the *Delete* button to remove a plot from the legend. Click the *Up* arrow or *Down* arrow to change the order that plots are listed in the legend.

The Line Properties Tab

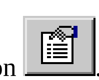
The **Line Properties** tab sets the line style used for the box that contains the legend. Refer to ***Line Properties*** on page 157 for more information about the options on this tab.

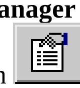
The Fill Properties Tab

The **Fill Properties** tab sets the fill color and pattern used in the legend box. Refer to *Line Properties* on page *157* for more information about the options on this tab.

EDITING LEGENDS

To easily open the **Legend** dialog box use one of the methods listed below.

1. Select the legend and click on the **Edit | Properties** command.
2. Right-click on the legend and choose **Properties** from the pop-up menu.
3. Double-click on the selected legend.
4. Select the legend in the **Object Manager** and click the *Properties* button . Legends created with the **Add to Graph** command appear in the branch beneath the graph object title. Top-level legends appear on the main branch in the **Object Manager**.

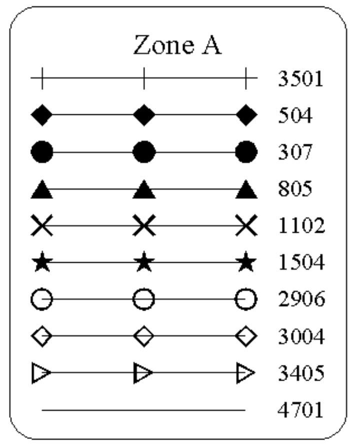
5. Select the legend in either the **View | Style | Window w/Object Manager** or the **View | Style | Window w/Graph Manager** view and click the *Properties* button .

Cutting and Pasting Legends

If the legend is cut and then pasted elsewhere in **Grapher**, the legend becomes a top-level legend. Since all objects must be added to a top-level legend, only the title shows. See *Creating a Top-Level Legend* on page 227 for more information on adding information to a top-level legend.

To avoid creating a top-level legend, use the **Edit | Paste Special** command and paste the legend as a *Picture (Metafile)*. Once pasted as a metafile, the legend is not be updated.

To have the graph legend in a different position, you can move the legend on the page instead of cutting and pasting it. Doing so retains all of the graph information and links to the graph. To move the legend, select it, hold down the left mouse button, and drag it to the new position.



A legend for a single graph with ten data curves.

Editing a Top-Level Legend

To edit individual objects in the top-level legend, select the top-level legend, click the **Edit | Cut** command, and the **Edit | Paste Special** command. In the **Paste Special** dialog box select *Picture (Metafile)* as the object type and answer "yes" when prompted about breaking apart the metafile. This allows editing of individual objects in the legend. After the legend as been edited, you can use the **Arrange | Combine** command to create a composite object. Changes made to the graphs are not reflected in the top-level legend after it has been cut and pasted as a picture.

DETACHING LEGENDS

Use the **Graph | Detach Legend** command to unlink a legend from a graph. This command is available for legends created with the **Graph | Add to Graph | Legend** command. Select the legend and then choose **Graph | Detach Legend**. Detaching a legend breaks the link to the graph and breaks apart the legend into individual drawing objects. This allows more flexibility in editing the legend. Once a legend has been detached, the legend does not reflect any changes in the graph. Top-level legends cannot be detached from a graph because they are not attached to a graph. To edit a top-level legend, see *Editing a Top-Level Legend* above.

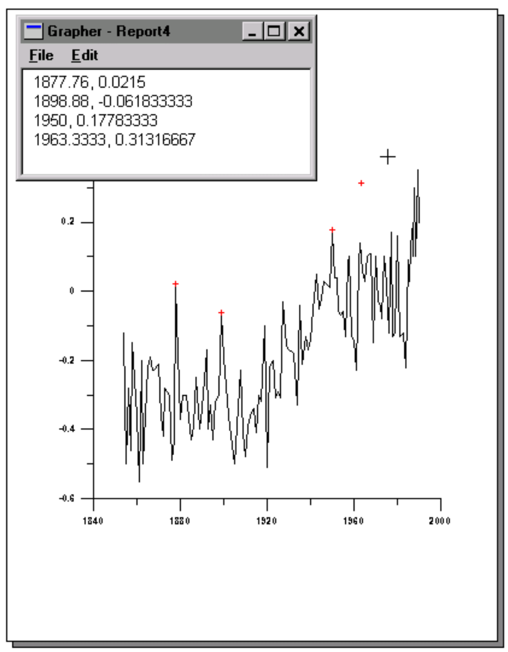
Digitizing a Plot

The digitizing features in **Grapher** allow you to create a data file of digitized points with the graph's coordinates. Once a plot is in digitizing mode, you can view the exact coordinates of any point simply by clicking on it.

DIGITIZING A GRAPHER PLOT

1. Select the plot that you want to digitize.
2. Select **Graph | Digitize** or **Graph | Digitize Fixed**, as desired.
   - When the **Graph | Digitize** command is used, the entire **Grapher** window becomes a digitizing space. This allows you to get the coordinates, in graph units, of any point in the window.
   - When **Graph | Digitize Fixed** is used, the mouse's range is constrained to read only those points directly on the plot.

   The mouse pointer becomes a crosshair, indicating that the plot is in digitizing mode.
3. Obtain digitized data by moving the crosshair pointer over the data points you want to record and then clicking the mouse button. The report window opens to record the data.



When a plot is digitized, the report window logs the coordinates of each point on which you click.

4. When you have finished recording data, end the digitize mode by pressing the ESC key.
   - In the report window, use the **File** menu commands to save the data as a text file or print it.
   - Use the **Edit** menu commands to copy the selected data to the Windows clipboard.

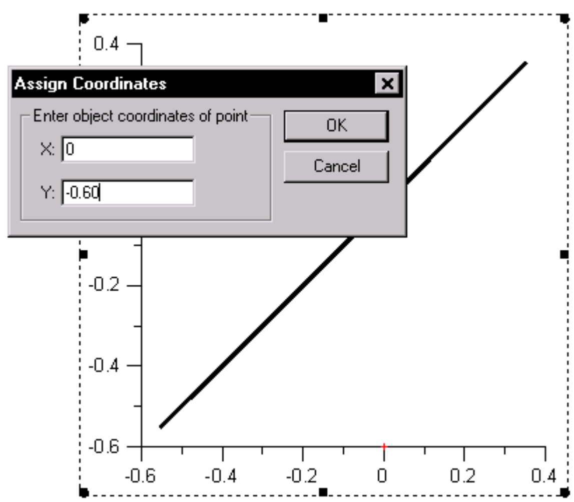
ASSIGNING COORDINATES TO A BITMAP

If you have drawn or pasted a plot image into **Grapher** as a bitmap object, you can assign a linear coordinate system to the image and then digitize it to read the data values from anywhere on the image. This process creates a coordinate system for the bitmap based on three points.

To assign coordinates to a bitmap:

1. Select the bitmap image.
2. Click on the **Graph | Assign Coordinates** command. A message box appears providing the next set of instructions. Click *OK* to continue.

   The mouse pointer changes to a crosshair.
3. Move the crosshair over a known point on the image. If the image has labeled axes, select a data point on the axis to minimize the error in reading the values.
4. Click the left mouse button. The **Assign Coordinates** dialog box opens.
5. Enter the *X* and *Y* coordinates in the appropriate fields, and click *OK* to close the dialog box. Another message box appears providing the next set of instructions. Click *OK* to digitize the second point.
6. Move the crosshair over another point on the image and click the left mouse button. Ideally, this point should be away from the point selected in step 3 to minimize error.
7. The **Assign Coordinates** dialog box opens. Enter the data value for the second point and click *OK*.
8. Another message box appears providing the next set of instructions. Click *OK* to digitize the third point.
9. Move the crosshair over the last point on the image and click the left mouse button. Ideally, this point should be away from the other two points.
10. The **Assign Coordinates** dialog box opens. Enter the data value for the last point and click *OK*.



When assigning coordinates to a bitmap image with axis labels, it is a good idea to select one data point from each axis, since the data values are well known. This helps minimize error.

The coordinate system is now assigned to the image. To re-assign the coordinates, select the bitmap image, click the **Graph | Reassign Coordinates** command, and repeat the above process.

Reading Values from an Image

After you have used the above procedure to assign coordinates to an image, you need to digitize it in order to read data values from it.

1. Select the image.
2. Select **Graph | Digitize**. The mouse pointer changes to a crosshair.
3. Move the crosshair over any point on the image and click the left mouse button. The report window opens and records the values at each location you click.
4. To end the digitize mode, hit the ESC key.

In the report dialog box, use the **File** menu commands to save the data as a text file or print it. Use the **Edit** menu commands to copy the selected data to the Windows clipboard.

Chapter 8

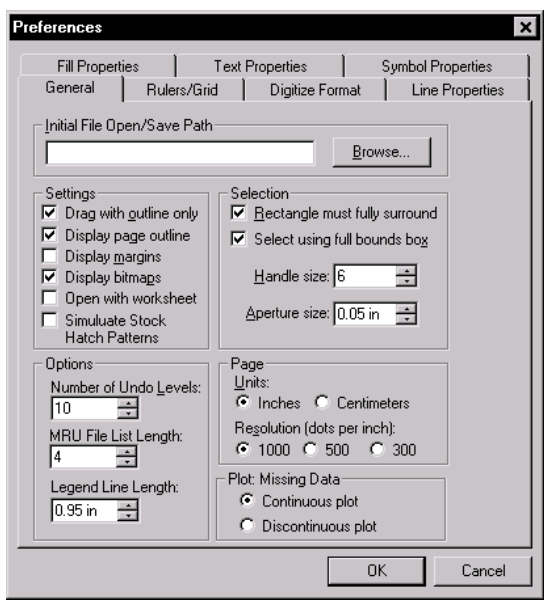
Default Settings

Grapher's default application settings can be customized through the **Preferences** dialog box.

The Preferences Dialog Box

The **Preferences** dialog box is accessed by selecting **File | Preferences**.

The changes made in the **Preferences** dialog box change the default settings used by **Grapher**. Both current and future documents are affected by the changes you make in this dialog box. Any graphs or templates saved before the preference changes are made retain their original settings. For example, if you change the default *Page Units* to *Centimeters*, any current or future graphs have centimeter page units. If an older graph that was created while the *Page Units* was set to *Inches* is opened, its page units are still in inches.



*The **Preferences** dialog box allows you to choose settings that affect the display of objects in the plot window.*

GENERAL TAB

Select **File | Preferences** and click on the **General** tab to set the open and save paths, the page units, number of undo levels, selection options, and other settings.

***Initial File Open/Save Path* group box**

In the *Initial File Open/Save Path* field, enter the path that you want **Grapher** to use as the default location for opening and saving files. Use the *Browse* button to locate a path, or type a path directly into the edit box. When you open or save a file, this directory path appears as the default location for the file.

***Settings* group box**

Use the options in the *Settings* group box to control how objects are displayed.

The *Drag with outline only* check box controls the appearance of objects as they are being moved. If this box is checked, a dashed outline of the object is shown when the object is moved. If this box is not checked, the entire object is shown when the object is dragged.

The *Display page outline* check box turns the outline of the page on or off in the plot window. When this box is checked, the page outline is displayed. Set the size of the page with the **File | Page Setup** command.

The *Display margins* check box turns the outline of the margins on or off in the plot window. When checked, the margins display as dashed lines inside the page outline. Set the size of the margins with the **File | Page Setup** command.

The *Display bitmaps* check box controls how bitmaps are displayed. If this option is checked, bitmaps are shown in the plot window. If this option is not checked, bitmaps are displayed as a gray box with the word *Bitmap* in the center of the box.

The *Open with worksheet* check box controls how the initial window in **Grapher** opens. When checked, the initial window opens with a blank worksheet. When unchecked, the initial window opens with a blank plot window.

The *Simulate Stock Hatch Patterns* check box allows **Grapher** to display the Windows stock fill patterns for printing optimization. When checked, the patterns are displayed better on a printed page. When unchecked, the patterns are displayed better on the screen.

***Selection* group box**

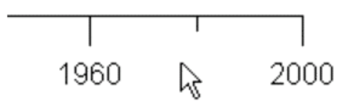
Use the options in the *Selection* group box to control how objects are selected.

The *Rectangle must fully surround* check box controls how the **Edit | Block Select** command functions. When unchecked, an object is selected if any portion of the object's bounding box is contained in the block select rectangle. When checked, the object must be completely surrounded by the block select rectangle in order to be selected.

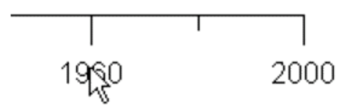
When the *Select using full bounds box* option is checked, you can click anywhere within an object's bounding box to select the object. If this check box is cleared, you must click directly on an object in order to select it. Clicking on any white space around the object does not select it.

Example:

To select an axis when the *Select using full bounds box* option is enabled, click anywhere inside the axis' bounding box to select it. If the *Select using full bounds box* option is not checked, you must click directly on an axis label, tick mark, or axis line to select it. Clicking between labels or on any white space within the bounding box does not select the axis if this option is not checked.



When Select using full bounds is checked, you can click anywhere in the axis bounding box to select the axis.



When Select using full bounds box is not checked, you must click directly on an axis label, tick mark, or axis line to select the axis.

The *Handle size* edit box controls the width and height of the selection handles that appear around selected objects. The larger the number in the *Handle size* box, the larger the boxes are.

The *Aperture size* edit box controls the distance between the pointer and the object when selecting an object. When the aperture size is set to zero, the pointer must be directly on the object in order to select it. The aperture setting range is from 0.0 to 0.50 inches or from 0.0 to approximately 1.27 centimeters. The aperture size does not affect the size of the bounding box, it just controls the distance the pointer can be from the object to select it.

***Options* group box**

The number of actions remembered for the **Edit | Undo** command is set in the *Number of Undo Levels* edit box. Once the maximum number of actions has been performed, the oldest action is dropped from the list as new actions are added. The maximum number of **Undo** levels is 25. Setting the undo levels to zero disables the **Undo** command.

The *MRU File List Length* controls the number of files in the *Recently Used File List*. The *Recently Used File List* is the list of files that were last open and is found in the **File** menu. Once the maximum number of files has been opened, the bottom file is dropped from the list as new files are opened. This value can be set between 0 and 16.

The *Legend Line Length* sets the default length of the line samples that display in a graph's legend box.

Page **group box**

Use the *Units* options to set the default measurement units to either *Inches* or *Centimeters.*

Use the *Resolution (dots per inch)* options to set the page resolution to *1000* dpi, *500* dpi, or *300* dpi. This function is most useful with Windows 95 and Windows 98 operating systems when plotting page sizes greater than 32 inches. Changing the resolution affects the maximum page size in the program but it does not re-scale any existing objects. If a two inch by two inch rectangle is drawn at 500 dpi and the resolution is then switched to 1000 dpi, the rectangle appears as one inch by one inch.

> **IMPORTANT!** Since the page resolution alters the internal program coordinates, do not change the resolution unless it is absolutely necessary. It is best to make resolution changes before creating a document. The default resolution is 1000 dpi.
>
> Maximum page sizes:

	Windows 95 and 98	**Windows NT 4 and 2000**
1000 dpi	32.76 inches (83.21 cm)	200 inches (508 cm)
500 dpi	65.53 inches (166.45 cm)	400 inches (1016 cm)
300 dpi	109.22 inches (277.42 cm)	666 inches (1691.64 cm)

Plot: Missing Data group box

The *Plot: Missing Data* group box allows you to globally set how to control missing data in plots. Choose *Continuous plot* to have the plot draw a straight line between the two points on either side of a gap in the worksheet. Choose *Discontinuous plot* to have the line break when a row is missing a value in the worksheet.

RULERS/GRID TAB

The options on the **Rulers/Grid** tab control the default layout of the **Grapher** document, including the appearance of the rulers and the use of grid marks.

Display Options group box

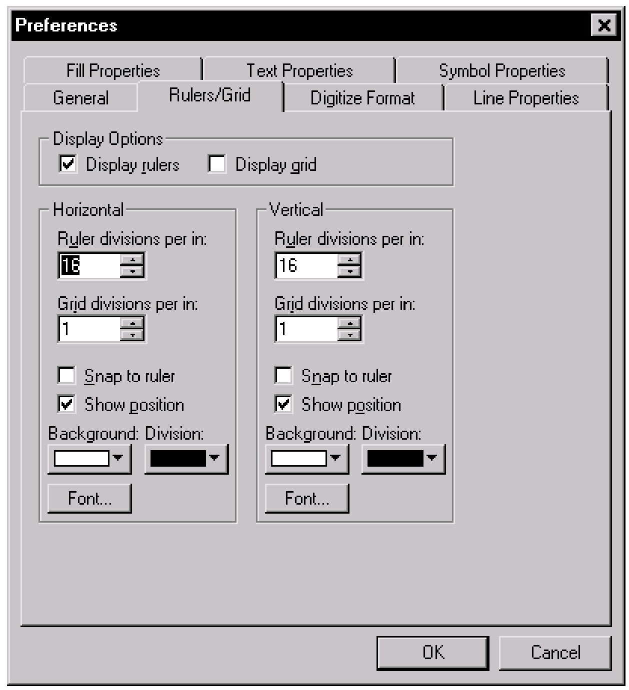
The *Display rulers* control turns the horizontal and vertical rulers on and off. When checked, the rulers are displayed on the plot window.

The *Display grid* command turns the grid on and off. When checked, the grid appears as a series of evenly spaced dots in the plot window. The horizontal and vertical rulers and grid settings can be set independently.

Horizontal / Vertical group box

The *Ruler divisions per in* (or *cm*) command set the number of divisions per page unit on the ruler.

The *Grid divisions per in* (or *cm*) set the number of divisions per page unit on the grid.



*The **Rulers/Grid** tab controls the display of the rulers.*

The *Snap to ruler* command causes objects to snap to the ruler divisions as objects are drawn or moved.

The *Show position* command indicates the current mouse position as lines on the rulers. The position indicator changes colors with the background setting of the plot.

Background and *Division* color palettes

Use these color palettes to select the color you want to apply to the ruler's background or to the ruler's division marks.

Font button

Clicking the *Font* button opens the **Text Properties** dialog box. The type face, point size, style, and color of the font used by the numbers on the ruler are set on this dialog box.

DIGITIZE FORMAT TAB

Select **File | Preferences** and click on the **Digitize Format** tab to set the numeric format of digitized points. Points can be digitized from a selected plot using the **Graph | Digitize** or **Graph | Digitize Fixed** commands.

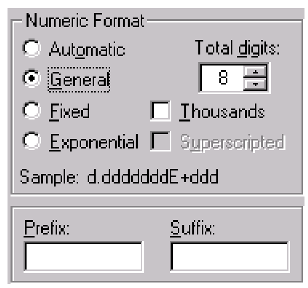
Numeric Format **group box**

Numbers can be displayed in one of four formats:

Automatic displays numbers as fixed or exponential up to 15 digits.

