Version 7

Getting Started Manual

OriginLab Corporation

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Chapter 1, Introduction

Welcome to Origin

Thank you for purchasing Origin version 7! This manual is provided to familiarize you with the fundamentals of Origin in a minimal amount of time. The manual provides information for new and upgrade users, including:

=> A summary of the major new features in version 7.

=> An overview of the major Origin concepts and terminology.

=> Tutorials covering a broad range of Origin topics.

This manual also provides installation and registration assistance. For additional help using Origin, review the Origin Help file (**Help:Origin**) or visit the OriginLab web site at www.OriginLab.com.

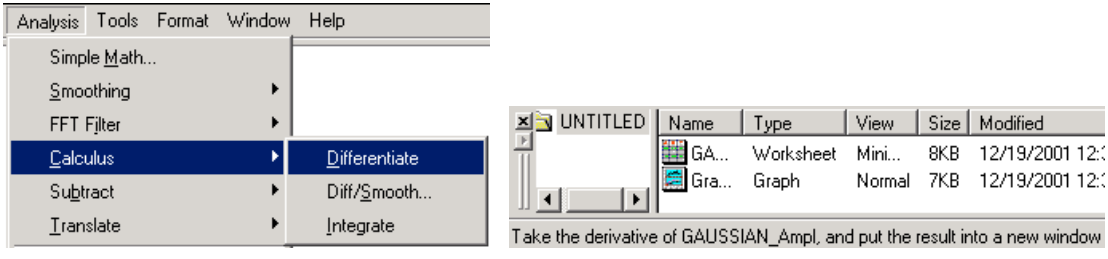
Getting Help Using Origin

If you have a question about using Origin, assistance is available from several different sources.

From the Software

=> The status bar in the Origin window provides text clarifying the function of toolbar buttons, tool elements, and menu commands. It also displays Origin status messages.

Figure 1: The Status Bar Messages



=> The Origin Help contains information on all of Origin's features. To open the Origin Help, select **Help:Origin** or press F1. If a dialog box is open when you press F1, the Help opens displaying information specific to the dialog box.

Programming Help is also available from the **Help:Programming** submenu. Select **Program Guide** to learn general tips and strategies on programming in Origin. Select **Origin C Reference** to find information on a specific Origin C class or function. Select **LabTalk Reference** to find information on the LabTalk programming language.

Viewing Origin's Help files requires Internet Explorer version 4.0 or higher.

Important Note about Origin's Help Files: The Origin Help files are compiled HTML Help. To view these Help files, you must have Internet Explorer version 4.0 or higher installed on your computer. (We recommend having Internet Explorer version 5.0 or higher installed.) Internet Explorer need not be your default browser, but it must be installed.

=> Sample Origin projects and data files are provided with Origin. These files are located in the Origin \Samples subfolder. Sample projects show you how to perform analysis routines, create custom graphs, and program routines in Origin.

From the Manuals

=> This *Getting Started Manual* includes a "Getting Started Using Origin" section with basic information on using Origin. Tutorials are also provided which step you through common Origin operations.

=> The *Programming Guide* provides general tips and strategies on programming in Origin.

From the Web Site

You can access helpful areas of the OriginLab web site by selecting **Help:Origin on the Web**. This menu command opens a submenu providing fast access to a number of useful areas. These resource pages include support, custom tools, the graph gallery, a user forum, and the OriginLab home page. To access the OriginLab home page directly from your browser, go to www.OriginLab.com.

From Your Origin Technical Support Representative

OriginLab and our team of international support representatives are committed to providing high quality technical support to our registered users of Origin. To contact OriginLab Technical Support or to find out how to contact your local support representative, select **Help:Origin on the Web:Technical Support**. Alternatively, go to www.OriginLab.com and click the Technical Support link.

=> Customers with local technical support representatives can find contact information on the OriginLab technical support web pages.

=> If OriginLab is your technical support representative, you can submit a technical question to OriginLab from the web site.

Additionally, if OriginLab is your technical support representative, you can contact OriginLab Technical Support at tech@originlab.com.

Phone: 1-800-969-7720 or 1-413-586-2013

Additional Products Available from OriginLab

OriginLab provides two major products, Origin and OriginPro. In addition, OriginLab provides custom tools and modules that enhance Origin and OriginPro.

OriginPro

OriginPro includes all the features found in Origin. Additionally, OriginPro is an application development environment for building custom analysis applications based on Origin. After development, custom applications can be run on the standard Origin version or the OriginPro version.

Create Sophisticated Custom Interfaces

=> Create dialog boxes, tabbed tools, and wizards using OriginPro's Dialog Builder.

=> Select controls from industry standard development tools.

=> Save wizard procedures as a toolbar button.

=> Add your own menus and menu commands to the Origin menu bar.

Powerful Programming Environment with Origin C (Origin C is also part of standard Origin)

=> ANSI C with some C++ features.

=> String, vector, matrix, complex, complex matrix support built-in.

=> Access to Origin objects such as worksheets, data plots, and Project Explorer.

=> Essential elements of the Numerical Algorithms Group (NAG®) numerical library included for advanced computation.

=> Code Builder environment provides syntax coloring, debugging with breakpoints, and output windows.

=> Add custom classes into Origin C classes with external DLL. (This feature is only available in OriginPro.)

Design Dynamic Data Exchange (DDE) Applications

=> Program your Visual Basic or Visual C++ applications to send data to Origin to display complex graphs in real time.

=> Use Origin as a graphics server.

The Peak Fitting Module

Work in chromatography, spectroscopy, engineering, pharmacology, and other fields frequently requires analysis of data sets exhibiting multiple peaks. Analysis of multi-peak data is particularly difficult when peaks overlap, or when data are "noisy." The Peak Fitting Module (PFM) provides the tools needed for serious peak analysis, including:

=> Data filtering.

=> Automatic and/or manual baseline and peak detection.

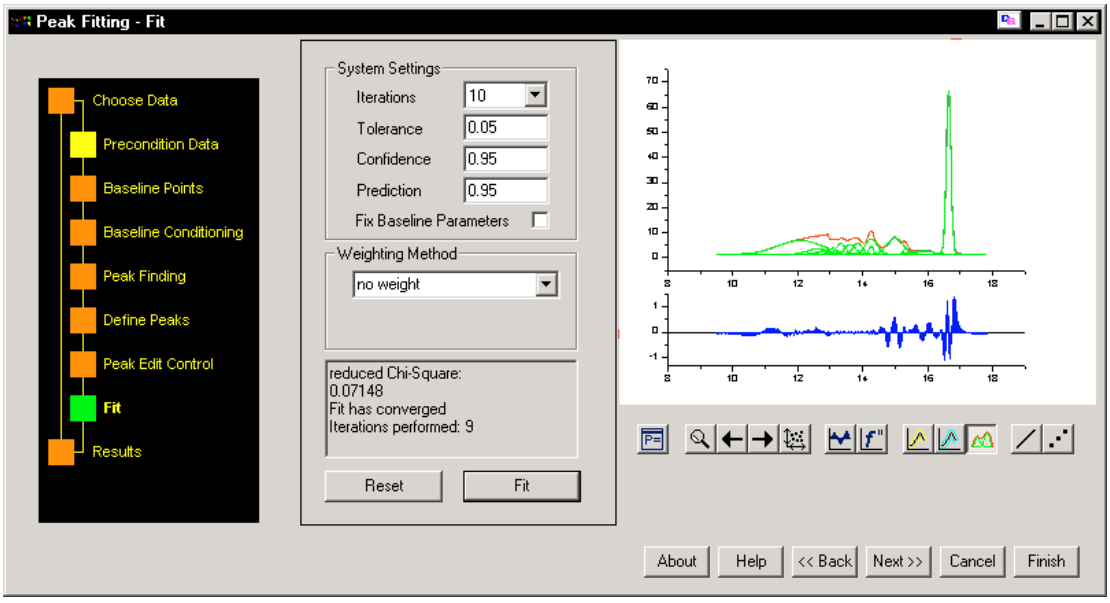
=> Built-in or user-defined curve-fitting functions.

=> Highly accurate nonlinear least squares curve fitting.

=> Publication-quality output.

The PFM provides a wizard interface to simplify peak analysis. You can run the PFM on Origin or OriginPro.

Figure 2: The Peak Fitting Module



Additional Add-ons

In addition to the Peak Fitting Module, OriginLab offers custom tools and modules that are available from the OriginLab web site (www.OriginLab.com). Some tools are available free of charge and others are available at a cost. The tools add specific enhancements to Origin and OriginPro.

Most of the tools and modules are provided in a special file format with a .OPK extension. After downloading the file, these tools and modules are easily installed by dragging the file from Windows Explorer onto your running copy of Origin or OriginPro.

Chapter 2, Installing and Registering Origin

System Requirements

Origin version 7 requires the following minimum system configuration:

Microsoft Windows 95 or later or Windows NT 4.0 or later.
133 MHz or higher Pentium compatible CPU.
64 MB of RAM.
CD-ROM drive.
50 MB of free hard disk space.
Internet Explorer version 4.0 or later (we recommend version 5.0 or later). Internet Explorer need not be your default browser, but it must be installed for viewing Origin's compiled HTML Help.

Installing Origin - Single User License

For network installation information, see "Installing Origin - Network License" on page 14.

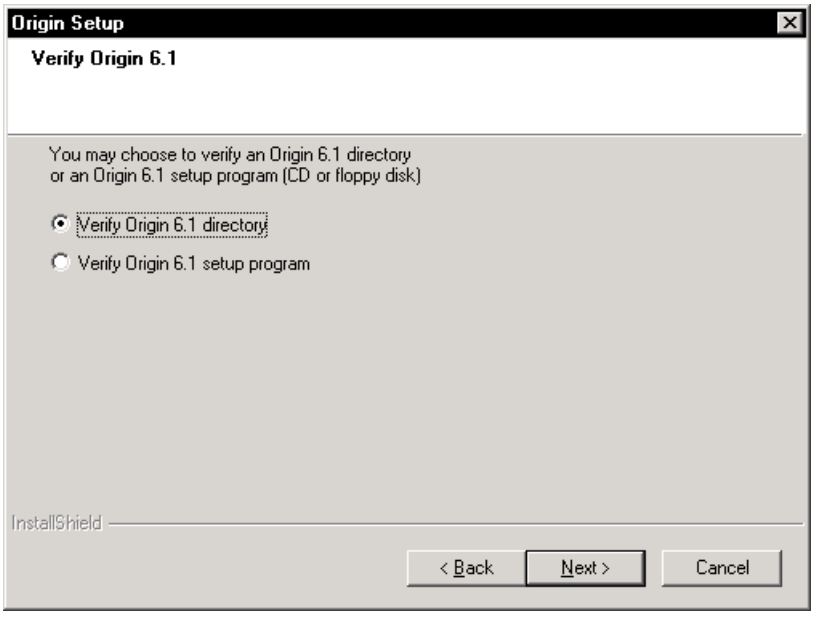
To install a new copy of Origin or OriginPro, or to upgrade an existing copy, insert the Origin 7 CD into your CD-ROM. A window opens with a number of options, including installing Origin. Click the link to install Origin. If the CD does not start automatically, browse the CD and run ORIGINCD.EXE directly.

The setup program prompts you to type in your Origin serial number and license key. These numbers are located inside your registration card in the Origin product package.

Upgrading an Existing Version of Origin

After entering your serial number and license key, the Upgrade setup program will verify that the previous version of Origin is installed on your computer. If the Upgrade setup program does not automatically find this version, it opens the following dialog box.

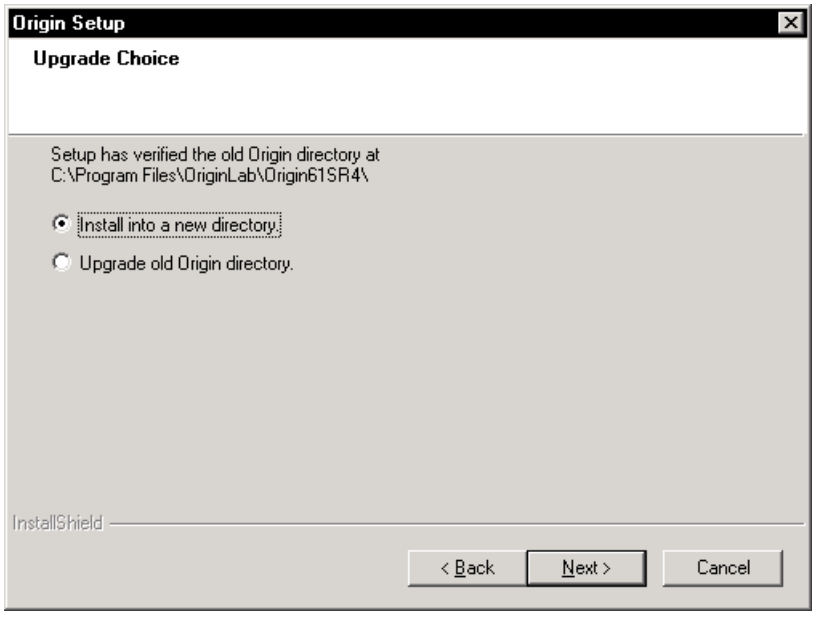
Figure 1: Verifying a Previous Version



This dialog box allows you to instruct the Upgrade setup program to perform the version verification from a folder on your hard disk or from the previous version's CD or floppy disk (if the previous version is not installed on your computer).

After verification of the previous version, the Upgrade setup program offers you the option to either upgrade your existing copy of Origin, or to install Origin 7 into a new folder, leaving the existing copy of Origin unaltered. To learn more about these options, see Table 1 on page 11.

Figure 2: Upgrading an Existing Folder or Installing into a New Folder



If you install Origin 7 into a new folder, you have the option to:

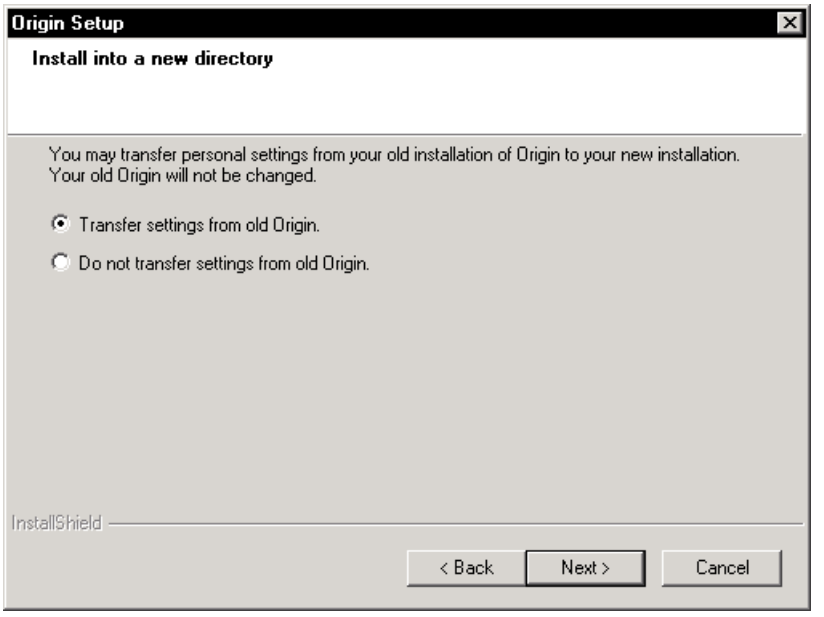
=> Copy your user-defined fitting functions to the new program folder's \FitFunc subfolder.

=> Copy any modified built-in files to the new program folder's \Modified Files subfolder. (Built-in files are files that were installed by your previous Origin installation. For a list of the built-in file types that can be modified, see the following table.)

=> Copy any user-defined toolbar settings to the new program folder.

To learn more about this option, see Table 1 on page 11.

Figure 3: Installation Option to Transfer Previous Settings



The following table summarizes your upgrade installation options.

Table 1: Upgrade Installation Options

Upgrade Option	Description	When to Choose this Option
Install into a new folder, transfer previous Origin settings.	1) You are given the option to modify the default program folder name. 2) Origin is installed into this new folder. 3) The install program then copies all built-in files of the following type that you have modified in your previous version of Origin to a \Modified Files subfolder in your new Origin 7 program folder. This includes template (OTW, OTP, OTM), script (OGS), initialization (INI), configuration (CNF), Origin project (OPJ), data (DAT, etc.), and fitting function (FDF) files. Your modified file in the original location is left unaltered. 4) User-defined toolbar settings are copied from your previous version of Origin to your new Origin 7 program folder. The user-defined toolbar settings in the original location are left unaltered. 5) User-defined fitting functions are copied into the \FitFunc folder in your new Origin 7 program folder. 6) Other user-created files (excluding user-defined fitting functions) that are not modified built-in files are not copied from your previous version of Origin. For example, templates, Origin projects, data files, and script files that are not provided as part of the previous version are not copied over.	This is the recommended upgrade installation option. This option leaves your previous Origin installation unaltered, but transfers your custom settings to the new installation. If you select this option, do not delete your previous Origin installation until you have copied any needed user-created files to the new program folder.
Install into a new folder, do not transfer previous Origin settings.	1) You are given the option to modify the default program folder name. 2) Origin is installed into this new folder. 3) Your previous version of Origin is left unaltered.	Select this option if you do not want any of your custom settings transferred to the new installation.

Upgrade Option	Description	When to Choose this Option
Upgrade previous Origin folder.	1) You are not given the option to change the program folder name. Thus, if the previous path was C:\Program Files\OriginLab\Origin61, it remains the same after your upgrade. If you change the path after installation, then the Add/Remove program (see "Un-installing Origin" on page 13) will be unable to find your Origin files. (Note: If you want to rename your program folder name, do this before installing the upgrade.) 2) All built-in files of the following type that you have modified are copied into a \Modified Files subfolder. This includes template (OTW, OTP, OTM), script (OGS), initialization (INI), configuration (CNF), Origin project (OPJ), data (DAT, etc.), and fitting function (FDF) files. During the upgrade installation, your modified file in the original location is replaced with the Origin 7 version of the file. 3) User-created files that are not modified built-in files (such as new templates and new fitting functions) are not altered or moved during the upgrade. 4) User-defined toolbars remain available after upgrading.	Select this option if you are low on disk space.

Required System DLLs

Origin requires the following three system DLLs to run properly:

Mfc42.dll File Version: 6.00.8665.0 or later
Msvcrt.dll File Version: 6.00.8797.0 or later
Comctl32.dll File Version: 5.8 or later

These DLLs are most commonly installed to the \Windows\System folder (Windows 95/98/ME/XP) or the \Windows\System32 folder (Windows NT/2000). To check the version of any DLL, locate the file using the Windows Explorer or the Find program, right-click on the DLL file, select **Properties** from the shortcut menu, and then select the Version tab in the Properties window.

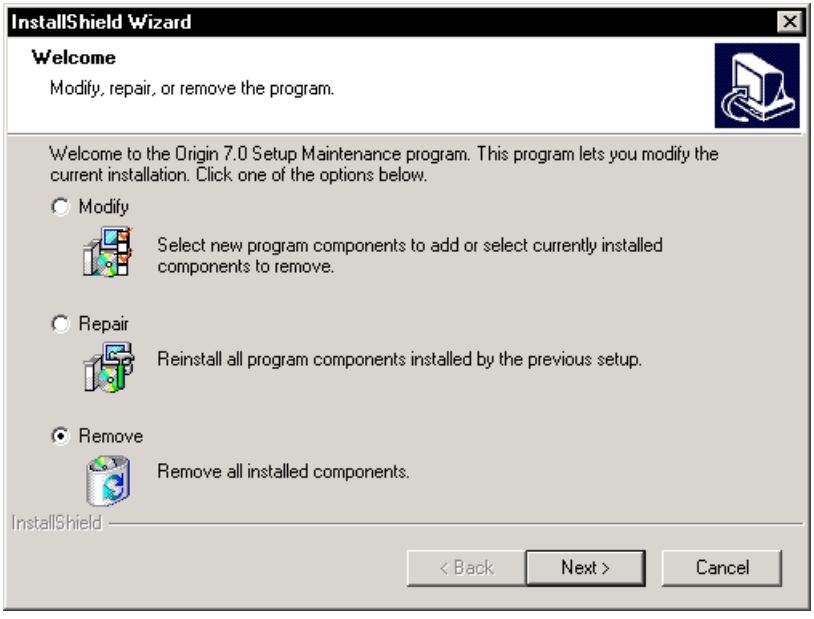
During the Origin installation, the setup program will update the DLLs if older versions are present. If an older version is in use and can not be replaced during installation, then a reboot is required after installation. The setup program will inform you of this. Furthermore, if an older version of a DLL is found, you are given the option to save a copy of the older version in your Origin \OldSystemDLLs subfolder.

There may be cases where the setup program fails to update the system DLLs. If this occurs, you can download the DLLs from the Technical Support area of the OriginLab web site (www.OriginLab.com).

Un-installing Origin

To remove Origin from your computer, run the Origin 7 Add/Remove program. This program opens the following dialog box. Select the Remove option.

Figure 4: Un-installing Origin



The Remove option copies all built-in files of the following type that you have modified into a \Modified Files subfolder. This includes template (OTW, OTP, OTM), script (OGS), initialization (INI), configuration (CNF), Origin project (OPJ), data (DAT, etc.), and fitting function (FDF) files. It then removes all installed files (excluding the \Modified Files subfolder). User-created files that are not modified built-in files (such as new templates and new fitting functions) are not removed during this process.

Re-installing Origin

To re-install Origin, first un-install Origin by running the Origin 7 Add/Remove program and selecting the Remove option (see the previous topic). Then insert the Origin 7 CD into your CD-ROM and click the link to install Origin.

Installing Origin - Network License

Origin 7 supports a server-based network which can have either machine-based clients, roaming-user clients, or both. The server must be installed to a server machine running Windows NT 4.0, 2000, XP or a later version, and the server machine must use the TCP/IP network protocol. Client machines must have Windows 95, 98, ME, NT 4.0, 2000, XP or a later version installed.

Installing the Origin 7 Server

You must run the Server setup program on the server computer - you can not run it on a remote computer. Additionally, you must log on to an account that has administrator privileges on the local computer. The server can be installed anywhere on the server machine that is writable. After installing the Origin server, it can be shared as read-only.

To install a new copy of the Origin 7 server or to upgrade an existing version of an Origin server, insert the Origin 7 CD into your CD-ROM. A window opens with a number of options, including installing Origin. Click the link to install Origin. If the CD does not start automatically, browse the CD and run ORIGINCD.EXE directly.

The Server setup program prompts you to type in your Origin serial number and license key. These numbers are located inside your registration card in the Origin product package.

If you are upgrading a server installation, you will also be asked if you want to upgrade your existing version or install the Origin 7 server into a new folder, leaving the existing copy unaltered. For information on these upgrade options, see "Upgrading an Existing Version of Origin" on page 7.

After completing the installation, the Origin 7 server is a full working version of Origin 7. However, the Origin 7 server does not need to be running for Origin 7 clients to be able to run.

Un-installing the Server

To remove an Origin 7 server, run the Origin 7 Server Add/Remove program. Select the Remove option in the dialog box that opens. This option copies all built-in files of the following type that have been modified into a \Modified Files subfolder. This includes template (OTW, OTP, OTM), script (OGS), initialization (INI), configuration (CNF), Origin project (OPJ), data (DAT, etc.), and fitting function (FDF) files. It then removes all installed files (excluding the \Modified Files subfolder). User-created files that are not modified built-in files (such as

new templates and new fitting functions) are not removed during this process.

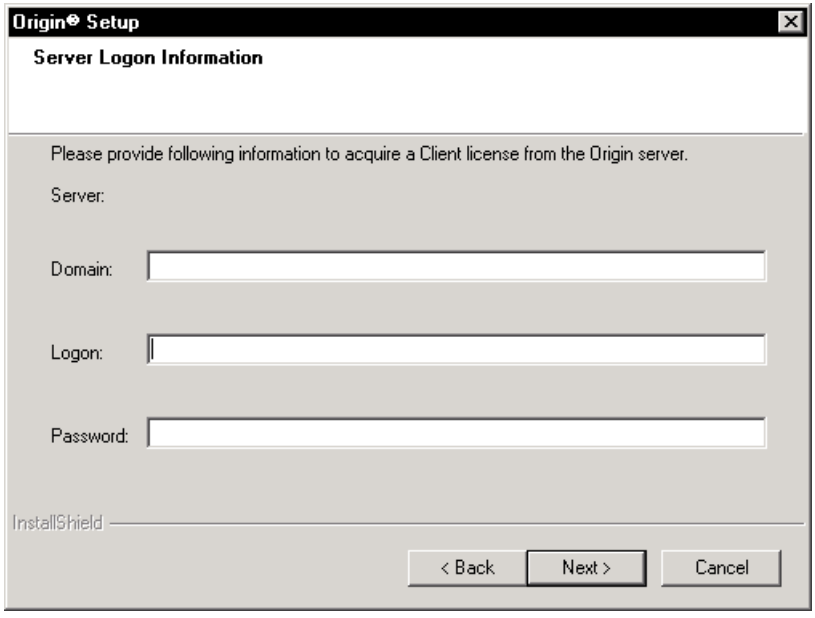
Installing the Origin 7 Clients

After the server installation is complete, the Origin server folder includes a \ClientSetup subfolder that contains a client setup program. The client setup icon can be double-clicked by the client to install the Origin client. Alternatively, you can mail the client users an active link to the client setup program.

If installing to a Windows NT or Windows 2000 computer, you should log on to an account that has administrator privileges on the client computer. You do not have to run the Client setup program on the client computer, but if you run it on a remote computer you must manually verify that the client computer has the correct version of all required system DLLs (see "Required System DLLs" on page 12).

During the client installation, you will be asked to enter the network license serial number and a client installation folder path. You will also be asked to enter the server logon information shown in the following figure.

Figure 5: Server Logon Information



After successful verification, the following dialog box indicates the client license was successfully allocated.

Figure 6: Successful Allocation of the Client License

If you are upgrading a client installation, you will also be asked if you want to upgrade your existing version or install the Origin 7 client into a new folder, leaving the existing copy of Origin unaltered. For information on these upgrade options, see "Upgrading an Existing Version of Origin" on page 7.

Installing a Machine-Based or Roaming-User Origin Client

Origin 7 supports a server-based network which can have either machine-based clients, roaming-user clients, or both. If you log on to any Windows computer and specify a user account that is not set up as a roaming-user account (on the Windows NT/2000 Domain Controller) and install an Origin 7 client, that client installation will be machine-based. In order to use that particular Origin client you will have to log on to that machine.

If you log on to any Windows computer and specify a user account that is set up as a roaming-user account (on the Windows NT/2000 Domain Controller) and install an Origin 7 client, the client installation of Origin will be a roaming-user client if the following conditions are met:

=> When asked to enter the path to the Origin 7 client software folder during the client installation, you must ensure that the path will be valid no matter which computer is logged on to. You can either enter a UNC path to the client folder (\\ComputerName\ShareName\...\Origin 7.0 Client) or enter a mapped drive path (H:\Origin 7.0 Client) that is always valid whenever you log on to that roaming-user account. This condition is minimally restrictive since UNC paths are absolute and mapped drives, while relative, are stored as part of a roaming-user's profile.

=> During the client installation you should choose the Personal (<UserName>) radio button when asked which location you want the

Origin 7 client program folder to be installed to. This ensures that the program icons will become part of the roaming-user's profile.

=> You must ensure that the correct version of all required system DLLs are installed on any computer on which you intend to run an Origin client. One way to do this is to run the Client setup on each computer that you will be using a roaming Origin client. This will ensure that the correct system DLLs are there. You can then uninstall the Origin client and the updated system DLLs will remain. Alternatively, you can manually check that the correct DLLs are present. For more information on manually checking, see "Required System DLLs" on page 12.

Once the pathing, program folder location, and system DLL conditions are met, Windows will automatically manage the Origin client for that roaming-user account. You will have complete access to the installed Origin 7 client no matter which computer you log on to.

Un-Installing a Client

To remove an Origin 7 client from your computer, run the Origin 7 Client Add/Remove program. Select the Remove option in the dialog box that opens. This option copies all built-in files of the following type that you have modified into a \Modified Files subfolder. This includes template (OTW, OTP, OTM), script (OGS), initialization (INI), configuration (CNF), Origin project (OPJ), data (DAT, etc.), and fitting function (FDF) files. It then removes all installed files (excluding the \Modified Files subfolder). User-created files that are not modified built-in files (such as new templates and new fitting functions) are not removed during this process.

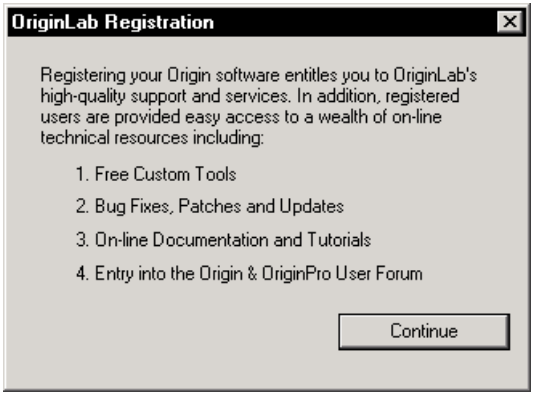
Starting and Registering Origin

To start Origin, click Start, then select **Programs**. Point to the Origin 7 folder and select the Origin 7 (or OriginPro 7) program icon from the submenu.

=> If this is a new installation, if you are upgrading from a version prior to 6.1, or if you are upgrading from version 6.1 but did not enter a registration ID in your 6.1 program, then the OriginLab Registration dialog box displays after you start Origin.

=> If you are upgrading from version 6.1 and you had entered a registration ID in your Origin 6.1 program, then Origin starts without displaying the OriginLab Registration dialog box. In this case, your registration ID is already entered in your upgrade. You can verify this by selecting **Help:About Origin**. You registration ID should be listed in the About Origin dialog box.

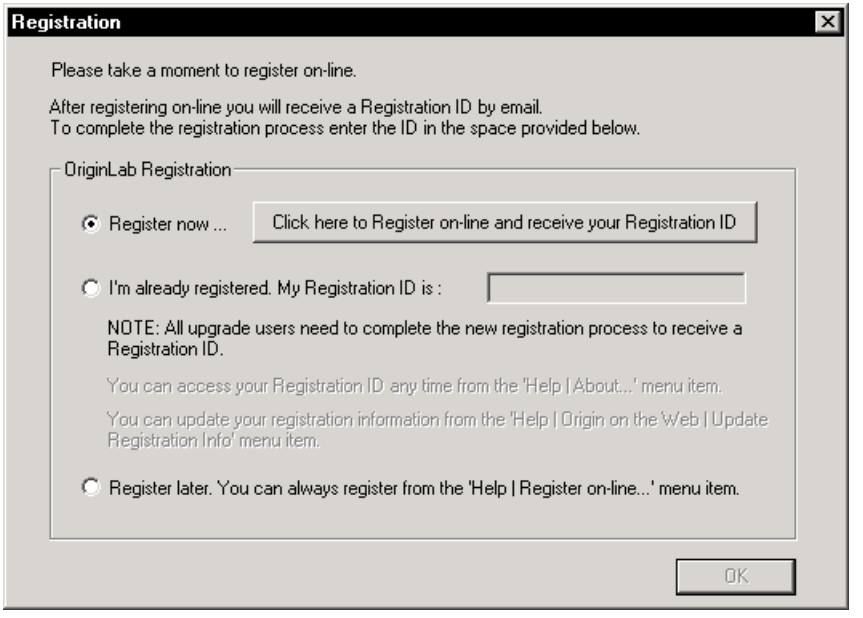
Figure 7: The OriginLab Registration Dialog Box



This dialog box reviews the benefits of registering Origin 7. These benefits include receiving technical support and having access to services that are available from the OriginLab web site (www.OriginLab.com).

When you click Continue, the Registration dialog box opens.

Figure 8: The Registration Dialog Box



=> If you are upgrading from version 6.1 and you had entered a registration ID in your Origin 6.1 program, then this dialog box does not display because your upgrade is already registered.

If you do not have web or email access, contact your Origin representative to complete the registration process.

=> In all other cases, you must register your copy of Origin by entering your registration ID (a registration ID is not the same as a serial number or a license key). If you do not have a registration ID, then click the associated button in the Registration dialog box. This button starts your browser and takes you to the OriginLab registration web page. After you complete the registration form on this web page, you will be sent an email message notifying you of your registration ID. Type this registration ID in the Registration ID text box on the Registration dialog box. Once you enter your registration ID in Origin, both your serial number and registration ID will display in the About Origin dialog box (**Help:About Origin**).

Chapter 3, What's New in Version 7

Introduction

Origin 7 offers new features that make Origin easier to use and provide increased analysis power. The following sections introduce the major new features in version 7. For more information on a feature, review the Origin Help file (**Help:Origin**). Additionally, review the Release Notes provided with the product.

Ease-of-Use

Annotations

Text Editing

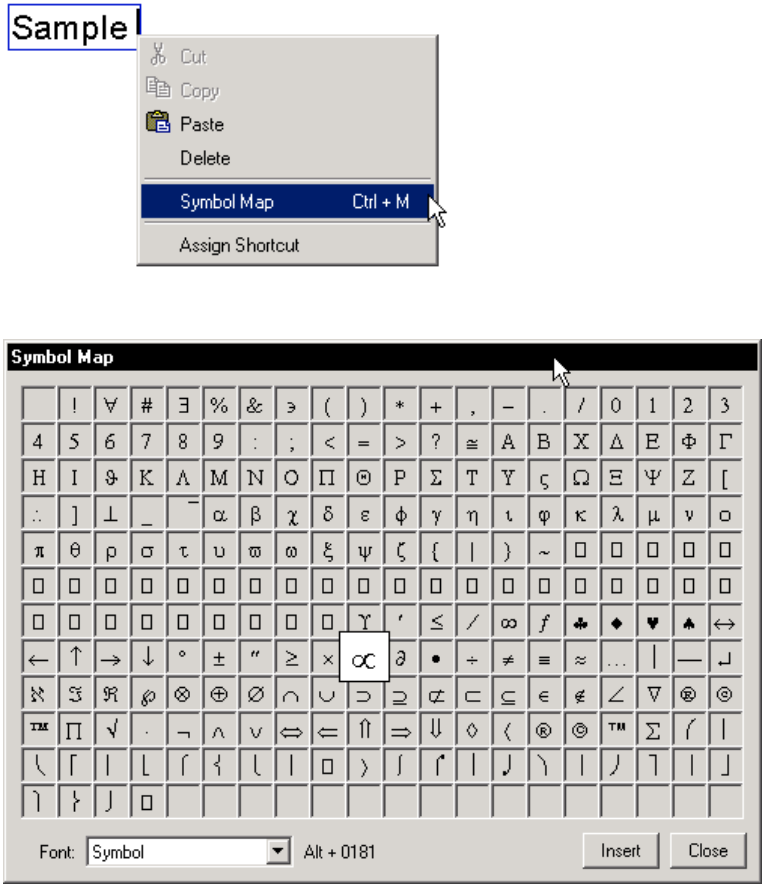
Origin 7 provides enhanced annotation tools including in-place text editing and toolbar button access to common formatting options.

=> To create a new text label, right-click and select **Add Text** from the shortcut menu or click the Text Tool button  and then click at the desired location. Then begin typing the text. As you type your text, formatting options are available from the Format toolbar and color control is available from the Style toolbar.

Figure 1: The Format and Style Toolbars

If no text is currently highlighted, the formatting/color option begins at the current cursor location. Otherwise, the formatting/color applies to the highlighted text only. You can also add characters from a selected font set by right-clicking while in in-place editing mode and selecting **Symbol Map** from the shortcut menu (or by pressing CTRL+M).

Figure 2: Adding Characters from a Selected Font Set



To exit the text entering and editing mode, click off the label or press ESC.

=> To edit an existing text label, double-click to enter the in-place editing mode. (Tip: To temporarily turn off the rotation when you in-place edit rotated labels, select **Tools:Options** to open the Options dialog box. Select the Text Fonts tab and then select the Do Not Rotate Text While In-Place Editing check box.)

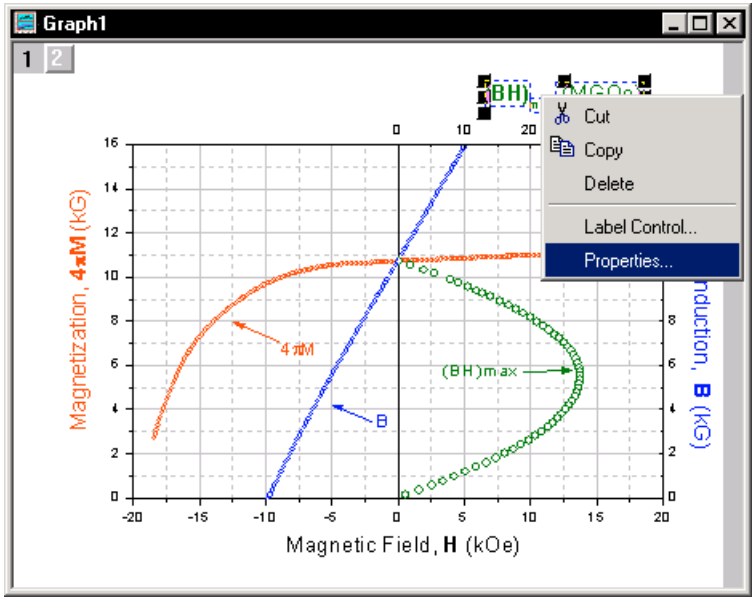
=> To resize a text label, click once on the label and then select the desired font size from the combo box on the Format toolbar.

Alternatively, click the Increase Font or Decrease Font buttons on this toolbar. You can also drag a control handle to resize the label.

=> To rotate a text label, click once on the label, pause long enough to avoid a double-click (about a second), and then click a second time on the label. A rotation symbol displays in the middle of the label and rotation handles display at the corners of the label. Click on a rotation handle and rotate the label as desired. (You can also specify a specific rotation angle in the Text Control dialog box.)

=> To access the Text Control dialog box, right-click on the text label and select **Properties** from the shortcut menu. Alternatively, press CTRL while double-clicking on the label.

Figure 3: Opening the Text Control Dialog Box



Drawing

Four new drawing tools have been added to the Tools toolbar in Origin 7:

Polygon Tool: To draw a polygon, click on the tool and then click in the window at each of the corner locations for the polygon. Either double-click at the last location or click once and then press ESC.

 Region Tool: To draw a region, click on the tool and then click and drag the desired region. Release the mouse button to complete the operation.

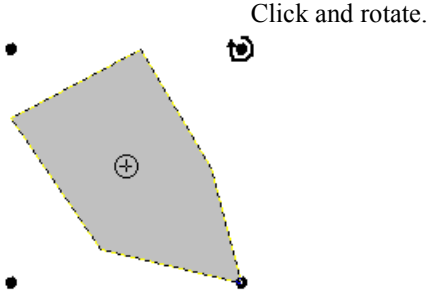
 Polyline Tool: To draw a polyline, click on the tool and then click in the window at each of the corner locations for the polyline. Either double-click at the last location or click once and then press ESC.

 Freehand Draw Tool: To draw a freehand line, click on the tool and then click and drag the desired line. Release the mouse button to complete the operation.

All of Origin's drawing objects can be rotated and skewed. Additionally, individual points can be moved.

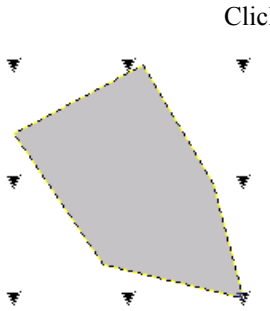
=> To rotate an object, click once on the object, pause long enough to avoid a double-click (about a second), and then click a second time on the object. A rotation symbol  displays in the middle of the object and rotation handles display at the corners of the object. Click on a rotation handle and rotate the object as desired.

Figure 4: Rotating an Object



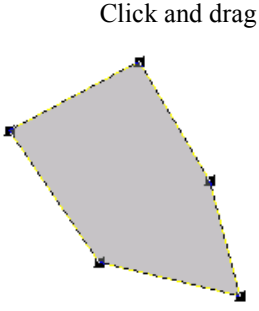
=> To skew an object, click once on the object, pause long enough to avoid a double-click (about a second), and then click a second time on the object. Pause again and then click a third time on the object. Triangular skew handles display at the corners of the object. Click on a skew handle and drag as desired.

Figure 5: Skewing an Object



=> To move points in an object, follow the "skew" procedure and then click one more time (a total of four clicks with pauses in between). Handles appear on moveable points. Drag the desired points to new locations.

Figure 6: Moving an Object's Points



Additionally, when a drawing object is selected, the Style toolbar buttons are available for customizing the object's display. For closed objects, this includes the pattern and fill color controls.

Additional object controls are available from the Object Control dialog box which is accessed by double-clicking on the object.

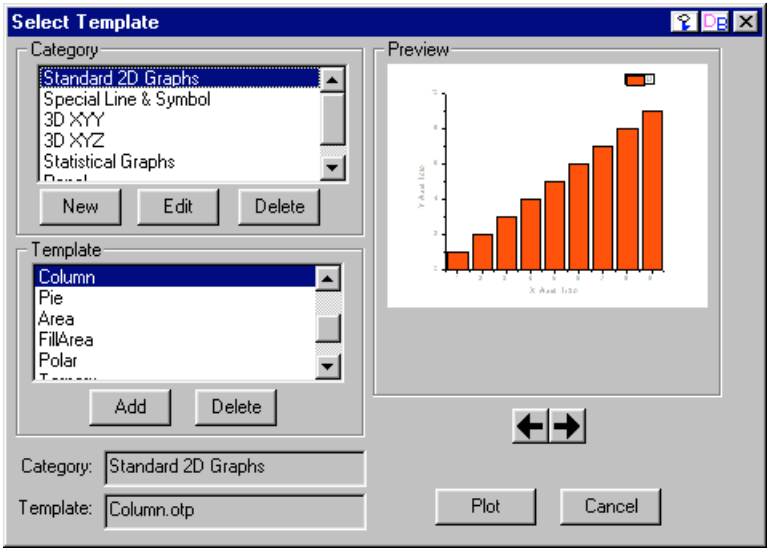
Plotting

Template Library Tool

Origin provides a Template Library tool for categorizing and accessing graph templates. To open the Template Library tool when a worksheet or

an Excel workbook is active, select **Plot:Template Library**. In addition to organizing graph templates, you can also use the tool to plot your worksheet or Excel workbook data. If you highlighted data in the worksheet or workbook before opening the tool, and your data selection is appropriate for the template you've selected, then click the Plot button to plot the data into the template. If you did not highlight data or if your selection was not appropriate for the template you've selected, then click the Plot button to open an intermediary dialog box for data selection.

Figure 7: The Template Library Tool



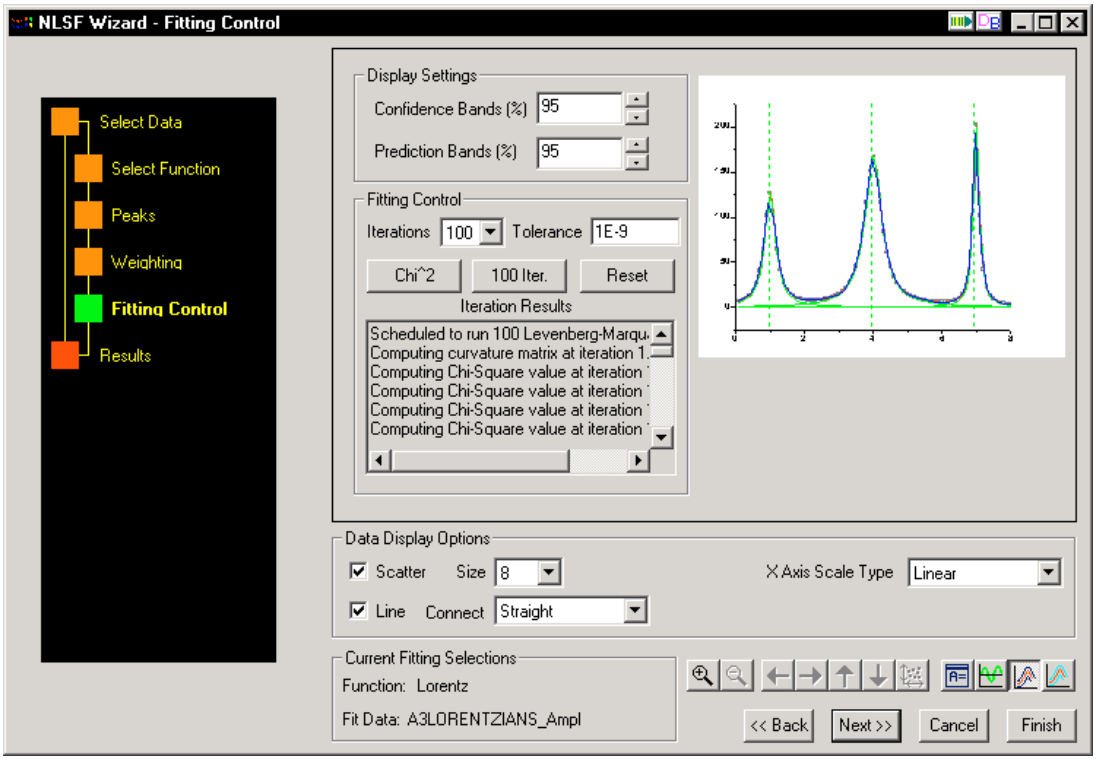
Analysis

NLSF Wizard

Origin 7 provides a wizard for performing nonlinear least squares fitting. The NLSF wizard is easier to use than the advanced fitting tool (NLSF), as it steps you through the fitting process. The wizard provides only the most frequently used fitting options. For complete fitting options, open the NLSF.

To open the NLSF Wizard, select **Analysis:Nonlinear Curve Fit:Fitting Wizard**.

Figure 8: The NLSF Wizard



Analysis Apply Button

The following analysis routines now have an Apply button available in their respective dialog boxes. When the Apply button is clicked, the interim results display in the graph. The dialog box remains open and is available for further changes. Each time you change a dialog box setting and click Apply, the results update in the graph. The results are not finalized until you click OK.

