

**Spreadsheet Link™**

User's Guide



**MATLAB®**

R2023a



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*Spreadsheet Link™ User's Guide*

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## Revision History

May 1996	First printing	New for Version 1.0
May 1997	Second printing	Revised for Version 1.0.3
January 1999	Third printing	Revised for Version 1.0.8 (Release 11)
September 2000	Fourth printing	Revised for Version 1.1.2
April 2001	Fifth printing	Revised for Version 1.1.3
July 2002	Sixth printing	Revised for Version 2.0 (Release 13)
September 2003	Online only	Revised for Version 2.1 (Release 13SP1)
June 2004	Online only	Revised for Version 2.2 (Release 14)
September 2005	Online only	Revised for Version 2.3 (Release 14SP3)
March 2006	Online only	Revised for Version 2.3.1 (Release 2006a)
September 2006	Online only	Revised for Version 2.4 (Release 2006b)
September 2006	Seventh printing	Revised for Version 2.4 (Release 2006b)
March 2007	Online only	Revised for Version 2.5 (Release 2007a)
September 2007	Online only	Revised for Version 3.0 (Release 2007b)
March 2008	Online only	Revised for Version 3.0.1 (Release 2008a)
October 2008	Online only	Revised for Version 3.0.2 (Release 2008b)
March 2009	Online only	Revised for Version 3.0.3 (Release 2009a)
September 2009	Online only	Revised for Version 3.1 (Release 2009b)
March 2010	Online only	Revised for Version 3.1.1 (Release 2010a)
September 2010	Online only	Revised for Version 3.1.2 (Release 2010b)
April 2011	Online only	Revised for Version 3.1.3 (Release 2011a)
September 2011	Online only	Revised for Version 3.1.4 (Release 2011b)
March 2012	Online only	Revised for Version 3.1.5 (Release 2012a)
September 2012	Online only	Revised for Version 3.1.6 (Release 2012b)
March 2013	Online only	Revised for Version 3.1.7 (Release 2013a)
September 2013	Online only	Revised for Version 3.2 (Release 2013b)
March 2014	Online only	Revised for Version 3.2.1 (Release 2014a)
October 2014	Online only	Revised for Version 3.2.2 (Release 2014b)
March 2015	Online only	Revised for Version 3.2.3 (Release 2015a)
September 2015	Online only	Revised for Version 3.2.4 (Release 2015b)
March 2016	Online only	Revised for Version 3.2.5 (Release 2016a)
September 2016	Online only	Revised for Version 3.3 (Release 2016b)
March 2017	Online only	Revised for Version 3.3.1 (Release 2017a)
September 2017	Online only	Revised for Version 3.3.2 (Release 2017b)
March 2018	Online only	Revised for Version 3.3.3 (Release 2018a)
September 2018	Online only	Revised for Version 3.4 (Release 2018b)
March 2019	Online only	Revised for Version 3.4.1 (Release 2019a)
September 2019	Online only	Revised for Version 3.4.2 (Release 2019b)
March 2020	Online only	Revised for Version 3.4.3 (Release 2020a)
September 2020	Online only	Revised for Version 3.4.4 (Release 2020b)
March 2021	Online only	Revised for Version 3.4.5 (Release 2021a)
September 2021	Online only	Revised for Version 3.4.6 (Release 2021b)
March 2022	Online only	Revised for Version 3.4.7 (Release 2022a)
September 2022	Online only	Revised for Version 3.4.8 (Release 2022b)
March 2023	Online only	Revised for Version 3.4.9 (Release 2023a)



## 1

## Getting Started

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## **Spreadsheet Link Product Description**

### **Use MATLAB from Microsoft Excel**

Spreadsheet Link connects Excel® spreadsheet software with the MATLAB® workspace, enabling you to access the MATLAB environment from an Excel spreadsheet. With Spreadsheet Link software, you can exchange data between MATLAB and Excel, taking advantage of the familiar Excel interface while accessing the computational speed and visualization capabilities of MATLAB.

### **Key Features**

- Data preprocessing, editing, and viewing in the familiar Excel environment
- Sophisticated analysis of Excel data using MATLAB and application toolboxes
- Delivery of Excel based applications, using MATLAB as a computational and graphics engine and Excel as an interface
- Interactive selection of available functions using the MATLAB Function Wizard
- Visual interface for customization of all Spreadsheet Link preferences



# Installation

## In this section...

“Product Installation” on page 1-3

“Supported Excel Versions” on page 1-3

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

“After You Upgrade the Spreadsheet Link Software” on page 1-4

To use Spreadsheet Link, you must install Microsoft Excel first, and then install Spreadsheet Link. Ensure that you use the correct MATLAB version based on the supported version of Excel. After Spreadsheet Link is installed on your computer, you must set up the Spreadsheet Link add-in in Excel.

## Product Installation

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

---

**Note** If you have several versions of MATLAB installed on your computer, Spreadsheet Link uses the version that you registered last.

To install the Spreadsheet Link add-in, you need administrator system privileges on the computer. Contact your system administrator to enable these privileges.

---

## Supported Excel Versions

Use the following table to determine the correct MATLAB version to install, based on the version of Excel installed on your computer. Each row in the table matches the MATLAB version with the supported versions of Excel.

MATLAB Version	Excel Versions
R2016b and later	365, 2021, 2019, 2016, 2013

## Files and Folders Created by the Installation

---

**Note** The MATLAB root folder, *matlabroot*, is where MATLAB is installed on your system.

---

The Spreadsheet Link installation program creates a subfolder under *matlabroot\toolbox\*. The *exlink* folder contains these files:

- *exclink.xlam*: The Spreadsheet Link add-in for Microsoft Excel
- *ExliSamp.xls*: Spreadsheet Link example files described in this documentation

## After You Upgrade the Spreadsheet Link Software

If MATLAB and Spreadsheet Link are installed on your computer, to upgrade to a newer version:

- 1 Install the new version of MATLAB and Spreadsheet Link.
- 2 Start MATLAB and a Microsoft Excel session.
- 3 Configure the Spreadsheet Link software. For details, see “Add-In Setup” on page 1-5.
- 4 If you have existing workbooks with macros that use Spreadsheet Link, update references to Spreadsheet Link in each workbook.

To update the references in an existing workbook in Microsoft Excel:

- 1 In a Microsoft Excel session, open the Visual Basic® Editor window by clicking **Visual Basic** on the **Developer** tab. (If you do not find the **Developer** tab, see the Excel Help.)
- 2 In the left pane, select a module for which you want to update a reference.
- 3 From the main menu, select **Tools > References**.
- 4 In the References dialog box, select the **SpreadsheetLink** check box.
- 5 Click **OK**.

## See Also

### More About

- “Add-In Setup” on page 1-5

## Add-In Setup

### In this section...

“Configure Microsoft Excel” on page 1-5

“Work with Excel Macros” on page 1-8

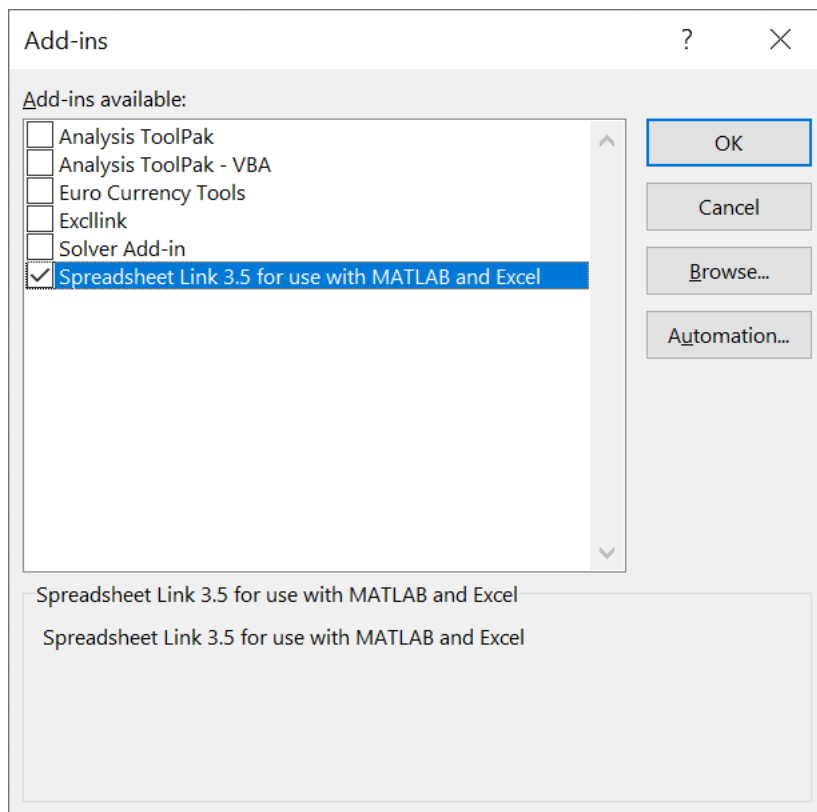
“Work with Microsoft Visual Basic Editor” on page 1-8

## Configure Microsoft Excel

To enable the Spreadsheet Link add-in, start a Microsoft Excel session and follow these steps.

For Microsoft Excel 2013 and later versions:

- 1 Select **File** from the main menu.
- 2 Click **Options**. The Excel Options dialog box opens.
- 3 Click **Add-Ins**.
- 4 From the **Manage** selection list, choose **Excel Add-Ins**.
- 5 Click **Go**. The Add-Ins dialog box opens.
- 6 Click **Browse**.
- 7 Select `matlabroot\toolbox\exlink\excllink.xlam`. (`matlabroot` returns the full path to the folder where MATLAB is installed.)
- 8 Click **Open**. In the Add-Ins dialog box, the **Spreadsheet Link for use with MATLAB and Excel** check box is selected.



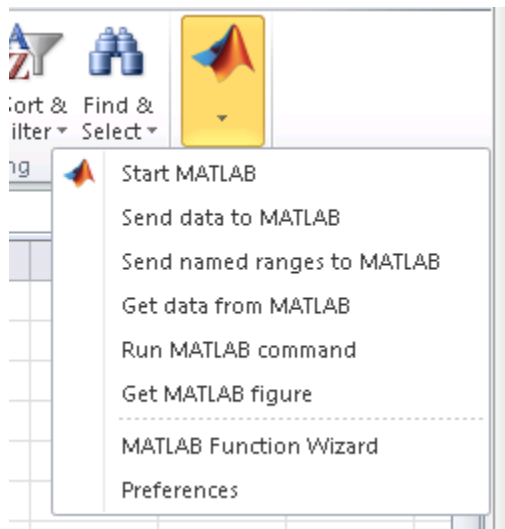
- 9 Click **OK** to close the Add-Ins dialog box.
- 10 Click **OK** to close the Excel Options dialog box.

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

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

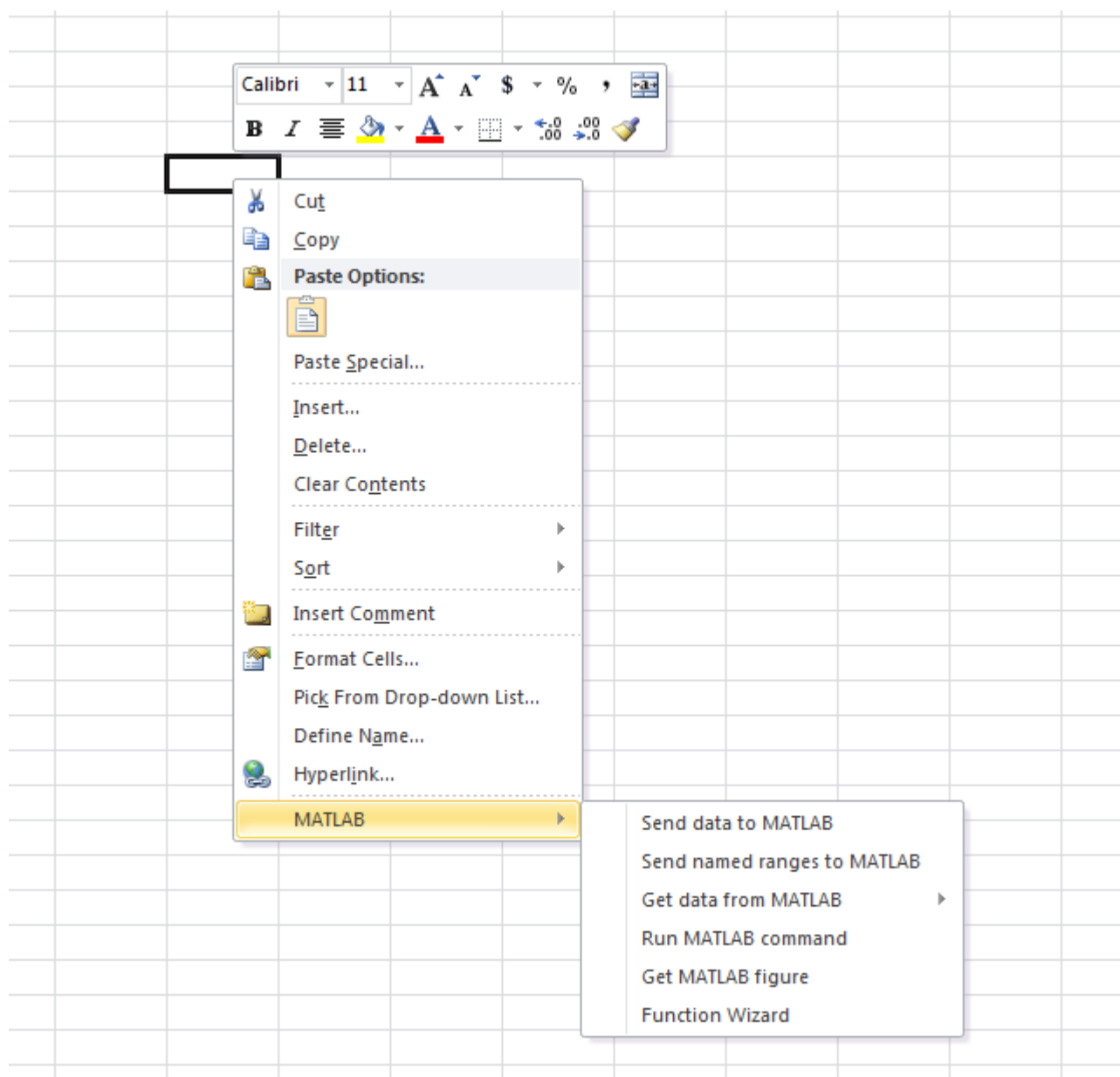


The MATLAB group appears on the top right of the **Home** tab in your Excel worksheet.



Spreadsheet Link is ready for use.

Right-click a cell to list the MATLAB options.



**Note** If the options are missing from the context menu and if the Trust Center dialog box has the **Require Application Add-ins to be signed by Trusted Publisher** check box selected, then you must click the **Enable Content** button for every session.

To check the settings in the Trust Center dialog box:

- 1 Click the **Developer** tab.
- 2 In the **Code** group, click the **Macro Security** button. The Trust Center dialog box opens.
- 3 Click **Add-ins**.

## Work with Excel Macros

To work with Excel macros, follow these steps to enable the **Developer** tab on the Excel ribbon.

For Microsoft Excel 2013 and later versions:

- 1 Click the **File** menu.
- 2 Click **Options**. The Excel Options dialog box opens.
- 3 Click **Customize Ribbon**.
- 4 From the **Main Tabs** list, select **Developer** and click **OK**. The Excel ribbon displays the **Developer** tab.
- 5 In the **Code** section of the **Developer** tab, click **Macros**. The Macro dialog box opens. Use this dialog box to run existing macros, create macros, and edit and delete macros.

## Work with Microsoft Visual Basic Editor

To enable Spreadsheet Link as a Reference in the Microsoft Visual Basic Editor:

- 1 Open a Visual Basic session. Click the **Visual Basic** button on the **Developer** tab, or press **Alt +F11**.

---

**Note** For instructions about displaying the **Developer** tab, see Excel Help.

---

- 2 In the Visual Basic toolbar, select **Tools > References**.
- 3 In the References — VBA Project dialog box, select the **SpreadsheetLink** check box.
- 4 Click **OK**.

### See Also

matlabroot

### More About

- “Installation” on page 1-3

## Set Spreadsheet Link Preferences

### In this section...

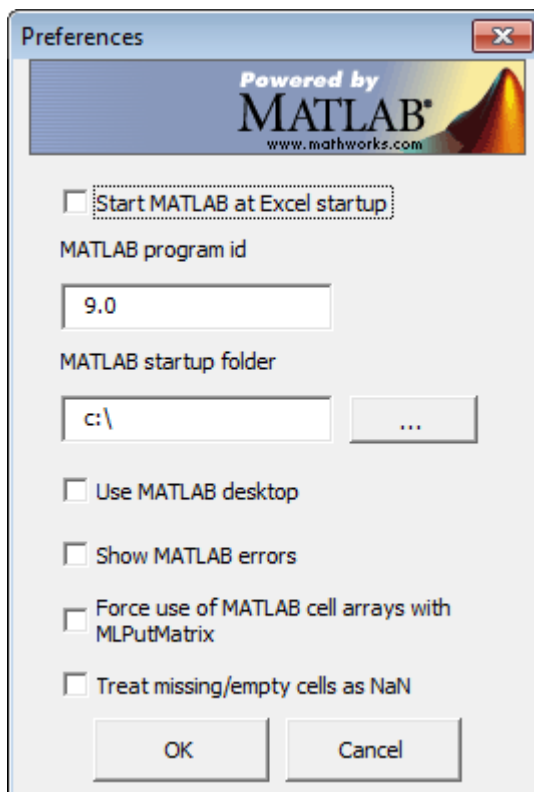
“Preferences Dialog Box” on page 1-9

“Preferences in Worksheet Cells” on page 1-9

To control how Spreadsheet Link and MATLAB behave when Spreadsheet Link starts MATLAB in Microsoft Excel, you can set preferences with the Preferences dialog box or within individual worksheet cells.

### Preferences Dialog Box

- 1 Click **Preferences** in the MATLAB group. The MATLAB group appears to the top right of the **Home** tab in your Excel worksheet.



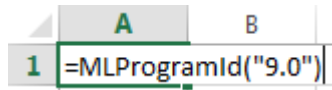
- 2 Set your preferences by selecting check boxes and filling in the text boxes. For the **MATLAB program id**, enter the MATLAB version as shown in the Windows registry. For the **MATLAB startup folder**, enter the full path of the startup folder. Select **Use MATLAB desktop** to start MATLAB in full desktop mode (only the Command Window opens by default).

### Preferences in Worksheet Cells

To set a preference in a worksheet cell in Microsoft Excel, enter text that runs the corresponding Spreadsheet Link function in the worksheet cell. For example, to set the MATLAB version in a worksheet cell:

- 1 Set the MATLAB version to 9.0, which corresponds to MATLAB R2016a, by entering this text.

```
=MLProgramId("9.0")
```



- 2 To run the function, press enter.

For details, see `MLProgramId`.

## See Also

`MLPutMatrix`

## More About

- “Worksheet Cell Errors” on page 3-2
- “Startup Errors” on page 3-11



## Start and Stop Spreadsheet Link and MATLAB

### In this section...

“Start Spreadsheet Link and MATLAB Automatically” on page 1-11  
 “Start Spreadsheet Link and MATLAB Manually” on page 1-11  
 “Connect to an Already Running MATLAB Session” on page 1-11  
 “Specify the MATLAB Startup Folder” on page 1-12  
 “Stop Spreadsheet Link and MATLAB” on page 1-12

### Start Spreadsheet Link and MATLAB Automatically

When installed and configured according to the instructions in “Add-In Setup” on page 1-5, the Spreadsheet Link and MATLAB software automatically start when you start a Microsoft Excel session.

### Start Spreadsheet Link and MATLAB Manually

- 1 Select **Tools > Macro**.
  - In Excel 2007, click the **View** or **Developer** tab, and then click the **Macros** button.
  - In Excel 2010, click the **View** menu and select **Macros** on the Excel toolstrip, and then click **View Macros**.
- 2 Enter `matlabinit` into the **Macro Name/Reference** field.
- 3 Click **Run**. The **MATLAB Command Window** button appears on the Microsoft Windows taskbar.

### Connect to an Already Running MATLAB Session

By default, Spreadsheet Link starts a new MATLAB session. Alternatively, it can connect to an already running MATLAB session.

---

**Note** If several versions of MATLAB are installed on your computer, Spreadsheet Link always uses the last registered version. If you try to connect to an already running MATLAB session that is not the last registered version, Spreadsheet Link starts a new MATLAB session. Spreadsheet Link does not connect to the existing one. To change the last registered version, see “Startup Errors” on page 3-11.

---

To connect a new Excel session to an already running MATLAB session:

- 1 In MATLAB, enter the following command:
 

```
enableservice('AutomationServer',true)
```

This command converts a running MATLAB session into an Automation server.
- 2 Start a new Excel session. It automatically connects to the running MATLAB session.

Alternatively, you can start MATLAB as an automation server from the beginning. To start MATLAB as an automation server, use the `automation` command-line option:

```
matlab -automation
```

This command does not start MATLAB in a full desktop mode. To do so, use the `-desktop` option:

```
matlab -automation -desktop
```

If you always use MATLAB as an automation server, modify the shortcut that you use to start MATLAB:

- 1 Right-click your MATLAB shortcut icon. (You can use the icon on your desktop or in the Windows **Start** menu.)
- 2 Select **Properties**.
- 3 Click the **Shortcut** tab.
- 4 Add `-automation` in the **Target** field. Remember to leave a space between `matlab.exe` and `-automation`.
- 5 Click **OK**.

For details, see “Manually Create Automation Server”.

## Specify the MATLAB Startup Folder

MATLAB starts in the MATLAB root folder and completes the initialization. After starting, MATLAB changes to the Spreadsheet Link MATLAB startup folder. For details about specifying the startup folder, see `MLStartDir`.

## Stop Spreadsheet Link and MATLAB

If you started the Spreadsheet Link and MATLAB software from the Excel interface:

- To stop both the Spreadsheet Link and MATLAB software, close the Excel session as you normally would.
- To stop the Spreadsheet Link 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` function to restart the Spreadsheet Link and MATLAB sessions manually.

If you connected an Excel session to an existing MATLAB session, close Excel and MATLAB sessions separately. Closing one session does not automatically close the other.

## Create Diagonal Matrix Using Microsoft Excel Ribbon

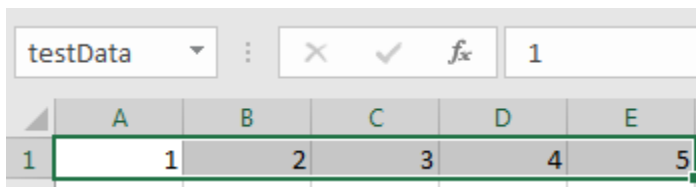
This example shows how to execute Spreadsheet Link functions to export a named range in a worksheet to MATLAB and create a diagonal matrix using the Microsoft Excel ribbon.

The MATLAB group on the Microsoft Excel ribbon contains commands for common Spreadsheet Link functions. For the list of common functions, see “Execute Spreadsheet Link Functions” on page 1-30.

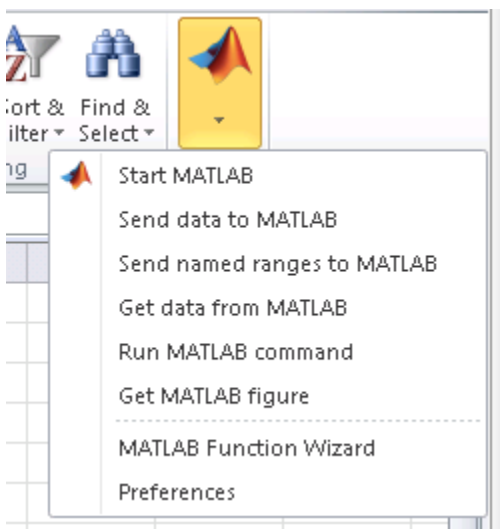
This example assumes that MATLAB is running after Microsoft Excel opens. For starting MATLAB, see “Start and Stop Spreadsheet Link and MATLAB” on page 1-11.