General displays numbers as fixed or exponential depending on the number set in the *Total digits* box.

> **Example:** If the numeric format is set to *General* with two *Total digits*, the number 1998 is displayed as 1.9e+003. If the *Total digits* are set to six, the number 1998 is displayed as 1998.00.



*The Numeric Format options on the **Digitize Format** tab control the display of digitized points.*

Fixed displays numbers as d.ddd. The number to the left of the decimal can vary, but the number to the right of the decimal is determined by the value in the *Digits after decimal point* edit box.

Exponential displays numbers as d.dddE+ddd. The number to the right of the decimal is set in the *Digits after decimal point* box. For instance, if the *Numeric Format* is set to *Exponential* with two *Digits after the decimal point*, the number 1998 is displayed as 1.99e+003. When *Exponential* is checked, the *Superscripted* option becomes available, which allows the number to be written as $1.99x10^3$.

If the *Thousands* box is checked, a comma appears every three digits to the left of the decimal point.

The *Prefix* and *Suffix* fields set the numbers or letters that precede or follow the digitized numbers.

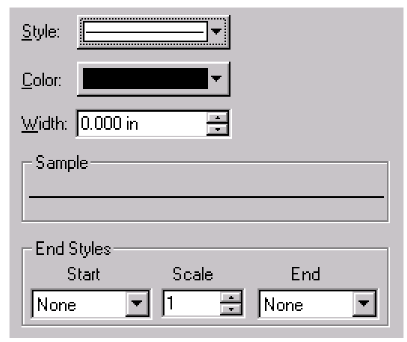
> **Example:** Suppose you want the unit “cfs” to follow all digitized numbers. Type “ cfs” into the *Suffix* box without the quotes. When the numbers are digitized, they appear as *17 cfs*, *2 cfs*, and *35 cfs*. Make sure to enter a space preceding the unit letters to avoid merging the numbers and units together. Without a preceding space, the number would show as *17cfs* rather than *17 cfs*.

LINE PROPERTIES TAB

Select **File | Preferences** and click on the **Line Properties** tab to set the default line color, style, size, and end styles used by **Grapher**. The default line properties affect all lines, including grid lines, axis lines, axis tick marks, line plots, etc.

Style drop-down list

Set the line *Style* by selecting a new style from the line style palette. Click the *Style* button to open the palette and then click on a style to select it. The name of the line style appears at the top of the palette. Click the *Custom* button at the bottom of the palette to create a new style.



*Set the style for all lines in the plot window on the **Line Properties** tab of the **Preferences** dialog box.*

Color drop-down list

Change the *Color* of the line by selecting a new color from the color palette. Click the *Color* button to open the palette and the click on a color to select it.

The name of the color appears at the top of the palette. The color name is useful when automating **Grapher** with Scripter. See *Chapter 10, Automating Grapher* for more details about **Grapher's** automation features. Click the *Custom* button at the bottom of the palette to create a new color.

Width edit box

Change the line *Width* by typing a new number into the *Width* edit box or by using the arrow buttons to the right of the box. The line width can be set from 0 to 0.5 inches or 0 to 1.27 cm. A line width of zero creates a line that is one pixel wide.

End Styles group box

The line ends can have arrowheads on them as defined in the *End Styles* group box. The *Start* style is placed at the first vertex of the line. The *End* style is placed at the last vertex. The *Scale* determines the size of the arrowhead.

Creating Custom Lines and Colors

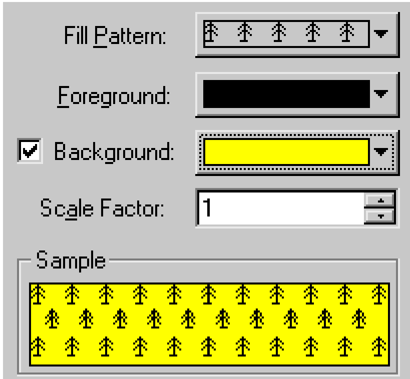
You can create custom line styles and colors by clicking the *Custom* button at the bottom of the *Style* and *Color* palette boxes. See *Customizing Lines, Symbols, and Fill Patterns* on page 245 for more information on creating new colors and line styles.

FILL PROPERTIES TAB

Select **File | Preferences** and click on the **Fill Properties** tab to set the default fill pattern and fill color. Changes made on this tab affect any objects created with fill properties, such as legends, curves, and drawing objects like ellipses and rectangles.

Fill Pattern drop-down list

Change the *Fill Pattern* by selecting a pattern from the pattern palette. Open the pattern palette by clicking the *Fill Pattern* button. The pattern name and type (stock, bitmap, or vector) appears at the top of the palette. Click the *Custom* button at the bottom of the palette to create a new pattern.



*Fill options are set on the **Fill Properties** tab of the **Preferences** dialog box.*

Foreground drop-down list

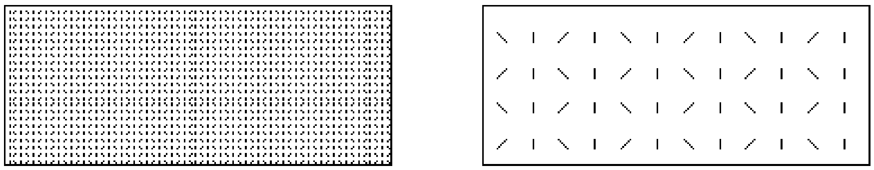
The *Foreground* color is the color of the pattern lines or pixels. You can change the color of the *Foreground* by selecting a new color from the color palette. Click the *Foreground* button to open the palette and then click on a color to select it.

Background drop-down list

The *Background* color is the color behind the pattern. All raster (pixel) patterns must have a background color. The default background color is white. Window stock patterns and vector patterns (lines) can have a transparent background by removing the check mark in the *Background* check box. If the pattern is a raster pattern, the check box is grayed out. Change the color by clicking *Background* button to open the palette and then click on a color to select it.

Scale Factor edit box

The *Scale Factor* is used with vector fill patterns to make the pattern easier to see on paper and on the screen. Changing the value to two changes the size of the pattern to twice as large as when the *Scale Factor* is set to one. Smaller scale factor values result in a denser pattern.



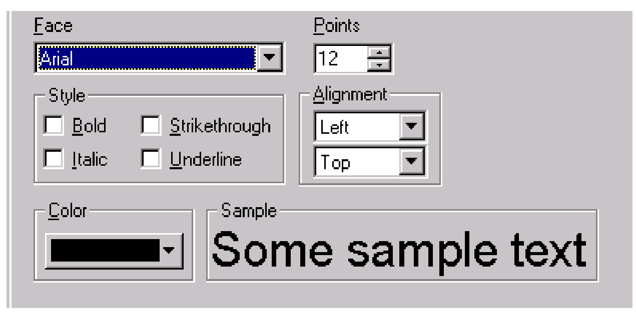
The box on the left uses a vector fill pattern with a Scale Factor of 1. The box on the right uses the same fill pattern with the Scale Factor set to 5.

Creating Custom Fill Patterns and Backgrounds

You can create new fill patterns and colors by clicking the *Custom* button at the bottom of the palette boxes. See *Customizing Lines, Symbols, and Fill Patterns* on page 245 for more information on creating new patterns and colors.

TEXT PROPERTIES TAB

You can set the default font properties used in **Grapher** by selecting **File | Preferences** and clicking on the **Text Properties** tab. Changes made on this tab affect the default axis title font, tick mark labels font, legend title font, legend entry font, and text created using the **Draw | Text** command.



*Font, color, and style options on the **Text Properties** tab control the display of all text in the plot window.*

Face drop-down list

Select a typeface to use from the *Face* drop-down list.

Style group box

Apply **Bold**, *Italic*, ~~Strikethrough~~, or Underline styles to text by checking the appropriate check box.

Color palette

Select a typeface color from the color palette. To open the palette, click on the down arrow next to the current color. To create a custom color, click on the *Custom* button at the bottom of the palette. See *Creating Custom Colors* on page 245.

Points edit box

Set the typeface size in the *Points* edit box.

***Alignment* group box**

The top drop-down list lets you select the default horizontal alignment that is applied to text objects created in **Grapher**. The options are: *Left*, *Center*, and *Right*.

The lower drop-down list lets you select the default vertical alignment that is applied to text objects created in **Grapher**. The options are: *Top*, *Baseline*, *Bottom*, and *Center*.

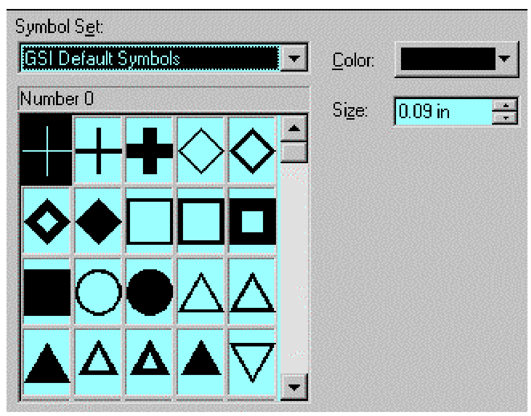
Refer to the topic, ***Using the Text Editor*** on page 207 for more information on text alignment.

Symbol Properties Tab

Select **File | Preferences** and click on the **Symbol Properties** tab to set the default symbol type, color, and size used by **Grapher**. Changes made on this tab set the default symbols for the various plots and symbols added using the **Draw | Symbol** command.

***Symbol Set* drop-down list**

Select the default *Symbol Set* from the drop-down list. **Grapher** includes a variety of different symbol sets. The default symbol set is the *GSI Default Symbols*. Choose the default *Symbol* from the symbol palette by clicking on a symbol. The number of the selected symbol is indicated in the title bar above the symbol palette. This number is a useful reference when automating **Grapher** with Scripter. Add 32 if you are using font sets or TrueType symbols, such as GSI Default Symbols.



*Set the default symbol and Symbol Set on the **Symbol Properties** tab of the **Preferences** dialog box.*

***Color* drop-down list**

Change the *Color* of the symbol by selecting a new color from the color palette. You can create new colors by clicking the *Custom* button at the bottom of the color palette. See *Creating Custom Colors* on page 245.

***Size* edit box**

Change the *Size* of the symbol by typing a new number into the edit box, or by using the arrows to scroll to a new number.

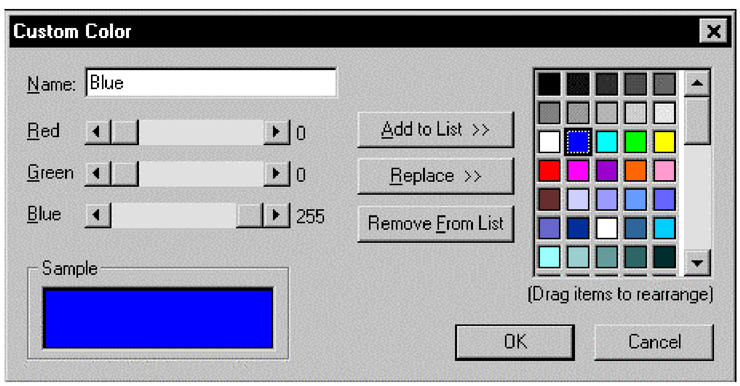
Customizing Lines, Symbols, and Fill Patterns

CREATING CUSTOM SYMBOLS

Custom symbols can be created to use in **Grapher**. TrueType font sets such as Golden Software's *GSI Default Symbols* can be modified using a third party TrueType font editing program. For more information on creating custom symbols, refer to the *Custom Symbols* topic in the online help system.

CREATING CUSTOM COLORS

Click the *Custom* button at the bottom of the color palette to create new colors. Create new colors by mixing red, green, and blue. You can add colors to the palette, remove colors from the palette, or replace existing colors in the palette through the **Custom Color** dialog box.



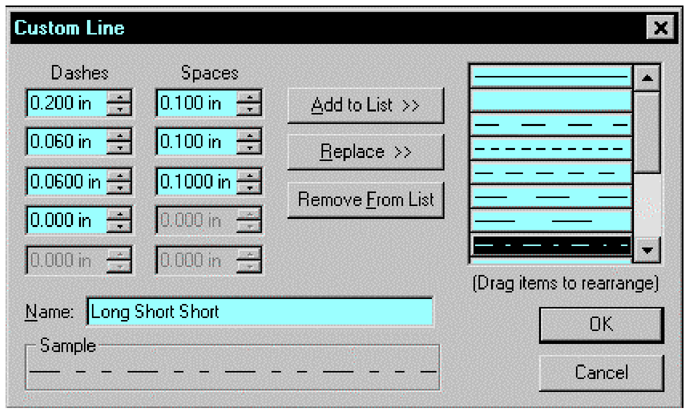
*New colors can be created in the **Custom Color** dialog box.*

In the **Custom Color** dialog box, the *Name* field indicates the name of the selected color. The name is important when using Scripter to automate **Grapher**. The *Red*, *Green*, and *Blue* scroll bars show the amount of each color used to form the color. The color amounts range from 0 to 255. To change the color amounts, slide the box along the scroll bar or press the ARROW keys. The *Sample* box shows the new color.

Click the *Add to List* button to add a new color to the color palette. Type the new color name into the *Name* field before adding the new color. The color is placed at the end of the color palette list. To replace the selected color in the palette with the modified color, click the *Replace* button. To delete the selected color, click the *Remove From List* button. Dragging a color on the palette inserts it into a new location on the color palette.

CREATING CUSTOM LINE STYLES

Select the *Custom* button at the bottom of the line *Style* palette to create new line styles. You can create custom line styles by editing dashes and spaces in the **Custom Line** dialog box. Add new line styles, replace existing line styles, delete line styles, or rearrange the styles in the palette in the **Custom Line** dialog box. This can be done from any line style dialog box in **Grapher**.



New line styles are created by entering dash and space lengths into the ***Custom Line*** *dialog box.*

In the **Custom Line** dialog box, the *Dashes* and *Spaces* fields determine the pattern of the custom line.

Example: Suppose you wanted to create the following custom line:

In this line, the long dash is 0.200 inches in length and the two short dashes that follow are each 0.060 inches in length. Each space between dashes has a length of 0.100 inches.

To create this line in the **Custom Line** dialog:

1. In the *Name* field, assign a descriptive name for the new line you are creating.
2. In the top row of *Dashes* and *Spaces* fields, enter 0.200 into the *Dashes* box and 0.100 in the *Spaces* box. This defines the length of the first dash in the line style and the amount of blank space after it.
3. In the second row, define the length of the second dash by entering 0.060 in the *Dashes* box and 0.100 in the *Spaces* box.
4. In the third row, define the third dash by entering 0.060 in the *Dashes* box and 0.100 in the *Spaces* box. The *Sample* box shows the new line style.

Click the *Add to List* button to make the new line part of the list of line styles on the right of the dialog box. The new style is added at the bottom of the palette. To overwrite the selected line style with the modified line style, click the *Replace* button. To delete the selected line style, click on the *Remove From List* button. To change a line's location in the list, you can drag and drop it to a different position in the style palette.

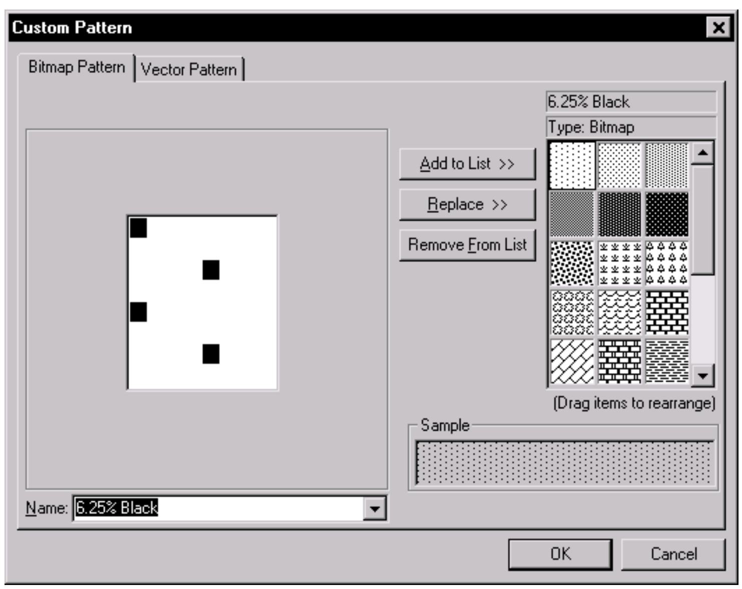
CREATING CUSTOM PATTERNS

To create a new pattern, select the *Custom* button at the bottom of the *Fill Pattern* palette. This opens the **Custom Pattern** dialog box where you can add patterns to the palette, replace existing patterns in the palette, or remove patterns from the palette. This can be done from any fill pattern style box in **Grapher**. The *Custom* button is disabled if a stock pattern is selected.

Once the **Custom Pattern** dialog box is displayed, click on the **Bitmap Pattern** tab to edit or create new bitmap patterns. Click on the **Vector Pattern** tab to create new vector pattern styles.

Creating and Editing Bitmap Patterns

Bitmap patterns can be created or edited using the tools on the **Bitmap Pattern** tab of the **Custom Pattern** dialog box.



*Create new bitmap patterns by clicking in the pattern edit box on the left side of the **Bitmap Pattern** tab.*

The pattern design box appears at the left side on the **Bitmap Pattern** tab. It is an 8 x 8-pixel area where you create new patterns by clicking on each pixel to turn it on or off. When an area is clicked, a black box (1 pixel) appears. Click the area a second time to turn off the pixel.

The *Name* field indicates the name of the selected pattern.

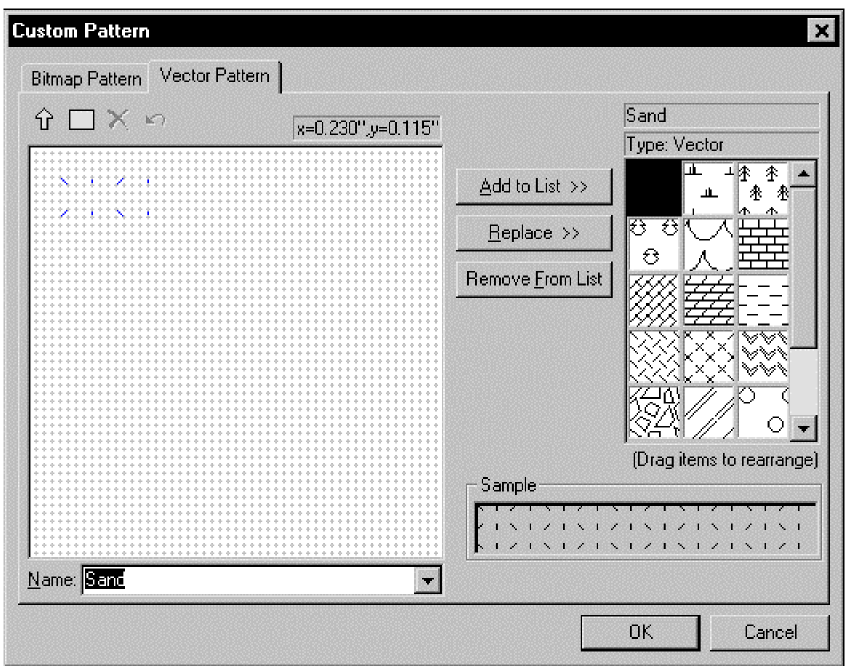
The *Sample* box shows you how the current pattern appears in **Grapher**.

