

## Plot and Solve Equations

With SigmaPlot's equation plotter and solver, you can

- plot curves of data from user-defined equations
- evaluate equations for data points, and solve them for a data range.

You can use equations from the built-in equation library, or you can add you own equations.

You can also write the results to the worksheet.

We will show four "Tours":

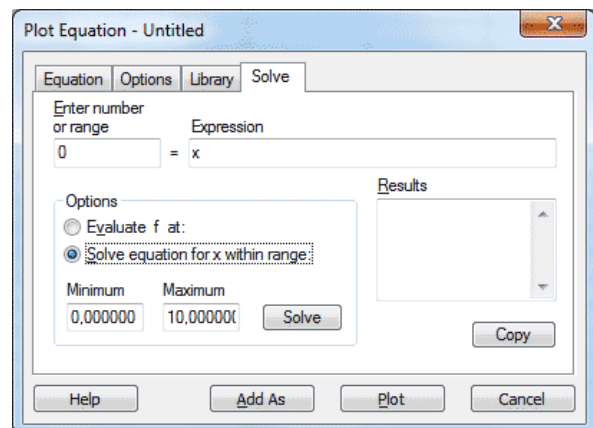
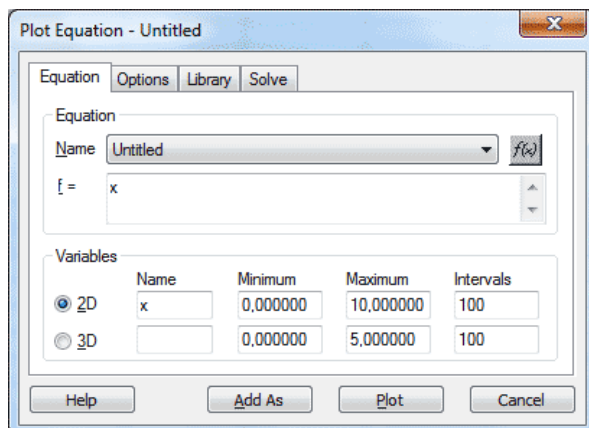
1. Plot an existing equation
  2. Plot a user-defined equation
  3. Evaluate an equation for one point
  4. Solve an equation for a data range,
- and some Notes at the end of the page.

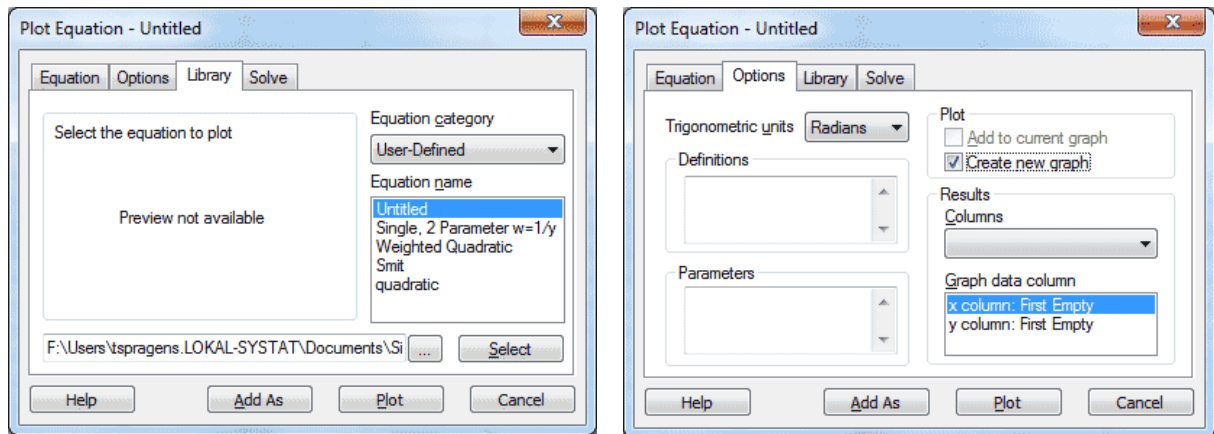
To run Plot/Solve Equation:

From the Analysis ribbon, in the Graph Analysis section, select Plot Equation.

