How Do You Graph Derivatives and Antiderivatives?

By John F. Mahoney

There are times when you or your students might be interested in the graphical relationship between a function and its derivatives or between a function and its antiderivatives. This is easy to do on a graphing calculator. The following is written primarily for users of a TI-82, TI-83, or TI-85.

As an example, let $Y_1=x^2 + 5\sin x$, set the MODE so that all the choices on the left are dark, so that in particular Radian and Func are selected. Change the viewing window to [-4, 4], [-10, 10] by making the appropriate changes in WINDOW.

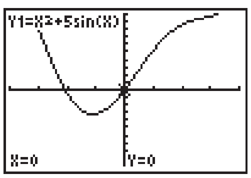

Figure 1

To graph the first derivative, set Y_2=nDeriv(Y_1, x, x). Y_1 is the function we are differentiating. The first x tells the calculator that we wish to differentiate with respect to the variable x. The second x tells the calculator that we wish to calculate the derivative at the value x. In other words, if x is 3, then we wish to calculate the value of the derivative at 3.

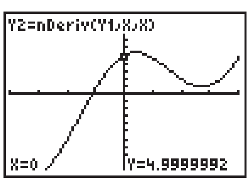

Figure 2

To graph the second derivative, set Y_3=nDeriv(Y_2, x, x). Here we are differentiating Y_2 , which itself is the derivative of Y_1.

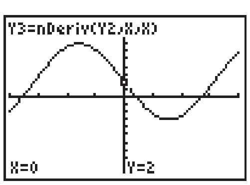

Figure 3

The process of graphing an antiderivative of a function is similar. If we keep our example the same: $Y_1=x^2+5\sin x$, we can let Y_4=fnInt(Y_1, x, 0, x). Here again, Y_1 tells the calculator which function we are integrating and the first x is the variable of integration. The 0 is arbitrary and is the lower limit of integration. The last x is the upper limit of integration. In more traditional symbols we have: $Y_4=\int_0^x x^2+5\sin x\, dx$

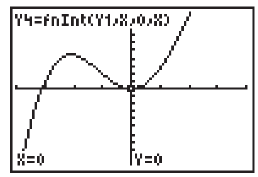

Figure 4

Notes and suggestions:

1. I recommend that you produce a handout for your students containing a graph of the function, its derivative, and its antiderivative. Then have the students try to determine from the graphs which is which.

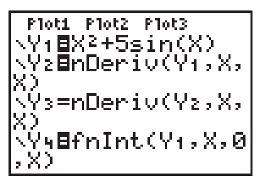

Figure 5

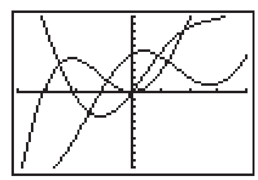

Figure 6

2. Users of TI-81's can graph the derivative by letting Y_2=nDeriv(Y_1, x).
3. The TI-81, TI-82, and TI-83 will not allow you to calculate the third derivative using nDeriv. One can write a program, however, to get around this limitation.
4. Consider changing the 0 in Y_4=fnInt(Y_1, x, 0, x) to other numbers for students to see that functions have many (related) antiderivatives.
5. Illustrate the chain rule by first defining:

   $Y_5 = x^2$
   $Y_6 = Y_1(Y_5)$
   Y_7 = nDeriv(Y_1, X, Y_5)*nDeriv(Y_5, X, X)
   Y_8 = nDeriv(Y_6, X, X)

   Then compare the graphs of Y_7 and Y_8 . ◆