=> The following graph menu commands have an Apply button:

Analysis:Smoothing:Savitzky-Golay, **Adjacent Averaging**, and **FFT Filter**

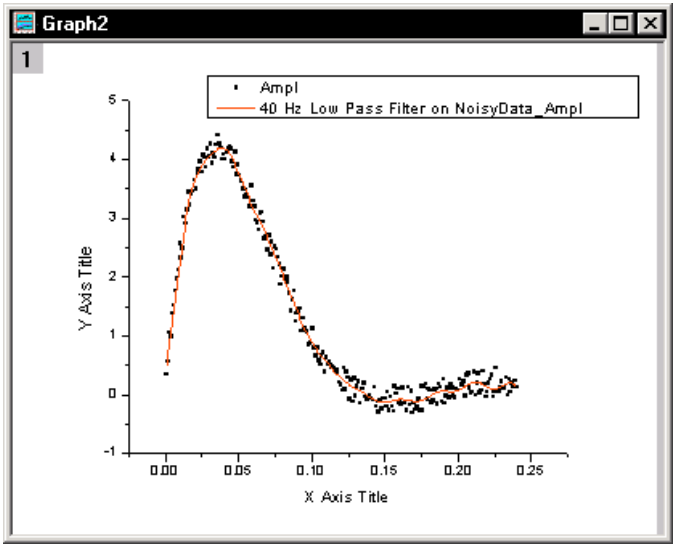
Analysis:FFT Filter:Low Pass, **High Pass**, **Band Pass**, and **Band Block**

Analysis:Interpolate/Extrapolate

=> The following worksheet menu commands have an Apply button:

Statistics:Descriptive Statistics:Frequency Count

Figure 9: 40 Hz Low Pass Filter Applied



Data Import and Handling

Thermo Galactic SPC

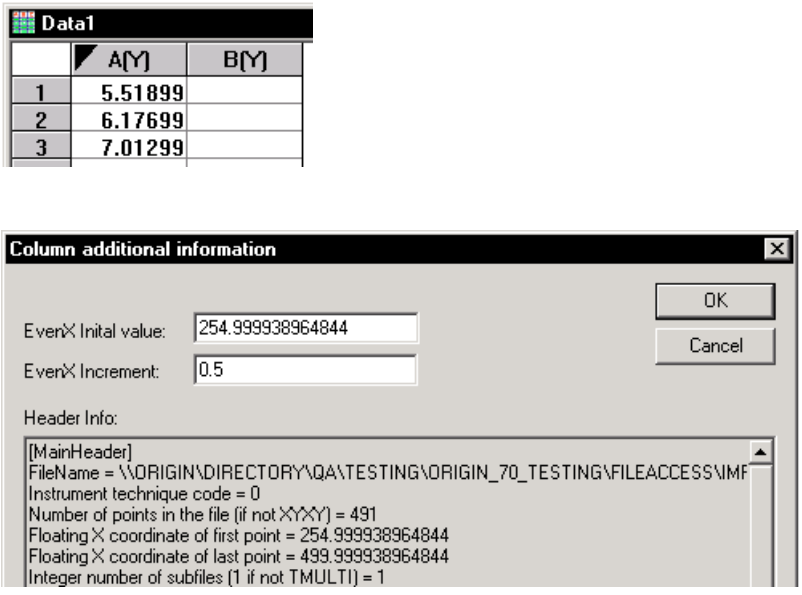
You can now import Thermo Galactic SPC data files into Origin by selecting **File:Import:Galactic (SPC)**. Origin supports both single and multiple arrays.

=> If the data file contains an array of X values, then Origin assigns those values to an X column.

=> If the initial X value and the increment are stored in the header, then Origin creates a hidden X column with the correct starting value and increment. To view this information in Origin, perform one of the following operations:

1) Double-click on the black triangle located in the upper-left corner of the column heading. This action opens the Column Additional Information dialog box. You can modify the starting X value and increment in the associated text boxes.

Figure 10: Reviewing the Starting X Value and Increment



2) Click on the column heading to select the column and then select **Format:Set Worksheet X**. This menu command also opens a dialog box for modifying the starting X value and increment.

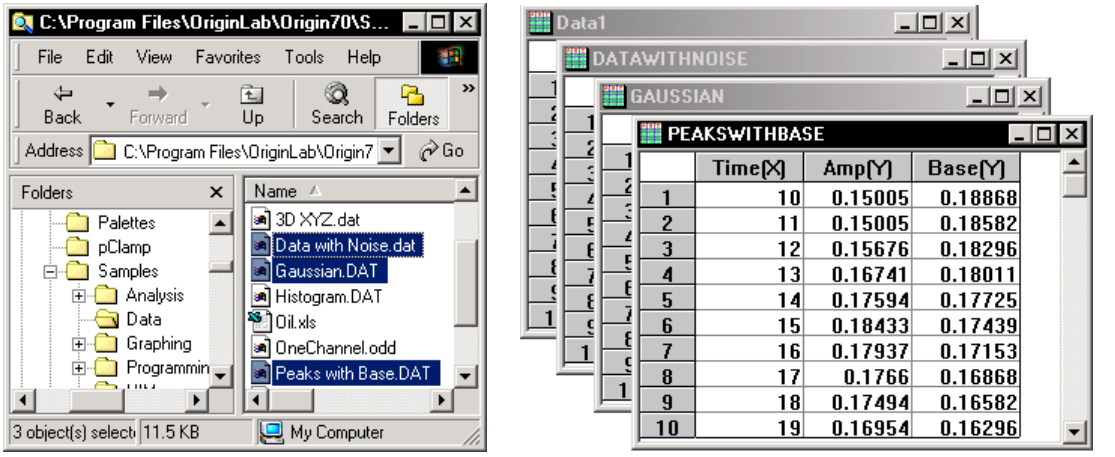
To view the hidden X column, select **View:Show X Column**.

Drag-and-Drop

You can drag-and-drop ASCII, SigmaPlot, Minitab, and Thermo Galactic SPC files into Origin. Once you have selected the file in Windows Explorer, if Origin isn't currently open you can drag the file onto your Origin desktop icon. If Origin is already open, you can drag the file over the Origin taskbar button and hold there until Origin becomes active. Then continue dragging and drop the file into the Origin workspace.

You can drop the data files into existing worksheets or graphs, or you can drop into a blank location of the workspace to import into a new worksheet for a single file, or multiple worksheets for multiple files.

Figure 11: Dragging Data Files Into Origin

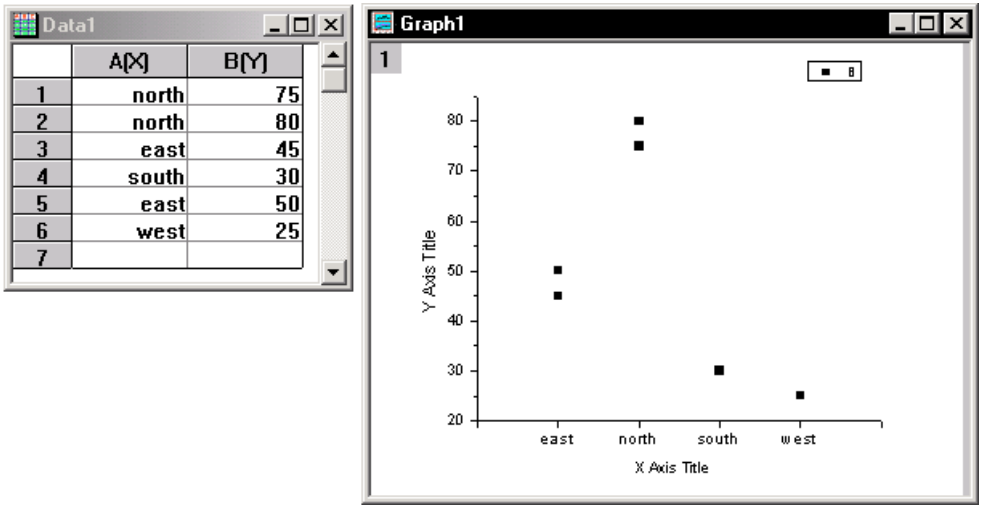


Categorical Data Support

Origin 7 supports plotting categorical data in both X and Y columns. Before plotting categorical data, you must set the column to Categorical by highlighting the column and selecting **Column:Set as Categorical**.

=> When you plot a Categorical X column and one or more associated Y columns, Origin creates a graph with the X categories as X axis tick labels. These tick labels are organized alphabetically (categories starting with numeric values are first) and then evenly spaced across the axis. The Y data is plotted using the associated X tick values.

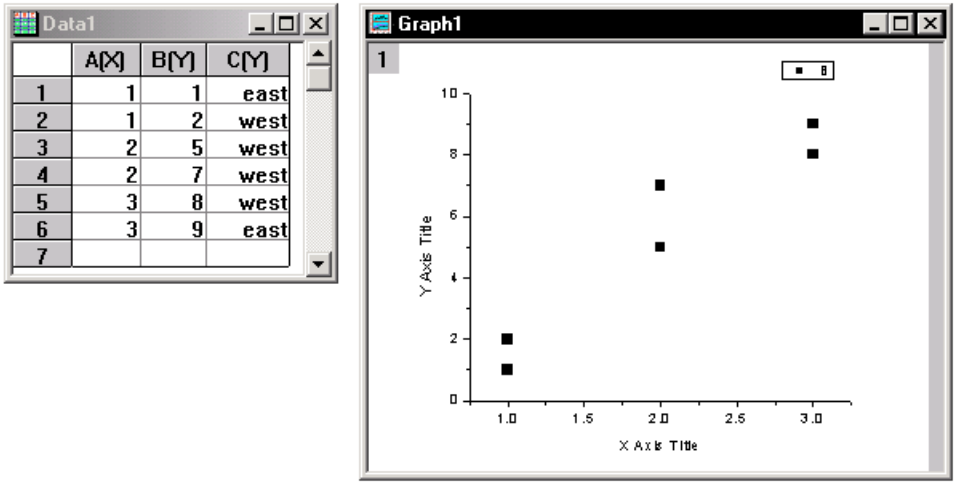
Figure 12: Plotting Categorical X Data



=> If your worksheet contains a Categorical Y column, then you can map this categorical data to your data plots, displaying categories of data using the same symbol shape, color, size, or other plot attribute.

For example, in the following figure, the A(X) and B(Y) columns are plotted using the Scatter template.

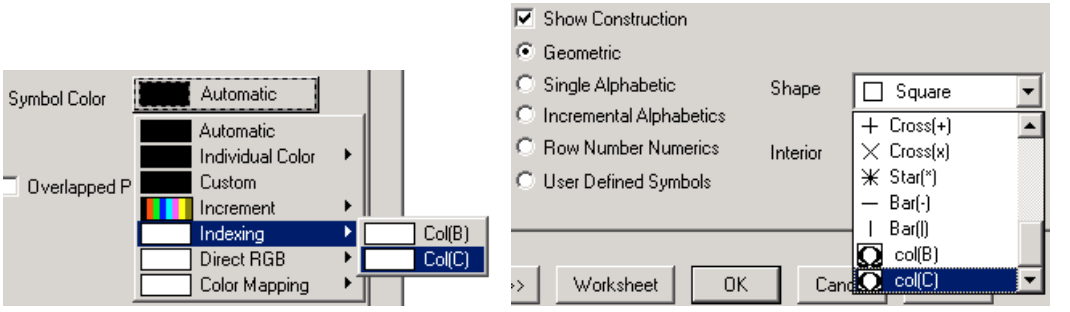
Figure 13: Plotting the A(X) and B(Y) Columns



To display categories of data (east, west) using the same symbol shape and color, open the Symbol tab of the Plot Details dialog box and edit the

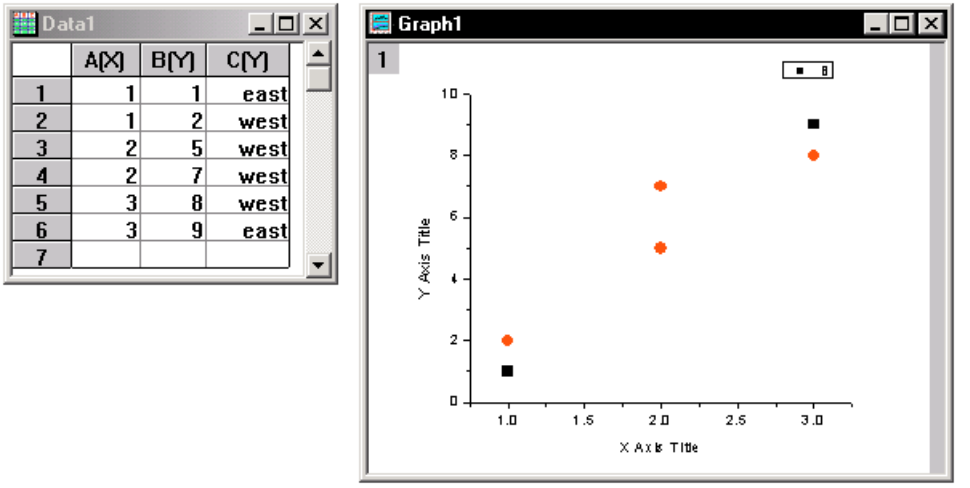
Symbol Color and Shape drop-down lists as shown in the following figure. In this example the colors for each category will be *indexed* from the color list.

Figure 14: Mapping the Symbol Color and Shape to Column C



The resultant graph displays the data using the column C categories for both the symbol color and shape. To do this, Origin alphabetizes the categories (categories starting with numeric values are first). Because color indexing was selected, Origin assigns the first category the first color in the color list, the second category the second color, etc. Origin performs this same alphabetic assignment for all other mapped plot attributes.

Figure 15: The Resultant Graph



Analysis Power

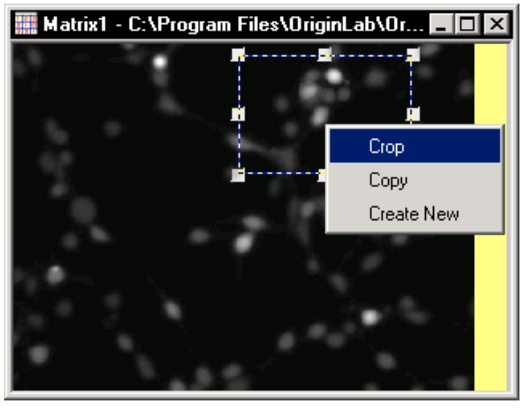
New Graph Types

Image Graph

Origin 7 provides enhanced support for importing, viewing, and plotting raster graphic images. To import a gray scale, 8-bit color or higher resolution color image into the active matrix, select **File:Import Image**. When you first import the image, Origin displays a device independent bitmap (DIB) of the image in the matrix.

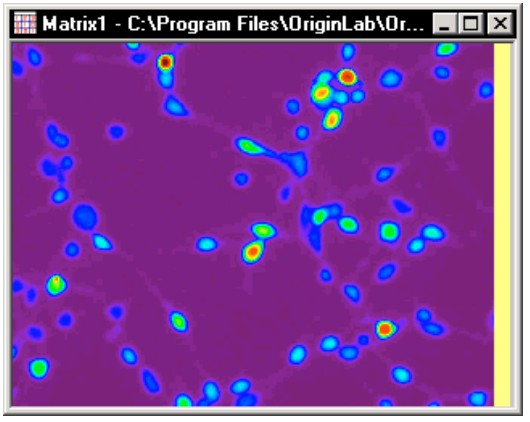
If you are only interested in a region of the image, you can select a region of the DIB using the Rectangle Tool (in "region of interest mode")  on the Tools toolbar.

Figure 16: Selecting a Region of Interest



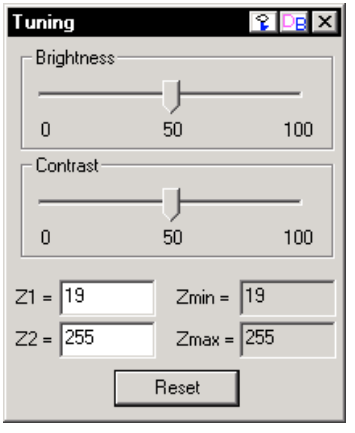
You can also view the image using a built-in or user supplied color palette. Viewing the image using a specified color palette may clarify regions of the image. To view the image using a color palette, you must first convert the DIB to matrix data. To do this, select **Image:Convert to Gray + Data**. Origin converts each pixel to an RGB value and then assigns the corresponding matrix cell an index number to a gray scale palette, based on the RGB value of the pixel. To display the image using a palette other than gray scale, select **Image:Palette:*PaletteSelection***.

Figure 17: Viewing the Image Using a Built-in Palette for Improved Clarity



When viewing the image from a palette, Origin maps each cell's index value to a color in the selected palette. Thus, the image's full matrix Z value range is mapped to the palette. You can adjust the brightness and the contrast of the image using the Tuning tool. To open this tool, select **Image:Tuning**. When you adjust the Contrast slider, you are increasing or decreasing the Z value range that is mapped to the palette. When you adjust the Brightness slider, you are shifting the range of Z values that are mapped to the palette.

Figure 18: Adjusting the Brightness and Contrast of the Image



To plot the image into a graph window, select **Plot:Image Plot**.

Figure 19: Plotting the Image into a Graph

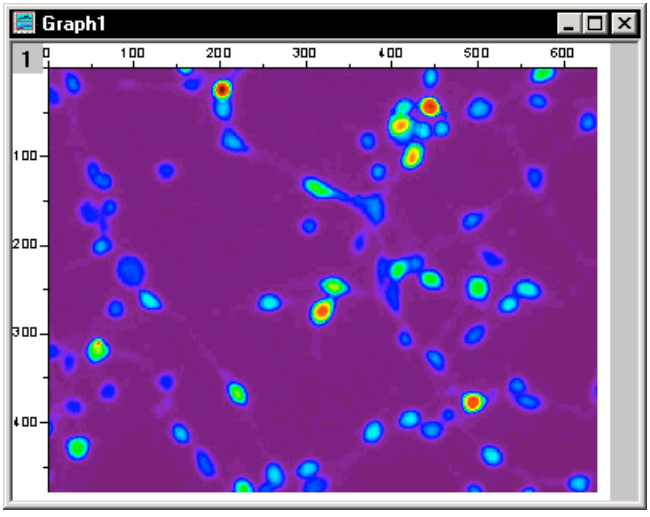


Image Histogram

After importing a raster graphic image into a matrix, Origin can create a histogram of the intensity values in the image. To plot a histogram from the image in the matrix, select **Plot:Histogram**.

Figure 20: Example Image Histogram

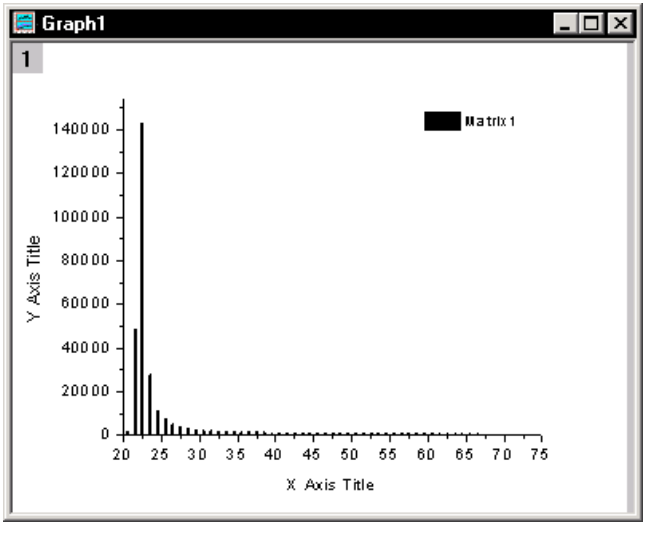
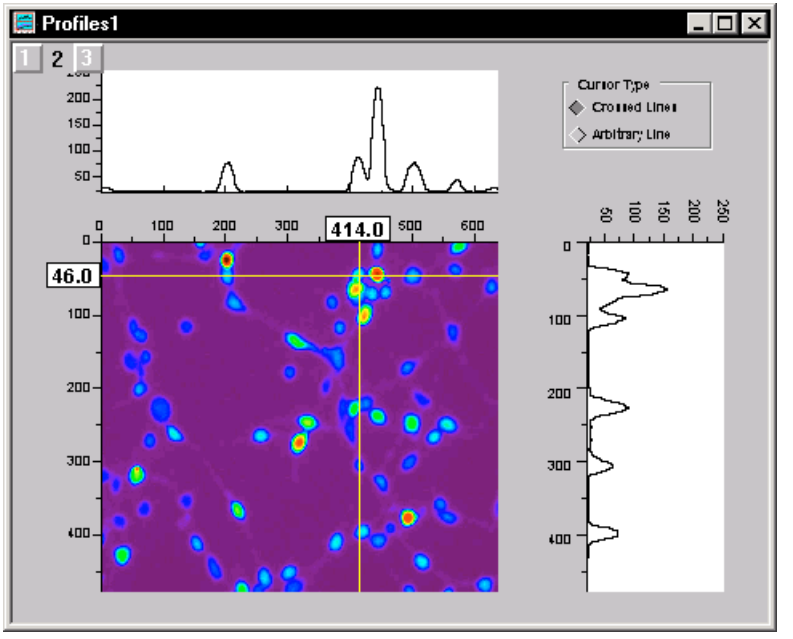


Image Profiling

Matrix images can also be plotted using a graph template that includes X and Y projections. To plot to this template, select **Plot:Profiles**. You can drag the lines to view different X and Y projections. You can also view the projections using an arbitrary line.

Figure 21: Viewing the Images X and Y Projections

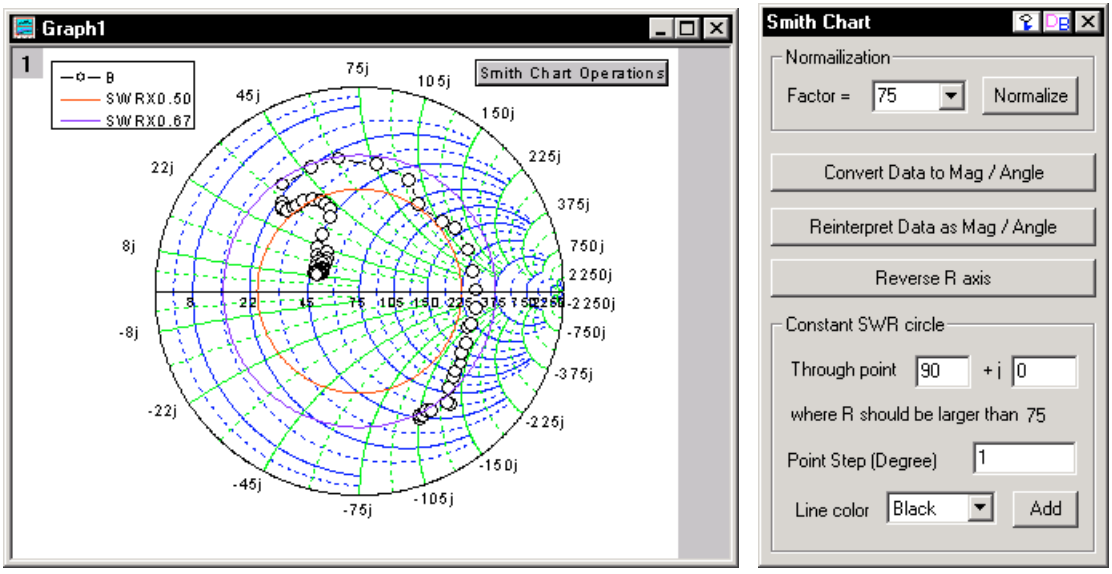


Smith Chart

You can now create Smith® Charts in Origin 7. To plot data using the Smith Chart template, select **Plot:Smith Chart** or click the Smith Chart button  on the 2D Graphs toolbar.

To customize the Smith Chart, edit the Plot Details and Axes dialog boxes. Additionally, click the Smith Chart Operations button to open the Smith Chart tool.

Figure 22: Smith Chart with Operations Tool



Statistical Analysis

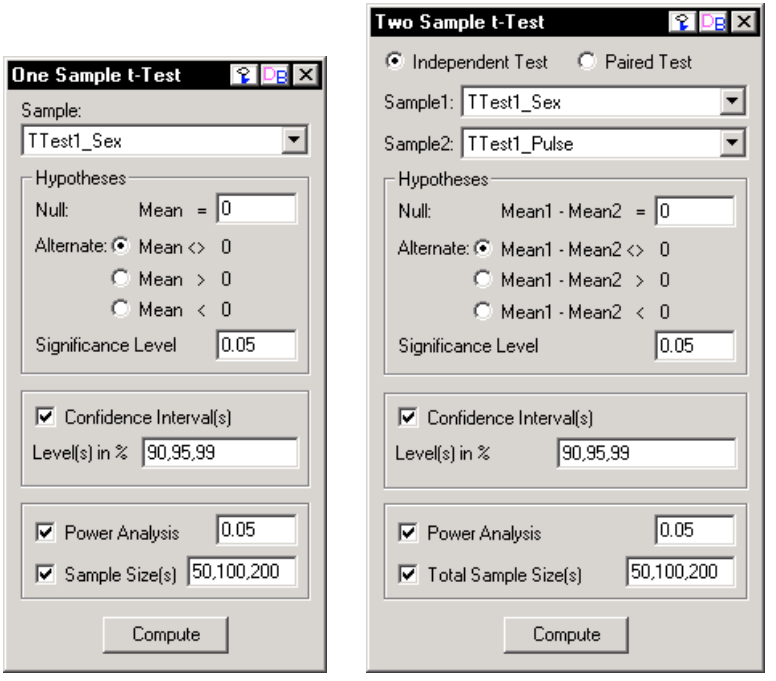
One / Two Sample t-Test

One and two sample t-Tests have been completely redesigned and expanded in Origin 7. The following new features have been added:

=> You can now select new data sets, change settings, and re-compute without having to re-open the dialog box each time.
=> Both one and two tailed tests can now be computed by selecting any one of three Alternate Hypotheses.
=> Confidence intervals for a number of different confidence levels can now be computed.
=> Actual Power can now be computed for any specified alpha level.
=> Hypothetical Power for a number of different sample sizes can now be computed.

One and two sample t-Tests are available from the **Statistics:Hypothesis Testing** menu.

Figure 23: One and Two Sample t-Test Dialog Boxes



Survival Analysis

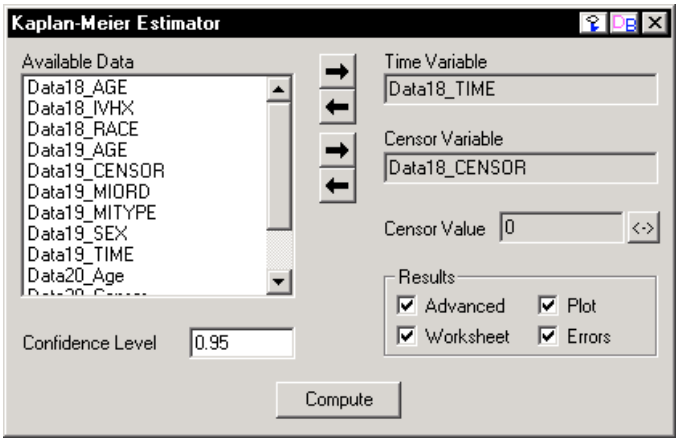
The Survival Analysis features are new in Origin 7. Two computations are available:

=> Kaplan-Meier Product Limit Estimator
=> Cox Proportional Hazards Model

Both of these computations are used to estimate the survivorship function which is the probability of survival to a given time based on a sample of failure times.

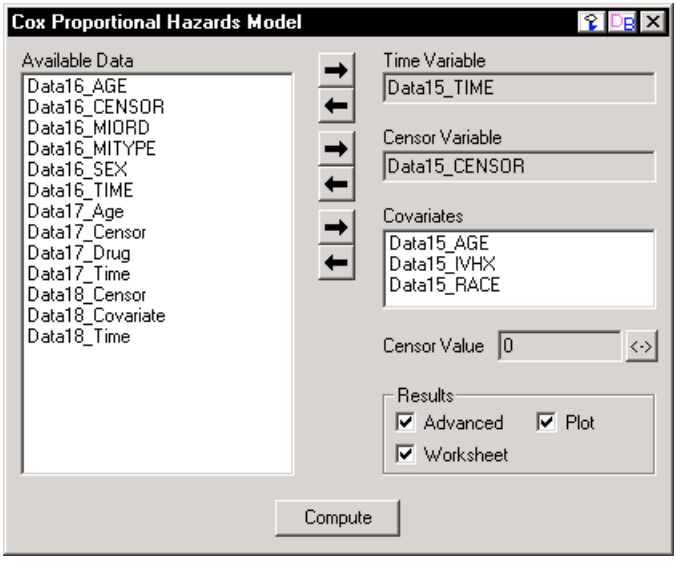
To use the Kaplan-Meier estimator, select **Statistics:Survival Analysis:Kaplan-Meier Estimator**.

Figure 24: Kaplan-Meier Estimator Dialog Box



To use the Cox Proportional Hazards model, select **Statistics:Survival Analysis:Cox Proportional Hazards Model**.

Figure 25: Cox Proportional Hazards Model Dialog Box



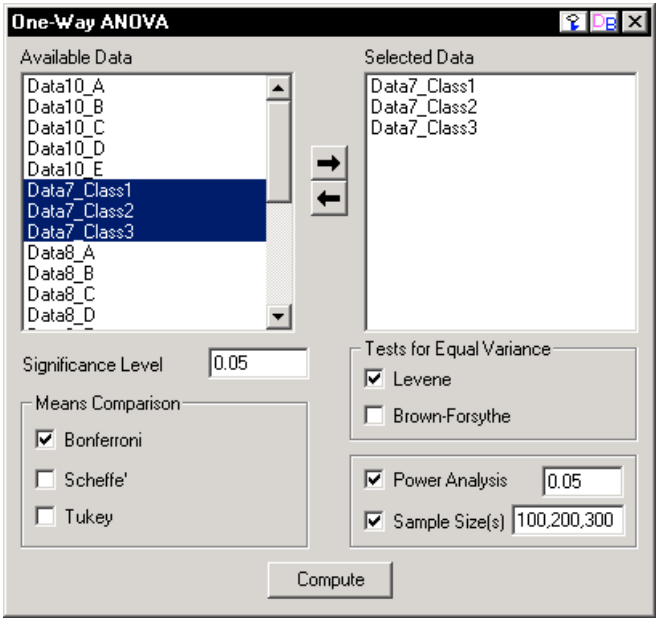
One-Way ANOVA

One-way ANOVA has been redesigned and expanded in Origin 7. The following new features have been added:

=> You can now select new data sets, change settings, and re-compute without having to re-open the dialog box each time.
=> Non-contiguous column selection from any worksheet in the project.
=> Three different methods of Means Comparison (Bonferroni, Scheffé, Tukey) can now be computed.
=> Two different Tests for Equal Variance (Levene, Brown-Forsythe) can now be computed.
=> Actual Power can now be computed for any specified alpha level.
=> Hypothetical Power for a number of different sample sizes can now be computed.

One-way ANOVA is available from the **Statistics:ANOVA** menu.

Figure 26: One-way ANOVA Dialog Box



Two-Way ANOVA

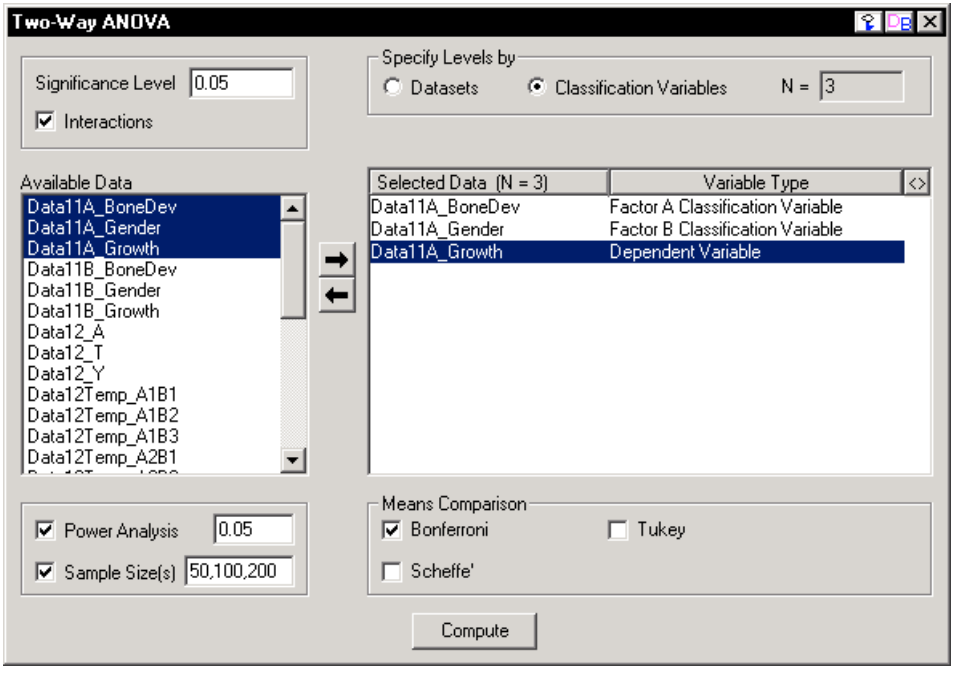
Two-way ANOVA evaluates the effect of two independent factors on a measured response and whether or not there is an interaction between the two factors. This feature is new in Origin 7 and will support the following new computations:

=> You can select new data sets, change settings, and re-compute without having to re-open the dialog box each time.
=> Non-contiguous column selection from any worksheet in the project, and the ability to group levels of each factor either by classification

variables or by data set.
=> Three different methods of Means Comparison (Bonferroni, Scheffé, Tukey) can be computed.
=> A computation that determines whether or not there are any interactions between the two factors.
=> Actual Power can be computed for any specified alpha level.
=> Hypothetical Power for a multiple number of different sample sizes can be computed.

Two-way ANOVA is available from the **Statistics:ANOVA** menu.

Figure 27: Two-way ANOVA Dialog Box



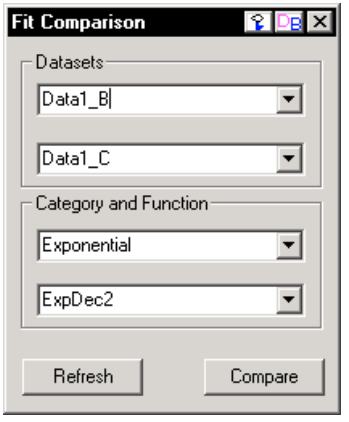
Normality Test

You can now perform a Shapiro-Wilk normality test by selecting one or more columns of data and then selecting **Statistics:Descriptive Statistics:Normality Test (Shapiro-Wilk)**. This test detects departures from normality without requiring that the mean or variance of the hypothesized normal distribution be specified in advance. For each selected data set, the sample size N, the Shapiro-Wilk statistic W and its significance level for testing normality P(W), and the decision rule are output to the Results Log.

Fit Comparison

A new Fit Comparison tool is available by selecting **Tools:Fit Comparison**. This tool compares two data sets by fitting the same function to the data. It then uses an F-test to determine whether the two data sets are significantly different from each other. The results are output to the Results Log.

Figure 28: Fit Comparison Tool



Programming

Origin C

Origin 7 introduces a new programming language called Origin C. Origin C supports a nearly complete ANSI C language syntax and a subset of C++ features including internal and DLL-extended classes. Furthermore, Origin C is "Origin aware". This means that Origin objects such as worksheets and graphs are mapped in Origin C, allowing direct manipulation of these objects and their properties from Origin C.

Typical programming routines in Origin include the following:

=> Adding functionality to Origin by creating new importing, analysis, graphing, and exporting routines.

=> Automating the work you do in Origin.

=> Performing simulations in Origin, with live feedback.

To learn more about programming using Origin C, select **Help:Programming:Program Guide** from the Origin menu. Additionally, sample Origin projects and associated source files are included in the \Samples\Programming subfolders.

Code Builder

Code Builder is Origin's integrated development environment. To open Code Builder, click the Code Builder button  on the Standard toolbar. Code Builder provides standard tools for writing, compiling, and debugging your Origin C functions. Once an Origin C function is compiled, the function becomes accessible from Origin.

NAG Numerical Library

Origin 7 includes the following Numerical Algorithms Group (NAG®) function libraries:

a02 - Complex Arithmetic
c06 - Fourier Transforms
e01 - Interpolation
e02 - Curve and Surface Fitting
F - Linear Algebra
f06 - Linear Algebra Support Functions
g01 - Simple Calculations on Statistical Data
g02 - Correlation and Regression Analysis
g03 - Multivariate Methods
g04 - Analysis of Variance
g08 - Nonparametric Statistics
g11 - Contingency Table Analysis
g12 - Survival Analysis
s - Approximations of Special Functions

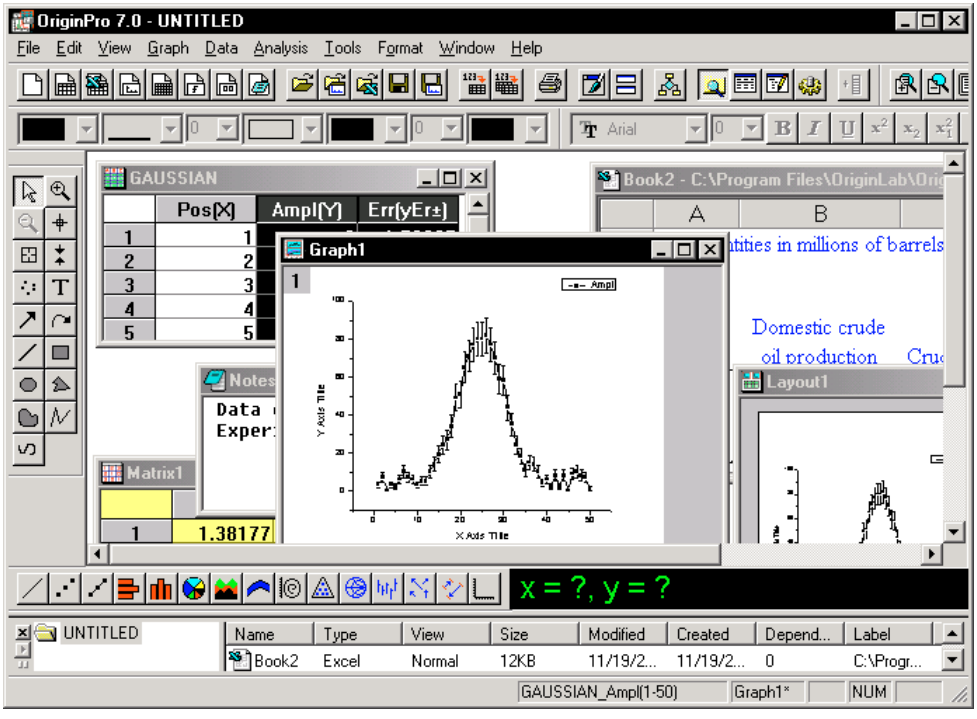
Many of these functions are called from built-in Origin routines. However, you can also call any of these NAG functions from Origin C. To learn more, review the sample Origin project files provided in the \Samples\Programming\NAG ... folders.

Chapter 4, Getting Started Using Origin

The Origin Workspace

When you start Origin, a new project opens displaying a worksheet window in the workspace. The worksheet is one type of window available in Origin. Origin also provides graph (including function graph), layout page, Excel workbook, matrix, and notes windows. Having various windows allows you to simultaneously view different visual representations of your data - such as data in a worksheet versus a graph - simplifying data manipulation and analysis.

Figure 1: The Origin Workspace and Supported Window Types



Menus and Menu Commands

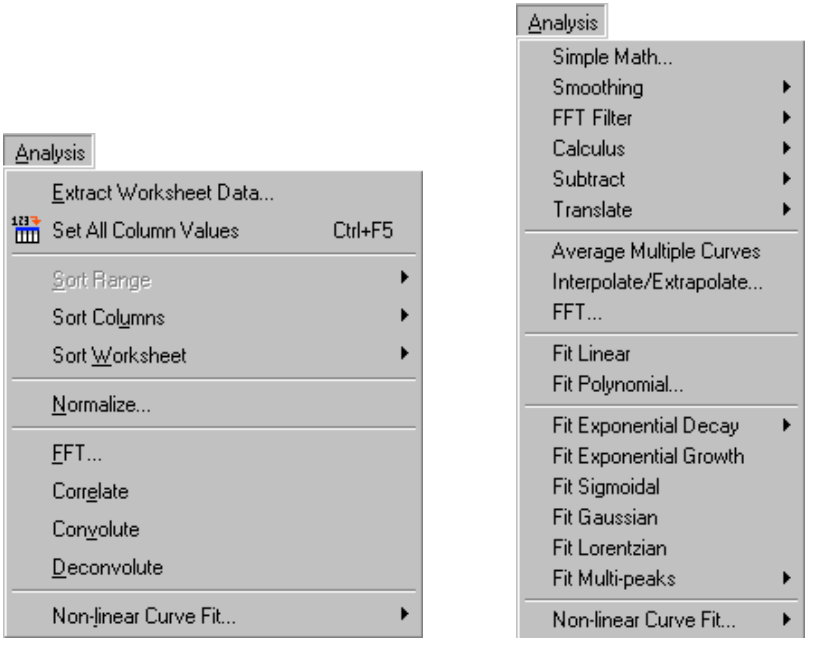
Origin's menu bar provides commands to perform operations on the active window and to perform general operations such as opening a Help file or turning on the display of a toolbar. The menu bar changes as you change the active window. For example, the following figures compare the worksheet and graph menu bars.

Figure 2: The Worksheet Window Menu Bar

Figure 3: The Graph Window Menu Bar

Menus are also sensitive to the active window. For example, the following figure compares the worksheet and graph **Analysis** menus.

Figure 4: The Worksheet and Graph Analysis Menus



Origin provides two menu "levels" which determine the number of menu commands that are available. By default, Origin displays the "full menu", which means that all available menu commands are provided. However, Origin also offers a "short menu" level, which provides a reduced set of menu commands for performing basic operations only. To activate this reduced set of commands, select **Format:Menu:Short Menus**. At any time you can re-activate the full set of commands by selecting **Format:Menu:Full Menus**.

Some menu commands have shortcut keys associated with them. If available, the shortcut key displays to the right of the menu command. For example, when a worksheet window is active, you can press CTRL+F5 to access **Set All Column Values**. (Note: You can't use a shortcut key if the menu is open.)

Some menu commands also have bitmaps that display to the left of the command. The bitmap indicates that the menu command also has toolbar button access. To access the command from a toolbar, look for the toolbar button represented by the command's bitmap.

Figure 5: Accessing a Command from a Toolbar

(To learn how to open additional toolbars, such as the Worksheet Data toolbar, see "Toolbars" on page 48.)

To turn off the display of bitmaps in the menus, select **Tools:Options** to open the Options dialog box. Select the Miscellaneous tab and then clear the Display Bitmaps in Menus check box. After you click OK, you are asked if you want to save this setting for future Origin sessions.

Many commands are also available from shortcut menus. To open a shortcut menu, right-click on the object you want to perform an action on. For example, if you right-click on a text label, the shortcut menu in the following figure opens.

Figure 6: Opening a Shortcut Menu

Toolbars

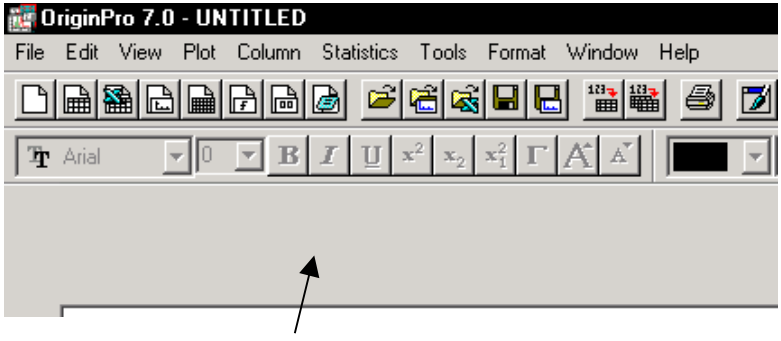
Origin provides toolbar buttons for frequently used menu commands. As with menu commands, some toolbars are only available when a particular window (for example, a worksheet) is active. Additionally, a toolbar that is available for multiple window types may contain buttons that are window-sensitive.

When you position the mouse pointer over a toolbar button, a view box opens displaying the button name, which indicates its purpose. A more detailed description also displays in the status bar.

Figure 7: Viewing a Button's Name and Purpose

If you open Excel workbooks in Origin, when you change the active window from an Excel workbook to any other window type (for example, a worksheet), or when you close an Excel workbook, the toolbar region displays a blank area where the Excel toolbars were located (see the following figure).

Figure 8: Blank Area in the Toolbar Region



To open the Options dialog box when an Excel workbook is active, select ***Window:Origin Options****.*

This area is called a toolbar spacer. To hide the toolbar spacer, right-click in the region and select **Hide Toolbar Spacer** from the shortcut menu. When you re-activate the Excel workbook window or re-open a workbook, Origin will automatically show the toolbar spacer with the Excel toolbars. (To prevent Origin from using the toolbar spacer, select **Tools:Options** to open the Options dialog box. Select the Miscellaneous tab and then clear the Use Toolbar Spacer check box. After you click OK, you are asked if you want to save this setting for future Origin sessions.)

When you first start Origin, the following toolbars are available: Standard, Graph, Format, Style, Tools, and 2D Graphs.

Figure 9: The Standard Toolbar

The Standard toolbar provides buttons for opening, saving, and creating new projects and windows, and for importing ASCII data. It also provides buttons for general window operations such as printing, duplicating, and refreshing windows. The Standard toolbar provides buttons for opening Project Explorer, the Results Log, the Script window, and Code Builder. A button is provided for custom programming. A button is also provided for adding a column to the worksheet.

Figure 10: The Graph Toolbar

The Graph toolbar is available when a graph or layout page is active. It provides buttons to zoom in and out and to rescale axes to show all the data. It provides buttons to display data plots in multiple layers, display layers in multiple windows, and to merge windows. Labeling buttons are available for legends and a time/date stamp.

Figure 11: The Format Toolbar

The Format toolbar is available when a text label is active. This toolbar provides text formatting buttons. Color control is available from the Style toolbar.

Note: The Greek button uses the Symbol font set. To associate the button with a different font set, select **Tools:Options** to open the Options dialog box. Select the Text Fonts tab and then select the desired font set from the Greek drop-down list.

Figure 12: The Style Toolbar

The Style toolbar is available when a text label or other annotation is selected. It provides buttons to set the line and fill color, style, and point size.

Figure 13: The Tools Toolbar

The Tools toolbar provides text, arrow, line, and other annotation buttons. It also provides buttons to enlarge a region of a graph. The Tools toolbar also provides buttons to read the XY (and Z, if 3D or contour) location on the page , and the XY (and Z) location of a data point . You can also define a range of data . Furthermore, a button is provided to draw a data plot .

For more information on the Screen Reader, Data Reader, and Data Marker buttons, see "Tutorial 2, Exploring Your Data".

Note: If you are viewing an image in a matrix, you can display the Rectangle tool in the "region of interest" mode . The region of

interest mode allows you to select a region of the image to crop, copy, or duplicate. The region of interest mode is controlled from the **Tools:Show Tools as ROI** menu command.

Figure 14: The 2D Graphs Toolbar

The 2D Graphs toolbar is available when a worksheet, Excel workbook, or graph window is active. It provides buttons for the common 2D graph templates, and for accessing a custom graph template.

=> When a worksheet or Excel workbook is active, first select the data that you want to plot and then click the button on the 2D Graphs toolbar to plot your data.

