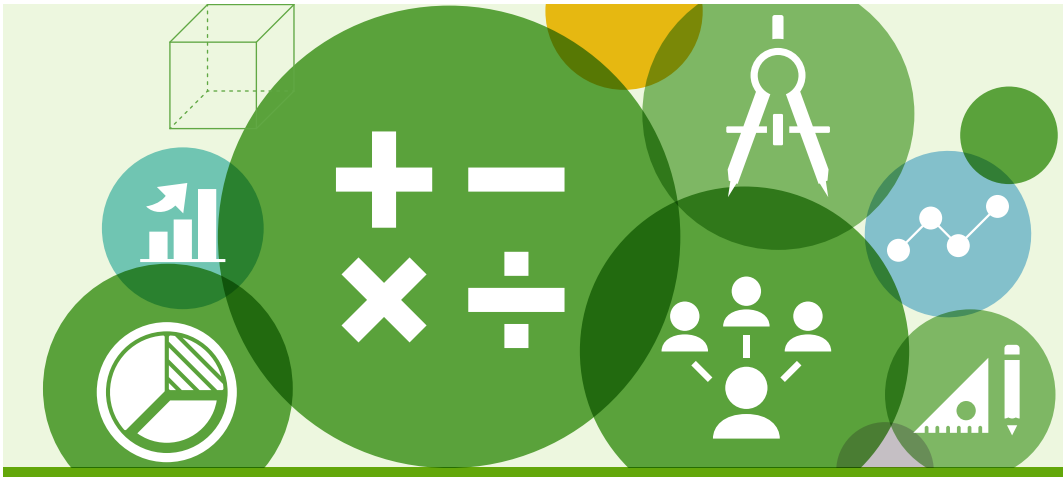


STUDENT VERSION

LINEAR MODELS – POPULATION GROWTH IN FIVE STATES

Activity Items

The following items are part of this activity and appear at the end of this student version.

- Item 1: Five States' Growing Populations by the Numbers: 1960–2020
- Item 2: Five States' Growing Populations in a Graph: 1960–2020

Student Learning Objectives

- I will be able to examine a linear model to estimate the slope and *y*-intercept.
- I will be able to interpret the slope and *y*-intercept.
- I will be able to understand how bivariate data can be simplified to make a linear model.

NAME:_____ DATE:_____

Introduction

Estimate and Interpret the Slope and *y*-Intercept (Optional)

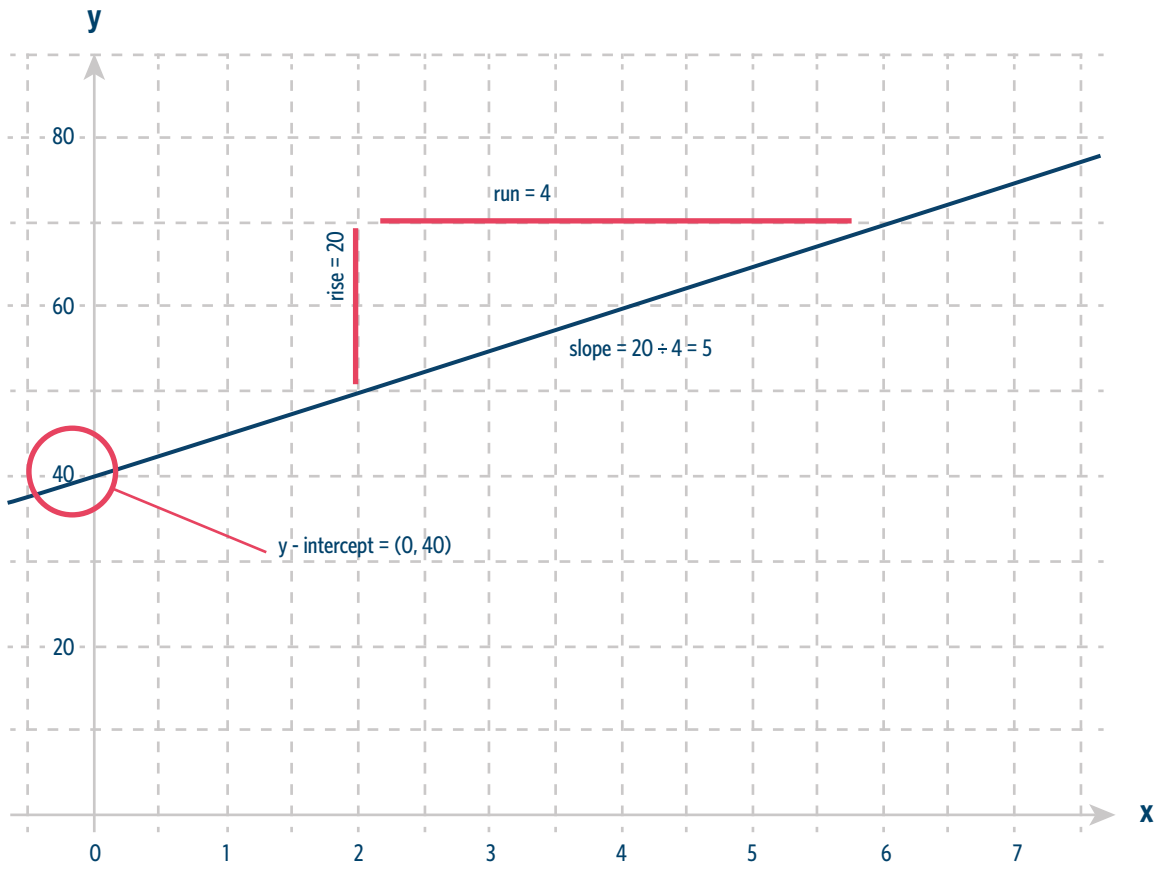
Read the example and then fill in the rest of this table:

	Slope		***y*-Intercept**	
	What is the slope?	What does the slope mean in the context of these data?	What are the coordinates of the *y*-intercept?	What does the *y*-intercept mean in the context of these data, and does that finding make sense?
***y* = 5*x* + 200**, EXAMPLE: where *y* is the cost of making T-shirts (in dollars) and x is the number of T-shirts made	5	On average, for each additional T-shirt made, the cost increases by $5.	(0, 200)	It costs $200 to make no T-shirts. This makes sense! (It costs money upfront to set up a T-shirt factory before the factory can start making shirts.)
***y* = -3*x* + 40**, where y is the number of turtles in a display and x is the number of weeks the turtles have been in the display				
***y* = 4*x* + 20**, where y is the height of a toddler in inches and x is the age of the toddler in years				

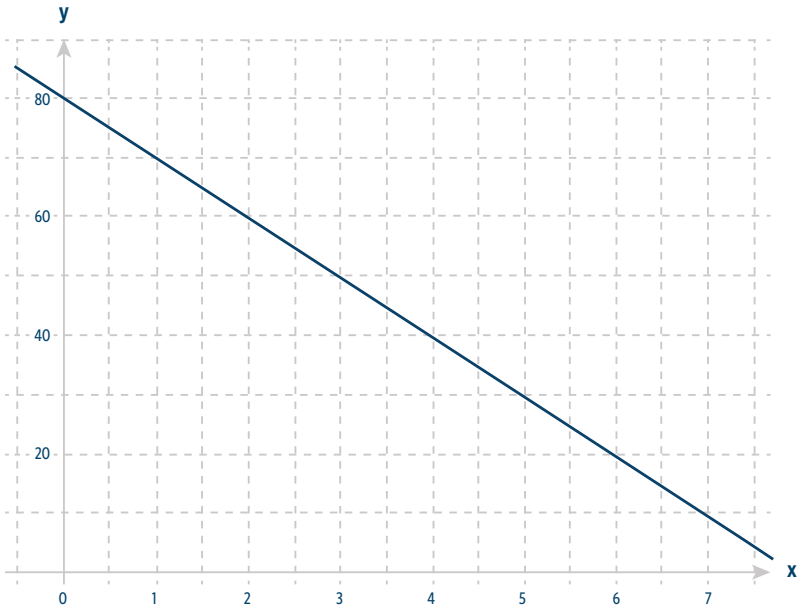
	Slope		*y*-Intercept	
***y* = -0.4*x* + 3.20**, where y is the price of a notebook in dollars and x is the number of weeks the notebook has been on sale				
***y* = 0.25*x* + 0.5**, where y is the amount of homework assigned (in hours) and x is the grade level in school (1 for first grade, 2 for second grade, etc.)				

