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## Study Guide

## Modeling Real-World Data with Exponential and Logarithmic Functions

The doubling time, or amount of time $t$ required for a quantity modeled by the exponential equation $N=N_{o} e^{k t}$ to double, is given by $t=\frac{\ln 2}{k}$.

## Example Finance Tara's parents invested $\$ 5000$ in an account that earns $11.5 \%$ compounded continuously. They would like to double their investment in 5 years to help finance Tara's college education. <br> a. Will the initial investment of $\$ 5000$ double within 5 years?

Find the doubling time for the investment. For continuously compounded interest, the constant $k$ is the interest rate written as a decimal.

$$
\begin{aligned}
t & =\frac{\ln 2}{k} & & \\
& =\frac{\ln 2}{0.115} & & \text { The decimal for } 11.5 \% \text { is } 0.115 . \\
& \approx 6.03 \text { years } & & \text { Use a calculator. }
\end{aligned}
$$

Five years is not enough time for the initial investment to double.
b. What interest rate is required for an investment with continuously compounded interest to double in 5 years?

$$
\begin{aligned}
t & =\frac{\ln 2}{k} & & \\
5 & =\frac{\ln 2}{k} & & \\
\frac{1}{5} & =\frac{k}{\ln 2} & & \text { Take the reciprocal of each side. } \\
\frac{\ln 2}{5} & =k & & \text { Multiply each side by } \ln 2 \text { to solve for } k . \\
0.1386 & \approx k & &
\end{aligned}
$$

An interest rate of $13.9 \%$ is required for an investment with continuously compounded interest to double in 5 years.
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# Modeling Real-World Data with Exponential and Logarithmic Functions 

## Find the amount of time required for an amount to double at the

 given rate if the interest is compounded continuously.1. $4.75 \%$
2. $6.25 \%$
3. $5.125 \%$
4. $7.1 \%$
5. City Planning At a recent town council meeting, proponents of increased spending claimed that spending should be doubled because the population of the city would double over the next three years. Population statistics for the city indicate that population is growing at the rate of $16.5 \%$ per year. Is the claim that the population will double in three years correct? Explain.
6. Conservation A wildlife conservation group released 14 black bears into a protected area. Their goal is to double the population of black bears every 4 years for the next 12 years.
a. If they are to meet their goal at the end of the first four years, what should be the yearly rate of increase in population?
b. Suppose the group meets its goal. What will be the minimum number of black bears in the protected area in 12 years?
c. What type of model would best represent such data?
