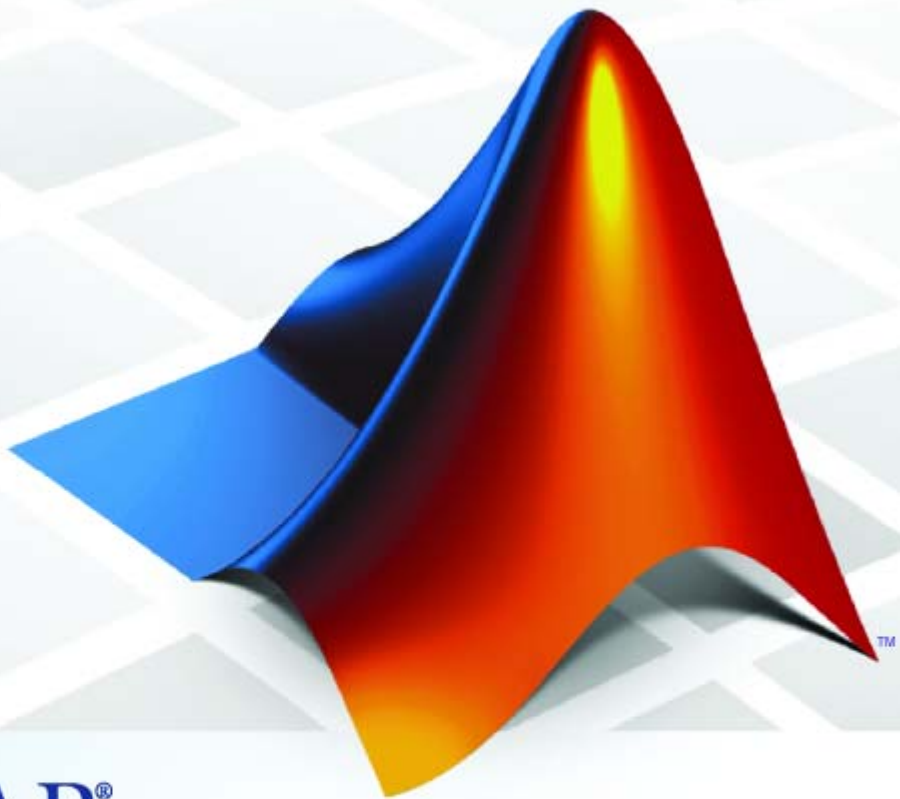


Spreadsheet Link™ EX 3

User's Guide



MATLAB®

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Spreadsheet Link™ EX User's Guide

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Getting Started

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How to install the Spreadsheet Link EX software

Configuring the Spreadsheet Link™ EX Software (p. 1-5)

How to configure the Microsoft Excel, MATLAB, and Spreadsheet Link EX software to work together

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How to start and stop the Spreadsheet Link EX software

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Discusses the two kinds of Spreadsheet Link EX functions: Link Management and Data Management

Working with Dates (p. 1-26)

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About Microsoft® Windows® regional settings

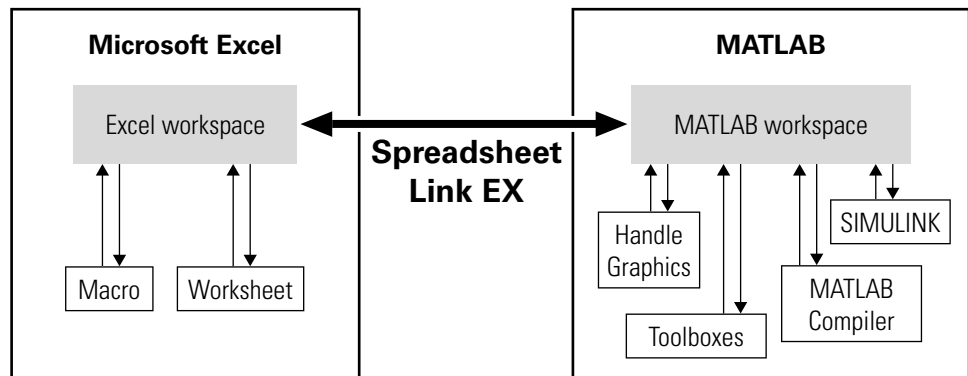
Product Overview

The Spreadsheet Link™ EX software add-in integrates the Microsoft® Excel® and MATLAB® products in a computing environment running Microsoft® Windows®. It connects the Excel® interface to the MATLAB workspace, enabling you to use Excel worksheet and macro programming tools to leverage the numerical, computational, and graphical power of MATLAB.

You can use Spreadsheet Link EX functions in an Excel worksheet or macro to exchange and synchronize data between Excel and MATLAB, without leaving the Excel environment. With a small number of functions to manage the link and manipulate data, the Spreadsheet Link EX software is powerful in its simplicity.

Note This documentation uses the terms *worksheet* and *spreadsheet* interchangeably.

The Spreadsheet Link EX software supports MATLAB two-dimensional numeric arrays, one-dimensional character arrays (strings), and two-dimensional cell arrays. It does not work with MATLAB multidimensional arrays and structures.



Installing the Spreadsheet Link™ EX Software

In this section...

“System Requirements” on page 1-3

“Product Installation” on page 1-3

“Files and Directories Created by the Installation” on page 1-3

“Modifying Your System Path” on page 1-4

System Requirements

For information on hardware and software requirements for this product, see <http://www.mathworks.com/products/excellink/requirements.html>.

The Spreadsheet Link™ EX product requires the MATLAB® for Microsoft® Windows® software. For best results with MATLAB figures and graphics, set the color palette of your display to a value greater than 256 colors:

- 1 Click **Start > Settings > Control Panel > Display**.
- 2 Click the **Settings** tab. Choose an appropriate entry from the **Color Palette** menu.

Product Installation

Install the Microsoft Excel® product *before* you install the MATLAB and Spreadsheet Link EX software. To install the Spreadsheet Link EX add-in, follow the instructions in the MATLAB installation documentation. Select the **Spreadsheet Link EX** check box when choosing components to install.

Files and Directories Created by the Installation

The Spreadsheet Link EX installation program creates a subdirectory under *matlabroot/toolbox/*, where *matlabroot* is the directory where the MATLAB software is installed on your system. The *exlink* directory contains the following files:

- *exclink.xla*: The Spreadsheet Link EX add-in

- ExliSamp.xls: Spreadsheet Link EX example files described in this documentation

The installation also creates a Spreadsheet Link EX initialization file, `exlink.ini`, in the appropriate Windows directory (for example, `C:\Winnt`).

The Spreadsheet Link EX software uses `Kernel32.dll`, which should already be in the appropriate Windows system directory (for example, `C:\Winnt\system32`). If not, consult your system administrator.

Modifying Your System Path

Add the following directories to your system path. For more information about editing your system path, consult your Windows documentation or your system administrator.

- On all supported operating systems, add `C:\MATLAB\bin` to your path.
- On Windows 2000, add the following additional entries to your path:
 - `C:\MATLAB\bin`
 - `C:\Winnt\system`
 - `C:\Winnt\system32`

Configuring the Spreadsheet Link™ EX Software

In this section...

“Configuring Version 2003 and Earlier Versions of the Microsoft® Excel® Software” on page 1-5

“Configuring Version 2007 of the Microsoft® Excel® Software” on page 1-7

“Setting Spreadsheet Link™ EX Preferences” on page 1-10

Configuring Version 2003 and Earlier Versions of the Microsoft® Excel® Software

- 1 Start Microsoft® Excel®.
- 2 Enable the Spreadsheet Link™ EX add-in.
 - a Click **Tools > Add-Ins**. The Add-Ins dialog box appears.
 - b Click **Browse**.
 - c Select `matlabroot/toolbox/exlink/excllink.xla`.

Note Throughout this document the notation `matlabroot` is the MATLAB® root directory, the directory where the MATLAB is installed on your system.

- d Click **OK**.

In the Add-Ins dialog box, the **Spreadsheet Link EX 3.0.1 for use with MATLAB** check box is now selected.

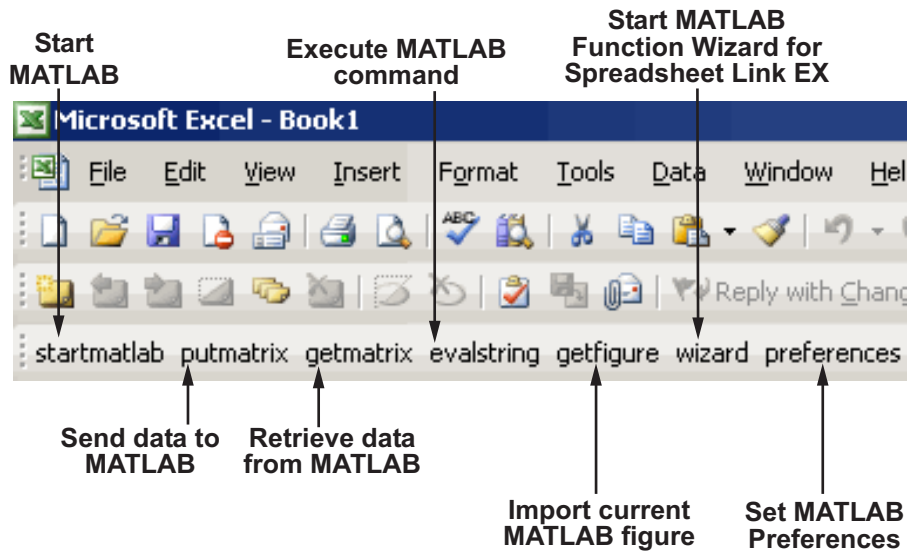
- e Click **OK** to exit the Add-Ins dialog box.

The Spreadsheet Link EX add-in loads now and with each subsequent Excel® software session.

The **MATLAB Command Window** button appears on the Microsoft® Windows® taskbar.



The Spreadsheet Link EX toolbar appears on your Excel worksheet.




The Spreadsheet Link EX software is now ready for use.

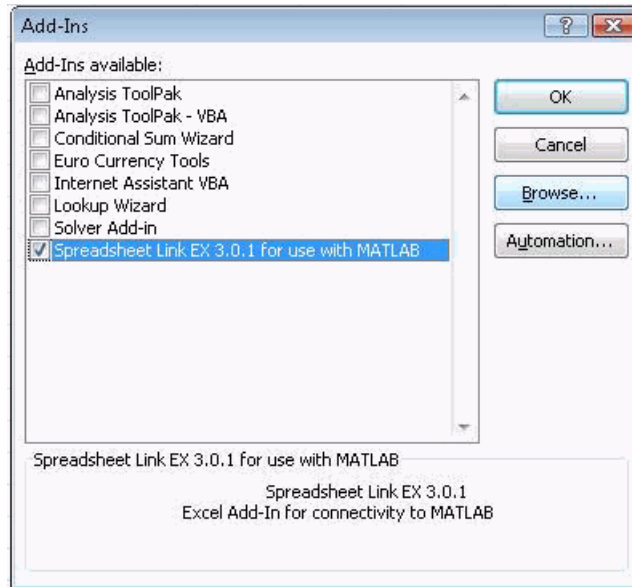
Configuring Version 2007 of the Microsoft® Excel® Software

- 1 Click **My Computer > Properties**. The System Properties pane appears.
- 2 Click the **Advanced** tab.
- 3 Click **Environment Variables**.
- 4 Under **System variables**, double-click the PATH variable. The Edit System Variable window appears.
- 5 Add `matlabroot\bin\win32` to the **Variable value** field.

Note Throughout this document the notation `matlabroot` is the MATLAB root directory, the directory where the MATLAB is installed on your system.

- 6 Click **OK** on all dialog boxes until you exit System Properties.
- 7 Right-click the **MATLAB** shortcut icon and choose **Properties** from its context menu. The Properties pane appears.
- 8 In the **Target** field, enter `/regserver`.
- 9 Click **Apply**.
- 10 Start a Microsoft Excel software session.
- 11 Enable the Spreadsheet Link EX add-in.
 - a Click , the Microsoft Office Button.
 - b Click **Excel Options**. The Excel Options dialog box appears.
 - c Click **Add-Ins**.
 - d From the **Manage** selection list, choose **Excel Add-Ins**.
 - e Click **Go**. The Add-Ins dialog box appears.
 - f Click **Browse**.

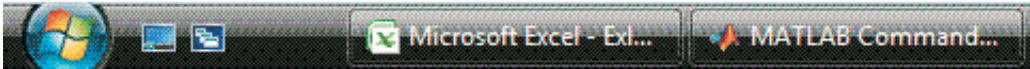
- g** Select `matlabroot/toolbox/exlink/excllink.xla`.
- h** Click **Open**.
- i** In the Add-Ins dialog box, the **Spreadsheet Link EX 3.0.1 for use with MATLAB** check box is now selected.



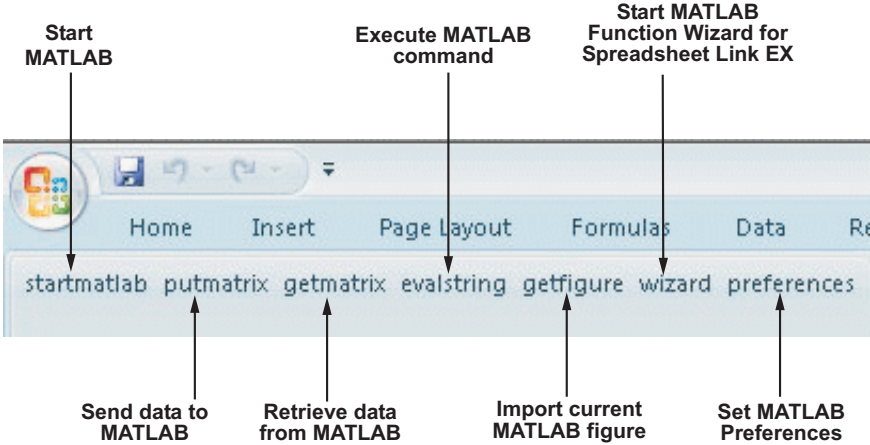
- j** Click **OK** to close the Add-Ins dialog box.
- k** Click **OK** to close the Excel Options dialog box.

The Spreadsheet Link EX add-in loads now and with each subsequent Excel software session.

The **MATLAB Command Window** button appears on the Microsoft Windows taskbar.



