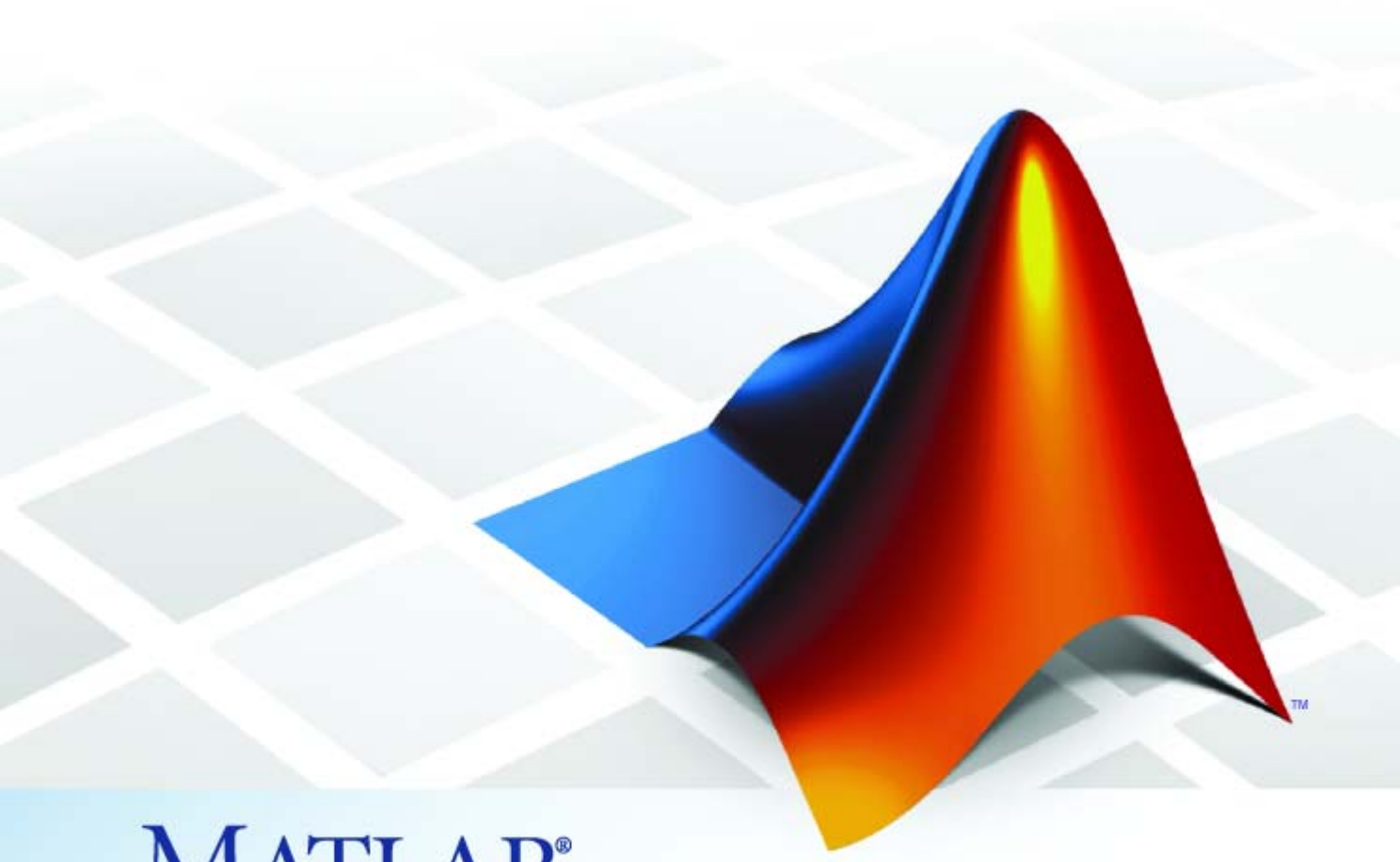
Spreadsheet Link™ EX 3

User's Guide



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Spreadsheet Link™ EX User's Guide

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1

Getting Started

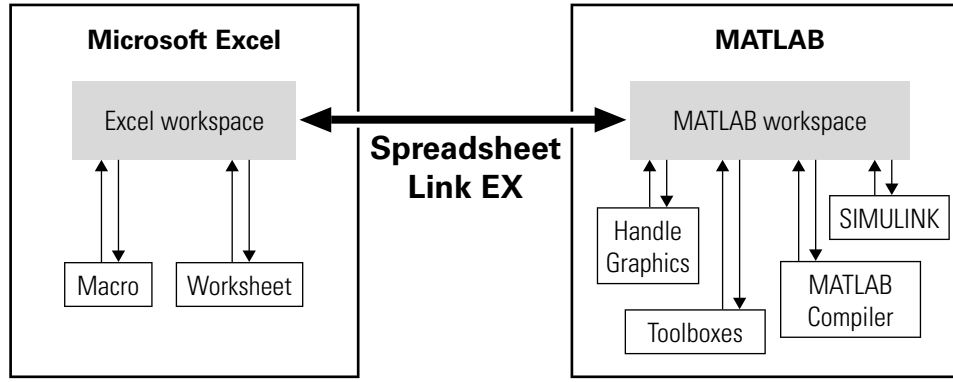
Product Overview

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

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

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

The Spreadsheet Link EX installation program creates a subdirectory under *matlabroot*\toolbox\. The exlink directory contains the following files:

- excllink.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 *matlabroot*\bin to your system path. For more information about editing your system path, consult your Windows documentation or your system administrator.

Configuring the Spreadsheet Link EX Software

In this section...

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 software is installed on your system.

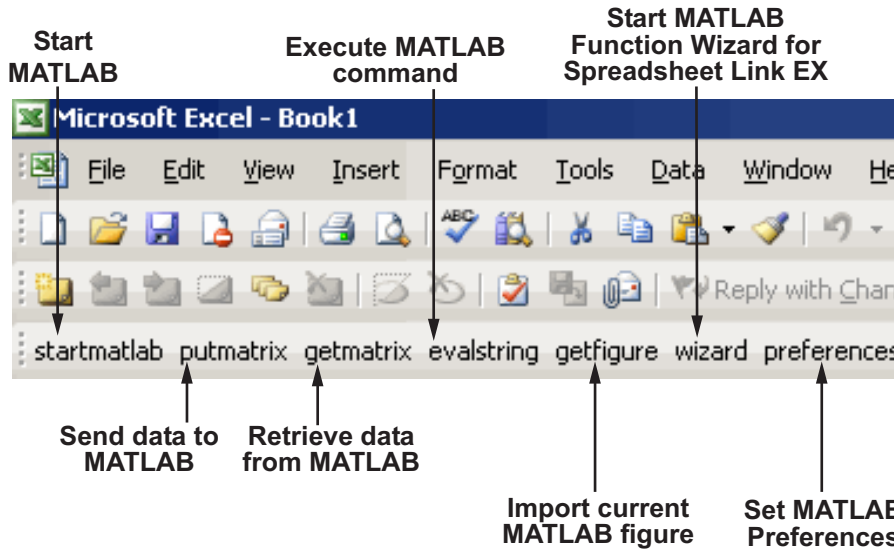
   d. Click **OK**.

      In the Add-Ins dialog box, the **Spreadsheet Link EX 3.0.3 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 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.

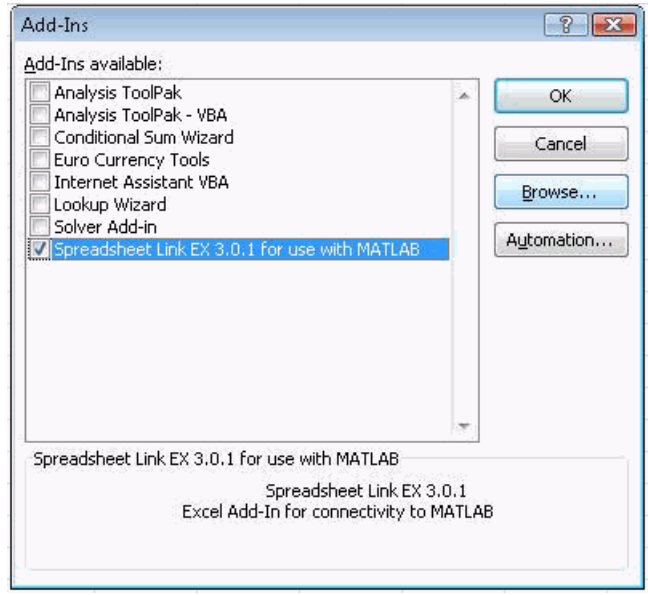
6. Click **OK** on all dialog boxes until you exit System Properties.
7. Right-click the **MATLAB** shortcut icon and choose **Properties** from its context menu. The Properties pane appears.
8. In the **Target** field, add a space character followed by `/regserver` to the end of the existing entry.
9. Click **Apply**.
10. Start a Microsoft Excel 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.