To edit an existing bitmap pattern, select the pattern from the list and edit it on the left side of the dialog box.

Click the *Add to List* button to add a new pattern to the end of the pattern palette. Click the *Replace* button to replace the selected pattern with the modified pattern. Click the *Remove From List* button to delete the selected pattern. Drag a pattern in the list to insert it into a new location.

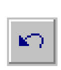
Creating and Editing Vector Patterns

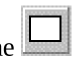
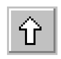
Vector (line) patterns are created and edited using the tools on the **Vector Pattern** tab of the **Custom Pattern** dialog box.



Create new vector patterns by clicking in the pattern edit box at the left side of the ***Vector Pattern*** *tab.*

The *Pattern Design Box* appears at the left side of the **Vector Pattern** tab. This is a grid consisting of a 250 x 250 unit area where you create new patterns simply by clicking on a starting point, dragging the cursor to create a line, and clicking on the ending point.

- To delete a line, right-click on it with the mouse and click the *Delete* button or click the delete button  on the toolbar.
- To undo a previous action, click the  button at the top of the design box.

- To clear all lines from the design box, click the  button at the top of the design box.
- To select a line, click the  button and click on the line.

The *Name* field indicates the name of the selected pattern.

The *Sample* box shows you how the new pattern appears in **Grapher**.

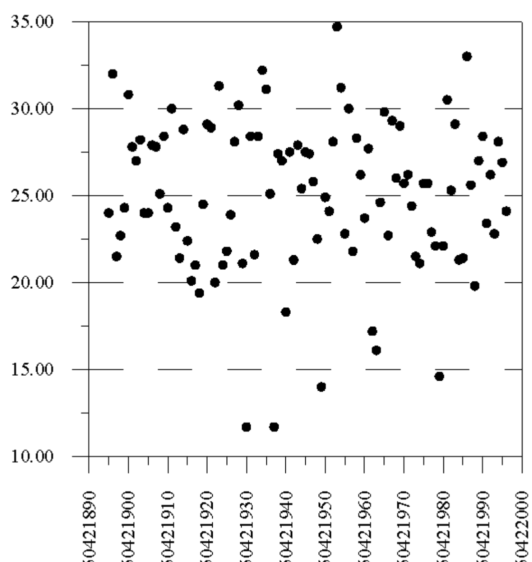
To edit an existing pattern, select the pattern from the list and make the desired changes in the left side of this dialog box. Stock patterns are not editable.

Click the *Add to List* button to add a new pattern to the end of the pattern list. Click the *Replace* button to replace the selected pattern with the modified pattern. Click the *Remove From List* button to delete the selected pattern. Drag a pattern in the list to insert it into a new location.

Creating Template Graphs

In addition to controlling settings with the **Preferences** dialog box, you can also define a set of styles in a template graph and then selectively apply the template to other **Grapher** documents.

To make a template, create a graph with the desired colors, number formats, tick mark spacing, legend styles, etc., and then select **File | Save As** and choose the *Save as type* to be *Plot Template (*.grt)*. This saves the graph as a template. Template graphs can be created in the plot window or in the template window (**File | New | Template**).



To create a graph with the same axis properties, symbol size and type, label colors, etc., create a template graph. Use template graphs to preserve all graph settings.

The main difference between template files [.GRT] and graph files [.GRF] is that template files do not have a data file associated with them.

Templates are also used in the **Text Editor** for creating equations. These should not be confused with the **Grapher** template files [.GRT]. When creating equations in the **Text Editor**, there are several *equation templates* available. For more information on the equation templates, refer to the *Text Editor* topic in the online help system.

CREATING A TEMPLATE GRAPH

1. Select **File | New** and choose *Template* in the **New** dialog box. Click *OK* to open the template window.
2. Design the graph in the template window. Create any graphs, set the axes properties, add titles, format legends, etc.
3. Save the completed graph as a *Plot Template [*.GRT]* or as a *Grapher File [*.GRF]*.

When the template file is saved, it does not contain any reference to specific data files. To save the file with a specific worksheet, save the file as a graph [.GRF] rather than a template [.GRT].

USING A TEMPLATE GRAPH

1. Select **File | New,** check the *Prompt for template* option and select *Plot*. Click *OK* to open the **Open** dialog box.
2. Select the template file [.GRT] and click Op*en.*
3. In the next dialog box, select a data file to use with the template. If there are multiple curves on the template that reference the same data file, place a check mark beside the *Use this worksheet for remaining items* check box. If the columns specified in the template do not coincide with the columns in the data file, place a check mark in front of *Set columns*. If you select this option, you are prompted for the columns to use for the X and Y axes.
4. Modify the graph in the plot window, if necessary.
5. Save the file as a [.GRF] or [.GRT], print the file, or export it in one of the many export file format types.

EDITING A TEMPLATE GRAPH

1. Select **File | Open**.
2. Choose a template file and make changes, if necessary.

When a template file is opened for editing, you are prompted to select worksheets if the file contains any plots. This is necessary to allow the plots within the template to be edited. When the editing is finished, save the file as a template [.GRT] or graph [.GRF].

TIPS ABOUT TEMPLATES

There are a few restrictions on the data types that can be used in a template.

- If the template settings do not match the data set, the resulting graph may look incorrect and/or an error message may occur. For example, the axes numbers change to accommodate different data set ranges as long as the *Auto* box is checked for the *Axis min* and *Axis max* on the **Axis** tab. If *Auto* is not checked and the *Axis min* and *Axis max* have been set outside the range of the data set, an empty graph could appear.
- If the data set cannot be used with the template (i.e. log axis with negative data), an error message appears.
- If an empty plot appears after the data set is chosen, check the plot properties and the data. Make sure the selected data columns contain numeric data. Also, check the axes limits to make sure they have not been set beyond the data range.

Chapter 9

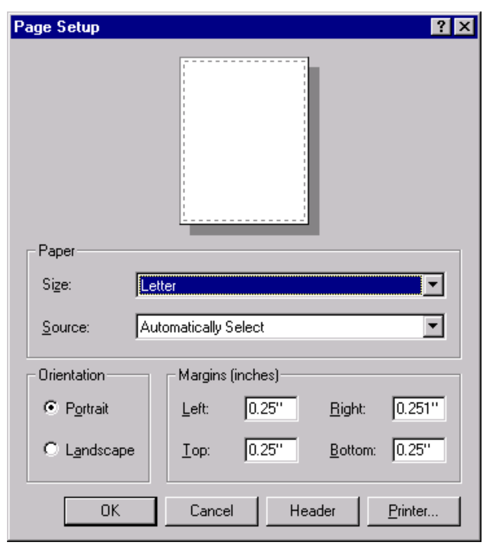
Printing, Saving, and Exporting

Once the graph is complete, you can save, print, or export it using the appropriate **File** menu commands. For instructions on saving and printing worksheets, see *Chapter 3, Working with Data Files.*

Page Setup

Before printing a document from **Grapher**, set the desired page options in the **Page Setup** dialog box. This dialog box is accessed by selecting **File | Page Setup**.

Note: Windows 95 and Windows 98 have a page size limitation of 32.76 inches. To increase the page size beyond that, you must reset the *Page Resolution* (dots per inch) setting in the **Preferences** dialog box (**File | Preferences)**.



*The **Page Setup** dialog box can be used to set page orientation and page margins.*

Paper group box

These settings are based on the selected printer. Use the *Size* field to select the dimensions of your **Grapher** document. Click the down arrow to change the size of the paper.

Printers that have multiple paper trays use the *Source* field. For instance, one tray might hold letter-sized paper while another tray contains legal-sized paper. If your printer supports this feature, select the tray containing the type of paper on which you are printing. Most printers have an *Automatically Select* option that manages this setting for you.

Margins group box

Margins are non-printing areas at the edge of each page. The current margin settings are represented by dashed lines in the page outline at the top of the **Page Setup** dialog box. You can change the margins by entering the desired distance from the edge of the page in the *Left, Right, Top,* and *Bottom* fields. The default *Margins* change based on the printer selected.

Note: Setting the margins does not move an existing graph on the page. If the margins are set too far into the page, objects are truncated at the margin when printing.

Orientation group box

Choose the appropriate option to print the document in either *Portrait* or *Landscape* mode.

Header button

The *Header* button opens the **Page Header/Footer** dialog box, where you can enter text that you want to display in the header at the top of the page or in the footer at the bottom of the page. After entering the text, choose a justification setting by clicking on either the *Left*, *Center*, or *Right* button. To modify your text or add special characters, click the *Editor* button to open the **Text Editor**. See *Using the Text Editor* on page 207.

Printer button

The *Printer* button opens a **Page Setup** dialog box where you select which printer you want to use. To edit the printer settings, click the *Properties* button.

THE PRINT COMMAND

The **File | Print** command opens the **Print** dialog box so you can print the active document.

Grapher's default printer is listed in the *Name* field. If more than one printer is installed on the computer, use the down arrow to the right of the name to select a different printer. To change the default printer, select **File | Page Setup** to open the **Page Setup** dialog box, and then click on the *Printer* button to specify the default printer. To change the default print settings, click on the *Properties* button. For information on specific printer settings, refer to the printer's Owner's Manual.

Print Range group box

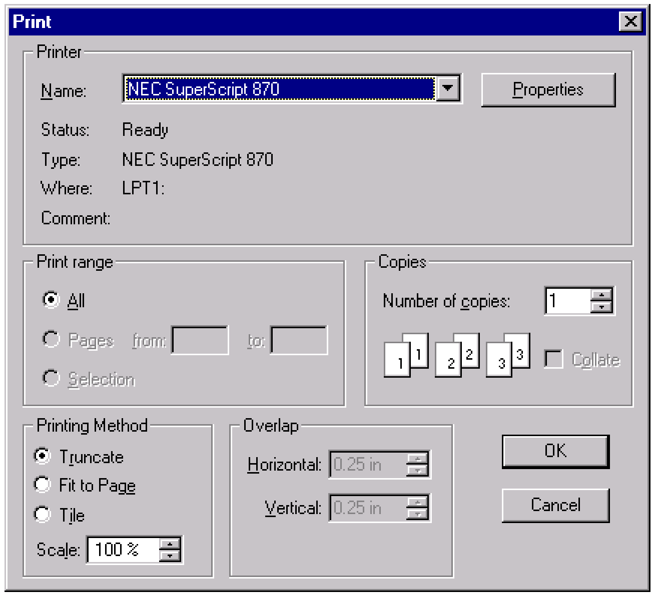
The *Print Range* group box options control how the document pages are printed. *All* prints all of the pages that contain objects.

Pages prints the pages specified in the *from* and *to* boxes.

Selection prints the selected objects only.

Copies group box

Enter a value into the *Number of copies* edit box to specify the number of copies to print. If two or more copies of a multiple page document are to be printed, select the *Collate* check box to separate the copies into individual packets.



*The **Print** dialog box for the plot window and plot template window control the portion of the document that prints.*

Printing Method group box

The *Printing Method* options control how the document is printed on the page. Objects that extend into the page margins are truncated at the margin unless the *Fit to Page* option is selected.

- *Truncate* clips objects that extend past the page margins.
- *Fit to Page* reduces the size of the plot so it fits within the selected page size and margins.
- *Tile* breaks the drawing into page size pieces and generates multiple pages of output. Each page overlaps adjacent pages by the amount specified in the *Horizontal* and *Vertical Overlap* group box fields.
- *Scale* is used to reduce or increase the overall size of the drawing when the *Truncate* or *Tile* options are used. 100% is actual size, 200% is twice as large, and 50% is half as large.

Overlap group box

These options are only available when printing with the *Tile* option in the *Printing Method* group box. When printing tiled pages, each page overlaps the adjacent pages by the amount specified in the *Horizontal* and *Vertical* fields.

THE PRINT MULTIPLE COMMAND

The **File | Print Multiple** command lets you print multiple data files with the same template. To print multiple data files, they must be in the same directory.

Note: You cannot configure the printer options here. This method always uses the current settings in the **Page Setup** dialog box.

To use the **Print Multiple** command:

1. Select **File | Print Multiple**. The **Select Template** dialog box opens.
2. Choose the template file that you want to use to print the data files and click *Open*. The **Select Worksheets** dialog box opens.
3. Select the data file(s) you want to print.
    - Hold down the CTRL key and click on each file you want to include to select multiple files.
    - To select a list of consecutive files, click on the first file in the list, then hold down the SHIFT key and click on the last file in the list. All files in between are selected.
4. Click the *Open* button. The selected data files are sent to the printer.

Saving Documents

THE SAVE COMMAND

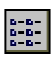
The first time you save a document, the **Save As** dialog box opens so you can enter a name and destination for the file. If the file has already been saved, use the **File | Save** command to update the file with any changes made since the last save. plot window documents and template window documents are saved as **Grapher** files [.GRF] or template [.GRT] files. If you would like to create a bitmap or some other file format, use the **File | Export** command.

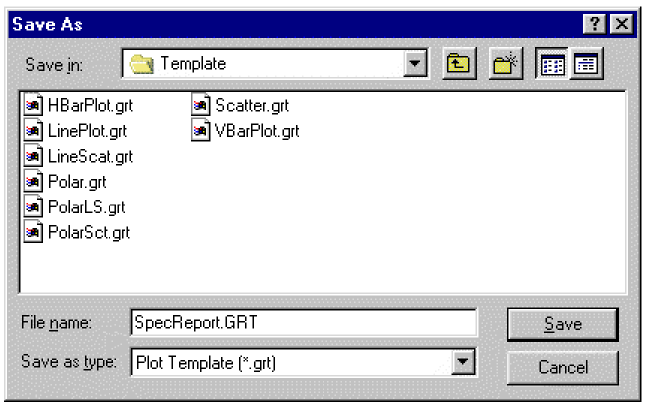
Grapher files [.GRF] save all of the document contents along with the data file used to create the plots. Plot templates [.GRT] save all of the document settings without a data file association. For more information on plot templates, refer to *Chapter 8, Default Settings*.

THE SAVE AS COMMAND

The **File | Save As** command allows you to save a **Grapher** document in a separate file with a different filename.

In the **Save As** dialog box, the *Save in* field shows the current directory. Click the down arrow to see the directory structure. Click on the folders to change directories.

- Click the  button to move up one folder.
- Click the  button to create a new folder.
- Click the  button to list the files and filenames.
- Click the  button to list all file details in the current folder.



***Grapher** documents can be saved in a different location and with a new name in the **Save As** dialog box.*

The *File* list displays all the files in the *Save in* directory that have the same file extension as specified in the *Save as type* edit box. To view or save files of a different type, select a different file extension from the *Save as type* drop-down list.

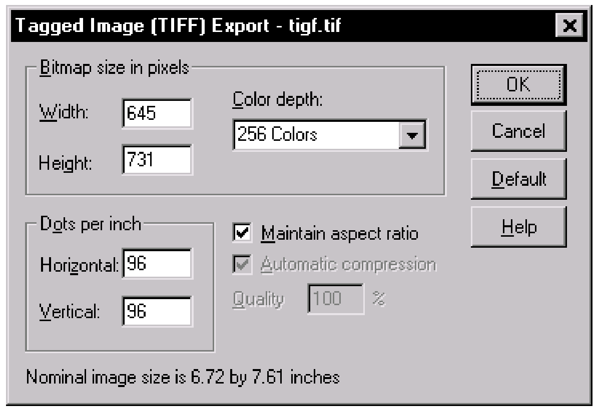
- To overwrite an existing file, select that file from the *File* list and click the *Save* button.
- To save the file under a new name, type the new name into the *File name* edit box and click the *Save* button.

The path and file name can also be entered directly into the *File name* edit box instead of navigating through folders in the *Save In* field.

Exporting Files

The **File | Export** command lets you save **Grapher** files as graphic files for use in other programs. Depending on the export format you choose, you may need to configure some export options as part of the export process. For more information on a file's export options, click the help button in the dialog box.

The rest of this section discusses some of the common export issues.



Depending on the export format you choose, you may need to set export options.

Setting the Width-to-Height Ratio

To export a document with the proper width-to-height ratio, note the dimensions of the file at the bottom of the **Export** dialog box.

- If the page coordinates are in inches, multiply the dimensions by 100 to export the image with 100 pixels per inch. This proportionally scales the bitmap. Type these values in the *Width* and *Height* edit boxes. If the page dimensions are in centimeters, try multiplying the dimensions by 25 to avoid excessively large file sizes.
- Instead of trying to determine a width to height ratio, you may want to check *Maintain Aspect Ratio* and set the number of *Dots Per Inch*. This automatically adjusts the width to height ratio.

Setting Export Resolution and Color Depth

A greater number of pixels per unit result in a better image resolution, however the more pixels per unit, the larger the file is.

Increasing the color depth also increases the file size, so a file saved as a *Monochrome* image has a much smaller file size than the same image saved as a *True Color* image.

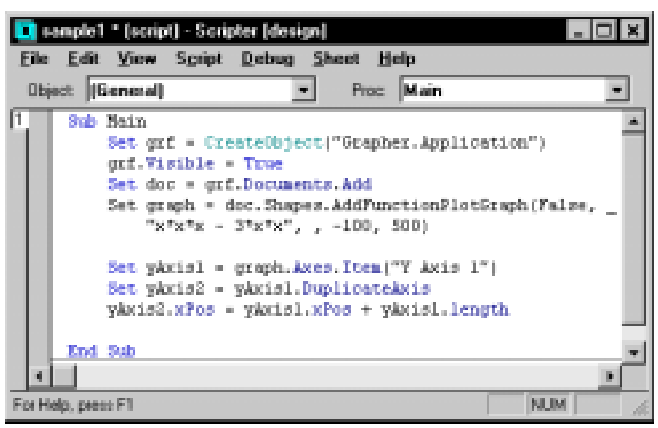
For detailed information on export file formats and export file options, refer to the online help system

Chapter 10

Automating Grapher

Introduction to Scripting

Grapher operations can be controlled automatically by scripts that you write. A script is a text file containing a sequence of instructions carried out by a script interpreter program. You can do practically everything with a script that you can do manually with the mouse or from the keyboard. Scripts are useful for automating repetitive tasks or consolidating a complicated sequence of steps, or acting as a “front end” to help novice users access **Grapher's** capabilities without having to become familiar with **Grapher**.



A script displayed in the main window of the Golden Software Scripter program. This script creates a function plot and duplicates the Y axis on the right side of the graph.