In a worksheet, enter the numbers 1 through 5 into the range of cells from A1 through E1. Define the name `testData` for this range of cells and select it. For instructions, see Excel Help and enter the search term: define and use names in formulas.

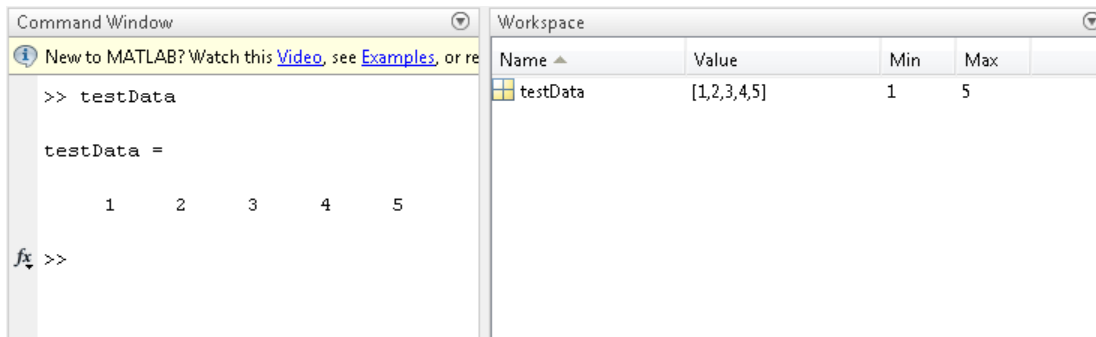
The named range `testData` appears in the **Name Box**.



On the **Home** tab of the Microsoft Excel ribbon, click the MATLAB group in the top-right corner. Then, select **Send named ranges to MATLAB**. When you select this command, the software executes `MLPutRanges`.



Microsoft Excel exports the named range `testData` into the MATLAB variable `testData` in the MATLAB workspace.



Select the MATLAB group option **Run MATLAB Command**. When you select this command, Microsoft Excel displays a dialog box. Next, create a diagonal matrix. Use the `diag` function to specify `testData` as the input argument and `d` as the output argument. Enter this MATLAB command in the dialog box and click **OK**.

```
d = diag(testData)
```

The software executes the `MLEvalString` function. The MATLAB variable `d` appears in the MATLAB workspace and contains a diagonal matrix.

Retrieve the diagonal matrix into the worksheet by selecting cell A3. Select the MATLAB group option **Get data from MATLAB**. When you select this command, Microsoft Excel displays a dialog box. Retrieve the diagonal matrix in `d` by entering `d` in the dialog box and clicking **OK**. The software executes the `MLGetMatrix` function.

The diagonal matrix displays in cells A3 through E7.

	A	B	C	D	E
1	1	2	3	4	5
2					
3	1	0	0	0	0
4	0	2	0	0	0
5	0	0	3	0	0
6	0	0	0	4	0
7	0	0	0	0	5

## See Also

[MLPutRanges](#) | [MLEvalString](#) | [MLGetMatrix](#)

## More About

- “Create Diagonal Matrix Using Microsoft Excel Context Menu” on page 1-15
- “Create Diagonal Matrix Using Worksheet Cells” on page 1-18
- “Create Diagonal Matrix Using VBA Macro” on page 1-20
- “Execute Spreadsheet Link Functions” on page 1-30

## Create Diagonal Matrix Using Microsoft Excel Context Menu

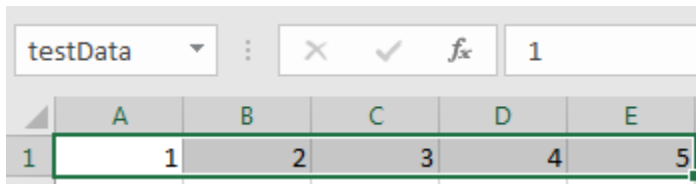
This example shows how to execute Spreadsheet Link functions to export a named range in a worksheet to MATLAB and create a diagonal matrix using the Microsoft Excel context menu.

The MATLAB group menu in the Microsoft Excel context menu contains commands for common Spreadsheet Link functions. For the list of common functions, see “Execute Spreadsheet Link Functions” on page 1-30.

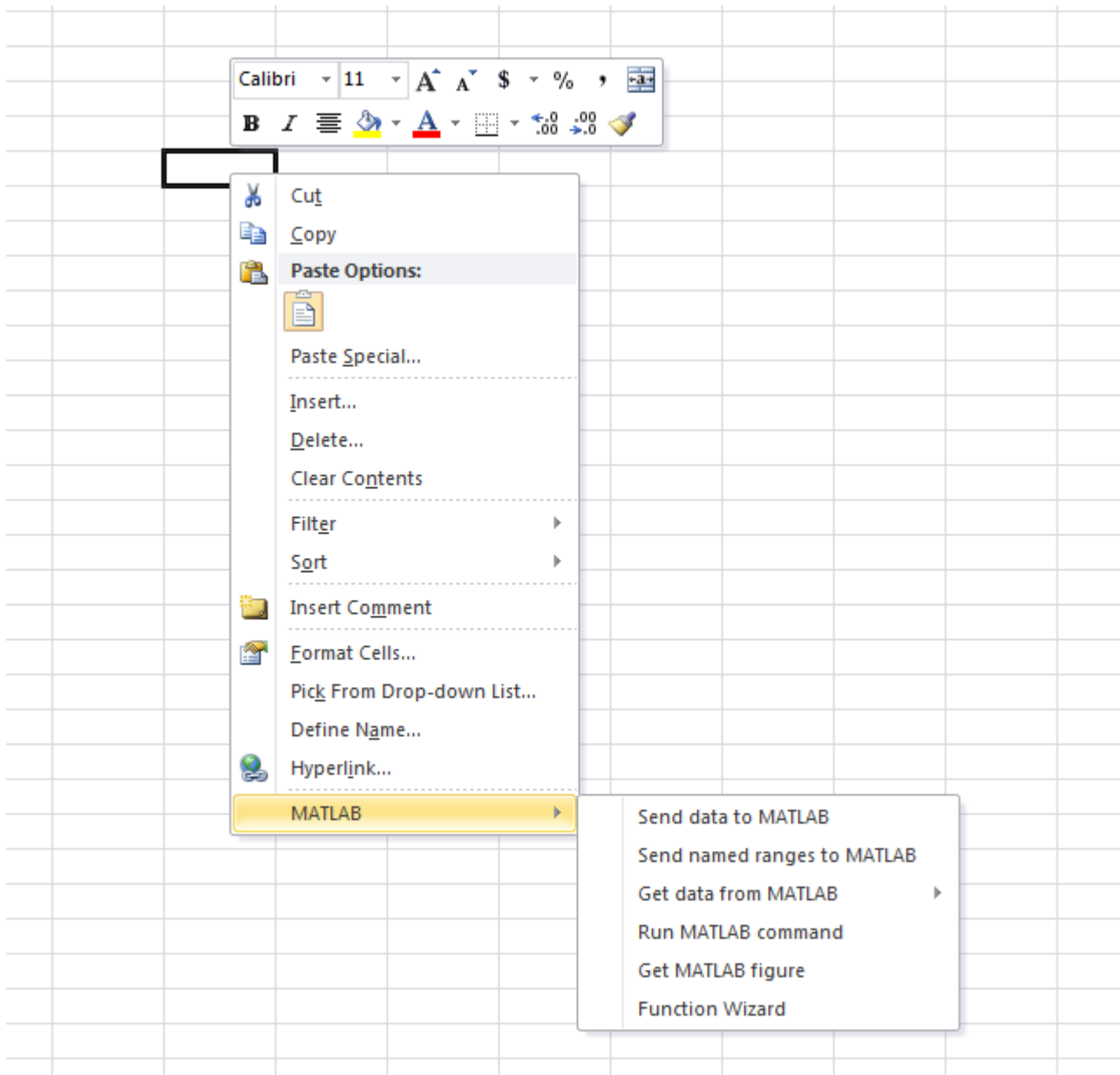
This example assumes that MATLAB is running after Microsoft Excel opens. For details, see “Start and Stop Spreadsheet Link and MATLAB” on page 1-11.

In a worksheet, enter the numbers 1 through 5 into the range of cells from A1 through E1. Define the name `testData` for this range of cells and select it. For instructions, see Excel Help and enter the search term: define and use names in formulas.

The named range `testData` appears in the **Name Box**.

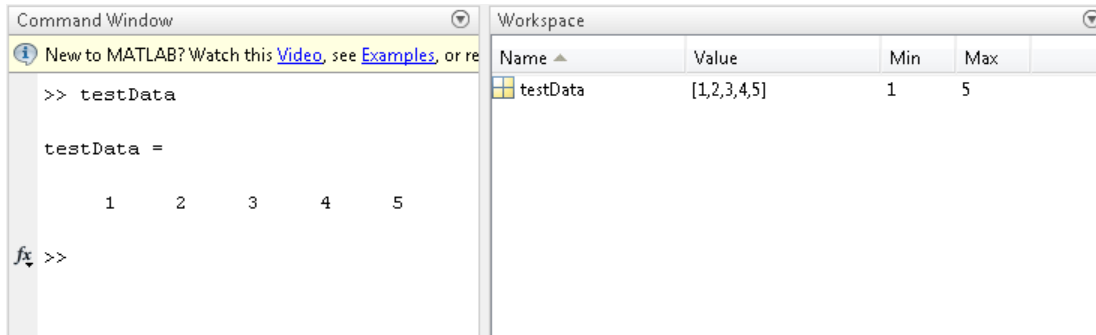


To find the command that exports the named range to MATLAB, right-click another cell outside of the named range in the worksheet. The Microsoft Excel context menu appears. To see the MATLAB group menu, select **MATLAB**.



Select **Send named ranges to MATLAB**. When you select this command, the software executes `MLPutRanges`.

Microsoft Excel exports the named range `testData` into the MATLAB variable `testData` in the MATLAB workspace.



Select the MATLAB group option **Run MATLAB Command**. When you select this command, Microsoft Excel displays a dialog box. Next, create a diagonal matrix. Use the `diag` function to specify `testData` as the input argument and `d` as the output argument. Enter this MATLAB command in the dialog box and click **OK**.

```
d = diag(testData)
```

The software executes the `MLEvalString` function. The MATLAB variable `d` appears in the MATLAB workspace and contains a diagonal matrix.

Retrieve the diagonal matrix into the worksheet. First select cell A3, and then select the MATLAB group option **Get data from MATLAB > d**. The software executes the `MLGetMatrix` function.

The diagonal matrix displays in cells A3 through E7.

	A	B	C	D	E
1	1	2	3	4	5
2					
3	1	0	0	0	0
4	0	2	0	0	0
5	0	0	3	0	0
6	0	0	0	4	0
7	0	0	0	0	5

## See Also

[MLPutRanges](#) | [MLEvalString](#) | [MLGetMatrix](#)

## More About

- “Create Diagonal Matrix Using Microsoft Excel Ribbon” on page 1-13
- “Create Diagonal Matrix Using Worksheet Cells” on page 1-18
- “Create Diagonal Matrix Using VBA Macro” on page 1-20
- “Execute Spreadsheet Link Functions” on page 1-30

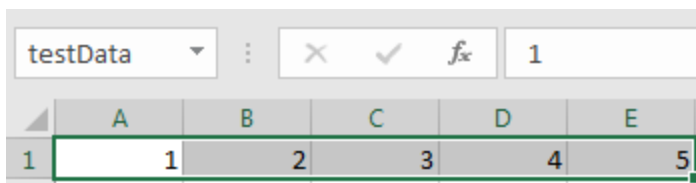
## Create Diagonal Matrix Using Worksheet Cells

This example shows how to execute Spreadsheet Link functions to export a named range in the worksheet to MATLAB and create a diagonal matrix using Microsoft Excel worksheet cells.

The example assumes that MATLAB is running after Microsoft Excel opens. For details, see “Start and Stop Spreadsheet Link and MATLAB” on page 1-11.

In a worksheet, enter the numbers 1 through 5 into the range of cells from A1 through E1. Define the name `testData` for this range of cells and select it. For instructions, see Excel Help and enter the search term: define and use names in formulas.

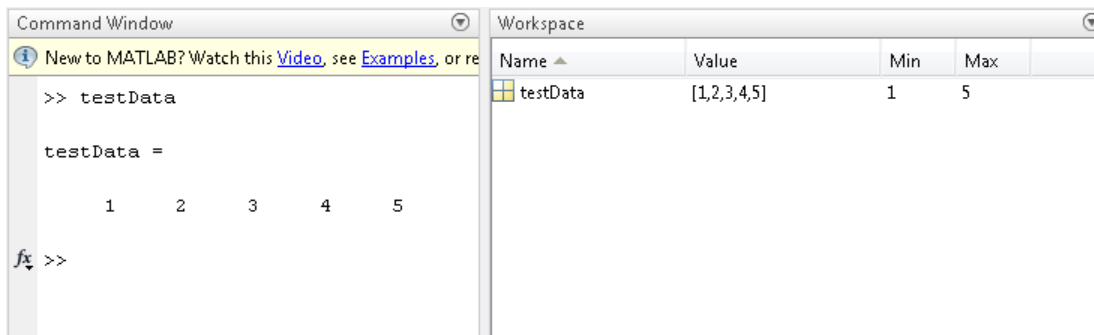
The named range `testData` appears in the **Name Box**.



Enter the Spreadsheet Link function `MLPutRanges` directly into the worksheet cell as a worksheet formula. Double-click cell A3. Enter this text.

```
=MLPutRanges( )
```

Press **Enter**. Microsoft Excel exports the named range `testData` into the MATLAB variable `testData` in the MATLAB workspace. After a Spreadsheet Link function successfully executes as a worksheet formula, the cell contains the value 0. While the function executes, the cell shows the entered formula.



Double-click cell A5. Next, create a diagonal matrix. Use the `diag` function to specify `testData` as the input argument and `d` as the output argument. The Spreadsheet Link function `MLEvalString` executes the MATLAB command. Enter this text.

```
=MLEvalString("d = diag(testData);")
```

Press **Enter**. MATLAB executes the `diag` function. The MATLAB variable `d` appears in the MATLAB workspace and contains the diagonal matrix.

Double-click cell A7. Now retrieve the diagonal matrix into the worksheet using the Spreadsheet Link function `MLGetMatrix`. Enter this text.



```
=MLGetMatrix("d","A9")
```

The diagonal matrix displays in cell A9 through E13.

	A	B	C	D	E
1	1	2	3	4	5
2					
3	0				
4					
5	0				
6					
7	0				
8					
9	1	0	0	0	0
10	0	2	0	0	0
11	0	0	3	0	0
12	0	0	0	4	0
13	0	0	0	0	5

## See Also

[MLPutRanges](#) | [MLPutMatrix](#) | [MLEvalString](#) | [MLGetMatrix](#)

## More About

- “Create Diagonal Matrix Using Microsoft Excel Ribbon” on page 1-13
- “Create Diagonal Matrix Using Microsoft Excel Context Menu” on page 1-15
- “Create Diagonal Matrix Using VBA Macro” on page 1-20
- “Execute Spreadsheet Link Functions” on page 1-30

## Create Diagonal Matrix Using VBA Macro

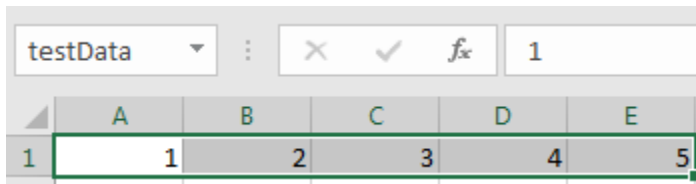
This example shows how to execute Spreadsheet Link functions to export a named range in the worksheet to MATLAB and create a diagonal matrix using a Microsoft Excel VBA macro.

The example assumes that MATLAB is running after Microsoft Excel opens. For details, see “Start and Stop Spreadsheet Link and MATLAB” on page 1-11.

To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see “Installation” on page 1-3.

In a worksheet, enter the numbers 1 through 5 into the range of cells from A1 through E1. Define the name `testData` for this range of cells and select it. For instructions, see Excel Help and enter the search term: define and use names in formulas.

The named range `testData` appears in the **Name Box**.



On the **Developer** tab in Microsoft Excel, click **Visual Basic**. The Visual Basic Editor window opens.

Insert a new module and create a diagonal matrix from the data in `testData`. To insert the module, select **Insert > Module**. In the Code section, enter this VBA code that contains a macro named `Diagonal`.

```
Sub Diagonal()
    MLPutRanges
    MLEvalString "b = diag(testData);"
    MLGetMatrix "b", "A3"
    MatlabRequest
End Sub
```

The `Diagonal` macro exports the named range into the MATLAB variable `testData` using the `MLPutRanges` function. Then, the macro uses the `MLEvalString` function to execute MATLAB code. The MATLAB code creates a diagonal matrix from the data in `testData` using the `diag` function. The code assigns the diagonal matrix to the MATLAB variable `b`. Then, the macro uses the `MLGetMatrix` function to import the diagonal matrix into the worksheet.

Copy and paste the code into the Visual Basic Editor from the HTML version of the documentation.

For details about working with modules, see Excel Help.

Run the macro by clicking **Run Sub/UserForm (F5)**. For details about running macros, see Excel Help.

The diagonal matrix displays in the worksheet cells A3 through E7.

	A	B	C	D	E
1	1	2	3	4	5
2					
3	1	0	0	0	0
4	0	2	0	0	0
5	0	0	3	0	0
6	0	0	0	4	0
7	0	0	0	0	5

## See Also

[MLPutRanges](#) | [MLEvalString](#) | [diag](#)

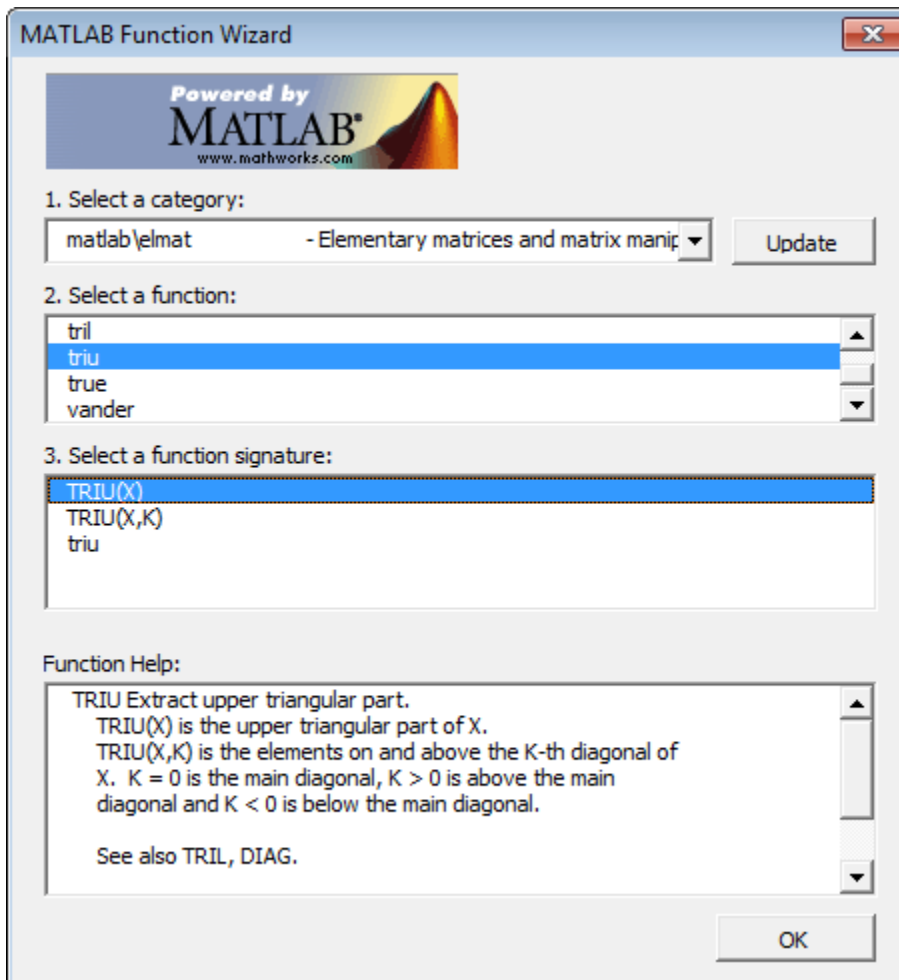
## More About

- “Create Diagonal Matrix Using Microsoft Excel Ribbon” on page 1-13
- “Create Diagonal Matrix Using Microsoft Excel Context Menu” on page 1-15
- “Create Diagonal Matrix Using Worksheet Cells” on page 1-18
- “Execute Spreadsheet Link Functions” on page 1-30

## Find and Execute MATLAB Function Using MATLAB Function Wizard

This example shows how to find and execute the `triu` function using the MATLAB Function Wizard for Spreadsheet Link. You can use the Function Wizard to find any MATLAB function.

First, open the MATLAB Function Wizard from Microsoft Excel. From the **Home** tab, select the MATLAB group option **MATLAB Function Wizard**. Locate the `triu` MATLAB function, choose the function signature, and then execute it.



Alternatively, you can execute the function in a Microsoft Excel worksheet cell by using function `matlabfcn` or `matlabsub`.

### List Folders and Function Categories

All folders or categories in the current search path appear in the **Select a category** field of the MATLAB Function Wizard. Click an entry to select it. Each entry in the list appears as a folder path and a description read from the `Contents.m` file in that folder. If no `Contents.m` file is found, the category list displays contains this message:

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

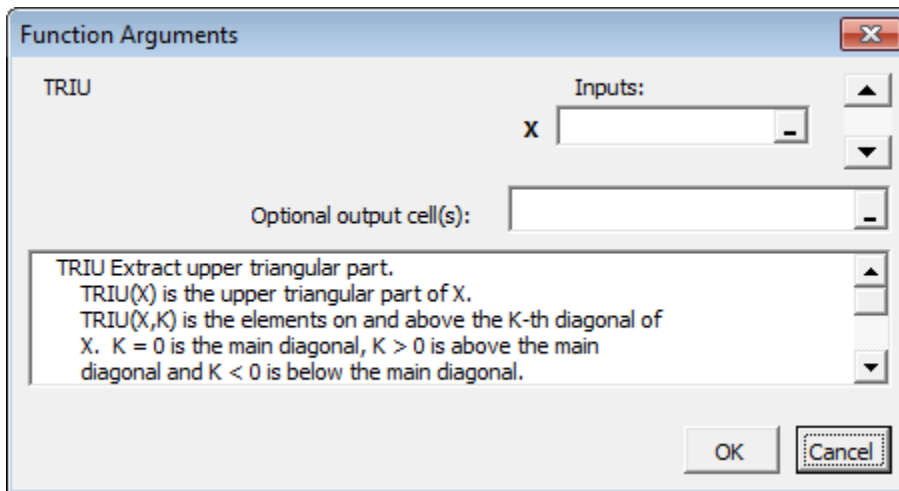
## Refresh and Select Category

Click **Update** to refresh the category list. For details about the search path, see [path](#).

The **Select a function** field displays a list of available functions for that category. Click the function name you want to execute. For help with the selected function, view the **Function Help** field.

## Select Function Signature and Enter Formula

The **Select a function signature** field displays available signatures for that function. Click a function signature to select it. The Function Arguments dialog box appears.



Specify the worksheet cell that contains the input argument **X**. By default, the output of the selected function appears in the current worksheet cell using the function `matlabfcn`.

