CHAPTER 5 PROJECT

Those Pesky Mosquitos

According to the Center for Disease Control and Prevention, the Zika virus is a disease "spread to people primarily through the bite of an infected Aedes species mosquito." Although the virus was first discovered in 1947, the first human case wasn't documented until 1952. Since then, outbreaks have been reported in Africa, Southeast Asia, and the Pacific Islands. So far, 86 countries and territories worldwide have reported evidence of mosquito-transmitted Zika infection. One of the latest epidemics of the Zika virus occurred between 2013 and early 2014, on a cluster of islands in the South Pacific called French Polynesia. Let's have a look at how fast it spread.

1. Based on what you've heard or know about viruses and your knowledge about functions, what type of growth do you think usually describes epidemics—exponential, polynomial, logarithmic, or linear? Explain your reasons for your choice.

2. The following table contains data of the weekly number of suspected Zika cases in French Polynesia in 2013 during the first four weeks of the outbreak. Plot the data on a graph.

Week #	New Cases	Cumulative Cases
1	49	49
2	191	240
3	369	609
4	331	940
5	333	1273

3. Here are five different functional models that might represent the growth of the number of Zika cases,where x represents the week number and y represents the number of cumulative cases.

1. Linear $y = 258.74x$
2. Logarithmic $y = 937.37\ln(x) - 202.03$
3. Quadratic $y = 31.357x^2 + 134.93x - 122$
4. Power $y = 55.278x^{2.0101}$
5. Exponential $y = 47.399e^{(0.6737x)}$

For each function model listed, create a graph for $1 \le x \le 5$, along with the Zika case data from part 2. Be sure your graphs clearly label the function and the actual data.

4. Which of the graphs in part 3 do you think best models the Zika data? Why?

5. On the graphs from part 3, extend the graphs by plotting the functions for $6 \le x \le 10$.

6. Which of these functions do you think will best model the growth of the number of Zika cases over weeks 6 through 10? Is it the same function as you choose in part 4? If not, what caused you to change your decision?

7. The following table contains the actual data for the spread of the Zika virus during weeks 6 through 10 of the epidemic.

Week #	New Cases	Cumulative Cases
6	571	1844
7	742	2586
8	955	3541
9	1029	4570
10	883	5453

Plot the actual data for weeks 6 through 10 on each of the function graphs. Is the function you chose in Step 6 still the best model for growth over weeks 1 through 10? Why or why not?

8. The following table contains the data for weeks 11 through 20. Plot the Zika data for weeks 1 through 20 on each of the function graphs. Discuss when each function ceases to be a good model for the data and why that might be.

Week #	New Cases	Cumulative Cases
11	682	6135
12	512	6647
13	412	7059
14	381	7440
15	343	7783
16	256	8039
17	247	8286
18	142	8428
19	82	8510
20	17	8581

Ioos S, Mallet HP, Leparc Goffart I, Gauthier V, Cardoso T, Herida M. "Current Zika virus epidemiology and recent epidemics."

Med Mal Infect (July 2014): 44(7):302-7 doi: 10.1016/j.medmal.2014.04.008. Epub 2014 Jul 4.

9. The population of French Polynesia at the time of the outbreak was about 270,000. The population of the United States in 2016 is approximately 322,762,000. How could you modify your function to model a potential spread of the Zika virus over the United States?

10. Discuss if it is reasonable to use your modified Zika function model for French Polynesia as a model for the United States.