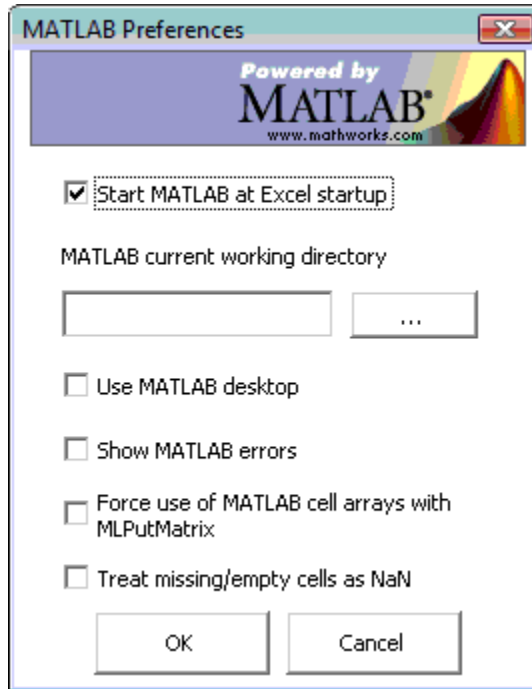
The Spreadsheet Link EX toolbar appears on your Excel worksheet.



The Spreadsheet Link EX software is now ready for use.

Setting Spreadsheet Link™ EX Preferences

Use the Preferences dialog box to set Spreadsheet Link EX preferences. Click the **preferences** button in the Excel toolbar to open this dialog box.



Preferences include:

- **Start MATLAB when Excel starts (enabled by default)** starts a MATLAB software session automatically when an Excel software session starts.
- **MATLAB current working directory** enables you to specify the current working directory for your MATLAB software session at startup.
- **Use MATLAB desktop** starts the MATLAB desktop, including the current directory, workspace, command history, and Command Window panes, when an Excel software session starts.

- **Force use of MATLAB cell arrays with MLPutMatrix** enables the MLPutMatrix function to use cell arrays for data transfer between the Excel software and the MATLAB workspace.
- **Treat missing/empty cells as NaN** sets data in missing or empty cells to NaN or zero.

Starting and Stopping the Spreadsheet Link™ EX Software

In this section...

“Automatically Starting the Spreadsheet Link™ EX Software” on page 1-12

“Manually Starting the Spreadsheet Link™ EX Software” on page 1-12

“Connecting to an Existing MATLAB® Software Session” on page 1-13

“Stopping the Spreadsheet Link™ EX Software” on page 1-13

Automatically Starting the Spreadsheet Link™ EX Software

When installed and configured according to the instructions in “Configuring the Spreadsheet Link™ EX Software” on page 1-5, the Spreadsheet Link™ EX and MATLAB® software automatically start when you start a Microsoft® Excel® software session.

Manually Starting the Spreadsheet Link™ EX Software

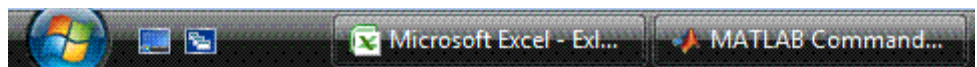
To start the Spreadsheet Link EX and MATLAB software manually from the Excel® interface:

- 1 Click **Tools > Macro**.
- 2 Enter `matlabinit` into the **Macro Name/Reference** box.

For more information about the `matlabinit` function, see Chapter 3, “Function Reference”.

- 3 Click **Run**.

The MATLAB Command Window button appears on the Microsoft® Windows® taskbar.



Connecting to an Existing MATLAB® Software Session

To connect a new Excel software session to an existing MATLAB session, start MATLAB with the `spreedsheetautomation` command-line option. This option starts MATLAB as an automation server. The Command Window is minimized, and the Desktop is not running.

- 1 Right-click your MATLAB shortcut icon.
- 2 Select **Properties**.
- 3 Click the **Shortcut** tab.
- 4 Add the string `/automation` in the **Target** field. Remember to leave a space between `matlab.exe` and `/automation`.
- 5 Click **OK**.

Note This option works only if the current MATLAB software session is a registered automation version. If not, the Excel software starts a new MATLAB software session rather than connecting to the existing one.

Stopping the Spreadsheet Link™ EX Software

- To stop both the Spreadsheet Link EX and MATLAB software, stop the Excel software session as you normally would.
- To stop the Spreadsheet Link EX and MATLAB software and leave the Excel software session running, enter the `=MLClose()` command into an Excel worksheet cell. You can use the `MLOpen` or `matlabinit` functions to restart the Spreadsheet Link EX and MATLAB software sessions manually.

About Functions

In this section...

“How Spreadsheet Link™ EX Functions Differ from Microsoft® Excel® Functions” on page 1-14

“Types of Spreadsheet Link™ EX Functions” on page 1-14

“Using Worksheets” on page 1-15

“Working with Arguments in Spreadsheet Link™ EX Functions” on page 1-17

“Using the MATLAB® Function Wizard for the Spreadsheet Link™ EX Software” on page 1-19

“Examples: Using Spreadsheet Link™ EX Functions in Macros” on page 1-22

How Spreadsheet Link™ EX Functions Differ from Microsoft® Excel® Functions

- Spreadsheet Link™ EX functions *perform an action*, while Microsoft® Excel® functions *return a value*.
- Spreadsheet Link EX function names *are not* case sensitive; that is, `MLPutMatrix` and `mlputmatrix` are the same.
- MATLAB® function names and variable names *are* case sensitive; that is, `BONDS`, `Bonds`, and `bonds` are three different MATLAB variables. Standard MATLAB function names are always lowercase; for example, `plot(f)`.

Note Excel® operations and function keys may behave differently with Spreadsheet Link EX functions.

Types of Spreadsheet Link™ EX Functions

Spreadsheet Link EX functions manage the connection and data exchange between the Excel software and the MATLAB workspace, without your ever needing to leave the Excel environment. You can run functions as

worksheet cell formulas or in macros. The Spreadsheet Link EX software enables the Excel product to act as an easy-to-use data-storage and application-development front end for the MATLAB software, which is a powerful computational and graphical processor.

There are two types of Spreadsheet Link EX functions: link management functions and data management functions.

Link management functions initialize, start, and stop the Spreadsheet Link EX and MATLAB software. You can run any link management function other than `matlabinit` as a worksheet cell formula or in macros. You must run the `matlabinit` function from the Excel **Tools > Macro** menu, or in macro subroutines.

Data management functions copy data between the Excel software and the MATLAB workspace, and execute MATLAB commands in the Excel interface. You can run any data management function other than `MLPutVar` and `MLGetVar` as a worksheet cell formula or in macros. The `MLPutVar` and `MLGetVar` functions can run only in macros.

For more information about Spreadsheet Link EX functions, see Chapter 3, “Function Reference”.

Using Worksheets

Entering Functions into Worksheet Cells

Spreadsheet Link EX functions expect A1-style worksheet cell references; that is, columns designated with letters and rows with numbers (the default reference style). If your worksheet shows columns designated with numbers instead of letters:

- 1 Click **Tools > Options**.
- 2 Click the **General** tab.
- 3 Under **Settings**, clear the **R1C1 reference style** check box.

Enter Spreadsheet Link EX functions directly into worksheet cells as worksheet formulas. Begin worksheet formulas with `+` or `=` and enclose

function arguments in parentheses. The following example uses `MLPutMatrix` to put the data in cell C10 into matrix A:

```
=MLPutMatrix("A", C10)
```

For more information on specifying arguments in Spreadsheet Link EX functions, see “Working with Arguments in Spreadsheet Link™ EX Functions” on page 1-17.

Note Do not use the Excel Function Wizard. It can generate unpredictable results.

After a Spreadsheet Link EX function successfully executes as a worksheet formula, the cell contains the value 0. While the function executes, the cell might continue to show the formula you entered.

To change the active cell when an operation completes, click **Excel Tools Options > Edit > Move Selection after Enter**. This action provides a useful confirmation for lengthy operations.

Automatic Calculation Mode Vs. Manual Calculation Mode

Spreadsheet Link EX functions are most effective in automatic calculation mode. To *automate* the recalculation of a Spreadsheet Link EX function, add to it a cell whose value changes. In the following example, the `MLPutMatrix` function reexecutes when the value in cell C1 changes:

```
=MLPutMatrix("bonds", D1:G26) + C1
```

Note Be careful to avoid creating endless recalculation loops.

To use `MLGetMatrix` in manual calculation mode:

- 1** Enter the function into a cell.
- 2** Press **F2**.

3 Press **Enter**. The function executes.

Spreadsheet Link EX functions do not automatically adjust cell addresses. If you use explicit cell addresses in a function, you must edit the function arguments to reference a new cell address when you do either of the following:

- Insert or delete rows or columns.
- Move or copy the function to another cell.

Note Pressing **F9** to recalculate a worksheet affects only Excel functions. This key does not operate on Spreadsheet Link EX functions.

Working with Arguments in Spreadsheet Link™ EX Functions

This section describes tips for managing variable-name arguments and data-location arguments in Spreadsheet Link EX functions.

Variable-Name Arguments

- You can *directly* or *indirectly* specify a variable-name argument in most Spreadsheet Link EX functions:
 - To specify a variable name directly, enclose it in double quotation marks; for example, `MLDeleteMatrix("Bonds")`.
 - To specify a variable name as an indirect reference, enter it without quotation marks. The function evaluates the contents of the argument to get the variable name. The argument must be a worksheet cell address or range name; for example, `MLDeleteMatrix(C1)`.

Data-Location Arguments

- A data-location argument must be a worksheet cell address or range name.
- Do not enclose a data-location argument in quotation marks (except in `MLGetMatrix`, which has unique argument conventions).

- A data-location argument can include a worksheet number; for example, Sheet3!B1:C7 or Sheet2!OUTPUT.

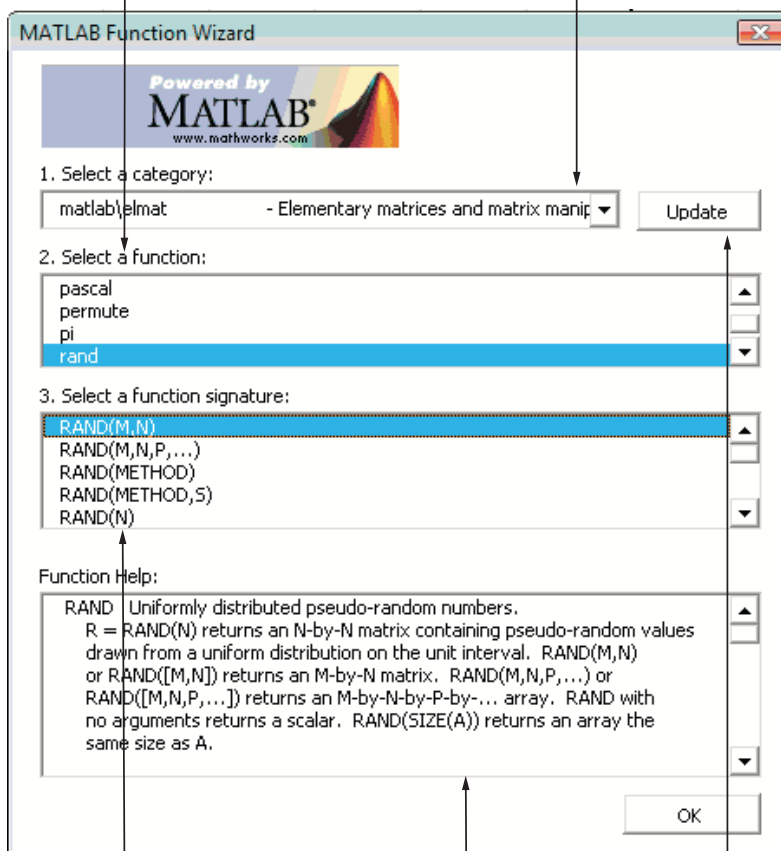
Note You can reference special characters as part of a worksheet name in `MLGetMatrix` or `MLPutMatrix` by embedding the worksheet name within single quotation marks (' ').

Using the MATLAB® Function Wizard for the Spreadsheet Link™ EX Software

The MATLAB Function Wizard for the Spreadsheet Link EX software allows you to browse MATLAB directories and run functions from within the Excel interface.

List functions available
for specified directory/category

Display list of MATLAB working directories
and available function categories



Select function signature
and enter formula into
specified spreadsheet cell

Display help for given
function signature

Refresh
directory/category list

You can use this wizard to:

1 Display a list of all MATLAB working directories and function categories

All directories or categories in the current MATLABPATH display in the **Select a category** field. Click an entry in the list to select it. Each entry in the list displays as a directory path plus a description read from the Contents.m file in that directory. If no Contents.m file is found, the directory/category display notifies you as follows:

```
finance\finsupport -(No table of contents file)
```

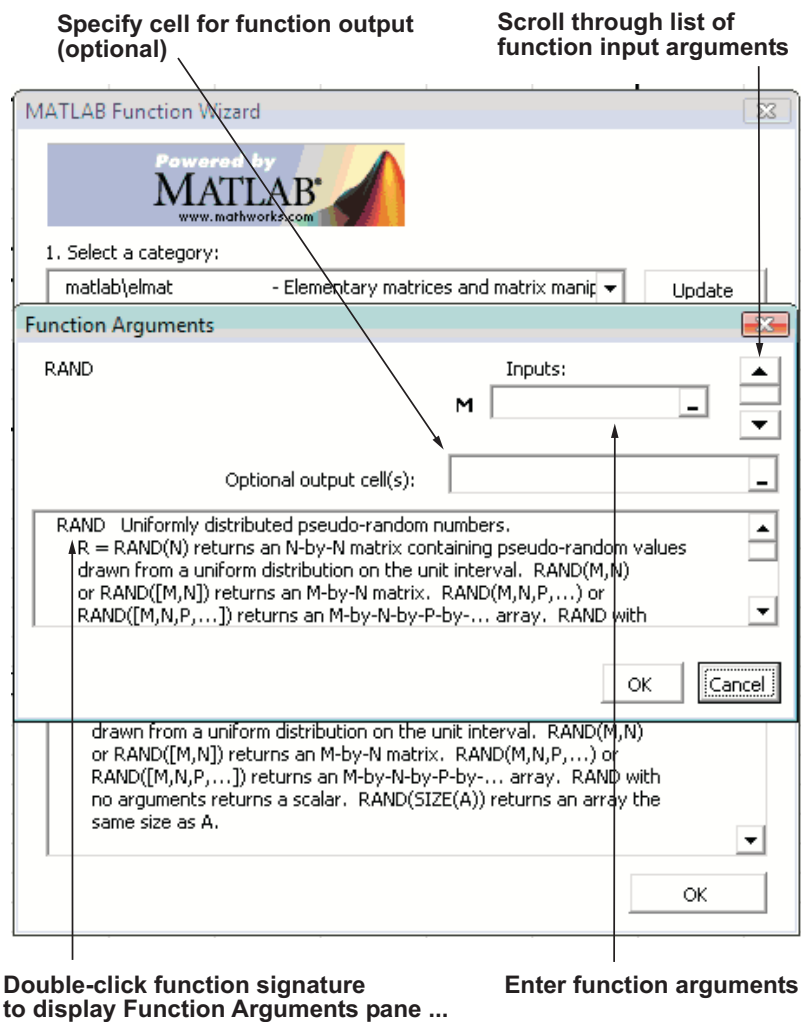
To refresh the directory/category list, click the **Update** button.