## See Also

`matlabfcn` | `matlabsub`

## More About

- “Find Custom MATLAB Function Using MATLAB Function Wizard” on page 1-24
- “Execute Spreadsheet Link Functions” on page 1-30

## Find Custom MATLAB Function Using MATLAB Function Wizard

This example shows how to write a custom function and find it using the MATLAB Function Wizard for Spreadsheet Link. To execute MATLAB functions using the MATLAB Function Wizard, see “Find and Execute MATLAB Function Using MATLAB Function Wizard” on page 1-22.

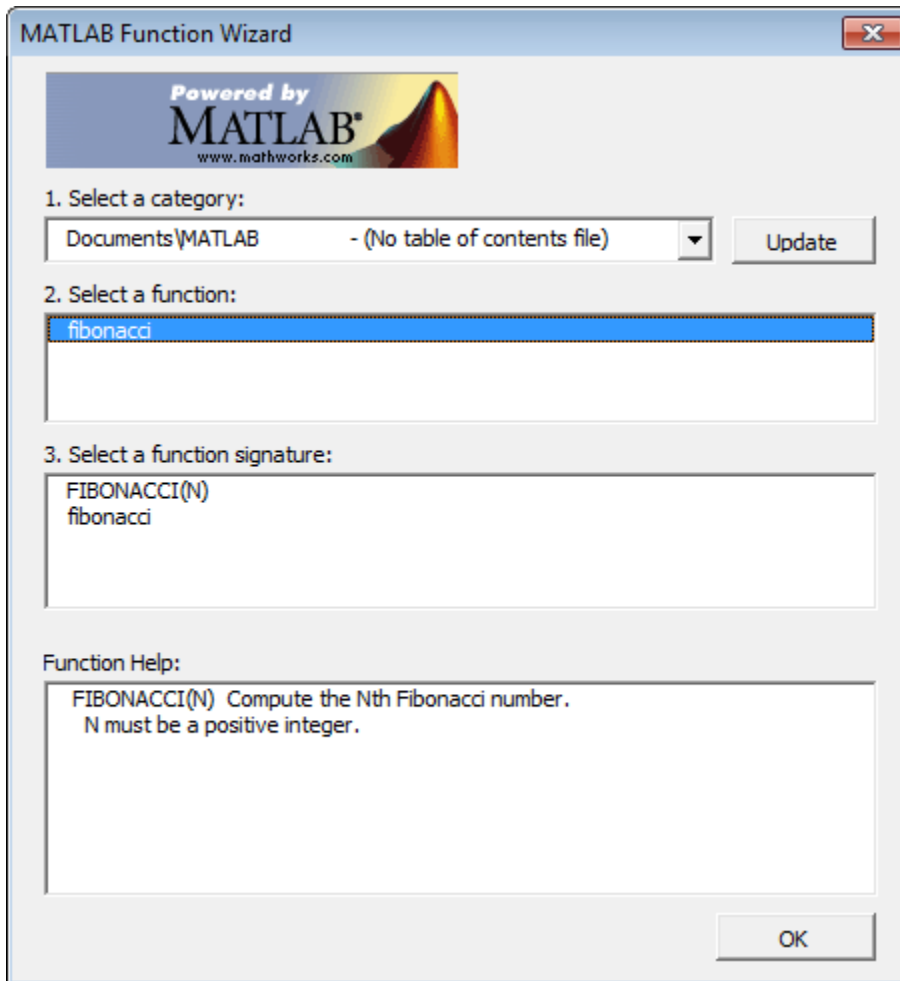
Create and save a custom function in MATLAB. First, create a help header in the function that contains supported function signatures to use with the MATLAB Function Wizard. Write the function that calculates the Fibonacci numbers, and then save the function in the folder Documents\MATLAB.

```
function f = fibonacci(n)
% FIBONACCI(N) Calculate the Nth Fibonacci number.
% N must be a positive integer.
    if n < 0
        error('Invalid number.')
    elseif n == 0
        f = 0;
    elseif n == 1
        f = 1;
    else
        f = fibonacci(n - 1) + fibonacci(n - 2);
    end;
```

For writing MATLAB functions, see “Create Functions in Files”.

Add the folder where you saved the function to the MATLAB search path. You can use the `pathtool` function or select **Set Path** in the MATLAB Toolstrip.

Open the MATLAB Function Wizard in Microsoft Excel using either the Microsoft Excel ribbon or context menu. Select the folder where you saved your function.



To execute this function, follow the steps in “Find and Execute MATLAB Function Using MATLAB Function Wizard” on page 1-22.

## See Also

[matlabfcn](#) | [matlabsub](#)

## More About

- “Find and Execute MATLAB Function Using MATLAB Function Wizard” on page 1-22
- “Execute Spreadsheet Link Functions” on page 1-30

## Return Multiple Output Arguments from MATLAB Function

This example shows how to execute a MATLAB function that returns multiple output arguments in Microsoft Excel using a Microsoft Excel VBA macro. The macro writes multiple output arguments from the MATLAB workspace to Microsoft Excel cells.

To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see "Installation" on page 1-3.

This example calculates the singular value decomposition of a matrix using `svd`.

In the Microsoft Excel cells from A1 through C3, create a range of data. Enter numbers from 1 through 3 in cells A1 through A3. Enter numbers from 4 through 6 in cells B1 through B3. Enter numbers from 7 through 9 in cells C1 through C3.

	A	B	C	D
1	1	2	3	
2	4	5	6	
3	7	8	9	
4				

Create a Microsoft Excel VBA macro named `appliesvd`. For details about creating macros, see Excel Help.

```
Public Sub appliesvd()
    MLOpen
    MLPutMatrix "x", Range("A1:C3")
    MLEvalString ("[u,s,v] = svd(x);")
    MLGetMatrix "u", "A5"
    MLGetMatrix "s", "A9"
    MLGetMatrix "v", "A13"
    MatlabRequest
    MLClose
End Sub
```

The macro:

- 1 Starts MATLAB.
- 2 Sends the data in the A1 through C3 cell range to the MATLAB workspace and assigns it to the MATLAB variable `x`.
- 3 Runs `svd` with the input argument `x` and output arguments `u`, `s`, and `v`.
- 4 Individually retrieves data for one output argument into a specific Microsoft Excel cell while accounting for the size of each output data matrix to avoid overwriting data. For the first output argument, the macro retrieves the data for the output argument `u` into cell A5.
- 5 Closes MATLAB.

Run `appliesvd`. MATLAB runs `svd` and populates the specified cells with data from the three output arguments.



	A	B	C
1	1	2	3
2	4	5	6
3	7	8	9
4			
5	-0.2148	0.8872	0.4082
6	-0.5206	0.2496	-0.8165
7	-0.8263	-0.3879	0.4082
8			
9	16.8481	0.0000	0.0000
10	0.0000	1.0684	0.0000
11	0.0000	0.0000	0.0000
12			
13	-0.4797	-0.7767	0.4082
14	-0.5724	-0.0757	-0.8165
15	-0.6651	0.6253	0.4082
16			

For details about running macros, see Excel Help.

## See Also

svd | MLOpen | MLGetMatrix | MLPutMatrix | MLEvalString | MLClose

## More About

- “Create Diagonal Matrix Using VBA Macro” on page 1-20
- “Execute Spreadsheet Link Functions” on page 1-30

## Convert Dates Between Microsoft Excel and MATLAB

Default Microsoft Excel date numbers represent the number of days that have passed since January 1, 1900. For example, January 1, 1950 is represented as 18264 in the Excel software.

However, MATLAB date numbers represent the number of days that have passed since January 1, 0000, so January 1, 1950 is represented as 712224 in the MATLAB software. Therefore, the difference in dates between the Excel software and the MATLAB software is a constant, 693960 (712224 minus 18264).

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.

### See Also

#### Related Examples

- “Create Diagonal Matrix Using Worksheet Cells” on page 1-18
- “Create Diagonal Matrix Using VBA Macro” on page 1-20

## Localization Information

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

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

### See Also

### Related Examples

- “Set Spreadsheet Link Preferences” on page 1-9

## Execute Spreadsheet Link Functions

Spreadsheet Link functions manage the connection and data exchange between Microsoft Excel and MATLAB, without leaving the Microsoft Excel environment.

To execute Spreadsheet Link functions, you must:

- Understand the differences between these functions and Microsoft Excel functions.
- Choose the right function type, execution method, and calculation mode for your situation.
- Decide how to specify functions and arguments.

### Spreadsheet Link and Microsoft Excel Function Differences

In Microsoft Excel, entering Spreadsheet Link functions can be similar to Microsoft Excel functions. The differences include:

- Spreadsheet Link functions perform an action, while Microsoft Excel functions return a value.
- Spreadsheet Link function names are case-insensitive. Entering either `MLPutMatrix` or `mlputmatrix` executes the `MLPutMatrix` function.
- MATLAB function names and variable names are case-sensitive. For example, `BONDS`, `Bonds`, and `bonds` are three different MATLAB variables.

### Spreadsheet Link Function Types

There are link management and data management functions in Spreadsheet Link.

Link management functions initialize, start, and stop the Spreadsheet Link and MATLAB software. Execute the `matlabinit` function from the Excel **Tools > Macro** menu or in macro subroutines.

Data management functions copy data between Microsoft Excel and the MATLAB workspace. These functions execute MATLAB commands in Microsoft Excel. Except for `MLPutVar` and `MLGetVar`, you can execute any data management function as a worksheet cell formula or in a VBA macro. The `MLPutVar` and `MLGetVar` functions execute only in VBA macros.

### Spreadsheet Link Function Execution Method

You can execute Spreadsheet Link functions using these various methods.

Execution Method	Advantages	Limitations
Microsoft Excel ribbon	<p>Quickly access common Spreadsheet Link functionality in the MATLAB group:</p> <ul style="list-style-type: none"> <li>• <code>matlabinit</code></li> <li>• <code>MLPutMatrix</code></li> <li>• <code>MLPutRanges</code></li> <li>• <code>MLGetMatrix</code></li> <li>• <code>MLEvalString</code></li> <li>• <code>MLGetFigure</code></li> <li>• MATLAB Function Wizard (For details, see “Find and Execute MATLAB Function Using MATLAB Function Wizard” on page 1-22.)</li> <li>• Preferences (For details, see “Set Spreadsheet Link Preferences” on page 1-9.)</li> </ul>	Full Spreadsheet Link functionality is unavailable.
Microsoft Excel context menu	<p>Quickly access common Spreadsheet Link functionality in a worksheet cell:</p> <ul style="list-style-type: none"> <li>• <code>MLPutMatrix</code></li> <li>• <code>MLPutRanges</code></li> <li>• <code>MLEvalString</code></li> <li>• <code>MLGetFigure</code></li> <li>• MATLAB Function Wizard (For details, see “Find and Execute MATLAB Function Using MATLAB Function Wizard” on page 1-22.)</li> <li>• <code>MLGetMatrix</code></li> </ul>	Full Spreadsheet Link functionality is unavailable.
Microsoft Excel worksheet cell	<ul style="list-style-type: none"> <li>• Execute any Spreadsheet Link function.</li> <li>• Execute MATLAB functions.</li> </ul>	You cannot execute <code>MLGetVar</code> , <code>MLPutVar</code> , or <code>matlabinit</code> within a worksheet cell.
Microsoft Excel VBA macro	<ul style="list-style-type: none"> <li>• Execute any Spreadsheet Link function.</li> <li>• Execute MATLAB functions.</li> <li>• Execute advanced VBA code.</li> </ul>	Requires knowledge of Microsoft Visual Basic.

Execution Method	Advantages	Limitations
MATLAB Function Wizard	<ul style="list-style-type: none"> <li>• Find MATLAB function by category or folder.</li> <li>• Explore MATLAB function syntaxes.</li> <li>• Execute MATLAB function by choosing a syntax and specifying arguments.</li> <li>• Execute custom MATLAB function.</li> </ul>	Execute a MATLAB function using only the Spreadsheet Link functions <code>matlabfcn</code> and <code>matlabsub</code> .

## Specify Spreadsheet Link Function in Microsoft Excel

When you specify a Spreadsheet Link function in a worksheet cell, enter the formula by starting with a + or = sign. Then, enclose function arguments in parentheses. This example formula uses the `MLPutMatrix` function to export data in cell C10 into matrix A.

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

In VBA macros, leave a space between the function name and the first argument. Do not use parentheses.

```
MLPutMatrix "A",C10
```

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

## Set Calculation Mode

Spreadsheet Link functions are most effective in automatic calculation mode. To automate the recalculation of a Spreadsheet Link function, add a cell reference to a cell whose value changes. For example, the `MLPutMatrix` function executes again when the value in cell C1 changes.

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

To use `MLPutMatrix` in manual calculation mode:

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

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

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

## Specify Spreadsheet Link Function Arguments

You can specify arguments in Spreadsheet Link functions using the variable name or by referencing the data location for the argument.

---

**Note:** Spreadsheet Link functions expect the default reference style (A1) worksheet cell references. The columns must be designated with letters and the rows with numbers. If your worksheet shows columns designated with numbers instead of letters, then follow this procedure:

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

### Variable-Name Arguments

- You can directly or indirectly specify a variable-name argument in most Spreadsheet Link 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 retrieve the variable name. The argument must be a worksheet cell address or range name; for example, `=MLDeleteMatrix(C1)`.

---

**Note** Spreadsheet Link functions do not support global variables. When exchanging data between Excel and MATLAB, the software uses the base workspace. Variables in the base workspace exist until you clear them or end your MATLAB session.

---

### 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 such as `Sheet3!B1:C7` or `Sheet2!OUTPUT`.

---

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

---

## Specify MATLAB Function in MATLAB Function Wizard

After you find the MATLAB function or custom function in the MATLAB Function Wizard, you can specify the syntax and arguments. Then, Spreadsheet Link specifies this command for evaluation in the MATLAB workspace.

To execute a MATLAB function with multiple outputs, specify where to write the output.

- Specifying a target range of cells using the **Optional output cell(s)** field causes the selected function to appear in the current worksheet cell as an argument of `matlabsub`. The `matlabsub` function includes an argument that indicates where to write the output. For example, the data from A2 is input to the `rand` function and the target cell for output is B2:

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

- Although the Function Wizard lets you specify multiple output cells, it does not return multiple outputs. If you specify a range of output cells, the wizard returns the first output argument starting in the first output cell. For example, if a function returns two elements *a* and *b*, and you specify A1:A2 as output cells, the Function Wizard displays *a* in cell A1. The Function Wizard discards element *b*. If an output is a matrix, the Function Wizard displays all elements of that matrix starting in the first output cell.

For multiple output arguments, see “Return Multiple Output Arguments from MATLAB Function” on page 1-26.

To execute multiple MATLAB functions or use MATLAB objects, write a wrapper function.

- The Function Wizard does not allow simultaneous execution of multiple MATLAB functions. Write a wrapper function instead. For example, to plot historical closing-price data from Bloomberg®, enter this code in MATLAB and save it as a function.

```
function plotbloombergdata(s)
% plotbloombergdata is a wrapper function that connects to
% Bloomberg(R), retrieves historical closing-price data for
% the year 2015, and plots the prices for a given
% Bloomberg(R) security s.
    c = blp;
    f = 'LAST_PRICE';
    fromdate = '01/01/2015';
    todate = '12/31/2015';
    d = history(c,s,f,fromdate,todate);
    plot(d(:,1),d(:,2))
    close(c)
end
```

For details about writing functions, see “Create Functions in Files”.

- Microsoft Excel has no context for MATLAB objects. To work with MATLAB objects, such as connections to service providers, write a wrapper function. The wrapper function executes the functions that create and manipulate these objects.

## See Also

[matlabinit](#) | [matlabfcn](#) | [MLGetMatrix](#) | [MLPutMatrix](#) | [MLEvalString](#)

## More About

- “Create Diagonal Matrix Using Microsoft Excel Ribbon” on page 1-13
- “Create Diagonal Matrix Using Microsoft Excel Context Menu” on page 1-15
- “Create Diagonal Matrix Using Worksheet Cells” on page 1-18
- “Create Diagonal Matrix Using VBA Macro” on page 1-20
- “Find and Execute MATLAB Function Using MATLAB Function Wizard” on page 1-22
- “Localization Information” on page 1-29



# Solving Problems with the Spreadsheet Link Software

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- “Model Data Using Regression and Curve Fitting” on page 2-2
- “Interpolate Thermodynamic Data” on page 2-8
- “Price Stock Options Using Binomial Model” on page 2-11
- “Plot Efficient Frontier of Financial Portfolios” on page 2-14
- “Map Time and Bond Cash Flows” on page 2-17

## Model Data Using Regression and Curve Fitting

This example shows how to execute MATLAB data regression and curve fitting in Microsoft Excel using a worksheet and a VBA macro.

The example organizes and displays the input and output data in a Microsoft Excel worksheet. Spreadsheet Link functions copy the data to the MATLAB workspace and execute MATLAB computational and graphic functions. The VBA macro also returns output data to a worksheet.

To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see "Installation" on page 1-3.

Open the `ExliSamp.xls` file and select the **Sheet1** worksheet. For help finding the `ExliSamp.xls` file, see "Installation" on page 1-3.

**Sheet1** of the spreadsheet contains the named range `DATA`, which consists of the example data set in worksheet cells A4 through C28.

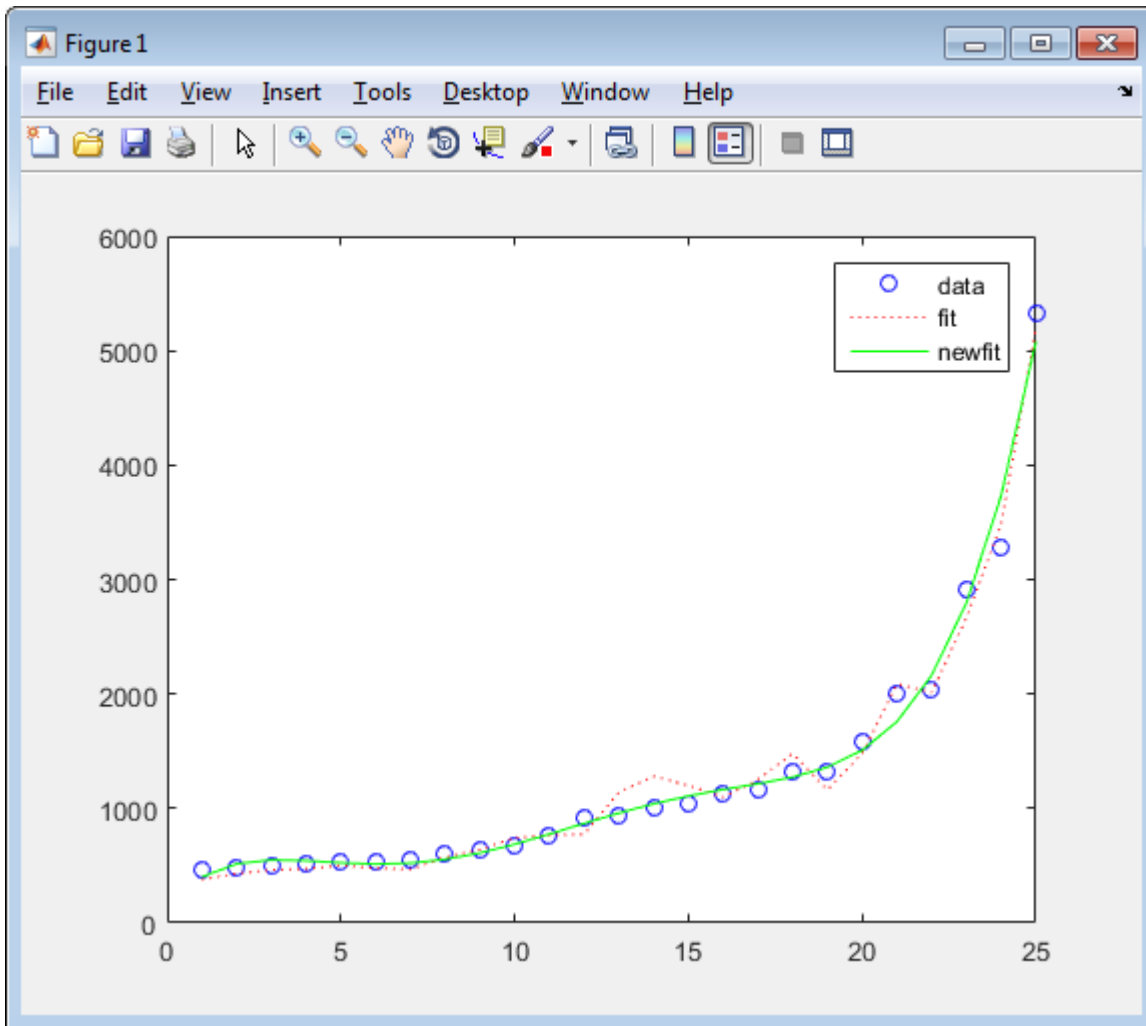
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	<b>Regression and Curve Fitting</b>												
2													
3		<b>DATA</b>			<b>Spreadsheet Link Functions</b>								
4	35	207	1325		1. Transfer the data to MATLAB.								
5	17	90	533		#MATLAB' <== MLPutMatrix("data",DATA)								
6	43	180	1013										
7	41	187	1163		2. Set up data for regression.								
8	177	552	5326		#MATLAB' <== MLEvalString("y = data(:,3)")								
9	57	354	2043		#MATLAB' <== MLEvalString("e = ones(length(data),1)")								
10	20	101	602		#MATLAB' <== MLEvalString("A = [e data(:,1:2)]")								
11	18	91	532										
12	17	86	543		3. Compute regression coefficients.								
13	35	180	1134		#MATLAB' <== MLEvalString("beta = A\y")								
14	25	136	766										
15	17	84	495		4. Calculate regressed result.								
16	23	102	635		#MATLAB' <== MLEvalString("fit = A*beta")								
17	24	148	913										
18	40	292	1591		5. Compare original data with regression results.								
19	25	126	671		#MATLAB' <== MLEvalString("[y,k] = sort(y)")								
20	17	88	521		#MATLAB' <== MLEvalString("fit = fit(k)")								
21	46	235	1319		#MATLAB' <== 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		#MATLAB' <== MLEvalString("[p,S] = polyfit(1:n,y',5)")								
25	66	300	2006		#MATLAB' <== 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		#MATLAB' <== MLEvalString("plot(1:n,y,'bo',1:n,fit,'r',1:n,newfit,'g'); legend('data','fit','newfit')")								

### Model Data in Worksheet

To perform regression and curve fitting, execute the specified Spreadsheet Link functions in worksheet cells.

- 1 Execute the Spreadsheet Link function that copies the sample data set to the MATLAB workspace by double-clicking the cell E5 and pressing **Enter**. 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.

- 2 Execute the functions in cells E8, E9, and E10. The Spreadsheet Link functions in these cells regress the third column of data on the other two columns, and create:
  - A single vector `y` containing the third-column data
  - A three-column matrix `A`, which consists of a column of 1s followed by the rest of the data
- 3 Execute the function in cell E13. This function calculates the regression coefficients by using the MATLAB back slash (`\`) operation to solve the *overdetermined* system of linear equations,  $A*\text{beta} = y$ .
- 4 Execute the function in cell E16. MATLAB matrix-vector multiplication produces the regressed result, `fit`.
- 5 Execute the functions in cells E19, E20, and E21. These functions:
  - 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.
- 6 Execute the functions in cells E24 and E25. Fit a polynomial equation to the data for a fifth-degree polynomial. The MATLAB `polyfit` function automates setting up a system of simultaneous linear equations and solutions for the coefficients. The `polyval` function then evaluates the resulting polynomial at each data point to check the goodness of the fit `newfit`.
- 7 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).