Determine the approximate slope and *y*-intercept of the lines on each of the following graphs by choosing any two points along the line, using this example to help you:

EXAMPLE:



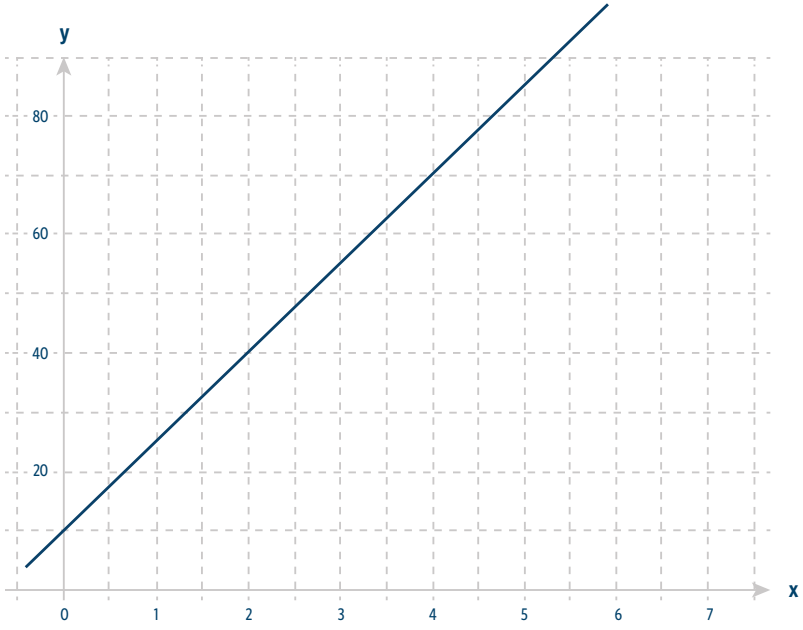
1.



Slope =

y-intercept =

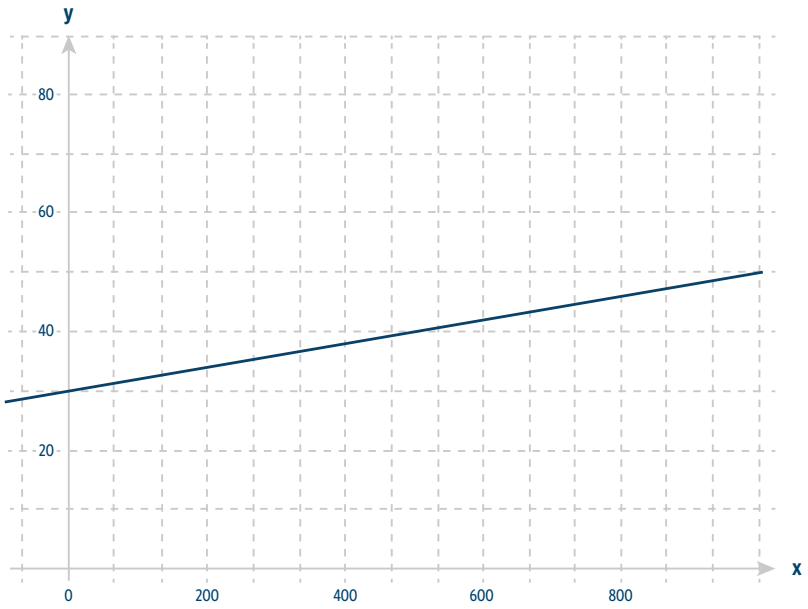
2.