2 Choose a particular directory or category, and list functions available for that directory or category

After you select a directory or category, available functions for that directory or category display in the **Select a function** field. Click a function name to select it.

3 Parse a specified function signature and enter a formula into the current spreadsheet cell

After you select a function, available function signatures for the specified function display in the **Select a function signature** field. Click a function signature to display the Function Arguments pane.



By default, the output of the selected function appears in the current spreadsheet cell using the Spreadsheet Link EX function `matlabfcn`. In the following example, the output displays in the current spreadsheet cell and generates a MATLAB figure:

```
=matlabfcn("plot",Sheet1!$B$2:$D$4)
```

Specifying a target range of cells using the **Optional output cell(s)** field in the Function Arguments dialog box causes the selected function to appear in the current spreadsheet cell as an argument of the `matlabsub` function. In addition, `matlabsub` includes an argument that indicates where to write the function's output. In the following example, the data from A2 is input to the `rand` function, whose target cell is B2:

```
=matlabsub("rand","Sheet1!$B$2",Sheet1!$A$2)
```

4 Display online help headers for functions

After you select a function signature from the **Select a function signature** field, its help header appears in the **Function Help** field.

Examples: Using Spreadsheet Link™ EX Functions in Macros

About the Examples

This section contains examples that show how to manipulate MATLAB data using Spreadsheet Link EX.

- For an example of how to exchange data between the MATLAB and Excel workspaces, see “Importing and Exporting Data between the Microsoft® Excel® Interface and the MATLAB® Workspace” on page 1-23.
- For an example of how to export data from the MATLAB workspace and display it in an Excel worksheet, see “Sending MATLAB® Data to an Excel® Worksheet and Displaying the Results” on page 1-23.

Importing and Exporting Data between the Microsoft® Excel® Interface and the MATLAB® Workspace

- This example uses `MLGetMatrix` in a macro subroutine to export data from the MATLAB matrix `A` into the Excel worksheet `Sheet1`.

```
Sub Test1()  
    MLGetMatrix "A", "Sheet1!A5"  
    MatlabRequest  
End Sub
```

Note The `MatlabRequest` function initializes internal Spreadsheet Link EX variables and enables `MLGetMatrix` to function in the subroutine.


- This example uses `MLPutMatrix` in a macro subroutine to import data into the MATLAB matrix `A`, from a specified cell range in the Excel worksheet `Sheet1`.

```
Sub Test2()  
    Set myRange = Range("A1:C3")  
    MLPutMatrix "A", myRange  
End Sub
```

Sending MATLAB® Data to an Excel® Worksheet and Displaying the Results

In this example, you run MATLAB commands using VBA, send MATLAB data to the Excel software, and display the results in an Excel dialog box.

- 1 Start an Excel software session.
- 2 Initialize the MATLAB software session by clicking the **startmatlab** button in the Spreadsheet Link EX toolbar or by running the `matlabinit` function.
- 3 If the Spreadsheet Link EX add-in is not enabled, enable it.

- For instructions on enabling this add-in for the Excel 2003 software, see “Configuring Version 2003 and Earlier Versions of the Microsoft® Excel® Software” on page 1-5.
 - For instructions on enabling this add-in for the Excel 2007 software, see “Configuring Version 2007 of the Microsoft® Excel® Software” on page 1-7.
- 4** Enable the Spreadsheet Link EX software as a Reference in the Microsoft® Visual Basic® editor.
- a** Open a Visual Basic® session.
 - If you are running the Excel 2003 software, click **Tools > Macro > Visual Basic Editor**.
 - If you are running the Excel 2007 software, click the Visual Basic button, , or press **Alt+F11**.
 - b** In the Visual Basic toolbar, click **Tools > References**.
 - c** In the References — VBA Project dialog box, select the **SpreadsheetLinkEX** check box.
 - d** Click **OK**.
- 5** In the Visual Basic editor, create a module.
- a** Right-click the **Microsoft Excel Objects** folder in the **Project — VBAProject** browser.
 - b** Select **Insert > Module**.
- 6** Enter the following code into the module window:

```
Option Base 1
Sub Method1()

    MLShowMatlabErrors "yes"

    '''To MATLAB:
    Dim Vone(2, 2) As Double    'Input
    Vone(1, 1) = 1
    Vone(1, 2) = 2
```



```
Vone(2, 1) = 3
Vone(2, 2) = 4

MLPutMatrix "a", Range("A1:B2")
MLPutVar "b", Vone
MLEvalString ("c = a*b")
MLEvalString ("d = eig(c)")

'''From MATLAB:
Dim Vtwo As Variant           'Output
MLGetVar "c", Vtwo
MsgBox "c is " & Vtwo(1, 1)

MLGetMatrix "b", Range("A7:B8").Address
MatlabRequest
MLGetMatrix "c", "Sheet1!A4:B5"
MatlabRequest

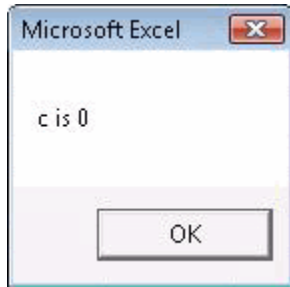
Sheets("Sheet1").Select
Range("A10").Select
MLGetMatrix "d", ActiveCell.Address
MatlabRequest

End Sub
```

Tip Copy and paste this code into the Visual Basic editor from the HTML version of the documentation.

7 Run the code. Press **F5** or click **Run > Run Sub/UserForm**.

The following dialog box appears.



8 Click **OK** to close the dialog box.

Note Do not include `MatlabRequest` in a macro function unless the macro function is called from a subroutine.

Tip In macros, leave a space between the function name and the first argument; do not use parentheses.

Working with Dates

Default Microsoft® Excel® date numbers represent the number of days that have passed since January 1, 1900; for example, May 15, 1996 is represented as 35200 in the Excel® software.

However, MATLAB® date numbers represent the number of days that have passed since January 1, 0000, so May 15, 1996 is represented as 729160 in the MATLAB software. Therefore, the difference in dates between the Excel software and the MATLAB software is a constant, 693960 (729160 minus 35200).

To use date numbers in MATLAB calculations, apply the 693960 constant as follows:

- Add it to Excel date numbers that are read into the MATLAB software.

- Subtract it from MATLAB date numbers that are read into the Excel software.

Note If you use the optional Excel 1904 date system, the constant is 695422.

Dates are stored internally in the Excel software as numbers and are unaffected by locale.

Localization Information

This document uses the Microsoft® Excel® software with an English (United States) Microsoft® Windows® regional setting for illustrative purposes. If you use the Spreadsheet Link™ EX software with a non-English (United States) Windows desktop environment, certain syntactical elements may not work as illustrated. For example, you may have to replace the comma (,) delimiter within Spreadsheet Link EX commands with a semicolon (;) or other operator.

Please consult your Windows documentation to determine which regional setting differences exist among non-U.S. versions.

Solving Problems with the Spreadsheet Link™ EX software

Running the Examples (p. 2-2)	How to use these examples
Modeling Data Sets Using Data Regression and Curve Fitting (p. 2-3)	Builds a mathematical model of a data set and uses a Microsoft® Excel® worksheet to organize and display the data
Interpolating Data (p. 2-11)	Uses a Microsoft Excel worksheet to organize and display input data and the interpolated output data
Pricing Stock Options Using the Binomial Model (p. 2-15)	Uses the Spreadsheet Link™ EX and Financial Toolbox™ software, to price options with the binomial model
Calculating and Plotting the Efficient Frontier of Financial Portfolios (p. 2-19)	Uses the Spreadsheet Link EX and Financial Toolbox software to analyze three portfolios, using rates of return for six time periods
Mapping Time and Bond Cash Flows (p. 2-23)	Uses the Spreadsheet Link EX and Financial Toolbox software to compute a set of cash flow amounts and dates, given a portfolio of five bonds

Running the Examples

The following sections show how the Microsoft® Excel®, Spreadsheet Link™ EX, and MATLAB® software work together to solve real-world problems.

These examples are included with the Spreadsheet Link EX product. To run them:

- 1 Start Excel®, Spreadsheet Link EX, and MATLAB software sessions.
- 2 Navigate to the directory `matlabroot/toolbox/exlink/`.
- 3 Open the file `ExliSamp.xls`
- 4 Execute the examples as needed.

Note Examples 1 and 2 use MATLAB functions only. Examples 3, 4, and 5 use Financial Toolbox™ functions. The Financial Toolbox software requires the Statistics Toolbox™ and Optimization Toolbox™ products.

Modeling Data Sets Using Data Regression and Curve Fitting

In this section...

“Using Worksheets” on page 2-3

“Using Macros” on page 2-6

Regression techniques and curve fitting attempt to find functions that describe the relationship among variables. In effect, they attempt to build mathematical models of a data set. MATLAB® matrix operators and functions simplify this task.

This example shows both data regression and curve fitting. It also executes the same example in a worksheet version and a macro version. The example uses Microsoft® Excel® worksheets to organize and display the data. Spreadsheet Link™ EX functions copy the data to the MATLAB workspace, and then executes MATLAB computational and graphic functions. The macro version also returns output data to an Excel® worksheet.

Using Worksheets

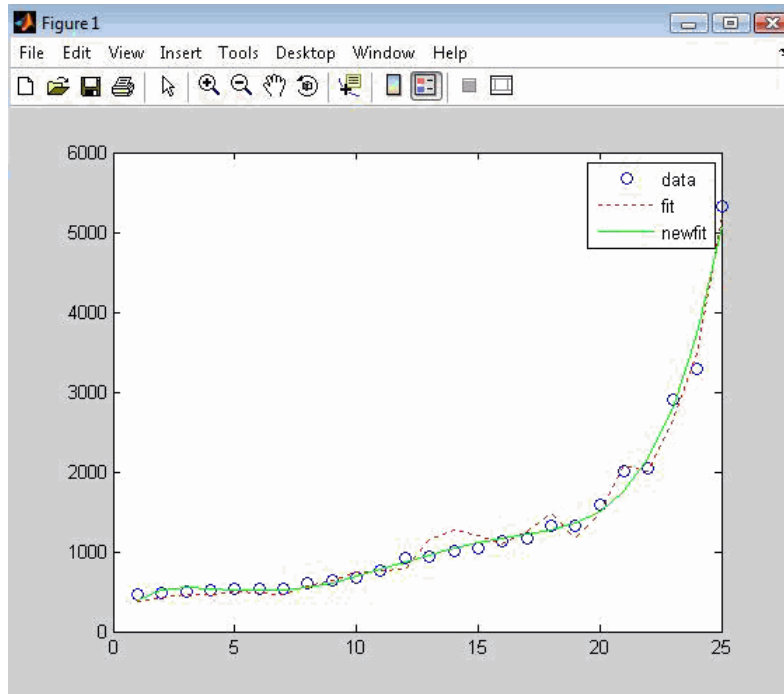
- 1 Click the **Sheet1** tab on the Ex1iSamp.xls window. The worksheet for this example appears.

	A	B	C	D	E	F	G	H	I	J	K	L
1	Regression and Curve Fitting											
2												
3		DATA			Spreadsheet Link EX Functions							
4	35	207	1325		1. Transfer the data to MATLAB.							
5	17	90	533		0 <== MLPutMatrix("data",DATA)							
6	43	180	1013									
7	41	187	1163		2. Set up data for regression.							
8	177	552	5326		0 <== MLEvalString("y = data(:,3)")							
9	57	354	2043		0 <== MLEvalString("e = ones(length(data),1)")							
10	20	101	602		0 <== MLEvalString("A = [e data(:,1:2)]")							
11	18	91	532									
12	17	86	543		3. Compute regression coefficients.							
13	35	180	1134		0 <== MLEvalString("beta = A\y")							
14	25	136	766									
15	17	84	495		4. Calculate regressed result.							
16	23	102	635		0 <== MLEvalString("fit = A*beta")							
17	24	148	913									
18	40	292	1591		5. Compare original data with regression results.							
19	25	126	671		0 <== MLEvalString("[y,k] = sort(y)")							
20	17	88	521		0 <== MLEvalString("fit = fit(k)")							
21	46	235	1319		0 <== MLEvalString("n = size(data,1)")							
22	37	204	1038									
23	15	68	458		6. Use MATLAB's polynomial solving functions for another curve fit.							
24	85	363	2904		0 <== MLEvalString("[p,S] = polyfit(1:n,y',5)")							
25	66	300	2006		0 <== MLEvalString("newfit = polyval(p,1:n,S)")							
26	39	161	938									
27	111	459	3282		7. Plot curves and add legend							
28	16	80	476		0 <== MLEvalString("plot(1:n,y,'bo',1:n,fit,'r',1:n,newfit,'g'); legend('data','fit','newfit')")							

The worksheet contains one named range: A4:C28 is named DATA and contains the data set for this example.

- 2 Make E5 the active cell. Press **F2**; then press **Enter** to execute the Spreadsheet Link EX function that copies the sample data set to the MATLAB workspace. The data set contains 25 observations of three variables. There is a strong linear dependence among the observations; in fact, they are close to being scalar multiples of each other.
- 3 Move to cell E8 and press **F2**; then press **Enter**. Repeat with cells E9 and E10. These Spreadsheet Link EX functions regress the third column of data on the other two columns, and create the following:
 - A single vector y containing the third-column data.
 - A three-column matrix A, that consists of a column of ones followed by the rest of the data.

- 4** Execute the function in cell E13. This function computes the regression coefficients by using the MATLAB back slash (`\`) operation to solve the (overdetermined) system of linear equations, $A \cdot \text{beta} = y$.
- 5** Execute the function in cell E16. MATLAB matrix-vector multiplication produces the regressed result (`fit`).
- 6** Execute the functions in cells E19, E20, and E21. These functions do the following:
 - a** Compare the original data with `fit`.
 - b** Sort the data in increasing order and apply the same permutation to `fit`.
 - c** Create a scalar for the number of observations.
- 7** Execute the functions in cells E24 and E25. Often it is useful to fit a polynomial equation to data. To do so, you would ordinarily have to set up a system of simultaneous linear equations and solve for the coefficients. The MATLAB `polyfit` function automates this procedure, in this case for a fifth-degree polynomial. The `polyval` function then evaluates the resulting polynomial at each data point to check the goodness of fit (`newfit`).
- 8** Execute the function in cell E28. The MATLAB `plot` function graphs the original data (blue circles), the regressed result `fit` (dashed red line), and the polynomial result (solid green line). It also adds a legend.

