Rule Time:

Salute to Sports!

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1. Record the number of people who have had the flu after each iteration in the table below. Continue until you have completed four iterations.

Iteration (Periods)	*Number of People who have had the flu*
1	
2	
3	
4	

2. What do you notice about the differences in the number of people who have had the flu from one period to the next? Is there a common difference?

3. Enter the data from the table into a calculator as L_1 and L_2.

4. Turn on STAT PLOT and graph a scatterplot of the data using an appropriate viewing window. Connect the points to draw a smooth curve on the grid below. Note the shape of the curve.

5. Describe the overall shape of the curve. Include in your description the intervals (and their units) on the horizontal axis where the graph:
   a. shows the flu beginning to spread through the population.

   b. shows the greatest increase in the rate of spread through the population.

6. Why do you think the graph is shaped the way it is? In other words, explain how the graph models the problem.

7. Fit a curve to the data by using your calculator and the **ExpReg** key on your calculator. What is the function that best fits the data using an exponential regression?

f(x) = _____

8. Using f(x) above, predict how many people will get the flu:
   a. by period 2 (f(2)). _____
   b. by period 10 (f(10)). _____
   c. if x (the # of periods) is allowed to increase indefinitely.
      _____

9. Using your model, determine how much time (periods) has elapsed when 200 people have had the flu.

10. Explain what “Solve f (x) = 100” means in the context of this problem.

11. How would question #9 be written mathematically? _____

12. Do you think that this model is an accurate portrayal of what would really occur in a real setting? Explain why or why not.

13. Sketch what you think a more accurate representation of the data would look like on the grid below. Label the axes and number them with realistic values.

14. Continue the table you constructed in step 1 until all students in your class have the flu. Fill in the table below.

Iteration(Periods)	***Number of People who have had the flu***
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

15. Enter the data from the table into a calculator as L_1 and L_2

16. Turn on STAT PLOT and graph a scatterplot of the data using an appropriate viewing window. Connect the points to draw a smooth curve. Note the shape of the curve and consider how it is different than the curve in problem 6.

17. Describe the overall shape of the curve in writing. Include in your description the intervals (and their units) on the horizontal axis where the graph:

    a. shows the flu beginning to spread through the population.

    b. shows the greatest increase in the rate of spread through the population.

    c. shows that the rate of spread seems to be slowing down.

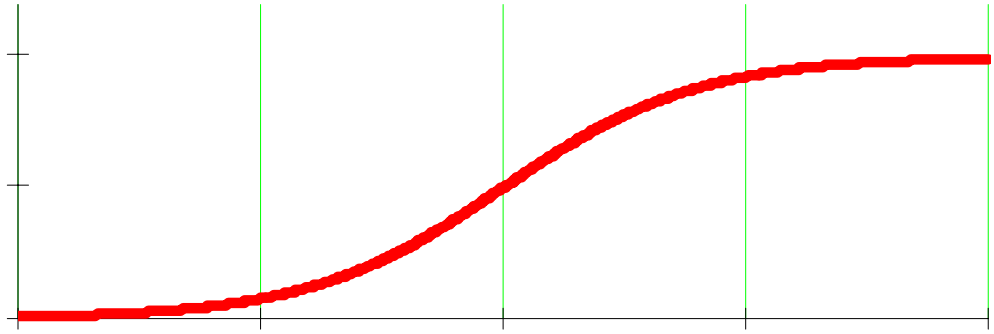
    d. shows that everyone appears to have had the flu.

18. What do you think happened that caused the graph to change shape from one interval to the next?

19. Explain what incorrect mathematical assumption Coach Lombardi might have been making in order to cause him to err in his prediction of how many of his players would have the flu by gametime. Why does Hal not think the situation is as bad as it seems?

This activity illustrates that growth throughout a population can be subdivided into several different stages only one of which is exponential. The initial-growth stage has a small increase in numbers. Then, once the flu has gotten out to a larger number of people, the number of people infected by the virus grows very rapidly. This growth produces a doubling effect that can be visualized using a graph. This is what is known as exponential growth. The next stage is a dampening of the growth due to such limiting factors as when the chances of contact being made between noninfected and infected persons becomes smaller or when people start getting vaccinated. Finally, a stage of equilibrium is reached when the virus can no longer infect anyone new. The graph is interpreted as having four distinct stages, or intervals:

1. *The initial-growth stage*
2. *The exponential-growth stage*
3. *The dampened-growth stage*
4. *The equilibrium-growth stage*



A representation of this scenario is given mathematically by an equation of the form:

$$y = \frac{c}{1 + ae^{-bx}}$$ *where a, b, and c are constants.*

The graph of an equation of this type is called a ***logistic*** *curve.*

20. Fit a curve to the new data (#14 above) by using your calculator and the Logistic key on your calculator. What is the function (h(x)) that best fits the data using logistic regression?

h(x)=_____

21. ***Using the equation for h(x) above***, predict how many people would get the flu if it was able to run its course (go until it can't anymore).

22. How does the answer to #21 relate to the function h(x)? What can be said about ***c*** in the general logistic equation?

23. Check the estimate made in problem #17 c. by using the graph of this function and the TRACE key.

24 a. What would h(3) mean in this particular setting?

b. What would h(4.5) mean in this particular setting?

c. What would $h^{-1}(38)$ mean in this particular setting?

d. What would $\frac{h(3)-h(1)}{3-1}$ mean in this particular setting?

25. Write in a complete sentence what h(x) = 28 means in this problem.

C. Go back to the video, "Rule Time: A Salute to Sports" to see how the Mustang football team did in the State Championship game!