**3.4 Lesson Notes**

Predicting Population

According to the U.S. Bureau of Census, the population of the United States was approximately 132 million in 1940 and 151 million in 1950. For today, we are going to assume the rate of change of population with respect to time is a constant value over the decade from 1940 to 1950. This means you are assuming that the relationship is linear.

1a. Write the given data as ordered pairs of the form (*t*, P(*t*)), where *t* is the number of years since 1940 and P(*t*) is the corresponding population, in millions.



 b. Plot the two data points, and draw a straight line through them. Label the horizontal axis from 0 to 25 and the vertical axis from 130-180.

2a. What is the average rate of change of population from *t* = 0 (1940) to *t* = 10 (1950)?

 b. What is the slope of the line connecting the two pints in part a? What is the practical meaning of the slope in this situation?

3. What is the P-intercept of this line? What is the meaning of it?

 b. Assume the average rate of change you determined in Problem 2 stays the same through 1960. Use your graph to estimate the population in 1960.

4a. Using the information you now know, write an equation for the line you graphed.

 b. Use your equation to find the population in 1960.

From the previous page, record:

Your estimated population in 1960 (#3b) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Your population in 1960 based off your equation (#4b) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The **error** in a prediction is the difference between the observed value (actual value that was measured) and the predicted value. The **relative error** of a prediction is the ratio of the error to the observed value.

$$relative error= \frac{observed value-predicted value}{observed value}= \frac{error}{observed value}$$

 5a. The relative error is usually reported as a percent. The actual U.S. population in 1960 was approximately 179 million. What is the *relative error* (expressed as a percent) in your prediction?

 b. What do you think was the cause of your prediction error?

**CREATE YOUR OWN:** Describe a situation where the rate of change would be constant for a short time period but over a longer time period might not remain constant. (You cannot use a topic we have already explored. You can make it fictional if you would like.)