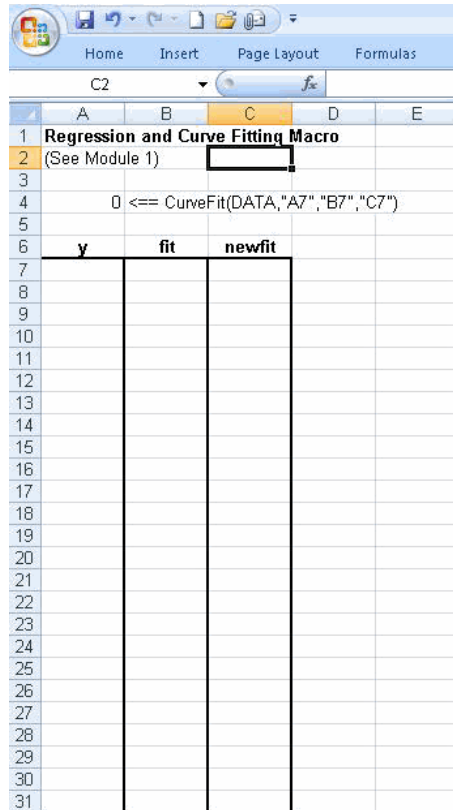


Since the data is closely correlated but not exactly linearly dependent, the `fit` curve (dashed line) shows a close, but not an exact, fit. The fifth-degree polynomial curve, `newfit`, is a more accurate mathematical model for the data.

When you finish this version of the example, close the figure window.

Using Macros

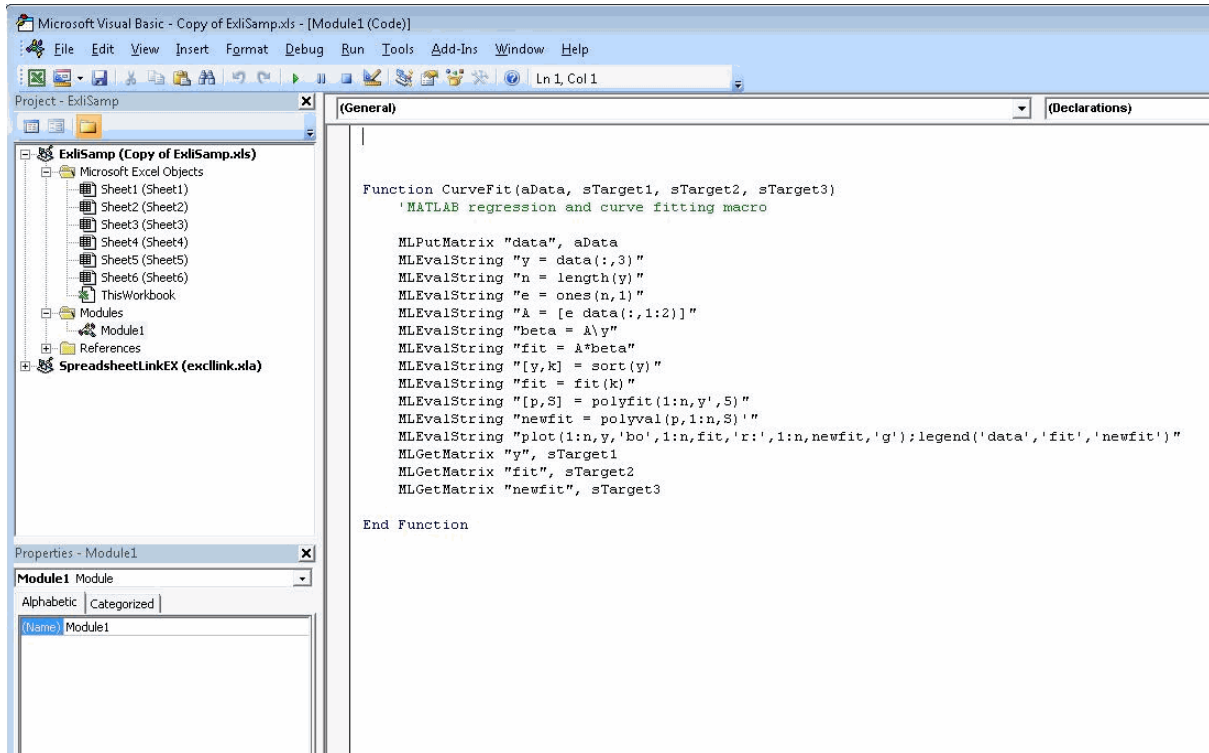
- 1 Click the **Sheet2** tab on `Ex1iSamp.xls`. The worksheet for this example appears.




2 Make cell A4 the active cell, but do not execute it yet.

Cell A4 calls the macro CurveFit, which you can examine in the Microsoft® Visual Basic® environment.

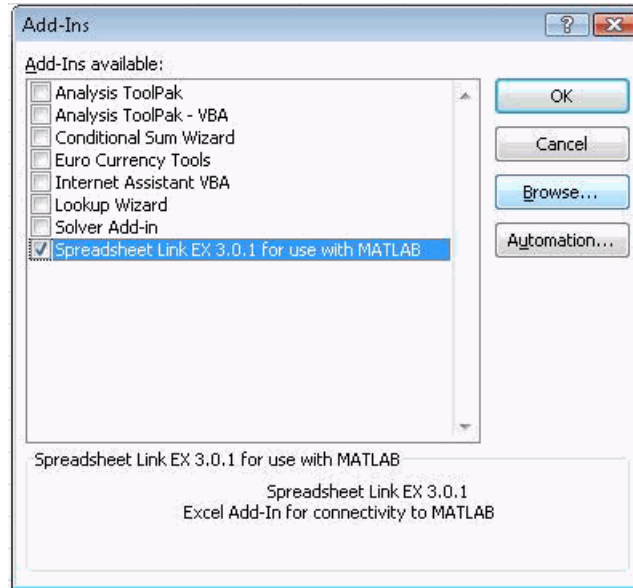
2 Solving Problems with the Spreadsheet Link™ EX software



3 While this module is open, make sure that the Spreadsheet Link EX add-in is enabled.

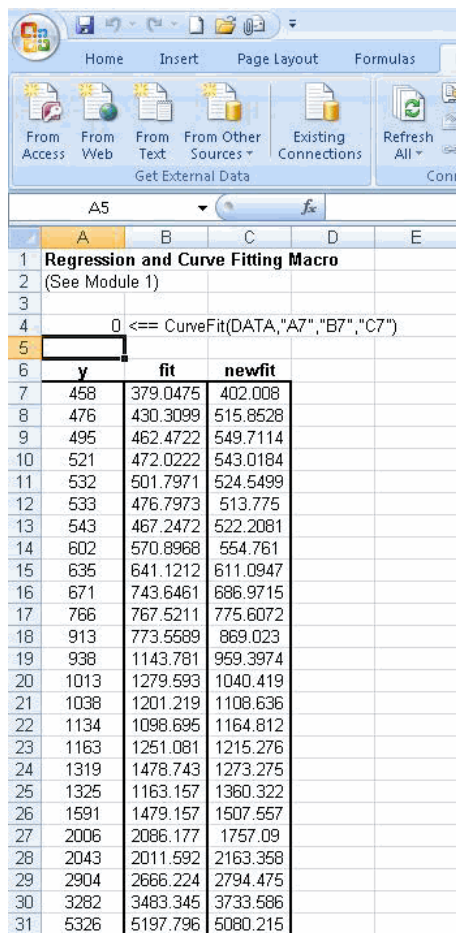
- If you are using the Excel 2003 software:
 - a** Click **Tools > References**.
 - b** In the **References** dialog box, make sure that the **exclink.xla** check box is selected. If not, select it.
 - c** Click **OK**.
- If you are using the Excel 2007 software:
 - a** Click the Microsoft® Office Button, .
 - b** Click **Options**. The Excel Options pane appears.
 - c** Click **Add-Ins**.

- d** From the **Manage** selection list, choose **Excel Add-Ins**.
- e** Click **Go**. The Add-Ins pane appears.
- f** Make sure that the **Spreadsheet Link EX 3.0.1 for use with MATLAB** check box is selected. If not, select it.



- g** Click **OK** to close the Add-Ins pane.
 - h** Click **OK** to close the Excel Options pane.
- 4** In cell A4 of **Sheet2**, press **F2**; then press **Enter** to execute the CurveFit macro. The macro does the following:
- a** Runs the same functions as the worksheet example (in a slightly different order), including plotting the graph.
 - b** Calls the MLGetMatrix function in the CurveFit macro. This macro copies to the worksheet the original data y (sorted), the corresponding regressed data fit, and the polynomial data newfit.

2 Solving Problems with the Spreadsheet Link™ EX software



The screenshot shows the Microsoft Excel interface. The ribbon includes Home, Insert, Page Layout, and Formulas. The 'Get External Data' group is active, showing options like 'From Access', 'From Web', 'From Text', 'From Other Sources', 'Existing Connections', and 'Refresh All'. The active cell is A5, containing the formula `=CurveFit(DATA,"A7","B7","C7")`. Below the formula bar, a table is displayed with three columns: 'y', 'fit', and 'newfit'. The table contains 25 rows of data, with the first row (row 7) serving as the header.

y	fit	newfit
458	379.0475	402.008
476	430.3099	515.8528
495	462.4722	549.7114
521	472.0222	543.0184
532	501.7971	524.5499
533	476.7973	513.775
543	467.2472	522.2081
602	570.8968	554.761
635	641.1212	611.0947
671	743.6461	686.9715
766	767.5211	775.6072
913	773.5589	869.023
938	1143.781	959.3974
1013	1279.593	1040.419
1038	1201.219	1108.636
1134	1098.695	1164.812
1163	1251.081	1215.276
1319	1478.743	1273.275
1325	1163.157	1360.322
1591	1479.157	1507.557
2006	2086.177	1757.09
2043	2011.592	2163.358
2904	2666.224	2794.475
3282	3483.345	3733.586
5326	5197.796	5080.215

Interpolating Data

Interpolation is a process for estimating values that lie between known data points. It is important for applications such as signal and image processing and data visualization. MATLAB® interpolation functions let you balance the smoothness of data fit with execution speed and efficient memory use.

This example uses a two-dimensional data-gridding interpolation function on thermodynamic data, where volume has been measured for time and temperature values. It finds the volume values underlying the two-dimensional, time-temperature function for a new set of time and temperature coordinates.

The example uses a Microsoft® Excel® worksheet to organize and display the original data and the interpolated output data. You use Spreadsheet Link™ EX functions to copy the data to and from the MATLAB workspace, and then execute the MATLAB interpolation function. Finally, you invoke MATLAB graphics to display the interpolated data in a three-dimensional color surface.

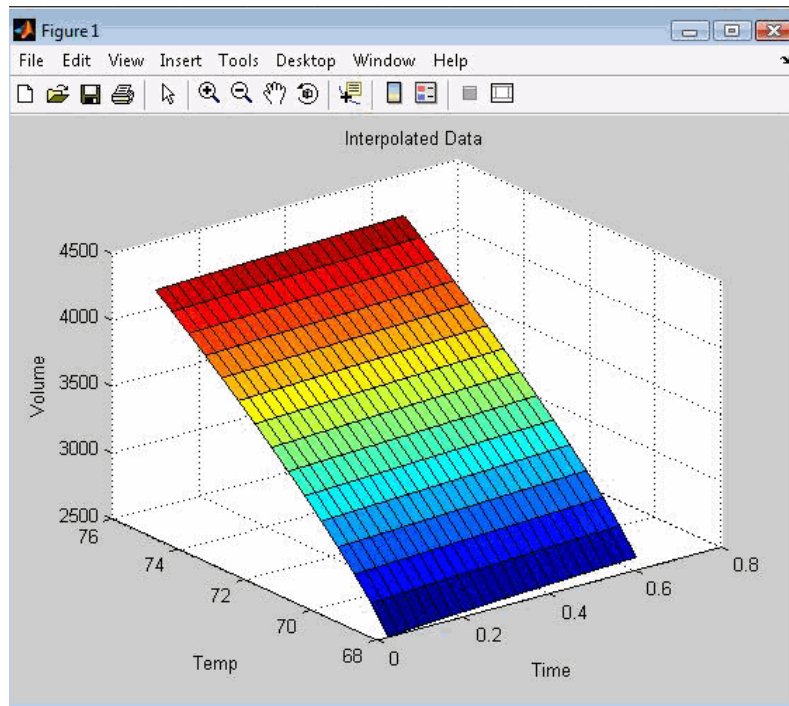
- 1 Click the **Sheet3** tab on Ex1iSamp.xls. The worksheet for this example appears.

original temperature data. Execute the function in cell A36 to copy the original volume data.

- 4 Move to cell A39 and press **F2**; then press **Enter** to copy the interpolation time values to the MATLAB workspace. Execute the function in cell A40 to copy the interpolation temperature values.
- 5 Execute the function in cell A43. `griddata` is the MATLAB two-dimensional interpolation function that generates the interpolated volume data using the inverse distance method.
- 6 Execute the functions in cells A46 and A47 to transpose the interpolated volume data and copy it to the Excel® worksheet. The data fills cells F7:T30, which are enclosed in a border.

