F-LE In the Billions and Exponential Modeling
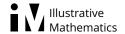
Task

The data in the table below was taken from Wikipedia.

Year	World Population in Billions (Estimate)
1804	1
1927	2
1960	3
1974	4
1987	5
1999	6
2012	7

a. For each span of years in the table below, assume that the relationship between the population, P, and the number of years since the beginning of the time period, t, is exponential and then determine the annual rate of growth r for that range of years.

For example, for the range of years 1804 through 1927, we have $P(t) = 1,000,000,000 \cdot b^t$, assumine an an exponential relationship. Since 1927 is 123 years after 1804, the population in 1927 can be expressed as $P(123)$ and we have

$$P(123) = 1,000,000,000 \cdot b^{123} = 2,000,000,000.$$

This means

$$b = \sqrt[123]{2} \approx 1.006$$

or that the population grew at a rate of approximately $1.006 - 1 = 0.006$ or 0.6% for each year between 1804 and 1927.

Span of Years	Approximate Annual World Population Growth Rate r
1804 - 1927	0.6%
1927 - 1960	
1960 - 1974	
1974 - 1987	
1987 - 1999	
1999 - 2012	

b. How many times bigger is the growth rate from 1927 to 1960 than the growth rate from 1804 to 1927?

c. Based on your answers to parts (a) and (b) would an exponential function be appropriate to model the relationship between the world population and the year? Explain why or why not.

d. Brainstorm some possible explanations for the overall behavior of the growth rates in part (a).