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

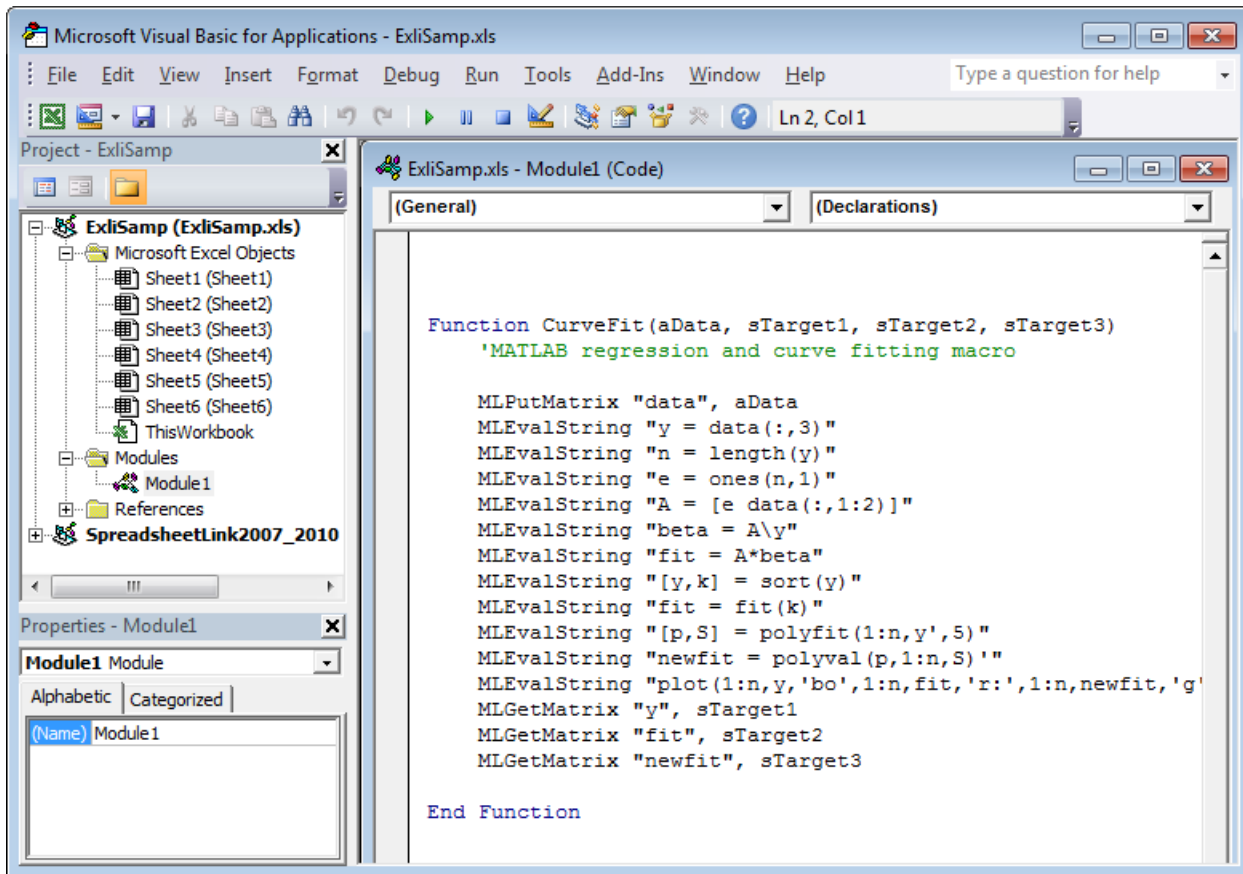
### Model Data Using VBA Macro

To model the data using a VBA macro, execute the Spreadsheet Link functions in a VBA macro.

- 1 In the `ExliSamp.xls` file, click the **Sheet2** tab. The worksheet for this example appears.

	A	B	C	D
1	<b>Regression and Curve Fitting Macro</b>			
2	(See Module 1)			
3				
4		0 <== CurveFit(DATA,"A7","B7","C7")		
5				
6	<b>y</b>	<b>fit</b>	<b>newfit</b>	
7				
8				
9				
10				
11				
12				
13				
14				
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31				

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



While this module is open, ensure that the Spreadsheet Link add-in is enabled. To enable it, see “Add-In Setup” on page 1-5. After the add-in is enabled, the Project Explorer lists it under the **References** folder.

- 2 Execute the CurveFit macro by double-clicking the cell A4 and pressing **Enter**. The macro runs the Spreadsheet Link functions. When the macro finishes, the input and output data appears in worksheet cells A7:C31.
  - Column A contains the original data y (sorted).
  - Column B contains the corresponding regressed data fit.
  - Column C contains the polynomial data newfit.

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

## See Also

MLGetMatrix | MLPutMatrix | MLEvalString | polyfit | polyval | plot

## More About

- "Interpolate Thermodynamic Data" on page 2-8
- "Price Stock Options Using Binomial Model" on page 2-11
- "Plot Efficient Frontier of Financial Portfolios" on page 2-14
- "Map Time and Bond Cash Flows" on page 2-17
- "Execute Spreadsheet Link Functions" on page 1-30

## Interpolate Thermodynamic Data

This example shows how to interpolate data using Spreadsheet Link to invoke MATLAB functions in Microsoft Excel.

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

To organize and display the original data and the interpolated output data, you can use Microsoft Excel worksheets.

Open the `ExliSamp.xls` file and select the **Sheet3** worksheet. For help finding the `ExliSamp.xls` file, see "Installation" on page 1-3.

This worksheet contains measured thermodynamic data in cell ranges A5 through A29, B5 through B29, and C5 through C29. The time and temperature values for interpolation are in cell ranges E7 through E30 and F6 through T6, respectively.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	
1	<b>Data Interpolation</b>																				
2																					
3	<b>Original Data</b>					<b>Interpolated Values</b>															
4	<b>Time</b>	<b>Temp</b>	<b>Volume</b>			<b>Temp</b>															
5	0.025	68.00	2504.08			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	
6	0.050	68.05	2535.07																		
7	0.075	68.07	2562.91		0.025																
8	0.100	68.09	2575.74		0.05																
9	0.125	68.20	2606.16		0.075																
10	0.150	68.50	2628.58		0.1																
11	0.175	68.85	2681.38		0.125																
12	0.200	69.22	2712.06		0.15																
13	0.225	70.08	2767.52		0.175																
14	0.250	70.33	2815.54		0.2																
15	0.275	70.59	2824.37		0.225																
16	0.300	70.85	2873.65		0.25																
17	0.325	71.11	2882.20		0.275																
18	0.350	71.44	2896.49		0.3																
19	0.375	71.82	2902.07		0.325																
20	0.400	72.33	2920.04		0.35																
21	0.425	72.65	2929.35		0.375																
22	0.450	73.46	2934.23		0.4																
23	0.475	73.85	2938.55		0.425																
24	0.500	74.22	3012.93		0.45																
25	0.525	74.37	3099.12		0.475																
26	0.550	74.55	3130.01		0.5																
27	0.575	74.67	3179.24		0.525																
28	0.600	74.72	3180.71		0.55																
29	0.625	75.00	3184.15		0.575																
30					0.6																
31	<b>Spreadsheet Link Functions</b>																				
32	1. Transfer original data to MATLAB.																				
33	#MATLAE <= MLPutMatrix("LLabels", A4:C4)																				
34	#MATLAE <= MLPutMatrix("X", A5:A29)																				
35	#MATLAE <= MLPutMatrix("T", B5:B29)																				
36	#MATLAE <= MLPutMatrix("V", C5:C29)																				
37																					
38	2. Transfer interpolation data points to MATLAB.																				
39	#MATLAE <= MLPutMatrix("Xa", E7:E30)																				
40	#MATLAE <= MLPutMatrix("Ta", F6:T6)																				
41																					
42	3. Execute MATLAB data interpolation function.																				
43	#MATLAE <= MLEvalString("[Xl, Tl, Vl] = griddata(X, T, V, Xa, Ta, 'nearest')")																				
44																					
45	4. Transpose output data matrix and transfer data to Excel.																				
46	#MATLAE <= MLEvalString("V = Vl;")																				
47	#MATLAE <= MLGetMatrix("V", "sheet3!F7")																				
48																					
49	5. Plot interpolated data and label the figure.																				
50	#MATLAE <= MLEvalString("surf(Xl, Tl, Vl); title('Interpolated Data'); xlabel(LLabels{1}); ylabel(LLabels{2}); zlabel(LLabels{3}); grid on")																				

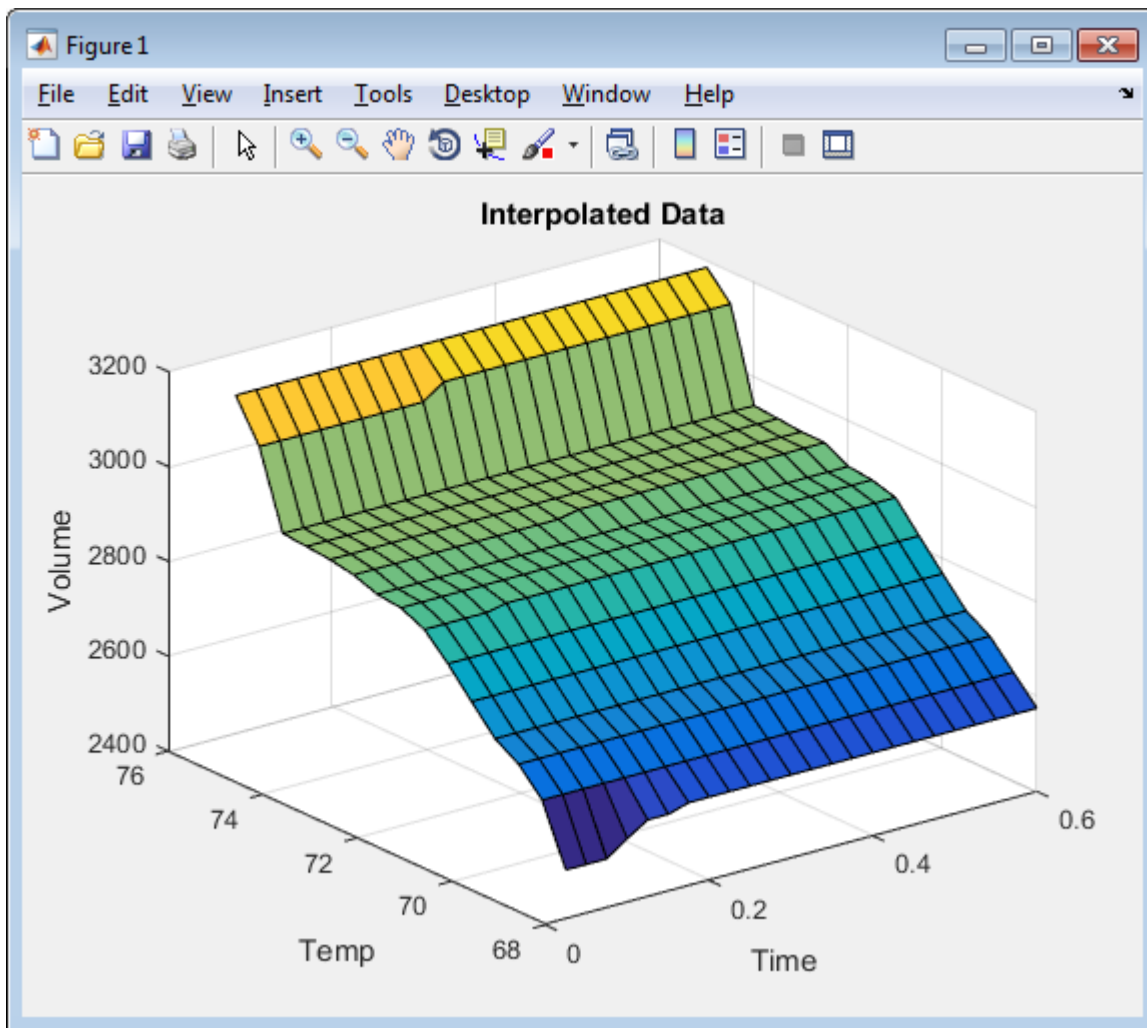
- 1 Execute the Spreadsheet Link function that passes the **Time**, **Temp**, and **Volume** labels to the MATLAB workspace by double-clicking the cell A33 and pressing **Enter**.



- 2 Copy the original time data to the MATLAB workspace by executing the function in the cell A34. To copy the original temperature data, execute the function in the cell A35. To copy the original volume data, execute the function in cell A36.
- 3 Copy the interpolation time values to the MATLAB workspace by executing the function in cell A39. To copy the interpolation temperature values, execute the function in cell A40.
- 4 Execute the function in cell A43. The `griddata` function performs two-dimensional interpolation that generates the interpolated volume data using the inverse distance method.
- 5 Transpose the interpolated volume data and copy it to the Excel worksheet by executing the functions in cells A46 and A47. The data fills the cell range F7:T30.

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	2638.15	2707.32	2750.09	2784.91	2851.19	2911.62	2940.67	2961.40	2983.17	3000.06	3006.32	3041.01	3125.78	3026.85
0.05	2507.26	2635.76	2704.79	2746.66	2779.96	2846.35	2907.00	2934.98	2955.07	2976.69	2993.64	2999.35	3034.49	3126.43	3036.68
0.075	2510.83	2633.45	2702.58	2743.62	2775.40	2841.84	2902.75	2929.64	2949.08	2970.51	2987.50	2992.60	3027.98	3126.97	3046.32
0.1	2513.93	2631.34	2700.70	2740.99	2771.27	2837.66	2898.88	2924.66	2943.43	2964.66	2981.67	2986.08	3021.49	3127.39	3055.77
0.125	2515.14	2629.60	2699.17	2738.77	2767.61	2833.83	2895.40	2920.07	2938.14	2959.14	2976.16	2979.83	3015.06	3127.71	3065.02
0.15	2514.31	2628.58	2698.02	2736.99	2764.49	2830.38	2892.31	2915.87	2933.23	2953.97	2970.99	2973.86	3008.70	3127.95	3074.08
0.175	2511.84	2628.88	2697.25	2735.66	2762.00	2827.31	2889.59	2912.08	2928.72	2949.17	2966.17	2968.21	3002.47	3128.11	3082.93
0.2	2508.10	2629.91	2696.87	2734.79	2760.22	2824.68	2887.26	2908.72	2924.62	2944.75	2961.71	2962.89	2996.39	3128.21	3091.57
0.225	2503.37	2631.32	2696.88	2734.37	2759.24	2822.57	2885.29	2905.80	2920.96	2940.73	2957.65	2957.93	2990.50	3128.25	3099.99
0.25	2497.84	2632.93	2697.28	2734.42	2759.10	2821.05	2883.68	2903.34	2917.76	2937.13	2953.97	2953.36	2984.86	3128.24	3108.19
0.275	2491.66	2634.64	2698.05	2734.91	2759.76	2820.23	2882.43	2901.33	2915.02	2933.97	2950.71	2949.20	2979.52	3128.18	3116.14
0.3	2484.92	2636.35	2699.18	2735.85	2761.12	2820.16	2881.55	2899.79	2912.78	2931.26	2947.88	2945.48	2974.53	3128.07	3123.83
0.325	2477.71	2638.00	2700.64	2737.22	2763.09	2820.81	2881.06	2898.72	2911.04	2929.03	2945.47	2942.21	2969.96	3127.90	3131.26
0.35	2470.07	2639.54	2702.41	2739.01	2765.59	2822.11	2880.97	2898.13	2909.82	2927.29	2943.52	2939.43	2965.89	3127.66	3138.38
0.375	2462.06	2640.93	2704.45	2741.19	2768.54	2823.98	2881.29	2898.00	2909.13	2926.05	2942.01	2937.16	2962.39	3127.30	3145.19
0.4	2453.70	2642.15	2706.75	2743.75	2771.89	2826.33	2882.03	2898.34	2908.97	2925.33	2940.96	2935.42	2959.55	3126.79	3151.66
0.425	2445.03	2643.15	2709.26	2746.67	2775.62	2829.13	2883.20	2899.16	2909.34	2925.14	2940.37	2934.25	2957.45	3126.07	3157.75
0.45	2436.07	2643.94	2711.97	2749.92	2779.68	2832.32	2884.78	2900.44	2910.23	2925.48	2940.24	2933.67	2956.16	3125.09	3163.42
0.475	2426.82	2644.48	2714.84	2753.48	2784.06	2835.88	2886.78	2902.19	2911.63	2926.34	2940.57	2933.71	2955.74	3123.85	3168.63
0.5	2417.31	2644.77	2717.84	2757.32	2788.73	2839.78	2889.19	2904.40	2913.52	2927.71	2941.36	2934.34	2956.22	3122.46	3173.31
0.525	2407.54	2644.80	2720.95	2761.44	2793.67	2844.01	2891.99	2907.04	2915.89	2929.57	2942.61	2935.55	2957.60	3121.27	3177.39
0.55	2397.51	2644.56	2724.14	2765.79	2798.87	2848.55	2895.19	2910.11	2918.72	2931.90	2944.30	2937.30	2959.85	3120.88	3180.74
0.575	2387.24	2644.05	2727.39	2770.37	2804.31	2853.38	2898.77	2913.60	2921.99	2934.68	2946.43	2939.57	2962.89	3121.69	3183.21
0.6	2376.71	2643.25	2730.67	2775.14	2809.97	2858.49	2902.71	2917.48	2925.67	2937.89	2948.99	2942.35	2966.66	3123.41	3184.53

- 6 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.



To generate different volume values, close the figure and change the measured thermodynamic data in cells A5:C29. Then, execute all the Spreadsheet Link functions again. The worksheet updates with new volume rates and MATLAB generates a new figure of the interpolated volume data.

### See Also

MLGetMatrix | MLPutMatrix | MLEvalString | griddata | surf

### More About

- "Model Data Using Regression and Curve Fitting" on page 2-2
- "Price Stock Options Using Binomial Model" on page 2-11
- "Plot Efficient Frontier of Financial Portfolios" on page 2-14
- "Map Time and Bond Cash Flows" on page 2-17
- "Execute Spreadsheet Link Functions" on page 1-30

## Price Stock Options Using Binomial Model

This example uses the binomial model to price a stock option. The binomial model assumes that the probability of each possible price over time follows a binomial distribution. Price values can become either one up or one down over any short time period. Plotting these two values over time is known as building a binomial tree. For details about the binomial model, see “Pricing and Analyzing Equity Derivatives” (Financial Toolbox).

The example organizes and displays the input and output data in a Microsoft Excel worksheet. Spreadsheet Link functions copy data to a MATLAB matrix, calculate prices, and return data to the worksheet.

Open the `ExliSamp.xls` file and select the **Sheet4** worksheet. For help finding the `ExliSamp.xls` file, see “Installation” on page 1-3.

This worksheet contains these 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`.

	A	B	C	D	E	F	G	H	I	J	K
1	<b>Binomial Option Pricing</b>										
2											
3		<b>bindata</b>				<b>Spreadsheet Link Functions</b>					
4	Asset price, <code>so</code>	\$ 52.00				1. Transfer data to MATLAB.					
5	Option exercise price, <code>x</code>	\$ 50.00				<code>#MATLAB' &lt;== MLPutMatrix("b", bindata)</code>					
6	Risk-free interest rate, <code>r</code>	10%									
7	Time to maturity, <code>t</code> (yrs)	0.416667	<code>=5/12</code>			2. Execute MATLAB Financial Toolbox binomial option pricing function.					
8	Time increment, <code>dt</code>	0.083333	<code>=1/12</code>			<code>#MATLAB' &lt;== MLEvalString("[p, o]=binprice(b(1), b(2), b(3), b(4), b(5), b(6), b(7))")</code>					
9	Volatility, <code>sig</code>	0.4									
10	Call (1) or put (0), <code>flag</code>	0				3. Transfer output data to Excel.					
11						<code>#MATLAB' &lt;== MLGetMatrix("p", "asset_tree")</code>					
12						<code>#MATLAB' &lt;== MLGetMatrix("o", "value_tree")</code>					
13											
14		Start	Period 1	Period 2	Period 3	Period 4	Period 5				
15	<b>Asset price tree, <code>p</code> (\$)</b>										
16											
17											
18											
19											
20											
21											
22											
23	<b>Option value tree, <code>o</code> (\$)</b>										
24											
25											
26											
27											
28											

**Note** This example requires Financial Toolbox™, Statistics and Machine Learning Toolbox™, and Optimization Toolbox™.

- 1 Execute the Spreadsheet Link function that copies the asset data to the MATLAB workspace by double-clicking the cell D5 and pressing **Enter**.
- 2 Execute the function that calculates the binomial prices in cell D8.
- 3 Copy the price data to the worksheet by executing the functions in cells D11 and D12.

The data in the worksheet updates.

	A	B	C	D	E	F	G	H	I	J	K
1	<b>Binomial Option Pricing</b>										
2											
3		<b>bindata</b>		<b>Spreadsheet Link Functions</b>							
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	<b>Asset price tree, p (\$)</b>	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	<b>Option value tree, o (\$)</b>	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				

The asset price tree contains these prices:

- Period 1 — The up and down prices
- Period 2 — The up-up, up-down, and down-down prices
- Period 3 — The up-up-up, up-up, down-down, and down-down-down prices
- And so on.

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.

You can generate different binomial prices by changing the data in the cell range B4:B10 and executing the Spreadsheet Link functions again. If you increase the time to maturity in cell B7 or change the time increment in cell B8, enlarge the output tree areas as needed.

## See Also

[MLGetMatrix](#) | [MLPutMatrix](#) | [MLEvalString](#) | [binprice](#)

## More About

- “Model Data Using Regression and Curve Fitting” on page 2-2
- “Interpolate Thermodynamic Data” on page 2-8
- “Plot Efficient Frontier of Financial Portfolios” on page 2-14
- “Map Time and Bond Cash Flows” on page 2-17
- “Pricing and Analyzing Equity Derivatives” (Financial Toolbox)
- “Execute Spreadsheet Link Functions” on page 1-30

## Plot Efficient Frontier of Financial Portfolios

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

For details about the efficient frontier of financial portfolios, see “Analyzing Portfolios” (Financial Toolbox). To learn about portfolio optimization theory, see “Portfolio Optimization Theory” (Financial Toolbox).

The example organizes and displays the input and output data in a Microsoft Excel worksheet. Spreadsheet Link functions copy data to a MATLAB matrix, perform calculations using Financial Toolbox functions, and return data to the worksheet.

Open the ExliSamp.xls file and select the **Sheet5** worksheet. For help finding the ExliSamp.xls file, see “Installation” on page 1-3.

This worksheet contains rates of return for three different portfolios: Global, Corporate Bond, and Small Cap.

