

Worksheet 48 - Exponential Functions

1. The population P (in thousands) of Pittsburgh, Pennsylvania from 2000 through 2003 can be modeled by $P = 2430e^{-0.0029t}$, where t represents the year, with $t = 0$ corresponding to 2000.
 - (a) According to the model, was the population of Pittsburgh increasing or decreasing from 2000 to 2003? Explain your reasoning.

 - (b) What were the populations of Pittsburgh in 2000 and 2003?

 - (c) According to the model, when will the population be approximately 2.3 million?

2. The number y of hits a new search engine website receives each month can be modeled by $y = 4080e^{kt}$, where t represents the number of months the website has been operating. In the website's third month, there were 10,000 hits. Using the model predict the number of hits the website will receive after 24 months.

3. The number N of bacteria in a culture is modeled by $N = 100e^{kt}$, where t is the time in hours. If $N = 300$ when $t = 5$, estimate the time required for the population to double in size.

4. A 2005 Jeep Wrangler that costs \$30,788 new has a book value of \$18,000 after 2 years.

(a) Find the linear model $V = mt + b$.

(b) Find the exponential model $V = ae^{kt}$.

(c) Use a graphing utility to graph the two models in the same window. Which model depreciates faster in the first two years?

(d) Find the book value of the vehicle after 1 year and after 3 years using each model.

(e) Explain the advantages and disadvantages of using each model to a buyer and a seller.

5. The IQ scores from a sample of a class of returning adult students at a small northeastern college roughly follow the normal distribution

$$y = 0.0266e^{-(x-100)^2/450}, \quad 70 \leq x \leq 115$$

where x is the IQ score.

(a) Use a graphing utility to graph the function. *Hint:* What window do you need?

(b) From the graph estimate the average IQ score.

6. A conservation organization releases 100 animals of an endangered species into a game preserve. The organization believes that the preserve has a carrying capacity of 1000 animals and that the growth of the pack will be modeled by the logistic curve

$$P(t) = \frac{1000}{1 + 9e^{-0.1656t}}$$

where t is measured in years.

- (a) Estimate the population after 5 years.

- (b) After how many years will the population be 500?

- (c) Use a graphing utility to graph the function and determine and interpret the horizontal asymptotes in context of the problem.

7. At 8:30 AM, a coroner was called to the home of a person who had died during the night. In order to estimate the time of death, the coroner took the person's temperature twice. At 9:00 AM the temperature was 85.7°F , and at 11:00 AM the temperature was 82.8°F . From these two temperatures, the coroner was able to determine that the time elapsed since death and the body temperature were related by the formula

$$t = -10 \ln \frac{T - 70}{98.6 - 70}$$

where t is the time in hours elapsed since the person dies and T is the temperature of the body. This formula is derived from a general cooling principle called Newton's Law of Cooling, assuming the person had a normal body temperature of 98.6°F in a room at 70°F . Use the formula to estimate the time of death of the person.