Interpolated Values															
Temp															
Time	68.0	68.5	69.0	69.5	70.0	70.5	71.0	71.5	72.0	72.5	73.0	73.5	74.0	74.5	75.0
0.025	2504.08	2700.39	2859.95	3006.62	3144.98	3277.18	3404.45	3527.63	3647.28	3763.86	3877.69	3989.04	4098.13	4205.14	4310.24
0.05	2509.72	2704.37	2863.51	3009.93	3148.12	3280.18	3407.35	3530.43	3650.01	3766.52	3880.28	3991.57	4100.61	4207.58	4312.63
0.075	2515.27	2708.29	2867.04	3013.22	3151.25	3283.18	3410.24	3533.23	3652.73	3769.17	3882.87	3994.10	4103.09	4210.01	4315.02
0.1	2520.45	2712.14	2870.53	3016.49	3154.36	3286.16	3413.11	3536.02	3655.44	3771.81	3885.45	3996.63	4105.57	4212.44	4317.40
0.125	2525.29	2715.91	2873.99	3019.74	3157.45	3289.13	3415.98	3538.80	3658.14	3774.44	3888.02	3999.15	4108.03	4214.86	4319.78
0.15	2529.89	2719.62	2877.41	3022.97	3160.53	3292.09	3418.84	3541.57	3660.84	3777.07	3890.59	4001.66	4110.50	4217.28	4322.15
0.175	2534.31	2723.25	2880.81	3026.18	3163.59	3295.03	3421.68	3544.33	3663.53	3779.69	3893.15	4004.17	4112.96	4219.69	4324.52
0.2	2538.58	2726.80	2884.16	3029.36	3166.63	3297.96	3424.52	3547.08	3666.21	3782.31	3895.71	4006.67	4115.41	4222.10	4326.89
0.225	2542.72	2730.29	2887.48	3032.52	3169.66	3300.88	3427.34	3549.82	3668.88	3784.91	3898.26	4009.17	4117.86	4224.50	4329.25
0.25	2546.77	2733.71	2890.77	3035.66	3172.67	3303.78	3430.16	3552.56	3671.54	3787.51	3900.80	4011.66	4120.30	4226.90	4331.61
0.275	2550.74	2737.07	2894.02	3038.77	3175.66	3306.67	3432.96	3555.28	3674.19	3790.11	3903.34	4014.14	4122.73	4229.29	4333.96
0.3	2554.62	2740.36	2897.23	3041.86	3178.64	3309.55	3435.75	3558.00	3676.84	3792.69	3905.87	4016.62	4125.17	4231.68	4336.30
0.325	2558.44	2743.59	2900.41	3044.93	3181.60	3312.41	3438.53	3560.70	3679.48	3795.27	3908.39	4019.09	4127.59	4234.06	4338.64
0.35	2562.20	2746.77	2903.56	3047.97	3184.54	3315.26	3441.29	3563.40	3682.11	3797.84	3910.90	4021.56	4130.01	4236.44	4340.98
0.375	2565.90	2749.89	2906.67	3050.99	3187.46	3318.10	3444.05	3566.08	3684.73	3800.40	3913.41	4024.02	4132.42	4238.81	4343.31
0.4	2569.55	2752.97	2909.74	3053.98	3190.37	3320.92	3446.80	3568.76	3687.34	3802.96	3915.92	4026.47	4134.83	4241.17	4345.64
0.425	2573.16	2756.00	2912.78	3056.96	3193.26	3323.73	3449.53	3571.42	3689.95	3805.50	3918.41	4028.92	4137.24	4243.54	4347.96
0.45	2576.72	2759.00	2915.79	3059.90	3196.13	3326.52	3452.25	3574.08	3692.54	3808.04	3920.90	4031.36	4139.63	4245.89	4350.28
0.475	2580.24	2761.95	2918.76	3062.83	3198.98	3329.30	3454.96	3576.72	3695.13	3810.58	3923.38	4033.80	4142.03	4248.24	4352.59
0.5	2583.72	2764.87	2921.70	3065.73	3201.81	3332.06	3457.66	3579.36	3697.71	3813.10	3925.86	4036.23	4144.41	4250.59	4354.90
0.525	2587.17	2767.76	2924.61	3068.61	3204.63	3334.82	3460.34	3581.98	3700.27	3815.62	3928.33	4038.65	4146.79	4252.93	4357.20
0.55	2590.58	2770.61	2927.49	3071.46	3207.43	3337.55	3463.02	3584.60	3702.84	3818.13	3930.79	4041.06	4149.17	4255.26	4359.50
0.575	2593.96	2773.44	2930.34	3074.29	3210.21	3340.28	3465.68	3587.21	3705.39	3820.63	3933.24	4043.48	4151.54	4257.59	4361.79
0.6	2597.31	2776.24	2933.16	3077.10	3212.98	3342.98	3468.33	3589.80	3707.93	3823.12	3935.69	4045.88	4153.90	4259.92	4364.08

- 7 Execute the function in cell A50. The MATLAB software plots and labels the interpolated data on a three-dimensional color surface, with the color proportional to the interpolated volume data.



When you finish the example, close the figure window.

Pricing Stock Options Using the Binomial Model

The Financial Toolbox™ product provides functions that compute prices, sensitivities, and profits for portfolios of options or other equity derivatives. This example uses the binomial model to price an option. The binomial model assumes that the probability of each possible price over time follows a binomial distribution. That is, prices can move to only two values, one up or one down, over any short time period. Plotting these two values over time is known as building a *binomial tree*.

This example organizes and displays input and output data using a Microsoft® Excel® worksheet. Spreadsheet Link™ EX functions copy data to a MATLAB® matrix, calculate the prices, and return data to the worksheet.

Note This example requires the Financial Toolbox software.

- 1 Click the **Sheet4** tab on Ex1iSamp.xls to open the worksheet for this example.

2 Solving Problems with the Spreadsheet Link™ EX software

The screenshot shows an Excel spreadsheet titled "Copy of ExlSamp [Comp...]" with the following content:

	A	B	C	D	E	F	G	H	I	J	K	
1	Binomial Option Pricing											
2												
3		bindata		Spreadsheet Link EX Functions								
4	Asset price, so	\$ 52.00		1. Transfer data to MATLAB.								
5	Option exercise price, x	\$ 50.00		0 <== MLPutMatrix("b", bindata)								
6	Risk-free interest rate, r	10%		2. Execute MATLAB Financial Toolbox binomial option pricing function.								
7	Time to maturity, t (yrs)	0.416667	=5/12	#COMMA <== MLEvalString("[p, o]=binprice(b(1), b(2), b(3), b(4), b(5), b(6), b(7))")								
8	Time increment, dt	0.083333	=1/12									
9	Volatility, sig	0.4		3. Transfer output data to Excel.								
10	Call (1) or put (0), flag	0		#NONEXIS <== MLGetMatrix("p", "asset_tree")								
11				#NONEXIS <== MLGetMatrix("o", "value_tree")								
12												
13												
14				Start	Period 1	Period 2	Period 3	Period 4	Period 5			
15	Asset price tree, p (\$)	0.011	-0.613	11.971	-97.507	331.414	156.731					
16												
17												
18												
19												
20												
21												
22												
23	Option value tree, o (\$)											
24												
25												
26												
27												
28												

The worksheet contains three named ranges:

- B4:B10 named bindata. Two cells in bindata contain formulas:
 - B7 contains =5/12
 - B8 contains =1/12
- B15 named asset_tree.
- B23 named value_tree.

2 Make D5 the active cell. Press **F2**; then press **Enter** to execute the Spreadsheet Link EX function that copies the asset data to the MATLAB workspace.

3 Move to D8 and execute the function that computes the binomial prices.

- 4 Execute the functions in D11 and D12 to copy the price data to the Excel® worksheet.

The worksheet looks as follows.

The screenshot shows an Excel spreadsheet titled "Copy of Exd1Samp [Comp:...]". The worksheet contains the following data and formulas:

	A	B	C	D	E	F	G	H	I	J	K
1	Binomial Option Pricing										
2											
3		bindata		Spreadsheet Link EX Functions							
4	Asset price, so	\$ 52.00		1. Transfer data to MATLAB.							
5	Option exercise price, x	\$ 50.00		0 <== MLPutMatrix("b", bindata)							
6	Risk-free interest rate, r	10%									
7	Time to maturity, t (yrs)	0.416667 =5/12		2. Execute MATLAB Financial Toolbox binomial option pricing function.							
8	Time increment, dt	0.083333 =1/12		0 <== MLEvalString("[p, o]=binprice(b(1), b(2), b(3), b(4), b(5), b(6), b(7))")							
9	Volatility, sig	0.4									
10	Call (1) or put (0), flag	0		3. Transfer output data to Excel.							
11				0 <== MLGetMatrix("p", "asset_tree")							
12				0 <== MLGetMatrix("o", "value_tree")							
13											
14		Start	Period 1	Period 2	Period 3	Period 4	Period 5				
15	Asset price tree, p (\$)	52.000	58.365	65.509	73.527	82.527	92.628				
16		0	46.329	52.000	58.365	65.509	73.527				
17		0	0	41.277	46.329	52.000	58.365				
18		0	0	0	36.776	41.277	46.329				
19		0	0	0	0	32.765	36.776				
20		0	0	0	0	0	29.192				
21											
22											
23	Option value tree, o (\$)	3.728	1.664	0.428	0	0	0				
24		0	5.918	2.964	0.876	0	0				
25		0	0	9.060	5.164	1.793	0				
26		0	0	0	13.224	8.723	3.671				
27		0	0	0	0	17.235	13.224				
28		0	0	0	0	0	20.808				

Read the asset price tree as follows:

- Period 1 shows the up and down prices.
- Period 2 shows the up-up, up-down, and down-down prices.
- Period 3 shows the up-up-up, up-up, down-down, and down-down-down prices.
- And so on.

Ignore the zeros. The option value tree gives the associated option value for each node in the price tree. The option value is zero for prices significantly

above the exercise price. Ignore the zeros that correspond to a zero in the price tree.

- 5 Try changing the data in B4:B10 and reexecuting the Spreadsheet Link EX functions.

Note If you increase the time to maturity (B7) or change the time increment (B8), you may need to enlarge the output tree areas.

- 6 When you finish the example, close the figure window.

Calculating and Plotting the Efficient Frontier of Financial Portfolios

MATLAB® and Financial Toolbox™ functions compute and plot risks, variances, rates of return, and the efficient frontier of portfolios. Efficient portfolios have the lowest aggregate variance, or risk, for a given return. Microsoft® Excel® and the Spreadsheet Link™ EX software let you set up data, execute financial functions and MATLAB graphics, and display numeric results.

This example analyzes three portfolios, using rates of return for six time periods. In actual practice, these functions can analyze many portfolios over many time periods, limited only by the amount of computer memory available.

Note This example requires the Financial Toolbox software.

- 1 Click the **Sheet5** tab on Ex1iSamp.xls. The worksheet for this example appears.

2 Solving Problems with the Spreadsheet Link™ EX software

	A	B	C	D	E	F	G	H	I	J
1	Portfolio Efficient Frontier									
2										
3	Rates of return	Global	Corp. Bnd	Small Cap		Risk	ROR	Global Weights	Corp. Bnd	Small Cap
4	Nov-91	7.125%	4.125%	8.375%						
5	Nov-92	5.125%	5.125%	3.875%						
6	Nov-93	-1.375%	5.750%	10.500%						
7	Nov-94	7.750%	6.000%	14.750%						
8	Nov-95	8.250%	6.375%	-3.625%						
9	Nov-96	12.625%	6.125%	9.125%						
10										
11										
12										
13	Spreadsheet Link EX Functions									
14	1. Transfer data to MATLAB.									
15		0	<== MLPutMatrix("Labels", F3:G3)							
16		0	<== MLPutMatrix("retseries", B4:D9)							
17										
18	2. Execute MATLAB Financial Toolbox functions.									
19		0	<== MLEvalString("ret, cov) = ewstats(retseries)")							
20	#COMMAND!		<== MLEvalString("risk, ror, weights) = portopt(ret, cov, 20)")							
21										
22	3. Transfer output data to Excel.									
23	#NONEXIST!		<== MLGetMatrix("risk", "F4")							
24	#NONEXIST!		<== MLGetMatrix("ror", "G4")							
25	#NONEXIST!		<== MLGetMatrix("weights", "H4")							
26										
27	4. Plot efficient frontier data and label the figure.									
28	#COMMAND!		<== MLEvalString("portopt(ret, cov, 20); grid on; xlabel(Labels{1}); ylabel(Labels{2})")							

- 2 Make A15 the active cell. Press **F2**; then press **Enter**. The Spreadsheet Link EX function transfers the labels that describe the output that the MATLAB software computes.
- 3 Make A16 the active cell to copy the portfolio return data to the MATLAB workspace.
- 4 Execute the functions in A19 and A20 to compute the Financial Toolbox efficient frontier function for 20 points along the frontier.
- 5 Execute the Spreadsheet Link EX functions in A23, A24, and A25 to copy the output data to the Excel® worksheet.

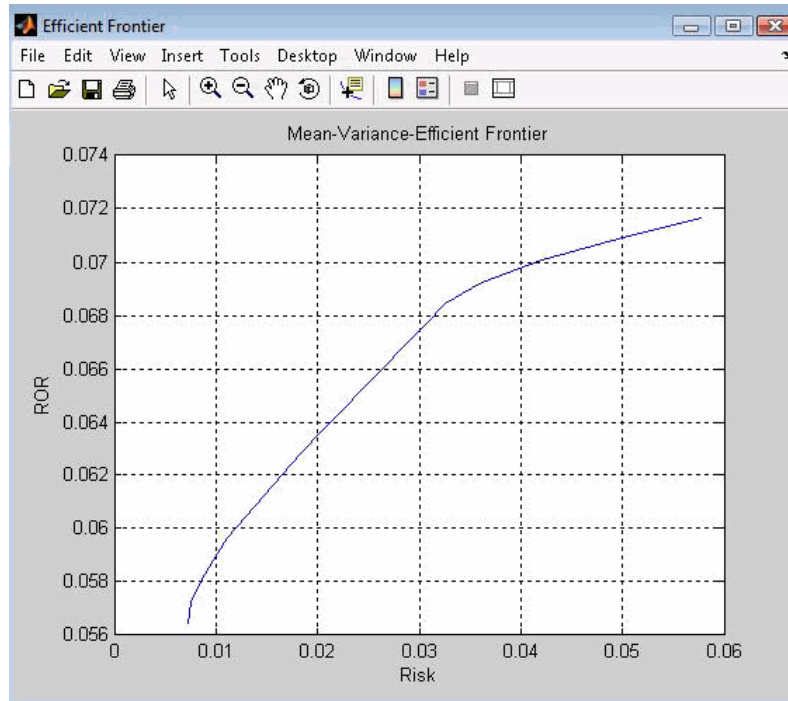
The worksheet looks as follows.

