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Lesson 7.5: Logistic Equations

Exponential growth modeled by $y = Ce^{kt}$ assumes __________________ growth and is **unrealistic** for most population growth.

More typically the growth rate decreases as the population ____________________ as the population grows and there is a maximum population.

This is modeled by the ___________________ differential equation $\frac{dP}{dt} = kP(M - P)$.

The solution equation is of the form $P = \frac{M}{1+Ce^{-kMt}}$.

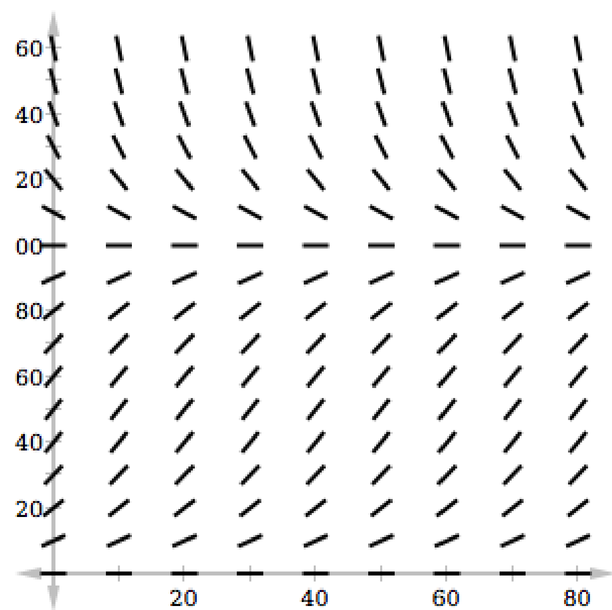
Note: Unlike in exponential growth equation, C is not the initial amount.

Example:

A national park is capable of supporting no more than 100 grizzly bears. We model the equation with a logistic differential equation with $k = 0.001$.

a. Write a differential equation.

b. The slope field for this differential equation is shown.



Where does there appear to be a horizontal asymptote?

What happens if the starting point is above the asymptote?

What happens if the starting point is below the asymptote?

c. If the park begins with ten bears, sketch a graph of $P(t)$ on the slope field.

d. Solve the differential equation to find $P(t)$ with this initial condition.

e. Instead of solving the differential equation, use the general form of a logistic equation $P = \frac{M}{1+Ce^{-kMt}}$ to find the same solution.

f. Find $\lim_{t\to\infty} P(t)$

g. When will the bear population reach 50?

h. When is the bear population growing the fastest.