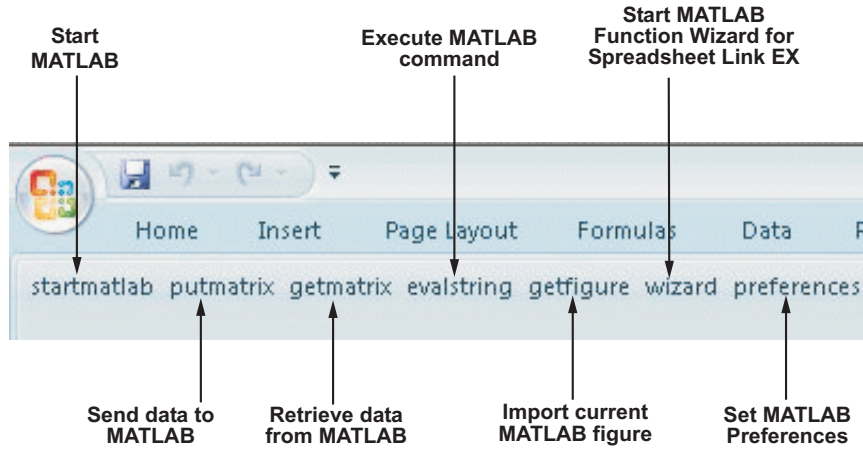
j Click **OK** to close the Add-Ins dialog box.

k Click **OK** to close the Excel Options dialog box.

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

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

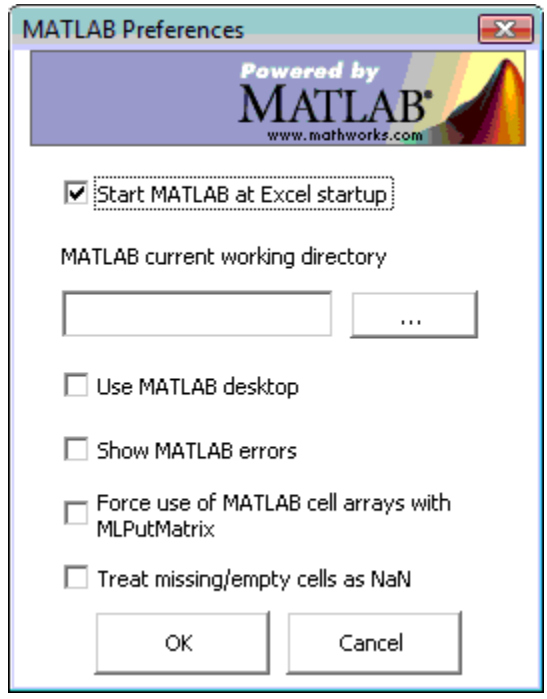
The Spreadsheet Link EX toolbar appears on your Excel worksheet.



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

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 session.

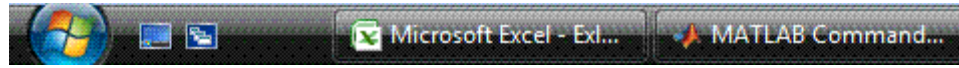
Manually Starting the Spreadsheet Link EX Software

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 Session

To connect a new Excel session to an existing MATLAB session, start MATLAB with the `spredsheetautomation` 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 session is a registered automation version. If not, the Excel software starts a new MATLAB 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 session as you normally would.
- To stop the Spreadsheet Link EX and MATLAB software and leave the Excel 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 sessions manually.

About Functions

In this section...

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 theExcel 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)`.

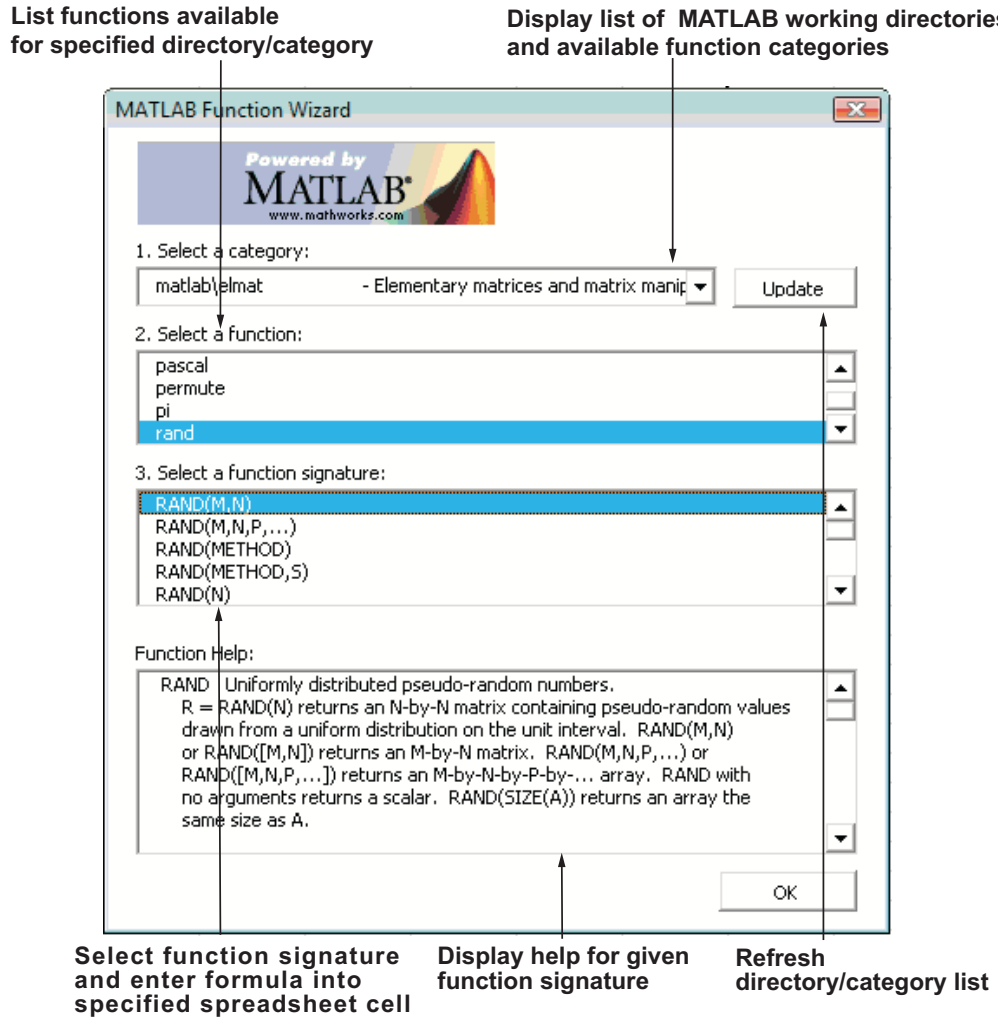
Data-Location Arguments

- 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.



