# Exercise 305

According to the World Bank, at the end of 2013 ($t = 0$) the U.S. population was 316 million and was increasing according to the following model: $P(t) = 316e^{0.0074t}$, where $P$ is measured in millions of people and $t$ is measured in years after 2013.

a. Based on this model, what will be the population of the United States in 2020?

b. Determine when the U.S. population will be twice what it is in 2013.

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**Solution**

**Part (a)**

2020 is 7 years after 2013, so plug in $t = 7$ to the equation.

$$P(7) = 316e^{0.0074(7)} \approx 332.80$$

According to the model, the population will be about 333 million in 2020.

**Part (b)**

Double the population of 316 million is 632 million.

$$P(t) = 316e^{0.0074t}$$

$$632 = 316e^{0.0074t}$$

Divide both sides by 316.

$$2 = e^{0.0074t}$$

Take the natural logarithm of both sides.

$$\ln 2 = \ln e^{0.0074t}$$

Use the property of logarithms that allows the exponent of the argument to be brought down in front.

$$\ln 2 = (0.0074t) \ln e$$

Use the fact that $\ln e = 1$.

$$\ln 2 = 0.0074t$$

Solve for $t$ by dividing both sides by 0.0074.

$$t = \frac{\ln 2}{0.0074} \approx 93.67$$

Therefore, it will take about 94 years from the end of 2013 for the population to double.