

# CleanUp-83 rev2

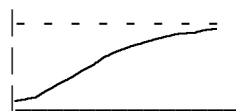
Materials needed: A large box of styrofoam packing peanuts with orange dots on about 20% of them.  
**TI-83** calculator                      A watch that displays seconds.

In an activity presented earlier in this course you encountered the concept of data transformation as it was used to construct a rational function with the use of a linear regression tool. (Gosh, what a wonderful topic of conversation at your next party!) The problem concerned the search for persons who had contracted a virus. A rational function (specifically, a hyperbolic function) was chosen for the model since the longer you searched for people, the fewer you found per day. The total accumulated number of people you found leveled off at a horizontal asymptote. A hyperbolic function has an asymptote, so it was a reasonable choice for a model of a clean up or search.

The TI-83 calculator has a very powerful regression tool available as a simple menu selection. It computes the best fitting "logistic function" for a set of data pairs. The logistic function is formed by composition of an exponential function and a hyperbolic function. It has this form:

$$y = \frac{c}{1 + ae^{-bx}},$$

and this shape:



Note that it, too, has a horizontal asymptote. In addition, it has three "parameters" (a, b, and c) whereas the hyperbola we got from a linear regression tool had only two parameters ( a and b, the slope and intercept of the corresponding line). The additional flexibility offered by the third parameter makes the logistic regression tool quite powerful for modeling phenomena characterized by constrained growth - like a clean up. Let's revisit an old problem:

You are given a box with packing peanuts in it. Each peanut represents one hundred persons in a large community. Many members of the community have contracted the deadly "tiger virus", a condition that can be recognized by a patch of orange on top of the head. The Center for Disease Control has determined that a large team of experts can be hired for \$50,000/day to seek out these individuals, and quarantine them in Williams-Brice Stadium where medication may be administered in the absence of other viruses of the same family. They will fund the community with a grant to find 99% of the ill citizens if you, as mayor, will determine what that cost will be. ...

As before, we simulate the search process with the box of packing peanuts. The box represents our community, and, as stated previously, each peanut represents 100 people. A day's search is represented by a *twenty second* search through the contents of the box, removing those

found with the virus. Repeat the process for six or seven days, shaking or stirring the box after each twenty second search. DO NOT replace the infected peanuts after each day's search. Work as a team or in pairs to gather data for the table below.

Day	# Contaminated Peanuts removed	Cumulative # Peanuts removed	Ordered Pairs for Graphing and for Analysis
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
7	_____	_____	_____

Note that, this time, your ordered pairs for graphing and your ordered pairs for analysis are the same - no data transformation is needed thanks to your TI-83. Perform the regression to the logistic function (selection B in the STAT CALC menu of your TI-83) and record your answers here:

1. Parameters: a = \_\_\_\_\_ b = \_\_\_\_\_ c = \_\_\_\_\_

2. Write the MODEL:  $Y =$  \_\_\_\_\_ Here X represents \_\_\_\_\_  
 \_\_\_\_\_ and Y represents \_\_\_\_\_  
 \_\_\_\_\_

3. What does the model predict to be the total number of infected citizens in the community?  
Answer in hundreds of people.

Tell how you got this answer: \_\_\_\_\_

4. Now use this model to solve for the number of days it will take to find 99% of the infected citizens. Show your work or describe how you got this answer from the calculator model:

5. Finally, **write a request to the CDC specifying how much money you will need.** The request must include a description of the logical and mathematical processes you used to arrive at your answer. Remember that if you ask for too much, you may lose credibility with the CDC and jeopardize your status as mayor. If you ask for too little, your community will have to pay more of the total bill. **Use a word processor such as Word or WordPerfect.** Attach your request to this completed handout.