

Exponential Growth (aka Geometric Progression)

Geometric progression refers to a progression of numbers where the next number in the progression is a fixed function of the previous number. For instance, in a doubling progression, the second number is twice the first, the third is twice the second, the fourth is twice the third, and so on. Describing such a progression mathematically involves exponents, and thus, it is known as exponential growth.

The precise mathematics are not important for our purposes, but the power of exponential growth is. The nature of the progression is such that between each generation, growth occurs more quickly. In a doubling progression that starts at 1, the difference between the first and second generation is 1. The difference between the fourth and fifth generations is 8. The difference between the eighth and ninth generations is 128, and the difference between the sixteenth and seventeenth generations is 32,768.

Population is not a doubling progression. I will build a theoretical progression that is more like population growth. Imagine that you start in year 0 with 10 infant individuals. After 20 years (which they magically survive without parents), they pair-off into couples and have one child. From that point forward, they continue to have one child every 20 years. Their children live 20 years from the time that they are born, and then they pair off and have a child. And they continue to have one child every 20 years. And the grandchildren live to 20, pair off, and start having one child every 20 years, and so on with each succeeding generation. This progression starts slowly. After 100 years, the population will have grown from 10 to 76. After 200 years, it will have grown to 576. In 300 years in will be 4,379. But after 800 years it will be 110,573,323. After 900 years it will be 839,666,173. In the first 100 years, growth will be only 66 people. But in the last 100 years it will be some 729 million. This is the power of exponential growth.

Now, this example is not true to life. Nobody dies in this example. They live forever and keep procreating. To be realistic, the example would have to take death rates into account. This would lower the rate of growth. On the other hand, people have historically had more than one child every 20 years. This would accelerate growth.

Estimates of world population throughout history suggest that population was roughly constant from the time of the ancient Greeks until the time of Shakespeare. After that it grew a bit more quickly, and it exploded after 1800.ⁱ The principle reason is that for most of history, death rates matched birth rates, and there were no increases at all. However, 1600 marked the opening of the Scientific Age and the Industrial Revolution, leading to improved food availability. Fewer people starved, and fewer were susceptible to disease due to malnutrition. At the same time, public health measures were being invented, such as safe drinking water, sewers, and pasteurization. These two factors drove the death rate down, but the birth rate stayed high, releasing the power of exponential growth. Population exploded.ⁱⁱ

ⁱ U.S. Census Bureau, International Programs Center, www.census.gov/ipc/www/worldhis.html.

ⁱⁱ An extensively referenced review of overpopulation is available at: *Overpopulation*. Wikipedia:
<http://en.wikipedia.org/wiki/Overpopulation>.