	A	B	C	D	E	F	G	H	I	J	
1	<b>Portfolio Efficient Frontier</b>										
2									Global	Corp. Bnd	Small Cap
3	<b>Rates of return</b>	Global	Corp. Bnd	Small Cap		<b>Risk</b>	<b>ROR</b>	<b>Weights</b>			
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	<b>Spreadsheet Link Functions</b>										
14	1. Transfer data to MATLAB.										
15	#MATLAB?	<== MLPutMatrix("Labels", F3:G3)									
16	#MATLAB?	<== MLPutMatrix("retseries", B4:D9)									
17											
18	2. Execute MATLAB Financial Toolbox functions.										
19	#MATLAB?	<== MLEvalString("ret, cov] = ewstats(retseries)")									
20	#MATLAB?	<== MLEvalString("[risk, ror, weights] = portopt(ret, cov, 20)")									
21											
22	3. Transfer output data to Excel.										
23	#MATLAB?	<== MLGetMatrix("risk", "sheet5!F4")									
24	#MATLAB?	<== MLGetMatrix("ror", "sheet5!G4")									
25	#MATLAB?	<== MLGetMatrix("weights", "sheet5!H4")									
26											
27	4. Plot efficient frontier data and label the figure.										
28	#MATLAB?	<== MLEvalString("portopt(ret, cov, 20); grid on; xlabel(Labels{1}); ylabel(Labels{2})")									

**Note** This example requires Financial Toolbox, Statistics and Machine Learning Toolbox, and Optimization Toolbox.

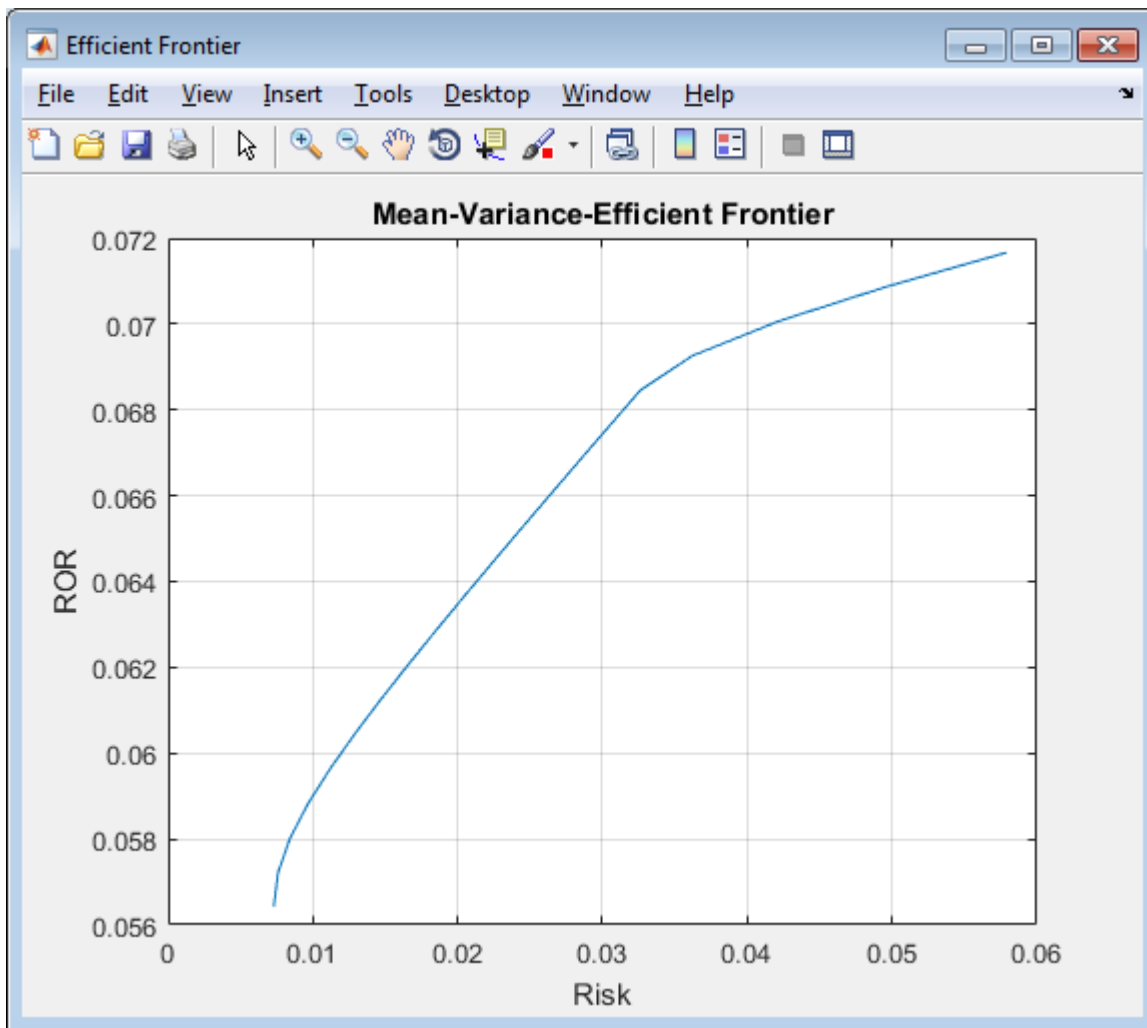
- 1 Execute the Spreadsheet Link function that transfers the plot labels for the x-axis and y-axis to the MATLAB workspace by double-clicking the cell A15 and pressing **Enter**.
- 2 Copy the portfolio return data to the MATLAB workspace by executing the function in the cell A16.
- 3 Generate efficient frontier data for 20 points along the frontier by executing the Financial Toolbox functions in A19 and A20.

- Copy the output data to the Excel worksheet by executing the Spreadsheet Link functions in A23, A24, and A25.

The output data contains the highest rate of return ROR for a given risk. The output data also contains the weighted investment in each portfolio **Weights** that achieves that rate of return.

	A	B	C	D	E	F	G	H	I	J
1	<b>Portfolio Efficient Frontier</b>									
2										
3	<b>Rates of return</b>	Global	Corp. Bnd	Small Cap		<b>Risk</b>	<b>ROR</b>	<b>Global Weights</b>	<b>Corp. Bnd</b>	<b>Small Cap</b>
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	<b>Spreadsheet Link Functions</b>					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", "sheet5!F4")				5.791%	7.167%	0.0%	0.0%	100.0%
24		0 <== MLGetMatrix("ror", "sheet5!G4")								
25		0 <== MLGetMatrix("weights", "sheet5!H4")								
26										
27	4. Plot efficient frontier data and label the figure.									
28	#MATLAB?	<== MLEvalString("portopt(ret, cov, 20); grid on; xlabel(Labels{1}); ylabel(Labels{2})")								

- Plot the efficient frontier for the same portfolio data by executing the Financial Toolbox functions in cell A28.



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

To generate different efficient frontier data, close the figure and change the data in cells B4:D9. Then, execute all the Spreadsheet Link functions again. The worksheet updates with new frontier data and MATLAB generates a new efficient frontier plot.

### See Also

MLGetMatrix | MLPutMatrix | MLEvalString | ewstats | portopt

### More About

- “Model Data Using Regression and Curve Fitting” on page 2-2
- “Interpolate Thermodynamic Data” on page 2-8
- “Price Stock Options Using Binomial Model” on page 2-11
- “Map Time and Bond Cash Flows” on page 2-17
- “Execute Spreadsheet Link Functions” on page 1-30



## Map Time and Bond Cash Flows

This example shows how to use Financial Toolbox and Spreadsheet Link to calculate a set of cash flow amounts and dates for a portfolio of five bonds.

Open the `ExliSamp.xls` file and select the **Sheet6** worksheet. For help finding the `ExliSamp.xls` file, see "Installation" on page 1-3.

This worksheet contains the maturity dates and coupon rates for five bonds.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	<b>Cash Flow and Time Mapping for a Portfolio of Bonds</b>													
2														
3	Settlement Date	26-Jul-99						Bond1	<b>Cash Flow Dates</b>					
4							Bond2							
5		<b>Bond Data</b>					Bond3							
6							Bond4							
7		<b>Maturity</b>	<b>Coupon Rate</b>				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											
13														
14								Bond1	<b>Cash Flow Amounts</b>					
15							Bond2							
16	<b>Spreadsheet Link Functions</b>							Bond3						
17	1. Transfer data to MATLAB.							Bond4						
18	#MATLAB' <== MLPutMatrix("maturity",Maturity)							Bond5						
19	#MATLAB' <== MLPutMatrix("cpnrate","CpnRate")													
20	#MATLAB' <== MLPutMatrix("sd",C3)													
21														
22	2. Execute MATLAB Financial Toolbox Cash flow and Time mapping function.													
23	#MATLAB' <== MLEvalString("md = x2mdate(maturity,0); sdm = x2mdate(sd,0)")													
24	#MATLAB' <== MLEvalString("[cfa, cfd] = cfamounts(cpnrate, sdm, md, 2)")													
25														
26	3. Transform date numbers to cell array of character vectors.													
27	#MATLAB' <== MLEvalString("i = find(isnan(cfd)); zcfd = cfd; zcfd(i) = 0; scfd=datestr(zcfd,2);")													
28	#MATLAB' <== MLEvalstring("ccfd = num2cell(scfd,2); ccf(i) = {'N/A'}; ccfd = reshape(ccfd, size(cfd));")													
29	#MATLAB' <== MLEvalString("ccfa = cfa; ccfa(i) = 0; alldates = ccf(end, :);")													
30														
31	4. Transfer output data to Excel.													
32	#MATLAB' <== MLGetMatrix("ccfd", "sheet6!i3")													
33	#MATLAB' <== MLGetMatrix("alldates", "sheet6!i13")													
34	#MATLAB' <== MLGetMatrix("ccfa", "sheet6!i14")													
35														
36	5. Plot the cash flow diagram.													
37	#MATLAB' <== MLEvalString("cfplot(cfd, cfa); dtaxis('x',6,sdm,50);title('Cash Flow Diagram');xlabel('Cash Flow Dates');ylabel('Bonds');")													

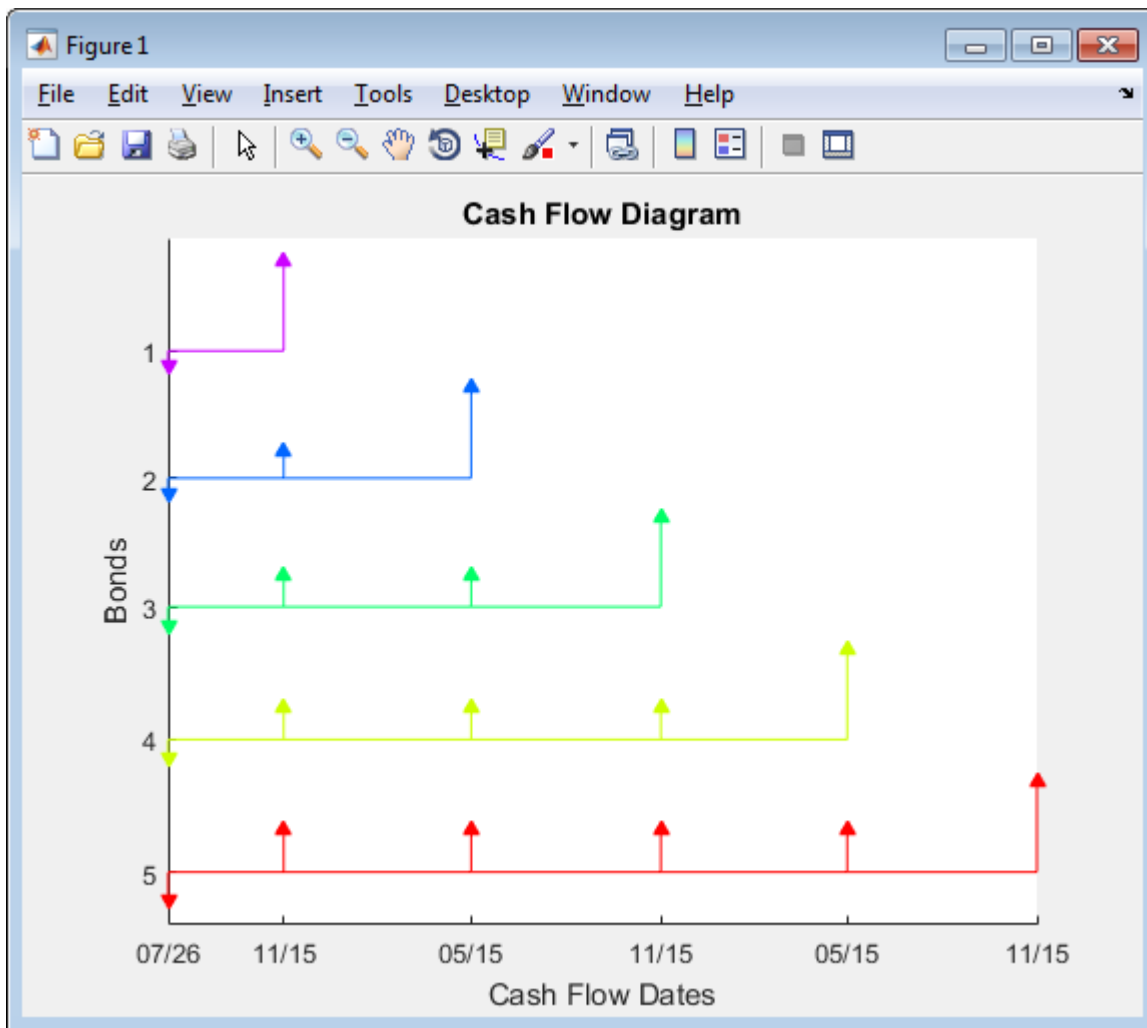
**Note** This example requires Financial Toolbox, Statistics and Machine Learning Toolbox, and Optimization Toolbox.

- 1 Execute the Spreadsheet Link function that transfers the column vector **Maturity** to the MATLAB workspace by double-clicking the cell A18 and pressing **Enter**.
- 2 Transfer the column vector **Coupon Rate** to the MATLAB workspace by executing the function in cell A19.
- 3 Transfer the settlement date to the MATLAB workspace by executing the function in cell A20.
- 4 Calculate cash flow amounts and dates by executing the Financial Toolbox functions in cells A23 and A24.

- 5 Transform the dates into a cell array of character vectors by executing the functions in cells A27 through A29.
- 6 Transfer the data to the Excel worksheet by executing the functions in cells A32 through A34.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
1	<b>Cash Flow and Time Mapping for a Portfolio of Bonds</b>														
2									<b>Cash Flow Dates</b>						
3	Settlement Date		26-Jul-99					<b>Bond1</b>	7/26/1999	11/15/1999	N/A	N/A	N/A	N/A	
4								<b>Bond2</b>	7/26/1999	11/15/1999	5/15/2000	N/A	N/A	N/A	
5			<b>Bond Data</b>					<b>Bond3</b>	7/26/1999	11/15/1999	5/15/2000	11/15/2000	N/A	N/A	
6								<b>Bond4</b>	7/26/1999	11/15/1999	5/15/2000	11/15/2000	5/15/2001	N/A	
7								<b>Bond5</b>	7/26/1999	11/15/1999	5/15/2000	11/15/2000	5/15/2001	11/15/2001	
8			<b>Maturity Coupon Rate</b>												
8	<b>Bond1</b>		15-Nov-99	0.05875											
9	<b>Bond2</b>		15-May-00	0.06375											
10	<b>Bond3</b>		15-Nov-00	0.08500											
11	<b>Bond4</b>		15-May-01	0.08000											
12	<b>Bond5</b>		15-Nov-01	0.15750											
13									<b>Cash Flow Amounts</b>						
14								<b>Bond1</b>	-1.1495	102.9375	0	0	0	0	
15								<b>Bond2</b>	-1.2473	3.1875	103.1875	0	0	0	
16	<b>Spreadsheet Link Functions</b>								<b>Bond3</b>	-1.6630	4.2500	4.2500	104.2500	0	0
17	1. Transfer data to MATLAB.								<b>Bond4</b>	-1.5652	4.0000	4.0000	4.0000	104.0000	0
18			0 <== MLPutMatrix("maturity", 'Maturity')					<b>Bond5</b>	-3.0815	7.8750	7.8750	7.8750	7.8750	107.8750	
19			0 <== MLPutMatrix("cpnrate", 'CpnRate')												
20			0 <== MLPutMatrix("sd", 'C3')												
21															
22	2. Execute MATLAB Financial Toolbox Cash flow and Time mapping function.														
23			0 <== MLEvalString("md = x2mdate(maturity,0); sdm = x2mdate(sd,0)")												
24			0 <== MLEvalString("[cfa, cfd] = cfamounts(cpnrate, sdm, md, 2)")												
25															
26	3. Transform date numbers to cell array of character vectors.														
27			0 <== MLEvalString("i = find(isnan(cfd)); zcfd = cfd; zcfd(i) = 0; scfd=datestr(zcfd,2);")												
28			0 <== MLEvalString("ccfd = num2cell(scfd,2); ccfd(i) = {'N/A'}; ccfd = reshape(ccfd, size(cfd));")												
29			0 <== MLEvalString("ccfa = cfa; ccfa(i) = 0; alldates = ccfd(end, :);")												
30															
31	4. Transfer output data to Excel.														
32			0 <== MLGetMatrix("ccfd", "sheet6!i3")												
33			0 <== MLGetMatrix("alldates", "sheet6!i13")												
34			0 <== MLGetMatrix("ccfa", "sheet6!i14")												
35															
36	5. Plot the cash flow diagram.														
37			0 <== MLEvalString("cfplot(cfd, cfa); dtaxis('x',6, sdm,50);title('Cash Flow Diagram');xlabel('Cash Flow Dates');ylabel('Bonds');")												

- 7 Display a plot of cash flows for each bond by executing the function in cell A37.



To generate cash flows for a different set of five bonds, close the figure and change the bond data in cells B8:C12. Then, execute all the Spreadsheet Link functions again. The worksheet updates with new cash flow dates and amounts and MATLAB generates a new figure of the cash flows.

## See Also

MLGetMatrix | MLPutMatrix | MLEvalString | cfamounts | x2mdate | cfplot

## More About

- “Model Data Using Regression and Curve Fitting” on page 2-2
- “Interpolate Thermodynamic Data” on page 2-8
- “Price Stock Options Using Binomial Model” on page 2-11
- “Plot Efficient Frontier of Financial Portfolios” on page 2-14
- “Execute Spreadsheet Link Functions” on page 1-30



# Error Messages and Troubleshooting

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- “Worksheet Cell Errors” on page 3-2
- “Microsoft Excel Errors” on page 3-5
- “Data Errors” on page 3-8
- “License Errors” on page 3-10
- “Startup Errors” on page 3-11
- “Audible Error Signals” on page 3-12

## **Worksheet Cell Errors**

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

The first column 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

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!	This error message represents any error that appears at the MATLAB command line. You can show the full error message from the MATLAB command line by using the <code>MLShowMatlabErrors</code> function. Or, you can set the corresponding preference in the Preferences dialog box available from the MATLAB group on the Excel Home tab.	Troubleshoot the MATLAB error.
#DIMENSION!	You used <code>MLAppendMatrix</code> 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 <code>MLAppendMatrix</code> reference page.
#INVALIDNAME!	You entered an invalid variable name.	Ensure that you use valid MATLAB variable names. MATLAB variable names must start with a letter, followed by letters, digits, or underscores. For details, see "Variable Names".
#INVALIDTYPE!	You specified an illegal MATLAB data type with <code>MLGetVar</code> or <code>MLGetMatrix</code> .	Make sure to use the supported MATLAB data types.
#MATLAB?	You used a Spreadsheet Link function and no MATLAB software session is running.	Start the Spreadsheet Link and MATLAB software. See "Start and Stop Spreadsheet Link and MATLAB" on page 1-11.
#NAME?	The function name is unrecognized. The <code>excllink.xlam</code> add-in is not loaded, or the function name might be misspelled.	Be sure the <code>excllink.xlam</code> add-in is loaded. See "Add-In Setup" on page 1-5. Check the spelling of the function name. Correct typing errors.
#NONEXIST!	You referenced a nonexistent matrix in an <code>MLGetMatrix</code> or <code>MLDeleteMatrix</code> function. The matrix name might be misspelled.  Also, you receive the #NONEXIST! error when you attempt to use <code>matlabfcn</code> to obtain an output.	Verify the spelling of the MATLAB matrix. Use the MATLAB <code>whos</code> 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.

<b>Error Message</b>	<b>Meaning</b>	<b>Solution</b>
#SYNTAX?	You entered a Spreadsheet Link 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.
#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.
#INVALIDRANGE!	The named range is defined incorrectly, or the named range spans multiple worksheets.	Select a range of data on only one worksheet and create an appropriate name for the range of data. For instructions about defining names, see Excel Help.

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

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

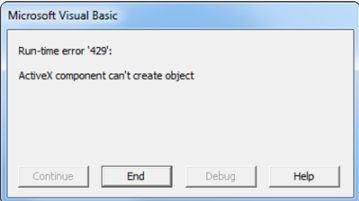


## Microsoft Excel Errors

The Excel software can display these error messages.

Error Message	Cause of Error	Solution
Error in formula	<p>You entered a formula incorrectly. Common errors include a space between the function name and the left parenthesis; or missing, extra, or mismatched parentheses.</p> <hr/> <p><b>Note</b> If you use the Spreadsheet Link software with a non-English (United States) Windows desktop environment, certain syntactical elements might not work. For details, see "Localization Information" on page 1-29.</p>	Review the entry and correct typing errors.
<p>Can't find project or library</p> <p>or</p> <p>Compile error: Sub or Function not defined</p>	You executed a macro and the location of <code>excllink.xlam</code> is incorrect or not specified.	Click <b>OK</b> . The References window opens. Remove the check mark from <b>MISSING: excllink.xlam</b> . Find <code>excllink.xlam</code> in its correct location, select its check box in the References window, and click <b>OK</b> . Or, select <b>Tools &gt; References</b> to open the References window. Select the box named <code>SpreadsheetLink</code> . Click <b>OK</b> .
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 software session and changes worksheet calculation mode to manual.	Click <b>OK</b> . Reset worksheet calculation mode to <code>automatic</code> , and save your worksheet as needed. Restart the Excel, Spreadsheet Link, and MATLAB software sessions.

<b>Error Message</b>	<b>Cause of Error</b>	<b>Solution</b>
MATLAB failed to check out a license of Spreadsheet Link or does not have a valid installation of Spreadsheet Link	You entered an invalid license pass code or did not install Spreadsheet Link properly.	Ensure that you entered the license pass code properly. Reinstall the Spreadsheet Link add-on. (See "Installation" on page 1-3.) If you followed the installation guidelines, used a proper pass code, and you are still unable to start the Spreadsheet Link 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.	Ensure that the Excel worksheet referenced by the data source exists, then retry the connection.
Could not load some objects because they are not available on this machine	This message appears when Excel 2013 is not configured properly.	From the Windows <b>Control Panel</b> , remove Microsoft Office 2010 in the programs list.

Error Message	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, ensure that you have administrator privileges on your machine and then perform the following:</p> <ol style="list-style-type: none"> <li><b>1</b> Shut down all MATLAB and Excel instances.</li> <li><b>2</b> Open a command prompt, and using <code>cd</code>, change to the <code>bin\win64</code> subfolder of the MATLAB installation folder.</li> <li><b>3</b> Type the command: <code>.\matlab /regserver</code></li> <li><b>4</b> When the MATLAB session starts, close it. Using <code>/regserver</code> fixes the registry entries.</li> <li><b>5</b> Start an Excel session. The Spreadsheet Link add-in now loads properly.</li> <li><b>6</b> Verify that the Spreadsheet Link software is working by entering the following command from the Command Window: <code>a = 3.14159</code></li> <li><b>7</b> Enter the following formula in cell A1 of the open Excel worksheet: <code>=mlgetmatrix("a", "a1")</code></li> <li><b>8</b> The value 3.14159 appears in cell A1.</li> </ol>

## Data Errors

### In this section...

“Matrix Data Errors” on page 3-8

“Errors When Opening Saved Worksheets” on page 3-8

## 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 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:
  - Ignore the messages.
  - Close MATLAB figure windows.
  - Execute the cell functions again one at a time in the correct order by pressing **F2**, and then **Enter**.
- If you save an Excel worksheet containing Spreadsheet Link functions, and then reopen it in an environment where the `excllink.xlam` 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:

- Click **No**.
- Select **Edit > Links**.
- In the Links dialog box, click **Change Source**.
- In the Change Links dialog box, select `matlabroot\toolbox\exlink\excllink.xlam`.
- 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 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.xlam`.

### License Errors

If you are running an automation server of MATLAB that does not have a Spreadsheet Link license associated with it, you will receive a license error message. To correct this issue, from the MATLAB installation that includes Spreadsheet Link, run the command:

```
matlab /regserver
```

## Startup Errors

### In this section...

“MATLAB Automatic Start Error” on page 3-11

“MATLAB Version Errors” on page 3-11

### MATLAB Automatic Start Error

If you have enabled `MLAutoStart` and `MLUseFullDesktop`, right-clicking a spreadsheet file in the MATLAB Current Folder browser and choosing **Open Outside MATLAB** causes a MATLAB System Error to appear. To open the file successfully, click **End Now** in the error window.

To avoid this issue, disable `MLUseFullDesktop`.