=> When a graph window is active, you can change the graph type (for example, from scatter to column) for the active data plot. To activate a data plot, select the data plot from the **Data** menu. Then click the button on the 2D Graphs toolbar to change the graph type.

In addition to these default toolbars, you can open the following additional toolbars. To do this, select **View:Toolbars** to open the Customize Toolbar dialog box. Then select the desired toolbar from the Toolbars tab.

Figure 15: The Edit Toolbar

The Edit toolbar provides cut, copy, and paste buttons.

Figure 16: The 2D Graphs Extended Toolbar

The 2D Graphs Extended toolbar is available when a worksheet, Excel workbook, or graph window is active. It provides buttons for the

additional 2D graph templates not accessible from the 2D Graphs toolbar.

Figure 17: The 3D Graphs Toolbar

The 3D Graphs toolbar is available when a worksheet, Excel workbook, or matrix is active. The first two buttons  are available for plotting XYZ data. The next four buttons  are available for plotting XYY data. The remaining buttons  are available for plotting matrices. The last button, the Image Plot button  , is available for plotting images.

Figure 18: The 3D Rotation Toolbar

The 3D Rotation toolbar is available when a 3D graph is active. This toolbar provides buttons to rotate the graph and change the perspective.

Figure 19: The Worksheet Data Toolbar

The Worksheet Data toolbar is available when a worksheet is active. This toolbar provides buttons to perform statistics on columns or rows of data, sort, use functions to set column values or mathematically transform values, update these column values, and fill columns with row numbers or random numbers.

Figure 20: The Column Toolbar

The Column toolbar is available when a worksheet column is selected. It provides buttons to set the column plotting designation and to move columns.

Figure 21: The Layout Toolbar

The Layout toolbar is available when a layout page is active. It provides buttons to add pictures of graphs or worksheets to the layout page.

Figure 22: The Mask Toolbar

The Mask toolbar is available when a worksheet or graph is active. This toolbar provides buttons to mask data from analysis.

Figure 23: The Object Edit Toolbar

The Object Edit toolbar is available when one or more annotation objects are selected in the active window, or when more than one picture is selected in a layout page. The toolbar provides buttons to align the selected objects/pictures, and to change the drawing order of the objects/pictures. Buttons are provided to group objects so that you can move or align the group. Additionally, buttons are provided to change the drawing order of objects relative to data plots.

Figure 24: The Arrow Toolbar

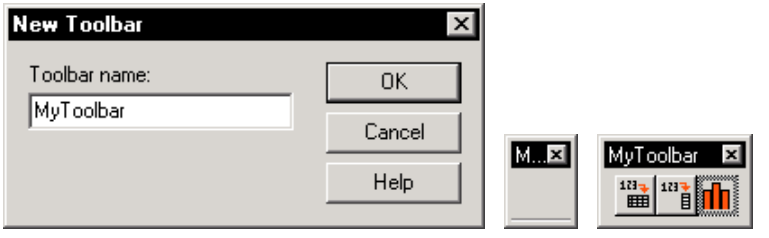
The Arrow toolbar is available when one or more lines or arrows are selected. This toolbar provides buttons to align multiple lines/arrows, and to customize the arrow head.

In addition to adding Origin's default toolbars to your workspace, you can add and remove buttons from any of the default toolbars, or create new toolbars containing a single button or a combination of buttons from the default toolbars.

To add and remove buttons from any of Origin's default toolbars, select **View:Toolbars** to enter the toolbar editing mode. You can now drag toolbar buttons between toolbars. To remove a button from a toolbar, drag the button off the toolbar (not on to another toolbar) and release the mouse button. To add a button to a toolbar, select the Button Groups tab on the Customize Toolbar dialog box. From the Groups list box, select the toolbar which displays the button by default. Then drag the desired button onto any of the toolbars.

To create a new toolbar, you can drag a button into the workspace or into the toolbar region (not on to another toolbar). Alternatively, click New on the Toolbars tab of the Customize Toolbar dialog box. Type the desired name in the New Toolbar dialog box and click OK. Now select the Button Groups tab and drag the desired buttons onto the new toolbar.

Figure 25: Creating a New Toolbar



Window Types

Origin provides a number of window types for viewing, analyzing, and presenting your data. These windows include worksheet, matrix, Excel

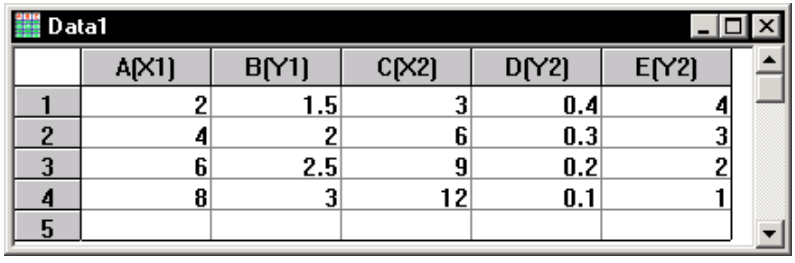
workbook, graph, layout page, and notes windows. The window type that is currently active in the Origin workspace determines the menu bar and toolbars that are available.

Worksheet Windows

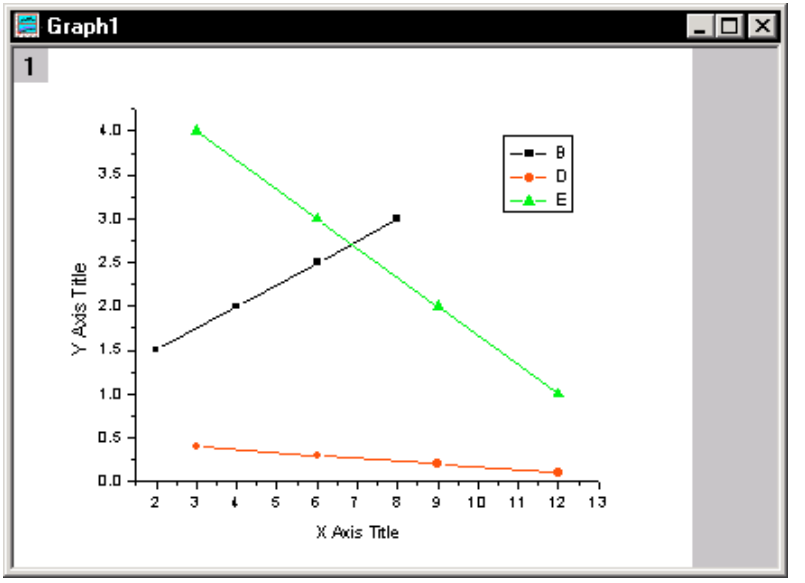
A worksheet's primary function is to hold and organize the data that you bring into Origin, and to provide tools for data manipulation, exploration, statistics, analysis, and plotting.

The columns in a worksheet are related to one another by their plotting designation (such as X and Y) and their location. The plotting designation determines how the selected data will plot. For example, in the following worksheet, if you select columns A through E and then click the Line & Symbol button  on the 2D Graphs toolbar, columns A and B, C and D, and C and E will plot as XY pairs.

Figure 26: Worksheet Column Plotting Designations



	A(X1)	B(Y1)	C(X2)	D(Y2)	E(Y2)
1	2	1.5	3	0.4	4
2	4	2	6	0.3	3
3	6	2.5	9	0.2	2
4	8	3	12	0.1	1
5					



Worksheet Menu Bar

File Edit View Plot Column Analysis Statistics Tools Format Window Help

The **File** menu provides Origin project and window commands that are available independent of the active window. When a worksheet is active, the **File** menu also provides commands to:
=> import and export data

Undo is available for most worksheet operations, but it is not available for all Origin operations.

The **Edit** menu provides cut, copy, paste, and undo commands that are available independent of the active window. Additionally, a "button edit mode" command is available for editing programmed labels. When a worksheet is active, the **Edit** menu also provides commands to:
=> set the worksheet display range
=> convert the worksheet to a matrix
=> transpose and paste transpose

The **View** menu provides commands to control the display of the Project Explorer window, toolbars, status bar, and Results Log. It also provides a command to display a grid for aligning objects. These commands are available independent of the active window. When a worksheet is active, the **View** menu also provides commands to:
=> update a graph after changing the worksheet data
=> go to a specified worksheet row
=> show a hidden X column

*Select your data first. Then select the **Plot** menu command.*

The **Plot** menu is only available when a worksheet, matrix, or Excel workbook is active. The **Plot** menu provides commands to:
=> plot data into a specified graph template

*Select your column first. Then select the **Column** menu command.*

The **Column** menu is only available when a worksheet is active. This menu provides commands to:
=> set the column's plotting designation
=> use functions to set column values or mathematically transform values
=> add and move columns

The **Analysis** menu provides commands to:
=> extract data
=> sort data
=> normalize data
=> perform FFT-related operations
=> perform nonlinear curve fitting

The **Statistics** menu is only available when a worksheet is active. This menu provides commands to:
=> perform a number of statistical tests on your data

The **Tools** menu command provides commands to set global preferences in the Options dialog box, re-activate reminder messages, and pack selected files into a single file to share with other Origin users. These commands are available independent of the active window. When a worksheet is active, the **Tools** menu also provides commands to:
=> associate LabTalk script with the worksheet
=> perform linear, polynomial, and sigmoidal fitting
=> compare two columns of data by fitting the same function to the data

The **Format** menu provides commands to display a reduced menu structure in which only basic operations are available, to edit the name and programming-related properties of a label, and to align objects to a grid. These commands are available independent of the active window. Additionally, the worksheet **Format** menu provides commands to:
=> set the worksheet or column display options
=> set incremental X values in a worksheet without a designated X column

The **Window** menu provides commands to arrange the windows in the workspace, open the Script window, activate a Project Explorer folder, and activate a window in the workspace. These commands are available independent of the active window.

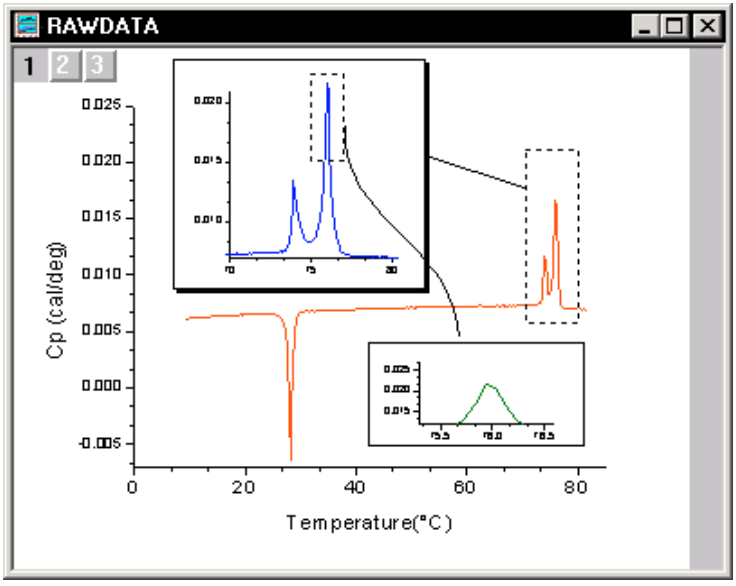
The **Help** menu provides commands to open the Origin and programming-related Help files, open a dialog box with tips on using Origin, go to the OriginLab web site, and register your copy of Origin. These commands are available independent of the active window.

Graph Windows

A graph window is a container and editor for creating graphs. Each graph window contains a single editable page. The page serves as a backdrop for the various graph objects, including layers, axes, annotations, and data plots.

There are many ways to create graphs in Origin. The easiest method is to select the worksheet data that you want to plot, and then select the desired graph type from the **Plot** menu or from one of the plotting toolbars. If you've already created a graph window, you can select and drag data from a worksheet into the graph window.

Figure 27: A Graph with Multiple Layers



Graph Menu Bar

File Edit View Graph Data Analysis Tools Format Window Help

(See the Worksheet Menu Bar for commands that are available for all window types.)

*When copying or when exporting to a vector image file, you can control the graph size from the Options dialog box (**Tools:Options**, Page tab).*

The **File** menu provides graph-specific commands to:
=> import ASCII data
=> import an image file
=> export the graph to an image file

The **Edit** menu provides graph-specific commands to:
=> copy a graph to the clipboard
=> add and arrange layers in the active graph
=> rotate the graph between landscape and portrait orientation
=> merge all the graph windows into one window

The **View** menu provides graph-specific commands to:
=> view the graph using the screen driver or active printer driver
=> zoom in and out of the graph
=> show or hide elements in the graph
=> resize the active graph layer so that it fills the page
=> resize the graph window so that it fills the screen

You can also drag data from a worksheet or Excel workbook into a graph.

The **Graph** menu provides commands to:
=> add data to the graph, including error bars or a function
=> rescale the axes and exchange the X and Y axes
=> create a new legend or color scale for color mapped data
=> stack grouped data (most useful for column and bar charts)

You can open the Plot Details dialog box for a data set by pressing CTRL and selecting it from the list.

The **Data** menu provides graph-specific commands to:
=> set the display range
=> move and remove data points
The **Data** menu also lists the data sets that are plotted in the active graph. The active data set is checked.

The **Analysis** menu provides graph-specific commands to:
=> perform linear and nonlinear fitting
=> perform math operations
=> smooth or filter the data
=> differentiate and integrate
=> perform a subtraction or translation
=> average curves
=> perform interpolation and extrapolation
=> perform an FFT

The **Tools** menu provides graph-specific commands to:
=> open analysis and fitting tools
=> open a tool for adding and arranging layers
=> compare two sets of data by fitting the same function to the data

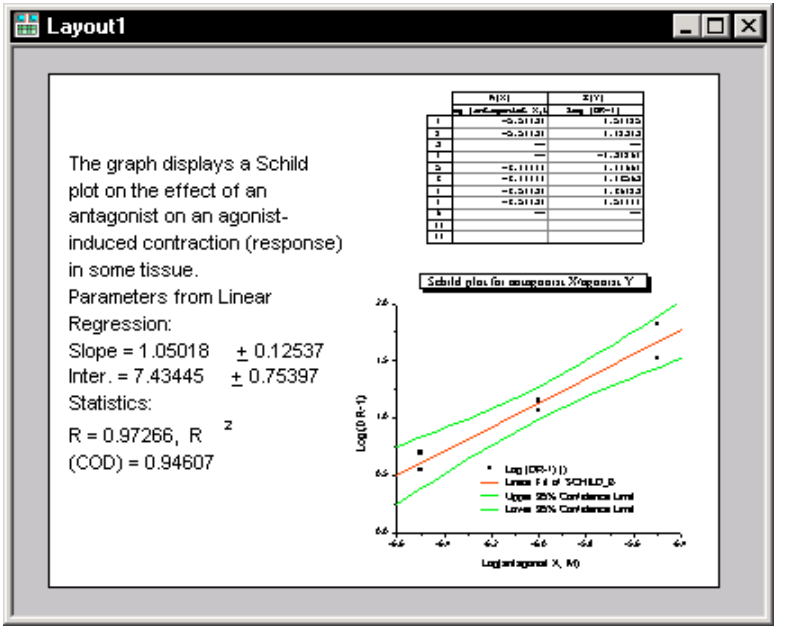
The **Format** menu provides graph-specific commands to:
=> set the page, layer, data plot, and axes display options

Layout Page Windows

A layout page window is a “display panel” for graphs and worksheets that have been created in other windows. You can add and arrange

worksheet and graph pictures in a layout page, as well as text and other annotations.

Figure 28: A Layout Page Window



Layout Page Menu Bar

File Edit View Layout Tools Format Window Help

(See the Worksheet Menu Bar for commands that are available for all window types.)

*When copying or when exporting to a vector image file, you can control the size from the Options dialog box (**Tools:Options**, Page tab).*

The **File** menu provides layout page-specific commands to:
=> import an image file
=> export the layout page to an image file

The **Edit** menu provides layout page-specific commands to:
=> copy a layout page to the clipboard
=> rotate the layout page between landscape and portrait orientation

The **View** menu provides layout page-specific commands to:
=> view the layout page using the screen driver or active printer driver
=> zoom in and out of the layout page
=> show master page items in the layout page

The **Layout** menu is only available when a layout page is active. This menu provides commands to:
=> add pictures of graphs or worksheets
=> view picture placeholders to increase redraw speed
=> view pictures using the screen driver to increase redraw speed

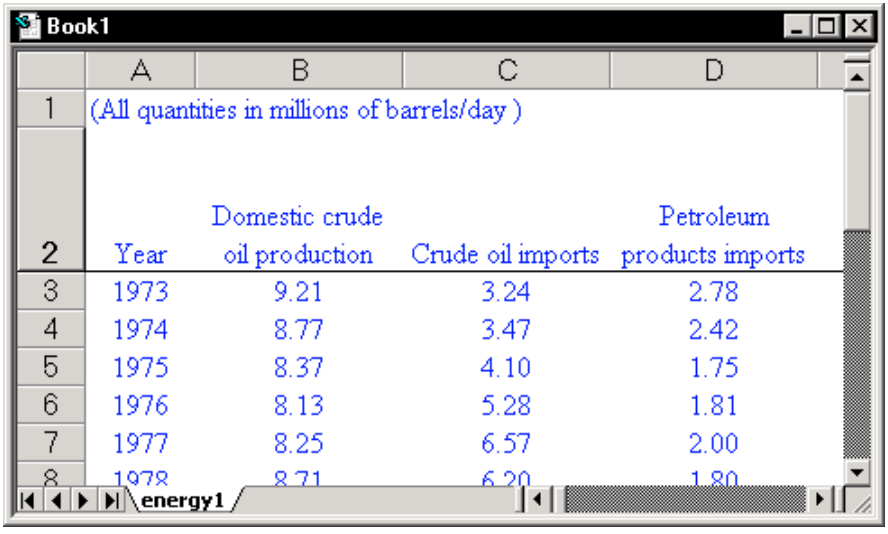
The **Format** menu provides layout page-specific commands to:
=> set the page display options

Excel Workbook Windows

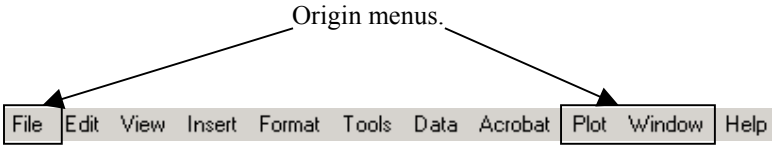
You can open Excel workbooks inside Origin, combining Origin's plotting and analysis power with Excel's spreadsheet tools. To plot your workbook data in Origin, you must have Excel version 7 (Microsoft Office 95) or later installed on your computer either as a local or network copy.

Note: When you change the active window from an Excel workbook to any other window type, the toolbar region displays a blank area where the Excel toolbars were located. To hide this spacer, right-click in this region and select **Hide Toolbar Spacer** from the shortcut menu.

Figure 29: Opening an Excel Workbook in Origin



Excel Workbook Menu Bar



*To open the Origin Help file, right-click on the workbook title bar and select **Help Contents** from the shortcut menu.*

When an Excel workbook is active in Origin, the menu bar displays both Origin and Excel menus. The **File**, **Plot**, and **Window** menus are Origin menus. All other menus are Excel menus.

The **File** menu provides Origin project and window commands.

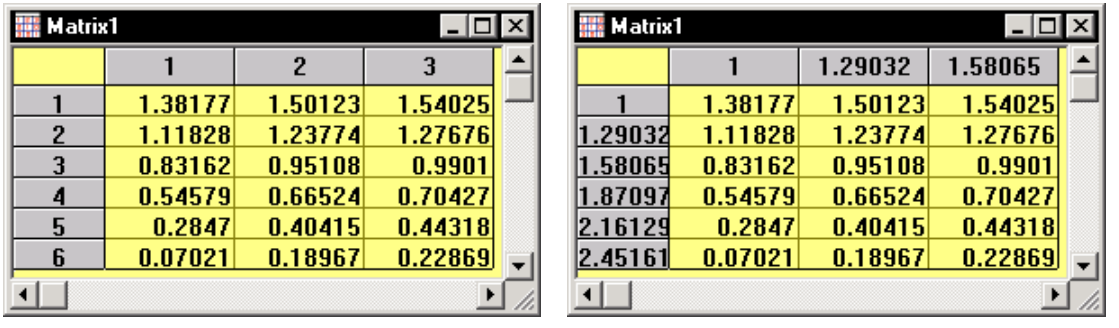
The **Plot** menu provides commands to plot data into a specified graph template.

The **Window** menu provides commands to:
=> set global preferences in the Options dialog box
=> control the display of the Project Explorer window, toolbars, and Results Log
=> convert an Excel workbook to a matrix using direct conversion
=> arrange the windows in the workspace, open the Script window, activate a Project Explorer folder, and activate a window in the workspace

Matrix Windows

A matrix displays a single data set containing Z values. Instead of displaying the data set as a column in a worksheet, a matrix displays the data in a specified dimension of rows and columns. A matrix is linearly mapped in X by columns and linearly mapped in Y by rows. By default, the column and row numbers display in the column and row headings. To display the X and Y values, select **View:Show XY**.

Figure 30: Showing the X and Y Matrix Values



Origin provides a number of methods for converting a worksheet to a matrix. This includes direct conversion, 2D binning, converting regular XYZ data, and converting random XYZ data using gridding. These conversion methods are available from the worksheet's **Edit:Convert to Matrix** submenu.

When a matrix is active, you can create 3D, surface, contour, and image plots.

Matrix Menu Bar

File Edit View Layout Tools Format Window Help

(See the Worksheet Menu Bar for commands that are available for all window types.)

The **File** menu provides matrix-specific commands to:
=> import and export data
=> import and export image files

The **Edit** menu provides matrix-specific commands to:
=> convert the matrix to a worksheet

The **View** menu provides matrix-specific commands to:
=> when viewing an image, zoom in and out of the image
=> when viewing data, go to a specified row
=> switch between data mode and image mode
=> show the column and row numbers or show the XY mapping for the Z values

The **Plot** menu provides commands to plot data into a specified graph template.

The **Matrix** menu is only available when a matrix is active. This menu provides commands to:
=> set matrix properties such as the internal data type and the display format
=> set the matrix dimensions and the XY mapping relationship
=> use functions to set the matrix values or mathematically transform values
=> transpose, invert, shrink using averaging, expand using bilinear interpolation, smooth, or integrate the matrix

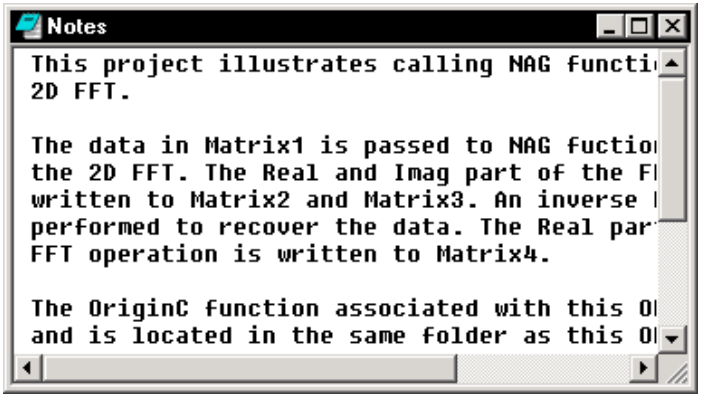
The **Image** menu is only available when a matrix is active. This menu provides commands to:
=> display images using selected color palettes
=> open a tool to adjust the brightness and contrast in the image

The **Tools** menu provides matrix-specific commands to:
=> display the Tools toolbar tools in the "region of interest mode" for selecting a region to copy, crop, or create a new matrix

Notes Windows

Notes windows can contain only text, and are thus used for recording information.

Figure 31: A Notes Window



Notes Menu Bar

File Edit View Layout Tools Format Window Help

(See the Worksheet Menu Bar for commands that are available for all window types.)

The **View** menu provides notes-specific commands to:
=> enable word wrapping

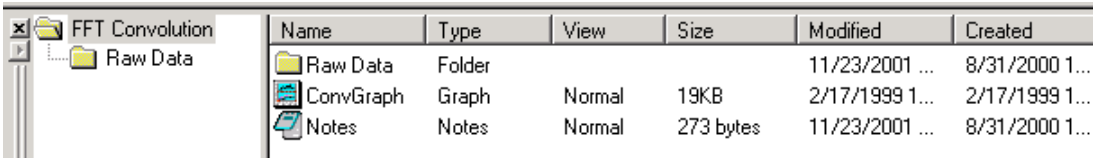
Project Explorer

Project Explorer is shown or hidden by clicking the Project Explorer button  *on the Standard toolbar.*

Project Explorer is a tool to help you organize your Origin projects. It is particularly useful if you are working with a project that contains more than a few windows. You can use Project Explorer to develop a folder structure for organizing the windows in your project. You can also use Project Explorer to control the view of your workspace.

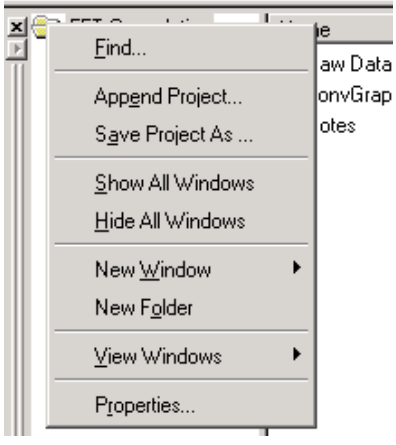
When you first start Origin, Project Explorer displays docked to the bottom edge of the workspace. You can dock it to any other edge or display it as a window in the workspace. To prevent Project Explorer from docking when positioning it as a window, press CTRL while dragging.

Figure 32: Project Explorer



To create a new folder, right-click on the project folder (or a subfolder) and select **New Folder** from the shortcut menu. Once you have created one or more subfolders, you can move windows between folders.

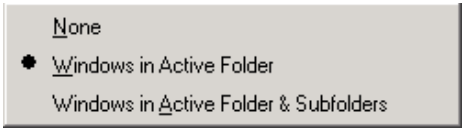
Figure 33: Creating a New Folder



In addition to adding and moving folders, Project Explorer also controls the view of your workspace. By default, only the windows in the active Project Explorer folder display in your workspace. For projects with lots of windows, this allows you to focus on specific windows in a clutter-free workspace.

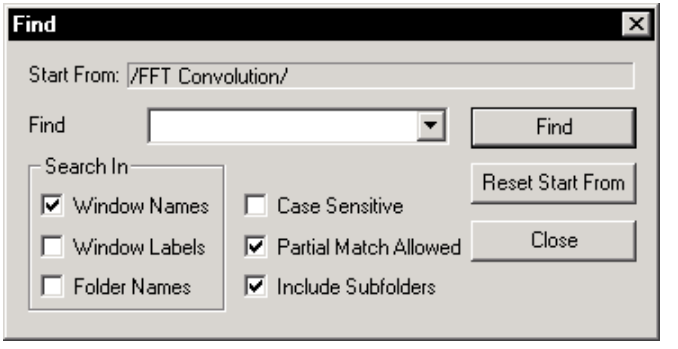
To control the view of the windows in your workspace, right-click on a Project Explorer folder or right-click in a blank space on the left side of Project Explorer. Select **View:*View Mode*** to alter the view mode. (Alternatively, select **View:View Windows:*View Mode*** from the Origin menu bar.)

Figure 34: Controlling the View of Windows in the Workspace



After you organize your windows into multiple folders, Project Explorer's Find dialog box helps you locate windows in your project. To open this dialog box, right-click on the Project Explorer folder that you want to start your search from and select **Find** from the shortcut menu. If you are unsure of the window location within your Project Explorer folder structure, right-click on the main project folder and select **Find**.

Figure 35: Finding Windows in Your Project

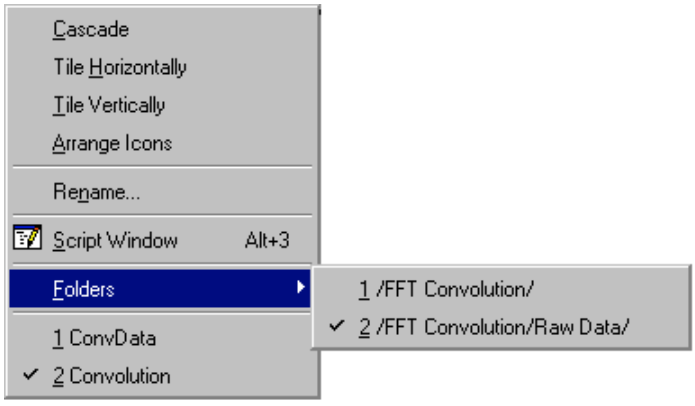


Because Project Explorer uses some of your workspace, you may want to close Project Explorer, even if you have already created a folder structure. To close Project Explorer, click the Project Explorer button  on the Standard toolbar.

When Project Explorer is closed, Origin continues to use your folder structure and view settings to display the windows in your workspace. Thus, if you are working with a project that contains subfolders, and the view mode is set to view only the active folder's windows, then Origin will display the windows in your currently active folder.

To access windows in other folders, you can re-open Project Explorer or you can select **Window:Folders:*Folder Name*** to view the windows in the selected Project Explorer folder. The window list at the bottom of the **Window** menu updates to reflect the windows in the ***Folder Name*** folder.

Figure 36: Accessing Folders and Windows from the Menu Bar



Results Log

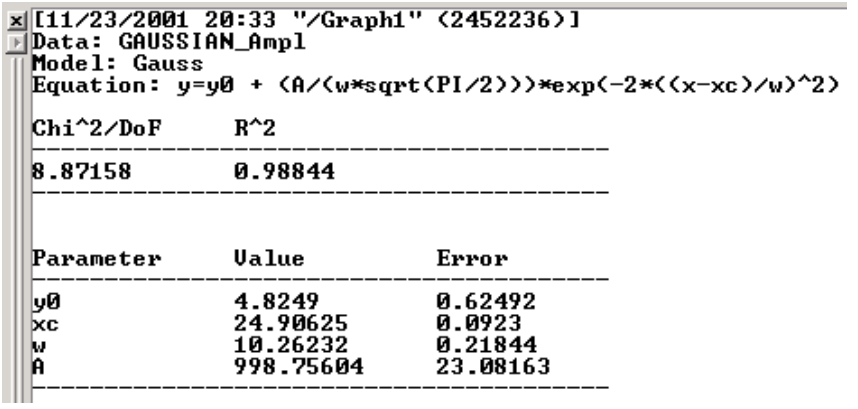
When you save an Origin project, the contents of the Results Log is saved with the project.

Origin automatically routes most analysis and fitting results to the Results Log. In most cases, when results are output to the Results Log, it opens automatically. However, to manually open (and close) the Results Log, click the Results Log button  on the Standard toolbar. Opening and closing the Results Log only controls its view state. You do not lose results by closing the log.

When the Results Log first opens, it displays docked to the top edge of the workspace. You can dock it to any other edge or display it as a window in the workspace. To prevent the Results Log from docking when positioning it as a window, press CTRL while dragging.

Each entry in the Results Log includes a date/time stamp, the window name, a numeric stamp which is the Julian day, the type of analysis performed, and the results.

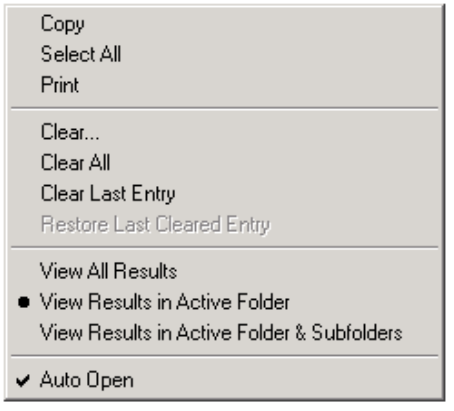
Figure 37: The Results Log



```
[11/23/2001 20:33 "/Graph1" (2452236)]
Data: GAUSSIAN_Ampl
Model: Gauss
Equation: y=y0 + (A/(w*sqrt(PI/2)))*exp(-2*((x-xc)/w)^2)

Chi^2/DoF      R^2
-----------------------------------------
8.87158        0.98844
-----------------------------------------


Parameter      Value          Error
-----------------------------------------
y0             4.8249         0.62492
xc             24.90625       0.0923
w              10.26232       0.21844
A              998.75604      23.08163
-----------------------------------------
```

You can right-click in the Results Log to open a shortcut menu with commands to copy, print, clear, and view additional results.

Figure 38: The Results Log Shortcut Menu



Note: When you close the Results Log after it has been docked to the edge of the workspace, the toolbar region may display a blank area where the log was located. To hide this spacer, right-click in this region and select **Hide Toolbar Spacer** from the shortcut menu.

Code Builder

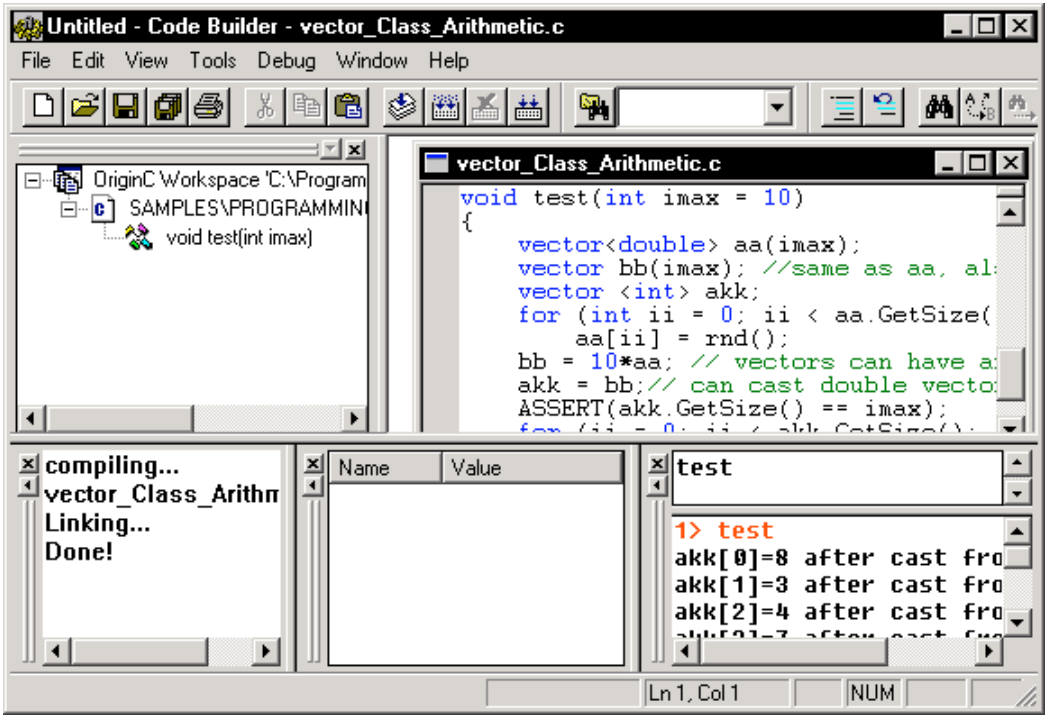
Origin's programming language is called Origin C. Origin C supports a nearly complete ANSI C language syntax as well as a subset of C++ features including internal and DLL-extended classes. In addition,

Origin C is "Origin aware". This means that Origin objects such as worksheets and graphs are mapped to classes in Origin C, allowing direct manipulation of these objects and their properties from Origin C.

Origin C's integrated development environment is called Code Builder.

To open Code Builder, click the Code Builder button  on the Standard toolbar. Code Builder provides tools for writing, compiling, and debugging your Origin C functions. Once an Origin C function is compiled, the function becomes accessible from Origin.

Figure 39: Code Builder



To learn more about programming in Origin, select **Help:Programming:Program Guide** or review the sample Origin projects located in the \Samples\Programming folder.

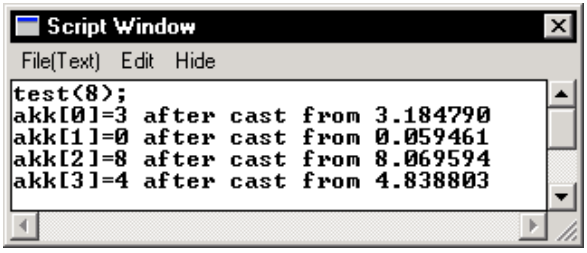
Script Window

The Script Window is available for executing LabTalk commands. LabTalk is Origin's "historic" programming language. It has been available in versions up to and including Origin 7. However, Origin 7

introduced the new Origin C programming language. Whereas LabTalk scripts are interpreted during execution by Origin, Origin C code is compiled to byte code form and therefore executes much faster than LabTalk.

Even though Origin C is the preferred programming language in Origin 7, Origin C functions must be called using LabTalk commands. These commands can be executed from the Script window, or from many other locations that support LabTalk script. To open the Script window, click the Script Window button  on the Standard toolbar. Note that when you save an Origin project, the Script window contents are not saved with the project.

Figure 40: The Script Window



To learn more about programming in Origin, select **Help:Programming:Program Guide** or review the sample Origin projects located in the \Samples\Programming folder.

Origin Project Files

Origin provides sample project files in the \Samples subfolders.

An Origin project file contains all the worksheet, matrix, graph, layout page, and notes windows that are open in the workspace when you save the project. These windows include minimized and hidden windows, as well as windows that are accessible from other Project Explorer folders in the current workspace.

Excel workbook windows are a special case. If a workbook is open in the workspace, the project can be saved with a link to the source workbook file, or the workbook can be saved internal to the project.
=> Saving the project with a link to the source workbook file allows you to maintain an external Excel file that is updated when changes are made to the associated workbook in Origin. This source file is also available for use in other applications and can be accessed by other users.
=> Saving the workbook internal to the project enhances the project's portability. You can open the project on any computer that has Origin

and Excel installed and have full access to your workbook data. To control how the workbook is saved with the project, right-click on the workbook window title bar and select **Properties** from the shortcut menu.

In addition to these window types, the contents of the Results Log is saved with an Origin project, as well as the current Project Explorer folder and window structure.

Saving a Project

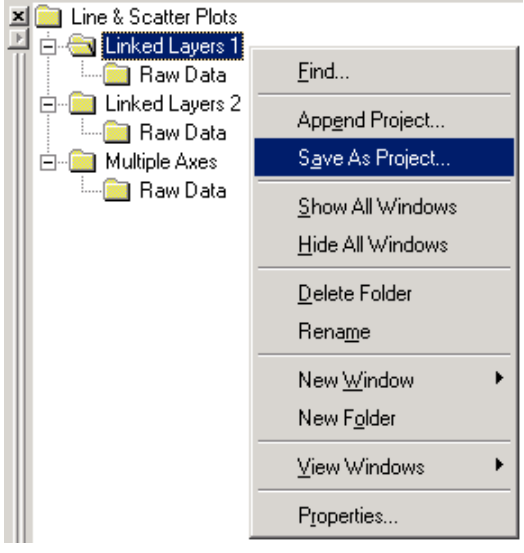
For information on customizing the default save path, see "Opening an Existing Project" on page 73.

To save a project to the current file name, select **File:Save Project**. If the project has not been previously saved, this menu command opens the Save As dialog box displaying the default file name, UNTITLED.OPJ, in the File Name text box. Type the desired file name in the text box (specify the path) and click Save to save the project.

To save the project to a new file name, select **File:Save Project As**. This menu command also opens the Save As dialog box.

If you have developed a folder structure in Project Explorer, you can save a selected folder and its subfolders to a new project file. To do this, right-click on the Project Explorer folder that you want to save to a project file and select **Save As Project** from the shortcut menu.

Figure 41: Saving a Project Explorer Folder to an Origin Project File



In this example, the Linked Layers 1 folder and its Raw Data subfolder, all the windows that they contain, plus Results Log output specific to these windows are saved to a new project file.

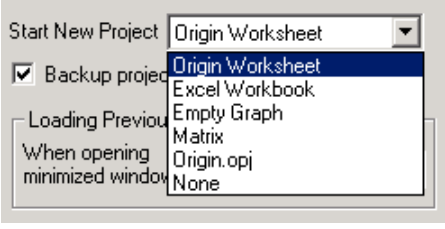
Automatically Creating a Backup

Origin will automatically create a backup of the currently saved project file before re-saving. Origin renames the saved file BACKUP.OPJ, and then saves the altered file using the specified file name.
The automatic backup feature is set on the Open/Close tab of the Options dialog box (**Tools:Options**).

Opening a New Project

A new project is opened each time you start Origin. You can also open a new project by clicking the New Project button  on the Standard toolbar. In both cases, the new project contains one worksheet window. You can, however, customize the new project that opens. To do this, select **Tools:Options** to open the Options dialog box. Select the Open/Close tab and then modify the Start New Project setting.

Figure 42: Customizing the New Project Setting



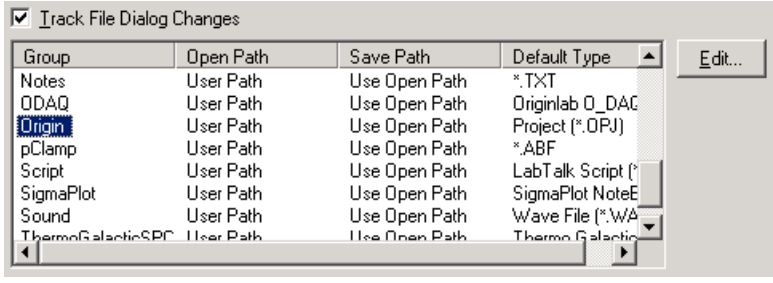
You can select from worksheet, Excel workbook, empty graph, matrix, ORIGIN.OPJ, or none. The ORIGIN.OPJ file includes a worksheet and a graph window. The graph window is configured to display a data plot of column A (X values) and column B (Y values) automatically, after you import or enter data into the worksheet columns. You can customize the ORIGIN.OPJ project file and resave it. After you click OK in the Options dialog box, you are asked if you want to save this setting for future Origin sessions.

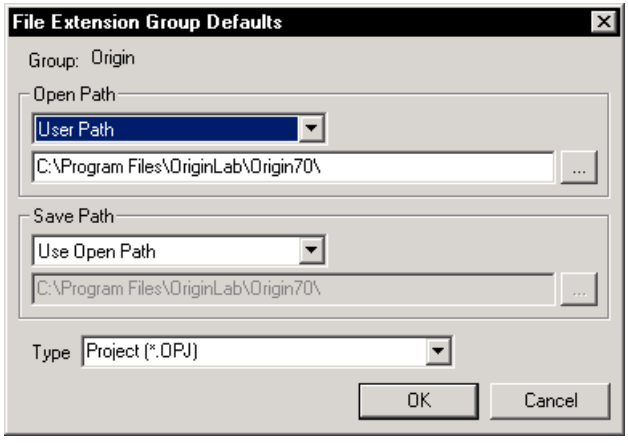
Opening an Existing Project

To open an existing project file, click the Open button  on the Standard toolbar and select the desired file from the Open dialog box.

By default, Origin will keep track of the project file path, so that each time you open a project in the current Origin session, the path to the last opened file will be selected by default in the Open dialog box. To turn off file tracking or to specify a custom project file path, select **Tools:Options** to open the Options dialog box. Select the File Locations tab. Select Origin from the top list box and then click Edit. This opens the File Extension Group Defaults dialog box.

Figure 43: Customizing File Tracking





=> To specify a custom project file path, select User Path in the Open Path group and then browse to the desired folder from the associated text box. Click OK.

=> To set your Origin folder as the project file path, select Origin Path from the Open Path drop-down list. Click OK.

To direct Origin to always use this custom path, clear the Track File Dialog Changes on the File Locations tab. Click OK. An Attention dialog box asks if you want to save this setting for future Origin sessions. Click Yes.

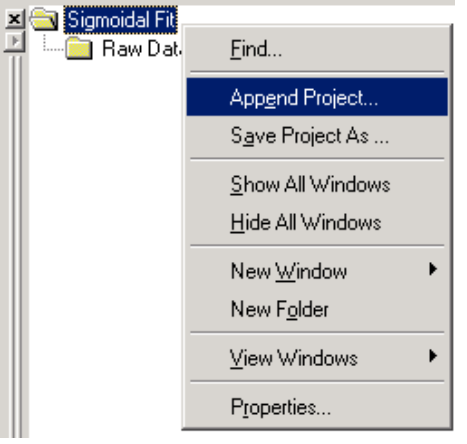
Opening More than One Project

Origin can only open one project at a time. To open multiple projects, you must start multiple instances of Origin.

Appending Projects

The contents of a project can be added to the currently opened project by selecting **File:Append** or by right-clicking on a Project Explorer folder and selecting **Append Project** from the shortcut menu.

Figure 44: Appending Projects



To re-activate the display of Reminder Message boxes, select ***Tools:Reactivate Reminder Messages****.*

After you select the project to append, Origin displays a Reminder Message asking if you want to append the contents of the new project into a new Project Explorer folder or into the current folder.

If duplicate window names exist between projects, Origin automatically changes the name of the appended window by adding an "A" to the window name (*AWindowName*). For example, in the following figure, a project containing a Data1 worksheet is appended to a project that also contains a Data1 worksheet. The appended window is renamed AData1.

Figure 45: Renaming Duplicate Window Names when Appending

Project Windows

To learn how to organize your project using Project Explorer, see "Project Explorer" on page 64.

Project windows include worksheet, matrix, Excel workbook, graph, layout page, and notes windows. You can create and open any number of windows in an Origin project. The only limitation is your machine's memory. However, you should keep your projects manageable by limiting the number of windows contained in a project. You should also consider organizing the windows using Project Explorer.

Creating a New Window

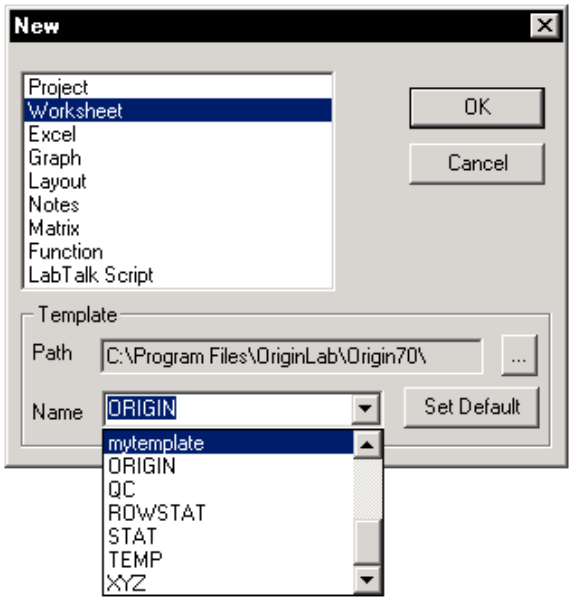
To create a new window, click one of the New *Window* buttons on the Standard toolbar.

Figure 46: New Window Buttons on the Standard Toolbar

To learn more about templates, see "Window Templates" on page 80.

These buttons create windows based on a default template. For example, the New Worksheet button  creates a worksheet based on the ORIGIN.OTW template. You can change the template that is associated with any of these buttons. To do this, select **File:New** to open the New dialog box. To change the template associated with the New Worksheet button, select Worksheet from the list box, then select the desired template from the Template group. Click Set Default to associate this template with the New Worksheet button.

