Student: ___________________________ Class: ___________________ Date:_____________

Using Functions in Models and Decision Making: Regression in Linear and Nonlinear Functions

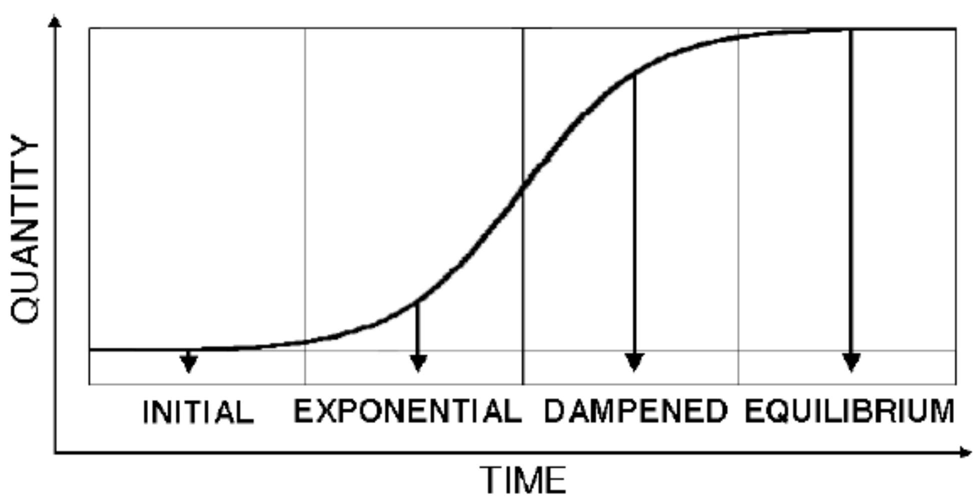
V.A Student Activity Sheet 3: Growth Model

H1N1—two letters and two numbers—are memorable as the most recent and perhaps greatest public health concern of this decade. The outbreak of this strain of influenza as most similar outbreaks can be simulated using mathematical techniques and models you are familiar with.

The simulation in this activity may create duplications or repetitions. For example, two people may both infect the same person. What are other possibilities of duplications or repetitions in a random number generating based simulation?

These duplications and repetitions are a desired aspect of the simulation because they signal the change from one stage of the simulation to the next stage.

The four stages of are labeled in the following graph. Remember the scenario you are considering here—the spread of the flu virus.



Intervals showing four stages of growth

1. What is happening with the spread of the flu virus in the graph?

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2. Use the following simulation procedure to complete the table on the next page. This simulates the introduction of the flu virus to a closed environment or population by means of a single infected individual.

Imagine a total population of 100 individuals. Each number from 0-99 in the Hundreds Chart represents an individual, with the number 0 used to portray the original host. Use the Hundreds Chart to keep track of the infected individuals by crossing off their number on the list as they become infected.

Hundreds Chart

0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89
90	91	92	93	94	95	96	97	98	99

Day 1: The original host infects a person represented by a randomly generated number. Generate a random integer between and including 0 and 99 using your graphing calculator or some other random number generating tool. Mark that person in the chart.

Day 2: The two infected people from Day 1 now infect two people, so generate two random integers.

Continue to simulate the rest of the days, completing the table of data up to Day 6.

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Day	Number of initially infected people	Number of newly infected people	Total number of infected people
1	1	1	1
2	1		
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

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3. How is the number of infected people growing? What function would you use to model these data?

4. Make a scatterplot of the data from Days 1–6. Determine and record the model that best fits the data set. How do you know this model is best?

5. What are the independent and dependent variables in this model?

6. Graph your function rule over your scatterplot of Days 1-6 data. How well does the function rule fit your data?

7. Use your regression equation to predict the number of infected persons by Day 10. What conclusions can you draw from the data and predictions to this point?

8. Add Days 7-9 to the table of simulated data.

9. **REFLECTION:** What do you expect to occur as additional days are simulated? Why do expect this?

10. Complete the table, recording your simulations through Day 15.

11. Make a scatterplot of the day related to the total number of people infected with the flu virus.

12. You should recognize this graph from your work in the previous unit as the *logistic* graph. Use the regression capabilities of your graphing calculator to determine the function rule that best fits this data. Then graph this function rule over the scatterplot.

13. How well does the function rule fit the data?

14. **EXTENSION:** The graph of the *logistic function* displays *asymptotic behavior*. Investigate the meaning of an *asymptote* and describe why this graph in fact demonstrates this behavior. Describe another scenario where the data and resulting graph are similar to this type of graph and behavior.