Exponential & Logarithmic Applications MATH 112
Spring 2012

1. Estimate the time it takes for an investment of \$100 to increase to \$120 if the annual interest rate is 3.2%, compounded monthly.

2. Suppose the amount of a substance decreases exponentially according to $Q(t) = 10^{3-0.2t}$ where Q is measured in grams and t is measured in years since 2004. When will there be 10^{-5} grams present?

3. You purchased a valuable painting in 1998 for \$125,000. You were told that the painting's value would double in 15 years. What is the annual appreciation rate if the value of the painting increased according to the model $V = V_0 e^{kt}$?

4. Suppose a body cools according to the equation below, where t is measured in hours after death and T is temperature of the body at that time. What is the temperature of the body 5 hours after death?

$$t = -10 \log\left(\frac{T - 75}{23}\right)$$

5. The cost of tuition at four-year public universities has been increasing roughly exponentially for the past several years. In 1997, the average cost of tuition was \$3,111. In 2004, the average cost was \$5,132. Find an equation to represent the average cost of tuition at four-year public universities as a function of time, with $t = 0$ corresponding to 1997. Use this model to estimate the average cost of tuition in the year 2007.

6. When rabbits were first brought to Australia in the last century, they multiplied very rapidly, as they had no natural predators. There were approximately 60,000 rabbits in Australia in 1865, and by 1867, there were 240,000. Assume that the number of rabbits increased exponentially.

   (a) Determine the growth rate, r, in the exponential growth model. ($A = Pe^{rt}$)

(b) How many rabbits do you predict there were in Australia in 1870?

(c) When was the first pair of rabbits introduced into the country?

7. Determine the growth rate, r, for a radioactive substance with a half-life of 10 years. What percentage of the original amount would remain radioactive after 22 years?

8. Suppose 80 ounces of a radioactive substance decays to 9 ounces in three hours. What is the half-life of the substance?

9. Atmospheric pressure is related to height above sea level according to an exponential equation where pressure is a function of the height. Suppose the pressure at 18,000 feet is half that at sea level. Determine the value r in the exponential decay model $A = Pe^{rt}$. Use this value of r to estimate the pressure at 1000 feet, as a percentage of the pressure at sea level.

10. A certain car purchased new in 1999 for \$12,000 is worth \$4,500 in 2005. Assuming that the value of the car decreased exponentially, determine an equation to model the value of the car as a function of time. Use this equation to estimate the value of the car in the year 2007.