In addition, scripts can integrate the features of several programs. For example, you could, with a single script, process data with Microsoft Excel, open the data file in **Grapher**, create a complex graph, and copy the graph to Microsoft Word.

If you simply want your graphs to have a consistent appearance, creating a template file with all your settings may be simpler than writing a script. See *Chapter 8, Default Settings* for information about using template files.

You can write scripts using the Golden Software Scripter™ program that comes packaged with **Grapher**. Scripter programs are written in a programming language that is compatible with Visual Basic for Applications. Scripter provides a full-featured environment for writing, running, and debugging scripts. If you are already familiar with another programming environment, you may want to write scripts using an application other than Scripter. Because **Grapher** exposes its services using ActiveX Automation (formerly called OLE Automation), you can use any programming tool that can access automation objects. Such tools include Visual Basic, Windows Scripting Host, Microsoft Excel macros and others.

The Grapher Object Model

The **Grapher** programming interface consists of several dozen automation objects. Each object represents an aspect of **Grapher** functionality such as axes, tick marks, or page layout. Every object has properties - frequency of tick marks or line thickness, for example - and methods (or actions) that they can perform.

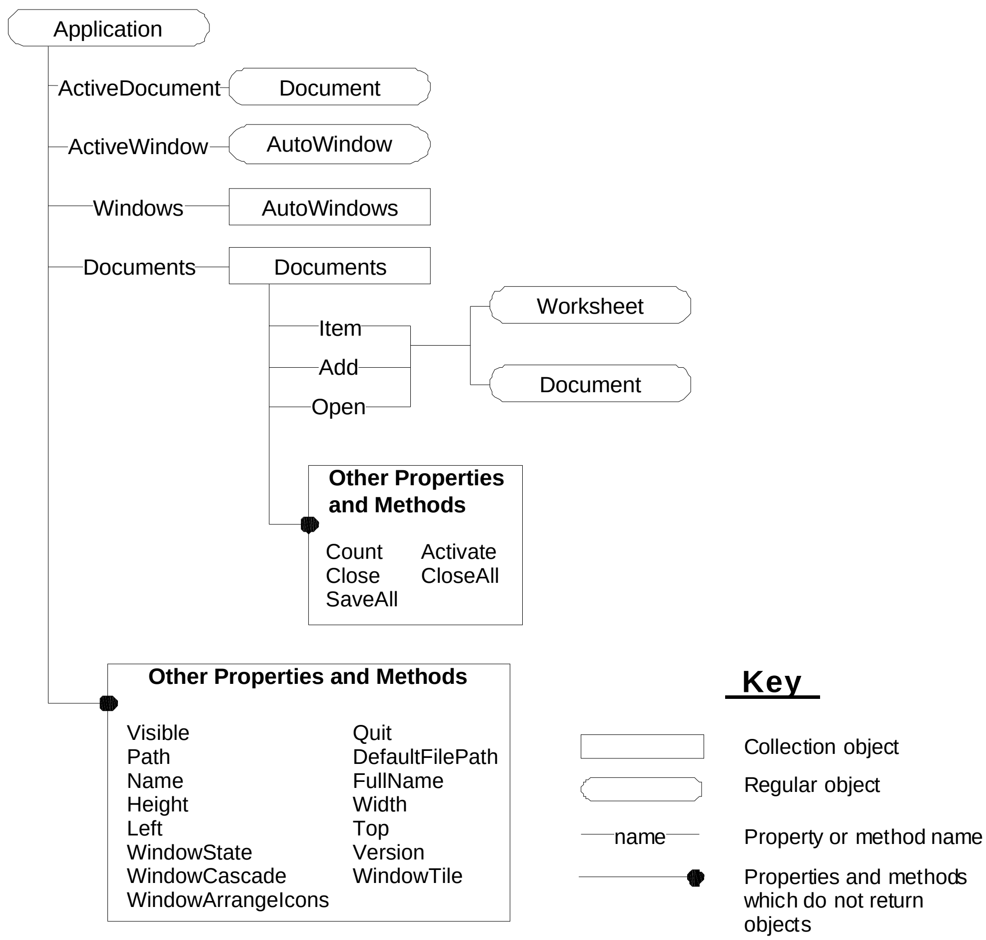
The automation objects are arranged in a hierarchy. The *Application* object is the top-level object through which all other objects are accessed. The means of accessing **Grapher** automation objects varies depending on the scripting tool and language being used. With the Golden Software Scripter program and other applications compatible with Visual Basic, the CreateObject function creates a **Grapher** *Application*:

```
Set x = CreateObject("Grapher.Application")
```

Here a variable named “x” is assigned the value returned by the built-in CreateObject function. The CreateObject function finds the name “Grapher.Application” in the system registry, automatically activates **Grapher**, and returns a reference to the **Grapher** *Application* object.

Once you have an *Application* object, you can access other **Grapher** objects through the properties and methods of the *Application* object. The object model charts on the following pages show you which objects provide access to other objects in the hierarchy. Although the *Application* object is at the top of the hierarchy, not all objects are directly accessible from the *Application* object. To access many objects you must traverse from the *Application* object through one or more layers of sub-objects. People often refer to “drilling” or “boring” through the object hierarchy to describe this traversal through several objects to obtain an object you want to use.

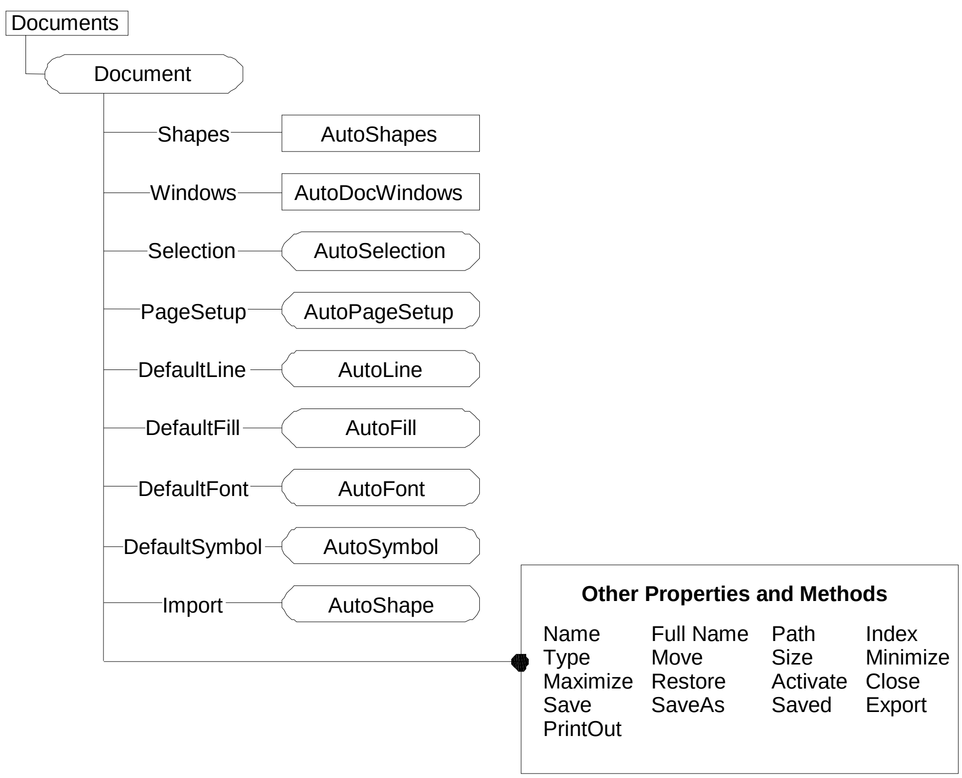
To “drill through” the object hierarchy you must know which properties and methods of an object provide access to the next level of objects. The object model charts show how to access the most commonly used objects and list the names of the properties and methods that provide access to other objects in the hierarchy.



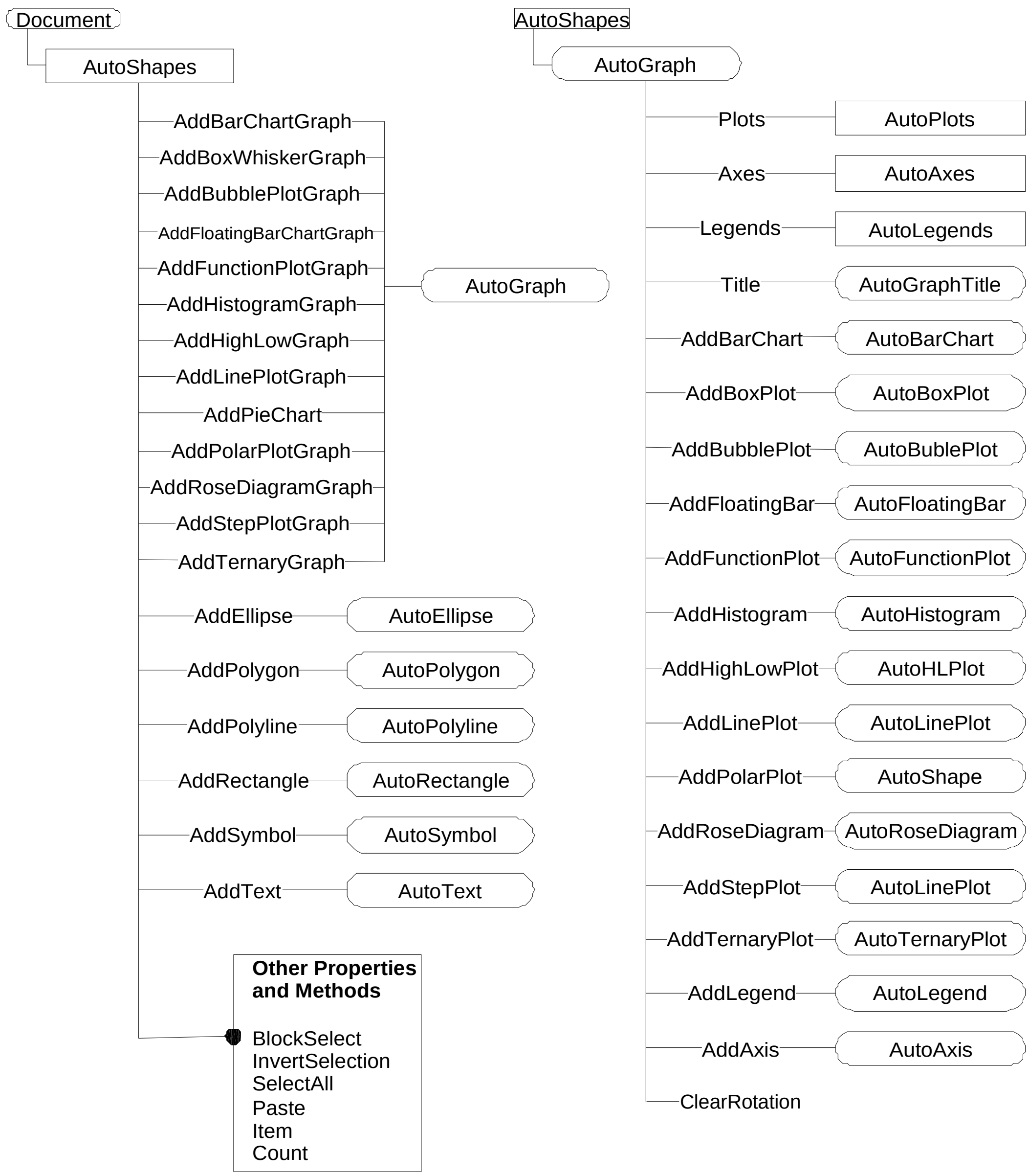
*The **Grapher** Application object and the Documents collection object. Collection objects are represented by rectangles and non-collection objects are represented by ovals. Lines connecting the objects are labeled with the method or property name that returns a reference to the object.*

Several non-visible objects, called *Collection* objects, are used to organize the object hierarchy. Collection objects are containers for groups of other, related, objects. For example, the *AutoAxes* collection contains all the *AutoAxis* objects associated with a graph. All collection objects, regardless of what the collection contains, can be processed using similar techniques.

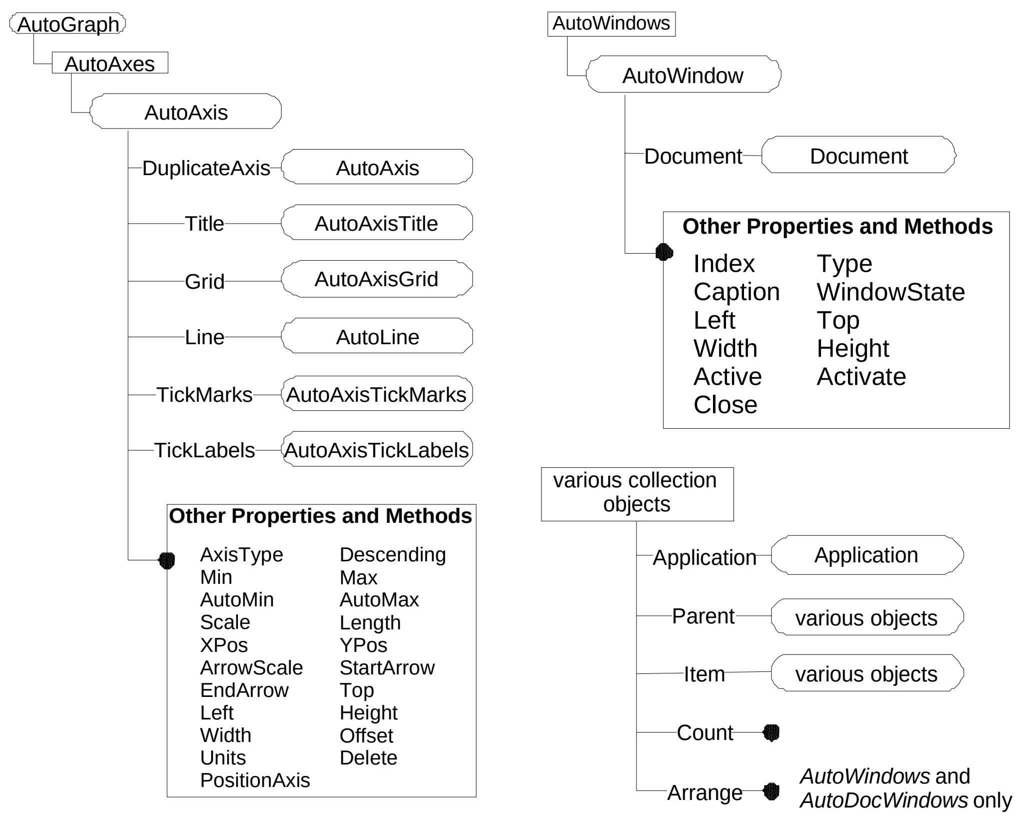
You can find all the properties and methods available for each of the automation objects, as well as a description of the objects themselves, in the online help. The Scripter **ActiveX Automation Members** dialog box also shows you the available objects, properties, and methods. To view this dialog, select the Scripter **Debug | Browse** command. See *The Object Browser* section of this chapter for information on this dialog box.



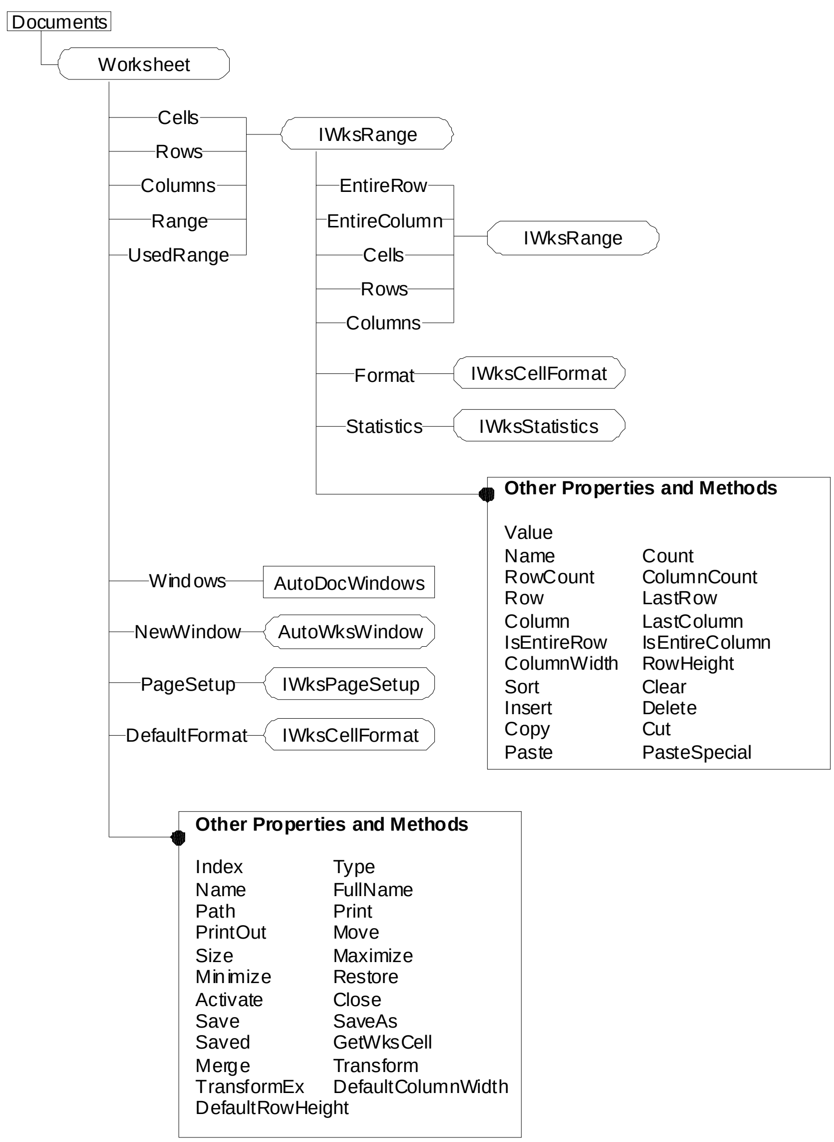
*The **Grapher** Document object. All graphic objects on a page are accessed through the Document object.*



The AutoShapes collection object and the AutoGraph object. The AutoShapes collection provides methods which create graphs, plots, and simple drawing objects such as rectangles and text annotations. The AutoGraph object provides access to all the elements in a graph – axes, plots, legends, titles, etc.



The AutoAxis object and the AutoWindow object (top right). The "various collection objects" group shows the properties and methods of nearly all the collection objects, including the Auto Axes, AutoDoc Windows, AutoFits, AutoLegends, AutoPlots, and AutoWindows collection objects. The layouts for the AutoShapes and the Documents collection objects are shown in other charts.



The Worksheet document object and IWksRange object. The IWksRange object represents one or more cells including their value and formatting.

Overview of Grapher Objects

Learning to use the **Grapher** automation objects in a script may appear daunting at first. Most tasks, however, can be accomplished using just a few **Grapher** objects. Once you become familiar with these primary objects and learn how to "drill through" the object hierarchy, you are able to access most of **Grapher's** features from your scripts.