### MATLAB Version Errors

If the MATLAB version is set incorrectly, MATLAB does not start and displays this error: **Unable to start MATLAB. Please register MATLAB Software as a COM Server. Set the MATLAB version using MLProgramId.**

Ensure that the correct MATLAB version appears in the Preferences dialog box before starting MATLAB. For details, see “Set Spreadsheet Link Preferences” on page 1-9.

If MATLAB is installed on your computer and setting the MATLAB version does not work, use the last registered version to start MATLAB. To specify the last registered version of MATLAB:

- 1 Shut down all MATLAB and Excel sessions.
- 2 Open a command prompt window, and using `cd`, change to the `bin\win64` subfolder of the MATLAB installation folder.
- 3 Enter the command:

```
.\matlab /regserver
```

### See Also

[MLAutoStart](#) | [MLProgramId](#)

### More About

- “Installation” on page 1-3
- “Add-In Setup” on page 1-5
- “Set Spreadsheet Link Preferences” on page 1-9

## **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.



# Functions

---

## matlabfcn

Evaluate MATLAB command given Microsoft Excel data

### Syntax

```
= matlabfcn(command,inputs)
```

### Description

= `matlabfcn(command,inputs)` specifies the MATLAB command for evaluation in the MATLAB workspace, given the input data `inputs`. Depending upon the MATLAB output, `matlabfcn` returns a single value or string into the calling worksheet cell. If the result contains more than one value in MATLAB, only the first value in the array returns in the calling worksheet cell. Use this syntax when working in a worksheet cell.

### Examples

#### Find Maximum Likelihood Estimate

Using `std`, find the maximum likelihood estimate of the standard deviation of data in worksheet cells A1 through A10. Assume that the data comes from a normal population. Specify a weight of one in cell C1. Return the result by entering this text into cell A12.

```
=matlabfcn("std",A1:A10,C1)
```

Cell A12 displays the maximum likelihood estimate of the standard deviation.

### Input Arguments

#### **command** — MATLAB command to evaluate

string

MATLAB command to evaluate, specified as a string. Enclose the string in double quotes. Or, enter the string in a cell without quotes and enter the corresponding cell reference without quotes as the input argument.

Example: "sum"

Example: A1

#### **inputs** — MATLAB command input arguments

Excel cell reference

MATLAB command input arguments, specified as an Excel cell reference or a reference to a range of cells. To specify multiple input arguments for a function, separate the cell references with commas.

Example: B1:B10

Example: A1:C1,A3

**Tip**

- If `matlabfcn` fails, a standard Spreadsheet Link error displays by default; for example, `#COMMAND`. To return MATLAB errors, use `MLShowMatlabErrors`.
- To execute a MATLAB command that returns no data, use the `MLEvalString` function instead of `matlabfcn`. In this case, write a command such as `MLEvalString("function(" & A1 & ")")`, where `function` is the name of the function that returns no data and `A1` is an input argument.

**Version History**

Introduced before R2006a

**See Also**

`matlabsub` | `MLShowMatlabErrors` | `std`

**Topics**

“Create Diagonal Matrix Using Worksheet Cells” on page 1-18

“Execute Spreadsheet Link Functions” on page 1-30

“Worksheet Cell Errors” on page 3-2

“Microsoft Excel Errors” on page 3-5

# matlabinit

Initialize Spreadsheet Link and start MATLAB

## Syntax

```
matlabinit
```

## Description

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

## Examples

### Initialize Spreadsheet Link and MATLAB from Microsoft Excel Toolbar

While you use Microsoft Excel, initialize Spreadsheet Link and start MATLAB manually any time by using the Excel toolbar.

On the **Developer** tab, in the **Code** group, click **Macros**.

In the **Macro name** box, enter `matlabinit` and click **Run**.

Spreadsheet Link initializes and MATLAB starts. You can now use Spreadsheet Link to import data from MATLAB or export existing data in the worksheet into MATLAB and run MATLAB functions in Excel.

## Tips

- You can include the `matlabinit` function in a macro subroutine.
- You cannot run the `matlabinit` function as a worksheet cell formula or in a macro function. `matlabinit` is a macro subroutine. Subroutines cannot run as functions in a worksheet cell. Only Excel functions can be run in a worksheet cell.

## Alternative Functionality

You can execute `MLOpen` to start MATLAB.

## Version History

Introduced before R2006a

## See Also

MLAutoStart | MLOpen

### Topics

“Set Spreadsheet Link Preferences” on page 1-9

“Create Diagonal Matrix Using Microsoft Excel Ribbon” on page 1-13

“Create Diagonal Matrix Using Microsoft Excel Context Menu” on page 1-15

“Create Diagonal Matrix Using Worksheet Cells” on page 1-18

“Create Diagonal Matrix Using VBA Macro” on page 1-20

“Find and Execute MATLAB Function Using MATLAB Function Wizard” on page 1-22

“Execute Spreadsheet Link Functions” on page 1-30

## matlabsub

Evaluate MATLAB command given Microsoft Excel data and designate output location

### Syntax

= matlabsub(command,result,inputs)

### Description

= matlabsub(command,result,inputs) specifies the MATLAB command for evaluation in the MATLAB workspace, given the input data inputs. The function returns the MATLAB output into the worksheet cell specified by result. Use this syntax when working in a worksheet cell.

### Examples

#### Return Fourth-Order Magic Square in Worksheet Cell

Enter the number four in cell A1.

Enter this text into cell A2. Specify the function magic as the command. Return the fourth-order magic square into the range of cells starting in cell A4. Reference cell A1 as the input argument for the magic function.

=matlabsub("magic","A4",A1)

	A	B	C
1	4		
2	=matlabsub("magic","A4",A1)		

The fourth-order magic square displays in the range of cells from A4 through D7.

	A	B	C	D
1	4			
2	0			
3				
4	16	2	3	13
5	5	11	10	8
6	9	7	6	12
7	4	14	15	1

#### Return Fourth-Order Magic Square in Target Worksheet Cell

Enter the number four in cell A1. Enter a target cell reference to cell A6 in cell A2.

Enter this text into cell A4. Specify the function `magic` as the command. Return the fourth-order magic square into the range of cells starting in cell A6 by entering the cell reference A2. Reference cell A1 as the input argument for the `magic` function.

```
=matlabsub("magic",A2,A1)
```

	A	B	C
1	4		
2	A6		
3			
4	=matlabsub("magic",A2,A1)		

The fourth-order magic square displays in the range of cells from A6 through D9.

	A	B	C	D
1	4			
2	A6			
3				
4	0			
5				
6	16	2	3	13
7	5	11	10	8
8	9	7	6	12
9	4	14	15	1

## Input Arguments

**command** — MATLAB command to evaluate  
string

MATLAB command to evaluate, specified as a string. Enclose the string in double quotes. Or, enter the string in a cell without quotes and enter the corresponding cell reference without quotes as the input argument.

Example: "sum"

Example: A1

**result** — MATLAB result

Excel cell reference

MATLAB result, specified as an Excel cell reference or range name that designates the location where to display the result of the MATLAB command. To return the result in a specific cell, specify the cell reference enclosed in quotes. To denote a worksheet cell address or range name that contains a cell reference to another cell, specify the cell reference without quotes.

Example: "A3"

Example: D6

**inputs — MATLAB command input arguments**

Excel cell reference

MATLAB command input arguments, specified as an Excel cell reference or a reference to a range of cells. To specify multiple input arguments for a function, separate the cell references with commas.

Example: B1:B10

Example: A1:C1, A3

**Tips**

- To return an array of data to the Microsoft Excel Visual Basic for Applications (VBA) workspace, see `MLEvalString` and `MLGetVar`.
- `result` must not include the cell that contains `matlabsub`. Do not overwrite the function itself.
- Ensure that there is enough room in the worksheet for writing matrix contents. If there is insufficient room, the function generates a fatal error.
- If `matlabsub` fails, a standard Spreadsheet Link error displays by default; for example, `#COMMAND`. To return MATLAB errors, use `MLShowMatlabErrors`.

**Version History**

Introduced before R2006a

**See Also**

`matlabfcn` | `MLShowMatlabErrors` | `magic`

**Topics**

“Create Diagonal Matrix Using Worksheet Cells” on page 1-18

“Execute Spreadsheet Link Functions” on page 1-30

“Worksheet Cell Errors” on page 3-2

“Microsoft Excel Errors” on page 3-5



# MLAppendMatrix

Create or append MATLAB matrix with data from Microsoft Excel worksheet

## Syntax

```
= MLAppendMatrix(var_name,mdat)
MLAppendMatrix var_name,mdat
out = MLAppendMatrix(var_name,mdat)
```

## Description

= MLAppendMatrix(var\_name,mdat) appends data in mdat to MATLAB matrix var\_name or creates var\_name if it does not exist. *Use this syntax when working directly in a worksheet.*

MLAppendMatrix var\_name,mdat appends data in mdat to MATLAB matrix var\_name or creates var\_name if it does not exist. *Use this syntax in a VBA macro.*

out = MLAppendMatrix(var\_name,mdat) lets you catch errors when executing MLAppendMatrix in a VBA macro. If MLAppendMatrix fails, then out is a string containing error code. Otherwise, out is 0.

## Examples

### 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.

### 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 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)
```

A1	B1
A2	B2

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

## Input Arguments

### **var\_name** — Matrix name

string scalar | worksheet cell address or range name

Name of MATLAB matrix to which to append data.

`var_name` in quotes directly specifies the matrix name. `var_name` without quotes specifies a worksheet cell address (or range name) that contains the matrix name. Do not use the MATLAB variable `ans` as `var_name`.

### **mdat** — Location of data

worksheet cell address or range name

Location of data to append to `var_name`.

`mdat` must be a worksheet cell address or range name. Do not enclose it in quotes.

`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 character vectors if the data is a string.

## Output Arguments

### **out** — Success indicator

0 | string scalar

0 if the command succeeded. Otherwise, a string containing error code.

## Tips

- `MLAppendMatrix` 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.
- If `mdat` is not initially an Excel Range data type and you call the function from a worksheet, `MLAppendMatrix` performs the necessary type coercion.
- If `mdat` 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.
- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see “Installation” on page 1-3.

## Version History

Introduced before R2006a

### See Also

`MLPutMatrix`

# MLAutoStart

Automatically start MATLAB

## Syntax

```
= MLAutoStart(flag)
MLAutoStart flag
out = MLAutoStart(flag)
```

## Description

= MLAutoStart(flag) sets automatic startup of the Spreadsheet Link and MATLAB software. A change of state takes effect the next time an Excel session starts. *Use this syntax when working directly in a worksheet.*

MLAutoStart flag sets automatic startup of the Spreadsheet Link and MATLAB software. A change of state takes effect the next time an Excel session starts. *Use this syntax in a VBA macro.*

out = MLAutoStart(flag) lets you catch errors when executing MLAutoStart in a VBA macro. If MLAutoStart fails, then out is a string containing error code. Otherwise, out is 0.

## Examples

### Cancel Automatic Startup of Spreadsheet Link and MATLAB

Enter this command in a worksheet:

```
MLAutoStart("no")
```

Spreadsheet Link and MATLAB do not start on subsequent Excel session invocations.

## Input Arguments

### flag — Automatic startup designation

"yes" (default) | "no"

Either "yes" or "no".

Specify "yes" to automatically start the Spreadsheet Link and MATLAB software every time a Microsoft Excel session starts. Specify "no" to cancel automatic startup of the Spreadsheet Link and MATLAB software.

## Output Arguments

### out — Success indicator

0 | string scalar

0 if the command succeeded. Otherwise, a string containing error code.

**Tips**

- If Spreadsheet Link and MATLAB are running, then `MLAutoStart("no")` does not stop them.
- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see “Installation” on page 1-3.

**Version History**

**Introduced before R2006a**

**See Also**

`matlabinit` | `MLClose` | `MLOpen`

**Topics**

“Start Spreadsheet Link and MATLAB Automatically” on page 1-11

# MLProgramId

Specify MATLAB version

## Syntax

```
= MLProgramId(version)  
MLProgramId version
```

## Description

= MLProgramId(version) specifies the MATLAB version to open when Spreadsheet Link starts in Microsoft Excel. Enter this syntax when working in a worksheet cell.

MLProgramId version specifies the MATLAB version. Enter this syntax when working in a VBA macro.

## Examples

### Specify MATLAB Version in Worksheet Cells

To open MATLAB (R2016a) in Microsoft Excel, enter this text in any worksheet cell:

```
=MLProgramId("9.0")
```

The worksheet cell displays 0 when MLProgramId runs.

To check that the preference is set, open the Preferences dialog box. The **MATLAB program id** box contains 9.0. For details about the Preferences dialog box, see "Set Spreadsheet Link Preferences" on page 1-9.

Start MATLAB.

For troubleshooting, see "Startup Errors" on page 3-11.

### Specify MATLAB Version in VBA Macro

To open MATLAB (R2016a) in Microsoft Excel, enter this text at the beginning of the VBA macro:

```
MLProgramId "9.0"
```

Run the macro by clicking **Run Macro** button. For details about running macros, see Excel Help.

To check that the preference is set, open the Preferences dialog box. The **MATLAB program id** box contains 9.0. For details about the Preferences dialog box, see "Set Spreadsheet Link Preferences" on page 1-9.

Start MATLAB.

For troubleshooting, see “Startup Errors” on page 3-11.

## **Input Arguments**

### **version — MATLAB version**

string

MATLAB version, specified as a string to indicate which MATLAB version to open when multiple versions are installed on the computer.

The Windows registry defines the MATLAB version number under . . . \Mathworks\MATLAB. For example, MATLAB R2016a corresponds to version 9.0 in the registry.

Example: "9.0"

## **Tips**

- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see “Installation” on page 1-3.

## **Version History**

**Introduced in R2016b**

## **See Also**

MLOpen | MLAutoStart

## **Topics**

“Set Spreadsheet Link Preferences” on page 1-9

“Startup Errors” on page 3-11

# MLClose

Stop MATLAB

## Syntax

```
= MLClose()  
MLClose  
out = MLClose()
```

## Description

= `MLClose()` 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. *Use this syntax when working directly in a worksheet.*

`MLClose` 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. *Use this syntax in a VBA macro.*

`out = MLClose()` lets you catch errors when executing `MLClose` in a VBA macro. If `MLClose` fails, then `out` is a string containing error code. Otherwise, `out` is `0`.

## Examples

### End the MATLAB Session

End the MATLAB session from a worksheet:

```
MLClose()
```

## Output Arguments

### out — Success indicator

0 | string scalar

0 if the command succeeded. Otherwise, a string containing error code.

## Tips

- If you use `MLClose` when no MATLAB process is running, nothing happens.
- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see “Installation” on page 1-3.

## Version History

Introduced before R2006a

**See Also**

MLAutoStart | MLOpen

**Topics**

“Stop Spreadsheet Link and MATLAB” on page 1-12



# MLDeleteMatrix

Delete MATLAB matrix

## Syntax

```
= MLDeleteMatrix(var_name)
MLDeleteMatrix var_name
out = MLDeleteMatrix(var_name)
```

## Description

`= MLDeleteMatrix(var_name)` deletes the named matrix from the MATLAB Workspace. *Use this syntax when working directly in a worksheet.*

`MLDeleteMatrix var_name` deletes the named matrix from the MATLAB Workspace. *Use this syntax in a VBA macro.*

`out = MLDeleteMatrix(var_name)` lets you find errors when executing `MLDeleteMatrix` in a VBA macro. If `MLDeleteMatrix` fails, then `out` is a string containing an error code. Otherwise, `out` is 0.

## Examples

### Delete MATLAB Matrix

Delete a matrix in the MATLAB Workspace using the `MLDeleteMatrix` function in an Excel worksheet.

Create a 2-by-2 MATLAB matrix A.

```
A = [2 3; 4 6];
```

Open Excel and make sure cell A1 is selected in the worksheet. Delete the matrix A using the `MLDeleteMatrix` function. Enter this text in the cell and press **Enter**.

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

The `MLDeleteMatrix` function deletes the matrix from the MATLAB Workspace.

### Delete MATLAB Matrix Using VBA Macro

Delete a matrix in the MATLAB Workspace using the `MLDeleteMatrix` function in a VBA macro.

Create a 2-by-2 MATLAB matrix A.

```
A = [2 3; 4 6];
```

On the **Developer** tab in Excel, click **Visual Basic** in the **Code** group. The Visual Basic Editor window opens.

Select **Insert > Module** to insert a new module. In the Module1 window, enter this VBA code containing a macro named DeleteMatrix.

```
Sub DeleteMatrix()  
    MLDeleteMatrix "A"  
End Sub
```

The DeleteMatrix macro uses the MLDeleteMatrix function to delete the matrix A from the MATLAB Workspace.

For details about working with modules, see Excel Help.

Run the macro by clicking **Run Sub/UserForm** button on the VBA toolbar. For details about running macros, see Excel Help.

The MLDeleteMatrix function deletes the matrix from the MATLAB Workspace.

## Input Arguments

**var\_name** — Name of MATLAB matrix

string

Name of the MATLAB matrix to delete, specified as a string.

var\_name in quotes directly specifies the matrix name. var\_name without quotes specifies a worksheet cell address (or range name) that contains the matrix name.

Example: "A"

## Tips

- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see “Installation” on page 1-3.

## Version History

**Introduced before R2006a**

## See Also

MLAppendMatrix | MLGetMatrix | MLPutMatrix

# MLEvalString

Evaluate MATLAB command in MATLAB

## Syntax

= MLEvalString(command)

MLEvalString command

err = MLEvalString(command)

## Description

= MLEvalString(command) specifies the MATLAB command for evaluation in the MATLAB workspace. Use this syntax when working in a worksheet cell.

MLEvalString command works in a VBA macro.

err = MLEvalString(command) returns the execution status when executing MLEvalString in a VBA macro.

## Examples

### Create Diagonal Matrix in Worksheet Cells

Enter the variable a into cell A1. Enter the numbers 1 through 5 into the range of cells from B1 through F1.

Assign the range of cells to variable a in MATLAB using MLPutMatrix. Enter this text in cell A3.

=MLPutMatrix(A1,B1:F1)

	A	B	C	D	E	F
1	a	1	2	3	4	5
2						
3	=MLPutMatrix(A1,B1:F1)					

Use diag to create a matrix b, containing a diagonal using the five numbers in variable a. Enter this text in cell A5.

=MLEvalString("b = diag(a);")

	A	B	C	D	E	F
1	a	1	2	3	4	5
2						
3	0					
4						
5	=MLEvalString("b = diag(a);")					

Retrieve matrix b from MATLAB into Excel cell A9. Enter this text in cell A7.

```
=MLGetMatrix("b","A9")
```

The matrix with the diagonal appears in cells A9 through E13.

	A	B	C	D	E	F
1	a	1	2	3	4	5
2						
3	0					
4						
5	0					
6						
7	0					
8						
9	1	0	0	0	0	
10	0	2	0	0	0	
11	0	0	3	0	0	
12	0	0	0	4	0	
13	0	0	0	0	5	

### Create Diagonal Matrix in VBA Macro

Enter the variable a into cell A1. Enter the numbers 1 through 5 into the range of cells from B1 through F1.

Click the **Developer** tab in Microsoft Excel, and then click **Visual Basic**. The Visual Basic Editor window opens.

Insert a new module and enter this VBA code into the Code section of the window. This sample code assumes a macro named **Diagonal**. For details on working with modules, see Excel Help.

```
Sub Diagonal()  
    MLPutMatrix "a", Range("B1:F1")  
    MLEvalString "b = diag(a);"  
    MLGetMatrix "b", "A3"  
    MatlabRequest
```

End Sub

Run the macro by clicking **Run Sub/UserForm (F5)**. The diagonal matrix appears in cells A3 through E7. For details on running macros, see Excel Help.

	A	B	C	D	E	F
1	a	1	2	3	4	5
2						
3	1	0	0	0	0	
4	0	2	0	0	0	
5	0	0	3	0	0	
6	0	0	0	4	0	
7	0	0	0	0	5	

### Return Error for Invalid Command

Enter the variable `a` into cell A1. Enter the numbers 1 through 5 into the range of cells from B1 through F1.

Click the **Developer** tab in Microsoft Excel, and then click **Visual Basic**. The Visual Basic Editor window opens.

Insert a new module and enter this invalid VBA code into the Code section of the window. This sample code assumes a macro named `Diagonal`. For details on working with modules, see Excel Help.

```
Sub Diagonal()
    Dim err As Variant

    MLPutMatrix "a", Range("B1:F1")
    err = MLEvalString("b = diag(2a);") 'Invalid code

    If err <> 0 Then
        MsgBox err
    End If

    MLGetMatrix "b", "A3"
    MatlabRequest

End Sub
```

Run the macro by clicking **Run Sub/UserForm** in the VBA toolbar. For details on running macros, see Excel Help.

This Spreadsheet Link error displays: `#COMMAND!`. To display MATLAB errors, see `MLShowMatlabErrors`.

## Input Arguments

### command — MATLAB command to evaluate

string

MATLAB command to evaluate, specified as a string. Enclose the string in double quotes. Or, enter the string in a cell without quotes and enter the corresponding cell reference without quotes as the input argument.

Example: "sum"

Example: A1

## Output Arguments

### **err** — Execution status

string | number

Execution status, returned as a string or number. If `MLEvalString` fails, then `err` is a string containing an error code or error message. Otherwise, the command executes successfully and `err` is 0.

By default when `MLEvalString` fails, `err` contains a standard Spreadsheet Link error, such as `#COMMAND`. To return MATLAB errors, execute `MLShowMatlabErrors`.

## Tips

- The specified action alters only the MATLAB workspace and has no effect on the Microsoft Excel workspace.
- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see “Installation” on page 1-3.

## Version History

**Introduced before R2006a**

## See Also

`MLPutMatrix` | `MLGetMatrix` | `MLShowMatlabErrors` | `diag`

## Topics

“Create Diagonal Matrix Using Worksheet Cells” on page 1-18

“Create Diagonal Matrix Using VBA Macro” on page 1-20

“Model Data Using Regression and Curve Fitting” on page 2-2

“Interpolate Thermodynamic Data” on page 2-8

“Price Stock Options Using Binomial Model” on page 2-11

“Execute Spreadsheet Link Functions” on page 1-30

“Worksheet Cell Errors” on page 3-2

“Microsoft Excel Errors” on page 3-5

# MLGetFigure

Import current MATLAB figure into Microsoft Excel worksheet

## Syntax

```
= MLGetFigure(width, height)
MLGetFigure width, height
out = MLGetFigure(width,height)
```

## Description

= MLGetFigure(width, height) imports the current MATLAB figure into an Excel worksheet, placing the top-left corner of the figure in the current worksheet cell. Specify the normalized width and height of the figure in Excel. *Use this syntax when working directly in a worksheet.*

MLGetFigure width, height imports the current MATLAB figure into an Excel worksheet, placing the top-left corner of the figure in the current worksheet cell. *Use this syntax in a VBA macro.*

out = MLGetFigure(width,height) lets you find errors when executing MLGetFigure in a VBA macro. If MLGetFigure fails, then out is a string containing an error code. Otherwise, out is 0.

## Examples

### Import Current MATLAB Figure into Excel

After you create a figure in MATLAB, import the figure into an Excel worksheet.

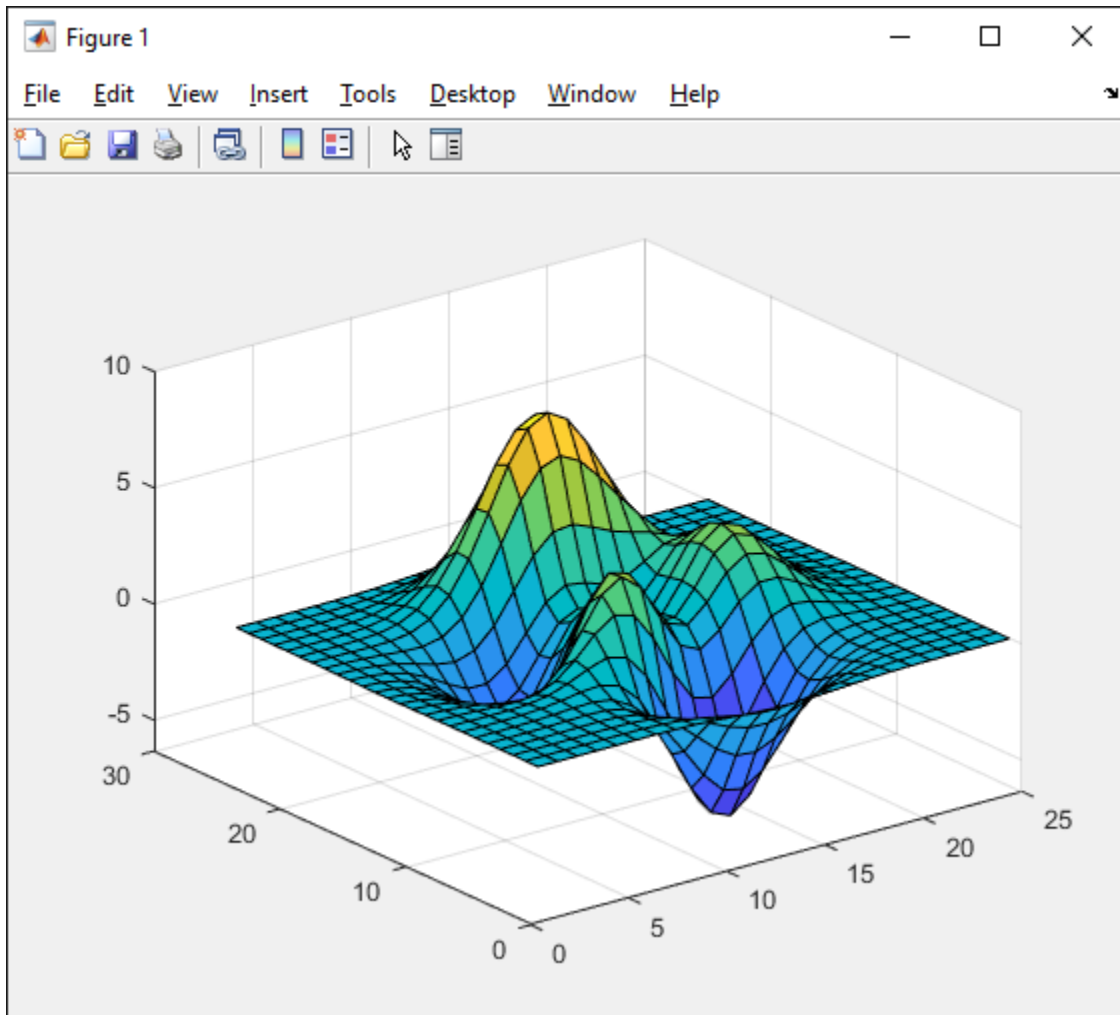
---

**Note** If you use Excel 2007 or 2010, the width and height of the imported figure will be a quarter of the size of the original figure.

---

Create a wireframe mesh in MATLAB using the peaks and surf functions. The figure window displays a wireframe mesh.