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)
   ```

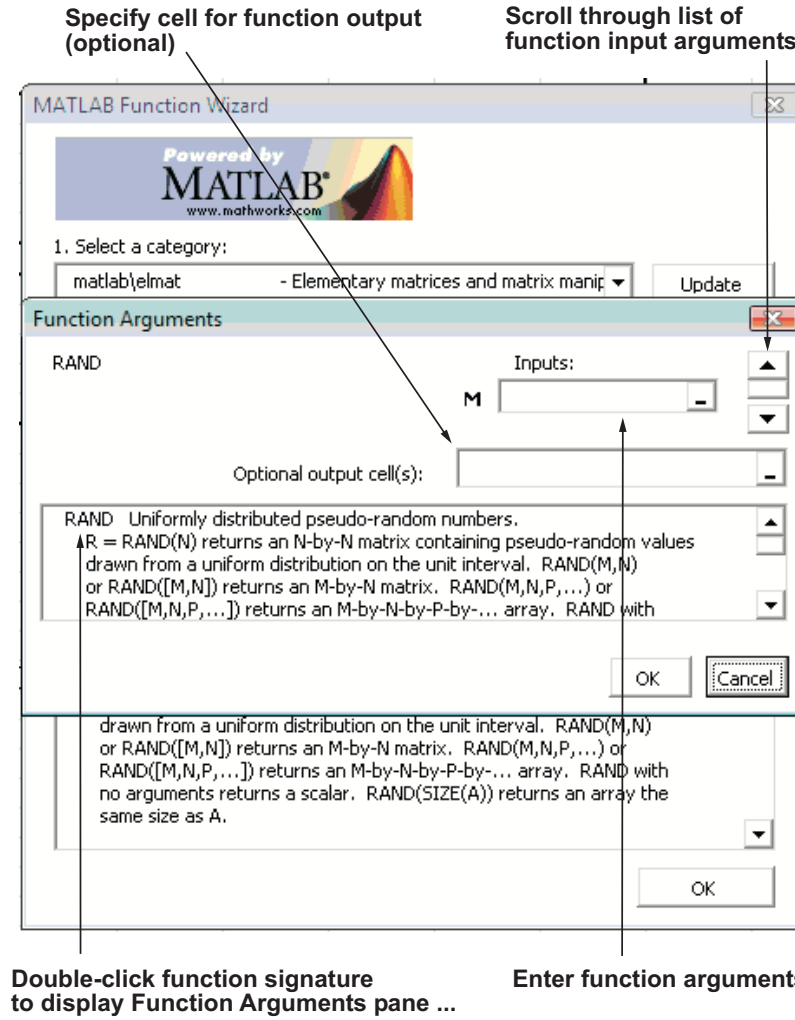
   To refresh the directory/category list, click the **Update** button.

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.


Specify cell for function output (optional)
Scroll through list of function input arguments
MATLAB Function Wizard
Powered by MATLAB
www.mathworks.com
1. Select a category:
matlab\elmat - Elementary matrices and matrix manip
Update
Function Arguments
RAND
Inputs:
M
Optional output cell(s):
RAND Uniformly distributed pseudo-random numbers.
R = RAND(N) returns an N-by-N matrix containing pseudo-random values drawn from a uniform distribution on the unit interval. RAND(M,N) or RAND([M,N]) returns an M-by-N matrix. RAND(M,N,P,...) or RAND([M,N,P,...]) returns an M-by-N-by-P-by-... array. RAND with
OK
Cancel
drawn from a uniform distribution on the unit interval. RAND(M,N) or RAND([M,N]) returns an M-by-N matrix. RAND(M,N,P,...) or RAND([M,N,P,...]) returns an M-by-N-by-P-by-... array. RAND with no arguments returns a scalar. RAND(SIZE(A)) returns an array the same size as A.
OK
Double-click function signature to display Function Arguments pane ...
Enter function arguments

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 session.
2. Initialize the MATLAB 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.

2

Solving Problems with the Spreadsheet Link EX Software

Note For other applications, see "Using Spreadsheet Link EX with Bioinformatic Data".

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 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

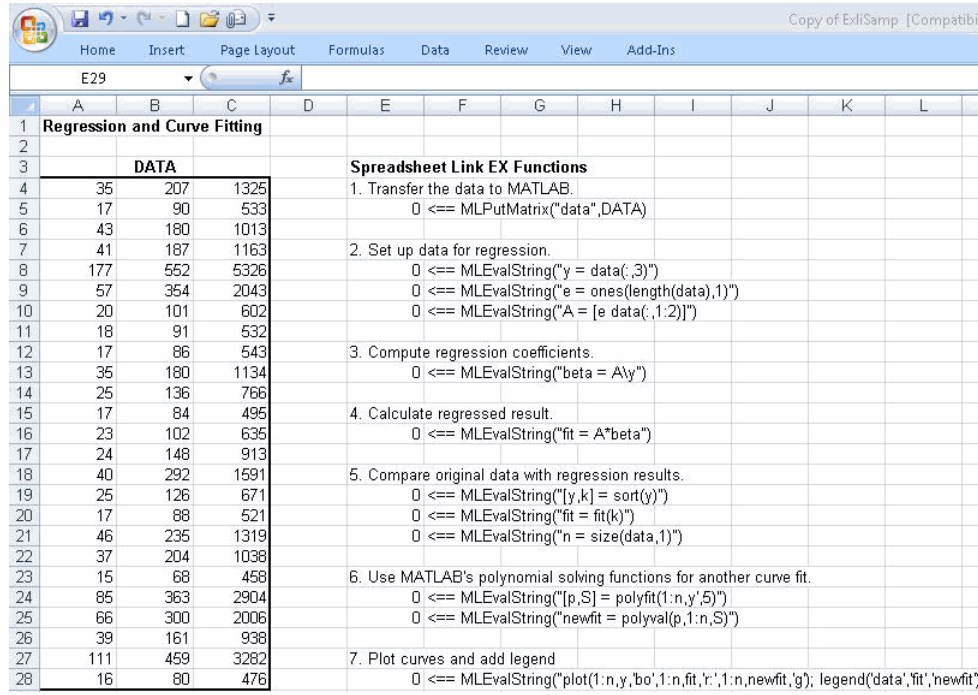
In this section...

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 `ExliSamp.xls` window. The worksheet for this example appears.



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Home Insert Page Layout Formulas Data Review View Add-Ins

E29

	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*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:

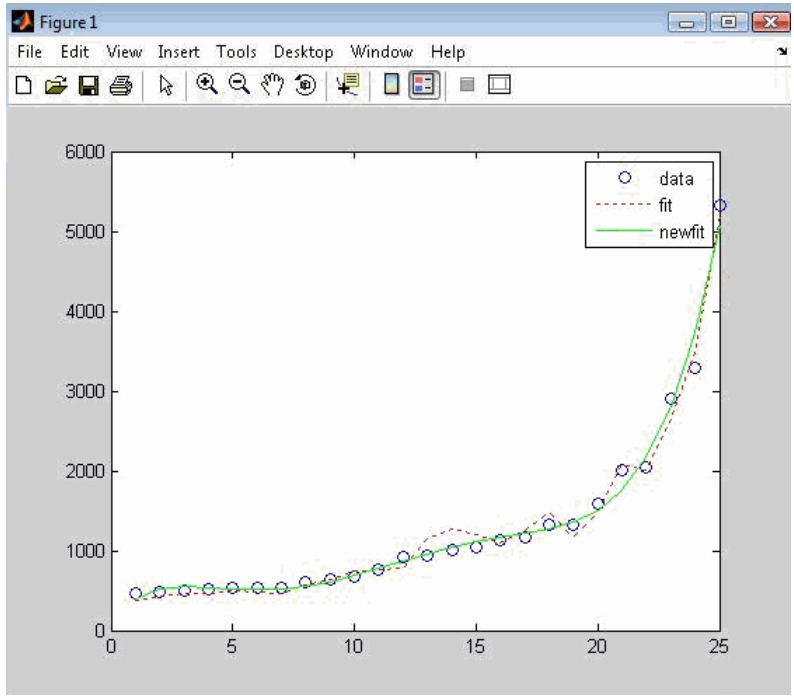
   a. Compare the original data with `fit`.

   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.

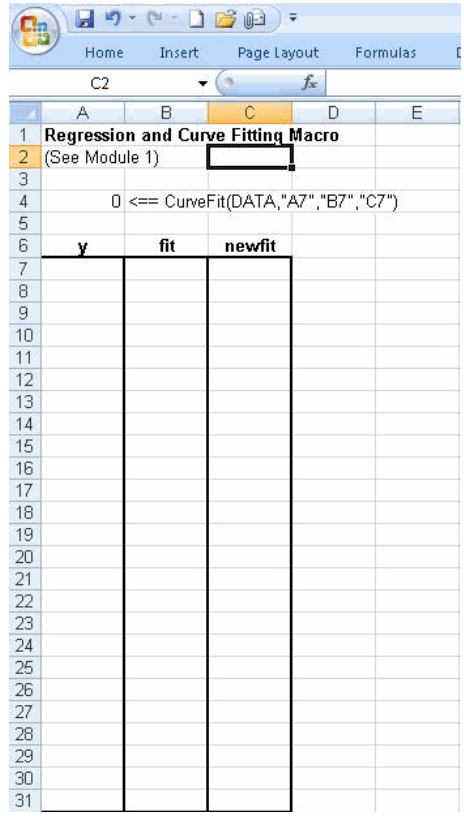


Since the data is closely correlated but not exactly linearly dependent, the `fit` curve (dashed line) shows a close, but not an exact, fit. The fifth-degree polynomial curve, `newfit`, is a more accurate mathematical model for the data.

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

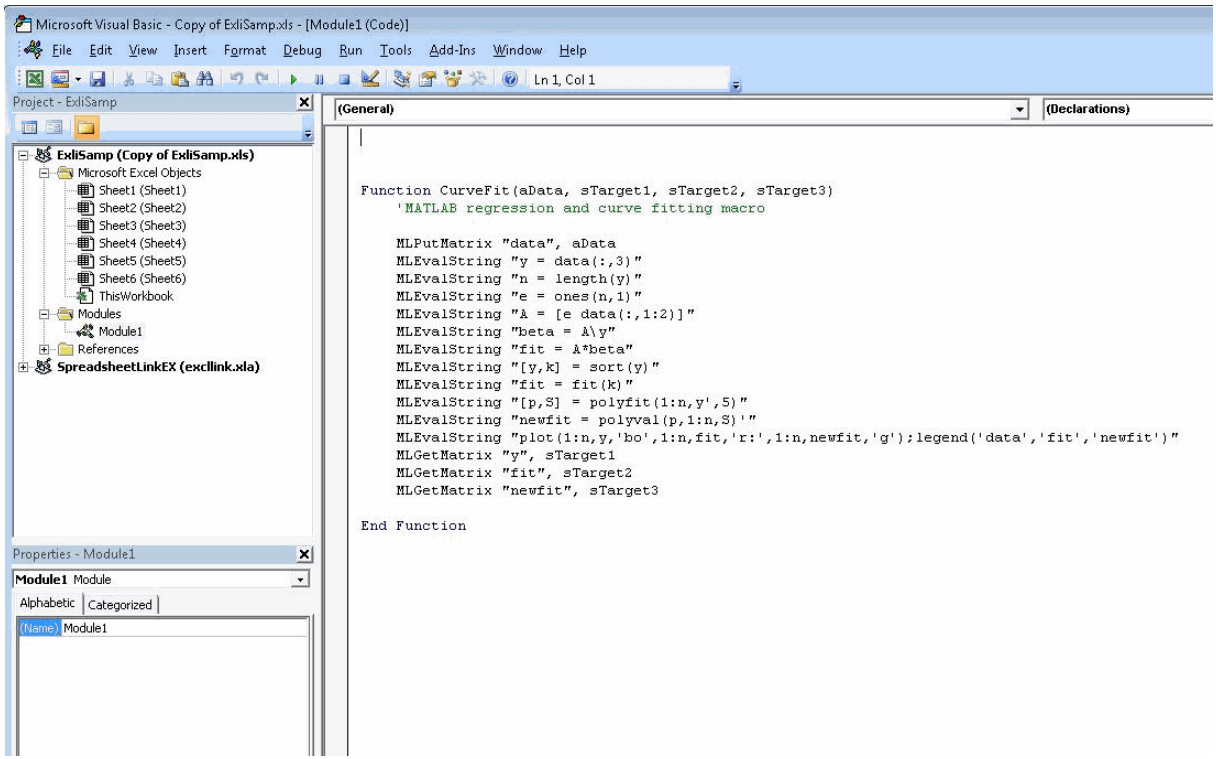
Using Macros

1 Click the **Sheet2** tab on `ExliSamp.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.



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:

  1 Click **Tools > References**.

