

M204: Exponential and Logarithmic Functions and Equations

Post-Badge Task

Reflecting on Badge Learning

Now that you have learned more about exponential and logarithmic functions and equations, respond to the questions that follow. These are the same questions you responded to before the start of this badge.



The Task

QUESTION 1: Nobody likes a pest! The National Invasive Species Information Center reports that more than 6,500 invasive species are in the United States.

- Research an invasive species in your state or region.
- Share a few interesting findings about this invasive species.
- What could happen to your state or area because of this species? Why is this important?



Answers will vary.

I looked at invasive species in California using this website:
<https://wildlife.ca.gov/Conservation/Invasives/Species>.

I looked at the Golden Mussel and learned that it has been found in the northern California area in the San Luis Reservoir.

The mussel is native to China, Thailand, Laos, Korea, Vietnam, Indonesia, and Cambodia.

A high population of Golden mussels would increase the competition for food (plant and animal) that species native to that area depend on. These mussels also form “dense” colonies which would impact the flow of water- wherever they make their home.

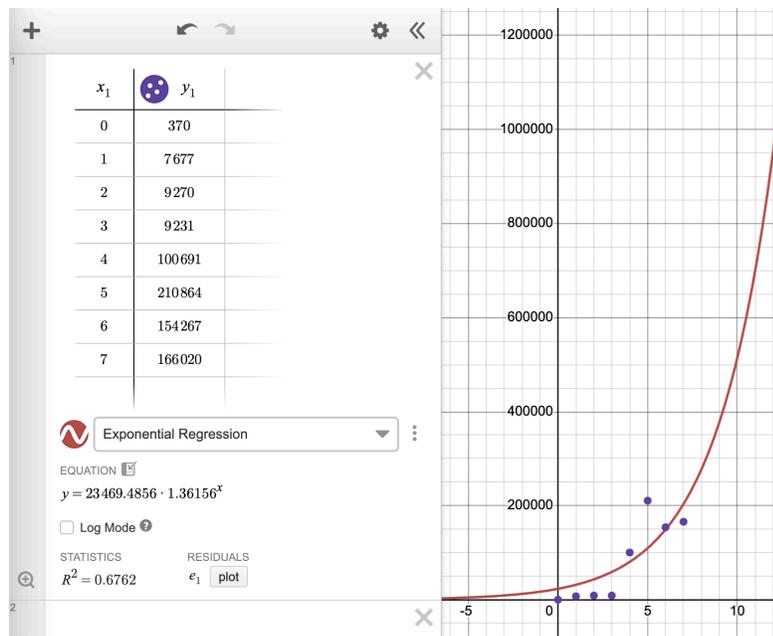
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QUESTION 2 The spotted lanternfly was first detected in the United States in 2014 in Berks County, Pennsylvania. This insect is an invasive species native to Asia. It has since rapidly spread across the United States. The spotted lanternfly has very few natural enemies and is able to feed on many plants. In 2014, the recorded spotted lanternfly population was 370. Since then, data has been collected for 8 years across 25 states.

- What do you **notice and wonder** about the data in the table? What information in the text above supports what you noticed in the table?
- What do the **x** and **y** variables in the table mean?
- Use **Technology** to find an exponential function that best fits the data in the table.
- How do you see growth happening across the table, graph, and equation? Explain any patterns or connections you see.
- Use technology to explore other possible best fit graphs and equations. Which do you feel is the best model for this data? Why?



x_1	 y_1
0	370
1	7677
2	9270
3	9231
4	100691
5	210864
6	154267
7	166020



- I notice the numbers in the right column go up...slow at first then there's a big jump, but then they come down a little. I wonder what those numbers represent...is it how much the spotted lanternfly eats or something else? Because the text says the population in 2014 was 370, this tells me those numbers represent the population. And because this species has no natural enemies, this tells me the population can grow really fast.
- The x represents the years after 2014 and y represents the spotted lanternfly's population.
- Answers will vary. Sample response is illustrated above.*
- Answers will vary. Sample response:* In the table and purple dots in the graph, you can see the population starts small then jumps up high fast. This matches how an exponential function behaves, which is why the equation is an exponential function. In the equation, we see the growth rate is 36% per year.
- Answers will vary. Sample response:* I used Desmos (<https://www.desmos.com/calculator/keymwqnfob>) to create a linear and quadratic model for this data. In looking at the graphs, between these two, the

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quadratic function fit best- it starts slow then goes up fast. Between the quadratic and exponential functions, I think I would go with the exponential because it stays above the x-axis. The quadratic model goes into the negatives- which doesn't make sense because we're talking about the population of an insect.

QUESTION 3 An invasive species is harmful when its population grows enough to hurt the local environment.

- What number of spotted lanternflies do you think would be dangerous? Explain why you picked that number.
- Using the model from the previous question, how many years would it take for the population to reach this dangerous number?



Answers will vary.

- I think 1,000,000 spotted lanternflies would be dangerous. That feels like a large number, that then would grow to about 1,360,000 in just one year. That feels out of control.
- $1,000,000 = 23469(1.36)^x \rightarrow$ I used the graph for this and got $x = 12.15698$ years. Which means it would be $2014 + 12 = 2026$.

QUESTION 4 Using your best fit model, what would the spotted lanternfly population be in 2021 if it kept growing without stopping?

- How does this number compare to the real population in 2021?
- Why might the numbers from the table in Question 2 and your model be different?



- In 2021, $x = 7$. Based on the graph, $y = 203595.9651$. The actual number is 166,020. The graph gives a larger estimate than reality.
- I think this happens because in the table we see that the population goes up, then down, then up again. The graph of the equation only shows an increasing relationship. Which means there are times when the graph doesn't match the real data exactly.

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QUESTION 5 Research ways people have tried to control the spotted lanternfly population.

- A. What methods were used to stop or slow down the spread of the spotted lanternfly?
- B. Look at the table from Question 2. When can you see these control methods being used or not used?



- A. *Answers will vary. Students may access a variety of websites that indicate various approaches to controlling this population of lanternflies. Based on this website: <https://www.fws.gov/story/stopping-spotted-lanternfly-its-tracks>, people in that area were asked to look for spotted lanternfly eggs and young flies in trees and surrounding areas and to destroy them.*
- B. *Based on the table, it looks like the population control efforts took place at $x=6$ (2020), that is the first year where the spotted lanternfly population dropped significantly.*

QUESTION 6 What else did you learn that was not reflected in Questions 1-5?



Answers will vary.

QUESTION 7 Compare your answers to these questions now to your answers from the earlier attempt. What do you notice about your progress?



Answers will vary. Look for students to explain what they know now compared to what they knew when responding to the pre-test.

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Sources

<https://neobiota.pensoft.net/article/101471/>

<https://www.fws.gov/story/stopping-spotted-lanternfly-its-tracks>

<https://www.aphis.usda.gov/plant-pests-diseases/slf>

<https://www.sciencedirect.com/science/article/abs/pii/S0025556421000985#:~:text=%E2%80%A2,be%20found%20in%20the%20literature.>

<https://neobiota.pensoft.net/article/101471/>