```
z = peaks(25);
surf(z)
```

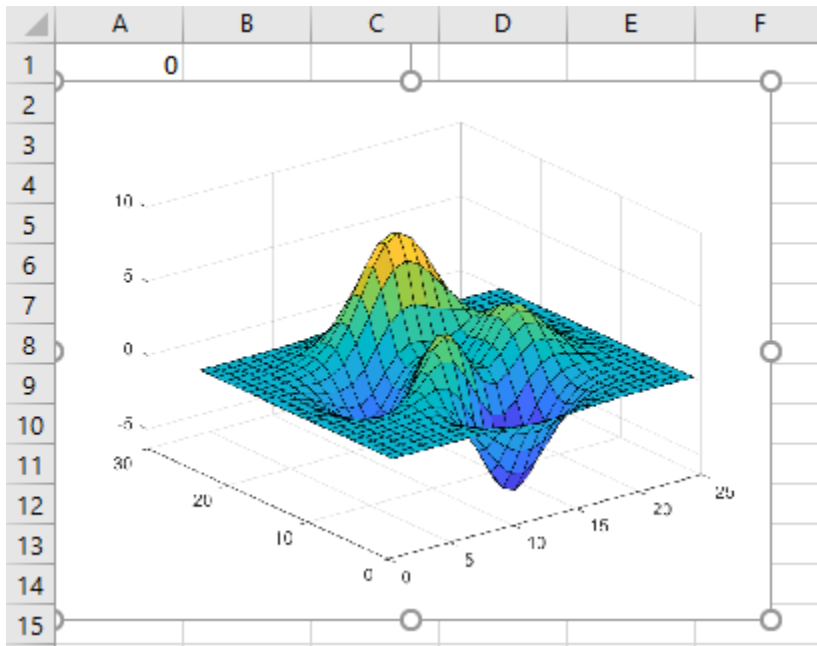


Open Excel and make sure cell A1 is selected in the worksheet. Import the current figure into the worksheet using the `MLGetFigure` function. Enter this text in the cell and press **Enter**.

```
= MLGetFigure(.8, .8)
```

The `MLGetFigure` function imports the current figure into the worksheet, placing the top-left corner of the figure in the selected cell.



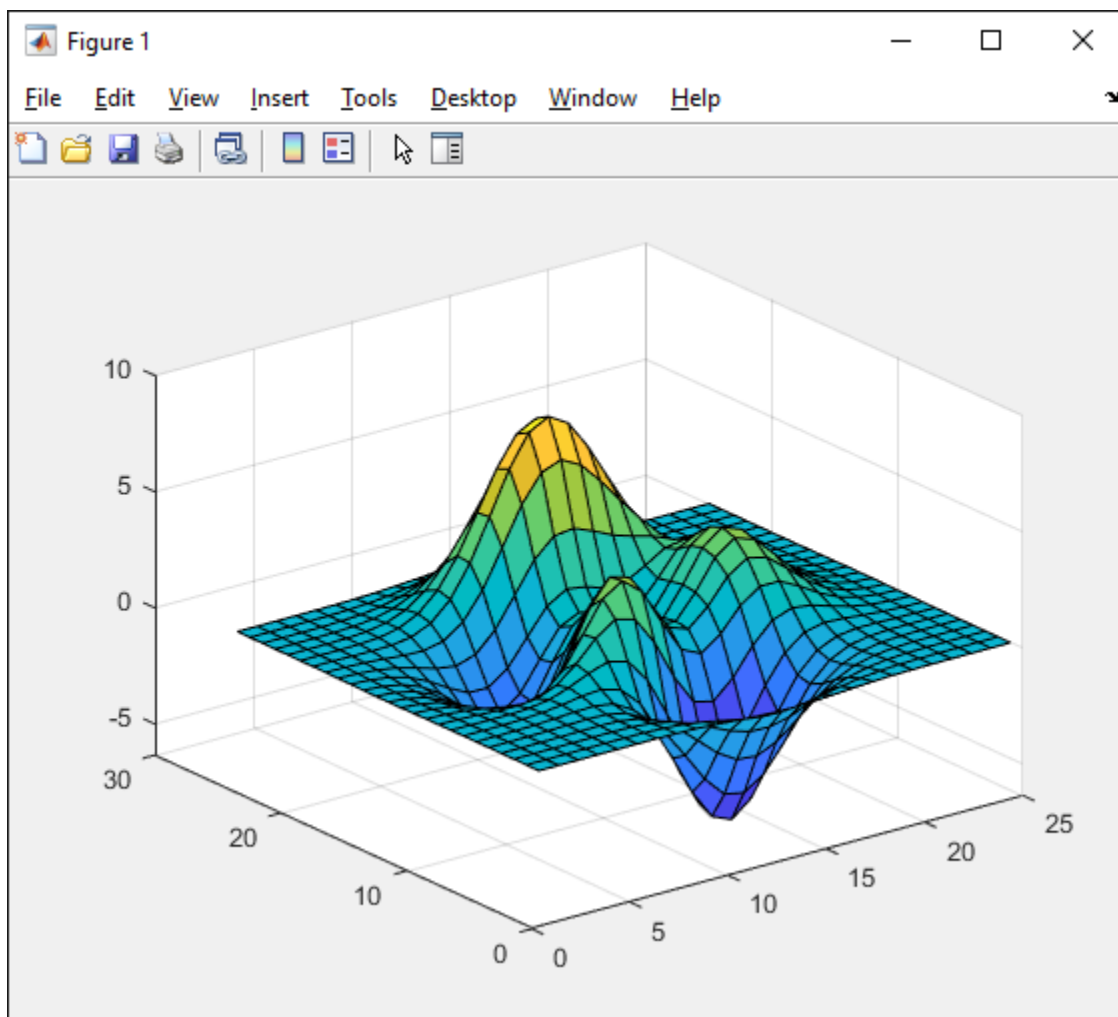


### Import Current Figure Using VBA Macro

After you create a figure in MATLAB, import the figure into an Excel worksheet using a VBA macro.

Create a wireframe mesh in MATLAB using the `peaks` and `surf` functions. The figure window displays a wireframe mesh.

```
z = peaks(25);  
surf(z)
```



On the **Developer** tab in Excel, click **Visual Basic** in the **Code** group. The Visual Basic Editor window opens.

Select **Insert > Module** to insert a new module. In the Module1 window, enter this VBA code containing a macro named `MyFigure`.

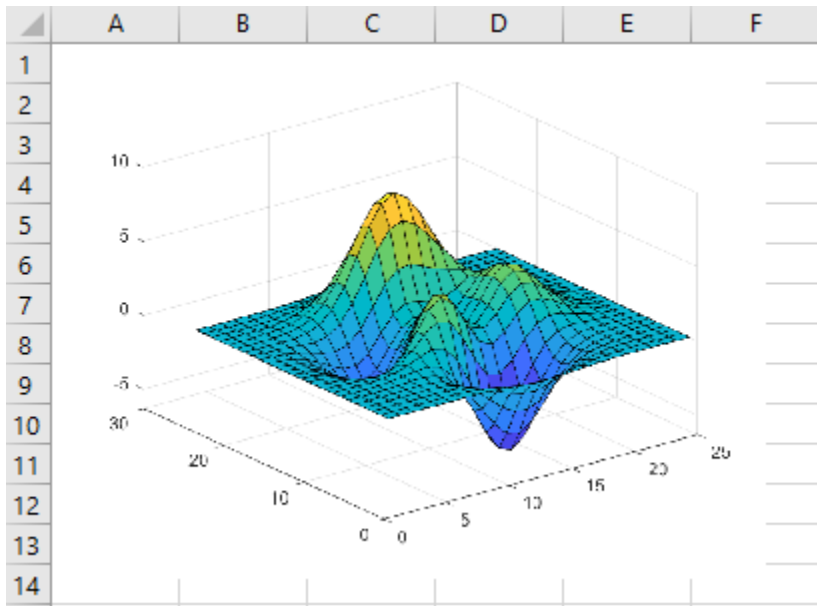
```
Sub MyFigure()
    MLGetFigure 0.8, 0.8
    MatlabRequest
End Sub
```

The `MyFigure` macro uses the `MLGetFigure` function to import the current figure into the worksheet. `MatlabRequest` initializes internal Spreadsheet Link variables and enables `MLGetFigure` to function in a subroutine.

For details about working with modules, see Excel Help.

Select cell A1 for the position of the figure. Run the macro by clicking **Run Sub/UserForm** button on the VBA toolbar. For details about running macros, see Excel Help.

The `MLGetFigure` function imports the current figure into the worksheet, placing the top-left corner of the figure in the selected cell.



## Input Arguments

### **width** — Width

real number

Width (in normalized units) of the MATLAB figure when imported into an Excel worksheet, specified as a real number.

Example: 0.5

### **height** — Height

real number

Height (in normalized units) of the MATLAB figure when imported into an Excel worksheet, specified as a real number.

Example: 0.5

## Tips

- If you use Microsoft Excel 2007 or 2010, `MLGetFigure` scales the imported figure by the product of `width` and `height` along both dimensions.
- If worksheet calculation mode is automatic, the software executes `MLGetFigure` 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. Note that pressing `F9` can also execute other worksheet functions and generate unpredictable results.
- If you use `MLGetFigure` in a macro subroutine, enter `MatlabRequest` on the line after `MLGetFigure`. The execution of `MatlabRequest` initializes internal Spreadsheet Link 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.

- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see “Installation” on page 1-3.

### **Version History**

**Introduced in R2006b**

### **See Also**

MLGetMatrix | MLGetVar

# MLGetMatrix

Write contents of MATLAB matrix to Microsoft Excel worksheet

## Syntax

```
= MLGetMatrix(var_name, edat)
```

```
MLGetMatrix var_name, edat
out = MLGetMatrix(var_name, edat)
```

## Description

= MLGetMatrix(var\_name, edat) writes the contents of MATLAB matrix var\_name in the Excel worksheet, beginning in the upper-left cell specified by edat. *Use this syntax when working directly in a worksheet.*

MLGetMatrix var\_name, edat writes the contents of MATLAB matrix var\_name in the Excel worksheet, beginning in the upper-left cell specified by edat. *Use this syntax in a VBA macro.*

out = MLGetMatrix(var\_name, edat) lets you find errors when you execute the MLGetMatrix function in a VBA macro. If the MLGetMatrix function fails, then out is a string containing an error code. Otherwise, out is 0.

## Examples

### Write Matrix Contents to Worksheet Using Location Directly

Access the contents of a matrix in MATLAB and write the contents to a worksheet. Specify the name of the matrix and the destination cells explicitly.

Define a 4-by-3 matrix A in MATLAB.

```
A = [1,2,3;4,5,6;7,8,9;10,11,12]
```

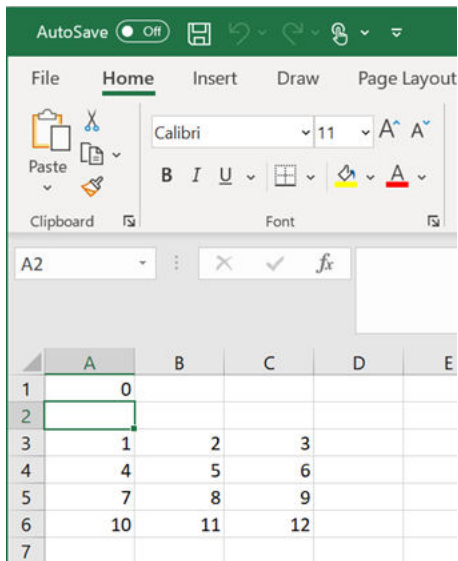
A =

1	2	3
4	5	6
7	8	9
10	11	12

Open Excel and make sure cell A1 is selected in the worksheet. To write the contents of the MATLAB matrix A starting in cell A3 of worksheet Sheet1, enter this text in cell A1 and press **Enter**:

```
= MLGetMatrix("A", "Sheet1!A3")
```

The MLGetMatrix function fills the cells A3 through C6 with data from the matrix.



### Write Matrix Contents to Worksheet Using Location Indirectly

Access the contents of a matrix in MATLAB and write the contents to a worksheet. Specify the destination for the matrix contents by using a cell reference.

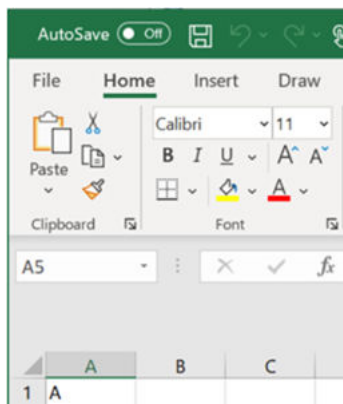
Define a 4-by-3 matrix A in MATLAB.

```
A = [1,2,3;4,5,6;7,8,9;10,11,12]
```

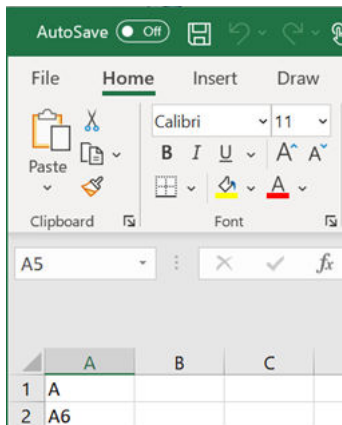
A =

1	2	3
4	5	6
7	8	9
10	11	12

Open Excel and enter the name of the matrix in cell A1.



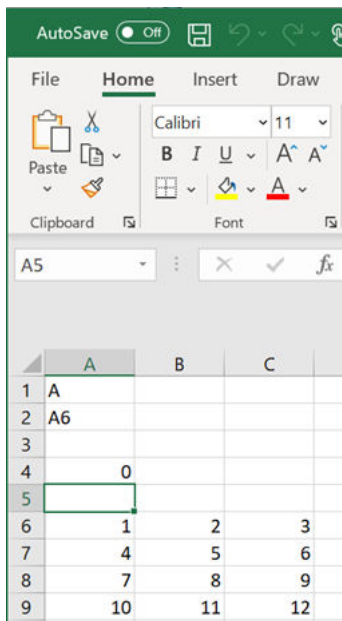
Enter the reference for the destination cell A6 in cell A2.



Make sure cell A4 is selected. Access the MATLAB matrix named by the string in cell A1 and write the contents of the matrix to the worksheet by using the reference in cell A2. Enter this text in cell A4 and press **Enter**:

```
= MLGetMatrix(A1,A2)
```

The `MLGetMatrix` function fills the cells A6 through C9 with data from the matrix.



### Write Matrix Contents to Worksheet Using VBA Macro

Access the contents of a matrix in MATLAB and write the contents to a worksheet using a VBA macro.

Define a 4-by-3 matrix A in MATLAB.

```
A = [1,2,3;4,5,6;7,8,9;10,11,12]
```

```
A =
```

1	2	3
4	5	6
7	8	9
10	11	12

On the **Developer** tab in Excel, click **Visual Basic** in the **Code** group. The Visual Basic Editor window opens.

From the **Insert** menu, select **Module** to insert a new module. In the Module1 window, enter this VBA code containing a macro named `GetMatrix`.

```
Sub GetMatrix()  
    MLGetMatrix "A", "B2"  
    MatlabRequest  
End Sub
```

`MatlabRequest` initializes internal Spreadsheet Link variables and enables `MLGetMatrix` to work in a subroutine.

The `GetMatrix` macro uses the `MLGetMatrix` function to access the contents of matrix A from the MATLAB Workspace. Then, the function writes the contents of the matrix starting at cell B2. For details about working with modules, see Excel Help.

Run the macro by clicking the **Run Sub/UserForm** button on the VBA toolbar. For details about running macros, see Excel Help.

The `MLGetMatrix` function accesses the contents of the matrix and writes them to the worksheet.

## Input Arguments

### **var\_name** — Name of MATLAB matrix

string

Name of the MATLAB matrix to access, specified as a string. `var_name` in quotes directly specifies the matrix name. `var_name` without quotes specifies a worksheet cell address (or range name) that contains the matrix name. Do not use the MATLAB variable `ans` as `var_name`.

Example: "A"

Example: A2

### **edat** — Location of data

string

Location of the data in the worksheet where the function writes the contents of `var_name`, specified as a string.

`edat` in quotes directly specifies the location. `edat` without quotes specifies a worksheet cell address (or range name) that contains a reference to the location. In both cases, `edat` must be a cell address or a range name.

Example: "B2"

Example: A6



## Tips

- 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.
- `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 the worksheet has enough room to write the matrix contents. If there is insufficient room, the function execution fails because the data has too many rows or columns. For details about the errors in the worksheet, see “Worksheet Cell Errors” on page 3-2.
- The `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 execute other worksheet functions again and generate unpredictable results.
- If you use `MLGetMatrix` in a macro subroutine, enter `MatlabRequest` on the line after the `MLGetMatrix` command. `MatlabRequest` initializes internal Spreadsheet Link variables and enables `MLGetMatrix` to work in a subroutine. Do not include `MatlabRequest` in a macro function unless the function is called from a subroutine.
- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see “Installation” on page 1-3.

## Version History

Introduced before R2006a

## See Also

`MLAppendMatrix` | `MLPutMatrix` | `MLPutRanges`

## Topics

“Create Diagonal Matrix Using Microsoft Excel Ribbon” on page 1-13

“Create Diagonal Matrix Using Microsoft Excel Context Menu” on page 1-15

“Create Diagonal Matrix Using Worksheet Cells” on page 1-18

“Create Diagonal Matrix Using VBA Macro” on page 1-20

“Find and Execute MATLAB Function Using MATLAB Function Wizard” on page 1-22

“Execute Spreadsheet Link Functions” on page 1-30

## MLGetVar

Write contents of MATLAB matrix in Microsoft Excel VBA variable

### Syntax

```
MLGetVar ML_var_name, VBA_var_name
```

### Description

MLGetVar ML\_var\_name, VBA\_var\_name writes the contents of MATLAB matrix ML\_var\_name in the Excel Visual Basic for Applications (VBA) variable VBA\_var\_name. The MLGetVar function creates VBA\_var\_name if it does not exist. The function replaces existing data in VBA\_var\_name.

### Examples

#### Write Contents of MATLAB Matrix into VBA Variable

Define a matrix variable in MATLAB and write its contents into a VBA variable using a VBA macro.

Define a 4-by-3 matrix A in MATLAB. The A variable appears in the MATLAB Workspace.

```
A = [1,2,3;4,5,6;7,8,9;10,11,12]
```

```
A =
```

```
     1     2     3
     4     5     6
     7     8     9
    10    11    12
```

On the **Developer** tab in Excel, click **Visual Basic** in the **Code** group. The Visual Basic Editor window opens.

From the **Insert** menu, select **Module** to insert a new module. In the Module1 window, enter this VBA code containing a macro named GetVar. Write the contents of the MATLAB matrix A into the VBA variable data.

```
Sub GetVar()  
    MLGetVar "A", data  
End Sub
```

The GetVar macro uses the MLGetVar function to access the contents of variable A from the MATLAB Workspace. Then, the function writes the contents of the variable to the VBA variable data. For details about working with modules, see Excel Help.

Run the macro by clicking the **Run Sub/UserForm** button on the VBA toolbar. For details about running macros, see Excel Help.

The MLGetVar function accesses the contents of the variable and writes them to the VBA variable.

## Input Arguments

### **ML\_var\_name — Name of MATLAB matrix**

string

Name of the MATLAB matrix to access, specified as a string. ML\_var\_name in quotes directly specifies the matrix name. ML\_var\_name without quotes specifies a VBA variable that contains the matrix name as a string.

Do not use the MATLAB variable ans as ML\_var\_name. If defined, ML\_var\_name must be specified with the VARIANT type. With any other type, the MLGetVar function returns a "TYPE MISMATCH" error.

Example: "A"

### **VBA\_var\_name — Name of VBA variable**

string

Name of the VBA variable where the function writes the contents of ML\_var\_name, specified as a string. Use VBA\_var\_name without quotes.

Example: data

## Tips

- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see "Installation" on page 1-3.

## Version History

Introduced before R2006a

## See Also

MLPutVar

## Topics

"Create Diagonal Matrix Using VBA Macro" on page 1-20

"Execute Spreadsheet Link Functions" on page 1-30

## MLMissingDataAsNaN

Set empty cells to NaN or 0

### Syntax

```
= MLMissingDataAsNaN(flag)  
MLMissingDataAsNaN(flag)  
out = MLMissingDataAsNaN(flag)
```

### Description

= MLMissingDataAsNaN(flag) sets empty cells to NaN or 0. When the Spreadsheet Link software is installed, the default is "no", so empty cells are handled as 0s. If you change the value of MLMissingDataAsNaN to "yes", the change remains in effect the next time a Microsoft Excel session starts. *Use this syntax when working directly in a worksheet.*

MLMissingDataAsNaN(flag) sets empty cells to NaN or 0. *Use this syntax in a VBA macro.*

out = MLMissingDataAsNaN(flag) lets you catch errors when executing MLMissingDataAsNaN in a VBA macro. If MLMissingDataAsNaN fails, then out is a string containing error code. Otherwise, out is 0.

### Examples

#### Set Empty Cells to Use 0s

Cancel the use of the value NaN for empty cells.

