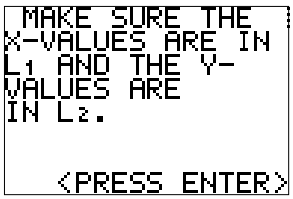
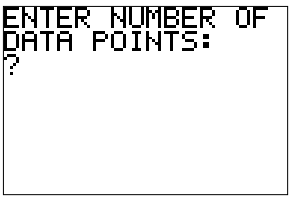
TI Lab 6: Approximating Integrals with Sums II

IN THIS LAB, YOU WILL: USE PROGRAMS TO APPROXIMATE A DEFINITE INTEGRAL IN VARIOUS WAYS

1. The program `RIEMANN` allows us to estimate various rectangular approximations and a trapezoid approximation to a definite integral, if we know what the function is. Often, we are simply given a table of data and asked to estimate the value of the definite integral of the function represented by the table. The `RIEMANN` program does not allow the function to be defined by a table. Luckily, you have another program that does just that, using trapezoids: `TRAPDATA`.





To use `TRAPDATA`, you must first enter the x- and y-values in `L1` and `L2`, respectively. Then the program prompts you for the number of data points and returns the trapezoid rule approximation.

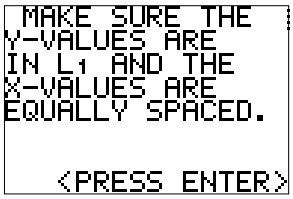
a) In an experiment, oxygen was produced at a continuous rate. The rate of oxygen produced was measured each minute and the results are given in the table below. Use `TRAPDATA` to estimate the total amount of oxygen produced in 6 minutes.

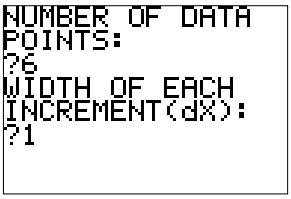
minutes	0	1	2	3	4	5	6
oxygen (ft^3/min)	0	1.4	1.8	2.2	3.0	4.2	3.6

b) All the information given about the continuous function f is found in the table below. Estimate the area of the region below the graph of f and above the x-axis over the interval $[1, 2]$.

x	1	1.2	1.4	1.6	1.8	2
$f(x)$	7.3	6.8	4.9	5.4	6.0	5.8

2. The program `SIMPDAT` also approximates the value of a definite integral of a function defined by a table. This program, however, uses Simpson's Rule.





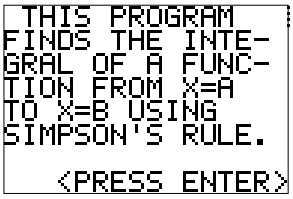
`SIMPDAT` is not as user friendly as `TRAPDAT`. You can only use this program if the x-values are equally spaced (in other words, if the change in each x-value is the same) and there are an even number of sub-intervals. Since the x-values are equally spaced, there is no need to enter the x-values—you are prompted for the number of data points and the width of each subinterval (how far apart the x-values are spaced). Note that the y-values go in `L1`.

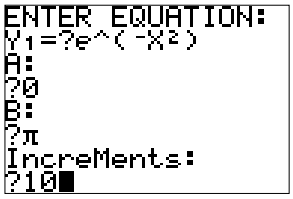
a) Repeat problem 1 part (a) using `SIMPDAT`.

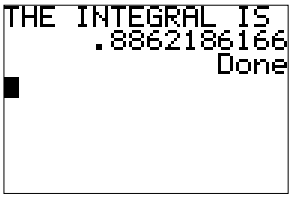
b) Compare your answers. Which is more accurate: the answer given by the trapezoid rule or by Simpson's Rule?

c) Repeat problem 1 part (b) using SIMPDAT. Why is the answer such an underestimate compared to using the trapezoid rule?

3. Finally, the program SIMPEQ approximates a definite integral of a function if the equation is known! The only qualification is that there must be an even number of subintervals.







a) Run SIMPEQ and enter the function $x^3 - 10x^2 + 26x$. Estimate the definite integral over $[0, 7]$ using 6 increments.

b) Repeat part (a) with 12 increments.

c) Using Simpson's Rule, estimate the value of $\int_{0.32}^{\pi} \sin(1/x)\, dx$ to three decimal places.