# Functions and Plots

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*Overview*

You will likely have to deal with graphs on a daily basis in your study of Calculus and beyond. The main objective of this lab is to learn to use Maple to produce report-quality graphs of functions. This important topic was introduced briefly in the New User's Tour, but we will explore it in more detail here.

*Maple Essentials*

- New Maple commands introduced in this lab include:

| Command | Description |
|---------|-------------|
| `plot` | plot one or more functions on a specified window |
| | `plot(f(x), x=a..b);` plots the graph of $f(x)$ for $a < x < b$; |
| | `plot([f(x), g(x)], x=a..b);` graphs two functions in a single plot |
| `:=` | assign a name to a quantity |
| `->` | `f:=x->a*x+b;` assigns $f$ to be the function $f(x) = ax + b$ |

- As introduced in the New User's Tour, the best way to start the **Plot Builder** assistant is right-clicking over an expression, but it can also be started from the Maple 12 user interface under the **Tools** menu:

<p align="center"><b>Tools → Assistants → Plot Builder</b> . . .</p>

*Related Course Material*

§1.1 and §1.2. Specifically, you should review Examples 3-5 (pages 18-21) in §1.2 for choosing an appropriate viewing window for graphing.

*Activities*

1. Create one plot that displays the graph of both $f(x) = \sqrt{x}$ and $g(x) = |x|/2$. Use the viewing window [-3,3]×[-3,3] for your plot. Change the line style for each expression so the curves can be distinguished from one another on a black and white copy. Give your plot a title and legend. Finally, transfer your plot to a **Microsoft Word** document. (Detailed steps for this activity are given on the next page.)

2. Create three plots of the function $f(x) = x^3 - x$ using the following different $x$-ranges: $-0.1 \le x \le 0.1$, $-10 \le x \le 10$, and $-2 \le x \le 2$. This example will demonstrate that your choice of viewing window can greatly affect your perception of the graph.

3. Repeat Activity 1 using $f(x) = 2\sin(4x)$, $g(x) = 2 + \cos(\frac{x}{2})$, and $h(x) = \sin(x)$ on the viewing window $[-\pi, \pi]$×[-4,4].

*Example: Activity 1*

- We will start with graphing $f(x) = \sqrt{x}$. Input the expression using proper Maple notation as shown. Remember, you can use the Expression palette if you wish.
  $>$ sqrt(x);
- Next, launch the **Interactive Plot Builder** by right-clicking over $\sqrt{x}$. From the context menu, choose **Plots** and then **Plot Builder**.
- Change the range for $x$ to be -3 to 3.
- Click **Options**. Under **Line**, change the style to **dash**. Under **Color**, change the color to **Blue**. Under **Title**, give your graph a title, say **My Graph**. Click **Plot**.
- Maple will return your plot with the following command:
  $>$ plot($\sqrt{x}$, x=-3..3, linestyle=dash, color=``Blue'', title=``My Graph'');
  Notice that each change we made using the Plot Builder corresponds to a different Maple command.
- We can add other functions and choices using square brackets, and we can change the window vertically by adding a command for the $y$-range.
- Say we want $f(x)$ red with a solid line and $g(x)$ blue with a dashed line, and we want to change the window to [-3,3]×[-3,3].
- First, assign $f(x)$ and $g(x)$ as functions as follows. This will make the functions easier to call and change in the future.
  $>$ f:= x -> sqrt(x);
  $>$ g:= x -> abs(x)/2;
- Next, mimic the plot command to reflect our new choices. Remember to use square brackets for more than one choice. You should come up with something like this:
  $>$ plot([f(x),g(x)], x=-3..3, y=-3..3, linestyle=[solid, dash], color= [``Red'', ``Blue''], title=``My New Graph'');
- To create the Legend, follow these steps:
  1. Position the cursor over the plot and right-click to see the context menu.
  2. Under the option **Legend**, select **Show Legend**.
  3. Double-Click to change the labels for Curve 1 and Curve 2.
- Finally, transfer your figure to a Microsoft Word document. If you have time, check out the other options in the context menu. For example, under **Title** choose to **Add Caption**, or under **Legend** choose to change the **Position**.

*Assignment*

Use Maple to complete Exercises 12, 14, and 19 in §1.2(page 25). **Make sure each graph has a title and legend**. Turn in your Maple worksheet to be graded. Attach any additional papers to the Maple worksheet. (This assignment is due at the beginning of next week's lab.)

*Remarks*

You should always save your lab worksheets in your **Z:** drive. This way, you can view them later for help with projects, quizzes, etc. Please do not forget to logout.