Exponential Modelling Problems
Math 130 *Kovitz*

1. The number of bacteria in a culture is increasing according to the law of exponential growth. The initial population is 800 bacteria, and the population after 12 hours is double the population after 1 hour. How many bacteria will there be after 7 hours?

2. Assume that the population of Alaska increases exponentially and that between 1970 and 1980 it increased from 120,000 to 180,000.

   (a) Find the population for the year 1987.
   (b) Find a, the annual growth *factor*. Briefly interpret it.
   (c) By what percent is the population of Alaska increasing each year?
   (d) Find the doubling time.
   (e) In which year will the population of Alaska reach 500,000?

3. A bank account is started with $320. Suppose that it grows exponentially and that the balance after t years is given by the function
$$B(t) = 320(1.07)^t,$$
where $t = 0$ represents January 1, 2010.
Determine:

   (a) the annual percent increase.
   (b) the balance to the nearest cent on January 1, 2015.
   (c) the date on which the account will first total at least $700.
   (d) the doubling time.

4. A colony of bacteria is growing exponentially in a laboratory culture as part of an experiment.

   At time 3 hours from the start of the experiment there are 521 bacteria present in the culture, and at time 7.2 hours from the start of the experiment there are 1220 bacteria present.

   Find:

   (a) a formula giving N, the number of bacteria, as a function of time t (t being measured in hours since the start of the experiment).
   (b) the percentage increase per hour.
   (c) the number of bacteria 24 hours from the start of the experiment.
   (d) the number of hours after the start of the experiment when there will be 20,000 bacteria in the colony.
   (e) the doubling time.

5. Suppose a bacteria colony has mass of 3 grams after 5 minutes and mass of 192 grams after 47 minutes and the mass grows exponentially. Find the doubling time. Check by walk-through.

6. Suppose a bacteria colony has mass of 8 grams after 8 minutes and mass of 32 grams after 32 minutes and the mass grows exponentially. Find the doubling time.

7. Suppose an exponentially growing population of bacteria is observed to increase by 5% in two hours. How many hours does it take for the population to triple? Be sure to explain your methods.

8. The temperature T of an object at time t is $T = 180 - 170e^{-0.2t}$.

   (a) Sketch the graph of T versus t for $t \geq 0$. Show all intercepts and asymptotes and $f(1)$.
   (b) When, if ever, is   *i)* $T = 157$?   *ii)* $T = 180$?   *ii)* $T = 190$?