This section shows how to access the **Grapher** automation objects using the Scripter Basic language. Refer to the *Writing Scripts* section on page 272 for information about Scripter Basic. If you are not familiar with computer programming, you may benefit from a programming tutorial. See the *Suggested Reading* section on page 298 for recommendations.

The online help is the complete reference for all of the **Grapher** automation objects, their properties, and their methods. The object model chart should serve as your guide for navigating through the object hierarchy.

DERIVED OBJECTS

Several objects shown in the object chart share common features. For example, the *AutoBarChart* object and the *AutoLinePlot* object each have "FirstRow" and "LastRow" properties for selecting the range of worksheet rows to plot. These common features are inherited from a predecessor *AutoPlot* object.

Derived objects inherit all the properties and methods of the predecessor object. Derived objects and their predecessor objects include:

- The *AutoShape* object is a predecessor of the *AutoPlot, AutoGraph, AutoPieChart, AutoAxis, AutoLegend, AutoRectangle, AutoEllipse, AutoSymbol, AutoText, AutoMText, AutoPolyline, AutoPolygon,* and *AutoComposite* objects.
- The *AutoPlot* object is the predecessor of the *AutoBarChart, AutoBoxPlot, AutoBubblePlot, AutoFitPlot, AutoFloatingBar, AutoFunctionPlot, AutoHistogram, AutoHLPlot, AutoLinePlot, AutoRoseDiagram,* and *AutoTernaryPlot* objects.

Note that since the various plot objects are derived from *AutoPlot* and since *AutoPlot* is itself derived from *AutoShape*, all of the plot objects also inherit the properties and methods of *AutoShape*.

USING COLLECTION OBJECTS

The **Grapher** object hierarchy includes several collection objects. Although these collections contain different types of data, they can be processed using similar techniques. All collection objects have a read-only property named “Count” which gives the number of objects in the collection.

Every collection also has a method called “Item” which retrieves one of the objects contained in the collection. The “Item” method accepts a single argument specifying either an index number or (for most collections) the name of the object to retrieve. An index number is a value between 1 and the value returned from the collection's “Count” property. The name used to identify items is typically the object ID (for example, "Bar Chart 1" or "X Axis 1").

PARENT AND APPLICATION PROPERTIES

Nearly every automation object provides a “Parent” and an “Application” property. The “Application” property returns a reference to the top-level Application object. This is a convenient way to access the Application object, particularly when passing Automation objects as arguments to subroutine and function calls.

The “Parent” property returns a reference to the collection object that an object is contained in, or the controlling object. If an object is not contained by a collection object, the “Parent” property typically returns a reference to the Application object.

Introducing Scripter

Golden Software Scripter™ is a program for developing and running scripts. A script is a text file containing a series of instructions carried out when the script is run. Instructions are written in a Visual Basic-like programming language.

Scripter offers many features to help you write, edit, and debug scripts. Its features include language syntax coloring, a drop-down list of the procedures defined in the script, an object browser for examining procedures available in external objects, and a visual dialog editor. Run the script using break points, single-step execution (including options to *step over* and to *step out of* procedures), a watch window for displaying the values of script variables, and others.

To start the Scripter program, select it from the Windows Start menu. Scripter is installed in the same program group as **Grapher**. If Scripter is not present in the Windows Start menu, installation of Scripter may have been skipped when **Grapher** was installed. You can install Scripter from the **Grapher** CD-ROM disk.

Scripter Windows

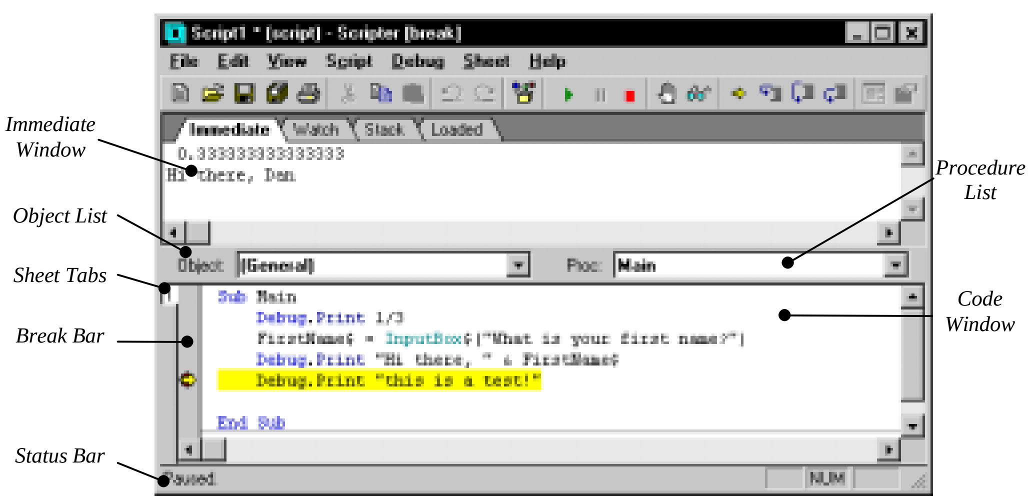
When Scripter is first started, you are presented with a text editor window containing the lines "`Sub Main`," followed by a blank line, and then "`End Sub`." This is the code editor window where you type script instructions and where the contents of script files are displayed.

The code window acts as a text editor similar to the Windows Notepad program with a few enhancements to facilitate script writing:

- After you press the ENTER key, tabs or spaces are automatically inserted at the beginning of the next line to maintain the same indentation level as the previous line.
- Key words and symbols of the Basic language are displayed in different colors. You can use the **View | Colors** command to modify the colors used to display the various elements of the programming language.
- A light horizontal divider line is automatically drawn between sections of your script. The divider lines help you to locate the start of subroutine and function definitions.

Above the code editor window is a bar containing the *Object* and *Proc* (procedure) drop-down lists. Selecting items from these lists moves the various sections of your script file into view. The object and procedure lists are useful when your script file becomes large.

Above the object and procedure lists, you may see a blank window area with a tab on top that reads "Immediate." If this window is not visible, select the **View | Always Split** command to make it appear. The "Immediate" window is used to execute one-line instructions immediately. When you type an instruction into this window and press the ENTER key, Scripter carries out the instruction.



The Scripter application window shown while execution of a script is paused.

In addition to being a scratch area for evaluating language statements, the immediate window shows debugging information. The output from the `Debug.Print` statement and the value of variables selected with the **Debug | Quick Watch** command are printed in the immediate window. While a script program is running, "Watch," "Stack," and "Loaded" tabs are added at the top of the immediate window area. Click these tabs for information that may be useful for debugging. See the *Debugging Scripts* section on page 293 for more information on the immediate, watch, stack, and loaded windows.

Along the left edge of the code window are code sheet tabs. When you select either the **File | New** command or the **File | Open** command, Scripter creates a new code sheet and inserts a new sheet tab. Each tab corresponds to one of the code sheets. Clicking once on a tab makes that sheet the current sheet. Double-clicking a tab closes the sheet.

Between the sheet tabs and the code window is an area called the "break bar." When a script is paused, a yellow arrow in the break bar shows which line is next to execute. The break bar also shows which lines have break points. Set a break point by clicking on the break bar. A red dot appears in the break bar, and the adjacent line in the code window is highlighted. When a line marked as a break point is about to be executed, Scripter pauses program execution. To clear a break point, click on the red dot in the break bar. See the *Debugging Scripts* section on page 293 for more information on break points.

A status bar along the bottom of the Scripter window shows information about the current state of the program. The **View | Status Bar** command hides or reveals the status bar. Before running a script, make sure that the status bar is visible because messages about typographical and syntax errors are displayed in the status bar.

Scripter Menu Commands

Working with Script Documents

To create a new script, select the **File | New** command. A blank script sheet is created. You can start typing script instructions into this sheet. Use the **File | Open** command to open existing scripts. If editing more than one sheet at a time, click the sheet tabs along the bottom of the editor window to switch among them or select the **Sheet | 1, Sheet | 2**, etc. menu commands.

The **File | New Module | Object module** and **File | New Module | Class module** commands open a blank sheet for creating a custom ActiveX object. See the *Code, Class, and Object Modules* section on page 282 of this chapter for information about creating custom ActiveX objects and about using more than one modules in your script.

Use the **File | Save** or **File | Save As** menu commands to save your scripts to the disk. To close the active script use the **File | Close** or **Sheet | Close commands** or double-click the sheet tab of the sheet.

Customizing the Scripter Windows

To show or hide the toolbar at the top of the Scripter window, select the **View | Toolbar** command. To show or hide the status bar, click **View | Status Bar**. When a command has a check mark next to it, it means that the item (toolbar or status bar) is displayed.

To show or hide the immediate window area while writing scripts, select the **View | Always Split** command. While a script is running, the immediate window is always displayed. In addition, while a script is running, the **Watch**, **Stack**, and **Loaded** tabs are added to the immediate window area. Click on a window tab or select one of the **View | Immediate**, **View | Watch**, **View | Stack**, or **View | Loaded** commands to display the contents of one of the window sheets. See the *Debugging Scripts* section on page 293 for more information about these windows.

Use the **View | Font** and **View | Colors** commands to change the font used in the Scripter windows and to change the colors used for syntax highlighting.

Click the **View | Tab Width** menu item to select the number of spaces represented by a tab. When you press the ENTER key, tab characters are inserted at the beginning of the new line so that the indentation level remains the same. Adjusting the tab width changes the indentation levels in your code. If the current line begins with spaces then spaces are inserted at the beginning of the new line instead of tabs.

Working with Code

The Scripter code window functions as a text editor. Select the **Copy**, **Cut**, **Paste**, and **Delete** commands from the **Edit** menu to move, delete, and rearrange information in the code window. Code can also be dragged from one location to another. Drag the cursor over the information you want to select, and then drag the highlighted text to a new position. To undo the last change select **Edit | Undo**. Select **Edit | Redo** to restore the change again.

To search for text, select the **Edit | Find** command and then enter the search text in the *Find what* box. If text is highlighted before invoking the command, it automatically is entered in the *Find what* box. To find additional instances of the same text, continue to click *Find Next.* After you have closed the find dialog box press F3 or select **Edit | Again** to repeat the same search.

To search for and replace text, click **Edit | Replace**. Then, enter the text you want to find and the text you want to replace it. To replace all instances of the text, click *Replace All*. Alternatively, to replace each instance of the text individually, click *Find Next*, and then click *Replace*.

To indent text, first select the lines you want to indent, and press the TAB key. The lines are indented to the next tab position. To shift text to the left select the lines you want to move and press the SHIFT + TAB key. The lines are moved left to the position of the preceding tab stop.

Refer to the following sections of this chapter for information about specialized menu commands:

- See *Creating Dialog Boxes* on page 286 for information about the **Edit | UserDialog Editor** command.
- See *Type Library References* on page 289 for information about the **Edit | References** command.
- See *Code, Class, and Object Modules* on page 282 for more information about the **Edit | Properties** command.
- See *Running* Scripts on page 292 for information about the **Script | Run** menu command.
- See *The Object Browser* on page 290 for information about the **Debug | Browse** command.
- See *Debugging Scripts* on page 293 for information about other **Debug** and **Script** menu commands.

PRINTING

To print a document, select the **File | Print** command. Before printing, you can change the default printer, the paper size, and paper orientation by selecting the **File | Print Setup** command.

USING SCRIPTER HELP

For information on Scripter program menu commands, select the Scripter **Help | Contents** command. Press the F1 key for information about the Scripter windows or the active dialog box. The **Help | Grapher Automation Help** command shows all **Grapher**-specific methods and properties.

The online help, shown when you select the **Help | BASIC Language Help** command or press SHIFT+F1, explains all of the Basic language statements and functions. Each help topic describes the purpose of a statement, and shows the syntax (the order of keywords and other symbols) to use when writing an instruction. The syntax examples in the online help use a shorthand method to explain the possible variations in usage:

Sub, End, True	Words with the initial letter capitalized indicate language-specific keywords.
name	Lower-case words with a dotted underline are placeholders for information you supply.
[param]	Items inside square brackets are optional. These may be omitted from the statement.
{Until | While}	Items between curly braces, and separated by a vertical bar are lists of options. You must use one of the items in list.

[Private | Public]	Items between square braces and separated by a vertical bar are lists of optional choices. You may use one of the items in the list, or none of them.
...	An ellipsis mark indicates that the preceding item in the syntax example is repeated. Repeated items are usually optional and separated by commas, as indicated by this: `[,...]`
; , . ( )	Other symbols must be typed as shown in the syntax example, with the exception that the underscore "_" character may be used to show that a sample line has been split.

WRITING SCRIPTS

To create a script, you must type the script text into the Scripter code window, or edit an existing script. If you want to perform a routine task such as creating a simple graph and modifying its properties you can probably open an existing script file and edit the file to meet your specific needs. **Grapher** comes with several sample scripts that may provide you with a starting point for your scripts.

After writing a new script or opening an existing one, use the Scripter program to execute the script's instructions. Executing a script is done by selecting the Scripter **Script | Run** command, by pressing the F5 key, or by clicking on the green arrow button on the Scripter toolbar. Here is a script that opens a data file, creates a line plot, and adds a linear fit:

```
Sub Main
   ' Create a programmable object to represent the Grapher program
   Set grf = CreateObject("Grapher.Application")

   grf.Visible = True               ' Make the Grapher window visible
   Set doc = grf.Documents.Add      ' Add a new plot document
   DataFile$ = GetFilePath$()       ' Prompt for name of the data file

   ' Invoke the Grapher AddLinePlotGraph command.  This function returns
   ' a graph object
   Set MyGraph = doc.Shapes.AddLinePlotGraph (DataFile$)

   ' "Drill down" through the object hierarchy to get a reference to the
   ' line plot we just created.  The names used to identify the graph and
   ' plot objects are uppercase/lowercase sensitive
   Set plot = MyGraph.Plots.Item(1)

   ' Add a linear fit To the Line plot
   plot.AddFit(grfLinearFit)
End Sub
```

When you execute the script, **Grapher** is automatically started and a plot window is displayed. The program prompts for the name of a data file. It then creates a line plot with the data file using the default settings for the x and y columns, line styles, tick marks, etc. Finally, it adds a linear fit to the graph. When the script execution is complete, you are returned to the Scripter window. The **Grapher** window remains open after this script has finished.

The Scripter BASIC Language

This section describes the major elements of the Scripter Basic programming language, but it does not explain the concepts of writing computer programs. Many good books on the subject of programming with BASIC (**B**eginner's **A**ll-purpose **S**ymbolic **I**nstruction **C**ode) have been written. If you are not moderately familiar with writing computer programs, we suggest that you refer to one of the books listed in the *Suggested Reading* section on page 298.

Scripts are text files that contain a sequence of instructions to be carried out by the Scripter program. Each instruction specifies a task such as defining a variable or displaying a message on the screen. When the Scripter program processes the script, the instructions are carried out one at a time, from top to bottom.

Execution of a script begins with the first statement of the subroutine called "Main." All scripts must therefore include the SUB MAIN and END SUB statements. Execution proceeds line-by-line until the end of the "Main" procedure, until an END statement is executed, or until an error occurs.

Program Statements

Statements are individual instructions to Scripter that carry out a specific operation. Statements are case insensitive and are typically written one to a line. To enter two or more statements on the same line, separate the statements with colons. For example:

```
a = 5 : b = 5 * a
```

Scripter Basic requires flow control statements (IF, WHILE, DO, etc.) and declaration statements (DIM, PUBLIC, TYPE, SUB, etc) to be placed on a line by themselves.

Line Continuation

Long statements, particularly function calls requiring a large number of arguments, often do not fit on a single line. A long line may be split into two or more lines by adding a space followed by an underscore " _" at the end of each line that is continued:

```
Function ComputeSomething( filename As String, _
value_array() As Double) As Double
```

Comment lines cannot be continued with an underscore; start each comment line with an apostrophe when writing multiple-line comments.

Comments

Writing comments in your scripts to explain how they work can save you time and frustration when you later need to modify the script. The apostrophe character (') signals the start of a comment. Scripter ignores all text following the apostrophe up to the end of the line. Comments can be placed on their own line, or they may be placed at the end of a line. For example:

```
grf.Documents.Add   ' This creates a new, blank plot document
```

In addition, you can use the REM statement to add a remark in the script. However, REM statements can only be used at the beginning of a line.

Double Quotes and Text

Text strings must be enclosed in double quotes. File names, for example, must be surrounded by double quotes. If quotes are missing, the text may be mistaken for a variable name.

```
Debug.Print  "This text string is printed in Scripter's immediate window"
```

Variables

A variable is a symbolic name for a value. A variable name starts with a letter and may contain digits. Variable names cannot be the same as a reserved word. Because the Scripter code window displays variable names in black and reserved words in color, you can see when you have selected a variable name that conflicts with a reserved word.

Variables may be one of several types. The type of a variable determines what kind of data it may contain. See the following table for the possible variable types. In addition to the built-in data types, the Scripter language supports user-defined compound data types, user-defined enumeration types, and user-defined objects (defined in object modules and class modules). See *User-defined Types* on page 276, and the *Module Types* section on page 282 of this chapter for more information. Refer to the Scripter online language help for information about enumeration types.

The type of a variable is declared in a DIM statement. The syntax of a DIM statement is:

```
Dim varname As type
```

where varname is the name of the variable being declared, and type is the variable's data type. Variables not declared in a DIM statement are a Variant type, unless the variable name ends with one of the type-definition characters. If a variable name ends with one of the special type-definition characters, listed below, its type is recognized based on this character.

Type	Type-definition Character	Description of Type
Integer	%	A 16-bit integer value
PortInt (Portable Integer)	?	A 16- or 32-bit integer value
Long	&	A 32-bit integer value
Single	!	A 32-bit floating-point value
Double	#	A 64-bit floating-point value
Currency	@	A 64-bit fixed-point value
String	$	A text string of any length
Byte	(none)	An 8-bit unsigned integer value
Boolean	(none)	A true or false value
Date	(none)	A 64-bit floating-point value
Object	(none)	A reference to an ActiveX object
Variant	(none)	Capable of holding any type of value

Using the DIM statement to declare the variable type is optional. Variables can be used without first being declared in a DIM statement, but this practice is not recommended for any script longer than a few dozen lines. To enforce this policy, an OPTION EXPLICIT statement should be placed at the top of long scripts. The OPTION EXPLICIT statement makes it an error to use any variable without first declaring it. Using this option lets you find typographical errors in variable names before a script is run. Without this option, typographical errors in variable names are usually detected only when the script fails to produce the expected results.

