6.8 Exponential Growth and Decay Models

▼ Population Growth or Decay

$$P(t) = P_0 e^{kt}$$

P_0-initial population (starting population or population at t=0)

k-growth or decay rate

t-time (any unit of time but be consistent)

P-Population after time

▼ Example: Insect Population

The size P of a certain insect population at time (in days) obeys the function $P(t) = 300e^{0.05t}$

Determine the number of insects at $t = 0$ days.

What is the growth rate of the insect population?

What is the population after 10 days?

When will the insect population double?

▼ Example: Population Growth

The population of a city follows the exponential law. If the population doubled in size over 13 months and the current population is 1,234, what will the population be in 5 years from now?

▼ Law of Uninhibited Growth or Decay

A_0-initial amount

$$A(t) = A_0 e^{kt}$$

k-growth or decay rate

t-time

A-Accrued amount

▼ Example: Half-Life

The chemical element has a half-life of approximately 4 days. If 236 grams are present now, how much will be present in 60 days?

▼ Example: Half-Life

The amount of caffeine in the human body has a half life of 4.9 hours to 6 hours depending on the person. Assuming the caffeine half life for a particular person is 5.5 hours find the decay rate of caffeine and build an exponential model for the decay rate. Find the amount of caffeine left in the body 2 hours after drinking a can of monster energy drink which contains 86 milligrams of caffeine. Round your answer to three decimal places.

▼ Logistic Model

b- growth rate

$$P(t) = \frac{c}{1 + ae^{-bt}}$$

c-carrying capacity

P-population

t-time

▼ Example: Logistic Model

For the logistic growth model $P(t) = \frac{1000}{1+30.94e^{-0.369t}}$

a) What is the carrying capacity?

b) What is the growth rage of the bacteria?

c) Determine the initial population.

d) What is the population after 6 hours?

e) When will the population be 900g?

f) How long does it take for the population to reach half of the carrying capacity?