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NOTES: Section 8.7 – Exponential Decay Functions

Goals: #1 - I can write and graph exponential decay functions. 

Homework: Section 8.7 Worksheet

Warm Up:

1. A family purchased a condo for $80,000. Each year the value of the condo increases by 5%.
   a. Write a model that represents the value of the condo over time.

$A = P(1+r)^t$ $A = 80{,}000(1+0.05)^t$

$A = 80{,}000(1.05)^t$

   b. Find the value of the condo after 6 years.

$A = 80{,}000(1.05)^6$

$A \approx \$107{,}207.65$

2. An initial population of 1000 starfish doubles each year for 4 years.
   a. Write a model that represents the population of the starfish over time.

$y = (1+r)^t$ $y = 1000(2)^t$

   b. What is the starfish population after 4 years?

$y = 1000(2)^4$

$y = 16{,}000$ starfish

Exploration #1: Tell whether the model is an exponential growth or exponential decay.

1. $y = 17(1.09)^t$ — growth — 9%
2. $y = 5500(0.8)^t$ — decay — 20%
3. $y = 80{,}000(2)^t$ — growth — 100%

What is the growth/decay rate (%) for each?

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Notes:

Another use of exponential functions is to model exponential decay

A quantity is decreasing exponentially if it decreases by the same percent in each unit of time.

Exponential Decay can be modeld by the equation:

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

Example #1: You bought a car for $16,000. You expect the car to lose value, or depreciate, at a rate of 12% per year. Write an exponential decay model to represent this situation.

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

$C = 16{,}000$

$r = 0.12$

$y = 16{,}000(1 - 0.12)^t$

$\boxed{y = 16{,}000(0.88)^t}$

a. Using the model, predict the value of the car after 7 years.

$y = 16{,}000(0.88)^7$

$\boxed{y \approx \$6{,}538.81}$

Example #2: In Lancaster, WI the population of 100,000 people decreases by 2% each year. Write a model to represent this situation.

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

$C = 100{,}000$

$r = 0.02$

$y = 100{,}000(1 - 0.02)^t$

$\boxed{y = 100{,}000(0.98)^t}$

a. Using the model, predict how many people will live in Lancaster in 20 years.

$y = 100{,}000(0.98)^{20}$

$\boxed{y \approx 66{,}761 \text{ people}}$

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You practice:

1. A business earned $85,000 in 2000. Then its earnings decreased by 2% each year for 10 years.

   a. Write a model to represent this situation.

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

   $C = 85{,}000$

   $r = 0.02$

   $y = 85{,}000(1-0.02)^t$

   $\boxed{y = 85{,}000(0.98)^t}$

   b. Using the model, predict how much the business will have earned in 5 years.

   $y = 85{,}000(0.98)^5$

   $y \approx \boxed{\$76{,}833.27}$

2. From 1894 to 1903, the number of miles of cable car track in the United States decreased by about 11% per year. There were 302 miles of track in 1894.

   a. Write a model to represent this situation.

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

   $C = 302$

   $r = 0.11$

   $y = 302(1-0.11)^t$

   $\boxed{y = 302(0.89)^t}$

   b. Using this model, predict how many miles of track there will be in 1900.

   ↳ $t = 6$

   $y = 302(0.89)^6$

   $y \approx \boxed{150 \text{ miles}}$

Notes:

- Exponential Growth:
  - Model: $y = C(1+r)^t$
  - Key words: increasing by %, grows, doubles, triples
- Exponential Decay:
  - Model: $y = C(1-r)^t$
  - Key words: decreasing by %, depreciates, half

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Example #5: At the start of a basketball tournament consisting of six rounds, there are 64 teams. After each round, one half of the remaining teams are eliminated.

a. Write an exponential decay model.

decay factor

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

$C = 64$

decay factor: $\frac{1}{2}$

$\boxed{y = 64\left(\frac{1}{2}\right)^t}$

b. How many teams remain after 3 rounds?

$y = 64\left(\frac{1}{2}\right)^3$

$y = \boxed{8 \text{ teams}}$

c. How many teams remain after 5 rounds?

$y = 64\left(\frac{1}{2}\right)^5$

$y = \boxed{2 \text{ teams}}$

d. Graph the exponential decay of the model using a table:

t	y
0	64
1	32
2	16
3	8
5	2

$64\left(\frac{1}{2}\right)^1$

$64\left(\frac{1}{2}\right)^2$