

TI-83

TechSkills 1: Functions

This TechSkills module explains one of the TI-83's most useful tools, working with a function: evaluation and graphing. We illustrate the desired skills with examples.

A Preliminary: The Mode Menu

The calculator has mode settings that deal with a Variety of formats. To get an appropriate solution you must have the calculator set up properly. To check your settings:

1. Turn your TI-83 **ON**. Press the **MODE** key.
2. The screen looks something like this. The standard settings are displayed at the right. To change a setting, use the arrow keys to highlight the mode you want to change, then press **ENTER**. When done, press **2nd** QUIT (located just above the MODE key) to save the mode settings and return to the home screen.



Note When graphing trigonometric functions, make sure that the calculator is in RADIAN mode and use functional notation; e.g., $\sin(x)$.

Evaluating A Function

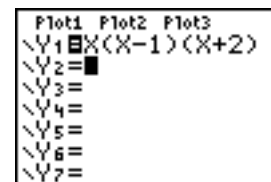
For example, let's enter the function $y=x(x-1)(x+2)$ and evaluate it at $x=5$.

Entering the Function in the Y= Menu

Enter the equation in the $y=$ format from the home screen by pressing **Y=**. We can then enter the function in terms of x . For example, our function $y=x(x-1)(x+2)$ is entered by pressing



Press **2nd** **θ** to return to the home screen.



A Functional Value

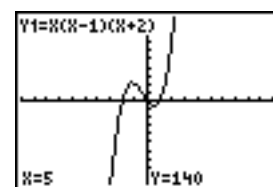
We now explain two methods to evaluate the function Y_1 at a single input value. One method

is through the **X,T,θ,n** menu, the second method is through the CALC menu. First, we evaluate a function through the **X,T,θ,n** menu. We illustrate by determining $Y_1(5)$.

Press $\boxed{\text{X,T,}\theta,\text{n}}$,
 then use the right arrow to highlight Y-Var.gifS,
 then press $\boxed{\text{ENTER}}$ to select 1:Function,
 then press $\boxed{\text{X,T,}\theta,\text{n}}$ to select 1:Y1,
 then $\boxed{(}$ $\boxed{5}$ $\boxed{)}$ $\boxed{\text{ENTER}}$.
 The answer, 140, appears at the right of the screen.

Y1(5) 140

Second, we compute a functional value through the CALC menu. CALC is located above the $\boxed{\text{TRACE}}$ key in the top row of keys; hence, press $\boxed{\text{2nd}}$ $\boxed{\text{TRACE}}$ to access the CALCULATE menu. Select 1:value by pressing either $\boxed{1}$ or $\boxed{\text{ENTER}}$. The graph screen then appears with a blinking cursor after X= in the bottom left of the screen. Press $\boxed{5}$ $\boxed{\text{ENTER}}$. The answer appears at the bottom of the screen as Y=140.



A potential trouble is that your input value (here, 5) must be between the Xmin and Xmax values defined in the graphing window; otherwise, the error screen appears. If the error screen appears, then press either $\boxed{1}$ or $\boxed{\text{ENTER}}$ to return to the home screen. If the input value is between -10 and 10, then you can return to the standard window by pressing $\boxed{\text{ZOOM}}$ $\boxed{6}$ to select 6:ZStandard. Now the CALC menu approach described in the preceding paragraph will work to produce the functional value.

If the input value is outside the standard window settings (less than -10 or greater than 10), then press $\boxed{\text{WINDOW}}$ and select appropriate Xmin and Xmax values for Xmin and Xmax. Then press $\boxed{\text{ZOOM}}$ $\boxed{0}$ to select 0:ZoomFit. Now the CALC menu approach described in the preceding paragraph will work to produce the functional value.

A Table of Functional Values

The TI-83 has nice features for creating a table of functional values.

Press $\boxed{\text{WINDOW}}$ to access TBL SET.

TABLE SETUP
 TblStart=0
 Δ Tbl=5
 Indent: $\boxed{\text{Auto}}$ Ask
 Depend: $\boxed{\text{Auto}}$ Ask

TblStart is the first input value to start our table. Type $\boxed{0}$ $\boxed{\text{ENTER}}$ to start the table at the input value of 0.

Δ Tbl= specifies the increment for the input values in the table. Here, we construct a table that steps by 5; hence, type $\boxed{5}$ $\boxed{\text{ENTER}}$.

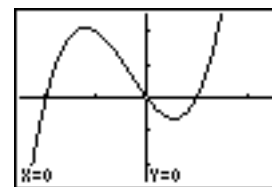
X	Y1
0	0
5	140
10	1080
15	3570
20	8360
25	16200
30	27840

X=0

Press $\boxed{\text{2nd}}$ $\boxed{\text{GRAPH}}$ to access TABLE. You get a nice table. You can use the up/down arrow keys to scroll through the table to see more values.