```
= MLMissingDataAsNaN("no")
```

### Input Arguments

#### flag – Empty cell indicator

"no" (default) | "yes"

Empty cell indicator, specified as "no" or "yes".

Specify "no" to set empty cells to use 0s. Specify "yes" to set empty cells to use NaNs.

### Output Arguments

#### out – Success indicator

0 | string scalar

Success indicator, returned as 0 if the command succeeded. Otherwise, a string containing error code.

## Tips

- A string in an Excel range always forces cell array output and empty cells as NaNs.
- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see “Installation” on page 1-3.

## Version History

Introduced in R2007a

## See Also

MLPutMatrix

## MLOpen

Start MATLAB

### Syntax

```
= MLOpen()  
MLOpen  
out = MLOpen()
```

### Description

= MLOpen() starts MATLAB process. Use MLOpen to restart the MATLAB session after you have stopped it with MLClose in a given Microsoft Excel session. *Use this syntax when working directly in a worksheet.*

MLOpen starts MATLAB process. Use MLOpen to restart the MATLAB session after you have stopped it with MLClose in a given Microsoft Excel session. *Use this syntax in a VBA macro.*

out = MLOpen() lets you catch errors when executing MLOpen in a VBA macro. If MLOpen fails, then out is a string containing error code. Otherwise, out is 0.

### Examples

#### Start a MATLAB Session

Start a MATLAB session from a worksheet:

```
MLOpen()
```

### Output Arguments

#### out — Success indicator

0 | string scalar

0 if the command succeeded. Otherwise, a string containing error code.

### Tips

- If a MATLAB process has already started, subsequent calls to MLOpen do nothing.
- To start a MATLAB session and initialize the Spreadsheet Link software, use matlabinit rather than MLOpen.
- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see “Installation” on page 1-3.

## Version History

Introduced before R2006a

**See Also**

matlabinit | MLClose

## MLPutMatrix

Create or overwrite MATLAB matrix with data from Microsoft Excel worksheet

### Syntax

```
= MLPutMatrix(var_name, mdat)
MLPutMatrix var_name, mdat
out = MLPutMatrix(var_name, mdat)
```

### Description

`= MLPutMatrix(var_name, mdat)` creates or overwrites the matrix `var_name` in the MATLAB Workspace with the data specified in `mdat`. The function `MLPutMatrix` creates `var_name` if it does not exist. *Use this syntax when working directly in a worksheet.*

`MLPutMatrix var_name, mdat` creates or overwrites the matrix `var_name` in the MATLAB Workspace with the data specified in `mdat`. *Use this syntax in a VBA macro.*

`out = MLPutMatrix(var_name, mdat)` lets you find errors when executing `MLPutMatrix` in a VBA macro. If `MLPutMatrix` fails, then `out` is a string containing an error code. Otherwise, `out` is 0.

### Examples

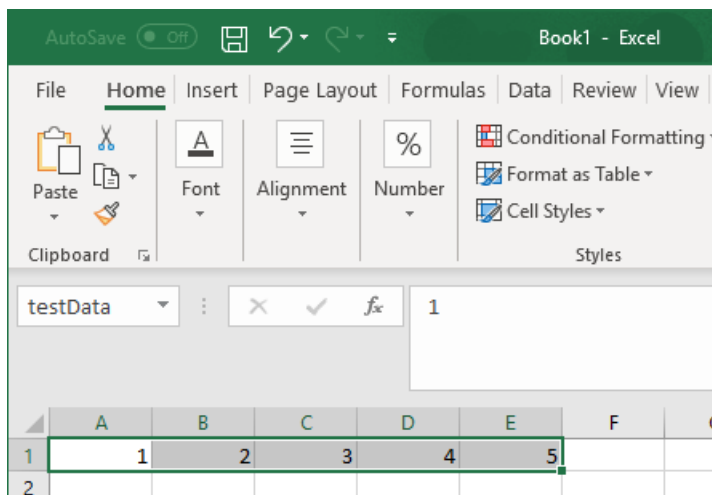
#### Create MATLAB Matrix

Create a matrix in the MATLAB Workspace using the `MLPutMatrix` function in an Excel worksheet.

Enter the values 1 through 5 in cells A1 through E1.

Define the name `testData` for the range of cells A1 through E1. For instructions on defining names, see Excel Help.

The range name `testData` appears in the **Name Box** when the range is selected.





Execute the `MLPutMatrix` function in cell A2. Use `A` as the name of the matrix to create. Specify the range name `testData` as the data to include in the matrix.

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

After you press **Enter**, Excel creates the matrix in the MATLAB Workspace. The matrix contains the data included in the `testData` cell range.

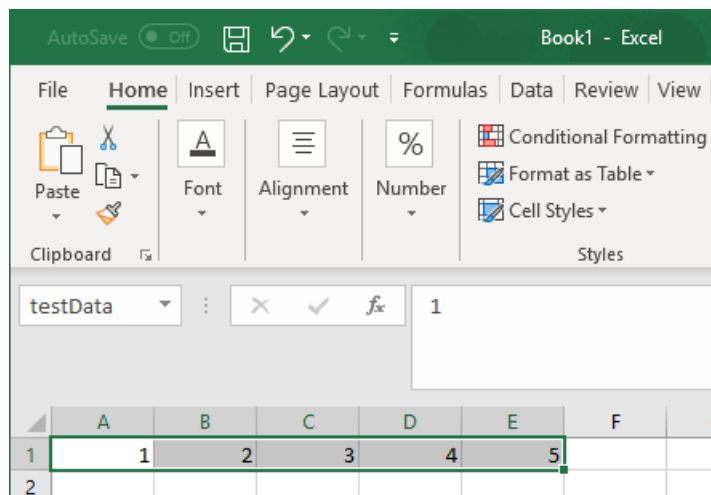
### Create MATLAB Matrix Using VBA Macro

Create a matrix in the MATLAB Workspace using the `MLPutMatrix` function in a VBA macro.

Enter the values 1 through 5 in cells A1 through E1.

Define the name `testData` for the range of cells A1 through E1. For instructions on defining names, see Excel Help.

The range name `testData` appears in the **Name Box** when the range is selected.



On the **Developer** tab in Excel, click **Visual Basic** in the **Code** group. The Visual Basic Editor window opens.

Select **Insert > Module** to insert a new module. In the Module1 window, enter this VBA code containing a macro named `PutMatrix`.

```
Sub PutMatrix()  
    MLPutMatrix "A", testData  
End Sub
```

The `PutMatrix` macro uses the `MLPutMatrix` function to create the matrix `A` in the MATLAB Workspace using the data in the cell range `testData`.

For details about working with modules, see Excel Help.

Select any worksheet cell. Run the macro by clicking **Run Sub/UserForm** button on the VBA toolbar. For details about running macros, see Excel Help.

The `MLPutMatrix` function creates the matrix in the MATLAB Workspace.

## Input Arguments

### **var\_name** — Name of MATLAB matrix

string

Name of the MATLAB matrix to create or overwrite, specified as a string.

`var_name` in quotes directly specifies the matrix name. `var_name` without quotes specifies a worksheet cell address (or range name) that contains the matrix name.

Example: "A"

### **mdat** — Location of data

string

Location of the data to copy into `var_name`, specified as a string.

`mdat` must be a worksheet cell address or range name. Do not enclose the location in quotes.

Example: `testData`

Example: `A1`

## Tips

- If `var_name` exists, the `MLPutMatrix` function replaces its contents with the contents of `mdat`.
- Empty numeric data cells in `mdat` become numeric zeros in the MATLAB matrix identified by `var_name`.
- If any element of `mdat` contains string data, `mdat` becomes a MATLAB cell array. Empty string elements in `mdat` become NaNs in 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
```

- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see "Installation" on page 1-3.

## Version History

**Introduced before R2006a**

**See Also**

MLAppendMatrix | MLGetMatrix | MLPutRanges

**Topics**

“Create Diagonal Matrix Using Microsoft Excel Ribbon” on page 1-13

“Create Diagonal Matrix Using Microsoft Excel Context Menu” on page 1-15

“Create Diagonal Matrix Using Worksheet Cells” on page 1-18

“Create Diagonal Matrix Using VBA Macro” on page 1-20

“Find and Execute MATLAB Function Using MATLAB Function Wizard” on page 1-22

“Execute Spreadsheet Link Functions” on page 1-30

## MLPutRanges

Send data in Microsoft Excel named ranges to MATLAB

### Syntax

```
= MLPutRanges()
```

```
MLPutRanges  
out = MLPutRanges()
```

### Description

`= MLPutRanges()` writes the named cell ranges in a Microsoft Excel worksheet into MATLAB variables. The variables are named with the same name specified by the cell range name in Microsoft Excel. To use this syntax, right-click in any Microsoft Excel cell, enter this syntax, and press **Enter**.

`MLPutRanges` writes the named cell ranges in a Microsoft Excel worksheet into MATLAB variables. The variables are named with the same name specified by the cell range name in Microsoft Excel. Use this syntax when working directly in a Microsoft Visual Basic macro.

`out = MLPutRanges()` returns the named cell ranges in a Microsoft Excel worksheet into MATLAB variables. The variables are named with the same name specified by the cell range name in Microsoft Excel. In this case, `out` specifies whether the `MLPutRanges` function executed successfully. Use this syntax when working directly in a Microsoft Visual Basic macro.

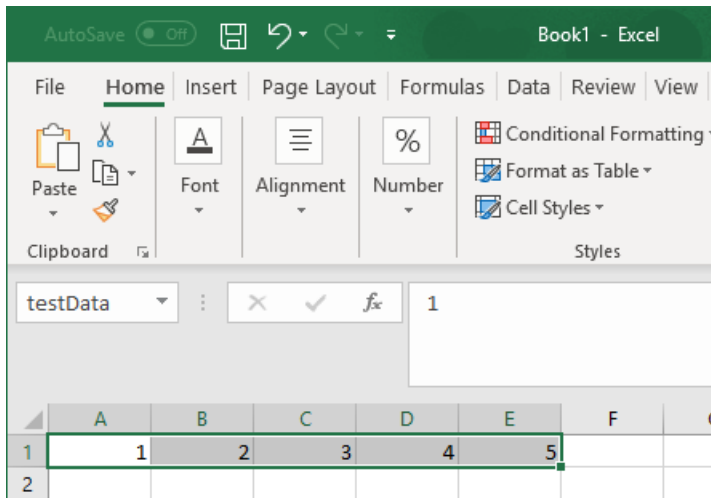
### Examples

#### Export Microsoft Excel Named Range to MATLAB in Microsoft Excel Cell

Enter the values 1 through 5 in cells A1 through E1.

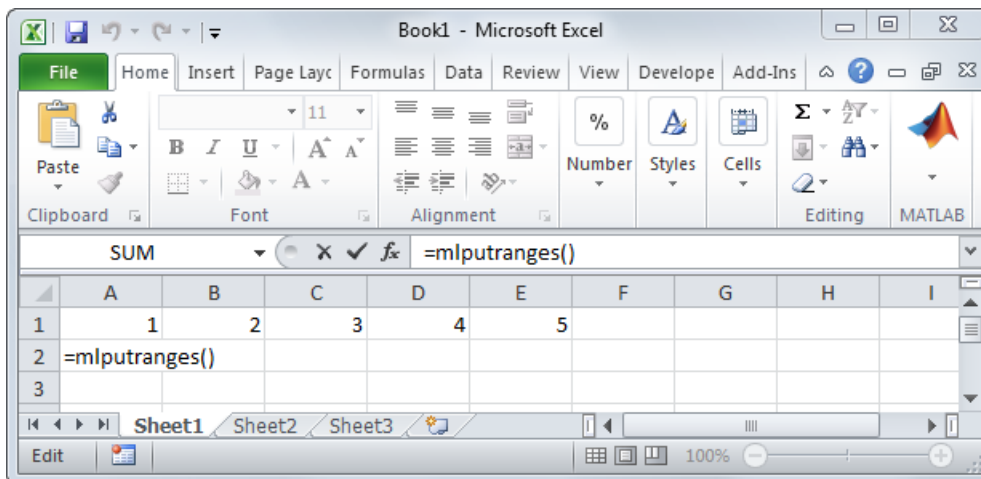
Define a name for a range of cells from cell A1 through cell E1. For instructions about defining names, see Excel Help and enter the search term: define and use names in formulas.

The name of the range of cells `testData` appears in the **Name Box**.

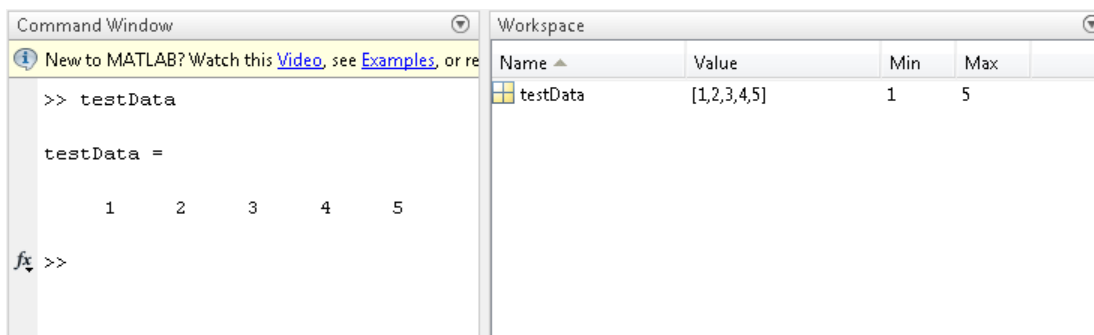


To send data in the named range in the current worksheet to MATLAB, execute the function inside a worksheet cell by entering this text.

= MLPutRanges ( )



After pressing **Enter**, Microsoft Excel exports the named range testData to the MATLAB variable testData in the MATLAB workspace.



### **Export Microsoft Excel Named Ranges to MATLAB in Microsoft Visual Basic Macro Without Output**

Call the function to send data in the named ranges in the current worksheet to MATLAB.

MLPutRanges

### **Export Microsoft Excel Named Ranges to MATLAB in Microsoft Visual Basic Macro with Output**

Call the function to send data in the named ranges in the current worksheet to MATLAB.

```
out = MLPutRanges()
```

out returns 0 if the function succeeded or a string with the corresponding error code if the function failed.

## **Output Arguments**

### **out — Status**

0 | string

Status for execution of MLPutRanges, returned as 0 if the function succeeded, or a string containing an error code.

## **Tips**

- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see “Installation” on page 1-3.

## **Version History**

Introduced in R2013b

## **See Also**

MLPutMatrix | MLGetMatrix

### **Topics**

“Create Diagonal Matrix Using Microsoft Excel Ribbon” on page 1-13

“Create Diagonal Matrix Using Microsoft Excel Context Menu” on page 1-15

“Create Diagonal Matrix Using Worksheet Cells” on page 1-18

“Create Diagonal Matrix Using VBA Macro” on page 1-20

“Find and Execute MATLAB Function Using MATLAB Function Wizard” on page 1-22

“Execute Spreadsheet Link Functions” on page 1-30

# MLPutVar

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

## Syntax

```
MLPutVar ML_var_name, VBA_var_name
out = MLPutVar ML_var_name, VBA_var_name
```

## Description

MLPutVar ML\_var\_name, VBA\_var\_name 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.

out = MLPutVar ML\_var\_name, VBA\_var\_name lets you catch errors when executing MLPutVar. If MLPutVar fails, then out is a string containing error code. Otherwise, out is 0.

## Examples

### Create a MATLAB Matrix Using Data Stored in a VBA Variable

Create (or overwrite) the MATLAB matrix K with the data in the VBA variable DataK:

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

## Input Arguments

### ML\_var\_name — Matrix name

string scalar

Name of MATLAB matrix to create or overwrite.

ML\_var\_name in quotes directly specifies the matrix name. ML\_var\_name without quotes specifies a VBA variable that contains the matrix name as a string.

### VBA\_var\_name — Variable name

variable name

Name of VBA variable whose contents are written to ML\_var\_name.

Use VBA\_var\_name without quotes.

## Output Arguments

### out — Success indicator

0 | string scalar

0 if the command succeeded. Otherwise, a string containing error code.

## **Tips**

- 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.
- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see “Installation” on page 1-3.

## **Version History**

**Introduced before R2006a**

## **See Also**

`MLGetVar`

## **Topics**

“Create Diagonal Matrix Using VBA Macro” on page 1-20

“Execute Spreadsheet Link Functions” on page 1-30



# MLShowMatlabErrors

Return standard Spreadsheet Link errors or full MATLAB errors

## Syntax

```
= MLShowMatlabErrors(flag)
MLShowMatlabErrors flag
```

## Description

= `MLShowMatlabErrors(flag)` sets the error message type when executing MATLAB commands using `MLEvalString` in Microsoft Excel. An error displays when `MLEvalString` fails. You can display two different types of error messages. At any point, you can switch between displaying Spreadsheet Link and MATLAB errors. Without this function, worksheet cells display only Excel error messages. Use this syntax when working in a worksheet cell.

`MLShowMatlabErrors flag` works in a VBA macro.

## Examples

### Display Spreadsheet Link Errors in Worksheet Cell

This Spreadsheet Link code assumes `MLEvalString` returns MATLAB errors upon failure.

Enter this text in any worksheet cell to display `MLEvalString` failures as Spreadsheet Link errors.

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

Enter this invalid text in any worksheet cell.

```
=MLEvalString("sum(2+b);")
```

This Spreadsheet Link error appears in the calling cell.

```
#COMMAND!
```

### Display MATLAB Errors in VBA Macro

This VBA code assumes `MLEvalString` returns Spreadsheet Link errors upon failure.

Enter this text at the beginning of a VBA macro to display `MLEvalString` failures as MATLAB errors.

```
MLShowMatlabErrors "yes"
```

Enter this invalid text in the VBA macro.

```
out = MLEvalString("sum(2+b);")
MsgBox (out)
```

When running this macro, this MATLAB error appears in a dialog box: ??? Undefined function or variable 'b'. For details on running macros, see Excel Help.

## **Input Arguments**

### **flag — Error message indicator**

"no" (default) | "yes"

Error message indicator, specified as "no" or "yes" to determine the type of error message displayed when `MLEvalString` fails. To display the standard Spreadsheet Link errors, specify "no". To display the full MATLAB errors, specify "yes".

## **Tips**

- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see "Installation" on page 1-3.

## **Version History**

**Introduced in R2006b**

## **See Also**

`MLEvalString`

## **Topics**

"Create Diagonal Matrix Using Worksheet Cells" on page 1-18

"Create Diagonal Matrix Using VBA Macro" on page 1-20

"Execute Spreadsheet Link Functions" on page 1-30

"Worksheet Cell Errors" on page 3-2

"Microsoft Excel Errors" on page 3-5

# MLStartDir

Specify MATLAB current working folder after startup

## Syntax

```
= MLStartDir(path)
```

```
MLStartDir path  
out = MLStartDir(path)
```

## Description

`= MLStartDir(path)` sets the MATLAB current working folder after MATLAB startup. *Use this syntax when working directly in a worksheet.*

`MLStartDir path` sets the MATLAB current working folder. *Use this syntax in a VBA macro.*

`out = MLStartDir(path)` lets you find errors when you execute the `MLStartDir` function in a VBA macro. If the `MLStartDir` function fails, then `out` is a string containing an error code. Otherwise, `out` is `0`.

## Examples

### Specify MATLAB Working Folder

Set the current working folder in a spreadsheet.

Open Excel and make sure cell A1 is selected in the worksheet. To set the MATLAB current working folder to `d:\work` after startup, enter this text in the cell and press **Enter**:

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

The `MLStartDir` function sets the current working folder.

### Specify MATLAB Working Folder with Spaces Using VBA Macro

Set the current working folder in a VBA macro. The folder name contains a space.

On the **Developer** tab in Excel, click **Visual Basic** in the **Code** group. The Visual Basic Editor window opens.

From the **Insert** menu, select **Module** to insert a new module. Embed the folder path in single quotes within double quotes. Set the MATLAB current working folder to `d:\my work`. In the Module1 window, enter this VBA code containing a macro named `StartDir`.

```
Sub StartDir()  
    MLStartDir "'d:\my work'"  
End Sub
```

The `StartDir` macro uses the `MLStartDir` function to set the current working folder. For details about working with modules, see Excel Help.

Run the macro by clicking the **Run Sub/UserForm** button on the VBA toolbar. For details about running macros, see Excel Help.

The `MLStartDir` function sets the current working folder.

## Input Arguments

### **path — MATLAB current working folder path**

string

MATLAB current working folder path, specified as a string. The string indicates the path to the new working folder after MATLAB starts.

Example: "d:\work"

## Tips

- 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 folder.
- The working folder changes only if you run MATLAB *after* you run this function. Running this function while MATLAB is running does not change the working folder for the current session. In this case, MATLAB uses the specified folder as the working folder when it is restarted.
- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see "Installation" on page 1-3.

## Version History

**Introduced in R2006b**

## See Also

`MLAutoStart`

## Topics

"Set Spreadsheet Link Preferences" on page 1-9

# MLUseCellArray

Toggle `MLPutMatrix` to use MATLAB cell arrays

## Syntax

```
= MLUseCellArray(flag)
MLUseCellArray flag
out = MLUseCellArray(flag)
```

## Description

`= MLUseCellArray(flag)` specifies whether `MLPutMatrix` must use cell arrays for transfer of data (for example, dates). When the Spreadsheet Link 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. *Use this syntax when working directly in a worksheet.*

`MLUseCellArray flag` specifies whether `MLPutMatrix` must use cell arrays for transfer of data. *Use this syntax in a VBA macro.*

`out = MLUseCellArray(flag)` lets you catch errors when executing `MLUseCellArray` in a VBA macro. If `MLUseCellArray` fails, then `out` is a string containing error code. Otherwise, `out` is 0.

## Examples

### Stop Using Cell Arrays When Transferring Data Structures

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

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

## Input Arguments

### flag — Cell array use specification

"no" (default) | "yes"

Either "yes" or "no".

Specify "yes" to automatically use cell arrays for transfer of data structures. Specify "no" to stop using cell arrays for transfer of data structures.

## Output Arguments

### out — Success indicator

0 | string scalar

0 if the command succeeded. Otherwise, a string containing error code.

## **Tips**

- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see “Installation” on page 1-3.

## **Version History**

**Introduced in R2007a**

## **See Also**

MLPutMatrix

# MLUseFullDesktop

Specify whether to use full MATLAB desktop or Command Window

## Syntax

```
= MLUseFullDesktop(flag)
MLUseFullDesktop flag
out = MLUseFullDesktop(flag)
```

## Description

= `MLUseFullDesktop(flag)` sets the MATLAB session to start with the full desktop or Command Window only. *Use this syntax when working directly in a worksheet.*

`MLUseFullDesktop flag` sets the MATLAB session to start with the full desktop or Command Window only. *Use this syntax in a VBA macro.*

`out = MLUseFullDesktop(flag)` lets you catch errors when executing `MLUseFullDesktop` in a VBA macro. If `MLUseFullDesktop` fails, then `out` is a string containing error code. Otherwise, `out` is `0`.

## Examples

### Start Only the Command Window

Set the MATLAB session to start with the command window only:

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

## Input Arguments

### flag — Full desktop startup designation

"yes" (default) | "no"

Either "yes" or "no".

Specify "yes" to start full MATLAB desktop. Specify "no" to start the Command Window only.

## Output Arguments

### out — Success indicator

0 | string scalar

0 if the command succeeded. Otherwise, a string containing error code.

### Tips

- To work with VBA code in Excel with Spreadsheet Link, you must enable Spreadsheet Link as a reference in the Microsoft Visual Basic Editor. For details, see “Installation” on page 1-3.

### Version History

Introduced in R2006b

### See Also

matlabinit | MLClose | MLOpen