BC Calculator Lab

Some students in this class have written calculator programs to investigate various areas of calculus. We will look at some of these programs today. (Students have written programs for the TI-89 and for the TI-84, but today we will only be using the TI-89.) Note, calculator programs are allowed on the AP test on any section where calculators are allowed.

If something does go wrong with an action your calculator is taking, you can (usually) stop the process by entering **ON**.

You will work today in groups of two students. You may work alone, if you wish. Your finished product will be a Word document answering the questions that is a clean, finished product. Each group will turn in one document with all members' names written on the top. When complete, place your work in the dropbox in School Space.

The first step is to make sure that you have a TI-89 with the right programs. The programs we want are named *rsums*, *euler*, and *tpoly*.The classroom set of 89's already has the programs loaded and some students in class will also have the programs on their calculator. To transfer the programs from a calculator that has a program, follow the following steps: link the calculators with a cord, making sure that the cord is inserted all the way; on the receiving calculator type **2ND VAR-LINK F3 2:Receive ENTER**; then on the sending calculator type **2ND VAR-LINK**; use the arrow key to page down to the programs you want to send, and check them by typing **F4**; after checking the three programs type **F3 1:Send ENTER**. If your batteries are low, then you may need to replace them.

Directions for using each program were also written by students.

The program *rsums* graphically demonstrates and calculates Riemann sums.
The program *euler* calculates an estimate using Euler's method.
tpoly shows Taylor polynomials algebraically and graphically.

Problems

1. Build a table showing estimates to $\int_4^9 \sqrt{x}\,dx$ using left hand sums and right hand sums for $n = 5$,10, 20, 50. (You might want to include a larger n if you can wait a few minutes for the answers.) You should also be able to compute the actual area. What do you notice about the values? Are the left hand sums over or under estimates? What about the right hand sums? Why? What about the average? How many divisions do you think would be necessary to estimate the area to three decimal places using $rsums$?

2. Repeat question number one for the function $g(x) = \sec^3 x$ from $x = 0$ to $x = 1$, except that this time you will probably want to use your calculator to compute the actual value.

3. Try question number one again, but this time for the function $g(x) = \tan 10x$ from $x = 0$ to $x = 1$. What happened?

4. A potato is shot upward at 20 m/s from a potato cannon that is 10 m above the ground. If $x(t)$ is the height in meters of the potato t seconds after being shot, then $\frac{dx}{dt} = 20 - 9.8t$ and $x(0) = 10$. What is the height of the potato after 2 seconds? Use Euler's method to estimate $x(2)$ with the number of steps being 1, 4, 10, and 50. What do you notice? Are these under or over estimates? Why? How many steps do you think you would need in order to estimate the height to three decimal places of accuracy?

5. (This problem may be harder.) Euler's method with the step size equal to 1 gives a discrete model of population change. This might be appropriate for animal population that give birth all at one time during the year. The logistic model, $\frac{dP}{dt} = kP(L - P)$ (with k and L constants), is a common model of population growth when there is a limit upon how many animals can be supported. Let $L = 1$. Try varying the value of k between 1 and 4, with the step size to some later population at 1. What do you see happen?

6. Use the program *tpoly* to look at Taylor polynomials for $f(x) = \sin x$ at $x = \pi$, $g(x) = \frac{1}{1-x}$ at $x = 0$, and $g(x)$ at $x = 1$. What do you see in each case?