Figure 47: Changing the Template for the New Worksheet Button



You can also use the New dialog box to create new windows based on specific templates.

Renaming a Window

To rename a worksheet, matrix, graph, layout page, or notes window, activate the window and then select **Window:Rename**. Alternatively, right-click on the window's title bar and select **Rename** from the shortcut menu. Both menu commands open the Rename dialog box.

To rename an Excel workbook window, right-click on the window's title bar and select **Properties** from the shortcut menu.

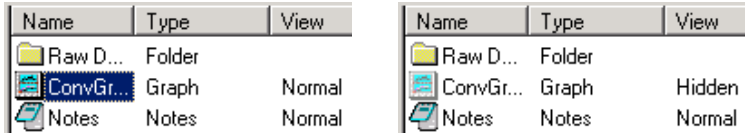
When renaming windows, consider the following:
=> The window name cannot start with a numeral.
=> Origin ignores any spaces between characters.
=> The name cannot exceed 13 characters in length.

For greater flexibility in window naming, include the Label field in the window title bar. The label allows more characters and accepts special characters (for example, an underscore and dollar sign). It also allows spaces between characters.

Hiding a Window

To maximize the use of your workspace, you can hide windows from view - without deleting them from the project. To hide a window in the workspace, select the desired window icon on the right side of Project Explorer and then double-click on this icon. To return the window to the normal view mode, double-click again on the window icon. These view controls are also available by right-clicking on the window icon in Project Explorer, or by right-clicking on the window title bar.

Figure 48: Hiding a Window from View



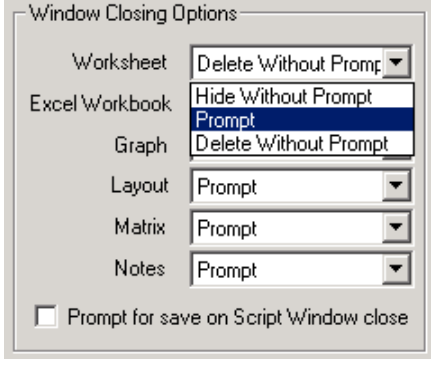
Deleting a Window

When you delete a window, it is no longer a part of the project.

To delete a window from the project, click the X button in the upper-right corner of the window. Origin then asks you if you want to hide or delete the window.

To prevent this verification prompt from displaying, select **Tools:Options** to open the Options dialog box. Then select the Open/Close tab. In the Window Closing Options group, select how you want Origin to respond when you click a particular window type's close button.

Figure 49: Setting the Close Option for a Window Type



Refreshing a Window

Whenever you change the contents of a graph window or a worksheet, or expose a part of a window that was hidden, Origin automatically redraws the affected portion of the window. Occasionally, a portion of the window may not refresh correctly. Whenever this occurs, click the Refresh button  on the Standard toolbar to refresh the active window.

Note: To control the percentage of the window that must be exposed before Origin automatically redraws the window, select **Tools:Options** to open the Options dialog box. Select the Miscellaneous tab and then edit the No Redraw (% Covered) combination box.

Duplicating a Window

To duplicate the active worksheet, graph, matrix, or layout page window, click the Duplicate button  on the Standard toolbar. When a duplicate window is created, Origin names the window using the default window name syntax:

DefaultWindowNameN

where *N* is assigned the lowest available number not used by other window names (of the same type) in the project.

Table 1: Default Window Names

Window	Default Name
Worksheet	Worksheet*N*
Graph	Graph*N*
Matrix	Matrix*N*
Layout Page	Layout*N*
Function Graph	Function*N*

Saving a Window

In addition to saving projects, windows (except for layout pages) can be saved to a file. When a window is saved to a file, the window can be opened in any other Origin project. To save the active window to a file, select **File:Save Window As**. This menu command opens the Save As dialog box. Origin automatically lists the correct file extension for the active window type in the Save as Type drop-down list.

Table 2: Window File Extensions

Window	File Extension
worksheet	.OGW
matrix	.OGM
graph	.OGG
Excel workbook	.XLS
notes	.TXT

Opening a Window from a File

To learn how to append projects, see "Appending Projects" on page 74.

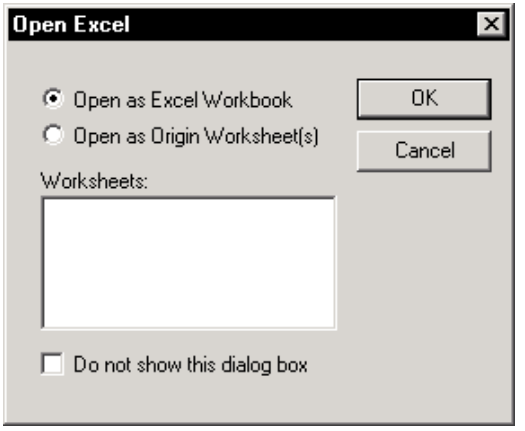
If you have a window in one project that you want to include in another project, you can append the projects. However, this action will add all the windows from a selected project into the currently open project. To "append" only the desired window, you must save the window to a file and then open the window in the desired project. To open a worksheet, graph, matrix, or notes window that was saved to a file, click the Open button  on the Standard toolbar. This button opens the Open dialog box. From the Files of Type drop-down list, select:

'Worksheets (*.OGW)' to open a worksheet window.
'Graphs (*.OGG)' to open a graph or function graph window.
'Matrix (*.OGM)' to open a matrix window.
'Text (*.TXT)' to open a notes window.

After you open a worksheet, graph, matrix, or notes window file in a project and then save the project, the window then remains a part of this project.

To open an Excel workbook file, click the Open Excel button  on the Standard toolbar. After you select your Excel file, a dialog box opens asking if you want to open the workbook as an Excel workbook or as an Origin worksheet.

Figure 50: Opening an Excel Workbook



If you open the workbook as a workbook, you can continue to use Excel's spreadsheet tools to process your data, all within the Origin workspace. You also have access to Origin's plotting and analysis tools. When you are ready to save your project, you can save the project with a link to your source workbook, and update the link, or you can save the workbook as part of your Origin project. When you update the link to a (linked) workbook, the updated workbook is available for other applications or other users.

If you open the workbook as one or more Origin worksheets, you have no access to Excel's spreadsheet tools in Origin. Furthermore, the data no longer has a connection to the source workbook. Thus, the changes you make to the data are lost to the original workbook.

Window Templates

When you create a new worksheet, graph, or matrix window, (for example, by clicking the  ,  , or  button on the Standard toolbar), Origin creates the new window based on a template. The template determines the properties of the new window. For example, if the new window is a worksheet, the template determines the number of columns in the worksheet, each column's plotting designation and display type, the ASCII import settings, and any formulas used to set the column values. If the new window is a graph, the template determines the number of layers (sets of XY axes) on the page and their arrangement, the types of data plots in each layer (for example, scatter or bars), the number of data plots, the axes scale type, and text labels and other annotations. Basically the template determines all the attributes of the

window, except for the actual data the window will contain. Data is never saved with a template.

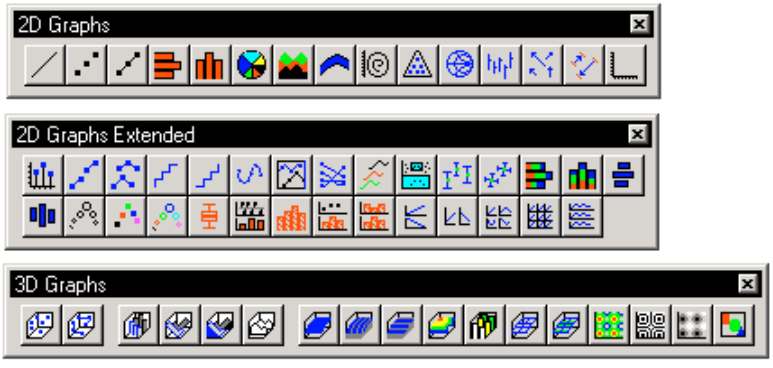
The following table lists the file extensions for the templates.

Table 3: Template File Extensions

Window	Template File Extension
worksheet	.OTW
graph or function graph	.OTP
matrix	.OTM

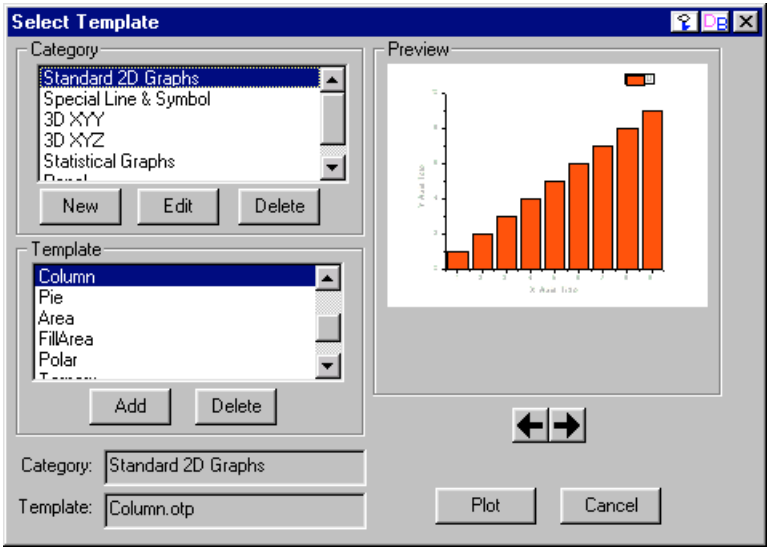
Origin provides many built-in templates. For example, most of the graph templates are accessible from the plotting toolbar buttons.

Figure 51: Plotting Toolbar Buttons



Origin also provides a Template Library tool for categorizing and accessing graph templates. To open the Template Library tool when a worksheet or an Excel workbook is active, select **Plot:Template Library**.

Figure 52: The Template Library Tool



You can also use the Template Library tool to plot your worksheet or Excel workbook data. If you highlighted data in the worksheet or workbook before opening the tool, and your data selection is appropriate for the template you've selected, then click the Plot button to plot the data into the template. If you did not highlight data or if your selection was not appropriate for the template you've selected, then click the Plot button to open an intermediary dialog box for data selection.

To create a custom template, you can modify an existing template or create a new template. The procedure is similar in both cases. You must first open a window based on a built-in template, customize the properties of the objects in the window, and then save the window as a template. The instructions on re-building the window are saved with the template. However, any data in the window is not saved with the template.

For example, suppose you want to customize the template associated with the New Worksheet button  on the Standard toolbar. To do this, click  to open a new worksheet. Now customize the attributes of this worksheet. For example, perhaps you always import ASCII data files that contain data in the format X, Y, Y Errors. In this case, click the Add New Columns button  on the Standard toolbar. Then right-click on the new column (C) and select **Set As:Y Error** from the shortcut menu.

To save this window as a template, select **File:Save Template As**. The built-in template ORIGIN.OTW is listed by default in the File Name text box. If you click Save, you will overwrite the built-in template with your custom settings. Alternatively, you can type a new file name to save your changes to a new template.

If you save to a new file name, you can associate the New Worksheet button  with this new template file (it is currently linked to ORIGIN.OTW). To do this, select **File:New** to open the New dialog box. Select Worksheet from the list box. Then select your new template file from the Template group. Finally, click the Set Default button to associate this template with the New Worksheet button.

Tutorial 1, Plotting Your Data

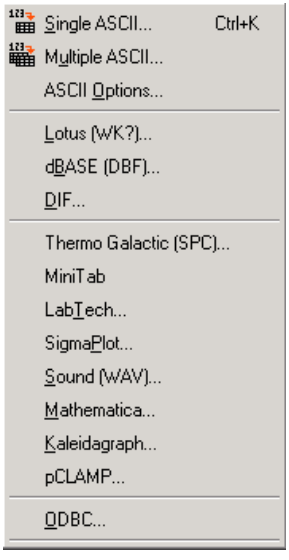
Introduction

This tutorial will show you how to import ASCII data into a worksheet, plot the data, and then customize some basic elements of the graph.

Importing Your Data

Origin imports data stored in a wide variety of formats. These import options are available from the worksheet's **File:Import** submenu.

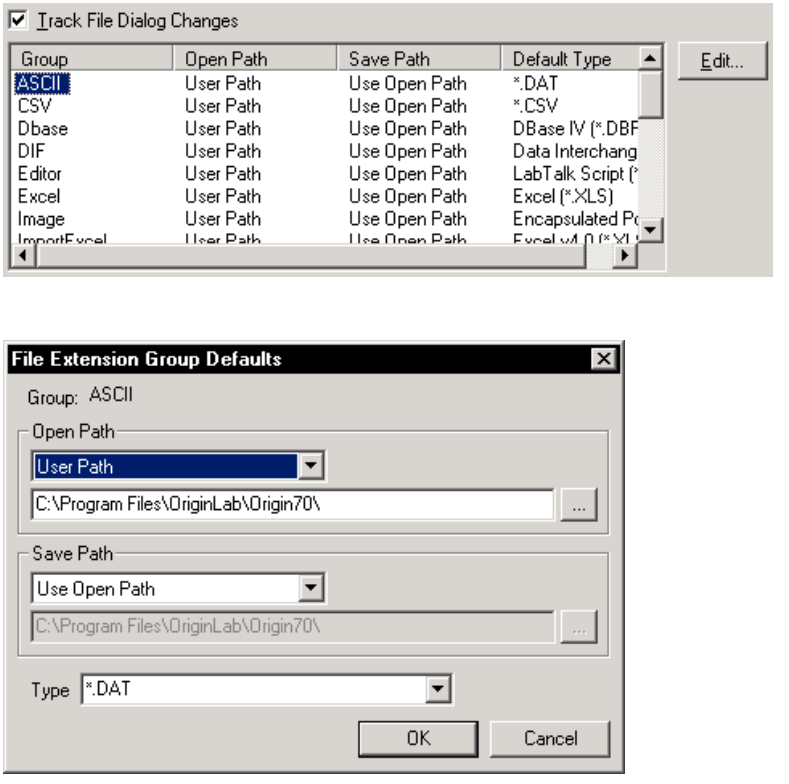
Figure 1: Importing Data into a Worksheet



When you import data from this submenu, Origin allows you to control the default folder that is listed in the associated "Open" dialog box. To do this, select **Tools:Options** to open the Options dialog box. Then

select the File Locations tab. Select the desired data type from the top list box and then click the Edit button.

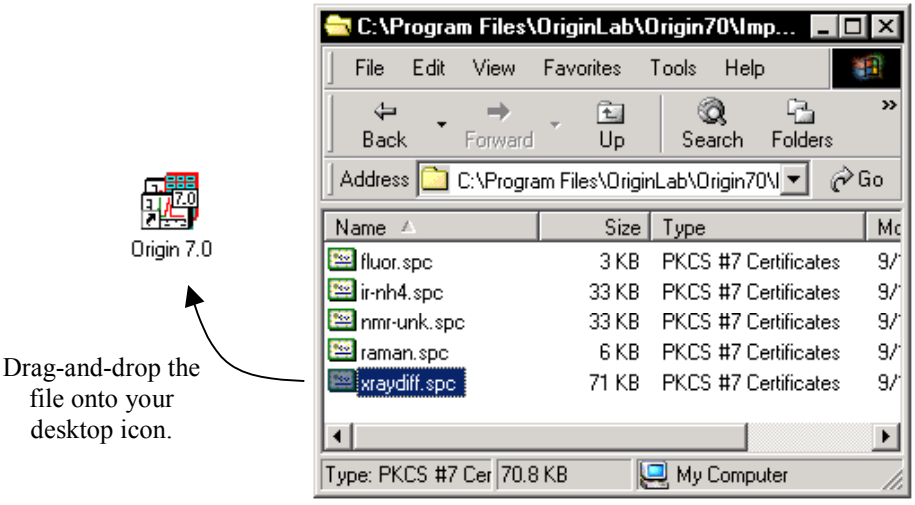
Figure 2: Customizing the Default Folder for the Import Data Types



If your data files are stored in the same location as your Origin project files, then select Project Path from the Open Path drop-down list. Click OK in this dialog box and in the Options dialog box. To save the settings for the next Origin session, click Yes at the Attention prompt.

In addition to the menu commands, you can also drag-and-drop ASCII, SigmaPlot, Minitab, and Thermo Galactic SPC files into Origin. Once you have selected the file in Windows Explorer, if Origin isn't currently open you can drag the file onto your Origin desktop icon. If Origin is already open, you can drag the file over the Origin taskbar button and hold there until Origin becomes active. Then continue dragging and drop the file into the Origin workspace.

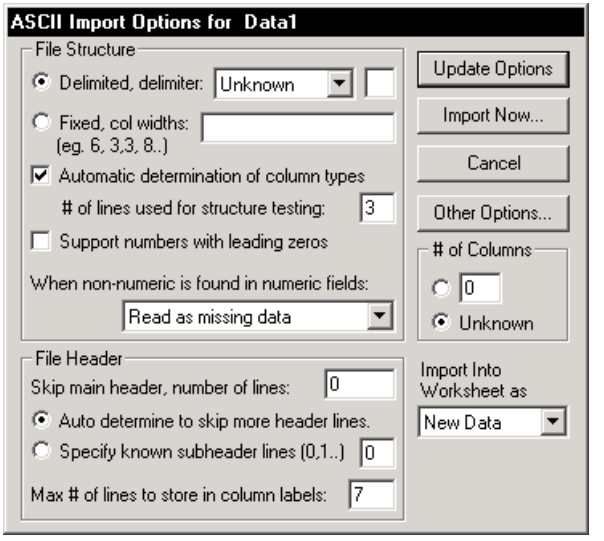
Figure 3: Dragging a Data File Onto Your Origin Desktop Icon



If you customize the ASCII Import Options settings, you can save your worksheet as a template to access the settings in the future.

When you import ASCII data by dropping into Origin, by selecting **File:Import:Single ASCII**, or by clicking the Import ASCII button  on the Standard toolbar, Origin uses the import settings defined in the ASCII Import Options dialog box. The default import settings will work well with many ASCII files. However, with complex ASCII files, you may need to customize these settings. To open the ASCII Import Options dialog box, select **File:Import:ASCII Options**.

Figure 4: Customizing the ASCII Import Settings



To Import the ASCII File:

1) Begin this lesson by clicking New Project on the Standard toolbar.

2) Click Import ASCII on the Standard toolbar.

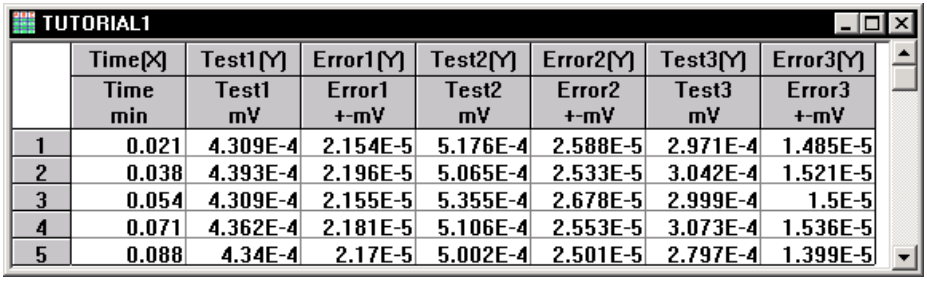
3) In the Origin \TUTORIAL folder, select TUTORIAL_1.DAT from the list of files.

4) Click Open. The ASCII file imports into the worksheet.

The worksheet is renamed using the name of the ASCII file you imported. Because the file contains text in the first two rows, the first row of text is used to rename the columns, while the first and second rows of text are used to create column labels. The labels are used for the text in the legend when a graph is created.

Note: You may need to resize the worksheet to see all the columns.

Figure 5: Importing the ASCII File



TUTORIAL1

	Time(X)	Test1(Y)	Error1(Y)	Test2(Y)	Error2(Y)	Test3(Y)	Error3(Y)
	Time min	Test1 mV	Error1 +-mV	Test2 mV	Error2 +-mV	Test3 mV	Error3 +-mV
1	0.021	4.309E-4	2.154E-5	5.176E-4	2.588E-5	2.971E-4	1.485E-5
2	0.038	4.393E-4	2.196E-5	5.065E-4	2.533E-5	3.042E-4	1.521E-5
3	0.054	4.309E-4	2.155E-5	5.355E-4	2.678E-5	2.999E-4	1.5E-5
4	0.071	4.362E-4	2.181E-5	5.106E-4	2.553E-5	3.073E-4	1.536E-5
5	0.088	4.34E-4	2.17E-5	5.002E-4	2.501E-5	2.797E-4	1.399E-5

Designating Worksheet Columns as Error Bars

When you import data into a worksheet, the default column designations of X, Y, Y, Y, etc. are used to show data associations. If your data is associated differently, you can manually set the column designations.

In this example, the data has the following associations: X, Y, Y Error, Y, Y Error, Y, Y Error.

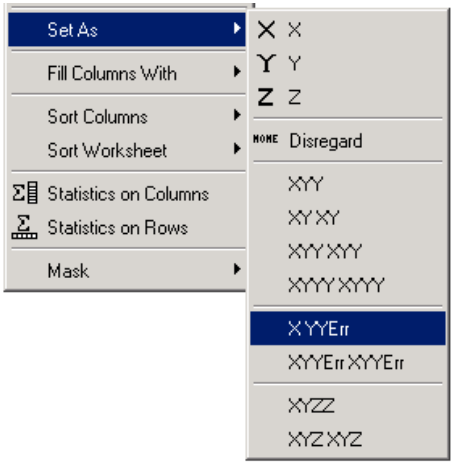
To Designate Columns as Error Bars:

1) Click on the Time(X) column heading and drag to the Error3(Y) column heading.

2) Right-click within the highlighted cells to open a shortcut menu.

3) Select **Set As:XYYErr** from the shortcut menu. This changes the Error1, Error2, and Error3 columns to error bar columns.

Figure 6: Setting the Column Designations



TUTORIAL1

	Time(X)	Test1(Y)	Error1(yEr±	Test2(Y)	Error2(yEr±	Test3(Y)	Error3(yEr±
	Time min	Test1 mV	Error1 +-mV	Test2 mV	Error2 +-mV	Test3 mV	Error3 +-mV
1	0.021	4.309E-4	2.154E-5	5.176E-4	2.588E-5	2.971E-4	1.485E-5
2	0.038	4.393E-4	2.196E-5	5.065E-4	2.533E-5	3.042E-4	1.521E-5
3	0.054	4.309E-4	2.155E-5	5.355E-4	2.678E-5	2.999E-4	1.5E-5
4	0.071	4.362E-4	2.181E-5	5.106E-4	2.553E-5	3.073E-4	1.536E-5
5	0.088	4.34E-4	2.17E-5	5.002E-4	2.501E-5	2.797E-4	1.399E-5

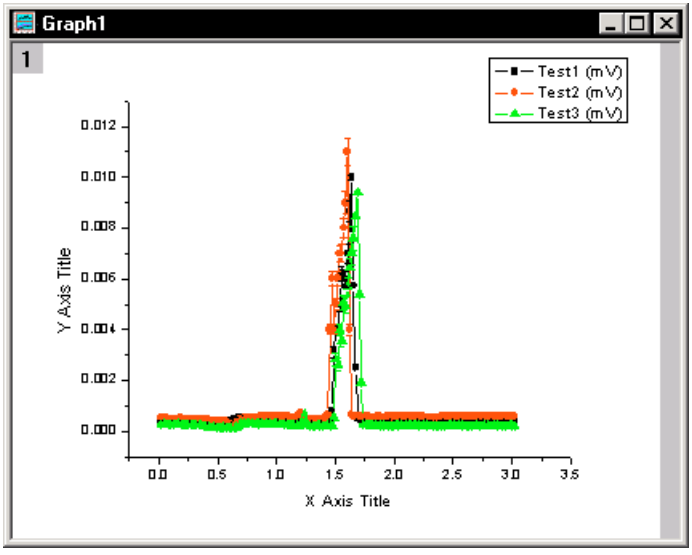
Plotting Your Data

Origin offers a broad range of plotting options. The quickest way to create a graph is to select your worksheet data by highlighting the column(s), and then clicking a button on one of the plotting toolbars. When you plot multiple columns using this technique, Origin automatically groups the data plots and increments attributes such as the symbol type and color, so that you can easily distinguish between data plots.

To Plot Your Worksheet Data:

1) With your worksheet data still selected, click the Line + Symbol button  on the 2D Graphs toolbar. The three Y columns are plotted as line and symbol data plots with error bars provided by the error bar columns to the right of the associated Y columns.

Figure 7: Plotting the Worksheet Data



Focusing on a Region of Your Graph

You may want to take a closer look at interesting areas of your data, particularly if you have a large number of points. Origin provides a number of tools to accomplish this, including the Enlarger tool. The Enlarger tool automatically rescales the axes of the graph to show only the region of the data plot(s) you select.

To Enlarge a Section of Your Data:

1) Click Enlarger  on the Tools toolbar.

2) Click-and-drag with the magnifying glass cursor to draw a box around the large peaks (near X = 1.5) in the graph window. Release the mouse button to complete the operation.

Figure 8: Enlarging a Section of Your Data

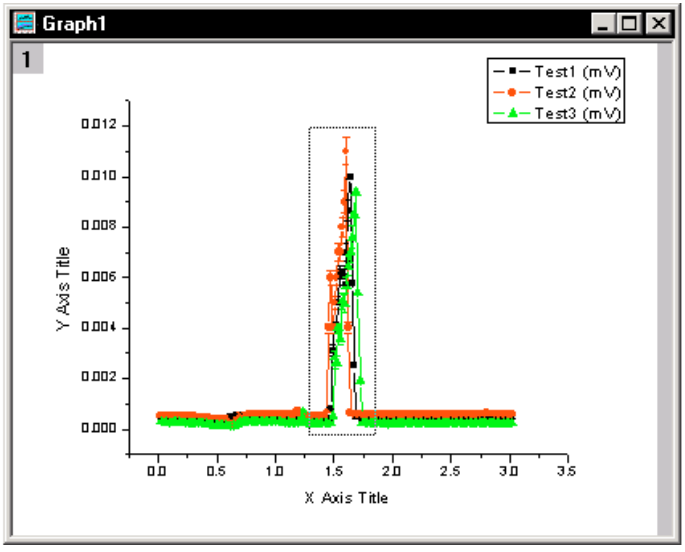
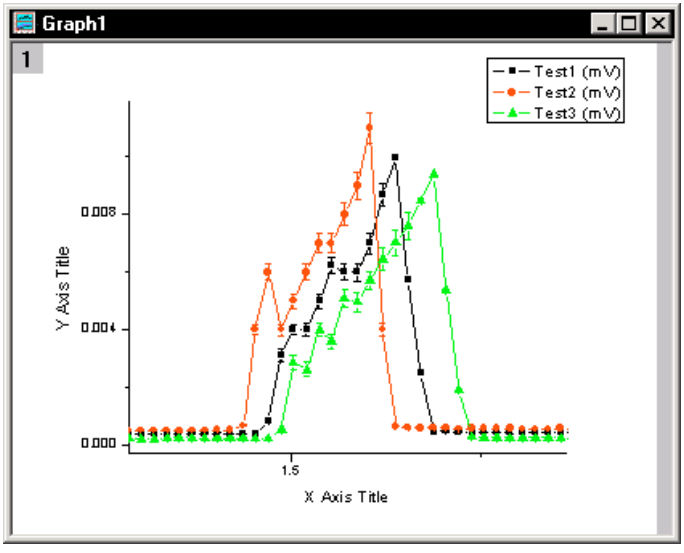


Figure 9: Rescaled Graph



Note: To return the axes to their original scale, click on the Undo Enlarge tool  on the Tools toolbar.

Customizing the Graph

Origin allows you to customize every aspect of your graph. The easiest way to customize graphic elements is to double-click on them.

Customizing the Data Plot

Double-clicking on a data plot or the data plot icon in the legend opens the Plot Details dialog box. This dialog box allows you to customize the data plot you selected, as well as all the features of the graph window except for the axes and text labels. The selection on the left side of the dialog box determines the controls available for customizing on the right side of the dialog box. For example, when a line and symbol data plot is selected, you can edit the attributes of the lines and symbols, draw drop-lines to either axis, and select which features are incremented between the grouped data plots.

To Customize the Data Plot:

1) Double-click on the Test1 data plot icon in the legend. The Plot Details dialog box opens with the TUTORIAL1:Time(x), Test1(Y) data plot icon selected on the left side of the dialog box.

2) Select the Symbol tab if it is not currently selected.

3) Select the open circle symbol type  from the Preview drop-down list.

4) Click OK.

Note: Because the data plots are grouped, the symbol type of the Test2 and Test3 data plots change to increment from the open circle symbol selected for the Test1 data plot.

Customizing the Axes

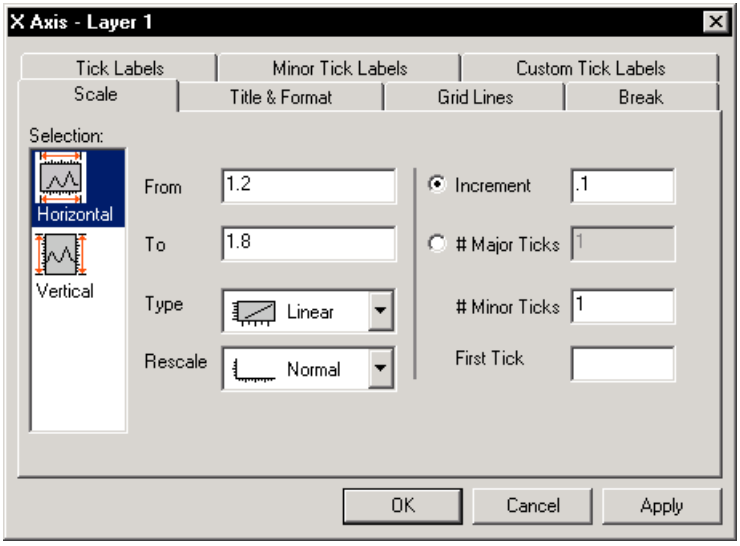
Double-clicking on any of the axes in the graph opens the Axis dialog box. Similar to the Plot Details dialog box, you can specify the axis you want to customize by selecting it from the Selection list box on the left side of the dialog box.

To Customize the Axes:

1) Double-click on the X axis.

2) On the Scale tab, type **1.2** in the From text box, **1.8** in the To text box, and **.1** in the Increment text box.

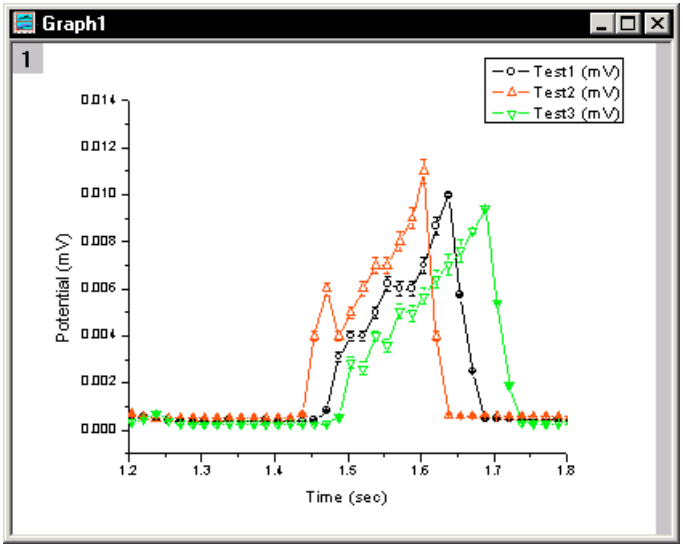
Figure 10: The X Axis Dialog Box



3) Select the Title & Format tab.
4) Type **Time (sec)** in the Title text box, overtyping the default text.
5) Select the Left icon 

from the Selection list box.
6) Type **Potential (mV)** in the Title text box, overtyping the default text.
7) Select the Scale tab.
8) Type **-.001** in the From text box, **.014** in the To text box, and **.002** in the Increment text box.
9) Click OK.

Figure 11: Customizing the Graph



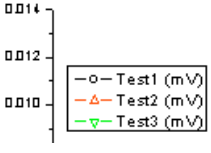
Adding Text to the Graph

To further customize your graph, you can add annotations including text, arrows, lines, and shapes. The tools that let you add these annotations are located on the Tools toolbar. Alternatively, you can right-click anywhere in the graph to add text using a shortcut menu.

To Add Text to the Graph:

1) First click and drag the legend so that it is located close to the Y axis. Click off the legend to de-select it.

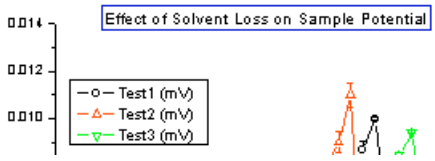
Figure 12: Moving the Legend



2) Click  on the Tools toolbar and then click in the upper-left position of the graph. The cursor begins flashing where you clicked.

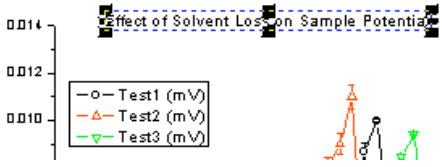
3) Type **Effect of Solvent Loss on Sample Potential**.

Figure 13: In-place Text Editing



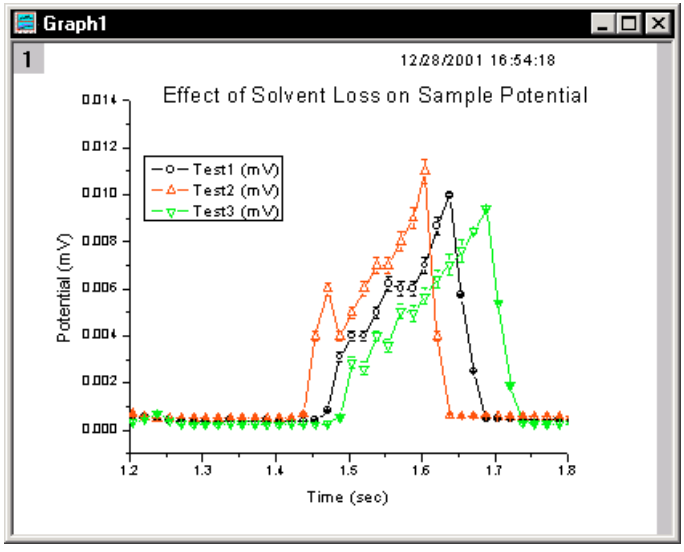
4) Press ESC to exit the text editing mode.
5) Click once on the new text label so that it becomes selected.

Figure 14: Selecting the Text Label



6) Drag the bottom right control handle to increase the size of the label.
7) Click off the label when done.
8) Click the Date & Time button on the Graph toolbar to add a date and time stamp.

Figure 15: The Finished Graph



Saving Your Project

Your project currently consists of one worksheet and one graph window and the data displayed in both. Both of these windows and the data they contain are saved within an Origin project file when you save the project.

To Save Your Project:

1) Click Save  on the Standard toolbar.

2) Type **Tutorial_1** in the File Name text box, then click Save. The project is saved as Tutorial_1.OPJ.

Tutorial 2, Exploring Your Data

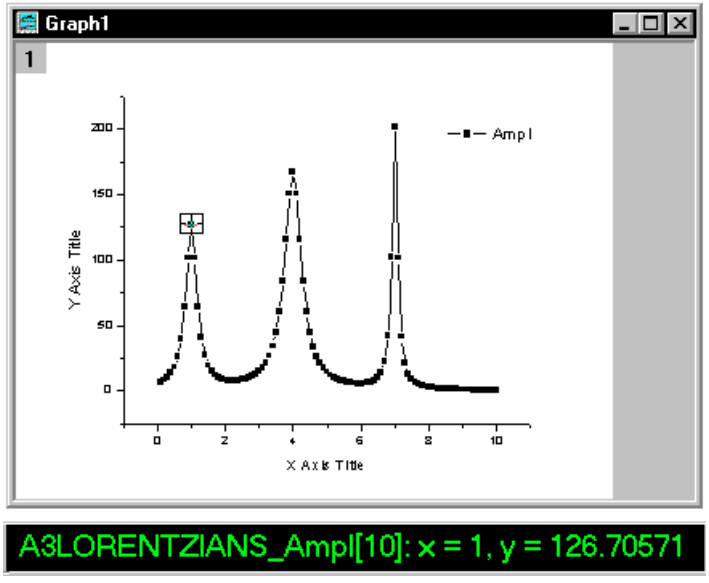
Introduction

Origin offers a number of tools to select a region of a data plot, view coordinate or screen values, enhance the data plot display, and mask data.

Data Reader

To read the X, Y, and Z (for 3D and contour) values for a data point, click the Data Reader button  on the Tools toolbar. This action opens the Data Display tool if it is not already open. Click on the desired data point to read its X,Y, and Z coordinates in the Data Display tool.

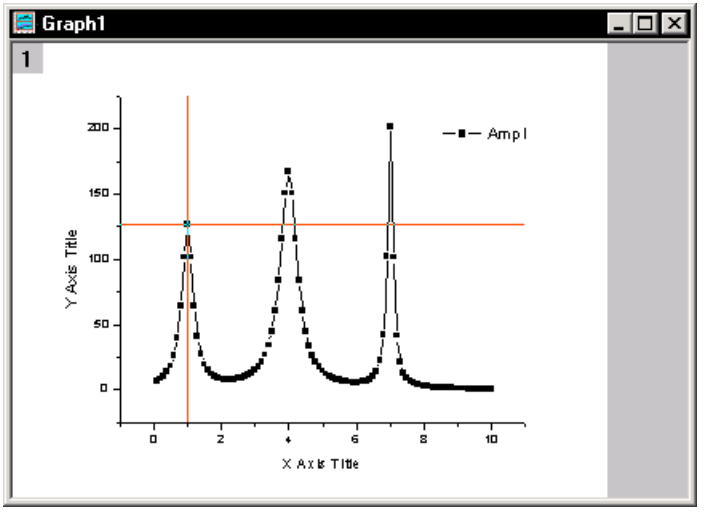
Figure 1: Using the Data Reader Tool



To move the cross-hair to the next data point along the data plot, use the left and right arrow keys or click on the data point.

To change the vertical and horizontal cross hair size after clicking on a point, press the spacebar. Continue pressing the spacebar to further increase the size of the cross hairs.

Figure 2: Increasing the Cross Hair Size



Press ESC or click the Pointer button  on the Tools toolbar when you are finished.

Screen Reader

To read the X, Y, and Z (for 3D and contour) values for any point on the screen, click the Screen Reader button  on the Tools toolbar. This action opens the Data Display tool if it is not already open. Click on the desired screen location to read its X,Y, and Z coordinates in the Data Display tool.

As with the Data Reader tool, you can press the spacebar to increase the cross hair size.

Press ESC or click the Pointer button  on the Tools toolbar when you are finished.

Data Selector

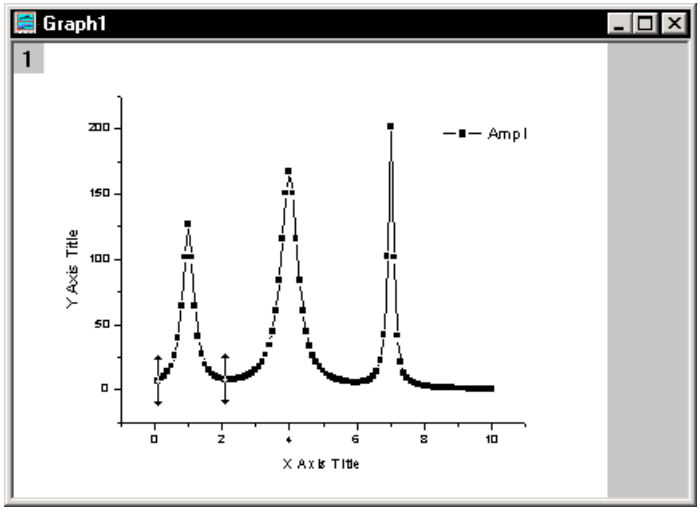
To select a range of a data plot for analysis, click the Data Selector tool  on the Tools toolbar. Data markers display at both ends of the active data plot. Additionally, the Data Display tool opens if it is not already open.

To mark the data segment of interest, click and drag the markers with the mouse. You can also use the left and right arrow keys to select a marker. The CTRL + left or right arrow keys move the selected marker to the next data point. Holding both the SHIFT and CTRL keys while depressing the left or right arrow keys moves the data markers in increments of five along the data plot. (Note: If your X data is not sorted, you may need to sort the data before selecting a range. To do this, activate the worksheet and select **Analysis:Sort Worksheet:Ascending**.)

As with the Data Reader tool, you can press the spacebar to increase the cross hair size.

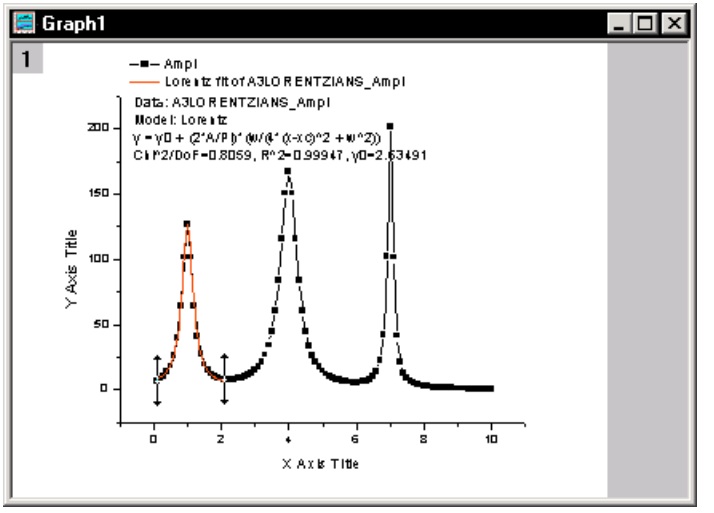
After you have defined the range of interest, press ESC or click the Pointer button  on the Tools toolbar.

Figure 3: Selecting a Range of Data for Analysis



Any analysis operations you perform on this data plot will apply to the selected region only.

Figure 4: Performing a Fit in the Selected Range



To hide the data outside this range, select **Data:Set Display Range**.

To remove the selection range, select **Data:Reset to Full Range**.

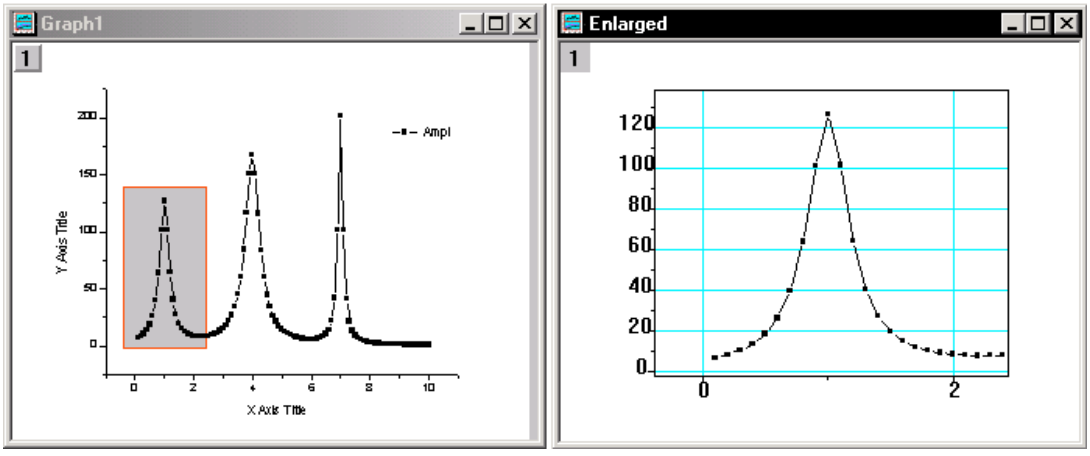
Enlarger Tool and Undo Enlarge

To magnify a portion of a data plot, click the Enlarger tool  on the Tools toolbar. The close-up of the data can be viewed in the current window or in a new window. When a data plot is magnified using the Enlarger tool, the axes are rescaled to show an expanded view of the data.

=> To view the magnified data in the current window, drag the area of interest in the graph. To re-display the entire data plot, click the Undo Enlarge button  .

=> To view the magnified data in a new window, hold down the CTRL key while dragging the area of interest in the graph window. Release the mouse button, then release the CTRL key. Origin opens a new graph window named Enlarged. A rectangle object with sizing handles appears in the original graph window (if the sizing handles are not displayed, click on the object to select it).

Figure 5: Viewing the Data in the Enlarged Window

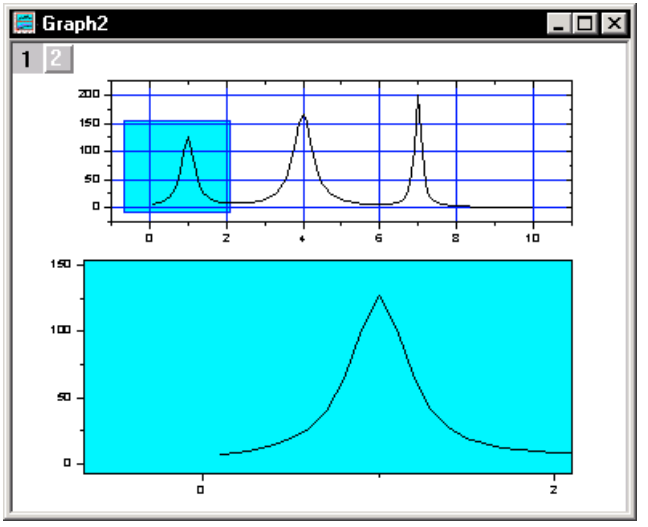


To change the data segment in the Enlarged window, resize the rectangular object or change its position by dragging in the original graph window. The Enlarged window updates accordingly.

After you finish analyzing the data, you can click on the rectangle object and delete it.

=> To view the magnified data in the same graph window (along with the full range of data), highlight the desired worksheet column(s) and click the Zoom button  on the 2D Graphs Extended toolbar. A graph window with two layers opens. The top layer displays the entire data range and the bottom layer provides a zoomed-in view of your data plot.

Figure 6: Viewing the Full and Enlarged Range Together



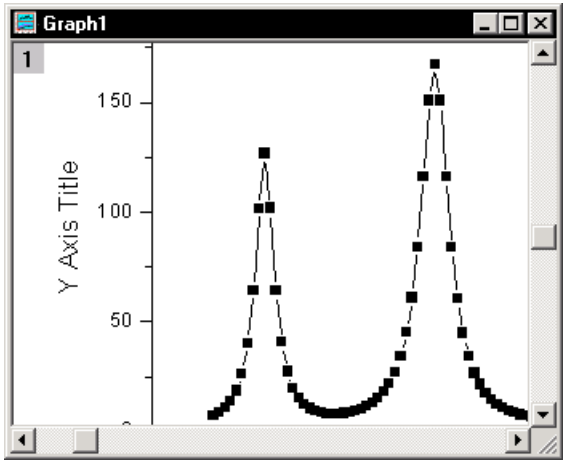
To change the data segment in the bottom layer, resize the rectangular object or change its position by dragging in the top layer.

