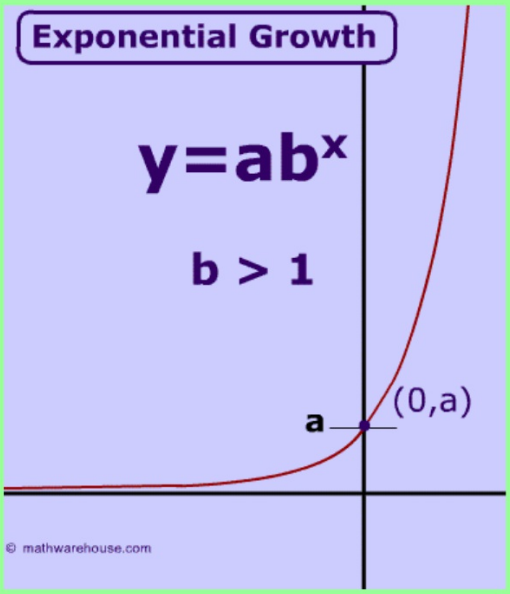
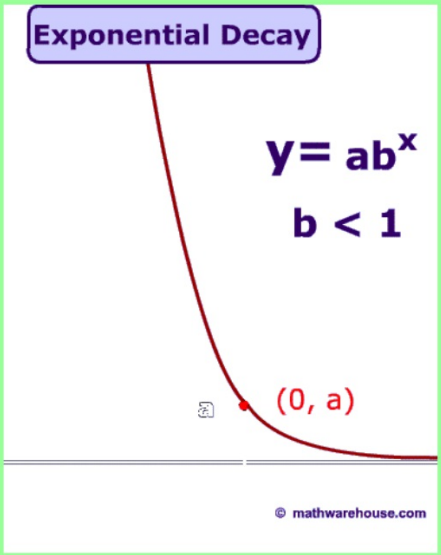
Exponential Growth and Decay





Exponential Growth

Occurs when a quantity increasing *by the same rate over time.*

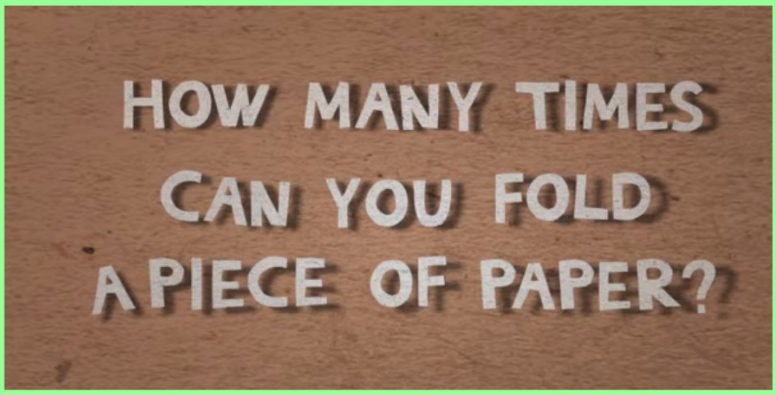
$y = a(1 + r)^t$

a = initial value

r = rate

t = time

greater than 1



Examples:

1. The original value of an investment is $1400, and the value increases by 9% each year. Write an exponential growth function to model this situation. Then, find the value of the investment after 25 years.

Step 1: Identify a, r, and t.

A =

R (percents to decimals) =

T =

$y = 1400(1+.09)^t$

$y = 1400(1.09)^t$

Step 2: Plug values into formula-- $y=a(1 + r)^t$.

$y = 1400(1.09)^{25}$

Step 3: Solve for y.

$\$12,072.31$

YR. 1 1400

YR. 2 1526 +126

YR. 3 1663.34 +137.34

The cost of tuition at a college is $12,000 and is increasing at a rate of 6% each year. Write an exponential growth function to model this situation. Then, find the tuition cost after 4 years.

Step 1: Identify a, r, and t.

A =

R (percents to decimals) =

T =

$y = 12000(1+.06)^t$

$y = 12000(1.06)^t$

Step 2: Plug values into formula-- $y=a(1 + r)^t$.