  2 In the **References** dialog box, make sure that the `excllink.xla` check box is selected. If not, select it.

  3 Click **OK**.

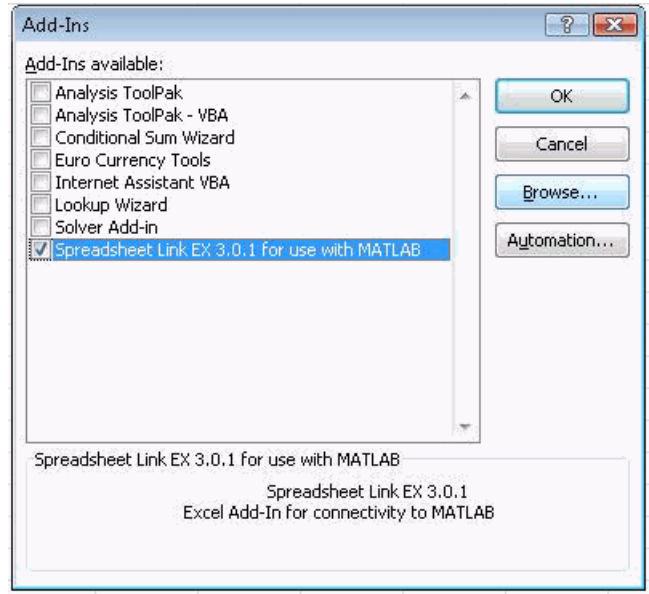
- If you are using the Excel 2007 software:

  1 Click the Microsoft Office Button,  .

  2 Click **Options**. The Excel Options pane appears.

  3 Click **Add-Ins**.

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



7. Click **OK** to close the Add-Ins pane.
8. 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`.

A5

	A	B	C	D	E
1	**Regression and Curve Fitting Macro**				
2	(See Module 1)				
3					
4	0	<== CurveFit(DATA,"A7","B7","C7")			
5					
6	**y**	**fit**	**newfit**		
7	458	379.0475	402.008		
8	476	430.3099	515.8528		
9	495	462.4722	549.7114		
10	521	472.0222	543.0184		
11	532	501.7971	524.5499		
12	533	476.7973	513.775		
13	543	467.2472	522.2081		
14	602	570.8968	554.761		
15	635	641.1212	611.0947		
16	671	743.6461	686.9715		
17	766	767.5211	775.6072		
18	913	773.5589	869.023		
19	938	1143.781	959.3974		
20	1013	1279.593	1040.419		
21	1038	1201.219	1108.636		
22	1134	1098.695	1164.812		
23	1163	1251.081	1215.276		
24	1319	1478.743	1273.275		
25	1325	1163.157	1360.322		
26	1591	1479.157	1507.557		
27	2006	2086.177	1757.09		
28	2043	2011.592	2163.358		
29	2904	2666.224	2794.475		
30	3282	3483.345	3733.586		
31	5326	5197.796	5080.215		

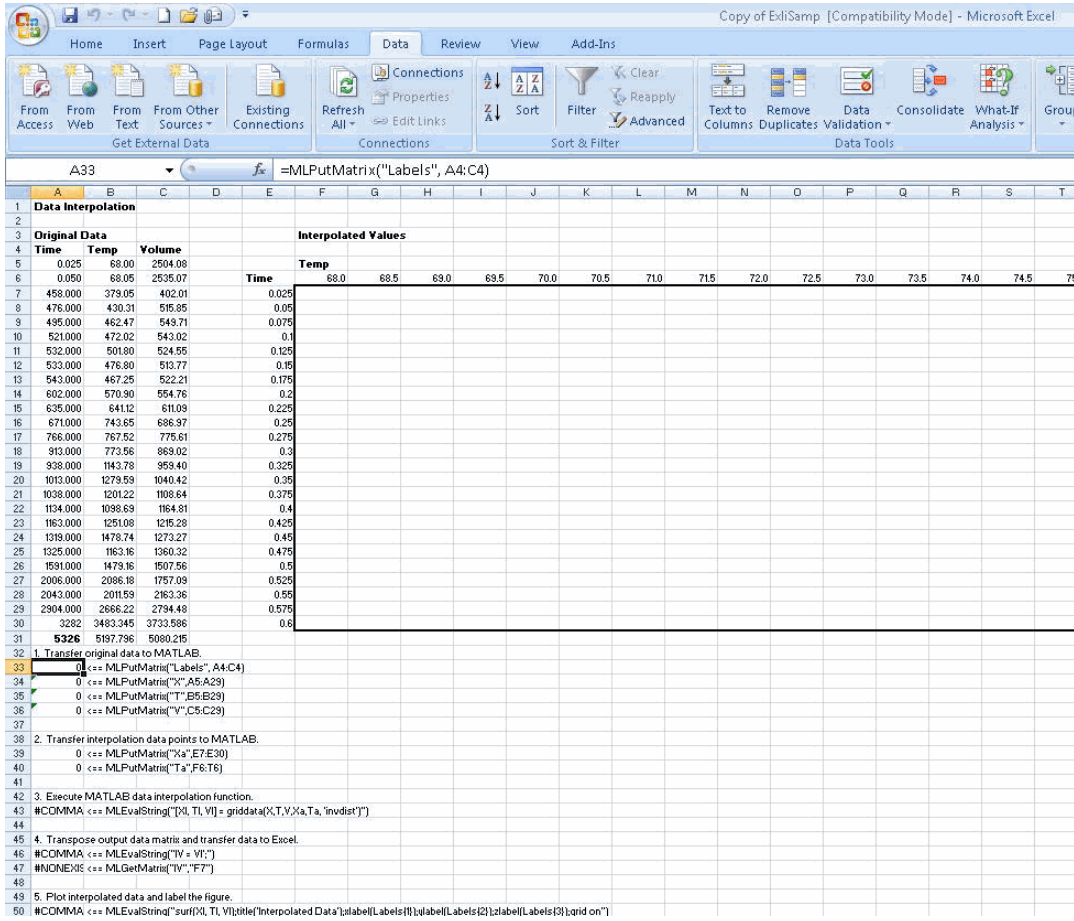
Interpolating Data

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 `ExliSamp.xls`. The worksheet for this example appears.



The worksheet contains the measured thermodynamic data in cells `A5:A29`, `B5:B29`, and `C5:C29`. The time and temperature values for interpolation are in cells `E7:E30` and `F6:T6`, respectively.

2 Make `A33` the active cell. Press **F2**; then press **Enter** to execute the Spreadsheet Link EX function that passes the `Time`, `Temp`, and `Volume` labels to the MATLAB workspace.

3 Make `A34` the active cell. Press **F2**; then press **Enter** to execute the Spreadsheet Link EX function that copies the original time data to the MATLAB workspace. Move to cell `A35` and execute the function to copy the

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

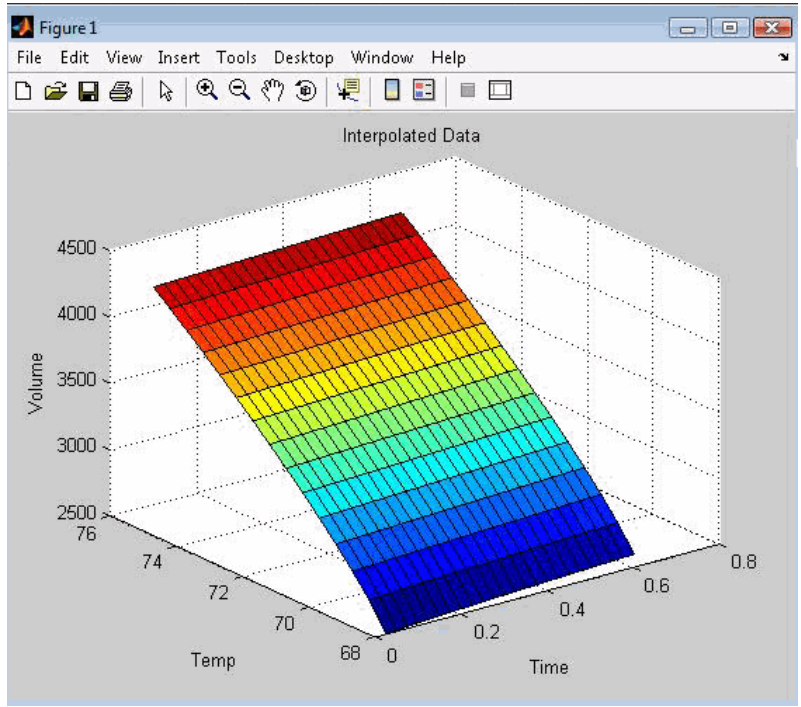
4 Move to cell `A39` and press **F2**; then press **Enter** to copy the interpolation time values to the MATLAB workspace. Execute the function in cell `A40` to copy the interpolation temperature values.

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.

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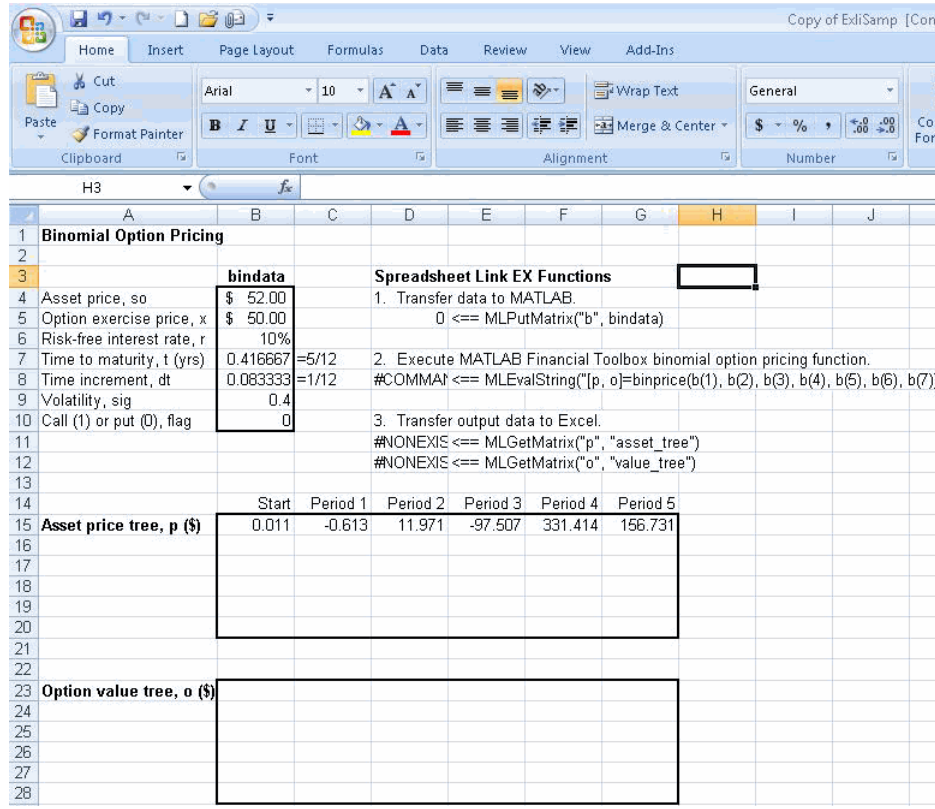
1. Click the **Sheet4** tab on `ExliSamp.xls` to open the worksheet for this example.



The worksheet contains three named ranges:

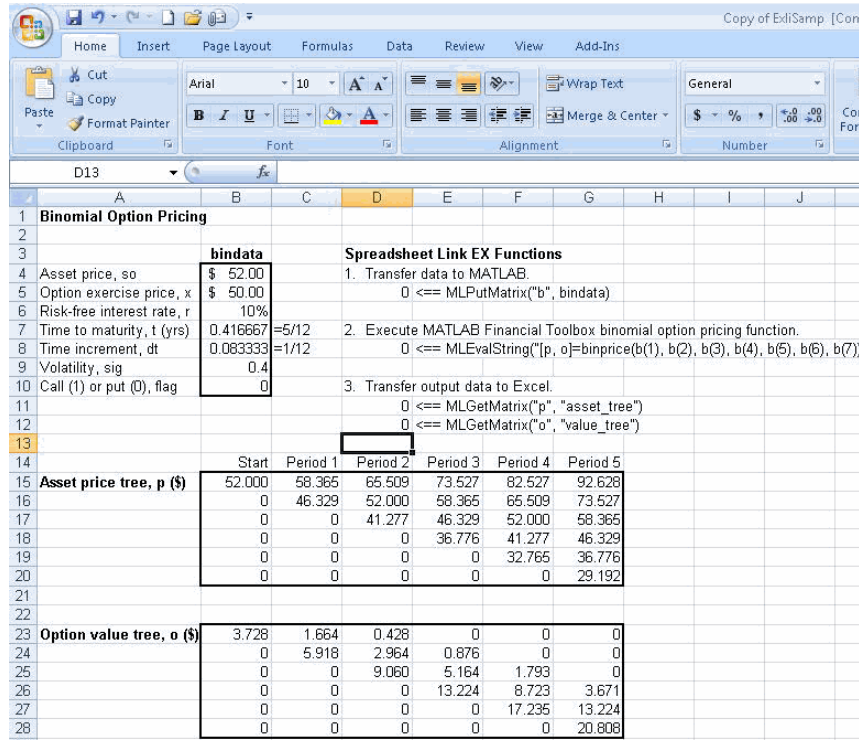