Portfolio Efficient Frontier				Risk	ROR	Global Weights	Corp. Bnd	Small Cap	
4		Global	Corp. Bnd	Small Cap					
4	Nov-91	7.125%	4.125%	8.375%	0.730%	5.643%	0.3%	96.1%	3.5%
5	Nov-92	5.125%	5.125%	3.875%	0.760%	5.723%	4.0%	89.7%	6.3%
6	Nov-93	-1.375%	5.750%	10.500%	0.844%	5.803%	7.7%	83.3%	9.0%
7	Nov-94	7.750%	6.000%	14.750%	0.968%	5.883%	11.3%	76.9%	11.8%
8	Nov-95	8.250%	6.375%	-3.625%	1.118%	5.964%	15.0%	70.5%	14.5%
9	Nov-96	12.625%	6.125%	9.125%	1.287%	6.044%	18.7%	64.0%	17.3%
10					1.466%	6.124%	22.3%	57.6%	20.0%
11					1.653%	6.204%	26.0%	51.2%	22.8%
12					1.846%	6.284%	29.7%	44.8%	25.5%
13	Spreadsheet Link EX Functions				2.042%	6.365%	33.3%	38.4%	28.3%
14	1. Transfer data to MATLAB				2.241%	6.445%	37.0%	32.0%	31.1%
15		0	<== MLPutMatrix("Labels", F3:G3)		2.443%	6.525%	40.6%	25.6%	33.8%
16		0	<== MLPutMatrix("retseries", B4:D9)		2.646%	6.605%	44.3%	19.1%	36.6%
17					2.850%	6.685%	48.0%	12.7%	39.3%
18	2. Execute MATLAB Financial Toolbox functions.				3.055%	6.766%	51.6%	6.3%	42.1%
19		0	<== MLEvalString("[ret, cov] = ewstats(retseries)")		3.262%	6.846%	55.0%	0.0%	45.0%
20		0	<== MLEvalString("[risk, ror, weights] = portopt(ret, cov, 20)")		3.620%	6.926%	41.3%	0.0%	58.7%
21					4.213%	7.006%	27.5%	0.0%	72.5%
22	3. Transfer output data to Excel.				4.955%	7.086%	13.8%	0.0%	86.2%
23		0	<== MLGetMatrix("risk", "F4")		5.791%	7.167%	0.0%	0.0%	100.0%
24		0	<== MLGetMatrix("ror", "G4")						
25		0	<== MLGetMatrix("weights", "H4")						
26									
27	4. Plot efficient frontier data and label the figure.								
28	#COMMAND!	<== MLEvalString("portopt(ret, cov, 20); grid on; xlabel(Labels(1)); ylabel(Labels(2))")							

The data describes the efficient frontier for these three portfolios: that set of points representing the highest rate of return (ROR) for a given risk. For each of the 20 points along the frontier, the weighted investment in each portfolio (Weights) would achieve that rate of return.

- 6 Now move to A28 and press **F2**; then press **Enter** to execute the Financial Toolbox function that plots the efficient frontier for the same portfolio data.

The following figure appears.



The light blue line shows the efficient frontier. Note the change in slope above a 6.8% return because the Corporate Bond portfolio no longer contributes to the efficient frontier.

- 7 To try running this example using different data, close the figure window and change the data in cells B4:D9. Then reexecute all the Spreadsheet Link EX functions. The worksheet then shows the new frontier data, and the MATLAB software displays a new efficient frontier graph.

When you finish this example, close the figure window.

- 3** Make A19 the active cell to transfer the column vector Coupon Rate to the MATLAB workspace.
- 4** Make A20 the active cell to transfer the settlement date to the MATLAB workspace.
- 5** Execute the functions in cells A23 and A24 to enable the Financial Toolbox software to compute cash flow amounts and dates.
- 6** Now execute the functions in cells A27 through A29 to transform the dates into string form contained in a cell array.
- 7** Execute the functions in cells A32 through A34 to transfer the data to the Excel® worksheet.

Copy of ExlSamp [Compatibility Mode] - Microsoft Excel

M1

Cash Flow and Time Mapping for a Portfolio of Bonds

Settlement Date 26-Jul-99

Bond Data	
Bond	Maturity Coupon Rate
Bond1	15-Nov-99 0.05875
Bond2	15-May-00 0.06375
Bond3	15-Nov-00 0.08500
Bond4	15-May-01 0.08000
Bond5	15-Nov-01 0.15750

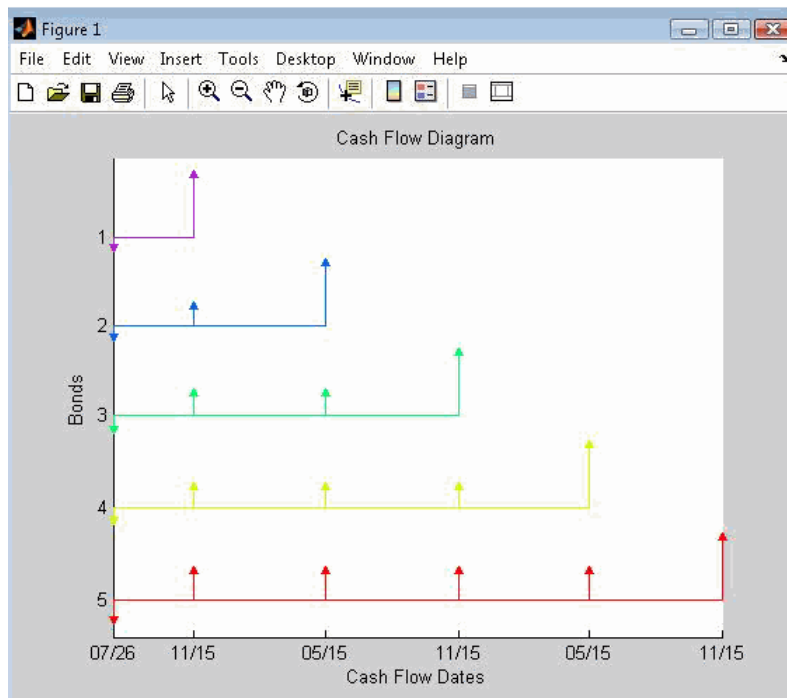
Cash Flow Dates						
Bond	7/26/1999	11/15/1999	5/15/2000	11/15/2000	5/15/2001	11/15/2001
Bond1	7/26/1999	11/15/1999	N/A	N/A	N/A	N/A
Bond2	7/26/1999	11/15/1999	5/15/2000	N/A	N/A	N/A
Bond3	7/26/1999	11/15/1999	5/15/2000	11/15/2000	N/A	N/A
Bond4	7/26/1999	11/15/1999	5/15/2000	11/15/2000	5/15/2001	N/A
Bond5	7/26/1999	11/15/1999	5/15/2000	11/15/2000	5/15/2001	11/15/2001

Cash Flow Amounts						
Bond	7/26/1999	11/15/1999	5/15/2000	11/15/2000	5/15/2001	11/15/2001
Bond1	-1.1495	102.9375	0	0	0	0
Bond2	-1.2473	3.1875	103.1875	0	0	0
Bond3	-1.8630	4.2500	4.2500	104.2500	0	0
Bond4	-1.5652	4.0000	4.0000	4.0000	104.0000	0
Bond5	-3.0815	7.8750	7.8750	7.8750	7.8750	107.8750

Spreadsheet Link EX Functions

- Transfer data to MATLAB.
 - 0 <= MLPutMatrix("maturity", Maturity)
 - 0 <= MLPutMatrix("cpnrate", "CpnRate")
 - 0 <= MLPutMatrix("sd", C3)
- Execute MATLAB Financial Toolbox Cash flow and Time mapping function.
 - 0 <= MLEvalString("md = x2mdate(maturity,0); sdm = x2mdate(sd,0)")
 - 0 <= MLEvalString("[cfa, cfd] = cfamounts(cpnrate, sdm, md, 2)")
- Transform date numbers to string cell array.
 - 0 <= MLEvalString("i = find(isnan(cfd)); zcfd = cfd; zcfd(i) = 0; scfd=datestr(zcfd,2);")
 - 0 <= MLEvalString("ccfd = num2cell(scfd,2); ccfdf(i) = {N/A}; ccfdf = reshape(ccfd, size(cfd));")
 - 0 <= MLEvalString("ccfa = cfa; ccfa(i) = 0; alldates = ccfdf(end, :);")
- Transfer output data to Excel.
 - 0 <= MLGetMatrix("ccfd", "i3")
 - 0 <= MLGetMatrix("alldates", "i13")
 - 0 <= MLGetMatrix("ccfa", "i14")
- Plot the cash flow diagram.
 - 0 <= MLEvalString("cfplot(cfd, cfa); dtaxis('x',5, sdm,50); title('Cash Flow Diagram'); xlabel('Cash Flow Dates'); ylabel('Bonds');")

8 Finally, execute the function in cell A37 to display a plot of the cash flows for each portfolio item.



9 When you finish the example, close the figure window.

Function Reference

- Link Management Functions (p. 3-2) Working with link management functions
- Data Management Functions (p. 3-3) Working with data management functions

Link Management Functions

<code>matlabinit</code>	Initialize Spreadsheet Link™ EX software and start MATLAB® process
<code>MLAutoStart</code>	Automatically start MATLAB process
<code>MLClose</code>	End MATLAB process
<code>MLOpen</code>	Start MATLAB process
<code>MLUseCellArray</code>	Toggle <code>MLPutMatrix</code> to use MATLAB cell arrays

Data Management Functions

<code>matlabfcn</code>	Evaluate MATLAB® command given Microsoft® Excel® data
<code>matlabsub</code>	Evaluate MATLAB command given Microsoft Excel data and designate output location
<code>MLAppendMatrix</code>	Create or append MATLAB matrix with data from Microsoft Excel worksheet
<code>MLDeleteMatrix</code>	Delete MATLAB matrix
<code>MLEvalString</code>	Evaluate command in MATLAB software
<code>MLGetFigure</code>	Import current MATLAB figure into Microsoft Excel spreadsheet
<code>MLGetMatrix</code>	Write contents of MATLAB matrix to Microsoft® Excel® worksheet
<code>MLGetVar</code>	Write contents of MATLAB matrix in Microsoft Excel VBA variable
<code>MLMissingDataAsNaN</code>	Set empty cells to NaN or 0
<code>MLPutMatrix</code>	Create or overwrite MATLAB matrix with data from Microsoft Excel worksheet
<code>MLPutVar</code>	Create or overwrite MATLAB matrix with data from Microsoft Excel VBA variable
<code>MLShowMatlabErrors</code>	Return standard Spreadsheet Link™ EX errors or full MATLAB errors using MLEvalString

MLStartDir

Specify MATLAB current working directory after startup

MLUseFullDesktop

Specify whether to use full MATLAB desktop or MATLAB Command Window

Functions — Alphabetical List

matlabfcn

Purpose Evaluate MATLAB® command given Microsoft® Excel® data

Syntax

Worksheet:	matlabfcn(command, inputs)
command	MATLAB command to evaluate. Embed the command in double quotation marks; for example, "command".
inputs	Variable length input argument list passed to a MATLAB command. The argument list may contain a range of worksheet cells that contain input data.

Description Passes the command to the MATLAB workspace for evaluation, given the function input data. The function returns a single value or string depending upon the MATLAB output. The result is returned to the calling worksheet cell. This function is intended for use as an Excel® worksheet function.

Examples

- 1 Add the data in worksheet cells B1 through B10, and then return the sum to the active worksheet cell:

```
matlabfcn("sum", B1:B10)
```

- 2 Plot the data in worksheet cells B1 through B10, using x as the marker type:

```
matlabfcn("plot", B1:B10, "x")
```

See Also matlabsub

Purpose Initialize Spreadsheet Link™ EX software and start MATLAB® process

Syntax matlabinit

Note To run matlabinit from the Microsoft® Excel® toolbar, click **Tools > Macro**. In the **Macro Name/Reference** box, enter matlabinit and click **Run**. Alternatively, you could include this function in a macro subroutine. You cannot run matlabinit as a worksheet cell formula or in a macro function.

Description Initializes the Spreadsheet Link EX software and starts MATLAB process. If the Spreadsheet Link EX software has been initialized and the MATLAB software is running, subsequent invocations do nothing. Use matlabinit to start Spreadsheet Link EX and MATLAB software sessions manually when you have set MLAutoStart to no. If you set MLAutoStart to yes, matlabinit executes automatically.

See Also MLAutoStart, MLOpen

Purpose

Evaluate MATLAB® command given Microsoft® Excel® data and designate output location

Syntax

Worksheet:	matlabsub(command, edat, inputs)
command	MATLAB command to evaluate. Enter the MATLAB command in double quotation marks, as "command".
edat	Worksheet location where the function writes the returned data. "edat" (in quotation marks) directly specifies the location and it must be a cell address or a range name. edat (without quotation marks) is an indirect reference: the function evaluates the contents of edat to get the location. edat must be a worksheet cell address or range name.
inputs	Variable length input argument list passed to MATLAB command. This argument list can contain a range of worksheet cells that contain input data.

Description

Passes the specified command to the MATLAB workspace for evaluation, given the function input data. The function returns a single value or string depending upon the MATLAB output. This function is intended for use as an Excel® worksheet function.

To return an array of data to theMicrosoft® Excel Visual Basic® for Applications (VBA) workspace, see MLEvalString and MLGetVar.

Caution edat must not include the cell that contains the matlabsub function. In other words, be careful not to overwrite the function itself. Also make sure there is enough room in the worksheet to write the matrix contents. If there is insufficient room, the function generates a fatal error.

Examples

Sum the data in worksheet cells B1 through B10, and then return the output to cell A1:

```
matlabsub("sum", "A1", B1:B10)
```

See Also

matlabfcn

MLAppendMatrix

Purpose Create or append MATLAB® matrix with data from Microsoft® Excel® worksheet

Syntax

Worksheet:	MLAppendMatrix(var_name, mdat)
Macro:	MLAppendMatrix var_name, mdat
var_name	Name of MATLAB matrix to which to append data. "var_name" (in quotation marks) directly specifies the matrix name. var_name (without quotation marks) is an indirect reference: the function evaluates the contents of var_name to get the matrix name, and var_name must be a worksheet cell address or range name
mdat	Location of data to append to var_name. mdat (no quotation marks). Must be a worksheet cell address or range name. If this argument is not initially an Excel® Range data type and you call the function from a worksheet, MLAppendMatrix performs the necessary type coercion. If this argument is not an Excel Range data type and you call the function from within a Microsoft® Visual Basic® macro, the call fails. The error message ByRef Argument Type Mismatch appears.

Description Appends data in mdat to MATLAB matrix var_name. Creates var_name if it does not exist. The function checks the dimensions of var_name and mdat to determine how to append mdat to var_name. If the dimensions allow appending mdat as either new rows or new columns, it appends mdat to var_name as new rows. If the dimensions do not match, the function returns an error. mdat must contain either numeric data or string data. Data types cannot be combined within the range specified

in `mdat`. Empty `mdat` cells become MATLAB matrix elements containing zero if the data is numeric, and empty strings if the data is a string.

Examples

Example 1: Append data from a worksheet cell range to a MATLAB matrix

In this example, `B` is a 2-by-2 MATLAB matrix. Append the data in worksheet cell range `A1:A2` to `B`:

```
MlAppendMatrix("B", A1:A2)
```

		A1
		A2

`B` is now a 2-by-3 matrix with the data from `A1:A2` in the third column.