The Plot Equation dialog opens with 4 tabs:

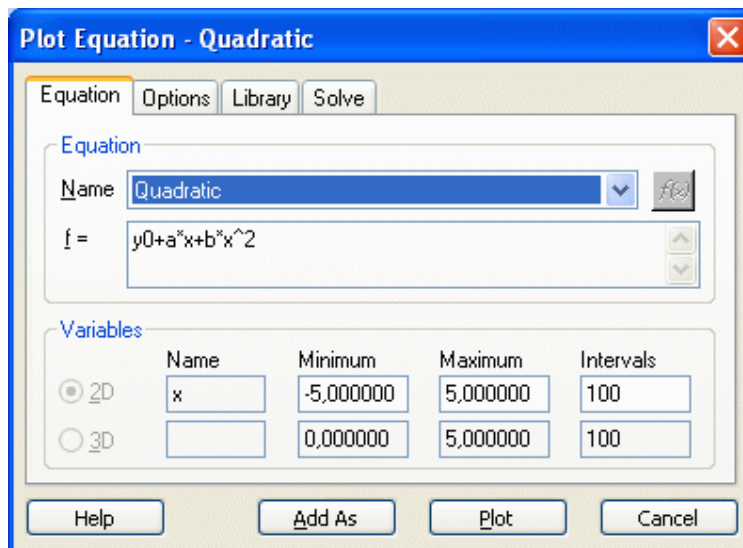
- **Equation**  
Select or enter an equation.  
Select the Minimum, Maximum, and Number of Intervals for the independent variable(s), x (2D) or xy (3D).
- **Options**
  - Create a new graph, or add a plot to an existing graph.
  - Under Results > Columns, select the worksheet columns for the results. Default is "First Empty".
  - Parameters and Definitions: Set the values for equation coefficients and necessary definitions.
- **Library**
  - Equation category: select an equation category from the list: Polynomial, Peak, ...
  - Equation name: select an equation from this list. The list changes with the selected category. (Example: Category Polynomial, Name Quadratic)
  - Click the Select button to select an equation.
- **Solve**
  - Evaluate the equation at a certain point (2D and 3D), or solve it for a range (2D)





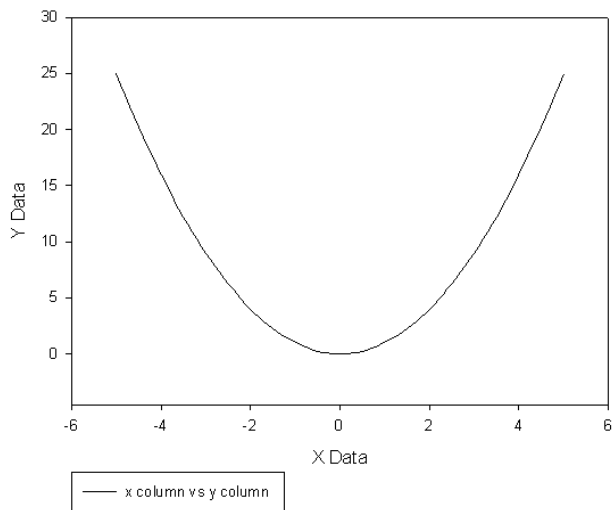
### Tour 1: Plot an existing equation

Quadratic Equation: In the Library tab, select Category: Polynomial, and Name: Quadratic.



a) The default Variables setting will create a XY data range for this equation, for  $-5 \leq x \leq 5$ , with 100 intervals, i.e. in steps of 0,1.

Click on "Plot":



The plot can be added to an existing graph, or it can be created as a new graph. See the “Plot” checkboxes in the Options tab.

b) Modified settings: change the equation coefficients, and the X data range.

In the Options tab, change the parameters to:  $y_0=-10$ ,  $a=5$ ,  $b=2$ .

**Parameters**

$y_0=-10$  ▲

$a=5$  ▬

$b=2$  ▼

**Graph data column**

x column: First Empty

y column: First Empty

In the Equation tab, change the x Minimum and Maximum values to -10 and 10, and Intervals to 20.