- `B4:B10` named `bindata`. Two cells in `bindata` contain formulas:
  - `B7` contains `=5/12`
  - `B8` contains `=1/12`
- `B15` named `asset_tree`.
- `B23` named `value_tree`.

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.



	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.

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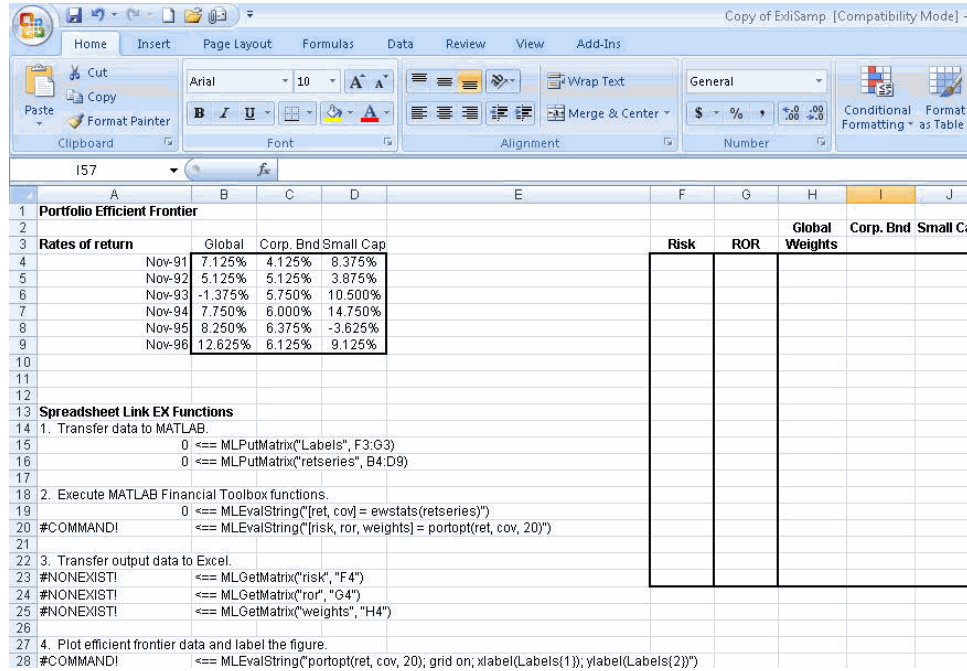
1. Click the **Sheet5** tab on `ExliSamp.xls`. The worksheet for this example appears.



Copy of ExliSamp [Compatibility Mode] - M

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Cut, Copy, Format Painter, Paste — Clipboard — Arial, 10 — Font — Wrap Text, Merge & Center — Alignment — General — Number — Conditional Formatting, Format as Table

I57

	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})")							

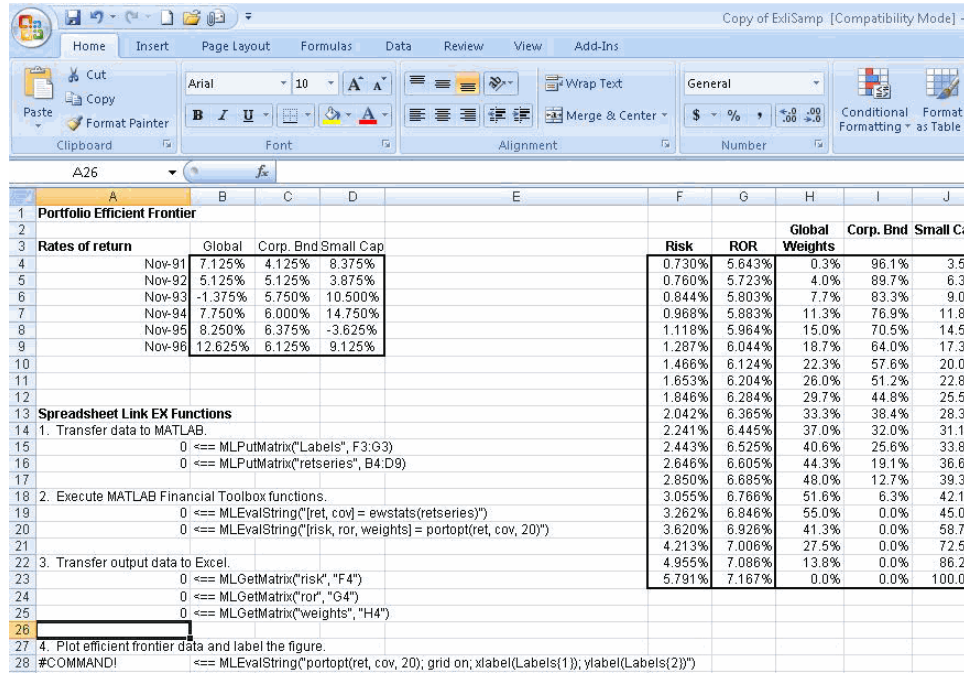
2 Make A15 the active cell. Press **F2**; then press **Enter**. The Spreadsheet Link EX function transfers the labels that describe the output that the MATLAB software computes.

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.



Copy of ExliSamp [Compatibility Mode] - M

Home | Insert | Page Layout | Formulas | Data | Review | View | Add-Ins

Cut, Copy, Format Painter, Paste — Clipboard — Arial, 10 — Font — Wrap Text, Merge & Center — Alignment — General — Number — Conditional Formatting, Format as Table

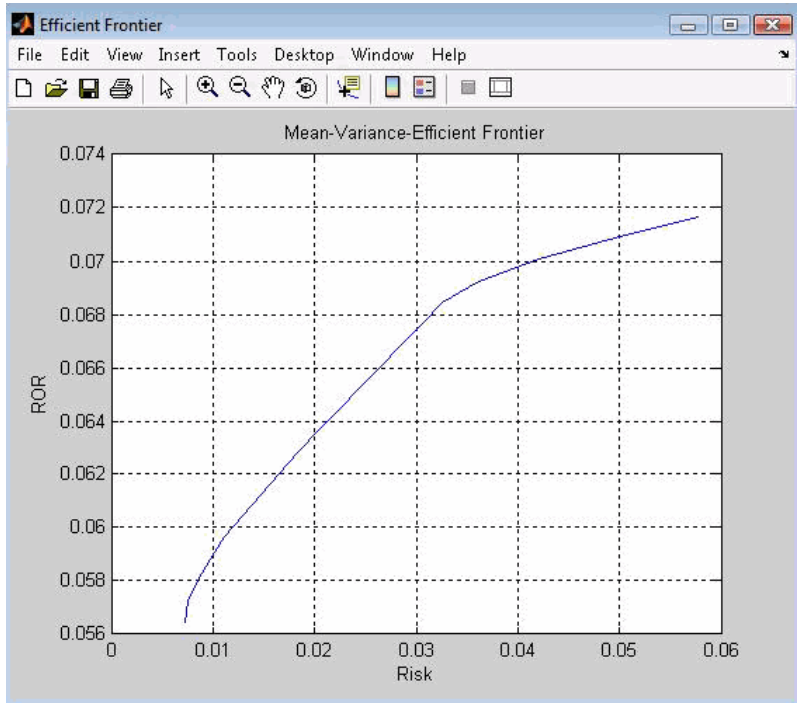
A26

	A	B	C	D	E	F	G	H	I	J
1	**Portfolio Efficient Frontier**									
2								**Global**	**Corp. Bnd**	**Small Cap**
3	**Rates of return**	Global	Corp. Bnd	Small Cap		**Risk**	**ROR**	**Weights**		
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.

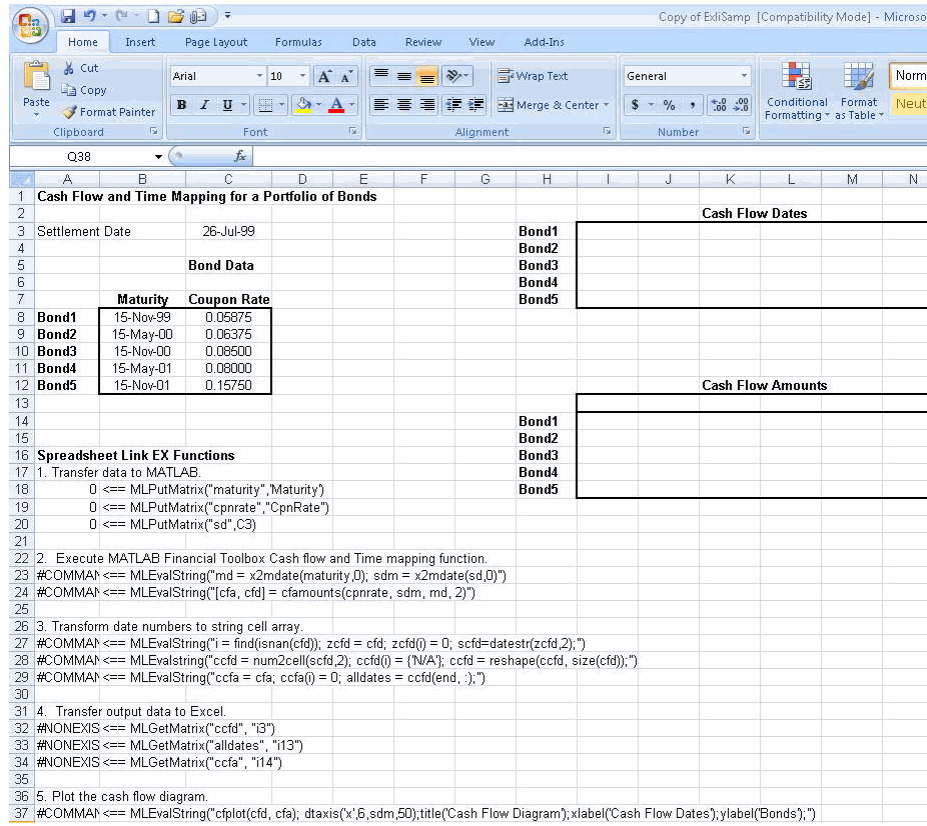
7 To try running this example using different data, close the figure window and change the data in cells `B4:D9`. Then reexecute all the Spreadsheet Link EX functions. The worksheet then shows the new frontier data, and the MATLAB software displays a new efficient frontier graph.

When you finish this example, close the figure window.

Mapping Time and Bond Cash Flows

This example shows how to use the Financial Toolbox and Spreadsheet Link EX software to compute a set of cash flow amounts and dates, given a portfolio of five bonds with known maturity dates and coupon rates.

1 Click the **Sheet6** tab on `ExliSamp.xls`. The worksheet for this example appears.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	**Cash Flow and Time Mapping for a Portfolio of Bonds**													
2											**Cash Flow Dates**			
3	Settlement Date		26-Jul-99					**Bond1**						
4								**Bond2**						
5			**Bond Data**					**Bond3**						
6								**Bond4**						
7		**Maturity**	**Coupon Rate**					**Bond5**						
