Handout for MATH 1300 (Barsamian) Lecture L26 Fri Oct 16, 2026 Section 3.6 Modeling with Exponential and Logarithmic Functions

Examples of building functions describing exponential growth or decay directly from the descriptions of the growth or decay.

A population has initial size 700 and doubles every 3 years.

$$P(t) = 700 \cdot 2^{\left(\frac{t}{3}\right)} = 700 \cdot \left(e^{\ln(2)}\right)^{\left(\frac{t}{3}\right)} = 700 \cdot e^{\left(\frac{\ln(2)t}{3}\right)}$$

A population has initial size 700 and halves every 3 years.

$$P(t) = 700 \cdot \left(\frac{1}{2}\right)^{\left(\frac{t}{3}\right)} = 700 \cdot \left(e^{\ln\left(\frac{1}{2}\right)}\right)^{\left(\frac{t}{3}\right)} = 700 \cdot \left(e^{-\ln(2)}\right)^{\left(\frac{t}{3}\right)} = 700 \cdot e^{\left(-\frac{\ln(2)t}{3}\right)}$$

A population has initial size 700 and grows 13% every 3 years.

$$P(t) = 700 \cdot (1.13)^{\left(\frac{t}{3}\right)} = 700 \cdot \left(e^{\ln(1.13)}\right)^{\left(\frac{t}{3}\right)} = 700 \cdot e^{\left(\frac{\ln(1.13)t}{3}\right)}$$

A population has initial size 700 and shrinks 13% every 3 years.

$$P(t) = 700 \cdot (0.87)^{\left(\frac{t}{3}\right)} = 700 \cdot \left(e^{\ln(0.87)}\right)^{\left(\frac{t}{3}\right)} = 700 \cdot e^{\left(\frac{\ln(0.87)t}{3}\right)}$$

A population has initial size 700 and has relative growth rate 0.013

$$P(t) = 700 \cdot e^{(0.013t)}$$

[1] A bacteria population has initial size 1800 and relative growth rate 0.19, with time in hours.
(a) Write a formula that describes the population $P(t)$ at time t hours.
(b) How many hours will it take the population to reach 2600? Give an exact answer in symbols, then a decimal approximation, rounded to 2 decimal places.

[2] A bacteria population is described by the formula $y = y_0 e^{(0.0623t)}$ where y_0 is the initial population and y is the population at time t hours. How many hours will it take the population to double? Give an exact answer in symbols, then a decimal approximation, rounded to 2 decimal places.

[3] A bacteria population grows exponentially at a rate of 5.4% per hour.
(a) Write a formula that describes the population $P(t)$ at time t hours.
(b) How many hours will it take the population to double? Give an exact answer in symbols, then a decimal approximation, rounded to 2 decimal places.

[4] The mass of a substance, which follows a continuous exponential growth model, has doubling time 12 days. There were 4.8 milligrams of the substance present at the beginning of the study.
(a) Let t be the time (in days) since the beginning of the study, and let y be the amount of the substance at time t. Write a formula relating y to t.
(b) How much of the substance will be present in 9 days? Give an exact answer in symbols, then a decimal approximation, rounded to 2 decimal places.