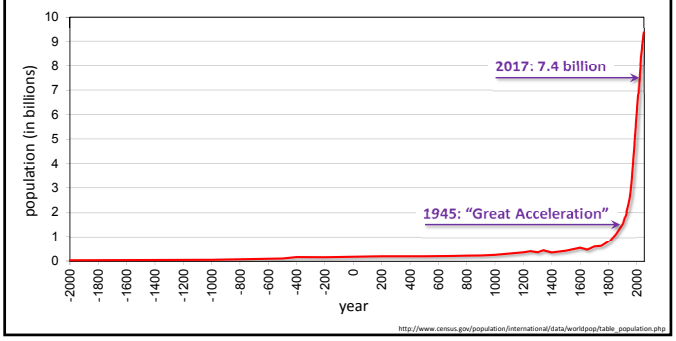
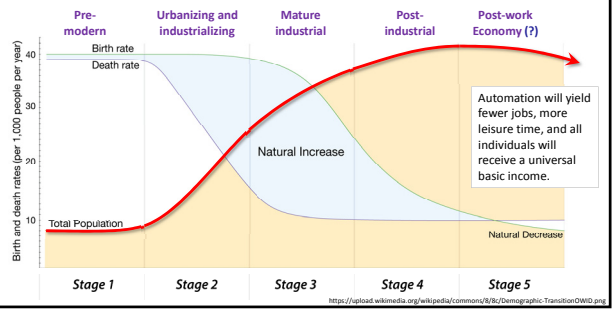
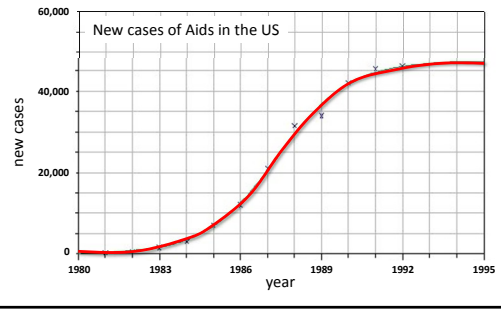
Rapid growth in the number of people on Earth is unabated.



The Demographic Transition Model represents one way to describe the evolution of societies.



Sigmoidal curves, S-curves, have an inversion point.



A reminder about percent, fractions, and decimals…

10% = 0.1

1% = 0.01

1/10% = 0.1% = 0.001

1/10% = 0.1% = 0.001 = 1‰

Note: always put a zero (or a number) in front of a decimal point, and always use a space before the units (except for most symbols).

A reminder about the distributive law…

1. **Yank out what is common between the pluses (+) and minuses (-).**
2. **Put it in front of the parentheses.**
3. **Put what is left inside the parentheses.**

Discrete Compounding

$$N_t = N_0(1+\lambda)^t$$

N_0 = initial amount
λ = rate of natural increase
t = time interval

Discrete Compounding

$$N_t = N_0(1+\lambda/m)^{mt}$$

N_0 = initial amount
λ = rate of natural increase
t = time interval
m = number of compounding events during one time interval

Continuous Compounding

$$N_t = N_0 e^{\lambda t}$$

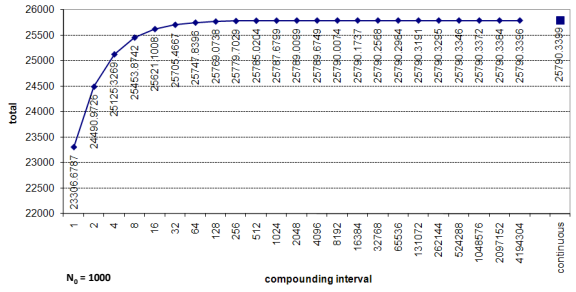
N_0 = initial amount
e = the natural log
λ = rate of natural increase
t = time interval

Calculus introduces the concepts of limits…

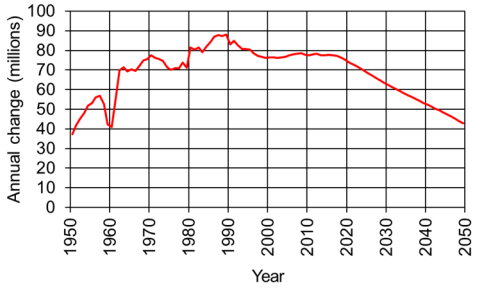
As the number of compounding events increases, the compounding interval becomes infinitesimally small, and the function becomes continuous; this is calculus.

spreadsheet: limits

An example of the relationship between compounding interval and total value after 50 years of growth at 6.5%.

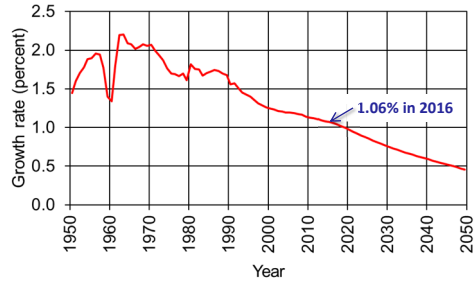


Annual world population change: 1950 to 2050.



Aug 2016 https://www.census.gov/population/international/data/idb/worldpopchggraph.php

Annual world population growth rates: 1950 to 2050.



Aug 2016 https://www.census.gov/population/international/data/idb/worldpopchggraph.php