

Newton's Method on Your Calculator

If you have a TI-83 calculator, or something similar, you can write a *program* on the calculator that will perform Newton's Method. Learning how to do this has two parts:

1. Writing the program and understanding how it works, and
2. Learning how to implement the program on the calculator.

Let's start with the first step. Suppose we want to use Newton's Method to solve the equation $f(x) = 0$ where $f(x) = x^5 + x^2 - 3$. We will start out with some initial guess, x , and then repeatedly replace x with $x - f(x)/f'(x)$. In this case we will be replacing x with $x - (x^5 + x^2 - 3)/(5x^4 + 2x)$. Here is a program that will do this:

```
: Input "Enter X", X
: For(I, 1, 5)
: X-(X^5+X^2-3)/(5*X^4+2*X)→X
: Disp X
: End
```

When we *run* this program we will be asked to "Enter X". At that point, we will enter our initial guess for Newton's Method and then press the "ENTER" key. The program then executes the "For" loop by repeating all the lines of code between "For(I, 1, 5)" and "End" five times. It will do this five times because of the "(I, 1, 5)" part of the "For" statement. If it had read "(I, 1, 10)", then it would do the loop 10 times, etc. There are two lines of code that are repeatedly executed. The first replaces X with $X - (X^5 + X^2 - 3)/(5X^4 + 2X)$, which is one step of Newton's Method. The replacement is accomplished with the arrow \rightarrow . The second statement is to display X. So what we are going to see on our calculator is the initial value of X that we enter and then the next 5 values of X generated by Newton's method.

Now we need to see how to enter this program into the calculator. Here are the steps:

1. Press the program key, "PRGM." This should bring up a list of all the programs that you have written for your calculator, which at the moment might be none. You need to choose something like "New" or "+" to create a new program, which you then get to name. Name it "Newton" and then "Save" it. This should take you to a screen where you can now enter the code for the program.
2. The first line of the program is

```
: Input "Enter X", X
```

To enter this, press the "PGRM" key and then the "I/O" (which stands for "Input/Output"). Then select "Input." Now you will have the word "Input" on the

first line of your program. You now need to type “Enter X”, X. Do this using the “ALPHA“ key to gain access to letters, the comma key, and the X key. Then press the “Enter” button to move to the next line.

3. To enter the next line, again press the “PGRM” key, then select “CTRL” (for Control) and then select “For(”. Now enter “I,1,5)” using the “ALPHA” key etc.
4. To enter : $X-(X^5+X^2-3)/(5*X^4+2*X) \rightarrow X$, use the X key, the various arithmetic operation keys, the parenthesis keys and the “STO” (for “store”) key to get the arrow.
5. Press the “PGRM”, key, choose “I/O”, and the choose “disp”
6. Press the “PGRM”, key, choose “CTRL”, and the choose “END.”
7. When you are all done typing the program, press the “QUIT” key.

To run the program, press the “PGRM” key and then choose the program “Newton”. Then press “ENTER”. You will then have to enter the initial value of X and press “ENTER”. After that, the program should display the next five values generated by Newton’s Method!