Object Variables

Object variables contain references to ActiveX objects. Creating the **Grapher** *Application* object is an example of declaring an object variable:

```
Dim GrapherApp As Object
Set GrapherApp = CreateObject("Grapher.Application")
```

In this example, a DIM statement declares that the variable named “GrapherApp” holds a reference to an object. The built-in CreateObject function returns a reference to a **Grapher** *Application* object, and the SET statement assigns this object reference to the “GrapherApp” variable. Unlike variables of other types, which can be assigned new values simply with an equal sign (“=”), object variables must be assigned values with a SET statement.

Array Variables

Array variables store a list or table of values. A single variable name refers to the entire collection, and individual values are distinguished by their numeric indices (their "subscripts"). The maximum number of values that can be stored in an array must be defined in a DIM statement. The elements of an array are accessed by using the variable name followed by a left parenthesis, the index of an array element, and a right parenthesis.

```
Dim month(11) As String
month(0) = "January"
month(1) = "February"
…
month(11) = "December"
```

Array subscripts begin with zero, unless an OPTION BASE statement is used at the start of a script. Notice that in the previous example an array whose maximum subscript value is 11 actually has room for twelve elements because the subscripts start with zero.

The DIM statement can reserve only a constant number of elements for an array. If the maximum number of elements cannot be known in advance, a *dynamic array* may be used. A dynamic array is an array whose number of elements can be changed while a script is running. The REDIM statement changes the maximum number of values that can be stored in a dynamic array. Refer to **Help | BASIC Language Help** in Scripter for more information on DIM and REDIM.

User-defined Types

A collection of related variables can be grouped together under one name. The TYPE statement defines the elements of a user-defined type.

```
Type measurement
   julianday As Integer
   level As Double
End Type
```

The TYPE definitions must appear at the top of a script file, before any subroutines. The TYPE…END TYPE statement defines a new type; it does not create a variable of that type. Variables of the user-defined type must be declared in a DIM statement. The elements of a user-defined type variable are accessed by using the variable name followed by a period and the element name:

```
Dim m As measurement
m.julianday = 192
m.level = 12.3
Debug.Print m.julianday  ' prints 192 in the Immediate window
Debug.Print m.level      ' prints 12.3 in the Immediate window
```

Global Variables

Variables declared in the body of a subroutine or function are available only within that procedure. If you want to share the same variable throughout a script file, then you can define it at the top of the file, before any subroutine definitions. Variables declared at the top of the file are available to all subroutines in the file.

The PUBLIC keyword may be substituted for the DIM keyword to allow a global variable to be used in other modules. See the *Code, Class, and Object Modules* section on page 282 of this chapter for more information on modules.

Operators

Operators are symbols that direct a script to perform basic calculations, such as addition, exponentiation, string concatenation, number comparison, and others. The language supports several arithmetic, comparison, and logical operators. Select the Scripter **Help | BASIC Language Help** command and search for "Operators" to see a complete list.

Flow Control

When you run a script, execution starts with the "Sub Main" statement and continues line-by-line until the "End Sub" statement at the end of the main procedure or until an End statement is encountered. Several flow control statements allow you to change this line-by-line progression according to conditions encountered by your script. The Scripter Basic language includes a variety of looping and branching statements that is typical for modern programming languages. The flow control statements include the following (see the online Basic language help for details on the syntax of these statements):

IF…END IF

Executes a statement only if a condition if true. The alternate IF…ELSE…END IF form executes one statement if a condition is true and a different statement if the condition is false.

SELECT CASE…END SELECT

Branches to one of several statements. Compares the value of an expression to several test values and executes the statements associated with the test value that matches the expression value.

DO…LOOP

This is the basic looping statement. Loops either while a condition is true or until a condition becomes true. Tests the condition either at the top of the loop or at the bottom of the loop.

This and all other loop structures may be stopped before the test condition has been met by placing an EXIT statement in the body of the loop.

WHILE…WEND

Loops while a condition is true; tests the condition at the top of the loop.

FOR…NEXT

Loops a number of times; increments (or decrements) an index variable each time through the loop.

FOR EACH…NEXT.

Iterates through all the elements in some collection objects. **Grapher** collection objects do not support enumeration using the FOR EACH statement.

Optional Arguments

Many procedures, especially the methods provided by **Grapher** automation objects, accept a large number of arguments. Some of the arguments are required. Every required argument must be supplied or the script fails to run. Some arguments are optional. Optional arguments may be omitted and the procedure assumes a default value for the missing arguments.

For example, the *PlotDocument* object's "PrintOut" method accepts up to four arguments, all of which are optional:

```
plot.PrintOut(Method, Scale, hrzOverlap, vertOverlap)
```

Since the arguments are optional, you can skip all or some of them when calling the procedure. To print at fifty-percent scale, for example, you would supply just the "Scale" argument value.

These arguments must be listed in the correct position, separated by commas, as shown below:

```
Set grf  = CreateObject("Grapher.Application")
Set plot = grf.Documents.Add
plot.PrintOut(,50)
```

Although only one of the four argument values is supplied in this example, the appropriate number of commas must be used to mark the positions of the missing arguments.

Grapher automation objects do not support named arguments.

SUBROUTINES AND FUNCTIONS

Writing a long or complicated script may be easier to manage if you divide the script into smaller pieces called procedures. A procedure is a separate sequence of instructions that you can call from multiple places within your script. The Basic language provides many pre-defined procedures for performing frequently needed tasks, and, in fact, the methods provided by the **Grapher** automation objects are themselves procedures.

When you call a procedure, the instructions in the procedure are executed. When the procedure finishes its task, it returns control to the instruction that called the procedure. The Scripter Basic language distinguishes two types of procedures: functions and subroutines. Functions return a value, whereas subroutines do not.

Subroutines and functions may accept one or more values, called arguments. Arguments are passed to a procedure by listing them after the procedure name. If there is more than one argument, the arguments must be separated by commas. For example:

```
x = Cos(0)              ' Returns the cosine of the argument (returns 1)
a$ = Left("AgAuPb",2)  ' Returns the left-most characters (returns "Ag")
Wait 5                  ' Waits for 5 seconds
```

COS, LEFT, and WAIT are procedures built-in to the Basic language. COS and LEFT are functions which return values to the caller. WAIT is a subroutine, and, by definition, it does not return a value. The WAIT subroutine waits for the number of seconds specified by its argument (5 seconds in this example) before returning CTRL to the calling location.

The arguments passed to a function must be enclosed in parentheses if the function's return value is used. If the function's return value is not used, the arguments may be listed without enclosing them in parentheses. Arguments passed to a subroutine are never enclosed in parentheses.

Writing Subroutines

To define subroutines within a script, use the SUB statement. Subroutine and function definitions cannot be nested within other procedures. That is, the SUB statement must appear after the END SUB statement of any preceding subroutine definitions. The syntax for a subroutine definition is:

```
Sub name ( arguments )
    statements
End Sub
```

where name represents the name you want to give to the subroutine, arguments represents a list of arguments names and types, and statements represents the instructions that comprise the body of the subroutine. There is no limit to the number of instructions you can include between the SUB and the END SUB lines. Consider the definition of a "Main" procedure and another subroutine:

```
Sub Main
   MultipleBeep 25   ' call the MultipleBeep subroutine
End Sub

Sub MultipleBeep (count As Integer)
   For i = 1 To count
      Beep
   Next
End Sub
```

Each time the "MultipleBeep" procedure is called the instructions between its SUB and END SUB statements are executed.

If the subroutine accepts arguments, the arguments are defined following the subroutine name using a format similar to the DIM statement. The argument definition list must be enclosed in parentheses, and argument definitions are separated by commas if there is more than one. When a subroutine is called, the variables listed in the argument list are automatically assigned the values passed in from the calling procedure.

Writing Functions

Functions are defined using the FUNCTION statement much the same as subroutines are defined with the SUB statement. Like subroutines, function definitions cannot be nested within other procedures. Unlike subroutines, functions can return a value to the calling procedure. The syntax of a function definition is:

```
Function name ( arguments ) As type
    statements
End Function
```

where name is the function name you want to use, arguments is a list of arguments names and types, type is the type of the value returned by the function, and statements are the instructions in the body of the function. To return a value from a function, assign a value to a variable with the same name as the function itself. For example:

```
Function hypotenuse(a As Double, b As Double) As Double
   c = a * a + b * b   ' The built-in Sqr function computes the square root
   hypotenuse = Sqr(c) ' Set the function's return value
End Function
```

You define the list of arguments accepted by a function the same way as you define the arguments accepted by subroutines.

BUILT-IN FUNCTIONS AND PROCEDURES

Numerous useful functions and subroutines are built-in to the Scripter Basic language. These routines can help you perform some of the most commonly required programming tasks. Functions for processing strings, performing mathematical calculations, error handling, working with disk files, and many others are available.

If you are not already familiar with the Visual Basic for Applications programming language, it may be worth your time to review the list of available routines. This list is found by selecting **Help | BASIC Language Help** from the Scripter menu.

USING GRAPHER OBJECTS

To access **Grapher** commands from your script you must create a **Grapher** *Application* object. To create an *Application* object, call the *CreateObject* function with "`Grapher.Application`" as the argument.

Every object has properties and methods associated with it. Properties are values describing the state of an object. Methods are actions an object can perform. Access properties and methods by typing the name of an object variable, followed by a period, followed by the property or method name.

You can use object properties as you would use variables: assign values to properties, branch based on the value of a property, or use the value of a property in calculations. You call an object's methods as you would call subroutines and functions. Use the return values from methods the same as you would use return values from functions.

When you "drill through" the object hierarchy, you can store references to intermediate objects in variables, or you can string together long sequences of object references. For example, you can set the default font for a plot document in a single line:

```
' Assume "grf" is a variable holding a reference to the Application object
grf.Documents.Item(1).DefaultFont.Bold = True
```

Alternatively, you can store each intermediate object in variables as you traverse the object hierarchy:

```
' Assume "grf" is a variable holding a reference to the Application object
Set docs = grf.Documents
Set plot = docs.Item(1)
Set font = plot.DefaultFont
font.Bold = True
```

The second form—storing intermediate objects—is more efficient if you are performing several actions with the same object. A third alternative is to use the WITH…END WITH statement:

```
' Assume "grf" is a variable holding a reference to the Application object
With grf.Documents.Item(1).DefaultFont
   .Bold = True
   .Size = 12
   .Color = grfColorHotPink
End With
```

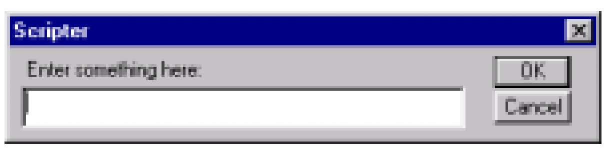
GETTING USER INPUT

The Scripter language provides several predefined functions for prompting the script user for information. The *GetFilePath* function displays a standard Windows file open dialog box. This allows the script user to select a file. The name of the selected file is returned by the function. The *InputBox* function allows the user to enter an arbitrary line of text.

This function returns the line of text entered.

```
UserText$ = InputBox("Enter something here:") 'show prompt

Debug.Print UserText$                          'show line in Immediate window
```



Example of the InputBox function. The text entered in the box is returned to the script.

In addition to these simple input routines, Scripter supports user-defined dialog boxes. You can design your own dialog boxes and process their input in any manner you choose. See the *Creating Dialog Boxes* section on page 286 of this chapter for more information.

CODE, CLASS, AND OBJECT MODULES

If you create very large scripts, or frequently reuse the same subroutines in several different scripts, you may want to split your script code into more than one file. Each script file is called a module.

A script can call subroutines and functions defined in other modules. In addition to procedures, global variables, type definitions, and enumeration definitions may be shared among modules. Just as procedures make long scripts easier to manage and debug, modules make large script projects easier to manage.

Module Types

The Scripter **File | New Module** command adds new code sheets to the workspace. Each sheet is stored in a separate file. When routines in one code sheet are used by other sheets, the code sheets are called modules. Scripter supports three types of modules:

- Code modules are used for stand-alone scripts and for storing libraries of useful procedures that can be called from other modules. The scripts described in this chapter are code modules, which contain a “Main” subroutine. Code modules without a “Main” subroutine cannot be run, but the routines contained in them can be shared by other scripts. Code modules are stored in files with a [.BAS] extension.
- Class modules are used to define ActiveX objects that you can use in other modules. A class module defines the properties and methods that the object supports. Other modules access the object’s properties and methods using the same syntax that is used to access **Grapher** automation objects. Unlike **Grapher** objects, new instances of the object defined in a class module are created using the NEW keyword. Class modules are stored in files with a [.CLS] extension.
- Object modules are identical to class modules, except that when a script uses the object defined in an object module, one instance of the object is automatically created. Additional instances of an object defined in an object module can be created with the NEW keyword. Object modules are stored in files with an [.OBM] extension.

The '#Uses Line

Before using the procedures and objects defined in another module, a script must indicate the name of the file containing the procedure or object definitions. You must place a '#USES statement at the beginning of a script, before any procedure definitions, to instruct Scripter to load all modules used by the script. For example:

```
'#Uses "c:\utils.bas"
'#Uses "test.cls"
Sub Main
   ' use the procedures and object defined in UTILS.BAS and TEST.CLS
End Sub
```

Scripter does not permit cyclic '#USES statements. That is, if module “A” uses module “B,” module “B” cannot use procedures from module “A.”

Private and Public Definitions

By default, all subroutines, functions, and user-defined types (including enumeration definitions) may be accessed from other modules. To prevent other modules from accessing procedures or user-defined types precede the definition with the PRIVATE keyword:

```
Private Sub MyBeep
    Beep : Beep
End Sub
```

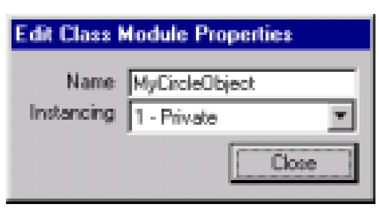
In contrast to procedures, the global variables defined at the top of one module are not available to other modules unless they are declared using a PUBLIC statement. When used for variable declarations, the PUBLIC statement has the same syntax as the DIM statement:

```
Public universal_data As String
```

The names of all definitions, even private ones, are visible in other modules. To avoid errors due to name conflicts you must avoid using the same procedure, type, and variable names in more than one module. A common technique for avoiding name conflicts is to append a prefix to the names of global variables and procedures. For example, if you write a module of text-processing functions, you might prefix each function name with “txt” (e.g., “txtFunction1”).

Module Properties

To set the name by which other modules refer to an object defined in a class or object module, select the **Edit | Properties** command. The **Edit Class Module Properties** dialog box appears. Type the name that you want other scripts to use when referring to the object defined in the module. The instancing options control how other applications access the object defined in the module, but these options are not relevant to scripts executed within Scripter. Code modules do not have module properties.



*The **Edit Class Module Properties** dialog box*

When an object module is used in a script, one instance of the object defined in the module is automatically created. The name of the object that is automatically created is the name specified in the **Edit Object Module Properties** dialog box.

Defining Object Properties and Methods

Class and object modules define the properties and methods of ActiveX objects. To define the methods for an object, simply define public subroutines and functions. All the public procedures in a class or object module are methods that users of the ActiveX object can call.

The properties of an object typically correspond to private global variables defined in the module. To allow users of the object to access the variable values, you provide "property get" and "property set" procedures. Use the PROPERTY GET statement to define a function that returns the value of a property. Use the PROPERTY LET statement (or the PROPERTY SET statement if the property is an object reference) to define a subroutine which changes the value of a property.

Two special subroutines are called when an object is first created and just before it is finally destroyed. In a class module, these subroutines are called "Class_Initialize" and "Class_Terminate." In an object module, these subroutines are called "Object_Initialize" and "Object_Terminate." These subroutines do not take any arguments.

Example: Defining an ActiveX Object in a Class Module

The following class module demonstrates how to define an ActiveX object. The sample defines a property named "Radius" and a method named "Draw."

```
' Declare a private global variable for storing the property called "Radius"
Dim cirRadius As Double

' Define the initialization subroutine
Private Sub Class_Initialize
    cirRadius = 99
End Sub

' Define the termination subroutine
Private Sub Class_Terminate
End Sub

 ' Define the "property get" function to retrieve the Radius property
Property Get Radius() As Double
   Radius = cirRadius
End Property

' Define the "property let" procedure to change the Radius value
Property Let Radius(val As Double)
   cirRadius = val
End Property

Sub Draw
   ' Method performs some action here
End Sub
```

Scripts that use the class module would access the object as follows (assuming the module is stored in the file CIRCLE.CLS and that the object name entered in the **Edit Object Module Properties** dialog box is "MyCircleObject")

```
'#Uses "circle.cls"
Sub Main
   Dim x As New MyCircleObject
   x.Radius = 7           ' sets the value of the Radius property
   x.Draw                 ' calls the Draw method
   Debug.Print x.Radius   ' prints 7 in the immediate window
End Sub
```

CREATING DIALOG BOXES

Scripter contains a dialog box editor that you can use to design customized dialog boxes. Select **Edit | UserDialog Editor** to visually design a dialog box. You can control the size and placement of the components of the dialog box, as well as customize the text included in the dialog box.

To add a component to a dialog, first select from the palette of components at the left side of the **UserDialog Editor**. After clicking a palette button, drag the mouse pointer diagonally in the dialog design area where you want to place the component. As you design the dialog box, you can edit the properties of components you have placed in the dialog box. To edit the properties of a component, double-click the item, click the right mouse button on the item, or select the component and click the **Edit Properties** toolbar button. See the table below for a list of dialog box components (also known as *dialog controls*) and their properties. Every dialog box must include an "OKButton" or a "CancelButton," or both.

When you have finished designing the dialog, click the **Save Dialog** toolbar button. The code for the dialog box is inserted into the script. To edit the dialog template after it has been inserted into the script, first move the cursor in the code window to any line between the BEGIN DIALOG statement and the END DIALOG statement. Next, select the **Edit | UserDialog Editor** command. The previously saved state of the dialog is shown in the dialog editor. When you save the dialog again, the previous dialog template is replaced with your changes.

To show your custom dialog in a script, first use the DIM statement to declare a variable as the "UserDialog" type, and then call the DIALOG function to display the dialog (see the example below). The DIALOG function takes a user dialog variable as its argument and returns a number indicating which button was clicked to end the dialog. The DIALOG function returns -1 if the OK button was clicked, 0 if the *Cancel* button was clicked, or an integer greater than zero if a push button was clicked (1 for the first push button listed in the dialog template, 2 for the second push button in the dialog template, and so forth).

If the return value is not needed, the DIALOG instruction may be called as a subroutine rather than as a function (in this case, do not enclose the dialog variable in parentheses). If the DIALOG instruction is called as a subroutine, however, the script ends with a run-time error if a cancel button is clicked.

To define more than one custom dialog in a script, you must place each dialog template in its own subroutine or function. If you try to define more than one custom dialog in the same procedure, Scripter shows an error indicating that the "UserDialog" type has already been defined.