Example 2: Append data from a named worksheet cell range to a MATLAB matrix

`B` is a 2-by-2 MATLAB matrix. Cell `C1` contains the label (string) `B`, and `new_data` is the name of the cell range `A1:B2`. Append the data in cell range `A1:B2` to `B`:

```
MlAppendMatrix(C1, new_data)
```

`B` is now a 4-by-2 matrix with the data from `A1:B2` in the last two rows.

A1	B1
A2	B2

See Also

`MlPutMatrix`

MLAutoStart

Purpose	Automatically start MATLAB® process
Syntax	Worksheet: MLAutoStart("yes") MLAutoStart("no") Macro: MLAutoStart "yes" MLAutoStart "no" "yes" Automatically start the Spreadsheet Link™ EX and MATLAB software every time a Microsoft® Excel® software session starts (default). "no" Cancel automatic startup of the Spreadsheet Link EX and MATLAB software. If these products are running, it does not stop them.
Description	Sets automatic startup of the Spreadsheet Link EX and MATLAB software. When the Spreadsheet Link EX software is installed, the default is yes. A change of state takes effect the next time an Excel® software session starts.
Examples	Cancel automatic startup of the Spreadsheet Link EX and MATLAB software: MLAutoStart("no") These products do not start on subsequent Excel session invocations.
See Also	matlabinit, MLClose, MLOpen

Purpose End MATLAB® process

Syntax

Worksheet:	MLClose()
Macro:	MLClose

Description Ends the MATLAB process, deletes all variables from the MATLAB workspace, and tells the Microsoft® Excel® software that the MATLAB software is no longer running. If no MATLAB process is running, nothing happens.

See Also MLOpen

MLDeleteMatrix

Purpose Delete MATLAB® matrix

Syntax

Worksheet:	MLDeleteMatrix(var_name)
Macro:	MLDeleteMatrix var_name
var_name	Name of MATLAB matrix to delete. "var_name" (in quotation marks) directly specifies the matrix name. var_name (without quotation marks) is an indirect reference: the function evaluates the contents of var_name to determine the matrix name, and var_name must be a worksheet cell address or range name.

Description Deletes the named matrix from the MATLAB workspace.

Example Delete matrix A from the MATLAB workspace:

```
MLDeleteMatrix("A")
```

Purpose Evaluate command in MATLAB® software

Syntax

Worksheet:	MLEvalString(command)
Macro:	MLEvalString command
command	MATLAB command to evaluate. "command" (in quotation marks) directly specifies the command. command (without quotation marks) is an indirect reference: the function evaluates the contents of command to get the command, and command must be a worksheet cell address or range name.

Description Passes a command string to the MATLAB software for evaluation. The specified action alters only the MATLAB workspace. It has no effect on the Microsoft® Excel® workspace.

Examples Divide the MATLAB variable b by 2, and then plot it:

```
MLEvalString("b = b/2;plot(b)")
```

This command only modifies the MATLAB variable b. To update data in the Excel® worksheet, use MLGetMatrix.

See Also MLGetMatrix

MLGetFigure

Purpose Import current MATLAB® figure into Microsoft® Excel® spreadsheet

Syntax

Worksheet:	MLGetFigure(width,height)
Macro:	MLGetFigure width, height
width	Specify the width in normalized units of the MATLAB figure when imported into an Excel® worksheet.
height	Specify the height in normalized units of the MATLAB figure when imported into an Excel worksheet.

Description Import the current MATLAB figure into an Excel worksheet, where the top-left corner of the figure is the current spreadsheet cell.

If worksheet calculation mode is automatic, MLGetFigure executes when you enter the formula in a cell. If worksheet calculation mode is manual, enter the MLGetFigure function in a cell, then press F9 to execute it. However, pressing F9 in this situation may also reexecute other worksheet functions and generate unpredictable results.

If you use MLGetFigure in a macro subroutine, enter MatlabRequest on the line after the MLGetFigure. MatlabRequest initializes internal Spreadsheet Link™ EX variables and enables MLGetFigure to function in a subroutine. Do not include MatlabRequest in a macro function unless the function is called from a subroutine.

Examples Import the current MATLAB figure into an Excel worksheet. Adjust the width of the figure to be half that of the original figure, and the height to be a quarter that of the original figure:

```
MLGetFigure(.50,.25)
```

See Also MLGetMatrix, MLGetVar

Purpose Write contents of MATLAB® matrix to Microsoft® Excel® worksheet

Syntax

Worksheet: MLGetMatrix(var_name, edat)

Macro: MLGetMatrix var_name, edat

var_name Name of MATLAB matrix to access. "var_name" (in quotation marks) directly specifies the matrix name. var_name (without quotation marks) is an indirect reference: the function evaluates the contents of var_name to get the matrix name, and var_name must be a worksheet cell address or range name. var_name cannot be the MATLAB variable ans.

edat Worksheet location where the function writes the contents of var_name. "edat" (in quotation marks) directly specifies the location and it must be a cell address or a range name. edat (without quotation marks) is an indirect reference: the function evaluates the contents of edat to get the location, and edat must be a worksheet cell address or range name.

Description

Writes the contents of MATLAB matrix var_name in the Excel worksheet, beginning in the upper-left cell specified by edat. If data exists in the specified worksheet cells, it is overwritten. If the dimensions of the MATLAB matrix are larger than that of the specified cells, the data overflows into additional rows and columns.

Caution

edat must not include the cell that contains the MLGetMatrix function. In other words, be careful not to overwrite the function itself. Also make sure there is enough room in the worksheet to write the matrix contents. If there is insufficient room, the function generates a fatal error.

MLGetMatrix function does not automatically adjust cell addresses. If edat is an explicit cell address, edit it to correct the address when you do either of the following:

- Insert or delete rows or columns.
- Move or copy the function to another cell.

If worksheet calculation mode is automatic, MLGetMatrix executes when you enter the formula in a cell. If worksheet calculation mode is manual, enter the MLGetMatrix function in a cell, and then press **F9** to execute it. However, pressing **F9** in this situation may also reexecute other worksheet functions and generate unpredictable results.

If you use MLGetMatrix in a macro subroutine, enter MatlabRequest on the line after the MLGetMatrix. MatlabRequest initializes internal Spreadsheet Link™ EX variables and enables MLGetMatrix to function in a subroutine. Do not include MatlabRequest in a macro function unless the function is called from a subroutine.

Examples

Example 1

Write the contents of the MATLAB matrix bonds starting in cell C10 of Sheet2. If bonds is a 4-by-3 matrix, fill cells C10..E13 with data:

```
MLGetMatrix("bonds", "Sheet2!C10")
```

Example 2

Access the MATLAB matrix named by the string in worksheet cell B12. Write the contents of the matrix to the worksheet starting at the location named by the string in worksheet cell B13:

```
MLGetMatrix(B12, B13)
```

Example 3

Write the contents of MATLAB matrix A to the worksheet, starting at the cell named by RangeA:


```
Sub Get_RangeA()  
MLGetMatrix "A", "RangeA"  
MatlabRequest  
End Sub
```

Example 4

In a macro, use the Address property of the range object returned by the VBA Cells function to specify where to write the data:

```
Sub Get_Variable()  
MLGetMatrix "X", Cells(3, 2).Address  
MatlabRequest  
End Sub
```

See Also

MLAppendMatrix, MLPutMatrix

MLGetVar

Purpose Write contents of MATLAB® matrix in Microsoft® Excel® VBA variable

Syntax MLGetVar ML_var_name, VBA_var_name

ML_var_name Name of MATLAB matrix to access. "ML_var_name" (in quotation marks) directly specifies the matrix name. ML_var_name (without quotation marks) is an indirect reference: the function evaluates the contents of ML_var_name to get the matrix name, and ML_var_name must be a VBA variable containing the matrix name as a string. var_name cannot be the MATLAB variable ans.

VBA_var_name Name of VBA variable where the function writes the contents of ML_var_name. Use VBA_var_name without quotation marks.

Description Writes the contents of MATLAB matrix ML_var_name in the Excel® Visual Basic® for Applications (VBA) variable VBA_var_name. Creates VBA_var_name if it does not exist. Replaces existing data in VBA_var_name.

Examples Write the contents of the MATLAB matrix J into the VBA variable DataJ:

```
Sub Fetch()  
MLGetVar "J", DataJ  
End Sub
```

See Also MLPutVar

Purpose Set empty cells to NaN or 0

Syntax

Worksheet:	MLMissingDataAsNaN("yes")
	MLMissingDataAsNaN("no") (Default)
Macro:	MLMissingDataAsNaN "yes"
	MLMissingDataAsNaN "no" (Default)
"yes"	Sets empty cells to use NaNs.
"no"	Sets empty cells to use 0s. (Default)

Description Sets empty cells to NaN or 0. When the Spreadsheet Link™ EX software is installed, the default is "no", so empty cells are handled as 0s. If you change the value of MLUseCellArray to "yes", the change remains in effect the next time a Microsoft® Excel® software session starts.

Note A string in an Excel® range always forces cell array output and empty cells as NaNs.

Examples Cancel the use of NaNs for empty cells:

```
MLMissingDataAsNaN('no')
```

See Also MLPutMatrix

MLOpen

Purpose Start MATLAB® process

Syntax

Worksheet:	MLOpen()
Macro:	MLOpen

Description Starts MATLAB process. If a MATLAB process has already started, subsequent calls to MLOpen do nothing. Use MLOpen to restart the MATLAB software session after you have stopped it with MLClose in a given Microsoft® Excel® software session.

Note We recommend using matlabinit rather than MLOpen, since matlabinit starts a MATLAB software session and initializes the Spreadsheet Link™ EX software.

Examples Starts a MATLAB session:

```
MLOpen()
```

See Also matlabinit, MLClose

Purpose Create or overwrite MATLAB® matrix with data from Microsoft® Excel® worksheet

Syntax

Worksheet: `MLPutMatrix(var_name, mdat)`

Macro: `MLPutMatrix var_name, mdat`

`var_name` Name of MATLAB matrix to create or overwrite. "var_name" (in quotation marks) directly specifies the matrix name. `var_name` (without quotation marks) is an indirect reference: the function evaluates the contents of `var_name` to get the matrix name, and `var_name` must be a worksheet cell address or range name.

`mdat` Location of data to copy into `var_name`. `mdat` (no quotation marks). Must be a worksheet cell address or range name.

Description Creates or overwrites matrix `var_name` in MATLAB workspace with specified data in `mdat`. Creates `var_name` if it does not exist. If `var_name` exists, this function replaces the contents with `mdat`. Empty numeric data cells within the range of `mdat` become numeric zeros within the MATLAB matrix identified by `var_name`.

If any element of `mdat` contains string data, `mdat` is exported as a MATLAB cell array. Empty string elements within the range of `mdat` become NaNs within the MATLAB cell array.

When using `MLPutMatrix` in a subroutine, indicate the source of the worksheet data using the Microsoft Excel macro `Range`. For example:

```
Sub test()  
  MLPutMatrix "a", Range("A1:A3")  
End Sub
```

If you have a named range in your worksheet, you can specify the name instead of the range; for example:

```
Sub test()  
MLPutMatrix "a", Range("temp")  
End Sub
```

where temp is a named range in your worksheet.

Examples

Example 1 – Create or overwrite a matrix in the MATLAB workspace

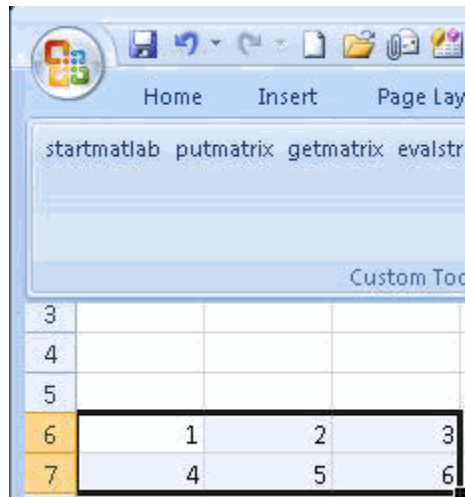
Create or overwrite matrix A in the MATLAB workspace with the data in the worksheet range A1:C3:

```
MLPutMatrix "A", Range("A1:C3")
```

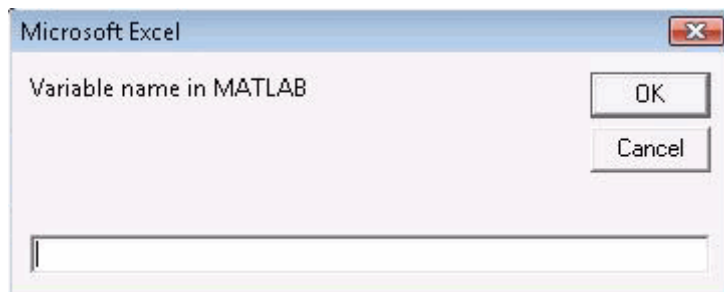
Example 2 – Use the putmatrix toolbar button to import data from a Microsoft Excel worksheet to the MATLAB workspace

Use the **putmatrix** toolbar button to import data from an Excel® worksheet to the MATLAB workspace:

- 1 In the Excel worksheet, select the columns and/or rows you want to export to the MATLAB workspace.



- 2 Click the **putmatrix** button on the Spreadsheet Link™ EX toolbar. A window appears that prompts you to specify the name of the MATLAB variable in which you want to store your data.



- 3 Enter `newmatrix` for the MATLAB variable name.
- 4 Click **OK**.

Now you can manipulate `newmatrix` in the MATLAB Command Window.

```
newmatrix
```

MLPutMatrix

```
newmatrix =
```

```
  1  2  3  
  4  5  6
```

See Also

MLAppendMatrix, MLGetMatrix

Purpose Create or overwrite MATLAB® matrix with data from Microsoft® Excel® VBA variable

Syntax `MLPutVar ML_var_name, VBA_var_name`

`ML_var_name` Name of MATLAB matrix to create or overwrite. "ML_var_name" (in quotation marks) directly specifies the matrix name. ML_var_name (without quotation marks) is an indirect reference: the function evaluates the contents of ML_var_name to get the matrix name, and ML_var_name must be a VBA variable containing the matrix name as a string.

`VBA_var_name` Name of VBA variable whose contents are written to ML_var_name. Use VBA_var_name without quotation marks.

Description Creates or overwrites matrix ML_var_name in MATLAB workspace with data in VBA_var_name. Creates ML_var_name if it does not exist. If ML_var_name exists, this function replaces the contents with data from VBA_var_name. Use MLPutVar only in a macro subroutine, not in a macro function or in a subroutine called by a function.

