Topics: solving exponential and logarithmic equations, applications of exponential and logarithmic functions

Student Learning Outcomes:

1. Students will be able to use exponential and logarithmic equations in applications.
2. Students will be able to construct equations from written descriptions.
3. Students will be able to identify growth vs decay.

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1 Solve Equations for a Specified Variable

1. One hundred emu, each 1 year old, are to be introduced into an emu sanctuary. The number $N(t)$ alive t years later is predicted to be $N(t) = 100(0.8)^t$.

   (a) Estimate the number alive after 5 years.

   (b) When will there be 50 emu remaining? (Round to the nearest year.)

2 Creating a Model for Growth and Decay

2. Suppose that \$15,000 is invested and at the end of 3 years, the value of the account is \$19,356.92. Use the model $A = Pe^{rt}$ to determine the average rate of return r under continuous compounding. (Round your answer to the nearest tenth of a percent.)

If you are not given a growth/decay function for your bacteria, radioactive substance, etc., assume that your function has the form $P = P_0 e^{kt}$ where the initial population is P_0, the rate of growth or decay is k, and t is time (in consistent units for the whole problem).

3. 75% of a radioactive material remains after 13 days.

   (a) Find the decay constant. (Do not round your answer.)

   (b) Find the time (in days) after the initial measurement when 15% of the original amount of radioactive material remains. (Round to the nearest whole number.)

4. If a certain bacteria population doubles in 3 hours, determine the time t (in hours) that it takes the population to triple. (Do not round your answer.)

3 Logistic Growth Models

Logistic Growth Model: A logistic growth model is a function written in the form $y = \dfrac{c}{1 + ae^{-bt}}$ where a, b, and c are positive constants.

5. The population of California $P(t)$ (in millions) can be approximated by the logistic growth function $P(t) = \dfrac{95.2}{1 + 1.8e^{-0.018t}}$, where t is the number of years since the year 2000. (Round to the nearest tenth of a year.)

   (a) Determine the population in the year 2000.

   (b) Use this function to determine the time required for the population of California to double from its value in 2000.

   (c) What is the limiting value of the population of California under this model.

Student Learning Outcomes Check

1. Can you use exponential and logarithmic equations in applications?
2. Are you able to construct equations from written descriptions?
3. Can you identify growth vs decay?

If any of your answers were no, please ask about these topics in class.