The values contained by dialog controls are accessed the same the way the fields of user-defined variable types are accessed. Type the dialog variable name, a period, and the field name of the dialog component. Option button values cannot be accessed directly, but are accessed via the field name of their associated option group. The value of an OptionGroup is the number of the selected option button (the first option button in the group is 0, second option button is 1, and so forth). You can initialize the values contained by dialog controls prior to showing the dialog, and retrieve the values entered in the dialog after it has been invoked.

User dialog displayed by the example.

Example: Defining a Simple User Dialog

The following function demonstrates how to define, display, and extract the values entered in a user dialog.

```
Function MyInputBox As String
   ' Define the dialog template.  This definition
   ' is inserted by the UserDialog editor.
   Begin Dialog UserDialog 250,112,"Caption"
      TextBox 10,14,230,28,.Text1
      Check box 20,49,160,14,"Check box",.Check1
      OKButton 20,77,90,21
      CancelButton 130,77,90,21
   End Dialog
   ' Declare a dialog variable
   Dim dlgvar As UserDialog

   ' Initialize the dialog CTRLs
   dlgvar.Text1 = "This is the initial text to display"
   dlgvar.Check1 = True  ' start with check box checked

   ' Display the dialog and wait for the OK or Cancel button to be pressed
   result = Dialog(dlgvar)

   ' Extract the information entered into the dialog
   If result = -1 Then   ' check to see if OK button was pressed
      MyInputBox = dlgvar.Text1
      If dlgvar.Check1 Then Debug.Print "The Check box was Checked!!"
   End If
End Function
```

To perform processing while a user dialog is active, define a special "dialog function." The dialog function is called when various dialog events occur. To define a dialog function:

1. While designing the dialog, double-click in a blank portion of the dialog design area to activate the **Edit | UserDialog Properties** dialog box.
2. Enter a name for the *Dialog Function* property of the dialog box. This property gives the name of a function that is called when dialog events occur.
3. When you save the dialog box, Scripter asks if it should create a skeleton dialog box function. Click the *Yes* button, and Scripter inserts the basic instructions for a dialog function into your script.

   Refer to the "DialogFunc" help topic in the Scripter Basic language help for more information about how to process dialog events in a dialog function.

The following table shows the dialog controls used in a dialog box and their associated properties:

Item	Description	Properties
GroupBox	A rectangle used to group related controls.	Field, Caption
Text	A text label. Requires no response from the user.	Field, Caption
TextBox	An edit box used to enter and edit text.	Field, Type (single line, multiple line, password)
CheckBox	A box which is checked and unchecked as the user clicks on it. A three-state check box has a disabled (grayed) state.	Field, Caption, Type (2 state, 3 state, 3 state auto check)
OptionButton	A round button for choosing from a set of options. Only one of a group of option buttons may be checked.	Field, Caption, Option Group
ListBox	A window that contains a list of items that can be selected by the user.	Field, Array of Items, Type (list, sorted list)
DropListBox	A list that is visible when opened by the user. The text may be editable or not. The list may be sorted or not.	Field, Array of Items, Type (list, text, sorted list, sorted text)
ComboBox	A text box with an attached list box. The list may be sorted or not.	Field, Array of Items, Type (text, sorted)
Picture	Displays a bitmap in the dialog	Field, Caption, Type (from file, from clipboard)
PushButton	A push button.	Field, Caption
OKButton	Push button with "OK" caption	Field
CancelButton	Push button with "Cancel" caption	Field
Dialog	Definition of dialog box	Dialog Function, Caption, Centered

Properties:

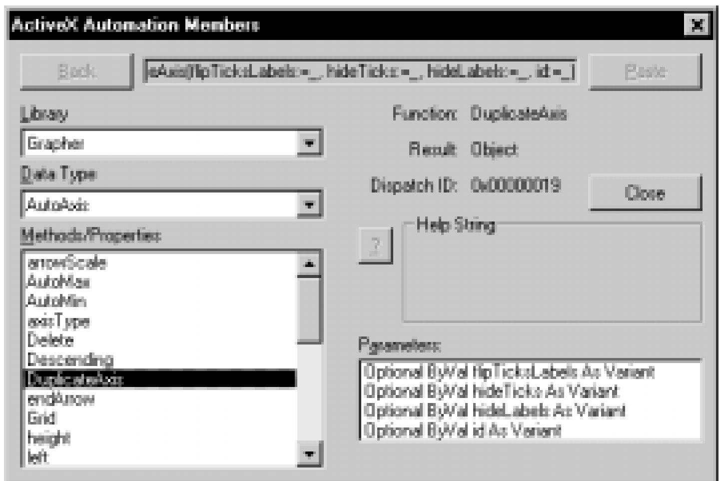
- **Dialog Function:** The name of a special function that is called when various events happen in a dialog. Define a dialog function to controls the behavior of a dialog and to retrieve its input.
- **Field Name:** The name used to refer to a component.
- **Caption:** The text displayed within a component.
- **Quoted:** When not quoted, the caption property gives the name of variable that contains the text to display for the caption. When quoted, the caption property is the literal text to display.
- **Array of Items:** The name of a string array variable, which contains the strings to display in a list. The array variable must be initialized before the dialog is invoked.
- **Type:** The behavior of some components varies depending on which option is selected. Refer to the online help for descriptions of the available component types.
- **Option Group:** For option buttons, the field name used to refer to a group of option buttons. Only one option button within a group may be checked.
- **Comment:** A comment to insert in the dialog definition block.

TYPE LIBRARY REFERENCES

Many application programs expose their services with ActiveX objects. These objects may be used in your scripts, just as the **Grapher** automation objects are used. Before you can use another application's objects, you must add a reference the application's type library. A type library is a file that describes the objects, properties, and methods provided by an application. The **Grapher** type library is automatically referenced.

To add a type library reference to the current script module:

1. Select the Scripter **Edit | References** command. The **References** dialog box is displayed.
2. Click on the check box next to the type library whose objects you want to use in your script.
3. Click on the up and down arrows to adjust the relative priority of the checked references. If two libraries describe items with the same name, the item described in the higher-listed library is used by your script.
4. Click **OK** when finished adding type library references to your script.



The ***ActiveX Automation Members*** *dialog box.*

The Object Browser

The Scripter **ActiveX Automation Members** dialog box shows the methods and properties of the ActiveX objects available to your script. This dialog provides a quick way to check the names of objects or to determine the argument list for a method.

Choose the **Debug | Browse** command to activate the **ActiveX Automation Members** dialog box.

- The *Library* list shows object libraries available for use in the current script. These are the same libraries checked in the **References** dialog box. See the *Type Library References* section of this chapter for information about adding type library references in your script.
- The *Data Type* list shows objects available in the type library selected from the *Library* list.
- The *Methods/Properties* list shows methods and properties available from the object selected in the *Data Type* list.
- The text box along the top of the dialog demonstrates the usage of the selected method or property. Click the *Paste* button to insert this sample into the code window.
- Information about the item selected in the *Methods/Properties* list is shown along the right half of the dialog box. The top line shows the selected item's type ("function," "property," or "property get") and its name. The second line, labeled *Result*, shows the type of value returned by the method or property. The third line, labeled *Dispatch ID*, shows a value that uniquely identifies a property of method (this value is not used in scripts).

- If a method or property returns a reference to another object in the type library, the *Result* label is replaced by a button labeled *Follow Value*. Click the *Follow Value* button to see the definition of the object returned by the method or property. After clicking the *Follow Value* button, the *Back* button becomes enabled. Click the *Back* button to return to the definition you were previously viewing.
- The *Help String* group shows a short description of the item selected in the *Methods/Properties* list. Click the *?* button to view the help file associated with the type library. Not all type libraries have help files available.
- If the item selected in the *Methods/Properties* list is a method that accepts parameters, a *Parameters* list shows the names and types of all parameters used by the method.
- Click the *Close* button to dismiss the object browser dialog.

Compatibility with Visual Basic

The Scripter Basic programming language is compatible with the Visual Basic for Applications language (VBA). Scripts that run in Scripter will work in a VBA environment with few or no modifications. Scripter programs also work under Microsoft Visual Basic. Unlike most Visual Basic programs, however, Scripter programs are not event-driven. Scripter programs are procedural. They start with the first statement of the “Main” procedure, and end when the “Main” procedure ends.

Some statements available in VBA are not supported in Scripter Basic, such as these:

The VBA *Collection* object	All Financial functions	LinkExecute
The VBA *Clipboard* object	Resume at current line	LinkPoke
GoSub	Erl	LinkRequest
On...GoSub	Option Compare	LinkSend
On...Goto	Conditional compilation	Line numbers
GoSub…Return	With Events	LoadPicture
Multiple statements on one line (separated by “:”)		

Conversely, some features of the Scripter Basic language are not supported by VBA. Do not use the following features if you want to transfer your scripts from Scripter into VBA:

Clipboard function	CallersLine	DDEExecute
User dialogs	PortInt	DDEPoke
MacroDir	Wait instruction	DDERequest
MacroRun	DDEInitiate	DDETerminateAll
MacroRunThis	DDETerminate	

Running Scripts

Scripts are simply plain text files. You could create script files with any text-editing program, such as the Windows Notepad. The usefulness of scripts is not realized until the script instructions are carried out. The Scripter program is designed to interpret script instructions and to carry them out. The process of carrying out the instructions in a script is called “running” or “executing” the script.

Running Scripts from Scripter

Scripts are placed in the code window either by typing a new script from scratch or by loading the script with the **File | Open** command. To run the script in the Scripter code window, select the **Script | Run** command, press the F5 key, or click on the green arrow button on the toolbar. Scripter examines the script instructions, and, if all the instructions are recognized, it begins to perform each instruction in turn.

More often than not, however, a newly typed script does not work correctly the first time it is run. Even simple typographical errors cause the script to fail. For information on finding and fixing errors in scripts, see the *Debugging Scripts* section on page 293 of this chapter.

Select the **Script | End** command or click the red square button on the tool bar to stop executing a script. This may be necessary when you want to edit a script after a run-time error occurs, or when you accidentally start a script and you want to cancel the execution.

Running Scripts from the Command Line

You can run scripts from a command prompt without having to manually load and execute the script in Scripter. The same commands that you would type at a command prompt may also be entered as the “target” for a shortcut in order to link a shortcut icon to a script. Enter the following to run a script from the command line or to link a shortcut to particular script file:

```
<Scripter path> -x filename.bas
```

where *<Scripter path>* represents the path to the Scripter program file (for example, “C:\ProgramFiles\Grapher\Scripter\Scripter.exe”), and *filename.bas* represents the name of the script to run. The space between the –x and the file name is required. This command opens the Scripter window, loads the specified script file, and automatically runs the script. When the script terminates—either successfully or unsuccessfully—the Scripter window closes.

To load a script file but not execute it, the following command can be used:

```
<Scripter path> filename.bas
```

This opens the Scripter window and automatically loads the specified script file. The Scripter window remains open.

DEBUGGING SCRIPTS

Bugs are errors in a script which keep it from performing as intended. Debugging is the process of locating and fixing these errors. The most common bugs are typographical errors in scripts or malformed instructions. Scripter detects these types of errors immediately when you try to run a script. The program beeps, highlights the line containing the error in red (or whatever color has been set with **View | Colors** command), and displays an error message on the status bar.

Before running a script, verify that the **View | Status Bar** command is enabled, otherwise you will not see the error message. To resolve the errors that Scripter immediately detects, you usually must interpret the error message and correct the indicated problem. Typical errors are typing mistakes, unbalanced parentheses, misuse of a Basic language instruction, or failure to declare variables in a DIM statement if you use the OPTION EXPLICIT statement. If you do not see an obvious problem, refer to the online Basic language help to make sure you are using the right syntax.

Scripts which encounter errors midway through script execution may be fixed much the same way as syntax errors. The error message should guide your actions. Some run-time errors cannot be detected until they are executed, such as when you try to open a file that does not exist. In these cases, you need to check for error conditions in your scripts. For example, use the DIR function to make sure a file exists before trying to open it. Alternatively, you can use the ON ERROR GOTO statement to specify an error handling section to execute when a procedure encounters a run-time error:

```
Sub OpenFile(grf As Object, filename As String)
   On Error Goto ErrLabel
   grf.Documents.Open filename
   Exit Sub

   ErrLabel:
      MsgBox "Unable to open file " & filename
      Exit  ' Must use RESUME or EXIT at end of error handling code
End Sub
```

Most difficult to correct are scripts which run, but do not work as expected. Fixing these scripts is hard because you do not know which line or statement is causing the problem. Scripter provides a number of debugging features to help you locate the source of problems.

Probably the simplest debugging technique is to insert instructions into your script to monitor the progress of the script and display the values of variables at various points throughout the script. Use the `Debug.Print` statement to display information in the Scripter immediate window:

```
Debug.Print "The value of variable x is "; x
```

To clear the contents of the immediate window, select the text in the window and press either DEL or BACKSPACE.

Insert the STOP instruction to pause script execution where you think there might be a problem. While the script is paused, you can examine and change the values of program variables. If a running script appears unresponsive, it may be stuck in an infinite loop. Select the **Script | Pause** command or click the toolbar button with a blue double vertical line to pause the script. To resume executing a paused script, select the **Script | Run** command.

While a script is paused, there are several ways to view the value of a variable:

- In the immediate window, type a question mark, followed by the variable name and press ENTER. The current value of the variable is displayed.
- In the code window, place the cursor on the variable name you want to examine (that is, click on the variable name in the code window). Press SHIFT+F9, select the **Debug | Quick Watch** command, or click the eyeglasses button on the toolbar. The current value of the variable is displayed in the immediate window.
- To continuously monitor a variable's value, click on the variable name in the code window, and press CTRL+F9 or select the **Debug | Add Watch** command. Alternatively, type the variable name in the watch window and press ENTER. The variable name and its value are displayed in the watch window. Every time script execution pauses, the variable value is automatically updated. To clear a variable from the watch window, highlight the line showing the variable value and press the DEL or BACKSPACE key.

To change the value of a variable, type an assignment expression in the immediate window and press ENTER. For example, type "A=5" (without quotes) and press ENTER to assign a new value to the variable named "A."

A powerful debugging technique is to watch Scripter execute your script one line at a time. This lets you check the effect of each instruction and verify that the script is doing what you expect. While stepping through a script, you can examine and change the values of script variables. Select the **Script | Run** command to resume script execution at full speed after stepping through script instructions.

- To execute your script one line at a time press the F8 key, or select the **Debug | Step Into** command. The first line of the script is executed (or, if the script was paused, the next highlighted line is executed). The next line is highlighted and a yellow arrow appears to the left of the next line. To execute the highlighted instruction, press F8 again.

- If a statement calls a subroutine or function that is defined within your script, the highlight moves into the called procedure. To keep from tracing execution into a called procedure, press SHIFT+F8 or select the **Debug | Step Over** command. This executes the whole subroutine or function in a single step.
- If you accidentally step into a procedure, press CTRL+F8 or select the **Debug | Step Out** command. This executes all remaining instructions in a procedure, and returns the highlight to the instruction that called the procedure.
- If you do not see the next highlighted instruction, select the **Debug | Show Next Statement** command to scroll the highlighted line into view.
- Sometimes you may want to skip the execution of some instructions or you may want to execute the same instructions several times without restarting the script. To change the next instruction line, click on the line you want to execute next and select the **Debug | Set Next Statement** command.

Watching Scripter execute every line of the script may be too time consuming. In this case, a breakpoint pauses the script where you think there might be a problem. A breakpoint is a line of code that you mark. When Scripter encounters a line marked as a breakpoint, it pauses the script just as if it had executed a STOP instruction. Breakpoints are more convenient than STOP instructions because they may be set and cleared while a script is paused, whereas STOP instructions may be changed only after a script has ended.

- To set a breakpoint, click in the break bar area next to the line you want to mark. The break bar is the area to the left of the code window, between the sheet tabs and the code window. Alternatively, click on the line you want to mark, and press F9 or select the **Debug | Toggle Break** command. The line becomes highlighted in red, and a round marker appears in the break bar area.
- To clear a breakpoint, click on the round marker, or move the cursor to the marked line and press F9 or select the **Debug | Toggle Break** command again. Clear all breakpoints by pressing SHIFT+CTRL+F9 or selecting the **Debug | Clear All Breaks** command.

A quick alternative to setting a breakpoint is the **Debug | Step To Cursor** command. This command has the same effect as setting a breakpoint on the current line, running the script, and then clearing the breakpoint after script execution has paused on the current line.

To check flow of execution through your script without having to watch each line of the script being executed, try using the TRACE function. To activate the trace function type "Trace" (without the quotes) in the immediate window and press ENTER. Trace On is displayed in the immediate window. As the script is run, the location of every instruction being executed is printed in the immediate window. After the script finishes, the trace function is automatically disabled.

If you nest procedure calls (that is, one procedure calls another procedure, which calls yet another procedure, and so forth), the stack window may be useful. When a script is paused, the stack window lists the procedures that have been called, and the order in which they were called. For instance, if the "Main" procedure calls procedure "A" which in turn calls procedure "B," the stack window displays three lines, one for each of the called procedures. Clicking on a line in the stack window moves the corresponding procedure into view in the code window.

Click the loaded window tab in the immediate window area to see which module files are being interpreted by Scripter. The loaded files include the current script file and any modules it includes with the '#Uses statement.