8	**Bond1**	15-Nov-99	0.05875											
9	**Bond2**	15-May-00	0.06375											
10	**Bond3**	15-Nov-00	0.08500											
11	**Bond4**	15-May-01	0.08000											
12	**Bond5**	15-Nov-01	0.15750									**Cash Flow Amounts**		
13														
14								**Bond1**						
15								**Bond2**						
16	**Spreadsheet Link EX Functions**							**Bond3**						
17	1. Transfer data to MATLAB.							**Bond4**						
18	0 <== MLPutMatrix("maturity",'Maturity')							**Bond5**						
19	0 <== MLPutMatrix("cpnrate","CpnRate")													
20	0 <== MLPutMatrix("sd",C3)													
21														
22	2. Execute MATLAB Financial Toolbox Cash flow and Time mapping function.													
23	#COMMAN <== MLEvalString("md = x2mdate(maturity,0); sdm = x2mdate(sd,0)")													
24	#COMMAN <== MLEvalString("[cfa, cfd] = cfamounts(cpnrate, sdm, md, 2)")													
25														
26	3. Transform date numbers to string cell array.													
27	#COMMAN <== MLEvalString("i = find(isnan(cfd)); zcfd = cfd; zcfd(i) = 0; scfd=datestr(zcfd,2);")													
28	#COMMAN <== MLEvalstring("ccfd = num2cell(scfd,2); ccfd(i) = {'N/A'}; ccfd = reshape(ccfd, size(cfd));")													
29	#COMMAN <== MLEvalString("ccfa = cfa; ccfa(i) = 0; alldates = ccfd(end, :);")													
30														
31	4. Transfer output data to Excel.													
32	#NONEXIS <== MLGetMatrix("ccfd", "i3")													
33	#NONEXIS <== MLGetMatrix("alldates", "i13")													
34	#NONEXIS <== MLGetMatrix("ccfa", "i14")													
35														
36	5. Plot the cash flow diagram.													
37	#COMMAN <== MLEvalString("cfplot(cfd, cfa); dtaxis('x',6,sdm,50);title('Cash Flow Diagram');xlabel('Cash Flow Dates');ylabel('Bonds');")													

2 Make `A18` the active cell. Press **F2**, then **Enter** to execute the Spreadsheet Link EX function that transfers the column vector `Maturity` to the MATLAB workspace.

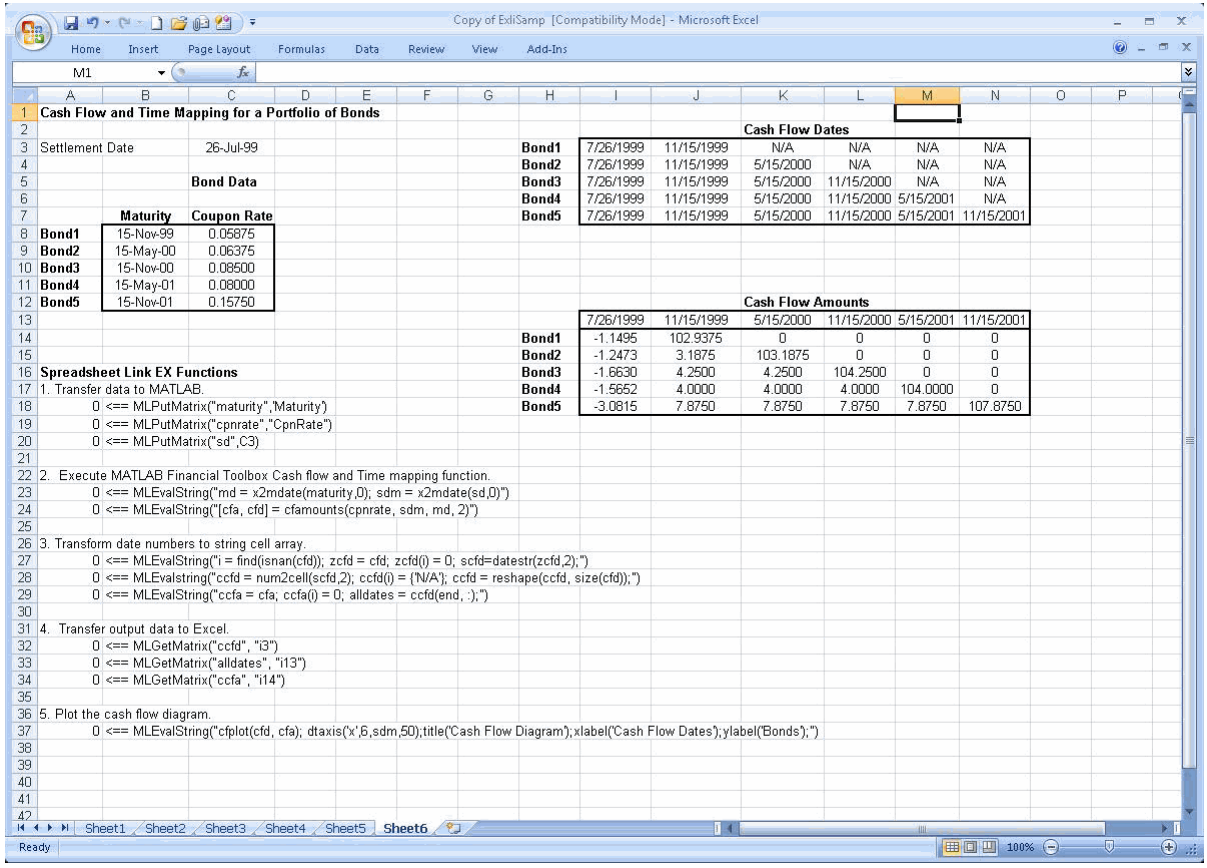
3 Make `A19` the active cell to transfer the column vector `Coupon Rate` to the MATLAB workspace.

4 Make `A20` the active cell to transfer the settlement date to the MATLAB workspace.

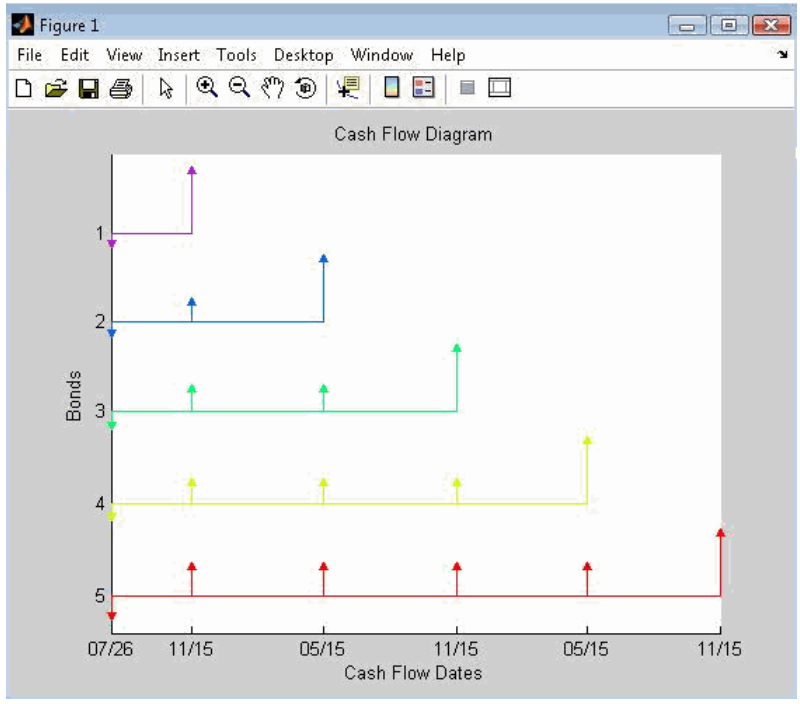
5 Execute the functions in cells `A23` and `A24` to enable the Financial Toolbox software to compute cash flow amounts and dates.

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.



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.

3

Function Reference

Link Management

`matlabinit`	Initialize Spreadsheet Link EX software and start MATLAB process
`MLAutoStart`	Automatically start MATLAB process
`MLClose`	End MATLAB process
`MLOpen`	Start MATLAB process
`MLUseCellArray`	Toggle `MLPutMatrix` to use MATLAB cell arrays

Data Management

`matlabfcn`	Evaluate MATLAB command given Microsoft Excel data