After you finish analyzing the data, you can click on the rectangle object and delete it.

Zoom In and Zoom Out

To display a close-up view of the graph page, click the Zoom In button  on the Graph toolbar, then click on the desired zoom location in the graph window. Origin zooms the page, centering the zoom view at this location in the window (the axes are not rescaled).

Figure 7: Zooming in on the Graph

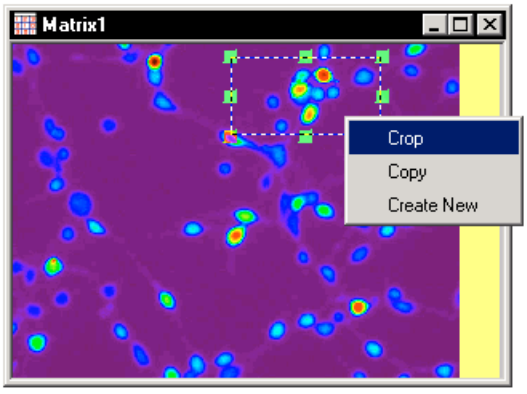


To zoom in closer, click the button again. To zoom out, click the Zoom Out button  . To return the view to the full page, click the Whole Page button  .

Region of Interest (Image Data)

When you import image data in a matrix, you can select a region of the image using the Rectangle Tool  on the Tools toolbar. (When a matrix with an image is active, the Rectangle tool displays in the "region of interest mode" by default. This setting is controlled from the **Tools:Region of Interest Tools** menu command.) Select the Rectangle Tool and then drag your region of interest. Then right-click in this region and select **Crop**, **Copy**, or **Create New** from the shortcut menu.

Figure 8: Selecting a Region of Interest in an Image



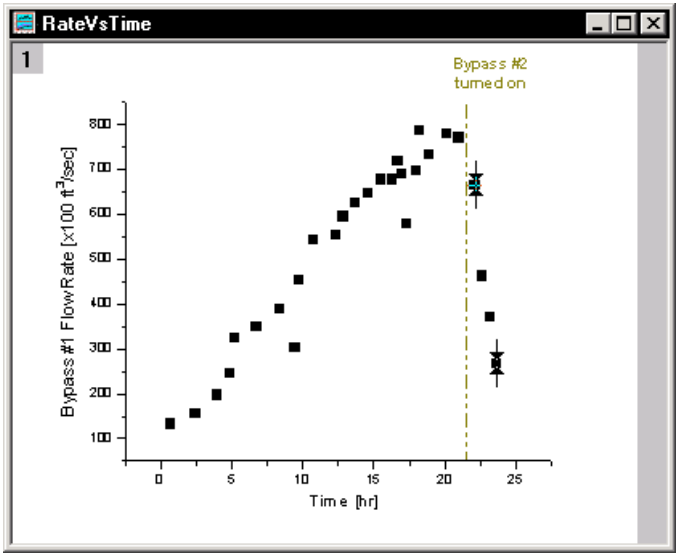
Masking

*Select **View:Toolbars** if the Mask toolbar isn't open.*

The Mask toolbar allows you to exclude ranges of data or individual data points from analysis. It is most useful if you want to analyze only a specific section of your data, or if you have erroneous data points that you do not want included in your analysis. The Mask toolbar is available for both worksheet and graph windows. For graph windows, masking is only available for scatter or line + symbol graphs.

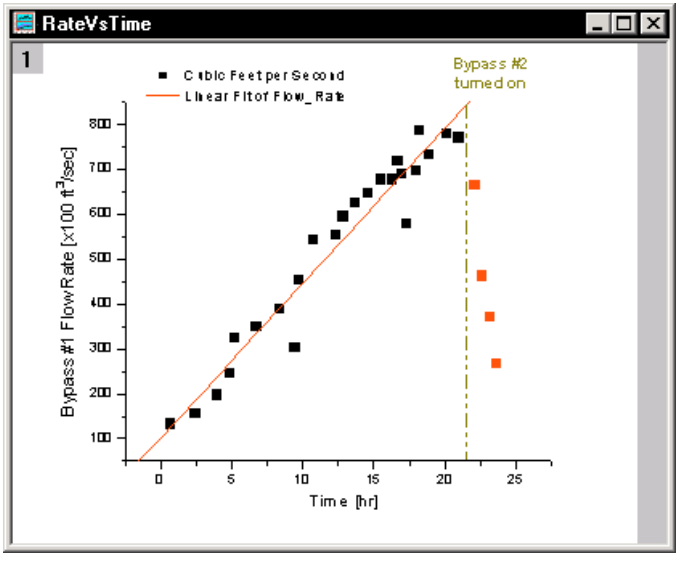
To mask a range in a graph, click the Mask Range button  . Then move the data markers so that they define the range you want to mask.

Figure 9: Masking a Range of Data



When finished defining the range, press ENTER. The masked points then display with red color. Any analysis you perform on this data plot will exclude the masked data.

Figure 10: Linear Fit Excluding the Masked Region



Getting Started

The following tutorial will show you more about using the masking tools. It will also show you how to mathematically transform data in a worksheet column, sort a worksheet based on primary and secondary columns, and plot a range of worksheet data.

To begin this tutorial, you will open a new Origin project and import ASCII data.

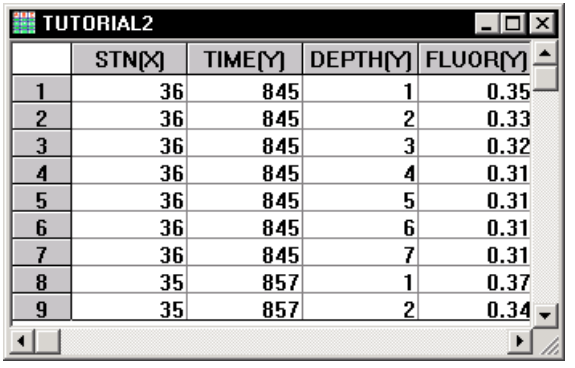
To Import the Data File:

1) Click New Project on the Standard toolbar.

2) Click Import ASCII, then select TUTORIAL_2.DAT from the Origin \TUTORIAL folder.

3) Click Open.

Figure 11: Importing the ASCII File



	STN(X)	TIME(Y)	DEPTH(Y)	FLUOR(Y)
1	36	845	1	0.35
2	36	845	2	0.33
3	36	845	3	0.32
4	36	845	4	0.31
5	36	845	5	0.31
6	36	845	6	0.31
7	36	845	7	0.31
8	35	857	1	0.37
9	35	857	2	0.34

Note: There are several columns that are not visible due to the current worksheet size. When there is a reference in this tutorial to a column that is not visible, scroll the worksheet to locate it.

Transforming Column Values

You can also include compiled Origin C functions in the Set Column Values dialog box.

You can create or transform data sets using any mathematical expression recognized by Origin in the Set Column Values dialog box. This dialog box provides a text box for you to type a value or mathematical expression to apply to the selected column or range of the column. It also includes a function drop-down list from which you can select a function to add to the text box. In addition, a column drop-down list contains a list of all the columns in the active worksheet. Select the column you want to add to the text box, then click Add Column to add the selected column to the text box.

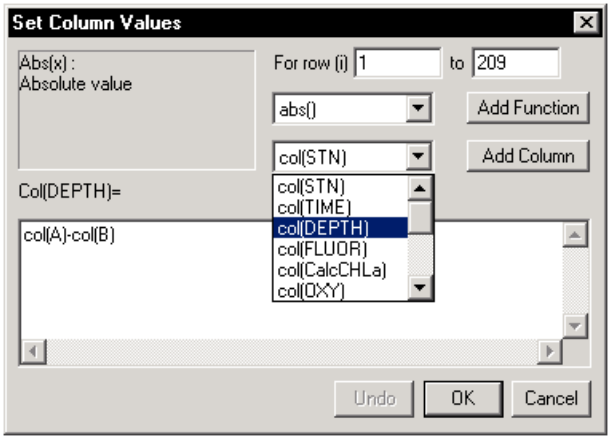
To Transform the Column Values:

1) Right-click on the Depth(Y) column heading.

2) Select **Set Column Values** from the shortcut menu.

3) Leave col(A)-col(B) highlighted in the text box and select col(DEPTH) from the Add Column drop-down list.

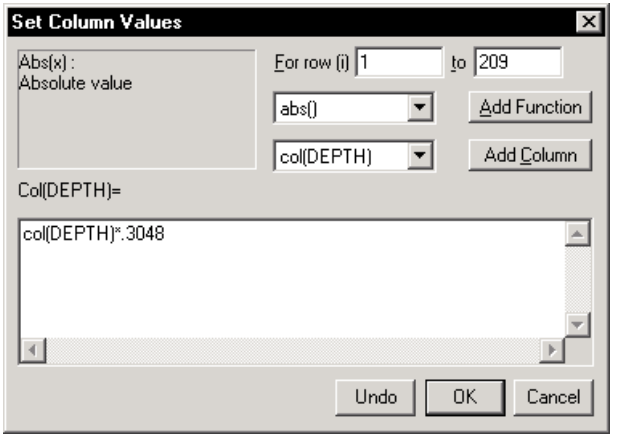
Figure 12: Selecting the Depth Column



4) Click Add Column. Col(DEPTH) overwrites the highlighted text.

5) Leave the cursor at the current location in the text box and type ***.3048** in the text box.

Figure 13: Transforming the Column Values



6) Click OK. The expression you typed in the Set Column Values dialog box is used to update the values in the DEPTH column.

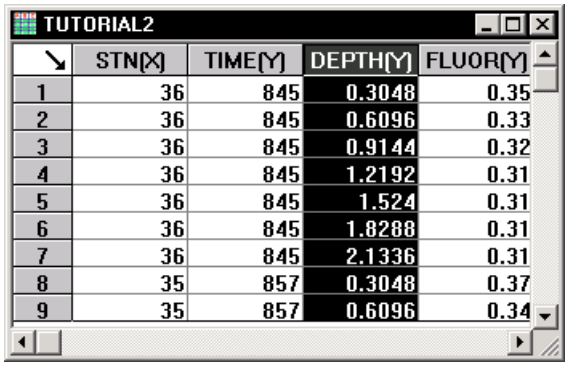
Sorting Worksheet Data

Origin can sort individual columns, multiple selected columns, or entire worksheets. Origin offers simple sorting in which specified data is sorted using one "sort by" column and a selected sort order, as well as nested sorting.

To Sort the Worksheet Data:

1) Move the mouse pointer to the upper-left corner of the worksheet to turn the cursor into a downward pointing arrow, then click to select all the columns in the worksheet.

Figure 14: Positioning the Cursor to Select All Columns

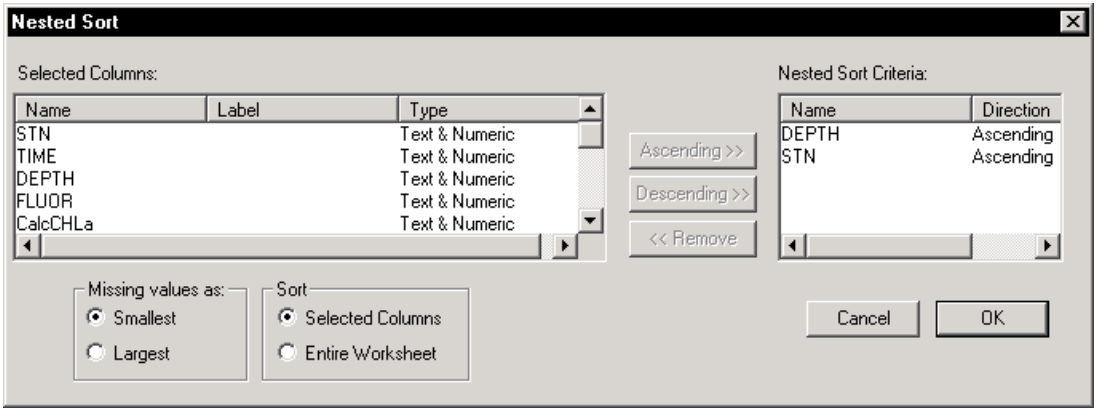


2) Click Sort on the Worksheet Data toolbar to open the Nested Sort dialog box.

3) Select DEPTH from the Selected Columns list box, then click Ascending. The column is added to the Nested Sort Criteria list box. This selection makes DEPTH the primary sort column in ascending order.

4) Select STN from the Selected Columns list box, then click Ascending. This makes STN the secondary sort column in ascending order.

Figure 15: Sorting the Worksheet



5) Click OK.

6) De-select the worksheet by clicking in the upper–left blank space in the worksheet (without the cursor changing to the downward pointing arrow).

The entire worksheet is sorted so that the values in the DEPTH (primary) column are ascending. If there are two cells of equal value in the DEPTH column, then the values in the corresponding rows of the STN (secondary) column are used to determine the worksheet order.

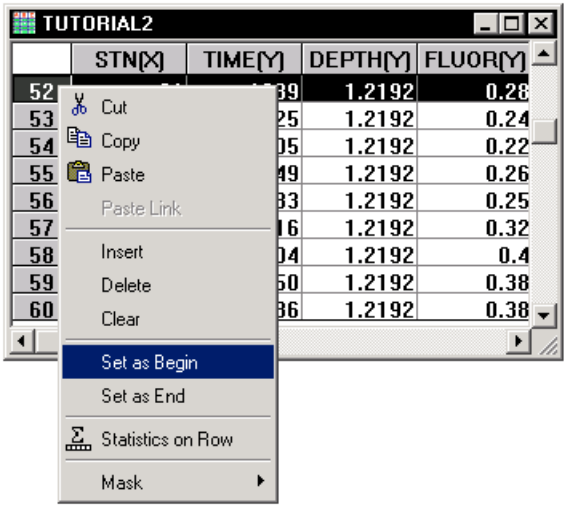
Plotting a Range of the Worksheet Data

You can set the worksheet display range so that subsequent plotting and analysis are performed only on the data of interest.

To Select a Range of the Worksheet Data:

1) Select **View:Go To Row**.
2) Type **52** in the dialog box that opens, then click OK.
3) Right-click on the row heading for row number 52.
4) Select **Set As Begin** from the shortcut menu.

Figure 16: Selecting a Range of Worksheet Data



5) Use the vertical scroll bar to move down in the worksheet so that row number 68 is visible.
6) Right-click on the row heading for row number 68.
7) Select **Set As End** from the shortcut menu.

Notice that the data outside the selected range is no longer displayed in the worksheet. The data has not been deleted from the worksheet, only hidden to provide for easier viewing of the selected range. The hidden data can be shown by re-selecting the entire worksheet and then selecting **Edit:Reset to Full Range**.

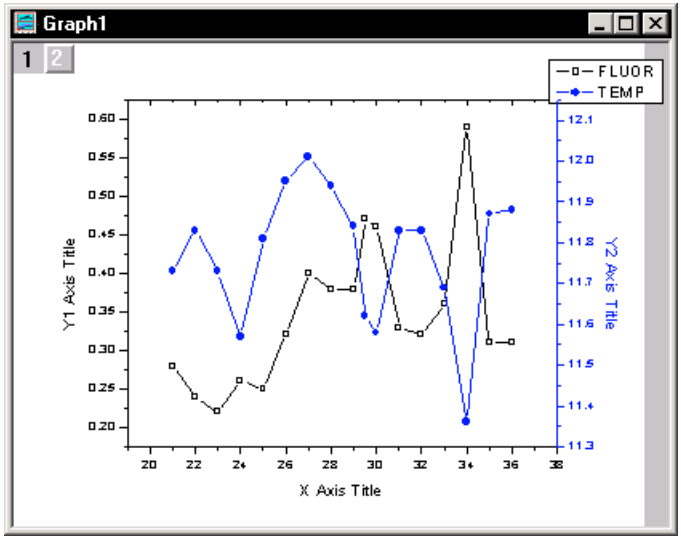
Plotting the Data:

1) Click the FLUOR column heading to select the column.

2) Scroll to the right in the worksheet and CTRL+click on the TEMP column heading. This selects the TEMP column while leaving the FLUOR column selected.

3) Click Double Y Axis  on the 2D Graphs Extended toolbar. (Select **View:Toolbars** if the 2D Graphs Extended toolbar isn't open.)

Figure 17: Plotting a Range of Worksheet Data



Masking Data in the Graph

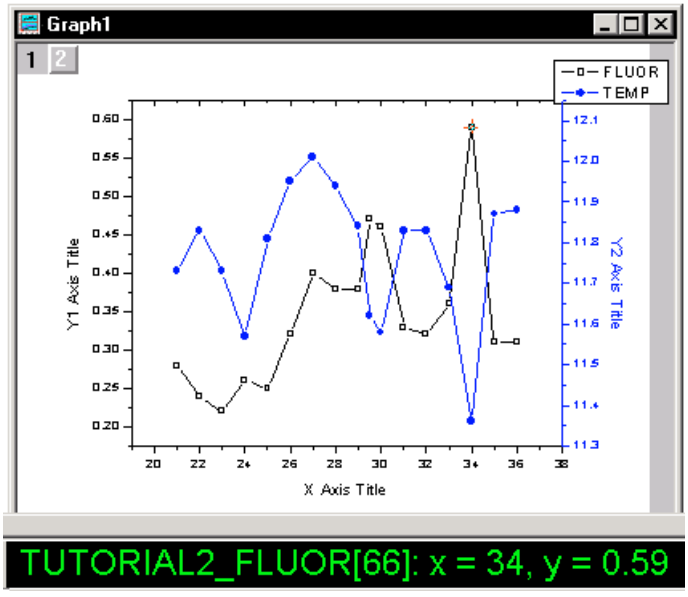
The Mask toolbar is provided for excluding data from Origin's analysis and fitting routines. You can mask individual data points or a range of data. Once data is masked, options become available to change the masked data color, hide or show the masked data, swap the masked and unmasked data, and enable or disable masking.

To Mask a Data Point in the Graph:

1) Click Mask Point Toggle  on the Mask toolbar. (Select **View:Toolbars** if the Mask toolbar isn't open.) This activates the Data Reader tool.

2) Click on the FLUOR data plot in the graph (black, open square symbols) and then use the right or left arrows on the keyboard to move the cursor to the data point at X = 34 and Y = .59. The Data Display tool displays the current coordinate values.

Figure 18: Masking Data in the Graph Window



3) Press ENTER to select this point for masking.

4) Click Change Mask Color  on the Mask toolbar. The color changes to green.

5) Click Hide/Show Masked Points  on the Mask toolbar to hide the masked data point.

6) Click Hide/Show Masked Points  on the Mask toolbar again to show the data point.

Performing a Linear Fit on the FLUOR Data Plot

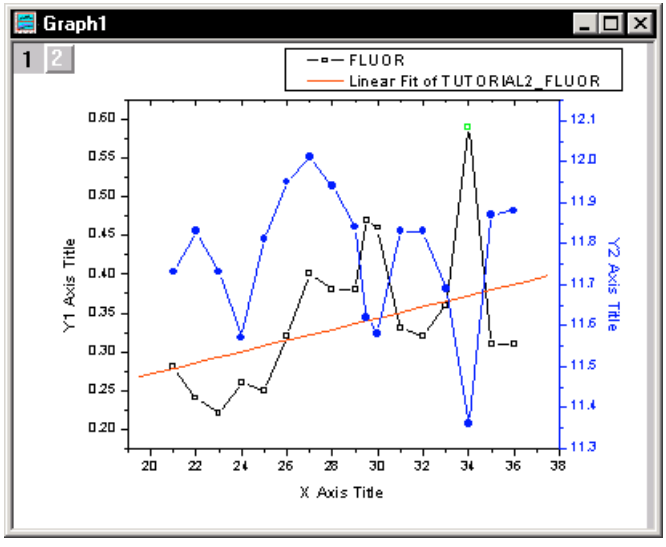
Now that a data point is masked in the FLUOR data plot, subsequent analysis and fitting are performed only on the non-masked data. You can, however, disable the mask on the data point, and analyze or fit all the data points in the current selection range.

To Perform a Linear Fit with the Data Point Masked:

1) Select **Analysis:Fit Linear**. A fit line is added to the graph and the Results Log opens displaying the fitting results. You can scroll the Results Log to view the results.

2) Click Refresh  on the Standard toolbar and reposition the legend so it fits on the page.

Figure 19: Linear Fit of the FLUOR Data Plot with a Masked Data Point



```
[12/3/2001 14:21 "/Graph1" (2452246)]
Linear Regression for TUTORIAL2_FLUOR:
Y = A + B * X

Parameter      Value          Error
------------------------------------------------------------
A              0.12658        0.11156
B              0.00723        0.00391
------------------------------------------------------------

R              SD             N              P
------------------------------------------------------------
0.44343        0.06872        16             0.08537
------------------------------------------------------------
```

By default, the Results Log shows the results for all fitting done in the currently active Project Explorer folder. To change this default behavior, right-click in the Results Log and select a different viewing option.

Each time a new fit is done the results are appended to the Results Log. Each entry in the Results Log includes a date/time stamp, the window name, a numeric stamp which is the Julian day, the type of analysis performed, and the results.

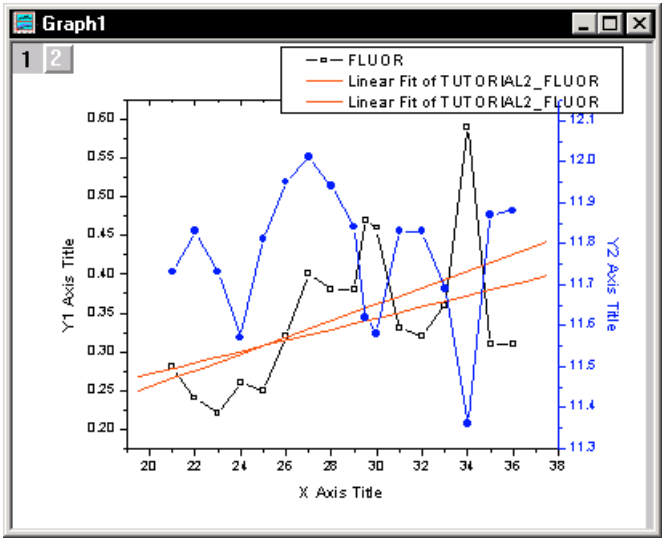
To Perform a Linear Fit with the Mask Disabled:

1) Click Disable/Enable Masking  on the Mask toolbar. The masked data point changes from green to black.

2) Select **Analysis:Fit Linear**. A second fit line is drawn on the graph.

3) Verify that the mask is disabled by comparing the two fit results in the Results Log.

Figure 20: Linear Fit of Data with Mask Disabled (2 Fit Lines)



To Remove the First Fit Line From the Graph:

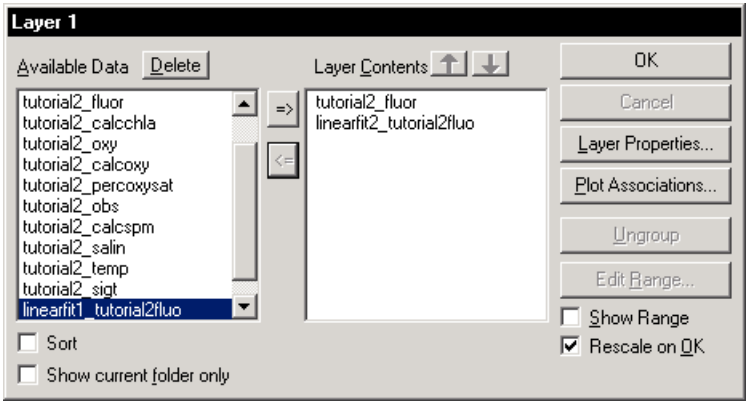
1) Double-click on the layer 1 icon 

in the upper-left corner of the graph. This opens the Layer 1 dialog box.

2) Select **linearfit1_tutorial2fluo** from the Layer Contents list box.

3) Click the <= arrow (to the left of the Layer Contents list box). The data set is removed from the list box.

Figure 21: Removing the First Fit Line from the Graph

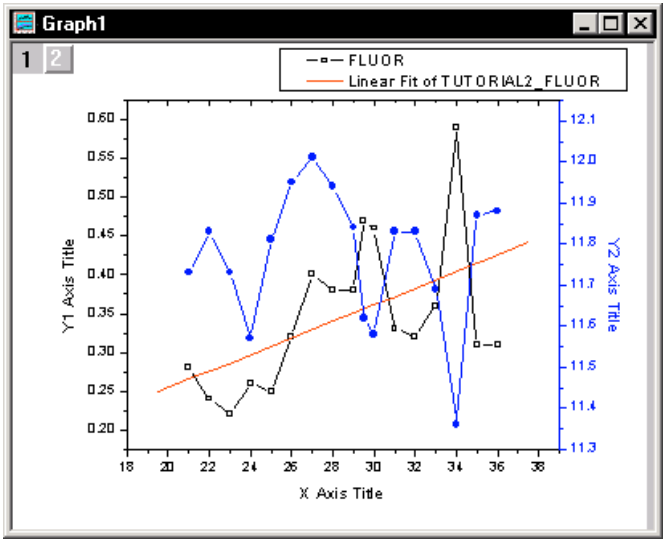


4) Click OK to close the dialog box.

5) Click New Legend  on the Graph toolbar to update the legend.

You may need to also click Refresh  on the Standard toolbar.

Figure 22: Linear Fit of Data with Mask Disabled (1 Fit Line)



Saving the Project

Your Origin project currently consists of your data, worksheets, graph, analysis results and the current folder organization in the Project Explorer.

To Save the Project:

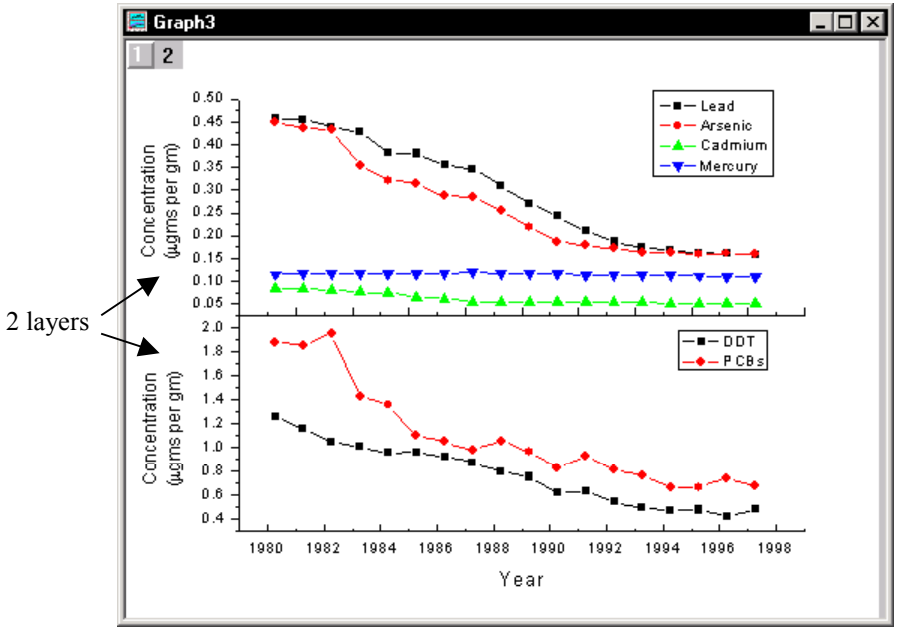
1) Select **File:Save Project**.
2) Type a name in the File Name text box.
3) Click Save.

Tutorial 3, Creating Multiple Layer Graphs

Introduction

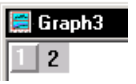
The layer is the fundamental building block of Origin graphs. A layer is an Origin object consisting of one set of controlling axes. Furthermore, any, none, or all of the four axes (the top and bottom X and right and left Y) that make up the layer may or may not be displayed. A layer can contain objects, such as labels, or data plots, that also may or may not be displayed. A graph window must contain at least one layer and may include as many as 80 layers.

Figure 1: Multiple Layer Graph



There is always one (only one) active layer in a graph window. This active layer is the only layer that is receptive to program commands. For example, any data or objects added to a graph will be added to the active layer. The active layer is denoted by a depressed layer icon in the upper-left corner of the graph window.

Figure 2: Layer 2 is Active

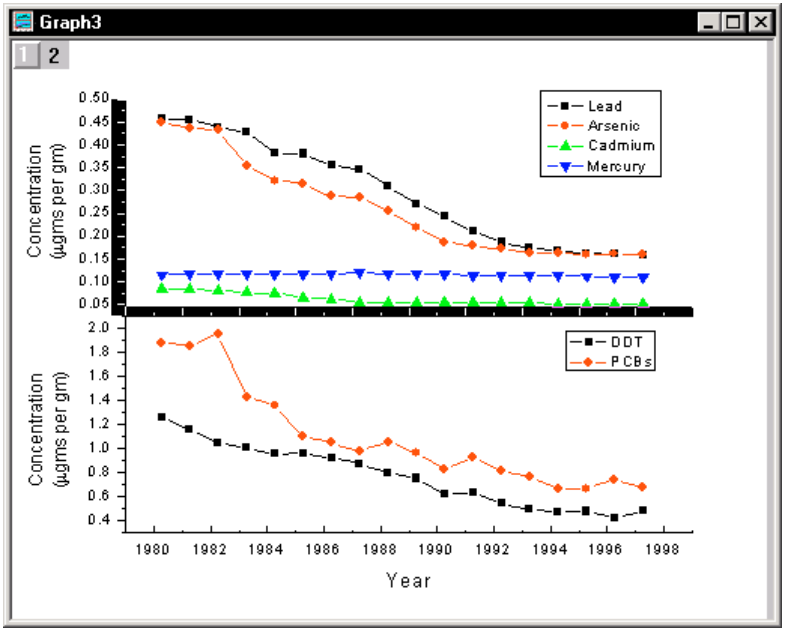


=> To hide the layer icons, select **View:Show:Layer Icons**.

=> To highlight the axes in the active layer, select **View:Show:Active Layer Indicator**.

Both these actions only effect the currently active graph window.

Figure 3: Highlighting the Axes in the Active Layer



To activate another layer, click the layer icon of the layer you want to be active.

This tutorial will introduce you to Origin's built-in multiple layer graph templates. It will also show you how to create your own multiple layer graph and then save it as a template.

Opening the Project File

The data for this tutorial is provided in a project file.

To Open the Project File:

1) Click Open  on the Standard toolbar.

2) In the Origin \TUTORIAL folder, select TUTORIAL_3.OPJ from the list of files.

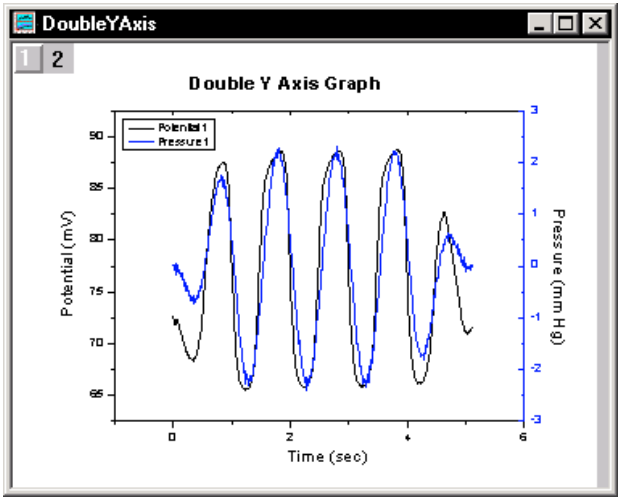
3) Click Open. A project containing four graph windows and a worksheet opens.

Origin's Multiple Layer Graph Templates

Origin contains several built-in, multiple layer graph templates. These templates allow you to select a range of data, then click a button to plot the selected data into multiple layers in a graph window.

The double Y axis graph template is ideal for plotting data that includes two or more dependent data sets and a common independent data set. A sample double Y axis graph is currently active in your project.

Figure 4: The Double Y Axis Graph

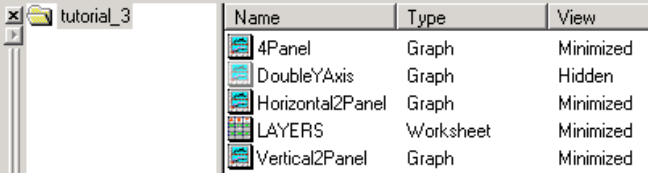


1) Right-click on the double Y axis graph window title bar and select **Hide** from the shortcut menu.

Project Explorer provides easy access to all the windows in the project. By default, Project Explorer is docked at the bottom of your workspace.

If your Project Explorer is closed, click  on the Standard toolbar.

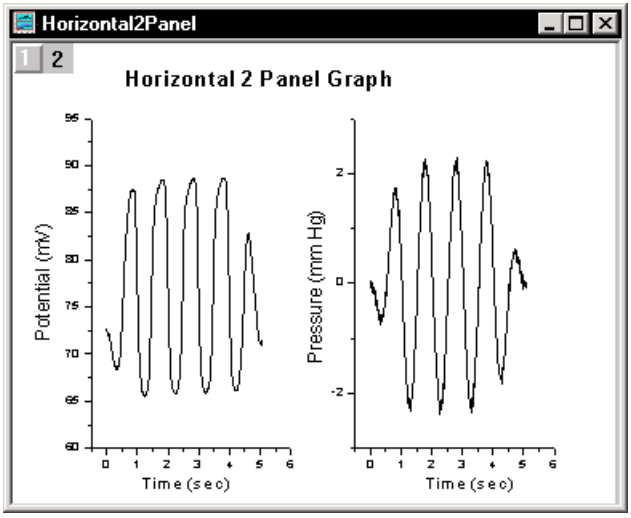
Figure 5: Project Explorer



2) Double-click on the Horizontal2Panel graph icon on the right pane of Project Explorer.

The horizontal 2 panel graph template is ideal for plotting related data that does not share an independent data set. You can use the **Edit:Add & Arrange Layers** menu command and the Layer tool to customize the spacing of the layers and to swap the layer arrangement.

Figure 6: The Horizontal 2 Panel Graph

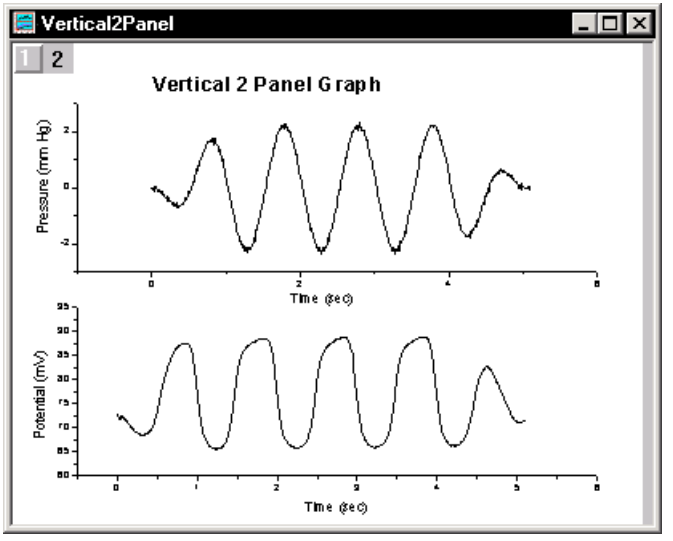


3) Right-click on the Horizontal2Panel graph icon on the right pane of Project Explorer and select **Hide Window** from the shortcut menu.

4) Double-click on the Vertical2Panel graph icon on the right pane of Project Explorer.

The vertical 2 panel graph template provides the same data presentation as the horizontal 2 panel graph template, but in a one column with two rows configuration.

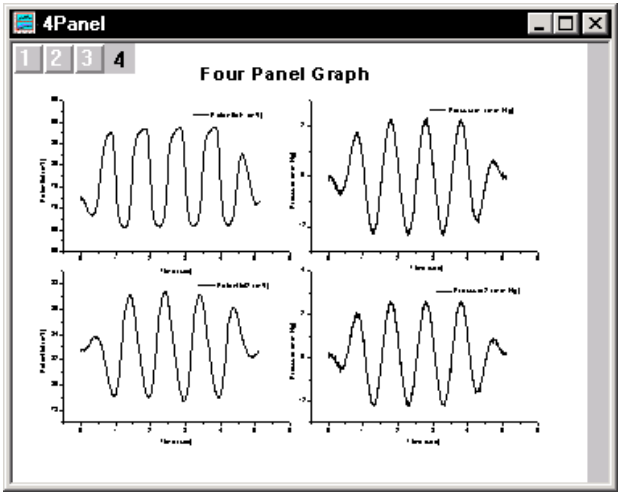
Figure 7: The Vertical 2 Panel Graph



5) Right-click on the Vertical2Panel graph icon on the right pane of Project Explorer and select **Hide Window** from the shortcut menu.

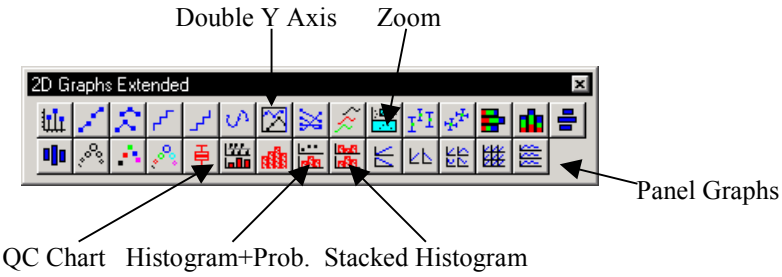
6) Double-click on the 4Panel graph icon on the right pane of Project Explorer.

Figure 8: The 4 Panel Graph



Additional multiple layer graphs are accessible from the 2D Graphs Extended toolbar (select your data before clicking the button).

Figure 9: The 2D Graphs Extended Toolbar



Designating Multiple X Columns in the Worksheet

When your worksheet includes multiple X columns, Y columns in the worksheet plot against the nearest X column to the left. Though this default behavior can be disregarded by selecting non-associated columns with CTRL selection, the default plotting behavior allows you to quickly create graphs from associated XY data sets.

To Designate a Second X Column:

1) Double-click on the Layers worksheet icon on the right pane of Project Explorer.

2) Right-click on the Trial2 column heading and select **Set As:X** from the shortcut menu.

The Trial2 column designation changes to X2 and the columns to the right of it are designated as Y2. In addition, the Trial1 column designation changes to X1 and the columns between Trial1 and Trial2 are designated as Y1. This allows you to quickly determine which column will be providing the X values for the data you are plotting.

Figure 10: Setting Trial2 as X

LAYERS

	Trial1(X1)	Potential1(Y1)	Pressure1(Y1)	Trial2(X2)	Potential2(Y2)	Pressure2(Y2)
	Trial1 sec	Potential1 mV	Pressure1 mm Hg	Trial2 sec	Potential2 mV	Pressure2 mm Hg
1	0	72.606	0	0	82.673	0
2	0.01	72.355	0	0.01	82.673	0.2464
3	0.02	71.917	-0.08764	0.02	82.735	0.0896
4	0.03	71.855	0.03528	0.03	82.735	0.2296
5	0.04	71.855	-0.15764	0.04	82.735	0.0896
6	0.05	72.293	-0.07	0.05	82.735	0.1764
7	0.06	72.293	0.01764	0.06	82.735	0.0896

Creating a Multiple Layer Graph

Origin does not contain pre-defined templates for all the different ways in which layers can be arranged. However, you can create your own custom multiple layer graph and save it as a template for future use.

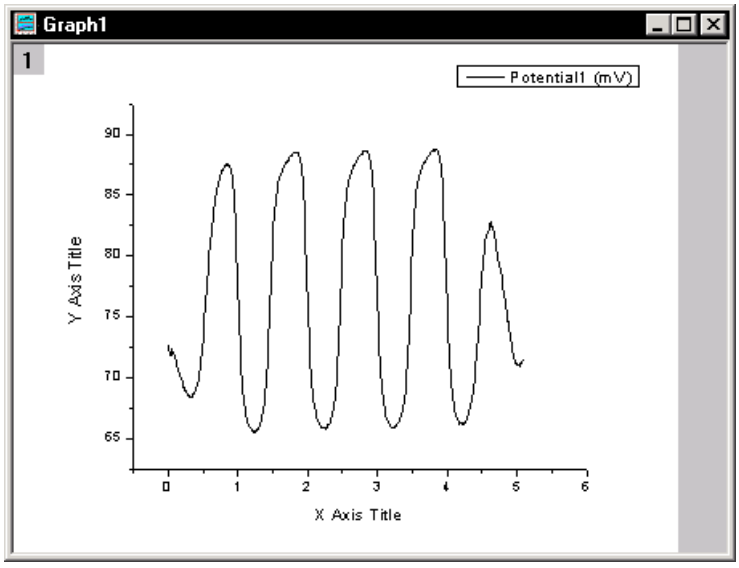
The following steps describe a method for creating a multiple layer graph, using a single layer graph as a starting point. This information is provided to familiarize you with important layer concepts. However, keep in mind that Origin provides a number of multiple layer graph templates that you can use as a starting point for your custom multiple layer graph.

To Create a Multiple Layer Graph:

1) Click on the Potential1 column heading to highlight the column.

2) Click Line  on the 2D Graphs toolbar.

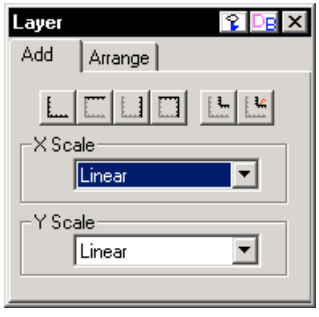
Figure 11: Line Graph of Potential1 Column



3) Select **Tools:Layer** to open the Layer tool.

4) With the Add tab selected, click Linked Right Y  . This adds a second layer to the graph displaying only the right Y axis. By default, the X axis of this layer is linked to the X axis of layer 1. This means that if you change the X axis scale in layer 1, the X axis scale in layer 2 automatically updates with the change.

Figure 12: The Layer Tool

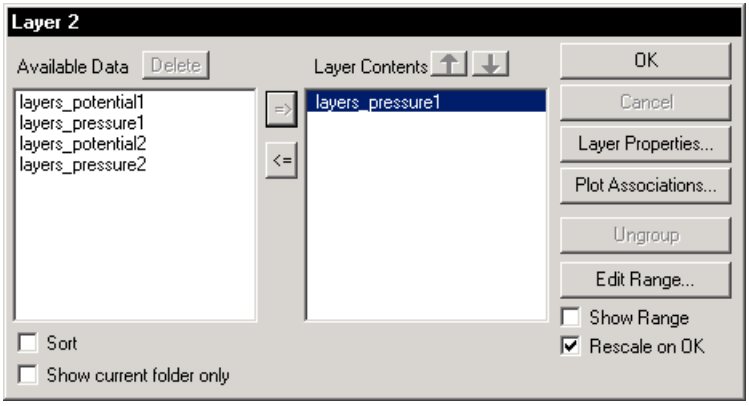


5) Double-click on the layer 2 icon in the upper-left corner of the graph window.

6) Select **layers_pressure1** in the Available Data list box.

7) Click => to add the data set to the Layer Contents list box.

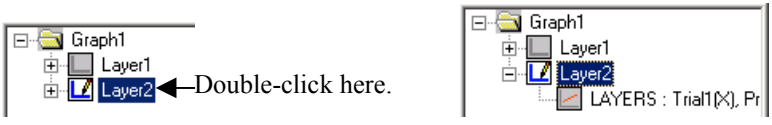
Figure 13: Adding Data to Layer 2



8) Click Layer Properties. The Plot Details dialog box opens.

9) Double-click on the Layer2 icon on the left side of the dialog box.

Figure 14: Opening the Layer Tree

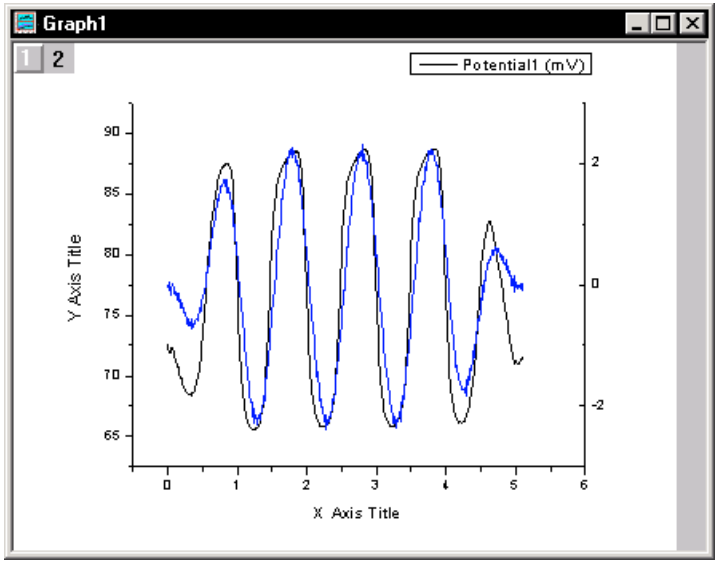


10) Click on the LAYERS:Trial1(X), Pressure1(Y) data plot icon on the left side of the dialog box. This action opens the Line tab.

11) Select Blue from the Color drop-down list, then click OK.

12) Click OK to close the Layer 2 dialog box.

Figure 15: Adding a Right Y Controlling Axis and Data



Origin provides many methods to add layers to your graph. In addition to the Layer tool, you can select menu commands from the **Edit** menu or from a shortcut menu available outside of the graph page (but within the window).

Arranging Layers in the Graph Window

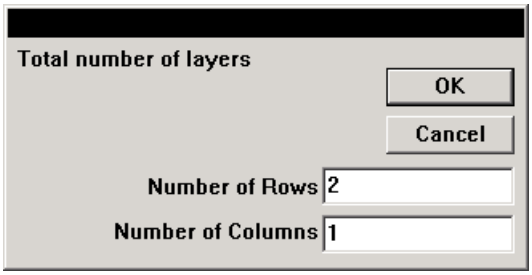
In this section, you will add and arrange layers to set up a vertical 2 panel graph with left and right Y axes.

To Add and Arrange Layers in the Graph:

1) Select **Edit:Add & Arrange Layers**.

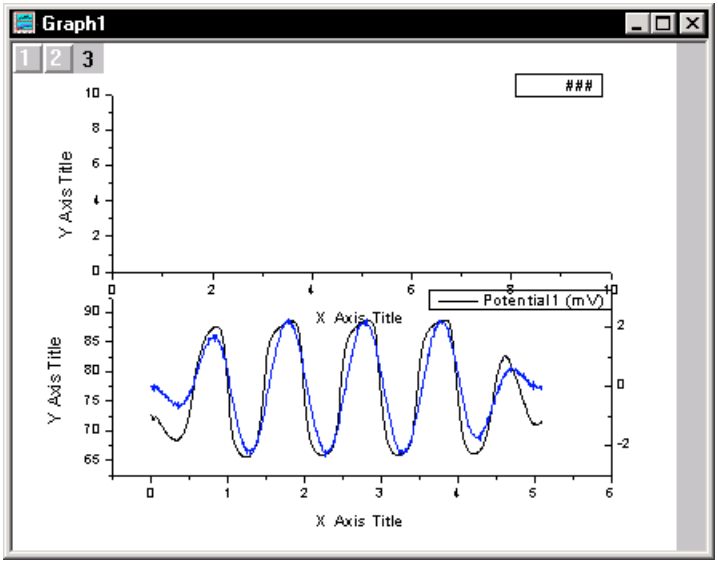
2) In the Total Number of Layers dialog box, type **2** in the Number of Rows text box.