Equation Options Library Solve

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**Equation**

Name: Quadratic ▼  $f(x)$

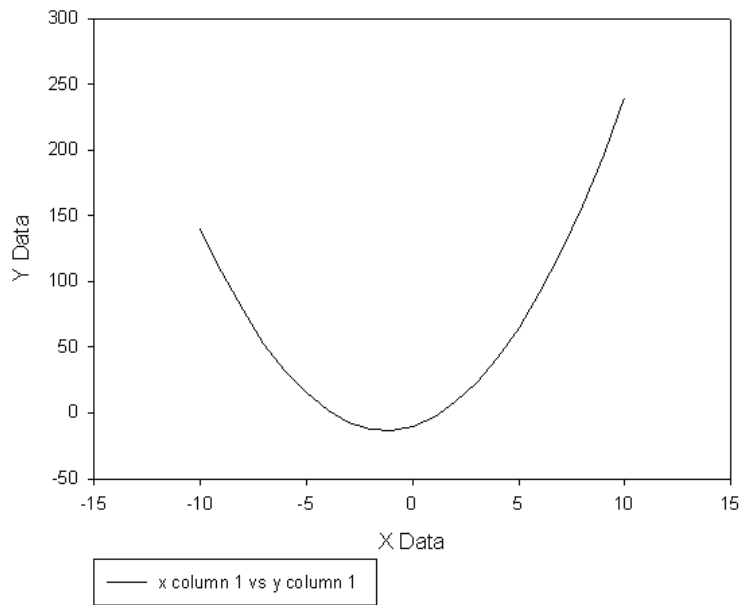
$f = y_0 + a*x + b*x^2$  ▲

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**Variables**

	Name	Minimum	Maximum	Intervals
<input checked="" type="radio"/> 2D	x	-10	10	20
<input type="radio"/> 3D		0,000000	5,000000	100

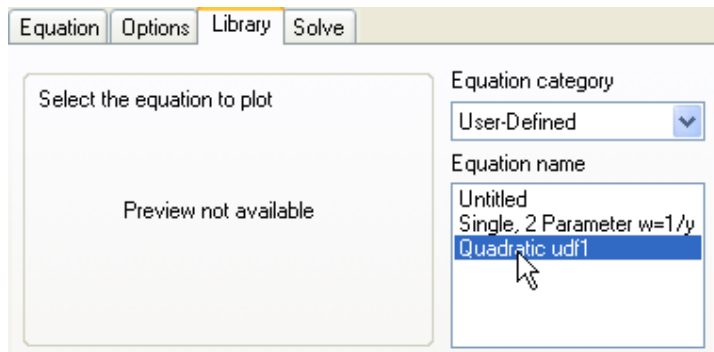
Click on “Plot”:



## Tour 2: Plot a user-defined equation

Click the “Add As” button in the Equation tab to copy an existing equation, and give the copy a new name. It will be saved in the “User-Defined” Category of the equation library.

The equations in the Equation library are read-only (other than parameters which you can edit in the Options tab).



**Important:** To apply and use this equation, click the “Select” button below the equation list.

Now you can modify parameters, set the data range, and plot the equation just like you did in Tour 1.

## Tour 3: Evaluate an equation at one point

- a) Select the equation
  - from the Category > Name list combination in the Library tab, or
  - from the Equation > Name dropdown list in the Equation tab.

The Equation > Name dropdown list shows the equations in the selected Category, plus the User-Defined equations.

The “Expression:  $f = \dots$ ” field in the Solve tab cannot be edited. It mirrors the content of the “ $f = \dots$ ” field in the Equation tab. Select the equation there, and then go to the Solve tab.

b) Compute the value  $f(x)$  for a given  $x$ , or  $f(x,y)$  for a given  $xy$  pair. In the Solve tab, select the “Evaluate  $f$  at:” option.