Example Scripts

Creating and Printing a Line/Symbol Plot with a Fit Curve

This examples automates the process of creating a line/symbol plot. The script creates a line plot with the default symbol from the data file, adds a linear fit, and prints the resulting graph.

```
Sub Main
	'Declare the variable that will reference the application
	Dim GrapherApp As Object

	'Creates an instance of the Grapher Application object
	' and assigns it to the variable named "GrapherApp"
	Set GrapherApp = CreateObject("Grapher.Application")

	'Make Grapher visible
	GrapherApp.Visible = True

	'Declares Docs as Object
	Dim Docs

	'Assigns the Documents collection to the variable named "Docs"
	Set Docs = GrapherApp.Documents

	'Declares Plot as Object
	Dim Plot As Object

	'Creates a new plot window and assign it to the variable named "Plot"
	Set Plot = Docs.Add(grfPlotDoc)

	'Declares Shapes as Object
	Dim Shapes As Object

	'Assigns the Shapes collection to the variable named "Shapes"
	Set Shapes = Plot.Shapes

	'Creates a new line plot and assigns it to the variable named "Graph"
	Set Graph = Shapes.AddLinePlotGraph(GrapherApp.Path+ _
		"\samples\sample3.dat")

	'Add Symbols to the Curve
```

```
        Graph.Plots(1).symbolFreq = 1

        'Add a Linear fit curve
        Set FitLinear = Graph.Plots(1).AddFit(grfLinearFit)

        'Change the Fit Curve Line Color to Green
        FitLinear.line.foreColor(grfColorGreen)

        'CopyStatsToClipboard
        FitLinear.CopyStatsToClipboard

        'Paste the statistics of the fit curve to the plot window
        Shapes.Paste(grfPasteBest,4.75,5)

        'Print the current plot
        Plot.PrintOut(grfPrintTruncate)

End Sub
```

Opening, Saving, and Closing Documents

The *Documents* collection provides access to the **Grapher** File commands. Use the *Documents* object's "Open" method to open an existing plot or worksheet. Use the "Add" method to create a blank plot or worksheet. The "SaveAll" method saves all open documents and the "CloseAll" method closes all open documents. To close an individual document, use the *Documents* object's "Close" method.

```
Sub Main
     Set GrapherApp = CreateObject("Grapher.Application")
     GrapherApp.Visible = True

     'Create a blank graph window
     GrapherApp.Documents.Add(grfPlotDoc)

     'Open an existing plot
     filename$ = GetFilePath(,"GRF")
     If filename$ <> "" Then
        GrapherApp.Documents.Open filename$
     End If

     'Close the active document
     GrapherApp.ActiveDocument.Close

     'Save the document whose window caption is "Plot1"
     GrapherApp.Documents("Plot1").SaveAs "MyDocument.grf"

     'Save all opened documents using current names
     GrapherApp.Documents.SaveAll

     'Close all documents
     GrapherApp.Documents.CloseAll

End Sub
```

ADDING ADDITIONAL CURVES TO AN EXISTING GRAPH

The following examples show how to add a bar chart to an existing line plot using the original axes.

```
Sub Main
     'Declare the variable that will reference the application
     Dim GrapherApp As Object

     'Creates an instance of the Grapher Application object
     ' and assigns it to the variable named "GrapherApp"
     Set GrapherApp = CreateObject("Grapher.Application")

     'Make Grapher visible
     GrapherApp.Visible = True

     'Declare Plot As Object
     Dim Plot As Object

     'Creates a new plot window and assign it to the variable named "Plot"
     Set Plot = GrapherApp.Documents.Add(grfPlotDoc)

     'Define DataFile$
     DataFile$ = GrapherApp.Path + "\samples\sample4.dat"

     'Add LinePlotGraph
     Dim Graph1 As Object
     Set Graph1 = Plot.Shapes.AddLinePlotGraph(DataFile$)

     'Add a Bar Chart to the existing graph
     Set Bar1 = Graph1.AddBarChart(DataFile$)

End Sub
```

SUGGESTED READING

This chapter has briefly introduced how to write scripts with the Scripter programming language. More information is available from the Scripter **Help | BASIC Language Help**. For additional help in learning how to program or for more information about the Visual Basic for Applications (VBA) language (which is nearly identical to the Scripter Basic language) we recommend the following books:

Harris, Matthew (1997), *Teach Yourself Visual Basic 5 for Applications in 21 Days, Third Edition*, SAMS Publishing, Indianapolis, IN, 1248 pp.

Lomax, Paul (1998), *VB and VBA in a Nutshell: The Languages*, O'Reilly & Associates, Inc., Sebastapol, CA, 633 pp.

Wang, Wallace (1998), *Visual Basic 6.0 for Windows for Dummies*, IDG Books Worldwide, Foster City, CA, 477 pp.

Appendix A

Mathematical Functions

Mathematical functions are used in function plots and in the worksheet to modify data. To create a function plot, choose **Graph | New Graph | Function**. For more information on creating function plots, refer to *Chapter 4, Creating Graphs.* Use the **Data | Transform** command to apply mathematical transformations to worksheet columns. If any cell contains text or is empty, the formula is not calculated for that row unless the *Treat text and empty cells as 0.0* is checked.

The mathematical expression can consist of constants, variables (such as column letters), or functions. The formulas follow standard precedence rules. Spaces are used in the equation for clarity. Equations can be up to 127 characters in length.

Formula Calculation

Formulas are specified using standard precedence rules. Operators in order of decreasing precedence are:

-	unary minus (or negative sign)
* /	multiplication and division
+ -	addition and subtraction

Operators of equal precedence are evaluated from left to right within the equation. Parentheses are used to override precedence, and expressions within the parentheses are performed first.

Mathematical Functions

The following built-in functions are supported.

TRIGONOMETRIC FUNCTIONS

All **Grapher** trigonometric functions are carried out in radians. If the data are in degrees, use the d2r(x) conversion function (under *Miscellaneous Functions*) to convert degree data to radians and then use the trigonometric functions.

sin(x)	Sine.
cos(x)	Cosine.
tan(x)	Tangent, where the value of x must not be an odd multiple of pi/2.
asin(x)	Arc sine, where the values are in the range -pi/2 to pi/2 and the value of x must be between -1 and 1.
acos(x)	Arc cosine, where the values are in the range 0 to pi and the value of x must be between -1 and 1.
atan(x)	Arc tangent, where values are in the range -pi/2 to pi/2.
atan2(y,x)	Arc tangent, where the values of x and y are not zero.

BESSEL FUNCTIONS

j0(x) j1(x) jn(n,x)	Bessel functions of the first kind at x of orders 0, 1, and n, respectively.
y0(x) y1(x) yn(n,x)	Return the Bessel functions of the second kind at x, of orders 0, 1, and n, respectively. For y0, y1, and yn, the value of x must not be negative.

EXPONENTIAL FUNCTIONS

exp(x)	Exponential function of x (e to the x).
sinh(x)	Hyperbolic sine of x.
cosh(x)	Hyperbolic cosine of x.
tanh(x)	Hyperbolic tangent of x.
ln(x)	Natural logarithm of x. The value of x must be positive.
log10(x)	Base 10 logarithm of x. The value of x must be positive.
pow(x,y)	X raised to the y-th power. Error conditions result if: x is zero and y is negative or zero, x is negative and y is not an integer, an overflow results.

MISCELLANEOUS FUNCTIONS

min(x,y)	Smaller of x and a number (y).
max(x,y)	Larger of x and a number (y).
randn(x,y)	An approximately normally (Gaussian) distributed real random number with mean x and standard deviation y.
randu(x)	A uniformly distributed real random number from the interval [0,x].
row()	Returns the row number.
ceil(x)	Smallest integer greater than or equal to x.
floor(x)	Largest integer less than or equal to x.
sqrt(x)	Square root of x, the value of x must not be negative.
fabs(x)	Absolute value of x.
fmod(x,y)	Floating point remainder of x/y, if y is zero, fmod returns zero.
d2r(x)	Convert values in degrees to radians.
r2d(x)	Convert values in radians to degrees. Example: sin(d2r(30)) computes the sine of 30 degrees. Sin(30) computes the sine of 30 radians.

STATISTICAL FUNCTIONS OF AN INTERVAL OF COLUMNS

sum(a..z)	Calculates the sum of a range of columns in a row.
avg(a..z)	Calculates the average of a range of columns in a row.
std(a..z)	Calculates the (population) standard deviation of a range of columns in a row.
rowmin(a..z)	Finds the minimum value of a range of columns in a row.
rowmax(a..z)	Finds the maximum value of a range of columns in a row.

The *Statistical Functions of an Interval of Columns* functions operate row-wise on an interval of columns. For example, SUM(A..Z) computes the sum of the twenty-six columns A, B, C, ... , Z. It does this for each row separately. Replace 'a..z' by any valid interval of columns, such as 'C..H' or 'W..AC.' There must be exactly two periods between the column labels. Columns may be given in reverse order, such as SUM(Z..A).

TRANSFORMING DATA IN THE WORKSHEET

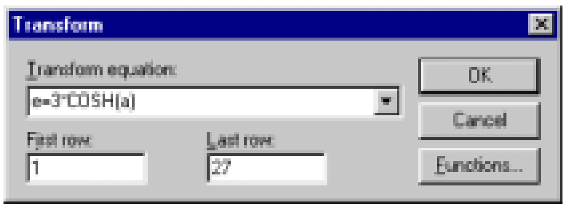
Worksheet equations consist of a destination column letter on the left side of the equation and a mathematical expression on the right side. Only specified rows are included in the calculation. An example of a formula is C = A + B. If the *Transformation Rows* option in the **Transform** dialog box is set from 1 to 25, the formula places the sum of the cells in columns A and B into column C. The equation is calculated for rows 1 through 25 only. Only numeric cells are used in calculations unless the *Treat text and empty cells as 0.0* is checked.

Click the *Functions* button in the **Transform** dialog box to add pre-defined mathematical functions to the equations. Change the variable (X) in the listed functions to a column letter in the transformation equation.

Example:
Transform column A with the equation 3cosh(x). That is, for numeric values in column A, find the hyperbolic cosine, multiply by three, and place the results in column E.

1. Click the **Data | Transform** command.
2. Delete any equations that appear in the *Transform equation* edit box.
3. Enter the destination column E followed by an equals sign into the *Transform equation* edit box.
4. Enter *3** following the equals sign.
5. Click the *Functions* button.

6. Select *COSH(X)* from the function list, and then click the *Insert* button. COSH(X) is inserted into the *Transform equation* edit box.



The destination column is column E, and the transformed column is column A. The calculation is made for rows 1 through 27 only.

7. Replace the X with the column letter A.

The transformed numbers appear in the destination column in the rows selected in the **Transform** dialog box. Remember that mathematical operators are necessary in the transform equations. If the above equation is entered without the multiplication sign (*), an error message results.

Errors

Error codes and special numeric values can appear in a worksheet cell depending on the type and nature of the condition within the cell.

Code	Explanation
#########	Number does not fit in the column. The column must be wider for the number to be shown.
#N/A	Value cannot be computed (for example, not enough data to calculate a statistic).
#DIV/0!	An attempt to divide-by-zero was made in performing a calculation.
#ERROR	A value could not be computed (for example, square root of a negative number).
#OVERFLOW	Value is too large for the worksheet (largest absolute value is about 1.797E+308).
1.#INF	Value is too large for the worksheet (i.e., "infinite" value).
1.#IND	Numeric value is indefinite (usually the result of performing a calculation with an infinite value or attempting to divide by zero).

Appendix B

Math Text

You can use math text instructions to control the appearance of axis or data point labels from the worksheet. Math text instructions can be used to change the typeface, size, color, weight, and style of text on a character-by-character basis. Greek letters and mathematical symbols can be used for worksheet labels or plot point labels using math text instructions. The math text instructions also allow for the detailed placement of characters and symbols; thus, superscripts, subscripts, and the superposition of characters are possible. Math text instructions are no longer necessary in the plot window.

Math Text Instruction Syntax

Unless otherwise indicated, all math text instructions begin with a backslash ("\"), and end with a single space. For example, the instruction "`\up50 `" shifts the baseline of the text up 50 percent of the current text height. All characters from the beginning backslash through the ending single space are interpreted as instructions by the math text interpreter, and are not included in the resulting label.

Each line in a text block starts with the default text properties such as typeface, size, color, and style. A line of text within a text block uses the current properties until a math text instruction is encountered. All text following an instruction is modified according to the instruction. For example, if the typeface is changed in the middle of a text string, the text following the instruction uses the new typeface until the end of the line of text is reached, or until another instruction affecting the typeface is encountered.

Math text instructions can also be encapsulated so they are not carried out over an entire line. A left curly brace ("{") instructs the math text system to remember all of the text properties in effect at that point. A right curly brace ("}") restores the properties to what they were at the matching left curly brace. This allows the insertion of special text in the middle of an otherwise uniform text block. The only instructions this does not apply to are text baseline instructions (`\dnX` and `\upX`), and the position instructions (`\rpX` and `\spX`). Curly braces can be nested.

To incorporate a backslash, right curly brace, or left curly brace as a text character in a text block, precede them with a backslash when entering the text string. For example, "\\" produces "\", and "\{" produces "{".

Instructions based on a percentage, such as font size, are cumulative. This means that a second percentage change within a text block is interpreted as a percentage of the first percentage change. For example, if the font is scaled by 50%, and later in the same text block the font is scaled by 50% again, the font size after the second percentage would be 25% of the original font size.

Math text instructions are not case sensitive except for typeface names. Typeface names must appear exactly as they are named, including capitalization.

Math Text Instructions

To Change Typeface Size and Style

\b	All text after the \b command is emboldened.
\f“x”	Change to the typeface named X. These are the names listed in the face drop-down list box in the **Text Editor** dialog box in the plot window. Typeface names are case sensitive, so type the name exactly as it appears in the face list. Enclose the face name in double quotes. If the typeface is not found, a generic stick typeface is used in place of the unfound typeface.
\fsX	Change the font size to X% of the current font size. For example, a value of 200 for X increases the font size by two, and a value of 50 for X decreases the font size by one-half.
\i	All text after the \i instruction is italicized.
\plain	This sets the text to normal weight, with no italics, no underlining, and no strikethrough.
\strike	Strikethrough the text.
\ul	All text after the \ul instruction is underlined.

TO CHANGE TEXT COLOR

\black	Sets the text color to black.
\blue	Sets the text color to blue.
\green	Sets the text color to green.
\cyan	Sets the text color to cyan.
\red	Sets the text color to red.
\magenta	Sets the text color to magenta.
\yellow	Sets the text color to yellow.
\white	Sets the text color to white.
\gray	Sets the text color to gray.
\rgbbX	Sets the amount of blue in an RGB text color (X = 0 to 255).
\rgbgX	Sets the amount of green in an RGB text color (X= 0 to 255).
\rgbrX	Sets the amount of red in an RGB text color (X= 0 to 255).

TO CHANGE TEXT POSITION

\dnX	Moves the text baseline down X% of the current font size. This instruction produces subscripts or returns the baseline to the original position following a \upX instruction. If a font size (\fsX) instruction follows the \dnX instruction, any subsequent \dnX or \upX instructions are relative to the changed font size.
\rpX	Restores the current position to position #X (X = 1 to 20). This instruction is used in conjunction with the \spX instruction. Any text following this instruction begins at the position defined with the \spX instruction. If the \rpX instruction is used without first setting a position with the \spX instruction, the position for the text is returned to starting position for the text block.
\spX	Saves the current position as position #X (X = 1 to 20). The position is the up, down, left, and right areas within the text block. When the \spX instruction is used, the current location within the text block is assigned a position number. Return to this position using the \rpX instruction. Specify the position number assigned with the \spX instruction when using the \rpX instruction. These instructions are most useful when placing both super- and subscripts after the same character.

\upX	Moves the text baseline up X% of the current font size. This instruction is used to produce superscripts or to return the baseline to the original position following a \dnX instruction. If a font size (\fsX) instruction follows the \spX instruction, any subsequent \upX or \dnX instructions are relative to the changed font size.

TO INSERT SPECIAL CHARACTERS OR THE DATE OR TIME

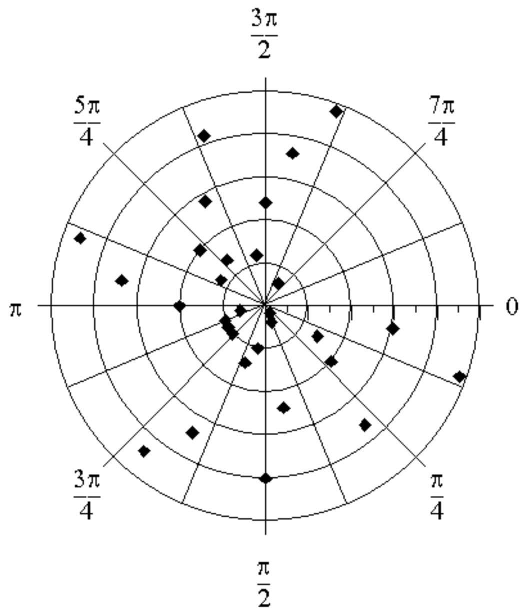
\aX	Inserts an ANSI character with the code given by X. Generally, this instruction is needed for characters with ANSI numbers beyond the normal limit of the keyboard. For example, use the ANSI character code to include an integral sign in a text string. By determining the character set that includes this symbol and the ANSI code for the symbol, the symbol can be included in the text block. Use the \f"X" instruction to change to the correct character set, followed by the \aX command to specify the correct character number. For example, an integral sign is located at ANSI position 242 in a symbol set called Symbol. Type \f"Symbol" \a242 for the integral sign to appear in the text block. The Character Map program is an accessory program in Windows installations. Use the Character Map to display each of the available character sets with the ANSI code. The ANSI code is displayed in the right half of the Character Map status bar when a character is selected.
\date	Inserts the current date. Be sure to follow this instruction with a space, even if there is not any other text following the date.
\time	Inserts the current time. The time text is updated whenever the text is redrawn or the graph is printed. Be sure to follow this instruction with a space, even if there is not any other text following the time.

Examples of Math Text Instructions

Note: Due to page size limitations, some of these examples contain multiple lines of math text instructions. These examples must be entered on one line for the text to be printed correctly.

10^3	`10\up50 \fs75 3`
N^{5}_{1}	`{\fs200 N}\sp1 \up100 \fs50 5 \rp1 1`
$X^2 + Y^2 = 1$	`X\up50 {\fs50 2} \dn50 + Y\up50 {\fs50 2} \dn50 = 1`
$(X_i - \bar{X})^2$	`(X\dn25 {\fs50 i}\up25  - \sp1 X \rp1 \up100 _\dn100 )\up50 \fs50 2`
$\sum_{i=1}^{n}$	`\sp1 {\fs200 \f"Symbol" \a229 }\rp1 \dn75 \fs75 i=1 \rp1 \up175   n`
$\int_{a-b}^{a+b} x+y \; dx$	`{\f"Symbol" \fs400 \a242  }\sp1 \up100 \sp2 \up150 {\fs75 \i a+b} \rp1 \dn30 {\fs75 \i a-b} \rp2 x+y \i dx`
$\frac{a_c}{b_c}$	`\sp1 \up25  a\dn25 {\fs75 c}\rp1 ___\rp1 \dn100 b\dn25 {\fs75 c}`
Length (μM)	`Length ({\f"Symbol" m}M)`
$\delta^{234}U$	`{\f"Symbol" d}\up50 {\fs75 234}\dn50 U`
104°37'	`104\f"Symbol" \a176 \f"Arial" 37'`

Example: Tick Labels from Worksheet



Polar plot angle axis tick mark labels using math text instructions from the worksheet.

The tick mark labels in the above polar plot were created with math text instructions. Use the *From Worksheet* option on the angle axis **Tick Labels** tab to use the Pi labels rather than the decimal radian labels.

MATH TEXT INSTRUCTIONS FOR PI LABELS

```
0
\sp1 \up20 \f"Symbol" p\rp1 _\rp1 \dn100 \f"Times New Roman" 4
\sp1 \up20 \f"Symbol" p\rp1 _\rp1 \dn100 \f"Times New Roman" 2
\sp1 \up20 \f"Symbol" 3p\rp1 __\rp1 \dn100 \f"Times New Roman"  4
\f"Symbol" p
\sp1 \up20 \f"Symbol" 5p\rp1 __\rp1 \dn100 \f"Times New Roman"  4
\sp1 \up20 \f"Symbol" 3p\rp1 __\rp1 \dn100 \f"Times New Roman"  2
\sp1 \up20 \f"Symbol" 7p\rp1 __\rp1 \dn100 \f"Times New Roman"  4
```

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