Section 11-3 Exponential Growth and Decay

EQ: How are exponential functions applied to real life situations?

remember ... exponential function:

$f(x) = ab^x$

$f(t) = a(1 + r)^t$ $f(t) = a(1 - r)^t$

a: original amount (a > 0)

r: rate as a decimal

t: time

y or f(t): final amount

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*Mark the text!

A sculpture is increasing in value at a rate of 8% per year, and its value in 2000 was $1200.

8%

r=.08

Write an exponential growth function to model this situation.

Keep t in the first equ.

$f(t) = 1200(1+0.08)^t$

Find the sculpture's value in 2006. t=6

Function with time substituted: $f(6) = 1200(1.08)^6$

Ending Value: $1904.25

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The population of a local stream is decreasing at a rate of 14% per year. The original population was 48,000.

r=0.14

a

Write the exponential decay function

$f(t) = 48{,}000(1-0.14)^t$

Find the population in 7 years.

t=7

Function with time substituted: $f(7) = 48{,}000(0.86)^7$

Ending Value: 16,700 fish

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Application of growth (business)

Compound interest:
Interest earned or paid on *both* the principal and previously earned interest.

$$f(t) = P\left(1 + \frac{r}{n}\right)^{nt}$$

P: Principal (original amount)

r: interest rate (as a decimal)

n: Number of times interest is compounded per year

monthly: 12 quarterly: 4 annually: 1

t: time in years

f(t): final amount

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$15,000 is invested at a rate of 4.8% compounded monthly for 2 years.

P

r=0.048 n=12 t

compound interest function:

$f(t) = 15{,}000\left(1 + \frac{0.048}{12}\right)^{12t}$

Find the balance after 2 years.

Function with time substituted: $f(2) = 15{,}000(1.004)^{24}$

Ending Value: $16,508.22

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Common application of exp. decay (chemistry)

Half-Life:
The amount of time it takes for ½ of a substance to decay.

$$f(t) = P(0.5)^{\frac{t}{h}}$$

P: original amount of substance

t: time

h: half life (given as time)

units of time must match!

f(t): final amount

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Astatine12 has a half-life of 2 seconds. Find the amount left from the same 500 gram sample of astatine after 1 ~~minute~~. 60 sec.

Function: $F(t) = 500(.5)^{\frac{t}{2}}$

Function with time substituted: $F(60) = 500(.5)^{30}$

Ending Value: $F(60) = .000000466$ grams

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Assignment:

Worksheet 11-3

1\. $F(t) = a(1+r)^t$

4\. $F(t) = a(1-r)^t$

7\. $F(t) = P(.5)^{\frac{t}{h}}$

10\. $F(t) = P\left(1+\frac{r}{n}\right)^{nt}$

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$1200 is invested at a rate of 2% compounded quarterly for 3 years.

Write the compound interest function for this situation.

Find the balance after 3 years.

The population of a town is decreasing at a rate of 3% per year. In 2000 there were 1700 people.

Write the exponential decay function

Find the population in 2012.

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Exponential growth:

☆When a quantity increases by the same rate (*r*) in each time period (*t*).

The value of the quantity at any given time can be calculated as a function of the rate and the original amount.

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An **exponential decay function** has the form

$f(t) = a(1 - r)^t$, where a > 0.

f(t) represents the final amount.

a represents the original amount.

r represents the rate of decay expressed as a decimal.

t represents time.

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An **exponential growth function** has the form

$f(t) = a(1 + r)^t$, where a > 0

y or F(t) represents the final amount.

a represents the original amount.

r represents the rate of growth expressed as a decimal

t represents time in years

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Exponential decay:

When a quantity decreases by the same rate (r) in each time period (t).

The value of the quantity at any given time can be calculated as a function of the rate and the original amount.

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What is the difference between exponential growth and exponential decay?

growth $F(t) = a(1 + r)^t$

decay $F(t) = a(1 - r)^t$

Hint...

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Astatine has a half-life of 2 seconds. Find the amount left from a 500 gram sample of astatine after 12 seconds.

Feb 27-7:46 AM

Attachments

Worksheet 11.3.doc