The screenshot shows the 'Solve' tab interface. At the top, the 'Expression' field contains the formula  $f = y0 + a*x + b*x^2$ . Below this, the 'Options' section has two radio buttons: 'Evaluate  $f$  at:' (which is selected) and 'Solve equation for  $x$  within range:'. Under the 'Evaluate  $f$  at:' option, there are two input fields for 'x' and 'y'. The 'x' field contains the value '0'. To the right of these fields is an 'Evaluate' button. On the right side of the interface, the 'Results' section displays the output: 'Evaluation: x = 0 f = -10'. Below the results is a 'Copy' button.

The result is written to the “Results” field, and you can select and copy it from there. The results are cumulated. Evaluate the equation for another value of  $x$ :

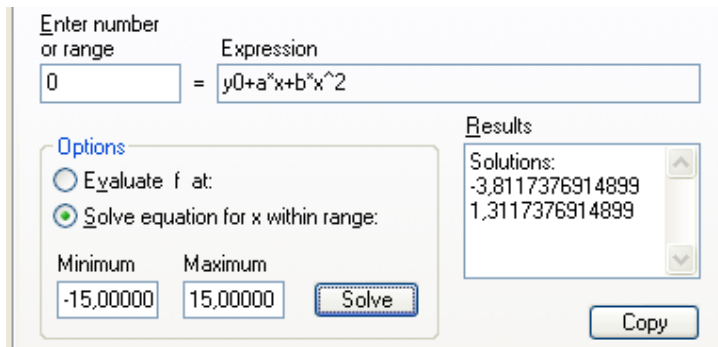
This screenshot shows the same 'Solve' tab interface as the previous one, but with the 'x' input field now containing the value '2'. The 'Evaluate' button is highlighted. The 'Results' section on the right now shows two entries: 'x = 0 f = -10' and 'Evaluation: x = 2 f = 8'. A 'Copy' button is located below the results.

#### Tour 4: Solve an equation for a data range

Determine the  $x$  value(s) where the evaluated equation has a certain value, mostly = 0.

- a) Select the equation (see Tour 3)
- from the Category > Name list combination in the Library tab, or
  - from the Equation > Name dropdown list in the Equation tab.

In the Solve tab, select the “Solve equation for  $x$  within range” option. For “Enter number or range”, leave the value at 0, or change it appropriately. Select the Minimum and Maximum values. Click the “Solve” button.



Note: The equation value (“Enter number or range”) and Minimum and Maximum values must be selected properly. If not chosen properly, existing solutions may not be in the selected range.

## Notes

### Equations lists

The Equation > Name dropdown list shows the equations in the selected Category, plus the User-Defined equations. To work with an equation, select it

- from the Category > Name list combination in the Library tab, or
- from the Equation > Name dropdown list in the Equation tab.

### Selecting an equation in the Library tab

When you have selected an equation in the Library tab, click the “Select” button to apply this equation to the Equation and Solve tabs.

### User-defined equations

Click the “Add As” button in the Equation tab to copy an existing equation, and give the copy a new name. The equations in the Equation library are read-only (other than parameters which you can edit in the Options tab).

### Solve > “Expression: f = ...”

The “Expression: f = ...” field in the Solve tab is not editable. It mirrors the content of the “f = ...” field in the Equation tab. Select the equation there, then go to the Solve tab.

### Library

The equations listed in the Library tab are those in the Standard.jfl library which is also used in the SigmaPlot Regression Wizard (Analysis > Nonlinear Regression > Regression Wizard). You can select another library by clicking on the “...” button.

### Solve > Results

You can select and copy solutions from the Results field.

### Solving at...

*Evaluate f at ...:* The equation is evaluated at the entered x value, i.e. y is computed for this x value (or z for xy value, with 3D equations).

*Solve equation within range:* By default the equation is solved for f = 0. But you can also solve it for another value, or for a data range (add numbers into a free worksheet column, e.g. col 5), and enter “col(5)” into this field. (This is the syntax of the SigmaPlot transform language).

**Out of range**

“Enter number or range” and “Minimum/Maximum” must match. Entering out of range values for all of these fields can lead to “No Solutions”.

**Function Palette**

In the Equation tab, you find the function palette button:  $[f(x)]$ . It opens a palette with transform language functions which you can use in the equations fields.