Empty numeric data cells within VBA_var_name become numeric zeros within the MATLAB matrix identified by ML_var_name.

If any element of VBA_var_name contains string data, VBA_var_name is exported as a MATLAB cell array. Empty string elements within VBA_var_name become NaNs within the MATLAB cell array.

Examples Create (or overwrite) the MATLAB matrix K with the data in the Excel® Visual Basic® for Applications (VBA) variable DataK.

```
Sub Put()  
    MLPutVar "K", DataK
```

MLPutVar

End Sub

See Also

MLGetVar

Purpose Return standard Spreadsheet Link™ EX errors or full MATLAB® errors using MLEvalString

Syntax

Worksheet:	MLShowMatlabErrors("yes") MLShowMatlabErrors("no") (Default)
Macro:	MLShowMatlabErrors "yes" MLShowMatlabErrors "no" (Default)
"yes"	Displays the full MATLAB error string upon MLEvalString failure.
"no"	Displays the standard Spreadsheet Link EX errors upon MLEvalString failure.

Description Sets the Spreadsheet Link EX error display mode when executing MATLAB commands using MLEvalString.

Examples

- Cause MLEvalString failures to show standard Spreadsheet Link EX errors, such as #COMMAND.

```
MLShowMatlabErrors("no")
```

- Cause MLEvalString failures to show MATLAB error strings, such as ??? Undefined function or variable 'foo'.

```
MLShowMatlabErrors("yes")
```

See Also MLEvalString

MLStartDir

Purpose Specify MATLAB® current working directory after startup

Syntax

Worksheet:	MLStartDir(path)
Macro:	MLStartDir path

path Specify the current MATLAB working directory after startup.

Description Sets the MATLAB working directory after startup. This function does not work like the standard Microsoft® Windows® **Start In** setting, because it does not automatically run startup.m or matlabrc.m in the specified directory.

Note The working directory changes only if you run MATLAB *after* you run this function. Running this function while MATLAB is running does not change the working directory for the current session. In this case, MATLAB uses the specified directory as the working directory when it is restarted.

Examples Set the MATLAB working directory to d:\work after startup:

```
MLStartDir ( d:\work )
```

If your directory path includes a space, embed the path in single quotation marks within double quotation marks. For example, to set the MATLAB working directory to d:\my work, run the command:

```
MLStartDir ( 'd:\my work' )
```

See Also MLAutoStart

Purpose Toggle MLPutMatrix to use MATLAB® cell arrays

Syntax

Worksheet:	MLUseCellArray("yes") MLUseCellArray("no")
Macro:	MLUseCellArray "yes" MLUseCellArray "no"
"yes"	Automatically uses cell arrays for transfer of data structures.
"no"	Do not automatically use cell arrays for transfer of data (default).

Description Using MLUseCellArray forces MLPutMatrix to use cell arrays for transfer of data (for example, dates). When the Spreadsheet Link™ EX software is installed, the default is "no". If you change the value of MLUseCellArray to "yes", the change remains in effect the next time a Microsoft® Excel® software session starts.

Examples Cancel automatic use of cell arrays for easy transfer of data:

```
MLUseCellArray("no")
```

See Also MLPutMatrix

MLUseFullDesktop

Purpose Specify whether to use full MATLAB® desktop or MATLAB Command Window

Syntax

Worksheet:	MLUseFullDesktop("yes") MLUseFullDesktop("no")
Macro:	MLUseFullDesktop "yes" MLUseFullDesktop "no"
"yes"	Start full MATLAB desktop.
"no"	Start the MATLAB Command Window only.

Description Sets the MATLAB software session to start with the full desktop or Command Window only. When the Spreadsheet Link™ EX software is installed, the default is "yes".

Examples Start only the MATLAB Command Window:

```
MLUseFullDesktop("no")
```

See Also matlabinit, MLClose, MLOpen

Error Messages and Troubleshooting

This appendix covers the following topics:

Worksheet Cell Errors (p. A-2)	Error messages displayed in a worksheet cell
Microsoft® Excel® Software Errors (p. A-5)	Microsoft® Excel® error messages and their meanings
Data Errors (p. A-8)	Undesirable data characteristics
Startup Errors (p. A-10)	Errors starting the Microsoft Excel or MATLAB® software
Audible Error Signals (p. A-11)	Audible error signals while passing data to the MATLAB workspace

Worksheet Cell Errors

You may see these error messages displayed in a worksheet cell.

The first column of the following table contains worksheet cell error messages. The error messages begin with the number sign (#). Most end with an exclamation point (!) or with a question mark (?).

Worksheet Cell Error Messages

Worksheet Cell Error Message	Meaning	Solution
#COLS>#MAXCOLS!	Your MATLAB® variable exceeds the Microsoft® Excel® limit of #MAXCOLS! columns.	This is a limitation in the Excel® product. Try the computation with a variable containing fewer columns.
#COMMAND!	The MATLAB software does not recognize the command in an MLEvalString function. The command may be misspelled.	Verify the spelling of the MATLAB command. Correct typing errors.
#DIMENSION!	You used MlAppendMatrix and the dimensions of the appended data do not match the dimensions of the matrix you want to append.	Verify the matrix dimensions and the appended data dimensions, and correct the argument. For more information, see the MlAppendMatrix reference page.
#INVALIDNAME!	You entered an illegal variable name.	Make sure to use legal MATLAB variable names. MATLAB variable names must start with a letter followed by up to 30 letters, digits, or underscores.
#INVALIDTYPE!	You have specified an illegal MATLAB data type with MlGetVar or MlGetMatrix.	For a list of supported MATLAB data types, see “Built-In Classes (Data Types)” in the MATLAB Programming Fundamentals documentation.

Worksheet Cell Error Messages (Continued)

Worksheet Cell Error Message	Meaning	Solution
#MATLAB?	You used a Spreadsheet Link™ EX function and no MATLAB software session is running.	Start the Spreadsheet Link EX and MATLAB software. See “Starting and Stopping the Spreadsheet Link™ EX Software” on page 1-12.
#NAME?	The function name is unrecognized. The excllink.xla add-in is not loaded, or the function name may be misspelled.	Be sure the excllink.xla add-in is loaded. See “Configuring the Spreadsheet Link™ EX Software” on page 1-5. Check the spelling of the function name. Correct typing errors.
#NONEXIST!	You referenced a nonexistent matrix in an MLGetMatrix or MLDeleteMatrix function. The matrix name may be misspelled.	Verify the spelling of the MATLAB matrix. Use the MATLAB whos command to display existing matrices. Correct typing errors.
#ROWS>#MAXROWS!	Your MATLAB variable exceeds the Excel limit of #MAXROWS! rows.	This is a limitation in the Excel product. Try the computation with a variable containing fewer rows.
#SYNTAX?	You entered a Spreadsheet Link EX function with incorrect syntax. For example, you did not specify double quotation marks (") , or you specified single quotation marks (') instead of double quotation marks.	Verify and correct the function syntax. For more information, see Chapter 4, “Functions — Alphabetical List”.

Worksheet Cell Error Messages (Continued)

Worksheet Cell Error Message	Meaning	Solution
#VALUE!	An argument is missing from a function, or a function argument is the wrong type.	Supply the correct number of function arguments, of the correct type.
#VALUE!	A macro subroutine uses <code>MLGetMatrix</code> followed by <code>MatlabRequest</code> , which is correct standard usage. A macro function calls that subroutine, and you execute that function from a worksheet cell. The function works correctly, but this message appears in the cell.	Since the function works correctly, ignore the message. Or, in this special case, remove <code>MatlabRequest</code> from the subroutine.

Note When you open an Excel worksheet that contains Spreadsheet Link EX functions, the Excel software tries to execute the functions from the bottom up and right to left. Excel may generate cell error messages such as `#COMMAND!` or `#NONEXIST!`. This is expected behavior. Do the following:

- 1** Ignore the messages.
 - 2** Close MATLAB figure windows.
 - 3** Reexecute the cell functions one at a time in the correct order by pressing **F2**, and then **Enter**.
-

Microsoft® Excel® Software Errors

The Excel® software may display one of the following error messages.

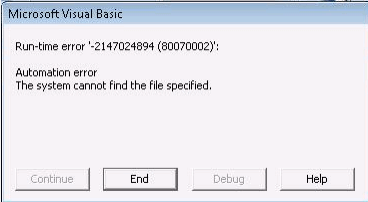
Excel® Error Messages

Error Message	Cause of Error	Solution
Error in formula	You entered a formula incorrectly. Common errors include a space between the function name and the left parenthesis; or missing, extra, or mismatched parentheses.	Check entry and correct typing errors.
Can't find project or library	You tried to execute a macro and the location of <code>excllink.xla</code> is incorrect.	Click OK . The References window opens. Remove the check from <code>MISSING: excllink.xla</code> . Find <code>excllink.xla</code> in its correct location, select its check box in the References window, and click OK .
Run-time error '1004': Cells method of Application class failed	You used <code>MLGetMatrix</code> and the matrix is larger than the space available in the worksheet. This error destabilizes the Spreadsheet Link™ EX software session and changes worksheet calculation mode to manual.	Click OK . Reset worksheet calculation mode to automatic, and save your worksheet as needed. Restart the Excel, Spreadsheet Link EX, and MATLAB® software sessions.

Excel® Error Messages (Continued)

Error Message	Cause of Error	Solution
Spreadsheet Link EX license checkout failed!	The license passcode that you entered was invalid.	Check that you entered the license passcode properly. If you used a proper passcode and you are still unable to start the Spreadsheet Link EX software, contact your MathWorks representative.
Datasource: Excel; prompt for user name and password	This message appears when an attempt to connect to the Excel software from the Database Toolbox™ software fails.	Make sure that the Excel spreadsheet referenced by the data source exists, then retry the connection.

Excel® Error Message Boxes

Error Message Box	Cause of Error	Solution
	<p>This error appears when you start the automation server from the Excel interface, and multiple versions of the MATLAB software are installed on your desktop.</p>	<p>To correct this error, perform the following:</p> <ol style="list-style-type: none"> 1 Shut down all MATLAB and Excel instances. 2 Open a Command Prompt window, and using <code>cd</code>, change to the <code>bin\win32</code> subdirectory of the MATLAB installation directory. 3 Type the command: <ul style="list-style-type: none"> <code>.\matlab /regserver</code> 4 When the MATLAB software session starts, close it. Using <code>/regserver</code> fixes the registry entries. 5 Start an Excel software session. The Spreadsheet Link EX add-in now loads properly. 6 Verify that the Spreadsheet Link EX software is working by entering the following command from the MATLAB Command Window: <ul style="list-style-type: none"> <code>a = 3.14159</code> 7 Enter the following formula in cell A1 of the open Excel worksheet: <ul style="list-style-type: none"> <code>=mlgetmatrix("a", "a1")</code> 8 The value 3.14159 appears in cell A1.

Data Errors

In this section...

“Matrix Data Errors” on page A-8

“Errors When Opening Saved Worksheets” on page A-8

Matrix Data Errors

Data in the MATLAB® or Microsoft® Excel® workspaces may produce the following errors.

Data Errors

Data Error	Cause	Solution
MATLAB matrix cells contain zeros (0).	Corresponding Excel® worksheet cells are empty.	Excel worksheet cells must contain only numeric or string data.
MATLAB matrix is a 1-by-1 zero matrix.	You used quotation marks around the data-location argument in <code>MLPutMatrix</code> or <code>MLAppendMatrix</code> .	Correct the syntax to remove quotation marks.
MATLAB matrix is empty ([]).	You referenced a nonexistent VBA variable in <code>MLPutVar</code> .	Correct the macro; you may have typed the variable name incorrectly.
VBA matrix is empty.	You referenced a nonexistent MATLAB variable in <code>MLGetVar</code> .	Correct the macro; you may have typed the variable name incorrectly.

Errors When Opening Saved Worksheets

This section describes errors that you may encounter when opening saved worksheets.

- When you open an Excel worksheet that contains Spreadsheet Link™ EX functions, the Excel software tries to execute the functions from the

bottom up and right to left. Excel may generate cell error messages such as #COMMAND! or #NONEXIST!. This is expected behavior. Do the following:

- i** Ignore the messages.
- j** Close MATLAB figure windows.
- k** Reexecute the cell functions one at a time in the correct order by pressing **F2**, and then **Enter**.
- If you save an Excel worksheet containing Spreadsheet Link EX functions, and then reopen it in an environment where the `excllink.xla` add-in is in a different location, you may see the message: This document contains links: Re-establish links?

To address this issue, do the following:

- a** Click **No**.
- b** Select **Edit > Links**.
- c** In the **Links** dialog box, click **Change Source**.
- d** In the **Change Links** dialog box, and select `matlabroot/toolbox/exlink/excllink.xla`.
- e** Click **OK**.

The Excel software executes each function as it changes its link. You may see MATLAB figure windows and hear error beeps as the links change and functions execute; ignore them.

- f** In the **Links** dialog box, click **OK**.

The worksheet now connects to the Spreadsheet Link EX add-in.

Or, instead of using the **Links** menu, you can manually edit the link location in each affected worksheet cell to show the correct location of `excllink.xla`.

Startup Errors

If you have enabled `MLAutoStart`, double-clicking an `xls` file in the MATLAB® Current Directory browser and choosing **Open Outside MATLAB** causes a Microsoft® Excel® error to appear. To open the file successfully, click **End** in the error window.

To avoid this issue, disable `MLAutoStart`. Start MATLAB software sessions from the Excel® interface by clicking the **startmatlab** button in the Excel menu bar.

Audible Error Signals

You may hear audible errors while passing data to the MATLAB® workspace using `MLPutMatrix` or `MLAppendMatrix`. These errors usually indicate that you have insufficient computer memory to carry out the operation. Close other applications or clear unnecessary variables from the MATLAB workspace and try again. If the error signal reoccurs, you probably have insufficient physical memory in your computer for this operation.

Examples

Use this list to find examples in the documentation.

Macro Examples

“Importing and Exporting Data between the Microsoft® Excel® Interface and the MATLAB® Workspace” on page 1-23

“Sending MATLAB® Data to an Excel® Worksheet and Displaying the Results” on page 1-23

Financial Examples

“Modeling Data Sets Using Data Regression and Curve Fitting” on page 2-3

“Interpolating Data” on page 2-11

“Pricing Stock Options Using the Binomial Model” on page 2-15

“Calculating and Plotting the Efficient Frontier of Financial Portfolios” on page 2-19

“Mapping Time and Bond Cash Flows” on page 2-23

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