Investigating Exponential Growth

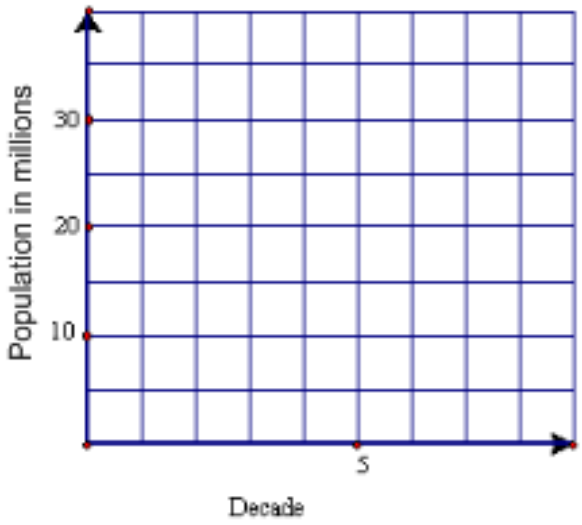
The Constitution of the United States requires that a census be taken every ten years. The table below contains data from the first U.S. census done in 1790 and data from each census for the next seven decades.

Census year	Decade	Population (millions)
1790	0	3.93
1800	1	5.31
1810		7.24
1820		9.64
1830		12.86
1840		17.06
1850		23.19
1860		31.44

STEP 1 Organize data

Make a list of ordered pairs where the independent variable is the number of decades after 1790 and the dependent variable is the corresponding population in millions. For example, your first ordered pair will be (0, 3.93).

STEP 2 Graph data Plot the ordered pairs on the graph below. Do not connect the points.



1. In each decade, does the U.S. population *increase* or *decrease*?

To find the ***proportional growth factor***, **divide the current population by the previous population.** Give each answer to the nearest hundredth.

To find the ***actual growth*****, subtract the previous population from the current population**. Give each answer to the nearest hundredth.

To find the ***percent growth*****, subtract 1.00 from the proportional growth factor, then write this decimal as a percent.**

Census year	Decade	Population (millions)	Proportional growth factor	Actual growth	Percent growth
1790	0	3.93	----------	----------	----------
1800	1	5.31			
1810	2	7.24			
1820	3	9.64			
1830	4	12.86			
1840	5	17.06			
1850	6	23.19			
1860	7	31.44			

5. What do you observe about the proportional growth factors for the decades from 1790 to 1860?

6. What do you observe about the actual growth for the decades from 1790 to 1860?

7. What are the units of actual growth?

8. Use your answer to Exercise 5 to explain the shape of the graph in Step 2.

9. Use your calculator to find the average proportional growth factor.

10. The following equation can be used to predict population values: Population = initial population • average growth factor ^{x}, when x is the number of decades.

Use the starting population at decade 0 and the average growth factor that you found in #9 above to write an equation to model this population.

Population = _____ • _____ ^{x}

11. Input this equation into your calculator. Using the table feature of your calculator, complete the table below.

Decade	0							
Pop.	3.93							

12. Plot the points on the graph on page 1. Connect with a smooth curve.

13. Use the equation to predict the population in the year 2020.