`matlabsub`	Evaluate MATLAB command given Microsoft Excel data and designate output location
`MLAppendMatrix`	Create or append MATLAB matrix with data from Microsoft Excel worksheet
`MLDeleteMatrix`	Delete MATLAB matrix
`MLEvalString`	Evaluate command in MATLAB software
`MLGetFigure`	Import current MATLAB figure into Microsoft Excel spreadsheet
`MLGetMatrix`	Write contents of MATLAB matrix to Microsoft Excel worksheet
`MLGetVar`	Write contents of MATLAB matrix in Microsoft Excel VBA variable
`MLMissingDataAsNaN`	Set empty cells to `NaN` or `0`
`MLPutMatrix`	Create or overwrite MATLAB matrix with data from Microsoft Excel worksheet
`MLPutVar`	Create or overwrite MATLAB matrix with data from Microsoft Excel VBA variable
`MLShowMatlabErrors`	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

4

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 sessions manually when you have set `MLAutoStart` to `no`. If you set `MLAutoStart` to `yes`, `matlabinit` executes automatically.

See Also

`MLAutoStart`, `MLOpen`

matlabsub

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 date. `"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 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 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`. If defined, `ML_var_name` should be of type `VARIANT`. Any other type will give a `"TYPE MISMATCH"` error.
`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 `NaN`s.
`"no"`	Sets empty cells to use `0`s. (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 `0`s. If you change the value of `MLUseCellArray` to `"yes"`, the change remains in effect the next time a Microsoft Excel session starts.

Note A string in an Excel range always forces cell array output and empty cells as `NaN`s.

Examples

Cancel the use of `NaN`s 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 session after you have stopped it with `MLClose` in a given Microsoft Excel session.

Note We recommend using `matlabinit` rather than `MLOpen`, since `matlabinit` starts a MATLAB 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 `NaN`s 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

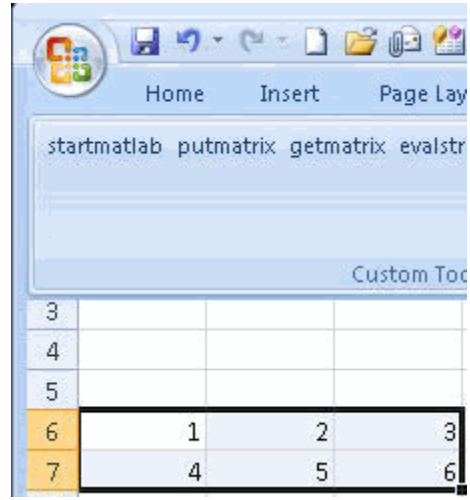
Create or overwrite matrix `A` in the MATLAB workspace with the data in the worksheet range `A1:C3`:

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

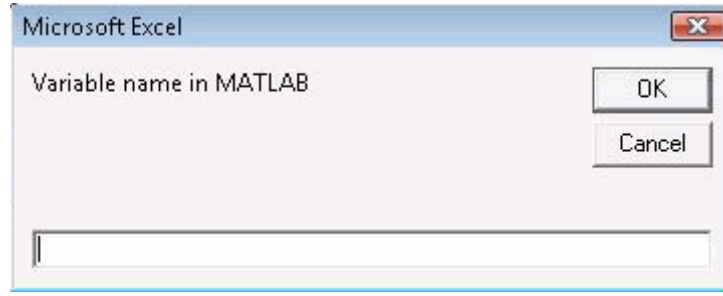
Example 2 — Use the putmatrix toolbar button to import data from a Microsoft Excel worksheet to the MATLAB workspace

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
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 `NaN`s 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
```

```
