

1.5 #29

### Population Growth

The population of Knoxville is 500,000 and is increasing at the rate of 3.75% per year. Approximately when will the population reach 1 million?

#### Solution

This is an example of exponential growth and is modelled by the equation  $y = y_0 e^{kt}$ . Here we have  $k = 3.75\% = 0.0375$  and the initial population  $y_0 = 500,000$  (so we set  $t = 0$  NOW). Then we have

$$y = y_0 e^{kt} = 500,000 e^{0.0375t}$$

The question is:  $t = ?$  when  $y = 1,000,000$ .

We consider the equation

$$1,000,000 = 500,000 e^{0.0375t}$$

$$\text{or } 2 = e^{0.0375t}$$

We now borrow information from Section 1.6 and apply a natural logarithm:

$$\ln(2) = \ln(e^{0.0375t}) = 0.0375t$$

$$\text{or } \boxed{t = \frac{\ln(2)}{0.0375} \approx 18.48 \text{ years.}} \quad \square$$