Figure 16: Setting the Number of Layers



3) Click OK. Origin asks for permission to create 1 more layer.
4) Click Yes.
5) Click OK in the Spacing dialog box to accept the default settings.

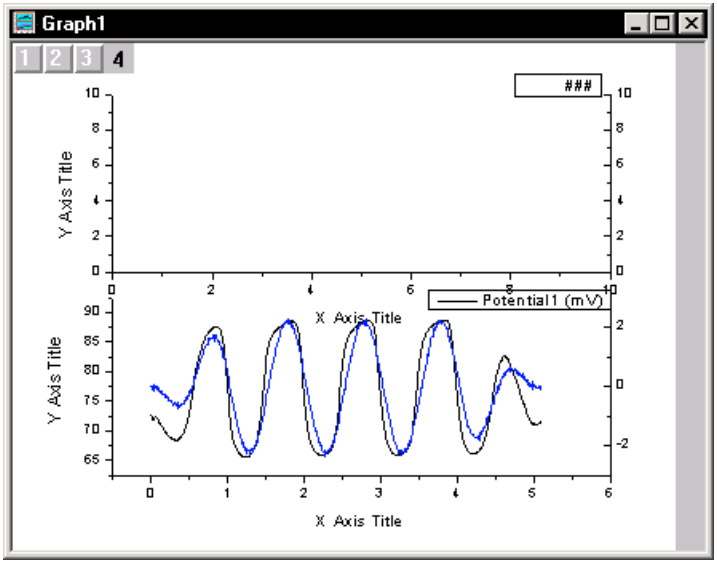
Figure 17: Adding and Arranging Layers



To Add the Right Y Controlling Axis to the Top Layer:

1) With the layer 3 icon selected, right-click in the gray area of the graph window, outside of the page and select **New Layer (Axes):(Linked): Right Y** from the shortcut menu.

Figure 18: Adding a Right Y Axis to the Top Layer



Adding Data to the New Layers

To add the data to layers 3 and 4, you will use the Layer *n* dialog box in the same way you added the data to layer 2.

To Add Data to the New Layers:

1) Double-click on the layer 3 icon.

2) In the Layer 3 dialog box, select **layers_potential2** in the Available Data list box, then click => to add it to the Layer Contents list box.

3) Click OK.

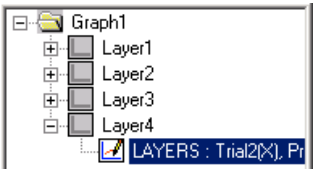
4) Double-click on the layer 4 icon.

5) In the Layer 4 dialog box, select **layers_pressure2** in the Available Data list box, then click => to add it to the Layer Contents list box.

6) Click Layer Properties to open the Plot Details dialog box.

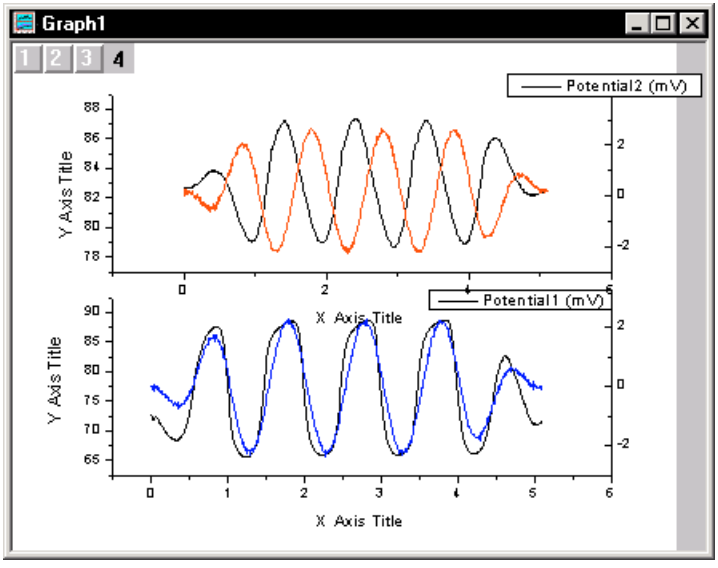
7) Double-click on the Layer4 icon on the left side of the dialog box, then click on the LAYERS:Trial2(X), Pressure2(Y) data plot icon.

Figure 19: Graph Tree of Plot Details Dialog Box



8) Select Red from the Color drop-down list.
9) Click OK to exit the Plot Details dialog box.
10) Click OK in the Layer 4 dialog box.

Figure 20: Adding Additional Layers and Data



Linking Axes

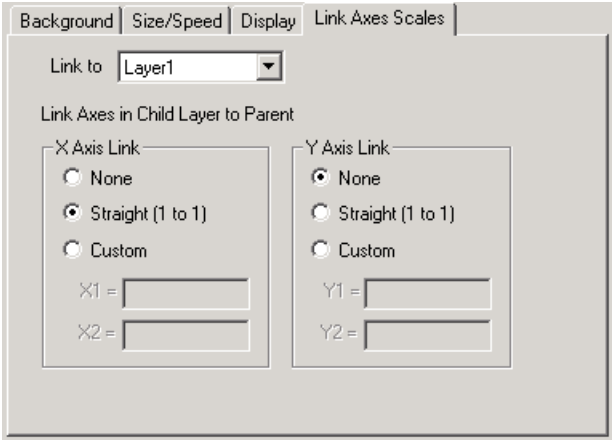
You can link axes between layers so that when you change the axis scale in one layer the other layer's linked axis updates to the same scale automatically.

To Link the X Axes:

1) Double-click on the layer 3 icon to open the Layer 3 dialog box.
2) Click Layer Properties.

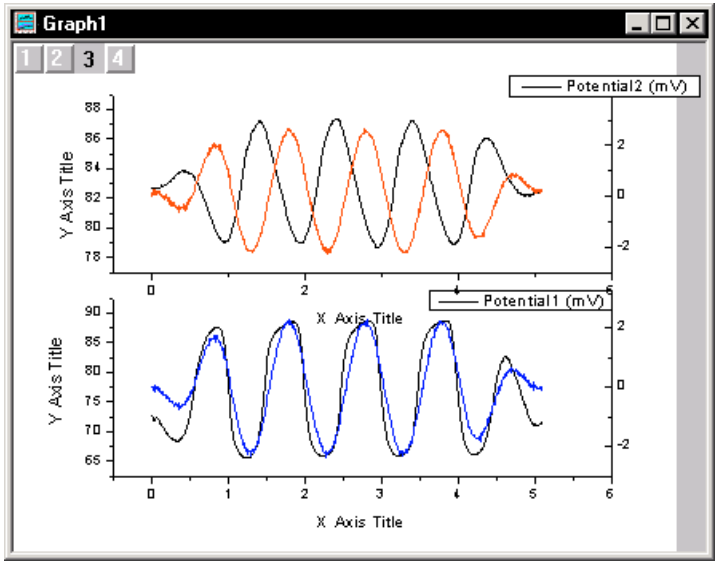
3) Select the Link Axes Scales tab.
4) Select Layer 1 from the Link To drop-down list.
5) Select the Straight (1 to 1) radio button in the X Axis Link group.

Figure 21: Setting the Axis Linking Relationship



6) Click OK to close the Plot Details dialog box.
7) Click OK in the Layer 3 dialog box.

Figure 22: Adding Data to the Layers

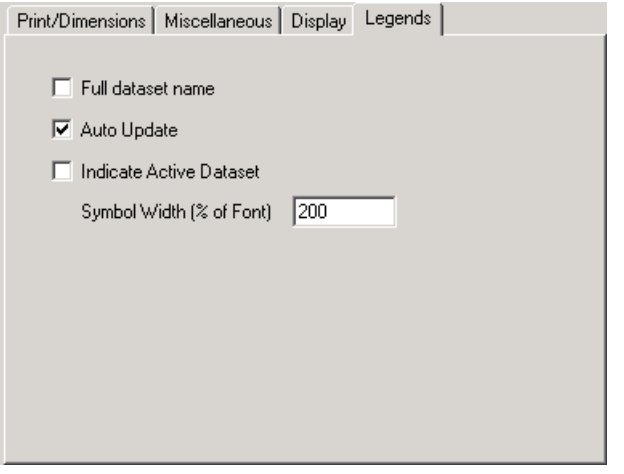


You can test the axis link by double-clicking on the bottom X axis and changing the From or To values on the Scale tab. After clicking OK, the top X axis also reflects your changes.

Customizing the Legend

Origin automatically displays a legend when you create a new graph. Furthermore, legends are layer-specific, so that if your graph has multiple layers, Origin displays a legend for each layer. If you add additional data to a layer, the legend will not update to include the new data unless you have selected the Auto Update check box on the Legends tab of the page's Plot Details dialog box (**Format:Page**).

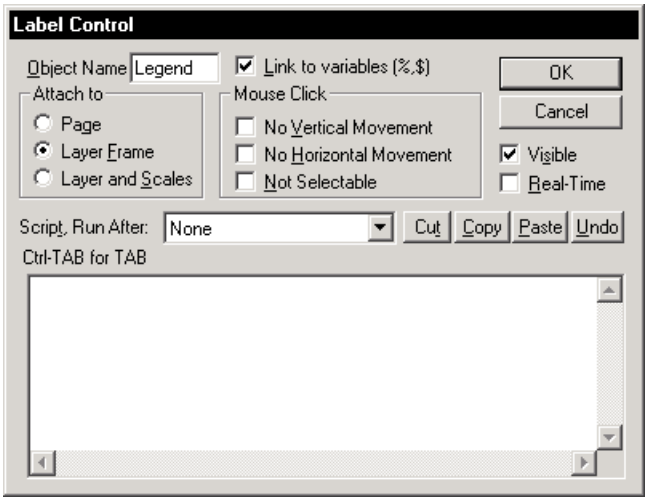
Figure 23: Setting the Legend to Update Automatically



You can also instruct Origin to update the legend for the active layer at any time by clicking the New Legend button on the Graph toolbar. If there is currently no legend in the layer, Origin creates one.

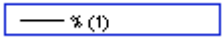
A legend is a unique text label. Origin names the text label "Legend" to identify it. This name is stored in the legend's Label Control dialog box. You can open this dialog box by selecting the legend and then selecting **Format:Label Control**. If you rename the legend, it will maintain its current contents but it will no longer update when you click New Legend or when you add data to the layer.

Figure 24: The Label Control Dialog Box for a Legend



A legend text label also uses special formatting to display the data set names and the data plot type icon (such as a line). If you double-click on the legend in the top layer of the current example, the in-place editing mode will display as shown in the following figure.

Figure 25: In-place Editing of a Legend Text Label



The %(1) is called substitution notation. This notation instructs Origin to display the data set name for the *first* data set in this layer.

When you are in-place editing any label, you can use substitution notation. For example, you can display the value of a specific data point in a data plot using the following substitution notation:
%(*WorksheetName*, *ColumnNumber*, *RowNumber*)
For example, if a worksheet is named data1, and you have plotted columns A(X) and B(Y), you can display the value of the data point in column 2, row 3 using:
%(data1, 2, 3)
To use this substitution notation, you must select the Link to Variables (%,$) check box in the Label Control dialog box (Figure 24).

In addition to substitution notation, Origin uses a special escape sequence to display the data plot icon in the legend (such as a line). This special escape sequence is:
\L(*DataListPosition*)
Where *DataListPosition* is the data plot's position in the data list, the list

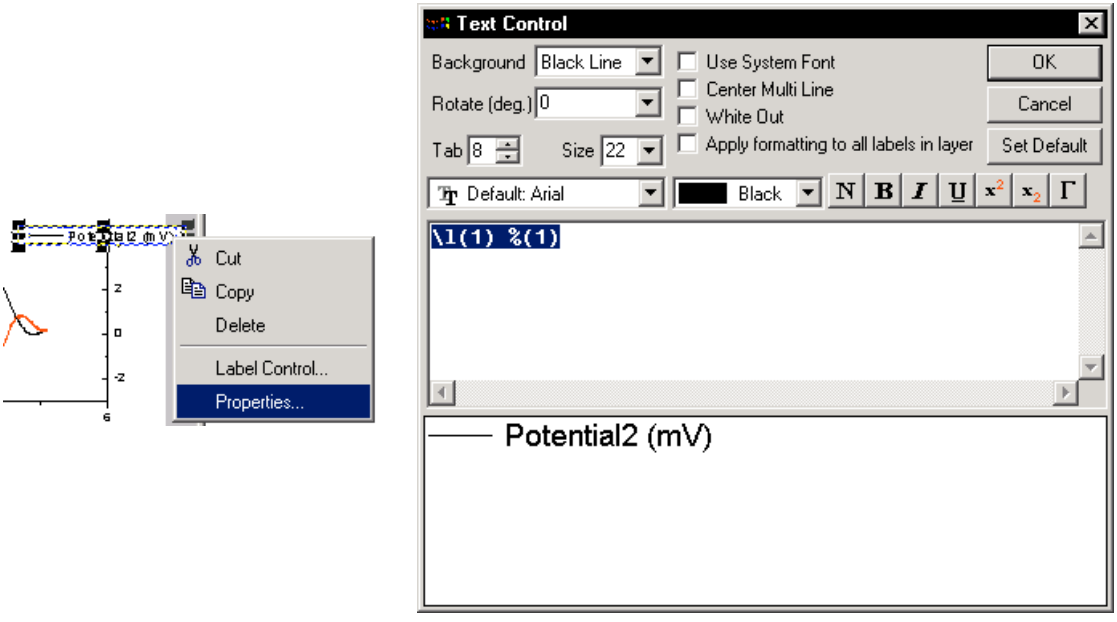
of plotted data at the bottom of the **Data** menu.
If you double-click on a legend to enter the in-place editing mode, you will see the data plot icon, not the \L( ) escape sequence. This is because Origin does not support using escape sequences in the in-place editing mode. To use escape sequences, you must edit the label in the Text Control dialog box (see the following instructions).

To Customize the Legend:

1) In the bottom layer, click on the text portion of the legend reading Potential1 (mV), then press DELETE.

2) In the top layer, right-click on the text portion of the legend reading Potential2 (mV) and select **Properties** from the shortcut menu. This opens the Text Control dialog box.

Figure 26: Opening the Text Control Dialog Box



3) In the Text Control dialog box, type the following text, overwriting \L(1) %(1):

\L(1.1) Potential1

\L(2.1) Pressure1

\L(3.1) Potential2

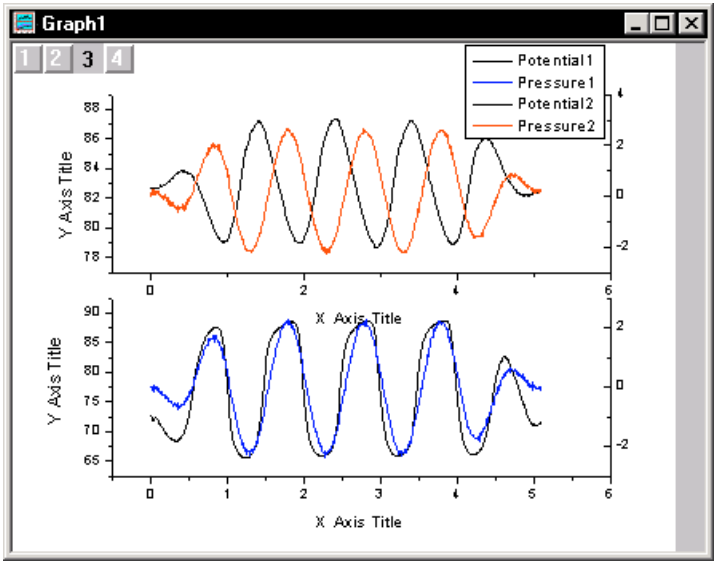
\L(4.1) Pressure2

The preview box on the bottom of the dialog box shows what the text will look like in the legend.

4) Click OK.

5) If necessary, drag the legend to a new location to minimize overlapping of graphic elements.

Figure 27: Updating the Legend to Include All the Data



The legend now displays the data plot type representations from all the layers in the graph. To prevent Origin from overwriting your custom legend (for example, if you click the New Legend button on the Graph toolbar) you can rename the legend.

To Rename the Legend:

1) Right-click on the legend text.

2) Select **Label Control** from the shortcut menu that opens.

3) Type **Custom Legend** in the Object Name text box.

4) Click OK.

Saving the Graph as a Template

Template files retain information on how to display the data, but do not actually save the data. If you save the current graph window as a template, then the next time you need to create a similar graph, you can select your worksheet data and then select your custom graph template. Your custom template is easily accessed by clicking the Template button  on the 2D Graphs toolbar or by selecting **Plot:Template Library**.

To Save Your Graph as a Template:

1) Right-click on the graph window title bar.
2) Select **Save Template As** from the shortcut menu.
3) Type **Multilayer** in the File Name text box.
4) Type **My Templates** in the Template Category combo box.
5) Click Save.

To test your template, you can make the Layers worksheet active, select all the worksheet columns, and then select **Plot:Template Library**. Select the My Templates category and then select your Multilayer template. Click Plot to plot your data.

Tutorial 4, Nonlinear Curve Fitting

Introduction

Origin offers several methods of fitting functions to your data. These methods vary in speed and complexity to optimize fitting for all users. In this tutorial, you will be introduced to fitting using the menu commands, the tools, the fitting wizard (NLSF Wizard), and the advanced fitting tool (NLSF). You will then use the NLSF to define your own function and fit sample data.

In addition to defining functions in the NLSF, Origin provides a C programming language called Origin C and an integrated development environment called Code Builder for defining and compiling functions. Once compiled, you can access the function from the NLSF. To learn more:

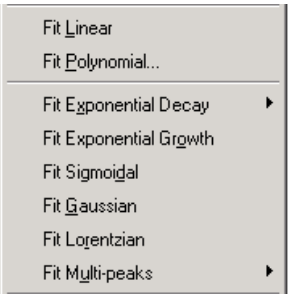
=> Review the AsymGauss.OPJ project that is located in the Origin \Samples\Programming\NLSF User-defined Function folder.

=> Review "Tutorial 8, Programming in Origin".

Fitting from the Menu

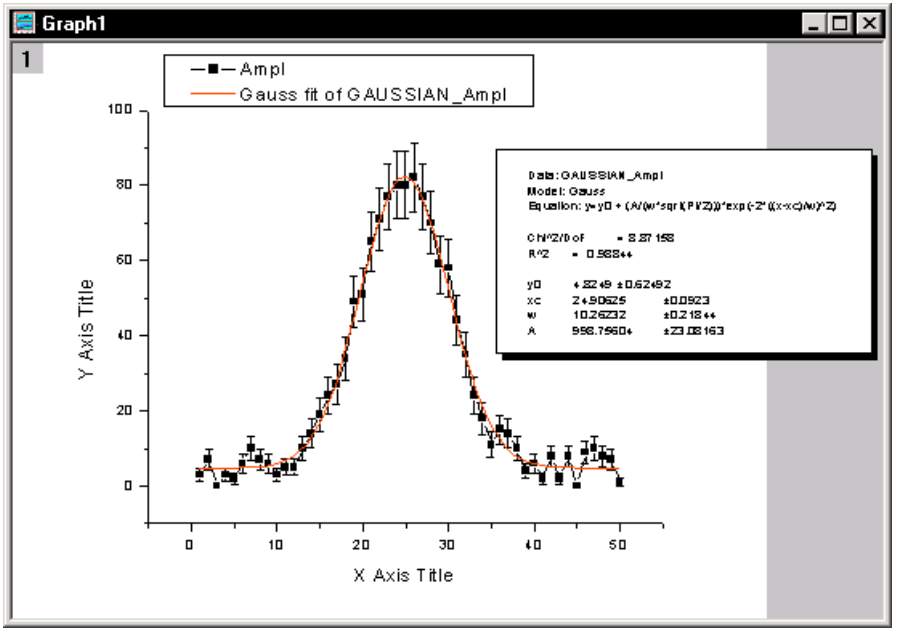
Origin offers access to several fitting functions directly from the **Analysis** menu. To perform a fit on your data using the menu commands, make sure that the data plot you want to perform the fit on is active, then select the type of fit you want to perform from the **Analysis** menu. Most of the menu commands require no parameter information from you and will carry out the fit automatically. Some may ask you for some parameter information, but will suggest default values based on your data.

Figure 1: Fitting Commands from the Graph Window Analysis Menu



After performing the fit, Origin displays the fit curve and results (depending on the fit selection) in the graph window, and outputs the full results to the Results Log.

Figure 2: Fitting from the Analysis Menu

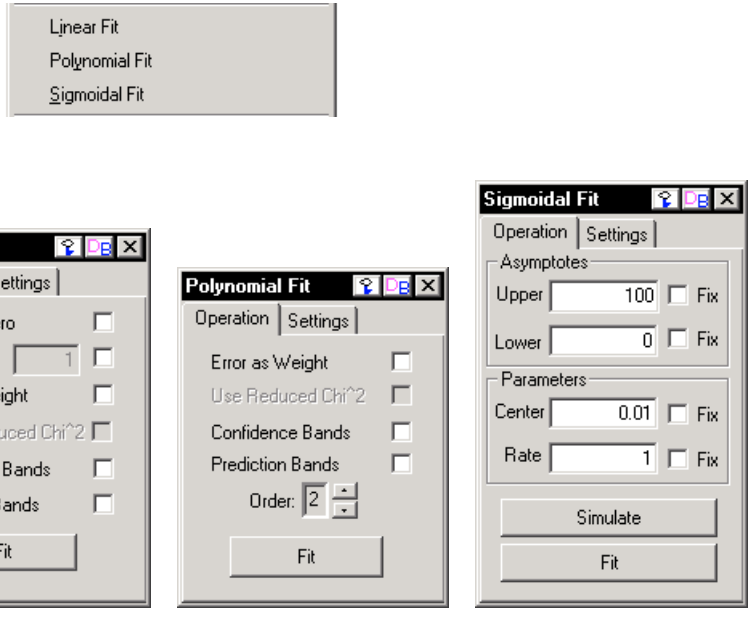


```
[12/10/2001 10:44 "/Graph1" (2452253)]
Gauss fit to GAUSSIAN_Ampl:
Weight given by GAUSSIAN_Err error bars.

Chi^2/DoF      8.87158
R^2            0.98844

Area           Center         Width          Offset         Height
-------------------------------------------------------------------
998.76         24.906         10.262         4.8249         77.652
```

Fitting Using the Tools

For a greater degree of control than the menu commands allow, Origin provides three fitting tools: the Linear Fit, Polynomial Fit, and Sigmoidal Fit tools. These tools are available from the **Tools** menu when a worksheet or a graph is active.

Figure 3: The Fitting Tools

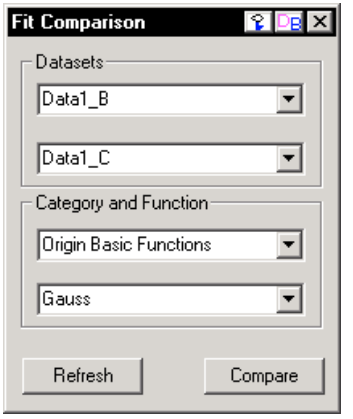


To use the fitting tools, select the data set or data plot you want to fit, open the tool and customize the options on both tabs of the tool, and then click Fit on the Operation tab.

Fitting Comparison

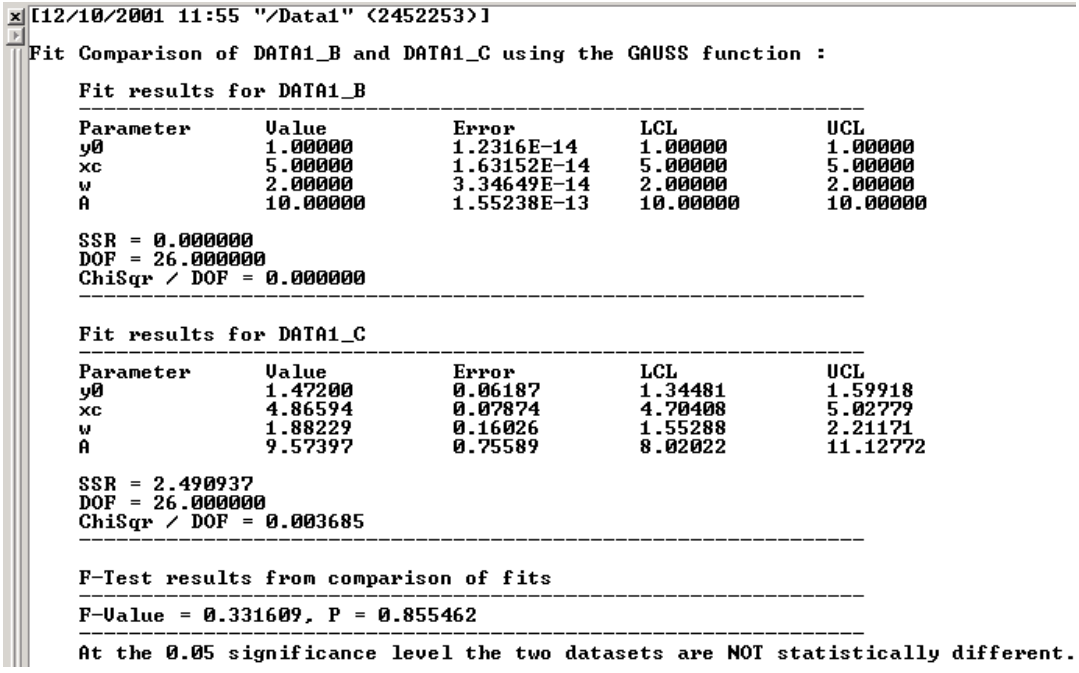
A Fit Comparison tool is available to determine if two data sets are representative samples from the same population or not. This tool compares the data sets by fitting the same function to the data. It then uses an F-test to determine whether the data sets are significantly different from each other. To open the Fit Comparison tool when a worksheet or graph is active, select **Tools:Fit Comparison**.

Figure 4: The Fit Comparison Tool



This tool outputs the results to the Results Log.

Figure 5: The Fit Comparison Results



[12/10/2001 11:55 "/Data1" (2452253)]

Fit Comparison of DATA1_B and DATA1_C using the GAUSS function :

Fit results for DATA1_B

Parameter	Value	Error	LCL	UCL
y0	1.00000	1.2316E-14	1.00000	1.00000
xc	5.00000	1.63152E-14	5.00000	5.00000
w	2.00000	3.34649E-14	2.00000	2.00000
A	10.00000	1.55238E-13	10.00000	10.00000

SSR = 0.000000
DOF = 26.000000
ChiSqr / DOF = 0.000000

Fit results for DATA1_C

Parameter	Value	Error	LCL	UCL
y0	1.47200	0.06187	1.34481	1.59918
xc	4.86594	0.07874	4.70408	5.02779
w	1.88229	0.16026	1.55288	2.21171
A	9.57397	0.75589	8.02022	11.12772

SSR = 2.490937
DOF = 26.000000
ChiSqr / DOF = 0.003685

F-Test results from comparison of fits

F-Value = 0.331609, P = 0.855462

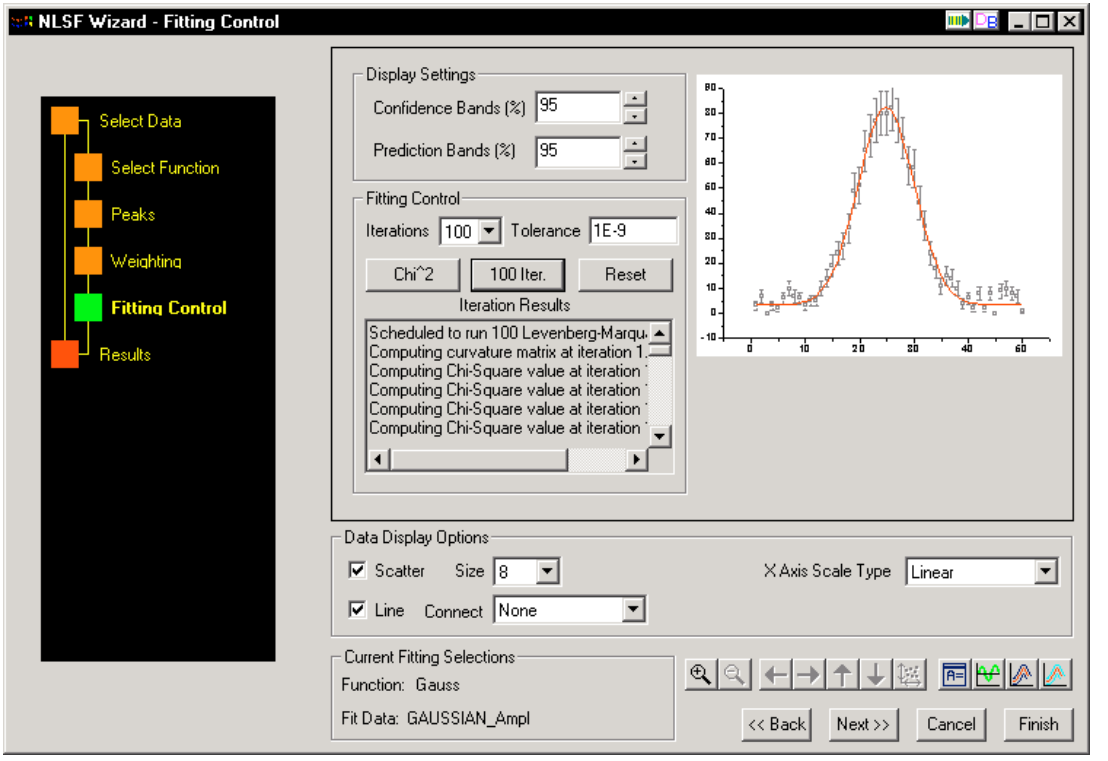
At the 0.05 significance level the two datasets are NOT statistically different.

The Fitting Wizard

Origin provides both a wizard (NLSF Wizard) and an advanced fitting tool (NLSF) for performing nonlinear least squares fitting. The wizard steps you through the fitting process, and is thus easier to use than the NLSF. However, the wizard does not provide all the fitting options available in the NLSF. For example, if you want to define a new fitting function, fit multiple data sets to a function, fit with multiple independent or dependent variables, or run scripts at specified triggers (for example, after a fit is performed), then you must use the NLSF.

To open the NLSF Wizard when a worksheet or graph is active, select **Analysis:Nonlinear Curve Fit:Fitting Wizard**.

Figure 6: The NLSF Wizard (Fitting Control Page)



The Advanced Fitting Tool

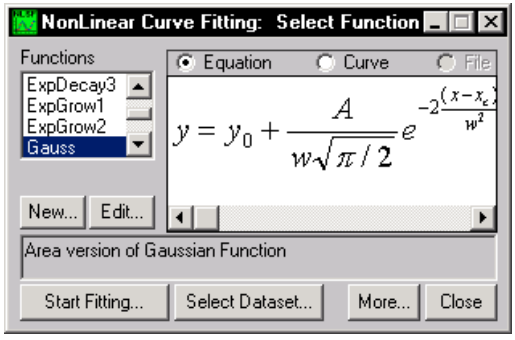
The advanced fitting tool (NLSF) is Origin's most powerful and complex method of fitting data. To open the NLSF when a worksheet or graph is active, select **Analysis:Nonlinear Curve Fit:Advanced Fitting Tool**.

There are two display modes available for the NLSF: basic and advanced. You can switch between modes by clicking the More button in the basic mode or the Basic Mode button in the advanced mode.

The Basic Mode

The basic mode of the NLSF provides an abbreviated fitting function list and a less complex interface than the advanced mode. Additionally, the basic mode offers less control over the fit and less customization of the reported results.

Figure 7: Basic Mode of the NLSF

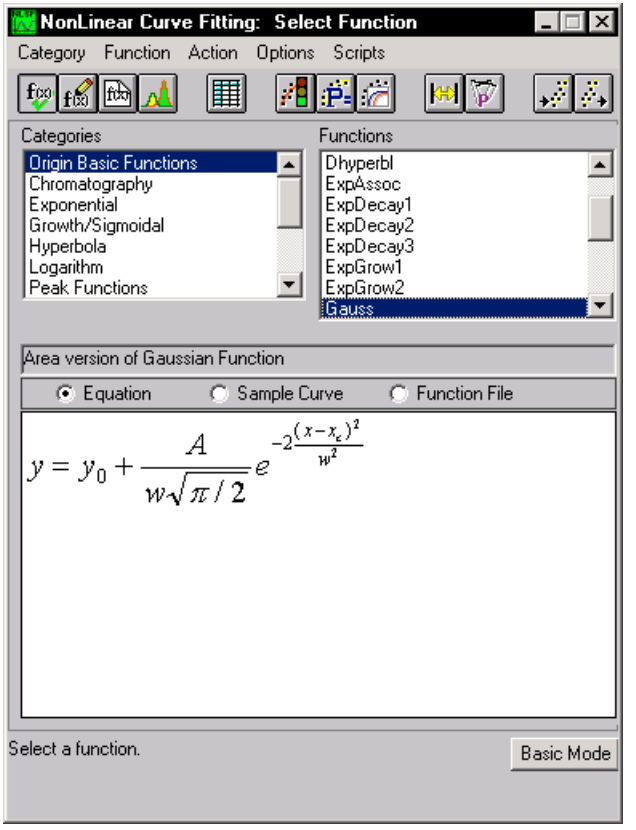


The Advanced Mode

The advanced mode lets you customize all aspects of the fitting process. It provides access to many more fitting functions than the basic mode and the functions are separated into categories to facilitate searching. The advanced mode also has its own menu and toolbar to provide access to all its features.

To select a function in the advanced mode, first select **Function:Select** from the NLSF menu if the Select Function page is not active. Then select the appropriate category from the Categories list box, and select the desired function from the Functions list box. Once a function is selected, the procedure for fitting is the same as for fitting after you define your own function (see the following sections).

Figure 8: Advanced Mode of the NLSF



Fitting a Data Set Using Your Own Function

Opening the Project File

The data for this tutorial is provided in an Origin project file.

To Open the Project File:

1) Click Open on the Standard toolbar.

2) In the Origin \TUTORIAL folder, select TUTORIAL_4.OPJ from the list of files.

3) Click Open.

The project opens showing a worksheet containing data and a graph window containing a data plot.

Defining a Function

You can define your own function in the NLSF and then access that function in future sessions. In the basic mode, you click New to define a function. The following procedure guides you through defining a function in the advanced mode.

To Define your own Function in the Advanced Mode:

1) Select **Analysis:Nonlinear Curve Fit:Advanced Fitting Tool**. This opens the NLSF.

2) If the NLSF opens in the basic mode, click More to switch to the advanced mode. (See pages 147 and 148 for pictures of the basic and advanced modes.)

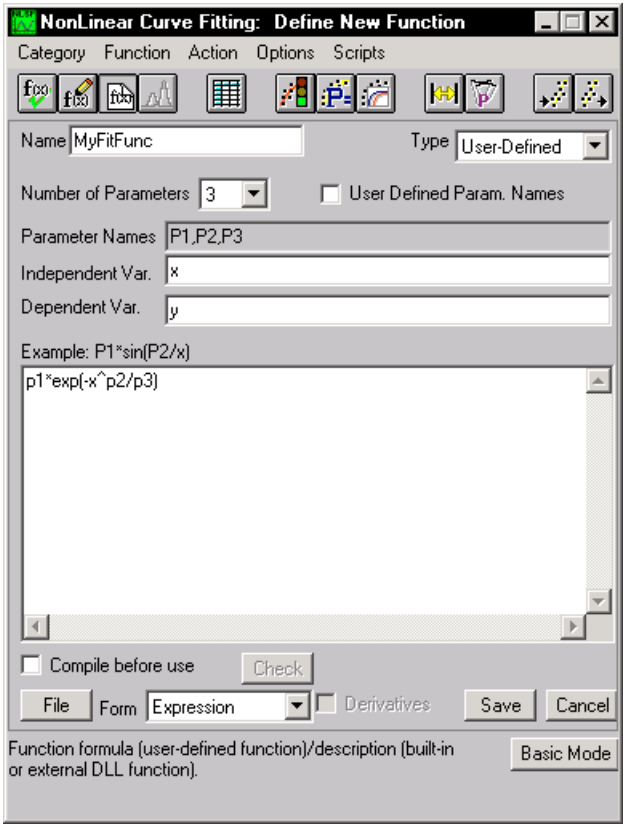
3) Select **Function:New** from the NLSF menu bar. This activates the Define New Function dialog box.

4) Type **MyFitFunc** in the Name text box.

5) Select 3 from the Number of Parameters drop-down list.

6) Type **p1*exp(-x^p2/p3)** in the Definition text box.

Figure 9: Defining a New Function



7) Click Save.

The function is saved under the name MyFitFunc. The MyFitFunc function will now be available in the list of functions under the currently active category. The currently active category is the selected category In the NLSF Select Function dialog box (**Function:Select** from the NLSF menu).

Assigning the Function Variables to the Data Sets

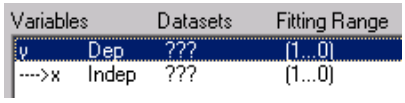
The next step is to assign the X and Y variables in the function to the corresponding X and Y data sets in the data plot you are fitting.

To Assign the Function Variables to Data Sets:

1) Select **Action:Dataset** from the NLSF menu bar. This activates the Select Dataset dialog box.

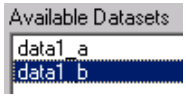
2) In the list box at the top of the fitter, the Y variable should be selected in the list. If not, select it.

Figure 10: Selecting the Y Variable



3) In the Available Datasets list box, select **data1_b**.

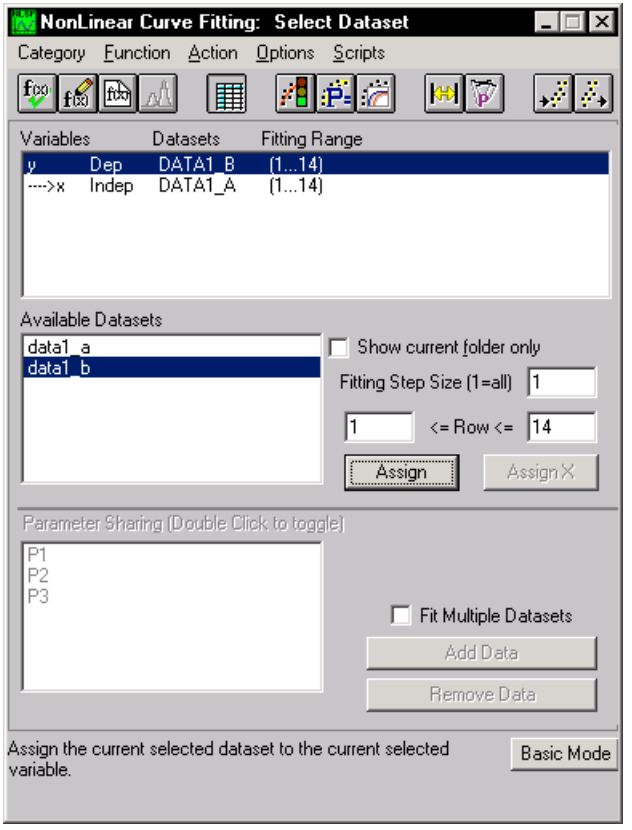
Figure 11: Selecting the Data Set



4) Click Assign.

When you assign the Y variable to **data1_b** (the Y data set), Origin automatically assigns the X variable to **data1_a** (the associated X data set).

Figure 12: Assigning Variables to Data Sets



Simulating Curves to Initialize the Parameter Values

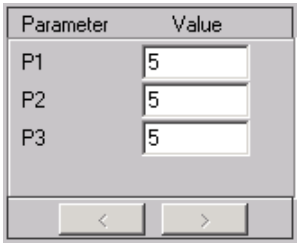
Origin lets you observe what the function will look like with various parameter values in the Simulate Curves dialog box. This enables you to get an understanding of which parameter values produce curves that look similar to your data. This is important because reasonably good starting parameter values are in most cases a precondition for the success of the fitting process.

To Simulate Curves:

1) Select **Action:Simulate** from the NLSF menu bar. This activates the Simulate Curves dialog box.

2) Type **5** in the P1, P2, and P3 text boxes (overwriting the dashes).

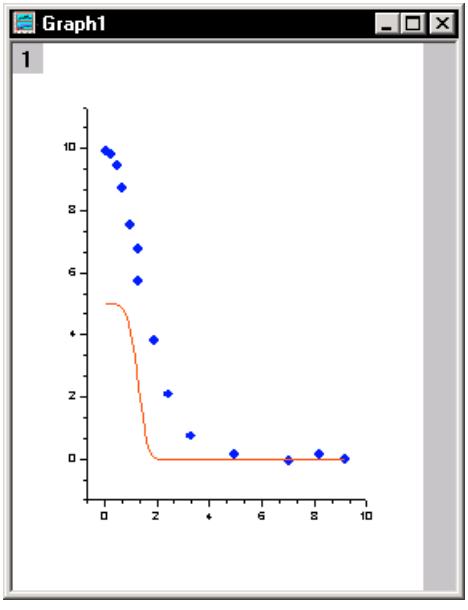
Figure 13: Initializing Parameter Values



3) Click Create Curve.

The parameters you typed in the text boxes are used to create a curve which is plotted in the graph window containing your data plot.

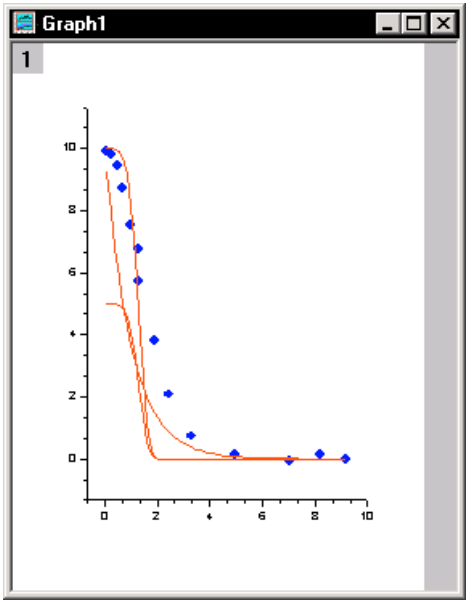
Figure 14: Simulated Curve



You can type new parameter values in the text boxes to create a simulated curve which looks more like your data.

4) Type **10** in the P1 text box (overwriting 5).
5) Click Create Curve.
6) Type **1** in the P2 and P3 text boxes (overwriting 5).
7) Click Create Curve.

Figure 15: Fine-tuning the Simulated Curve



The simulated curve is much more similar to the plotted data with the last set of parameter values. These will be the initial parameter values when Origin fits the data.

Fitting the Data

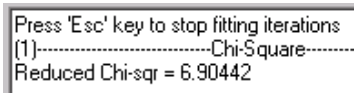
You will now fit the data using the function you defined. The initial parameter values will be used from the Simulate Curves dialog box.

To Fit the Data:

1) Select **Action:Fit** from the NLSF menu bar. This activates the Fitting Session dialog box.

2) Click Chi-Sqr. The reduced chi-squared value for the current parameter values displays in the view box.

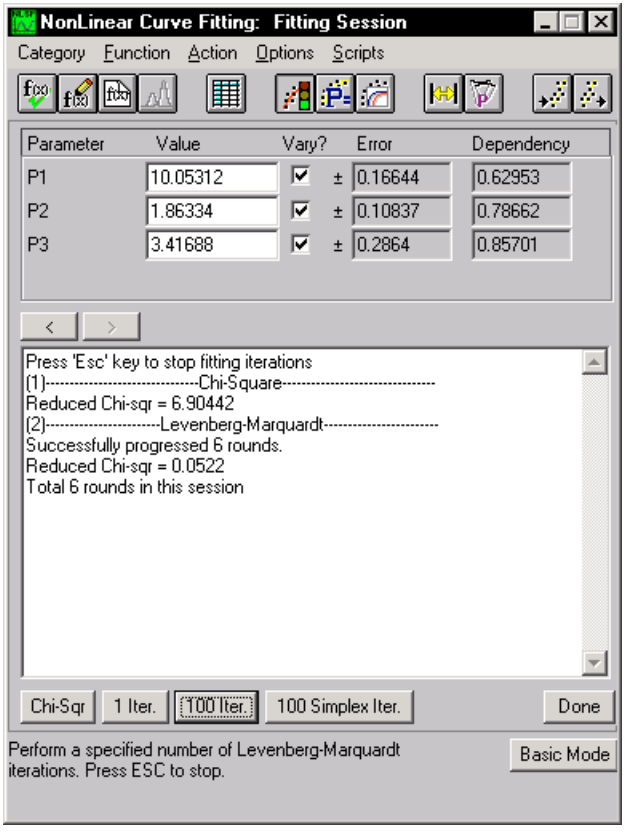
Figure 16: Calculating the Reduced Chi-Square Value



3) Click 100 Iter.

Origin fits the data, performing a maximum of 100 Levenberg-Marquardt iterations. The fit curve displays in the graph. The reduced chi-squared value and the number of iterations performed are reported in the NLSF view box. The updated parameter values are shown in the Value text boxes.

Figure 17: Fitting Session



Creating a Worksheet With the Fitting Results and Exiting the Fitter

After fitting your data, you can create a worksheet that contains all the results of your fitting session. Additionally, when you close the NLSF, Origin displays the parameter fitting results in the Results Log and in a label in the graph window.

To Create a Worksheet with the Fitting Results:

1) Select **Action:Results** in the NLSF. This activates the Generate Results dialog box.

2) Click Param. Worksheet.

3) Click Close in the upper-right corner of the NLSF to close the NLSF.

4) Click Yes at the Attention prompt.

After closing the NLSF, a Parameters worksheet displays all the fitting results.

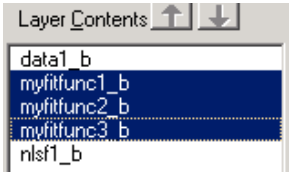
The graph window displays your data plot, the simulated curves, the fit curve, and a text label with the parameter results.

To Remove the Simulated Curves from the Graph:

1) In the Graph1 window, double-click on the layer 1 icon 1 located in the upper-left corner. This opens the Layer 1 dialog box.

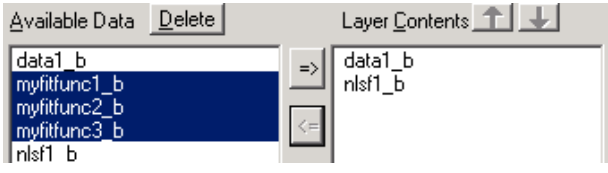
2) Select the **myfitfunc1_b**, **myfitfunc2_b**, and **myfitfunc3_b** data sets in the Layer Contents list box.