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 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 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`

A

Error Messages and Troubleshooting

This appendix covers the following topics:

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 “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 `MLGetMatrix` followed by `MatlabRequest`, 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 `MatlabRequest` 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

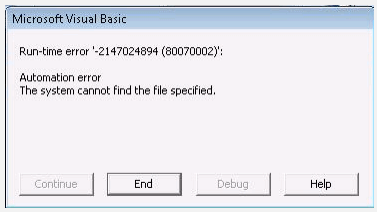
Error Message	Cause of Error	Solution
`Error in formula`	You entered a formula incorrectly. Common errors include a space between the function name and the left parenthesis; or missing, extra, or mismatched parentheses.	Check entry and correct typing errors.
`Can't find project or library`	You tried to execute a macro and the location of `excllink.xla` is incorrect.	Click **OK**. The References window opens. Remove the check from `MISSING: excllink.xla`. Find `excllink.xla` 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 `MLGetMatrix` 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

	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.	To correct this error, perform the following:
		1 Shut down all MATLAB and Excel instances.
		2 Open a Command Prompt window, and using `cd`, change to the `bin\win32` subdirectory of the MATLAB installation directory.
		3 Type the command:
		`.\matlab /regserver`
		4 When the MATLAB software session starts, close it. Using `/regserver` 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:
		`a = 3.14159`
		7 Enter the following formula in cell `A1` of the open Excel worksheet:
		`=mlgetmatrix("a","a1")`
		8 The value `3.14159` appears in cell `A1`.

Data Errors

In this section...

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 `MLPutMatrix` or `MLAppendMatrix`.	Correct the syntax to remove quotation marks.
`MATLAB matrix is empty ([ ]).`	You referenced a nonexistent VBA variable in `MLPutVar`.	Correct the macro; you may have typed the variable name incorrectly.
`VBA matrix is empty.`	You referenced a nonexistent MATLAB variable in `MLGetVar`.	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:

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**.

- 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:

  1. Click **No**.
  2. Select **Edit > Links**.
  3. In the **Links** dialog box, click **Change Source**.
  4. In the **Change Links** dialog box, and select *`matlabroot`*`\toolbox\exlink\excllink.xla`.
  5. 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.
  6. 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.

B

Examples

Use this list to find examples in the documentation.

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