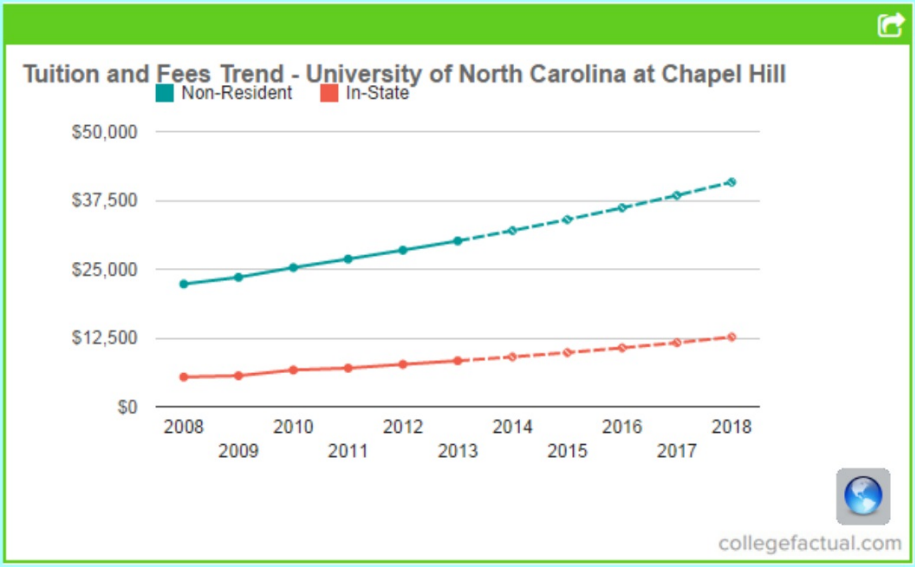
$y = 12000(1.06)^4$

Step 3: Solve for y.

$y = \$15,149.72$

Real World Model

The cost to attend the University of North Carolina at Chapel Hill increases on average 6.5% per year.



Costs from 2008 - 2018

3. The number of student athletes at a local high school is 300 and is increasing at a rate of 8% per year. Write an exponential growth function to model this situation. Then, find the number of student athletes after 5 years.

Step 1: Identify a, r, and t.

A =

R (percents to decimals) =

T =

$y = 300(1+.08)^t$

$y = 300(1.08)^5$

Step 2: Plug values into formula-- $y=a(1 + r)^t$.

$y = 300(1.08)^5$

Step 3: Solve for y.

$y = 440.8$

≈ 441 people

Exponential Decay

Occurs when a quantity _____ by the same rate over time.

$y = a(1 - r)^t$

a = _____

r = _____

t = _____

Key Words:
Decreasing, depreciates, loses

less than 1

7. The population of a town is decreasing at a rate of 1% per year. In 2000 there were 1300 people. Write an exponential decay function to model this situation. Then, find the population in 2008.

Step 1: Identify a, r, and t.

A =

R (percents to decimals) =

T =

$y = 1300(1 - .01)^t$

$y = 1300(.99)^t$

Step 2: Plug values into formula-- $y = a(1 - r)^t$.

$y = 1300(.99)^8$

Step 3: Solve for y.

$y = 1,200$ people

8. The value of a car is $18,000 and depreciating at a rate of 12% per year. Write an exponential decay function to model this situation. Then, find the value of the car after 10 years.

Step 1: Identify a, r, and t.

A =

R (percents to decimals) =

T =

$$y = 18000(1-.12)^t$$
$$y = 18000(.88)^t$$

Step 2: Plug values into formula-- $y=a(1 - r)^t$.

$$y = 18000(.88)^{10}$$
$$y = \$5,013.02$$

Step 3: Solve for y.

9. A farmer buys a tractor for $50,000. If the tractor depreciates 10% per year, write an exponential decay function to find the value of the tractor in 7 years.

Step 1: Identify a, r, and t.

A =

R (percents to decimals) =

T =

Step 2: Plug values into formula-- $y=a(1 - r)^t$.

Step 3: Solve for y.

Label each exponential function model as growth or decay and identify the rate (%).

1.) $y = 200(1.05)^5$ growth; 5% = r

2.) $y = 4(0.85)^{12}$ decay, r = 15%

$.85 + X = 1$

3.) $y = 1200(1.085)^{120}$ growth, r = 8.5%

4.) $y = 36(0.91)^7$

5.) $y = -2(1.09)^{24}$

Given $f(x) = 0.60\,(0.75)^x$, identify the growth/decay factor, growth/decay rate, and the initial value.

Growth/(Decay) Factor: 0.75

Growth/Decay (Rate): 25%

Initial Value: 0.60

Given $f(x) = 250\,(1.07)^x$, identify the growth/decay factor, growth/decay rate, and the initial value.

Growth/Decay Factor:_____

Growth/Decay Rate:_____

Initial Value:_____