Figure 18: Selecting Data Sets in the Layer



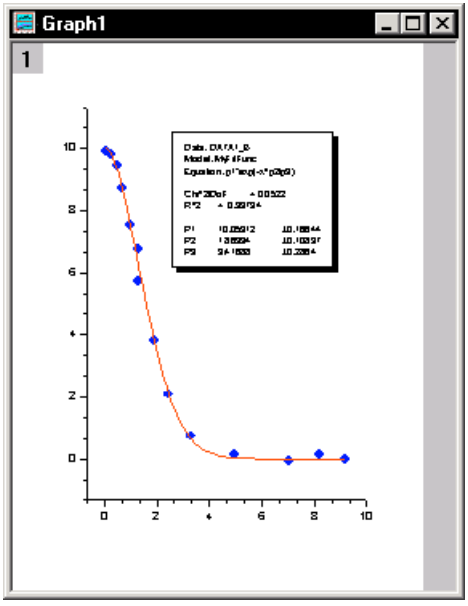
3) Click <= to move the selected data sets out of the layer.

Figure 19: Moving the Data Sets Out of the Layer



4) Click OK to close the Layer 1 dialog box.

Figure 20: Final Graph



The Results Log also displays the parameter results.

Figure 21: The Fitting Results in the Results Log

```
[12/12/2001 14:08 "/Graph1" (2452255)]
Data: DATA1_B
Model: MyFitFunc
Equation: p1*exp(-x^p2/p3)

Chi^2/DoF      R^2
--------------------------------------
0.0522         0.99734
--------------------------------------


Parameter      Value          Error
--------------------------------------
P1             10.05312       0.16644
P2             1.86334        0.10837
P3             3.41688        0.2864
--------------------------------------
```

Tutorial 5, Creating 3D Surface Graphs

Introduction to Matrices

There are two primary data structures in Origin: worksheets and matrices. Data stored in worksheets can be used to create any 2D graph and some 3D graphs, but in order to create a 3D surface graph or a 3D contour graph you must have your data stored in a matrix. Origin provides methods for converting worksheets to matrices, and for converting matrices to worksheets.

Matrices have numbered columns which are mapped to linearly spaced X values and numbered rows which are mapped to linearly spaced Y values. You can view the X and Y values in the matrix column and row headings by selecting **View:Show X/Y**. Each cell value in a matrix represents a Z value which is located in the XY plane by the cell's X value (determined by its column) and by the cell's Y value (determined by its row).

To Learn More about the XY Mapping in a Matrix:

1) Click the New Matrix button  on the Standard toolbar to create an empty matrix.

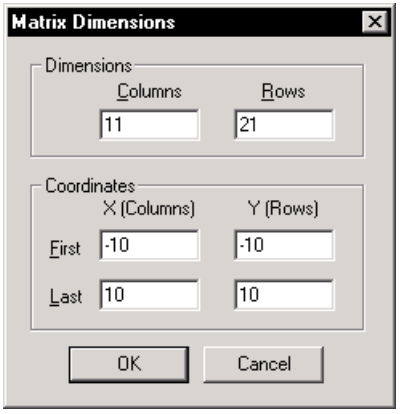
2) Select **Matrix:Set Dimensions** to specify its dimensions and coordinates.

3) In the Dimensions group, type **11** in the Columns text box and **21** in the Rows text box.

4) In the Coordinates group, type **-10** in both the First X text box and the First Y text box.

5) In the Coordinates group, type **10** in both the Last X text box and the Last Y text box.

Figure 1: Setting the Matrix Dimensions and XY Coordinates



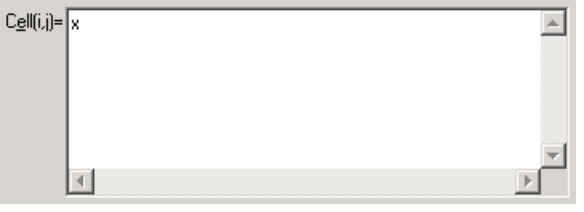
6) Click OK. You have created a matrix with 11 columns and 21 rows with each dimension mapped to the coordinates from -10 to 10.

7) Select **View:Show X/Y** to view the X and Y values in the matrix column and row headings.

8) Size and position the new matrix so that you can see all 11 columns and all 21 rows.

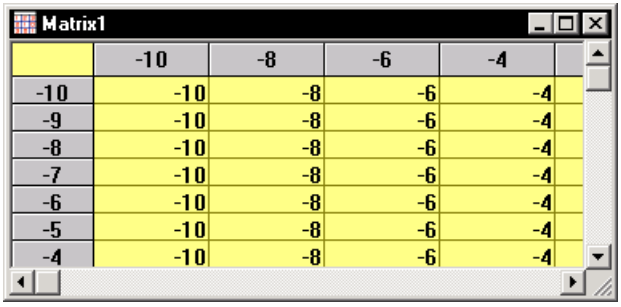
9) Select **Matrix:Set Values** to fill the empty cells with Z values. As a demonstration, type **x** in the Cell(i,j)= text box.

Figure 2: Setting the Matrix Z Values



9) Click OK. Each cell in each column is filled with a number equal to the X value of its column.

Figure 3: Filling Each Column with its X Value (full matrix not shown)



10) Re-select **Matrix:Set Values** and this time type **y** (replacing x) in the Cell(i,j)= text box.

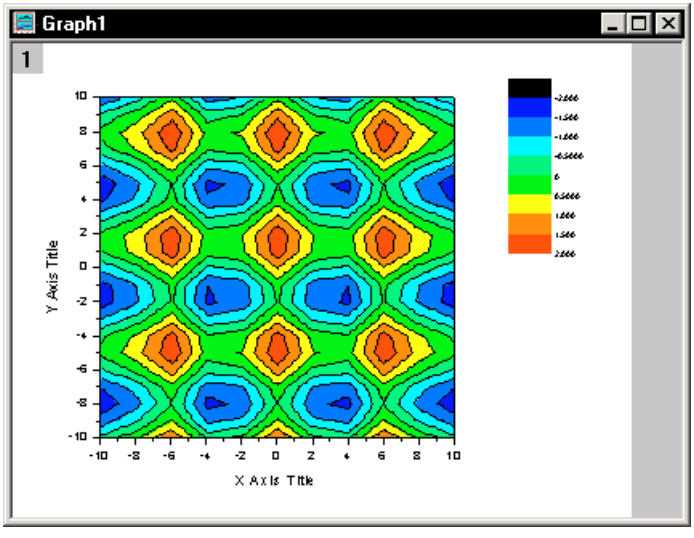
11) Click OK. Each cell in each row is filled with a number equal to the Y value of its row.

12) Re-select **Matrix:Set Values** and type the equation **cos(x)+sin(y)** in the Cell(i,j)= text box.

13) Click OK.

14) Select **Plot:Contour Plot:Contour-Color Fill** to create a contour graph of the matrix data. Note the X and Y scales (-10 to 10) on the resulting graph.

Figure 4: Creating a Contour Graph of the Matrix Data



Converting a Worksheet to a Matrix

In this section you will learn how to change a worksheet column's designation, then convert an XYZ worksheet to a matrix so that it can be plotted as a 3D surface graph.

The data for this lesson is provided in an ASCII file.

To Import the ASCII File:

1) Click New Project on the Standard toolbar.

2) Click Import ASCII on the Standard toolbar.

3) In the Origin \TUTORIAL folder, select TUTORIAL_5.DAT from the list of files.

4) Click Open.

Figure 5: Importing the ASCII File

TUTORIAL5

	A(X)	B(Y)	C(Y)
1	2.5536	43.65282	1.506E-6
2	5.1072	18.96488	2.655E-6
3	7.6608	-0.50993	2.705E-6
4	10.2144	-17.29591	4.291E-7
5	12.768	-40.6861	3.155E-7
6	15.3216	36.13428	1.927E-6
7	17.8752	16.20608	5.202E-6
8	20.4288	-4.96125	2.614E-6
9	22.9824	-22.80867	8.96E-7
10	25.536	-38.39416	5.74E-7

By default, when the file is imported columns are added to the worksheet as Y columns. To convert the worksheet to a matrix it must be in an XYZ format.

To Change the Column Designation:

1) Right-click on the C(Y) column heading.

2) Select **Set As:Z** from the shortcut menu. Column C is now designated as a Z column.

Selecting the Type of Conversion

Origin provides several methods for converting worksheets to matrices, including direct, expand columns, 2D binning, regular XYZ and random XYZ conversions. The method that you use will depend on the type of data in the worksheet.

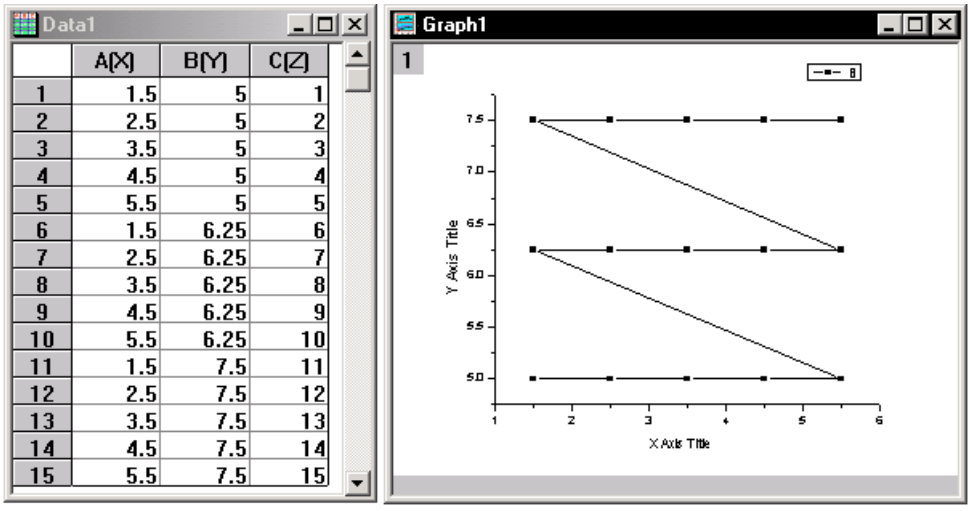
=> **Direct Conversion**: A common format for XYZ worksheet data is to have X data values in the left-most column, Y data values in the first row, and Z values in columns 2 to *N* and rows 2 to *M*. If your worksheet data is organized this way, you can use Direct Conversion. However, because matrices map X coordinates to columns and Y coordinates to rows, this worksheet setup requires that the worksheet be transposed before converting. To do this, select **Edit:Transpose**. You must then delete the first column and the first row. After you select the Direct Conversion method, Origin creates a new matrix that contains the same number of rows and columns as the worksheet. Origin fills the matrix with the worksheet values, maintaining the same row and column positions in the matrix. You can then set the matrix X and Y mapping relationship.

=> **Expand Columns**: There may be cases where a screen editor which is used to create an ASCII file has an upper limit for the number of characters allowed on a single line. This upper limit may even be less than the number of columns required in the matrix. To compensate for this, one row of matrix data can be stored in multiple rows of an ASCII file. After this type of data is imported in a worksheet, the Expand Columns method will copy the number of worksheet rows that you specify into the first row of a matrix. Origin repeats this procedure to convert all rows in the worksheet.

=> **2D Binning**: This method bins the XY data (creates a frequency count of data points falling within a given XY range) and stores the bin counts as Z values in a matrix.

=> **Regular XYZ**: In order for XYZ worksheet data to be classified as Regular, the XY data must meet the following requirements. Each X value must have the same number of Y values and each Y value must have the same number of X values. In addition, both the X and the Y data values must be equally spaced. To check for regularity, you can plot the XY data sets as a line and symbol graph.

Figure 6: Plotting Worksheet Data to Check Regularity



	A[X]	B[Y]	C[Z]
1	1.5	5	1
2	2.5	5	2
3	3.5	5	3
4	4.5	5	4
5	5.5	5	5
6	1.5	6.25	6
7	2.5	6.25	7
8	3.5	6.25	8
9	4.5	6.25	9
10	5.5	6.25	10
11	1.5	7.5	11
12	2.5	7.5	12
13	3.5	7.5	13
14	4.5	7.5	14
15	5.5	7.5	15

=> **Sparse XYZ**: This method converts "regular" XYZ data to a matrix by assuming missing values for missing X,Y data pairs.

=> **Random XYZ**: If your worksheet data does not fall into any of the previously mentioned types, then it can be classified as random data. The procedure for converting random XYZ data to a matrix is called gridding. Origin offers a number of gridding methods, including the method of Renka and Cline and a modification of Shepard's method. Both these methods are provided by the NAG® C Library eo1 Interpolation.

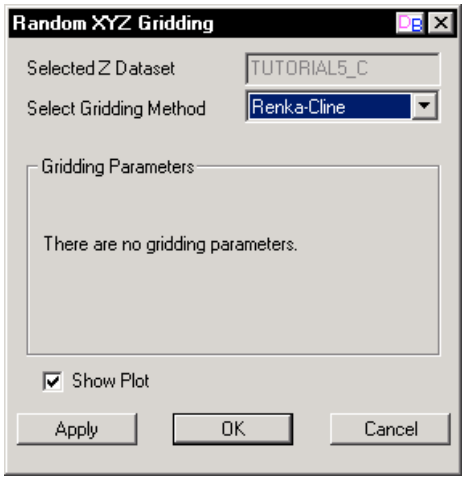
The data in this lesson is an XYZ worksheet with un-ordered XY data. Thus, random gridding will be used to convert the data to a matrix.

To Convert the Worksheet to a Matrix:

1) If it is not still selected, click on the C(Z) column heading to select the column.

2) Select **Edit:Convert to Matrix:Random XYZ**. This opens the Random XYZ Gridding dialog box.

Figure 7: The Random XYZ Gridding Dialog Box

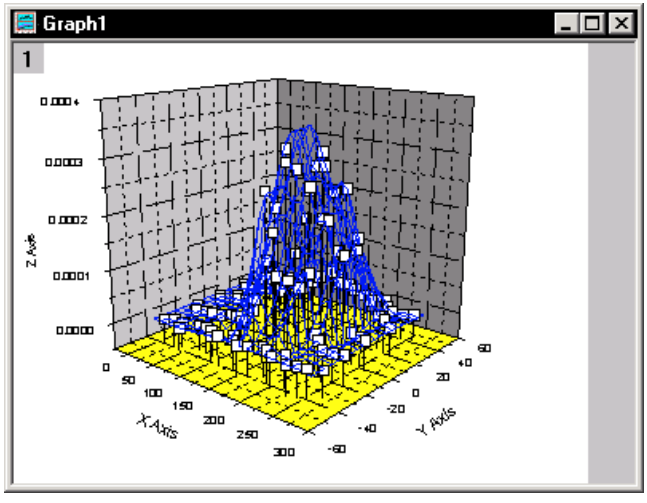


3) Select Renka-Cline from the Select Gridding Method drop-down list if it is not already selected.

4) Select the Show Plot button if it is not already selected.

5) Click Apply. A graph is created that shows the raw data as an XYZ scatter plot and the grid as a mesh plot.

Figure 8: Gridding Using the Renka-Cline Method



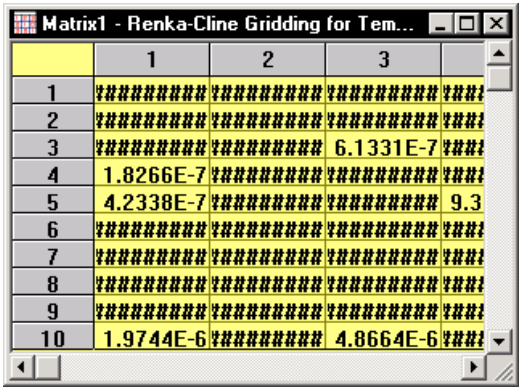
By changing the gridding method and re-clicking Apply, you can compare the graph output for the various methods and then choose the

method which produces a surface that best includes the points. For this data, the Renka-Cline method is the best choice.

6) Click OK to close the dialog box.

7) Activate the matrix window for the Renka-Cline gridding. (Note that if Origin cannot display an entire cell value, it displays # characters in the cell.)

Figure 9: The Matrix Containing the Gridding Results



Creating a 3D Surface Graph

Now that you have your data in a matrix you can create any type of contour or 3D surface graph. For this tutorial you will create a 3D color mapped surface graph.

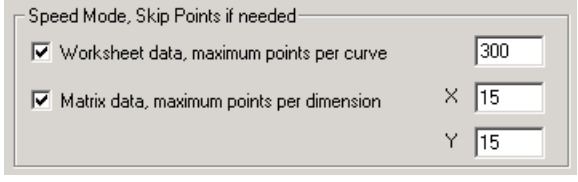
To Create a 3D Color Mapped Surface Graph:

1) With the matrix active, select **Plot:3D Color Map Surface**. A Reminder Message opens informing you that the graph will be displayed using Speed Mode.

Figure 10: A Reminder Message about Speed Mode

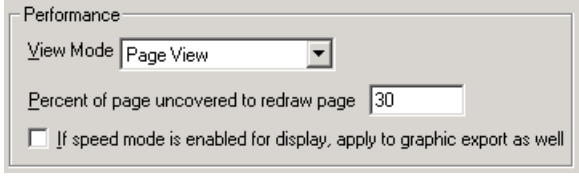
Speed Mode increases the redraw speed of your graph by displaying a reduced number of data points. You can control the Speed Mode setting by selecting **Format:Layer** to open the layer's Plot Details dialog box. Then select the Size Speed tab and edit the Speed Mode, Skip Points if Needed group.

Figure 11: Setting Speed Mode to Increase the Graph Redraw Speed



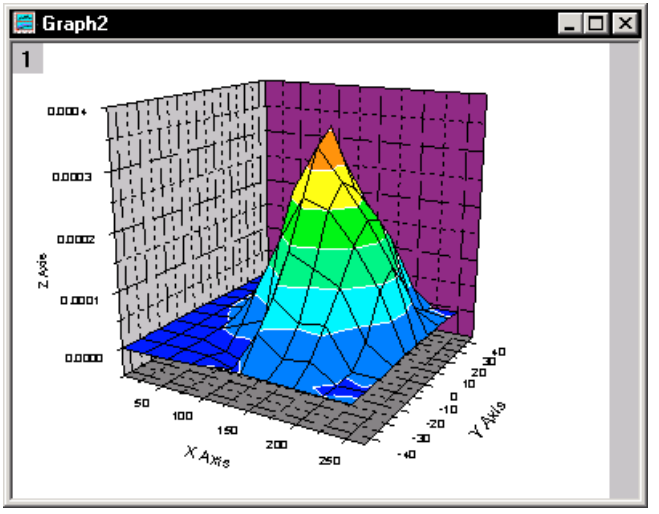
This Speed Mode setting only effects the view of the graph in Origin. When you copy, export, or print your graph, all the data points will be included. To use Speed Mode when you export or copy your graph, select **Format:Page** to open the page's Plot Details dialog box. Then select the Miscellaneous tab and edit the Performance group.

Figure 12: Setting Speed Mode for Exporting or Copying a Graph



2) Click OK to close the Reminder Message. The matrix data is plotted as a color map surface graph. The different colors represent different Z-value ranges.

Figure 13: Color Map Surface Graph



Customizing the Graph

Origin gives you full control over the color mapping applied to the surface data plot. All the options for customizing the color map are located on the Color Map tab of the Plot Details dialog box.

Changing the Color Map Values

The Color Map tab on the Plot Details dialog box displays the current color map associated with levels of Z values. To edit an individual level or color, click on the value or color in the Level or Fill column. To edit the entire range of levels or colors, click on the Level or Fill column heading. To edit a range of levels, SHIFT + click on the desired values to select a range, then click on the Level or Fill column heading.

To Change the Number of Levels in the Color Map:

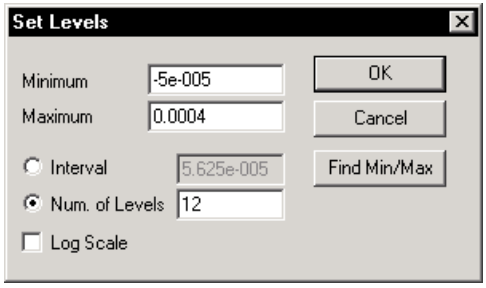
1) Right-click on the surface plot.

2) Select **Plot Details** from the shortcut menu.

3) Click on the Level column heading to open the Set Levels dialog box.

4) Select the Num. of Levels radio button, then type **12** in the associated text box.

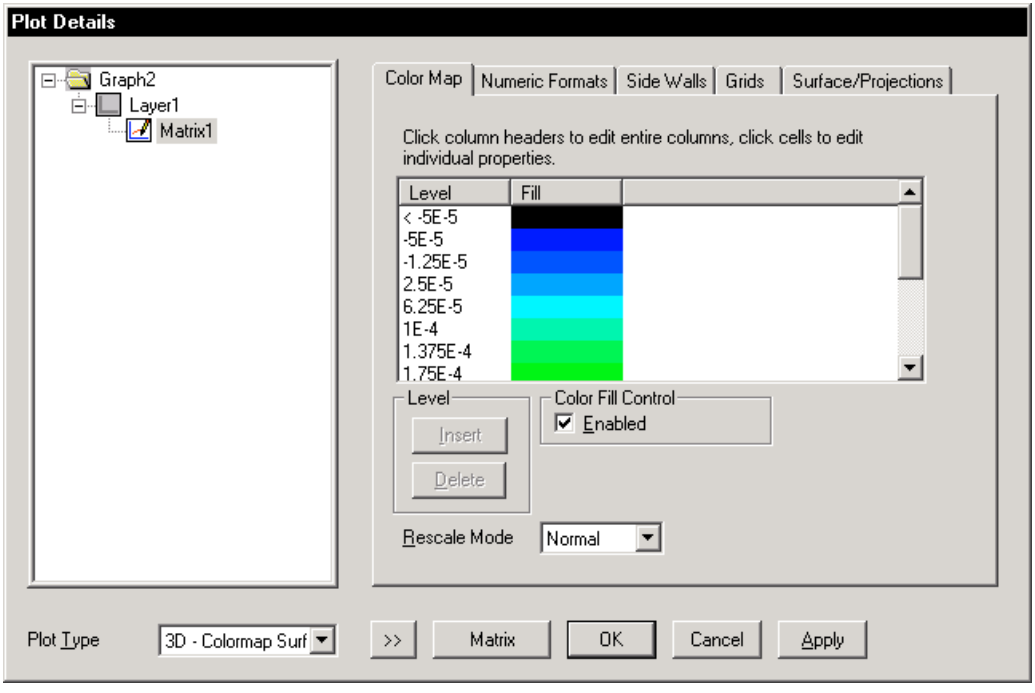
Figure 14: The Set Levels Dialog Box



5) Click OK.

The Color Map tab updates to show twelve levels (plus levels for values above and below the maximum and minimum levels) and associated colors in the list box.

Figure 15: Updated Color Map Tab

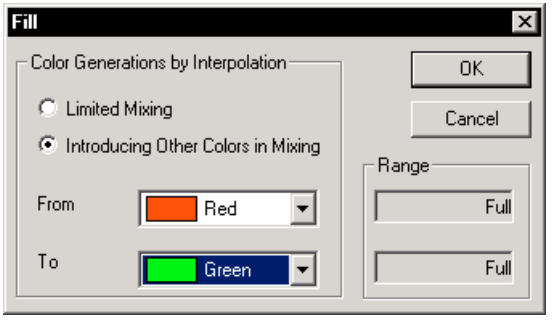


Changing the Color Map Colors

Customizing the Fill Color Range:

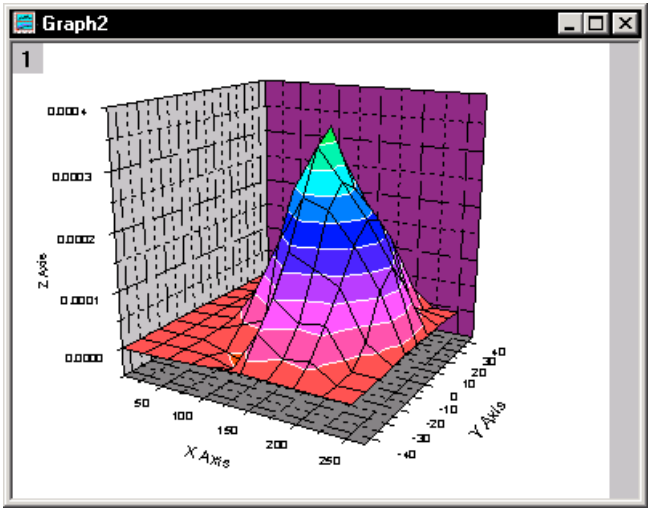
1) Click on the Fill column heading to open the Fill dialog box.
2) Select Red from the From drop-down list.
3) Select Green from the To drop-down list.

Figure 16: Editing the Fill Dialog Box



4) Click OK.
5) Click OK in the Plot Details dialog box.

Figure 17: The Customized Surface Graph



In addition to editing color ranges, you can edit individual colors. This is especially useful if you have an important section of your data that you want to highlight or make transparent.

To Edit an Individual Color:

1) Right-click on the surface plot.
2) Select **Plot Details** from the shortcut menu.
3) On the Color Map tab, click on the color associated with 1.75E -4.

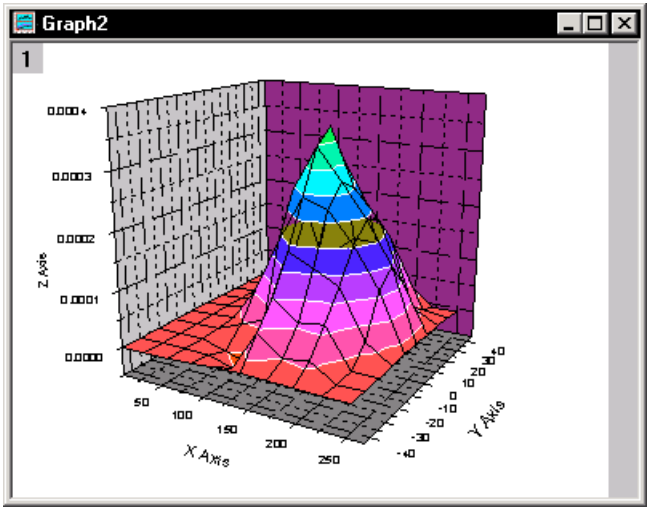
The Fill dialog box opens.

Figure 18: Selecting an Individual Color to Edit

4) Select None from the Fill Color drop-down list, then click OK.
5) Click OK in the Plot Details dialog box.

The data plot redraws showing the transparent level.

Figure 19: Editing an Individual Color



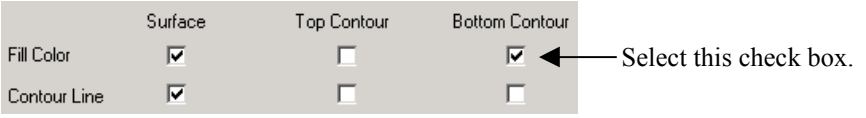
Adding Contours to the Color Map Surface Graph

To further enhance your graph, you can display contour lines and colors on the top or bottom plane of your surface graph. This is done on the Surface / Projections tab of the Plot Details dialog box.

To Add Contour Colors to the Bottom Plane of the Surface Graph:

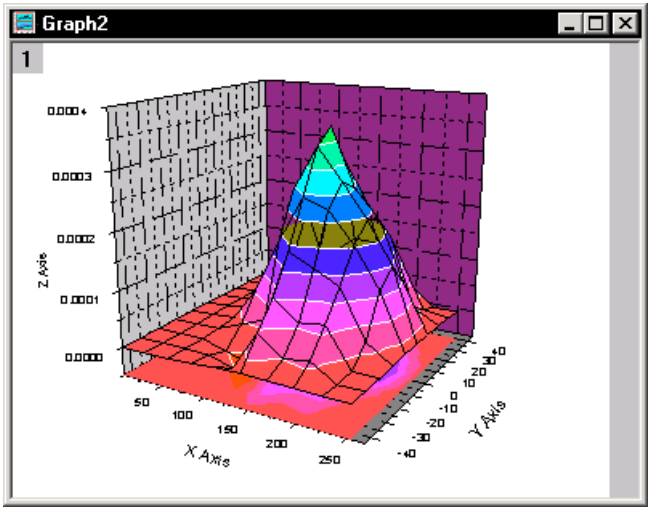
1) Right-click on the surface graph.
2) Select **Plot Details** from the shortcut menu.
3) Select the Surface / Projections tab.
4) Select the Fill Color check box under the Bottom Contour text.

Figure 20: The Surface / Projections Tab



5) Click OK.

Figure 21: Displaying Bottom Contour Colors

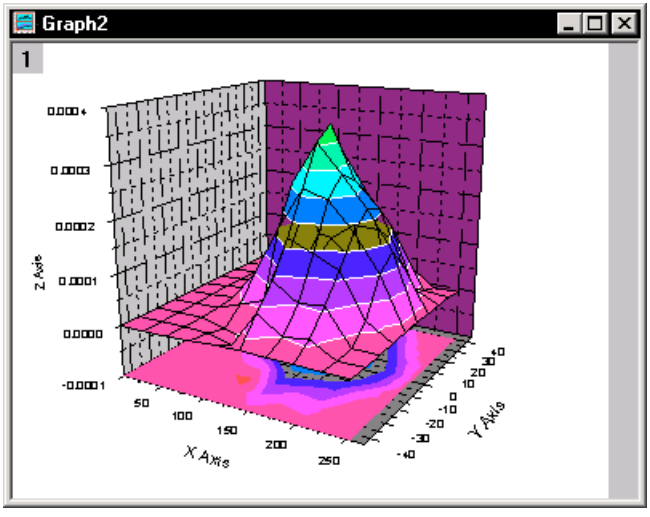


With the current Z axis scale range and the current view angle, the surface plot substantially overlaps the bottom contour, blocking it from view. To make more of the contour visible, you can change the Z axis scale to begin from a lower value.

To Change the Z Axis Scale:

1) Select **Format:Axes:Z Axis** to open the Z Axis dialog box.
2) In the From text box, type **-1E-4**.
3) Click OK.

Figure 22: Changing the Z Axis Scale



The Z axis now displays a greater range below the surface graph. This decreases the amount of overlap of the surface plot and the contour, providing for a better visual presentation.

Changing the Perspective of the Graph

When you create a 3D graph, the 3D Rotation toolbar automatically opens. This toolbar contains buttons for controlling the perspective of the 3D graph. By rotating the graph you can further reduce the overlap of the surface plot with the contour, providing better perspective for viewing the graph.

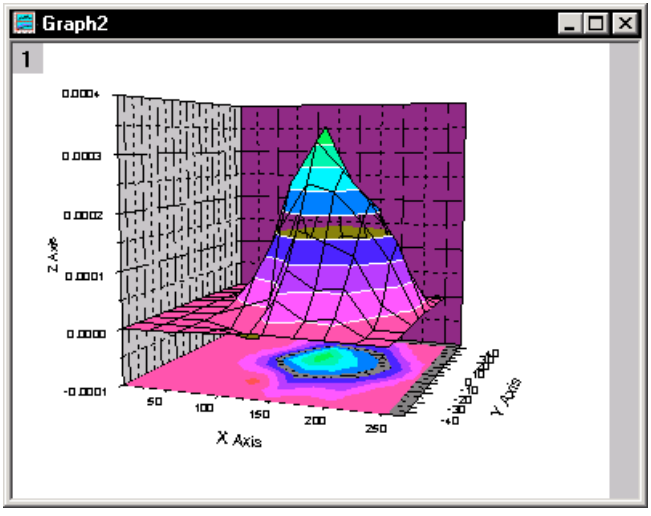
Figure 23: The 3D Rotation Toolbar

To Rotate the Graph:

1) Click Tilt Up on the 3D Rotation toolbar.

2) Click Rotate Counterclockwise on the 3D Rotation toolbar.

Figure 24: Rotating the Graph



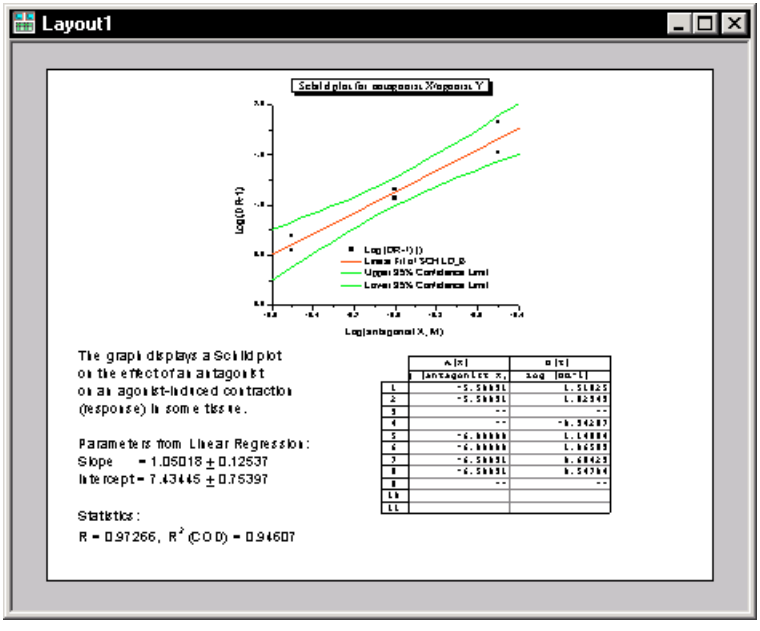
This new perspective eliminates the overlap between the surface plot and the contour, and provides better visibility of the transparent section of the surface plot.

Tutorial 6, Creating Presentations with the Layout Page

Introduction

Origin provides a layout page for displaying and arranging pictures of worksheets and graphs from other windows in your project, as well as text and other annotations.

Figure 1: Example Layout Page with Added Pictures and Text



Adding Graphs, Worksheets and Text to the Layout Page

Pictures of graphs and worksheets are added to the layout page by clicking the buttons on the Layout toolbar, or by selecting associated menu commands. Text can be added with the Text tool, or by pasting from the Clipboard. Shapes, lines, and arrows can be added using the drawing tools from the Tools toolbar.

Opening the Project File

The data for this tutorial lesson is provided in an Origin project file.

To Open the Project File:

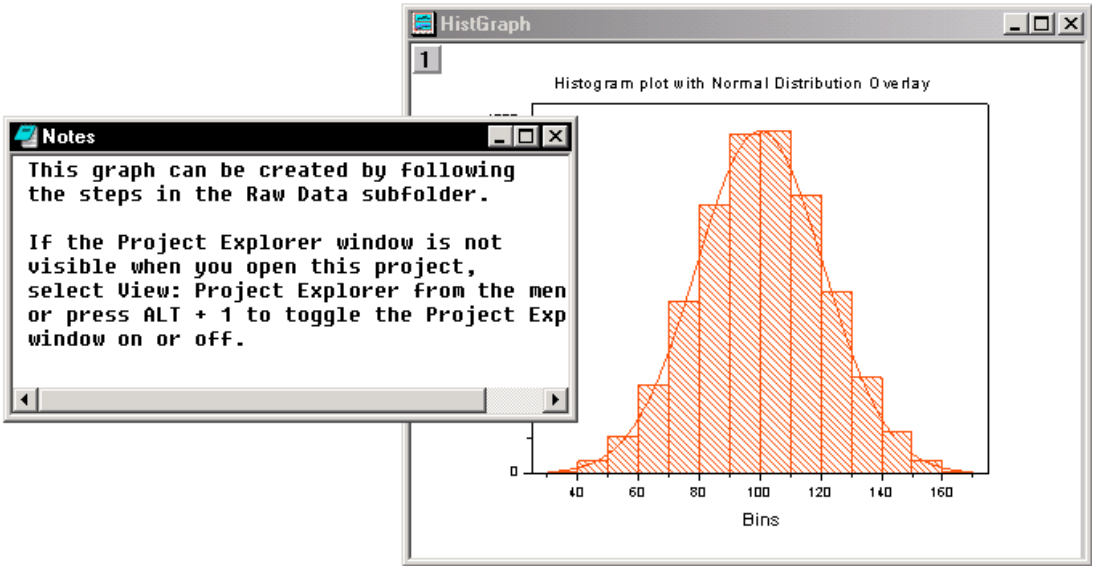
1) Click Open  on the Standard toolbar.

2) In the Origin \SAMPLES\GRAPHING\STATISTICAL GRAPHS folder, select HISTOGRAM.OPJ from the list of files.

3) Click Open.

A project opens displaying a notes window and a histogram in a graph window. Other windows are available in the current Project Explorer folder and in other folders.

Figure 2: The Histogram Project File

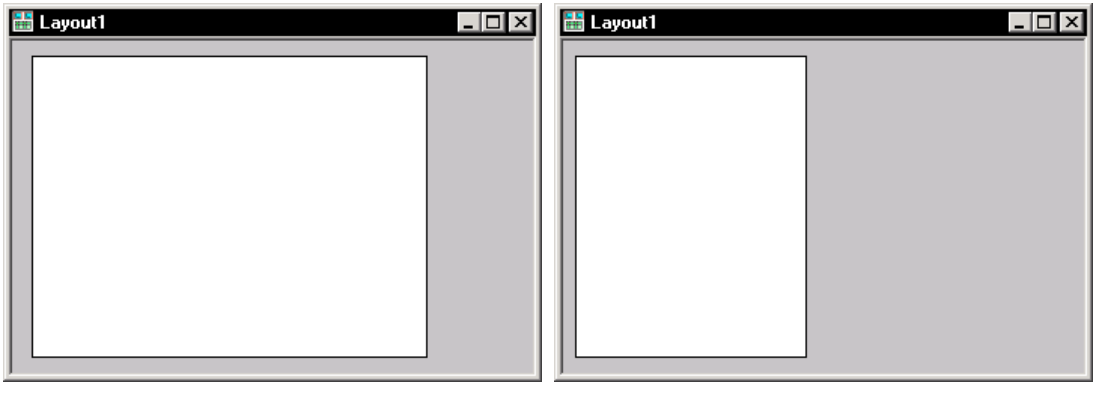


Creating a New Layout Page

To Create a New Layout Page:

1) Click New Layout  on the Standard toolbar. A blank layout page opens.

Figure 3: New Layout Page in Landscape vs. Portrait Orientation



2) If the layout page is displayed in the landscape orientation, right-click on the gray area of the layout page, then select **Rotate Page** from the shortcut menu that opens. The layout page should now display in portrait orientation.

3) Resize the layout page window if needed.

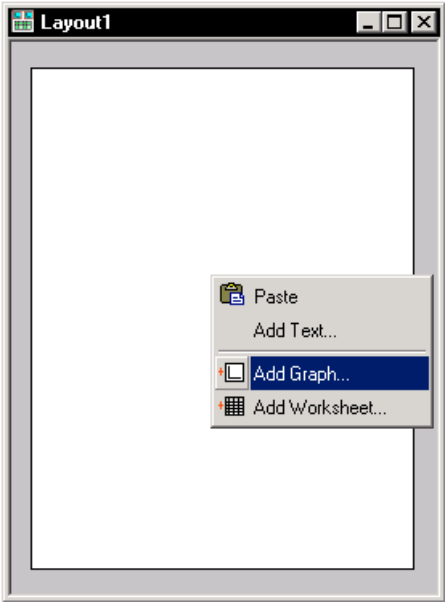
Adding Pictures and Text to a Layout Page

You can add pictures of worksheets and graphs that are currently in your project to a layout page. After you add a picture, if you want to change the details of the picture (for example, changing a line data plot to a scatter data plot), you must make the changes in the source window. After you do this, the picture in the layout page will update to reflect your changes.

To Add Pictures of Graphs and Worksheets to the Layout Page:

1) Right-click in the layout page and select **Add Graph** from the shortcut menu.

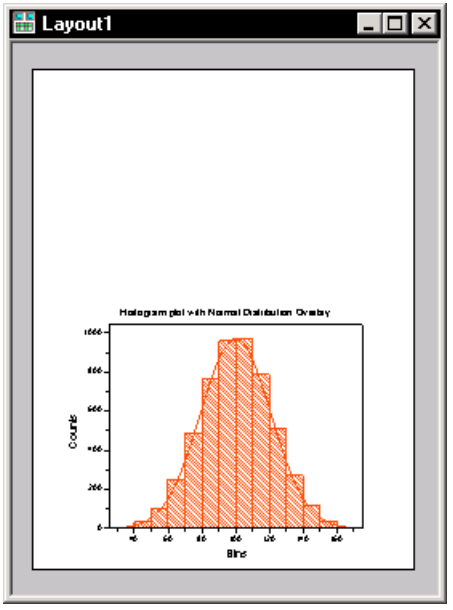
Figure 4: Adding a Graph Picture to the Layout Page



2) Select HistGraph from list box in the Select Graph Object dialog box and click OK.

3) Drag out a box on the bottom half of the layout page. After you release the mouse button, a picture of the HistGraph graph displays in the layout page.

Figure 5: Adding a Graph Picture to the Layout Page



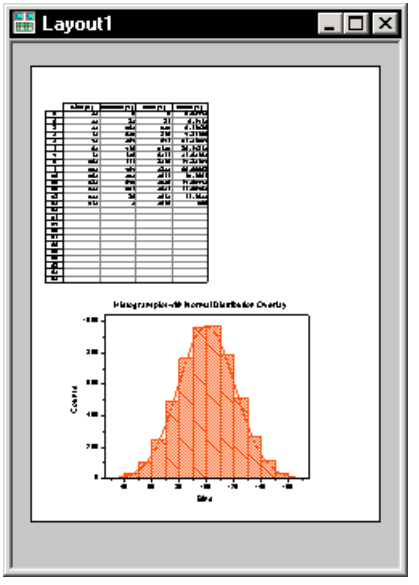
When the graph picture is selected, you can drag the picture to a new location or use the sizing handles to resize it.

4) Right-click on a blank section of the layout page and select **Add Worksheet** from the shortcut menu.

5) Select Bin1 from the list box in the Select Worksheet Object dialog box and click OK.

6) Drag out a box in the top half of the layout page, leaving some space at the top for a title.

Figure 6: Adding a Worksheet Picture to the Layout Page



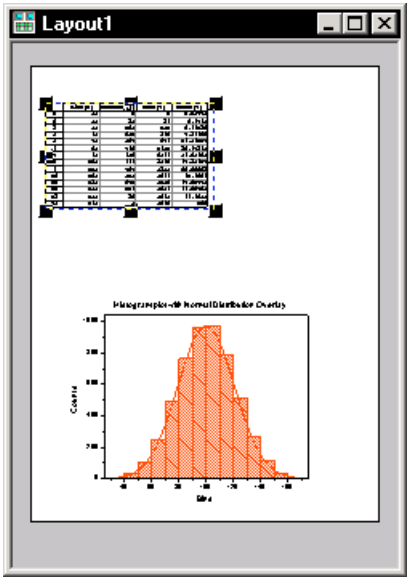
After you add the worksheet picture to the layout page, it may display a blank area to the right of the last worksheet column, and it may include a number of blank worksheet rows. To remove these blanks areas in the picture, you can disable the "keep aspect ratio" setting and resize the picture as desired.

7) Right-click on the worksheet picture in the layout page and select **Keep Aspect Ratio** from the shortcut menu. This de-selects the command.

8) Drag one of the control handles on the right edge of the worksheet picture so that only the four worksheet columns display.

9) Drag one of the control handles on the bottom edge of the worksheet picture so that only the worksheet rows with values display.

Figure 7: Resizing the Worksheet Picture



10) Re-position the worksheet picture in the layout page.

11) Click off the worksheet picture (but in the layout page) to de-select the picture.

To Add Text to the Layout Page using the Text Tool:

1) Click Text Tool  on the Tools toolbar.

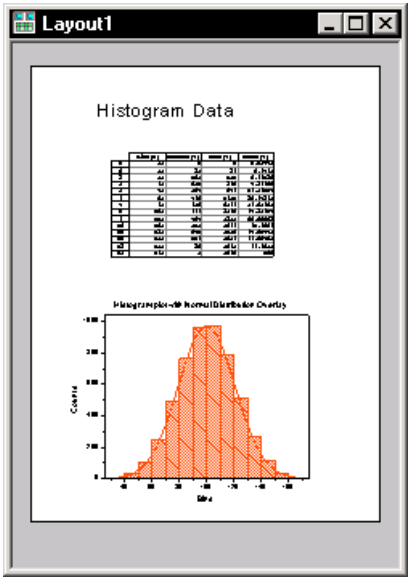
2) Click above the worksheet picture in the layout page.

3) Before you start typing, select 36 from the Style combo box 

4) Then type **Histogram Data**.

5) Click off the label to exit the editing mode.

Figure 8: Adding Text to the Layout Page



Customizing the Appearance of the Layout Page

In this section, you will fine tune the position of the pictures displayed in the layout page. In addition, you will make changes to the source graph window to change the picture's appearance in the layout page.

Arranging Pictures on the Layout Page

There are several ways to arrange pictures on the layout page. You can drag the pictures and estimate the position, use the Object Edit toolbar, or view the grid (**View:Show Grid**) on the layout page and align the pictures using the grid lines as a guide.

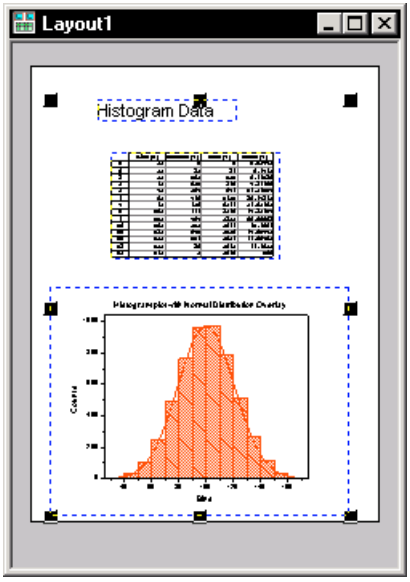
To Arrange the Pictures on the Layout Page Using the Object Edit Tools:

1) If the Object Edit toolbar is not currently open, select **View:Toolbars**, select the Object Edit check box on the Toolbars tab, then click Close.

2) Click on the Histogram Data text label to select it.

3) Press SHIFT and click on the worksheet picture and then on the graph picture (in that order). All three objects are now selected in the layout page.

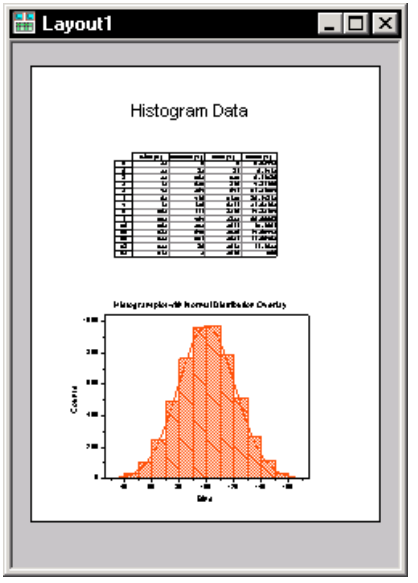
Figure 9: Selecting the Objects in the Layout Page



4) Click the Vertical button  on the Object Edit Toolbar. The pictures align vertically using the last selected picture (the graph).

