Chapter 11 Project

The Ups and Downs of Population Change

An activity to demonstrate the use of exponential functions in real life.

A midsized city with a population of 125,000 people experienced a population boom after several tech startups produced very successful products. The population of the city grew by 7% per year for several years. The population of the city can be modeled by the equation $P = P_0e^{rt}$, where P is the future population, P_0 is the initial population of the city, r is the rate of growth (or decay), and t is the time passed, in years.

1. Write the equation of the model for the city's population growth in terms of t.
2. Find the population of the city and then determine the number of new citizens after 5 years of growth. Round your answer to the nearest person.
3. Find the population of the city and then determine the number of new citizens after 10 years of growth. Round your answer to the nearest person.
4. Compare the number of new citizens after 5 years and after 10 years. Is the number of new citizens after 10 years twice the number of new citizens after 5 years? Explain your answer.

After 10 years, the population became too large for the city infrastructure (such as roads and freeways) to handle. The city raised taxes to improve the infrastructure, but the updates took a few years. Due to the traffic congestion in the city and the increased taxes, several of the large companies moved to neighboring cities. This loss of jobs in the city lead to a decline in population at a rate of 5% per year.

5. Write the equation of the model for the city's population decay in terms of t.
6. It took 4 years to finish the roadway project in the city and people continued to move away at a steady rate. Find the population of the city when the project was complete.
7. What percent of the population moved away during those 4 years? Round your answer to the nearest percent.

After the city infrastructure was updated, a few companies moved back to the city. As a result, the population started to grow by 2% per year.

8. Write the equation of the model for the city's population growth in terms of t.
9. At this rate of growth, how long would it takefor the city population to reach 250,000 citizens? Round your answer to the nearest year.