TI Lab 2: Derivatives

In this lab, you will: calculate the derivative of a function at a point from the home screen;
calculate the derivative of a function at a point from the graph;
graph the derivative of a function;
graph tangent lines; and
use a program to find the derivative of a function defined by a table of values.

1. The TI-83 calculates an approximation to the derivative of a function $f(x)$ around the point $x = a$ like this:

$$f(x) \approx \frac{1}{2}\left[\frac{f(a+h)-f(a)}{h} + \frac{f(a)-f(a-h)}{h}\right].$$

This is basically the definition of the derivative, calculated from both left and right sides of a, and then the average is taken. The command for the derivative is `nDeriv` and is under the `MATH` menu as choice 8. The format is `nDeriv(`*function, variable, point, h*`)`. The calculator automatically uses the value $h = 0.001$, but you can specify another value (the smaller the value, the more accurate the answer and the longer it takes to calculate).

a) Evaluate the derivative of $f(x) = x^3 - 4x$ at the point $x = 4$ by entering `nDeriv(X^3-4X,X,4)`.

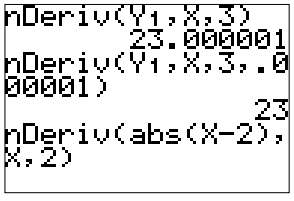
WARNING: `nDeriv` will not give good results of you mistakenly attempt to evaluate the derivative of a function where the derivative is not defined! For instance, $f(x) = |x - 2|$ is not differentiable at $x = 2$, and so the derivative there is undefined.

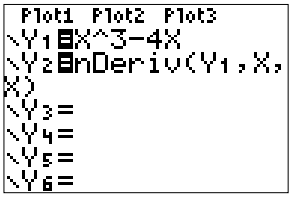
b) Enter `nDeriv(abs(X-2),X,2)`. What did you get?

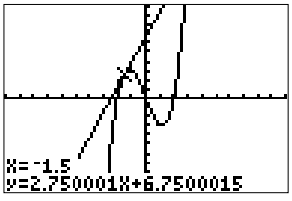
2. You can use nDeriv to graph the derivative of a function without finding the expression for the derivative.

a) Enter `X^3-4X` into `Y1`. Enter `Y2=nDeriv(Y1,X,X)`. Then choose `ZStandard`. Obviously the derivative of `Y1` is $3x^2 - 4$. Enter this on `Y3` and compare with `Y2` using the table. How accurate is the derivative approximation?

b) Clear `Y3`. Enter `Y1=sin(X)`, and change the graph style to bold on `Y2`. Make sure the mode is radians and then select `ZTrig`. What function does the derivative resemble?







3. The TI-83 can also graph the tangent line to a function at a point. That function is in the `DRAW` menu (`2nd PRGM`).

Clear `Y2`. Enter `Y1=X^3-4X` and choose `ZStandard`. With the graph on screen, choose tangent from the `DRAW` menu. Move the cursor to a point at which you want the tangent (or enter the x-value) and press enter. Notice that the equation of the tangent is at the bottom of the screen. What is the approximation to the tangent line? (When you are finished, you must choose `ClrDraw` from the `DRAW` menu to remove the tangent line, or clear the `Y=` screen.)

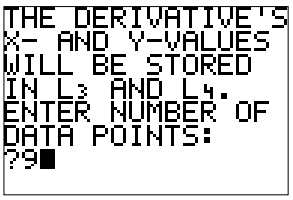
4. There is also a way to calculate the derivative directly on the graph by using the `dy/dx` function on the `CALC` menu (it is choice 6). Move the cursor to the point at which you want to calculate the derivative (or enter the value) and press `ENTER`. Remember that this is only an approximation.

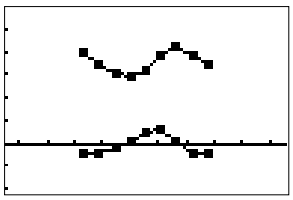
Graph $y = x^3 + x^2 + e^{-x/2}$ on the standard window and find the derivative at the points $x = 1$, $x = 2$, and $x = -0.95$. What conclusion can you draw from the value of the derivative at $x = -0.95$?

5. Finally, the program `DERDATA` calculates the approximate derivative from a function defined by a table of values. The x-values must be entered in `L1` and the y-values go in `L2`.

a) The following table gives the unemployment rate (as a percentage) in the U.S. for the years listed. Estimate the rate of change (the derivative) in the unemployment rate for the years 1987 and 1992.

year (x)	1986	1987	1988	1989	1990	1991	1992	1993	1994
% (y)	7.0	6.2	5.5	5.3	5.6	6.8	7.5	6.9	6.1





b) Estimate the derivative at $x = -1$ and at $x = 2$ for the function defined by the following table.

x	-6	-5	-2	-1	0	2	3	7
y	-3.8	-2.85	-1.66	-1.5	-1	0.08	0.83	5.83