5) Click in the layout page but off the pictures to de-select them.

Figure 10: Arranging the Objects on the Layout Page



Editing the Pictures in the Layout Page

Although you cannot edit the worksheets and graphs in the layout page directly, Origin provides a shortcut menu command to go to the source window.

To Edit a Source Window from the Layout Page:

1) Right-click on the graph picture in the layout page.

2) Select **Go To Window** from the shortcut menu. Origin makes the HistGraph window active.

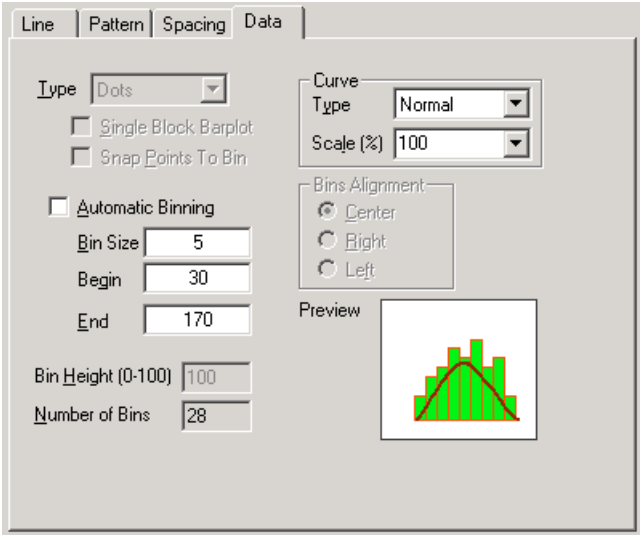
3) Right-click on the histogram and select **Plot Details** from the shortcut menu.

4) Select the Data tab.

5) Clear the Automatic Binning check box.

6) Type **5** in the Bin Size combo box.

Figure 11: Modifying the Number of Bins



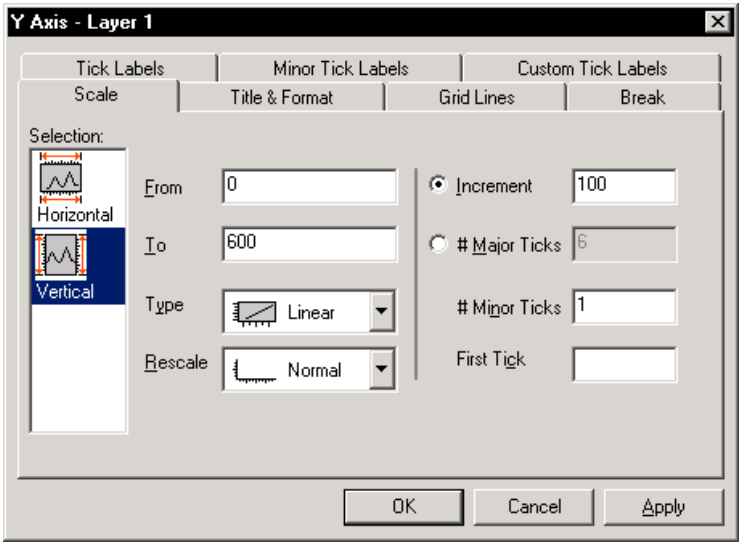
7) Click OK.

8) Double-click on the Y axis in the HistGraph window. This opens the Y Axis dialog box.

9) Select the Scale tab if it is not currently selected.

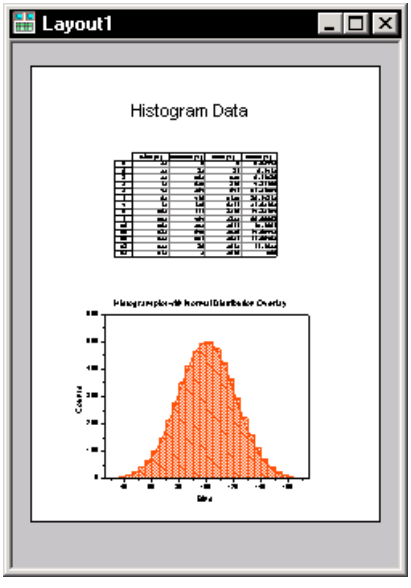
10) Type **600** in the To text box and **100** in the Increment text box.

Figure 12: Modifying the Axis Scale



11) Click OK.
12) Activate the layout page window.
13) Click the Refresh button on the Standard toolbar.

Figure 13: Updating the Layout Page

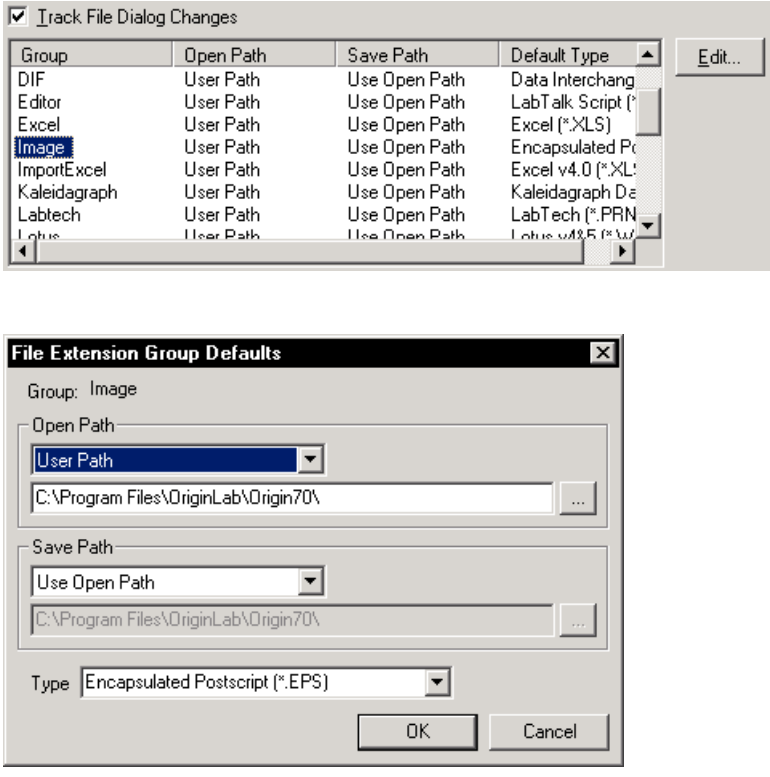


Exporting the Layout Page

In addition to customizing your layout page presentation in Origin, you can export the layout page into other applications. Origin provides a number of raster and vector graphic export filters. In addition, you can copy the layout page to the Clipboard and paste it into other applications.

When exporting a layout page or graph to a file, Origin tracks the previous save location and displays that folder by default in the Save As dialog box. To modify this behavior, select **Tools:Options** to open the Options dialog box. Then select the File Locations tab. Select Image from the top list box and then click the Edit button.

Figure 14: Customizing the Default File Save Folder

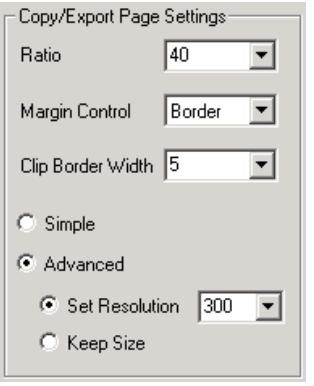


To store your image file in the same location as the open Origin project file, select Project Path from the Save Path drop-down list. (Note that you can also select the default image type that will display in the Save As dialog box.) Click OK in this dialog box and in the Options dialog box. To save the settings for the next Origin session, click Yes at the Attention prompt.

This discussion also applies to graph windows.

When you copy to the Clipboard and when you export to a vector image format (Adobe Illustrator (AI), Computer Graphics Metafile (CGM), AutoCAD Drawing Interchange (DXF), Encapsulated PostScript (EPS), Enhanced Metafile (EMF), Macintosh PICT (PCT), Portable Document Format (PDF), and Windows Metafile (WMF)), Origin uses settings in the Options dialog box (**Tools:Options**) to determine the size of the picture when pasted or inserted into another application. These settings are located on the Page tab.

Figure 15: Default Copy Page and Export Settings



The Ratio combo box controls the size of the picture when pasted or inserted into another application. The units are as a percentage of the page size in Origin. Thus, if you want the inserted picture to be 25% of the page size in Origin, set this combo box to 25. (To set the layout page size in Origin, select **Format:Layout Page** to open the Plot Details dialog box. Then edit the Print Dimensions tab.)

The Margin Control drop-down list controls the amount of the page that is copied or exported. The options are Border, Tight, and Page. The Border and Tight options use a bounding box to control the amount of page that is included. The bounding box is determined by the smallest rectangular box required to completely encompass all objects on the page.

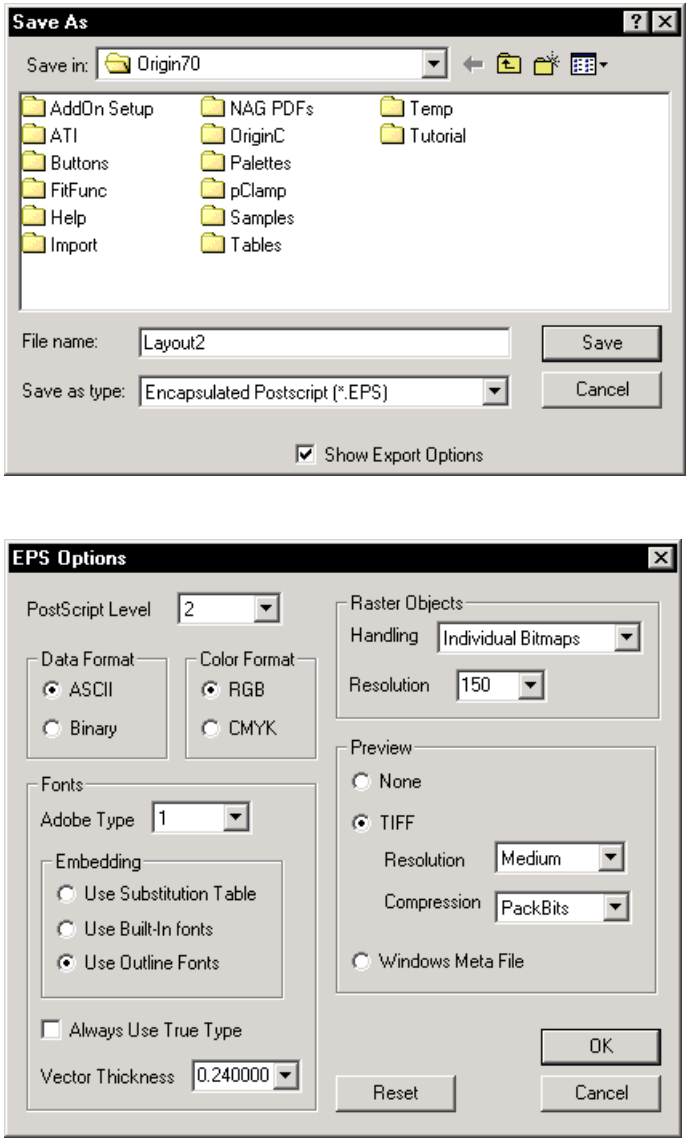
=> Select Border to copy or export the page within the bounding box *plus* add the border that is specified in the Clip Border Width combo box. The Clip Border Width value is a percentage of the width of the bounding box.

=> Select Tight to copy or export the page within the bounding box.

=> Select Page to copy or export the entire page.

The Options dialog box picture size settings are global preferences. Your custom settings will be used for the current Origin session and for future sessions (if you "Save as Origin's Startup Options"). In addition, both the vector and raster export image formats provide format-specific export options. These options are accessible by selecting the Show Export Options check box in the Save As dialog box (**File:Export Page**).

Figure 16: Accessing the Export Options



If you change these image export settings, Origin will remember and use the settings the next time you export using the same format. Thus, you can clear the Show Export Options check box once you have established settings appropriate to your needs.

To Export the Layout Page as an Encapsulated PostScript File:

1) Select **File:Export Page**.

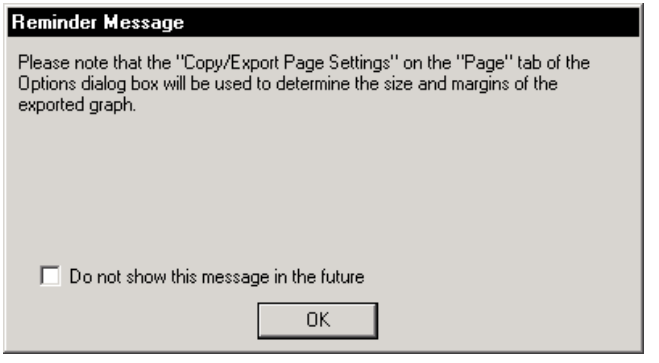
2) Type **Presentation1** in the File Name text box.

3) Select Encapsulated PostScript (*.EPS) from the Save As Type drop-down list.

4) Select the Show Export Options check box.

5) Click Save. A Reminder Message informs you that the settings from the Options dialog box (**Tools:Options**) will be used to determine the picture size.

Figure 17: Reminder Message when Exporting a Vector Format



6) Click OK. The EPS Options dialog box opens.

7) In the Preview group, select the TIFF radio button if it is not currently selected. (See Figure 16.)

8) Click OK.

The layout page is exported as an EPS file and can be inserted into any application that recognizes this file type.

Tutorial 7, Working with Excel in Origin

Introduction

You can open Excel workbooks directly in Origin, provided you have Excel 7 or later installed on your computer. This allows you to combine Excel's spreadsheet tools with Origin's powerful graphing and analysis tools. This tutorial will show you how to open Excel workbooks in Origin, plot using Origin graph templates, and then save workbooks from within Origin.

Opening an Excel Workbook in Origin

Note: To perform this tutorial, you must have Excel version 7 or later installed on your computer either as a local or network copy.

To Open an Existing Excel Workbook:

1) Click New Project  on the Standard toolbar.

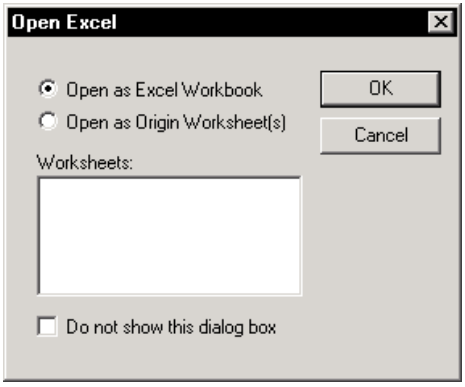
2) Click Open Excel  on the Standard toolbar.

3) In the Origin \TUTORIAL folder, select TUTORIAL_7.XLS from the list of files.

4) Click Open.

The Open Excel dialog box opens. This dialog box allows you to open your Excel workbook as a workbook in Origin, or as an Origin worksheet. To use Excel's spreadsheet tools in Origin, you must open as a workbook.

Figure 1: The Open Excel Dialog Box



5) If it is not already selected, select the Open As Excel Workbook radio button.

6) Click OK.

The workbook opens in the Origin workspace. In addition, a combination of Origin and Excel menus and toolbars are now displayed in the workspace.

Figure 2: Opening an Excel Workbook in Origin

Book1 - C:\Program Files\OriginLab\Origin70\Tutorial\Tutorial_7.xls

	A	B	C	D	E	F
1	Year	Domestic crude oil production (million barrels/day)	Crude oil imports (million barrels/day)	Petroleum products imports (million barrels/day)	Total imports (million barrels/day)	Crude oil exports (million barrels/day)
2	1973	9.21	3.24	2.78	6.03	0.00
3	1974	8.77	3.47	2.42	5.89	0.00
4	1975	8.37	4.10	1.75	5.85	0.00
5	1976	8.13	5.28	1.81	7.09	0.00
6	1977	8.25	6.57	2.00	8.57	0.05
7	1978	8.71	6.20	1.80	8.00	0.16

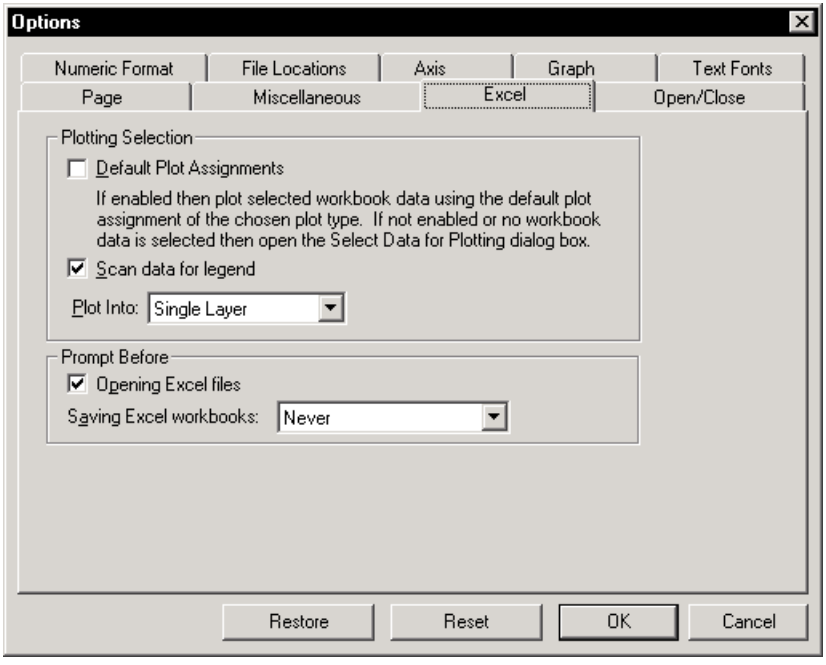
Sheet1 Sheet2 Sheet3

Plotting an Excel Workbook in Origin

Plotting Excel workbook data in Origin is very similar to plotting Origin worksheet data. If a graph window is already open, you can drag data from a workbook into the graph window. You can also create a new graph from your workbook data by activating your workbook and clicking a button on one of the plotting toolbars or by selecting a graph type from the **Plot** menu. An intermediary Select Data for Plotting dialog box will open for you to assign data sets. After you get familiar with Origin's graph templates, you can disable this dialog box and make your data set selections directly in the workbook.

By default, the Select Data for Plotting dialog box will always open when an Excel workbook is active and you then click a plotting button or select a plotting menu command. This dialog box opening behavior is controlled from the Options dialog box. To open the Options dialog box when a workbook is active, select **Window:Origin Options**. When any other window type is active, select **Tools:Options**. Then select the Excel tab.

Figure 3: The Excel Tab of the Options Dialog Box



The Default Plot Assignments check box determines whether or not the Select Data for Plotting dialog box will open.

=> When this check box is cleared (default), the Select Data for Plotting dialog box will always open for selecting data sets.

=> When this check box is selected, the Select Data for Plotting dialog box will only open if you did not select any workbook data. Otherwise, Origin will plot your selected data into a new graph window.

Creating a Graph Using the Select Data for Plotting Dialog Box

The Select Data for Plotting dialog box lets you select data and then assign plotting designations.

To Create a Graph Using the Select Data for Plotting Dialog Box:

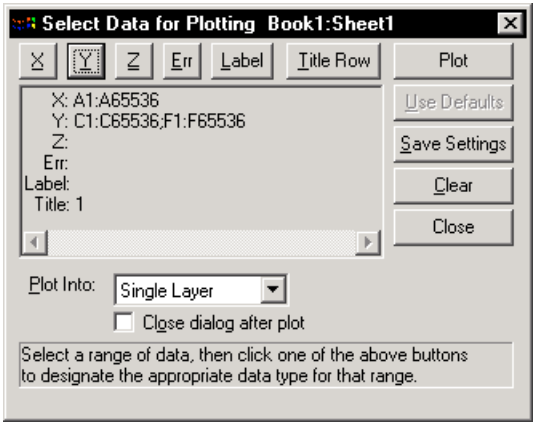
1) Click Column on the 2D Graphs toolbar. This opens the Select Data for Plotting dialog box.

2) Reposition the dialog box so that you can see the column headings in the Excel workbook.

3) Click the column A heading in the workbook, then click X in the Select Data for Plotting dialog box.

4) Click the column C heading, then CTRL+click the column F heading and then click Y in the Select Data for Plotting dialog box.

Figure 4: The Select Data for Plotting Dialog Box

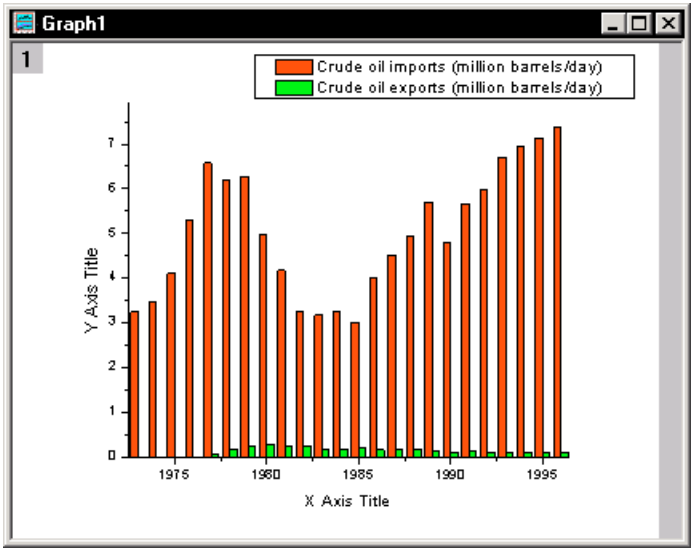


The box below the buttons shows the data ranges representing the data types. X:A1:A65536 means that the X data is being represented by

column A rows 1 to 65536. The last row number of the column is shown because you selected the whole column.

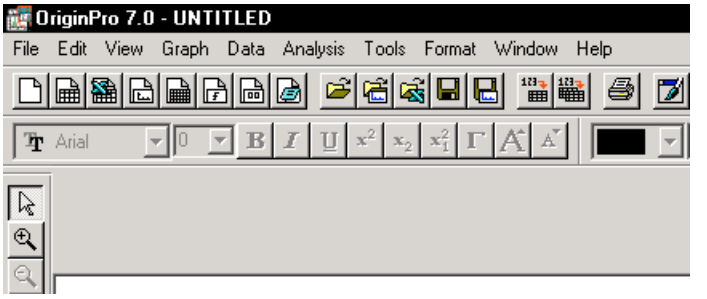
5) Click Plot in the Select Data for Plotting dialog box, then click Close.
6) Reposition the legend so that the entire legend is on the graph page.

Figure 5: Plotting Excel Data Using the Select Data for Plotting Dialog Box



When the graph window is active, you may notice a blank gray area in the toolbar region. This is called a toolbar spacer. The toolbar spacer is reserving space for the Excel toolbars, which will display when you re-activate the Excel workbook. If desired, you can hide the toolbar spacer by right-clicking in the spacer and selecting **Hide Toolbar Spacer** from the shortcut menu. When you re-activate the workbook, Origin will automatically display the spacer with the Excel toolbars.

Figure 6: The Toolbar Spacer



Creating a Data Plot by Dragging Data Into a Graph

When you drag Excel workbook data into a graph, Origin makes assumptions about the plotting designations of the selected data.

=> If one column (or a range from one column) is highlighted, then this column supplies the Y values for the data plot. The data is plotted versus row number.

=> If more than one column (or a range from more than one column) is highlighted, the leftmost column supplies the X values. All other columns supply the Y values. The data is plotted versus the X values.

=> If more than one column (or range from more than one column) is highlighted and the CTRL key is depressed while dragging the data, then all the columns supply the Y values. The data is plotted versus row number.

To Create a Graph Using the Drag-and-Drop Method:

1) Click New Graph  on the Standard toolbar. Move the new Graph2 window to the lower-right corner of the workspace, so that when the workbook is active it won't completely overlap the new graph window.

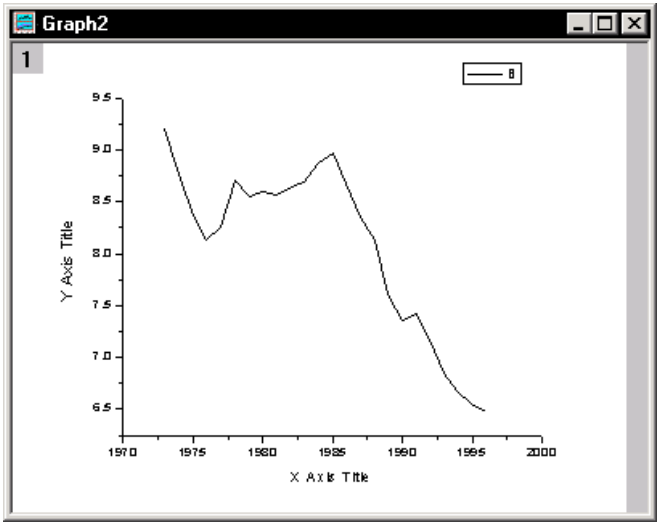
2) Select **Window:Book1** to activate the Excel workbook window.

3) Highlight the first two columns in the workbook.

4) Click on the right edge of the selected workbook data, then drag the data to the Graph2 window. When you release the mouse button, column B is plotted against column A as a line plot in the graph window.

5) Click on the graph window to make it the active window.

Figure 7: Dragging Data into a Graph Window



Creating a Graph Using Origin's Default Plot Assignments

For a complete discussion on this feature, see the Origin Help.

This plotting method allows you to select your workbook data and graph type, and then Origin creates the data plots by making assumptions about the plotting assignments of the selected data. This plotting method is not available by default. It must be activated from the Options dialog box.

To Create a Graph Using the Default Plot Assignments:

1) Select **Tools:Options** to open the Options dialog box. (If the workbook is active, then select **Window:Origin Options**.)

2) On the Excel tab, select the Default Plot Assignments check box.

3) Click OK, then click No in the dialog box that opens.

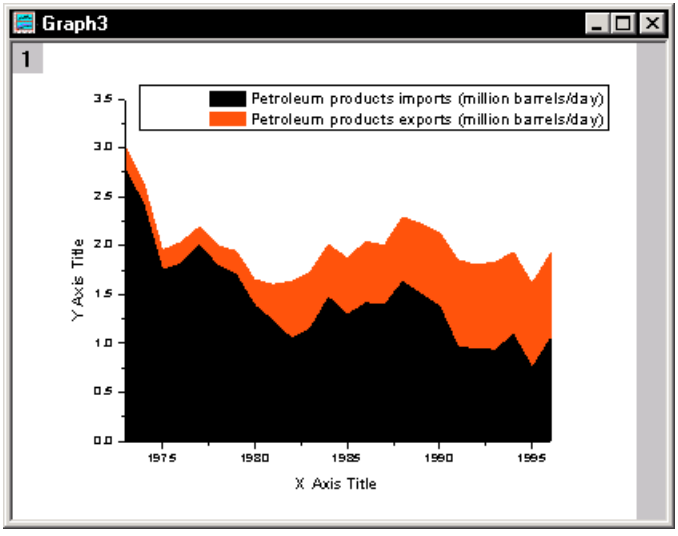
4) Make the Excel workbook active.

5) Click on the column A heading, then CTRL+click on the column D and G headings.

6) Click Area  on the 2D Graphs toolbar.

7) Reposition the legend so that the entire legend is on the graph page.

Figure 8: Plotting Excel Data Using the Default Plot Assignments



Saving an Excel Workbook in Origin

There are two ways to save Excel workbooks in Origin projects. You can save the workbook internal or external to the Origin project. When you save a workbook internal to the project, it is saved as part of the Origin project and can only be opened by opening the project. When you save a workbook external to the project, a link to the workbook is saved within the Origin project and the workbook can be opened and edited with Excel.

By default, pre-existing workbooks that are opened in an Origin project are saved external to the project, whereas workbooks that are created from within Origin are saved internal to the project. However, the save option can be changed in the Workbook Properties dialog box.

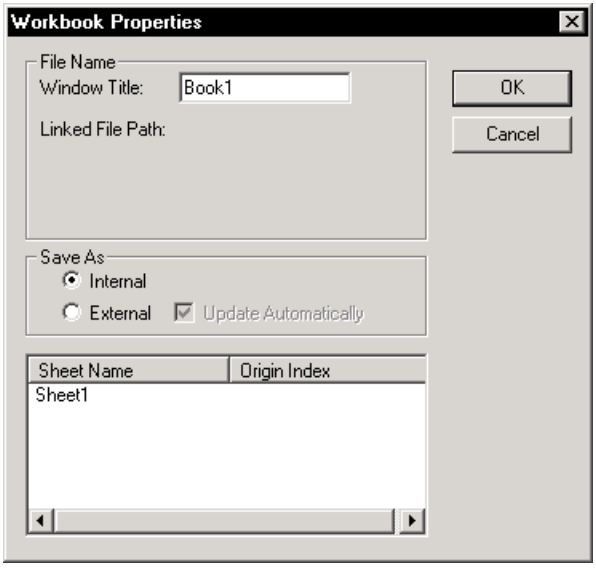
To Save the Workbook Internal to the Origin Project:

1) Make the Excel workbook active.

2) Right-click on the title bar of the workbook and select **Properties** from the shortcut menu. This opens the Workbook Properties dialog box.

3) Select the Internal radio button in the Save As group.

Figure 9: The Workbook Properties Dialog Box



4) Click OK.
5) Select **File:Save Project As**.
6) Type **Excel_Tutorial** in the File Name text box.
7) Click Save.

The project is saved and the workbook is saved internal to the project. Any changes that you now make to the Excel workbook located in the \TUTORIAL folder will not be reflected in the project file the next time it is opened.

Tutorial 8, Programming in Origin

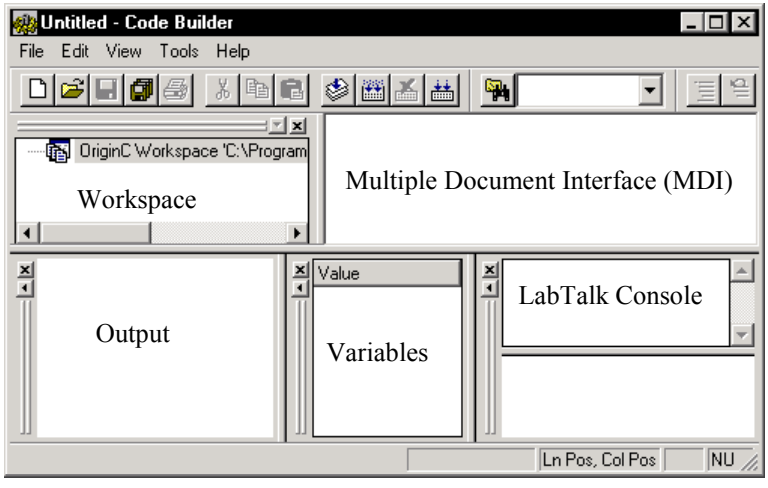
Introduction

Origin's programming language is called Origin C. Origin C supports a nearly complete ANSI C language syntax as well as a subset of C++ features including internal and DLL-extended classes. In addition, Origin C is "Origin aware". This means that Origin objects such as worksheets and graphs are mapped to classes in Origin C, allowing direct manipulation of these objects and their properties from Origin C.

Origin C's integrated development environment is called Code Builder.

To open Code Builder, click the Code Builder button  on the Standard toolbar.

Figure 1: Code Builder



Code Builder provides tools for writing, compiling, and debugging your Origin C functions. Once an Origin C function is compiled, the function becomes available from Origin.

For more information, review the Programming Guide and the sample projects and source files located in the Origin \Samples\Programming\ subfolders.

A number of techniques are available to call your compiled Origin C functions from Origin. For example, you can program the Custom Routine button  located on Origin's Standard toolbar. You can also program objects on windows, create new toolbar buttons, and even create new menu commands. Additionally, Origin C functions can be called from a number of Origin dialog boxes, including the nonlinear curve fitter and the Set Column Values dialog box.

This tutorial will show you how to create, compile, and test an Origin C function. You will then learn how to call your Origin C function from Origin. In this example, you will call the function to set a column's values.

Creating a New Source File

The data for this tutorial lesson is provided in an Origin project file.

To Open the Project File:

1) Click Open  on the Standard toolbar.

2) In the Origin \TUTORIAL folder, select TUTORIAL_8.OPJ from the list of files.

3) Click Open.

A project opens displaying a notes window and a worksheet window. The notes window contains the function that you will compile. (This is provided so that you don't have to re-type the function.)

To create a new function for global use in Origin, you must first open Code Builder.

To Open Code Builder and Create a New Source File:

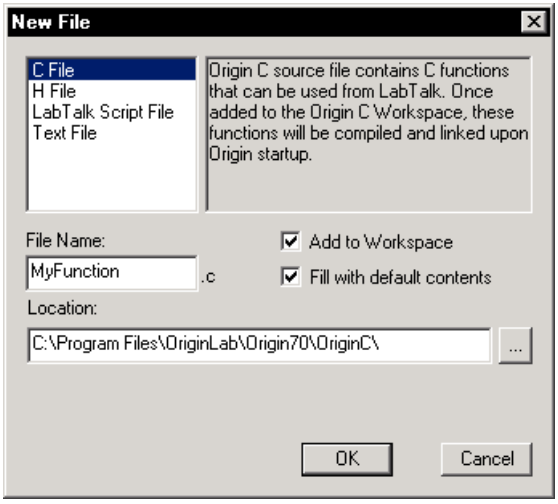
1) Click Code Builder  on Origin's Standard toolbar. Code Builder opens displaying a default workspace.

2) Click New  on Code Builder's Standard toolbar. This opens the New File dialog box.

3) If C File is not selected in the top list box, then select it.

4) In the File Name text box, type **MyFunction**.

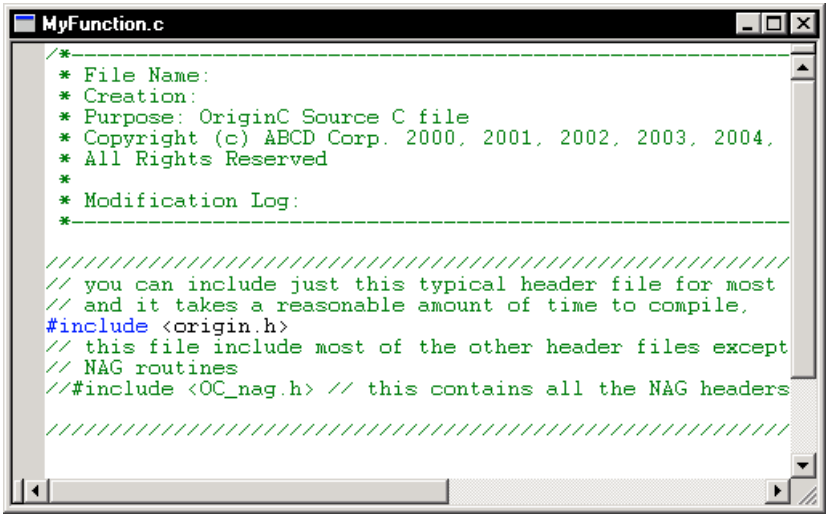
Figure 2: Creating a New Source File



5) Click OK.

A new source file window opens in Code Builder's Multiple Document Interface (MDI).

Figure 3: The Source File Window



Coding Your Function

When Code Builder creates a new source file, it adds starting contents to the source file. (This is the default setting in the New File dialog box.) This starting contents includes comments and one `#include` preprocessor directive:

```
#include <origin.h>
```

Origin 7 includes a number of the NAG function libraries. These functions are referenced in the Origin C Reference Help.

The origin.h header file contains `#include` preprocessor directives for all the additional Origin C header files except for the NAG header files.

(Note: To open the origin.h header file in the MDI, right-click on the text "origin.h" in the `#include` preprocessor directive of your new source file and then select **Open "origin.h"** from the shortcut menu. You can open any included file using this method as long as the `#include` preprocessor directive is not commented out.)

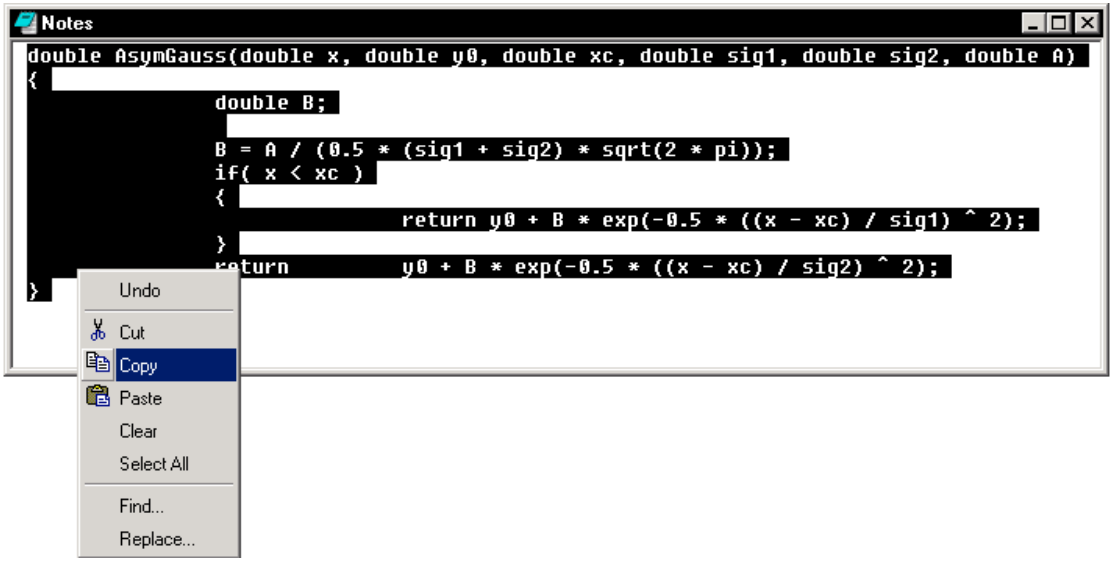
As with the C programming language, your Origin C function definitions must include a function header and a function body. The Origin C function definition for this example is provided in the Origin notes window.

To Enter the Function Definition:

1) Make Origin the active program.

2) From the notes window, copy the entire function definition for `AsymGauss` into the Clipboard.

Figure 4: Copying the AsymGauss Function to the Clipboard

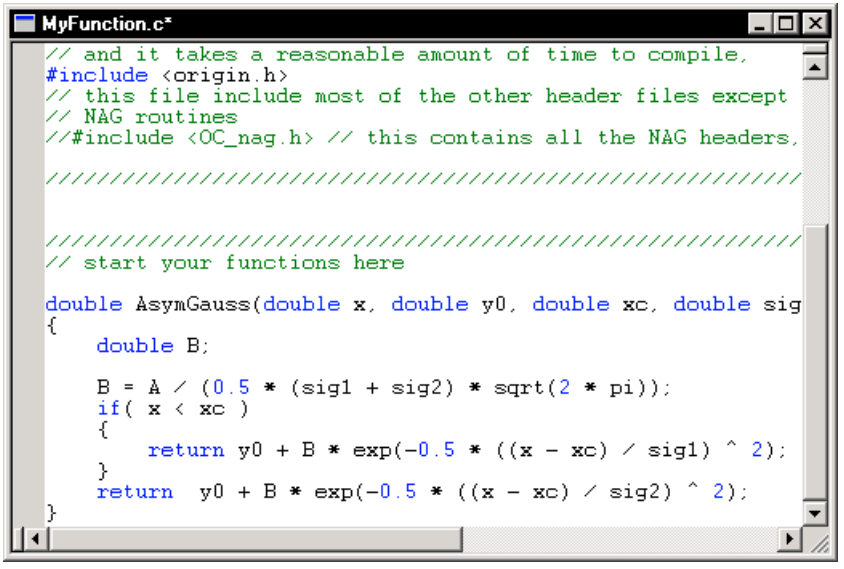


3) Make Code Builder the active program.

4) In the source file window, click after the line that reads `// start your functions here`.

5) Paste the `AsymGauss` function definition into the source file window.

Figure 5: Pasting the AsymGauss Function into the Source File Window



To make your code easier to read and edit, the Code Builder text editor automatically displays different elements of your code using different colors. Additionally, the text editor automatically indents your text depending on the previous lines of code.

Compiling and Testing the Function

Only source files that have been added to the Code Builder workspace can be compiled. When you create a source file by clicking the New button  or by selecting **File:New**, the source file is added to the workspace by default. However, if you open an existing source file you must select the Add to Workspace check box in the Open dialog box to add the file to the workspace. If you don't select this check box when opening a source file, you can add the file to the workspace later by

selecting **File:Add to Workspace** when the source file is active in the MDI.

To compile and link the functions that have been added to the workspace, click the Build button  on the Standard toolbar. If you encounter a compile error in the Output window, double-click on the error line to activate the source file and show the error line.

To Build the AsymGauss Function:

1) Click  on Code Builder's Standard toolbar.

Your function is compiled and linking is performed. The compilation results are output to the Output window.

Figure 6: Successfully Building the AsymGauss Function

To test your compiled function in Code Builder, you can call the function from the top pane of Code Builder's LabTalk Console.

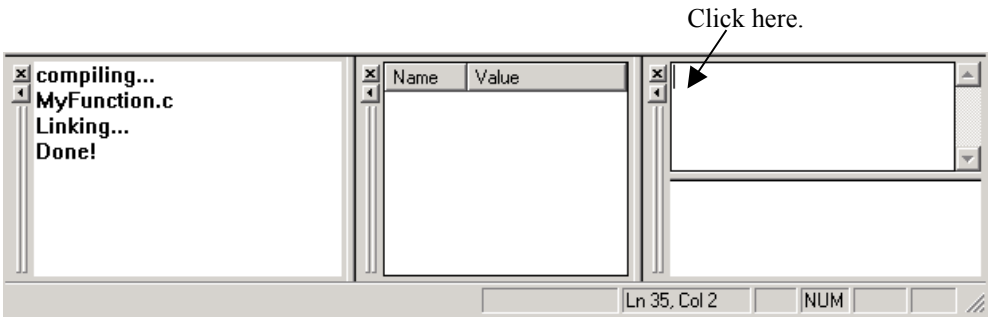
To learn more about LabTalk, review the LabTalk Reference Help.

LabTalk is Origin's historical programming language. LabTalk scripts are interpreted during execution by Origin, whereas Origin C code is compiled to byte code form and therefore executes much faster than LabTalk. Because of this, most of your Origin programming should be done in Origin C functions. However, you must still use LabTalk to call your Origin C functions from Origin.

To Test the AsymGauss Function:

1) Click in the top pane of Code Builder's LabTalk Console. The console is located in the lower-right corner of Code Builder.

Figure 7: The LabTalk Console



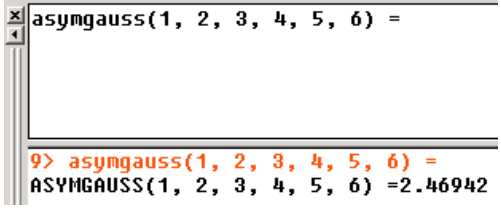
2) Type the following text and then press ENTER:

```
asymgauss(1, 2, 3, 4, 5, 6) =
```

(Note that a LabTalk call to an Origin C function is not case-sensitive. However, Origin C is case-sensitive.)

You should see the following result in the bottom pane of the LabTalk Console (except your line number will be different).

Figure 8: Testing the AsymGauss Function in the LabTalk Console



The `AsymGauss` function is ready to use in Origin.

Using the Function in Origin

After you compile an Origin C function, you can call the function from Origin. For example, you can call the function from the Script window, from the Label Control dialog box of an object, or from any other LabTalk script location. You can also call your function from the nonlinear curve fitter and from the Set Column Values dialog box.

To Set a Column's Values using the AsymGauss Function:

1) Make Origin the active program.

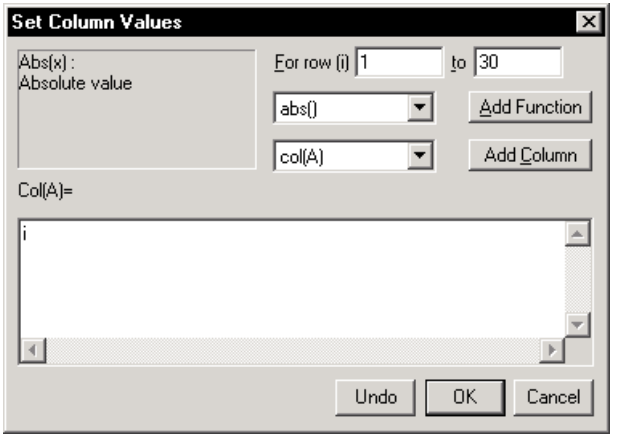
2) Activate the Data1 worksheet.

3) Click the A column heading to select the column.

4) Select **Column:Set Column Values**. This opens the Set Column Values dialog box.

5) In the Col(A) = text box, replace the highlighted text with **i**. This instructs Origin to fill rows one through 30 in column A with row numbers.

Figure 9: Setting the Column A Values



6) Click OK.

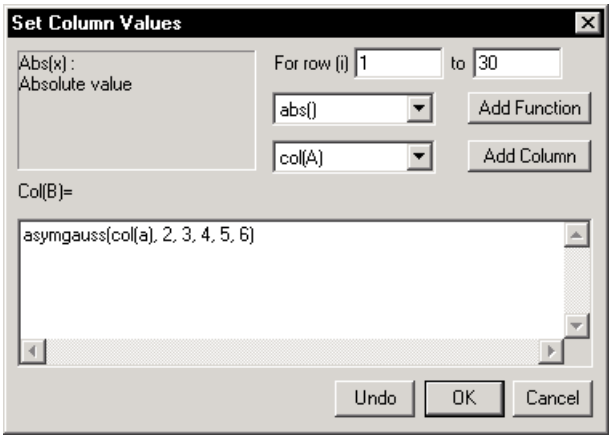
7) Click the B column heading to select the column.

8) Select **Column:Set Column Values**. This re-opens the Set Column Values dialog box but for column B.

9) In the Col(A) = text box, replace the highlighted text with the following:

```
asymgauss(col(a), 2, 3, 4, 5, 6)
```

Figure 10: Setting the Column B Values



10) Click OK.

For every cell in column B rows one through 30, Origin calls the `AsymGauss` function and passes it the associated value in column A as the first argument, and 2, 3, 4, 5, and 6 as the remaining arguments.

Figure 11: The Updated Worksheet

Data1

	A(X)	B(Y)
1	1	2.46942
2	2	2.51556
3	3	2.53192
4	4	2.52139
5	5	2.49103
6	6	2.4443
7	7	2.38626
8	8	2.32263
9	9	2.25891
10	10	2.19964

Note: The values in column B are calculated from the values in column A, as defined by the `AsymGauss` function. If the values in column A are changed, the column B values will not update automatically. To update the values in column B, select **Analysis:Set All Column Values** or click the Set All Column Values button  on the Worksheet Data toolbar.

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