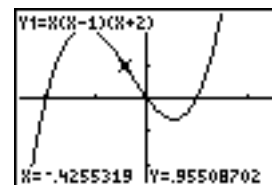
Graphing a Function

Once a function is entered in the Y= menu, to see its graph, press **GRAPH** . If the graph is not satisfactory, then adjust the view. There are two common menus for adjusting the view: WINDOW and ZOOM. For example, press **ZOOM** **2** to select 2:ZoomIn. If needed, use the arrow keys to place the cursor at the origin, $X=0$ and $Y=0$. The cursor defines the center for a new zoomed-in graph. Press **ENTER** . You now see a better view of the graph action.



Trace

The TI-83's TRACE feature allows you to use the arrow keys to move a pointer along the graph. The x- and y-coordinates will appear at the bottom of the screen. To use this feature, from the GRAPH screen merely press **TRACE** . A cursor will appear on the graph. Use the left and right arrow keys to move the cursor along the graph of the function. Note that the x- and y-coordinates of the indicated point are given at the bottom of the GRAPH screen, while the equation of the graph is given at the top.

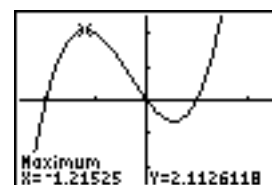


Extreme Values of a Function

At times it is important to find the lowest and highest range values in a given domain. These are called *extreme values* . The TI-83 can easily display extreme values by going through the CALC menu.

Access the CALC menu by pressing **2nd** **TRACE** .

Press **4** to select 4:maximum (or press **3** to select 3:minimum).



The TI-83 needs you to set bounds for its search. The TI-83 prompts you for a "Left Bound?" (press **(-)** **2** **ENTER**), a "Right Bound?" (press **0** **ENTER**), and a "Guess?" (press **(-)** **1** **ENTER**). Note that the upper and lower bounds are numbers between which the x-coordinate of the extreme value lies. An estimate for the local maximum is then (-1.21525, 2.1126118).

Alternatively, you may use the cursor to set the bounds and make the guess.

Piecewise Defined Functions

A frequently asked question is, How do I enter a piecewise defined function? For example, suppose the function f is defined as follows:

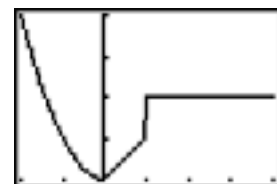
$$f(x) = \begin{cases} x^2 & \text{if } x < 0 \\ x & \text{if } 0 \leq x < 1 \\ 2 & \text{if } 1 \leq x \end{cases}$$

To enter f as a function all on one line, press $\boxed{V} =$. You first may want to highlight and CLEAR any previous functions. Then enter the new function as follows:

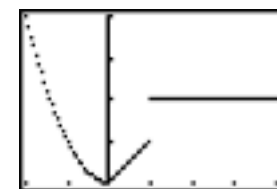
$$(X^2) \times (X < 0) + (X) \times (0 \leq X \text{ and } X < 1) + (2) \times (X \geq 1)$$

For safety, enclose each component function in parentheses, multiplied by the corresponding condition enclosed in parentheses. You find the comparison symbols ($<$, $>$, \leq , \geq) in the TEST menu (TEST is located just above the MATH key). Also you find the logical connectors (and, or, xor, not) in the TEST menu. In the TEST menu, use the thumbpad right arrow to access the **LOGIC** menu, then select the desired logical connector.

After the function is entered, enter the desired WINDOW (suggestion: use $X_{\min} = -2$, $X_{\max} = 4$), then ZOOM and select 0:ZoomFit. Notice that something appears wrong with the graph; in particular, the linear segment $y = x$ defined on the interval from 0 to 1 is joined to the horizontal segment $y = 2$ defined for $x > 1$. When constructing a graph, the TI_83 plots a graph pixel for each pixel value of x along the horizontal axis, then connects adjacent graph pixels with straight-line segments (just like playing connect-the-dots in elementary school).



For functions with a break, this connect feature is not desired. To avoid the connection, press MODE. In the fifth line in the mode menu, change **Connected** to **Dot** by using the thumbpad arrows, highlight Dot, press ENTER, and then press GRAPH. Watch the screen as the TI-83 plots individual points without connecting them. The jump discontinuity at $x = 1$ is now evident.



The Dot feature for graphing is important when graphing any function that would display a vertical asymptote or a jump discontinuity. As an illustration, graph $y = \tan(x)$ setting the x -window from $-\pi$ to π . Then view the graph using both the Connected and the Dot mode. For graphing trigonometric functions, it is handy to use the ZOOM menu, item 7:ZTrig. The ZTrig zoom feature scales the x -axis in units of $\pi/2$.

END

The author wishes to extend his appreciation to Texas Instruments for their professor assistance program. Visit the TI calculator website at <http://www.ti.com>.

Charles M. Biles, Ph.D.
Professor of Mathematics
Humboldt State University
Arcata, CA 95521-8299

email: cmb2@axe.humboldt.edu
