

# Essentials of Calculus

## Homework 4.7

### Logistic growth

1. The number of fish in a pond in  $t$  years is given by

$$y = \frac{1000}{1 + 9e^{-0.5t}}$$

fish.

- Sketch a graph of the fish population as a function of years.
  - What is the carrying capacity of the pond?
  - What is the current fish population of the pond?
  - How many fish will be in the pond in 5 years?
2. The number of bacteria in a dish in  $t$  days is given by

$$y = \frac{100000}{1 + 99e^{-2t}}$$

fish.

- Sketch a graph of the bacteria population as a function of days.
  - What is the carrying capacity of the dish?
  - What is the current bacteria population of the dish?
  - How many bacteria will be in the dish in one day?
3. An island contains 100 rodents, which have a growth rate of 0.2/year. The island has a carrying capacity of  $M = 10000$  rodents.
- Find a formula  $P(t)$  for the rodent population in  $t$  years.
  - How many rodents will be on the island in 3 years?
4. A lake contains 200 frogs, which have a growth rate of 0.1/year.
- Assuming exponential growth, how many frogs will there be in 10 years?
  - Assume that the lake has a carrying capacity of 5000 frogs. write down a formula for the population  $P(t)$  of frogs in  $t$  years.
  - Assuming logistic growth, how many frogs will there be in 10 years?

5. A jar contains 500 bacteria, which have a growth rate of 2/month.
- Assuming exponential growth, find a formula  $P(t)$  for the number of bacteria in  $t$  months.
  - Assuming exponential growth, how many bacteria will be in the jar in 12 months?
  - Assume that the jar has a carrying capacity of 10000 bacteria. write down a formula for the population  $P(t)$  of bacteria in  $t$  months.
  - Assuming logistic growth, how many bacteria will be in the jar in 12 months?
6. A mountain range contains 50 yeti, which have a growth rate of 0.05/year.
- Assuming exponential growth, write down a formula  $P(t)$  for the yeti population in  $t$  years.
  - Assuming exponential growth, how many yeti will be in the range in 50 years?
  - Assume that the mountain range has a carrying capacity of 1000 yeti. write down a formula for the population  $P(t)$  of yeti in  $t$  years.
  - Assuming logistic growth, how many yeti will there be in 50 years?
7. Assume that the human population is 7 billion and that we have a growth rate of 0.01/year.
- Assuming exponential growth, write down a formula  $P(t)$  for the human population in  $t$  years.
  - Assuming exponential growth, how many people there be in 2025?
  - Assume that the world has a carrying capacity of 100 billion people, write down a formula for the population  $P(t)$  in  $t$  years.
  - Assuming logistic growth, how many people will there be in 2025?