Slope =

y-intercept =

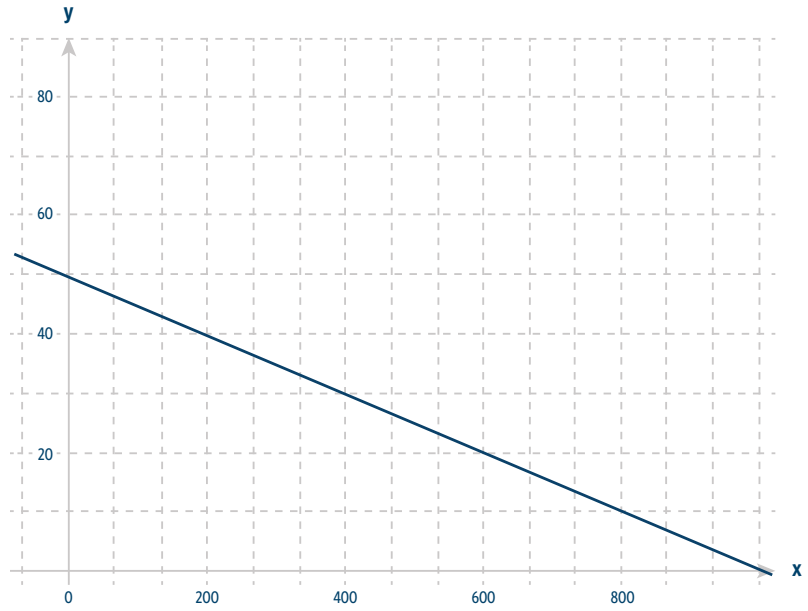
3.



Slope =

y-intercept =

4.



Slope =

y-intercept =

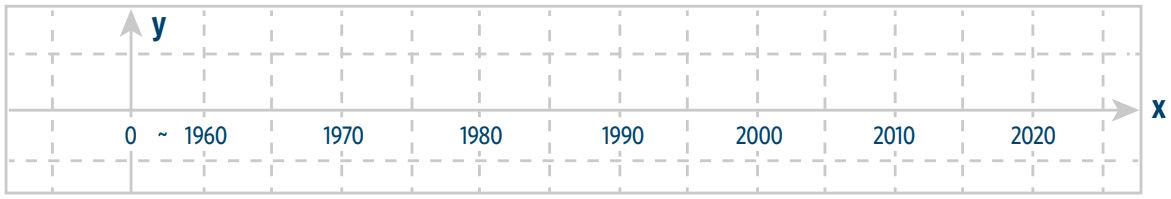
Part 1 – Simplify Data

Use **Item 1: Five States' Growing Populations by the Numbers: 1960–2020** to answer the following questions.

1. How were the years changed from the first table to look simpler in the second table?

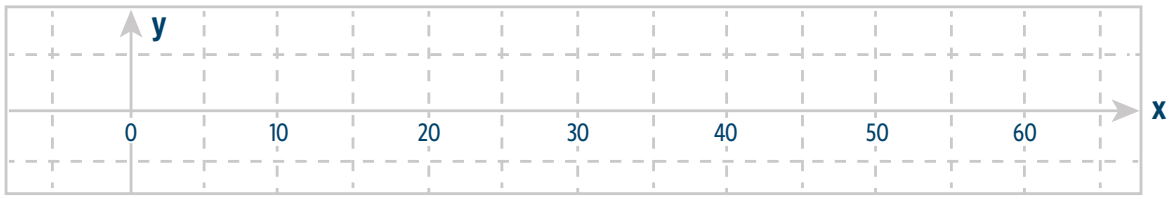
2. The following are a few ways to represent the years for these data on the horizontal axis of a graph. How would you label each axis?

A



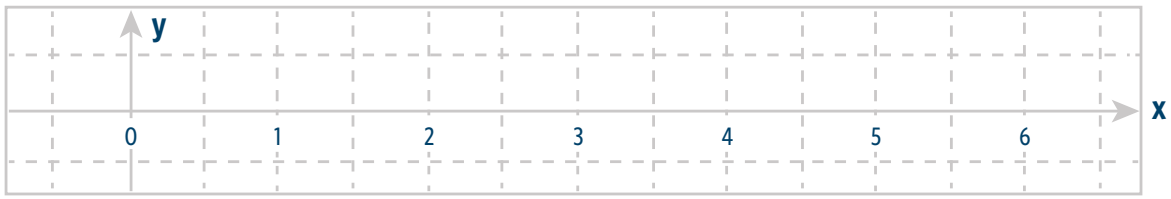
Horizontal Axis Label: _____

B



Horizontal Axis Label: _____

C



Horizontal Axis Label: _____

Part 2 – Interpret Visual Data

Use **Item 2: Five States' Growing Populations in a Graph: 1960–2020** to answer the following questions.

1. Which state had the fastest-growing population between 1960 and 2020, and why do you think it grew so rapidly?

2. Which state had a population of about 4 million in 1960?

3. Of the five states, how many had more than approximately 20 million people in 2020, and which states were they?

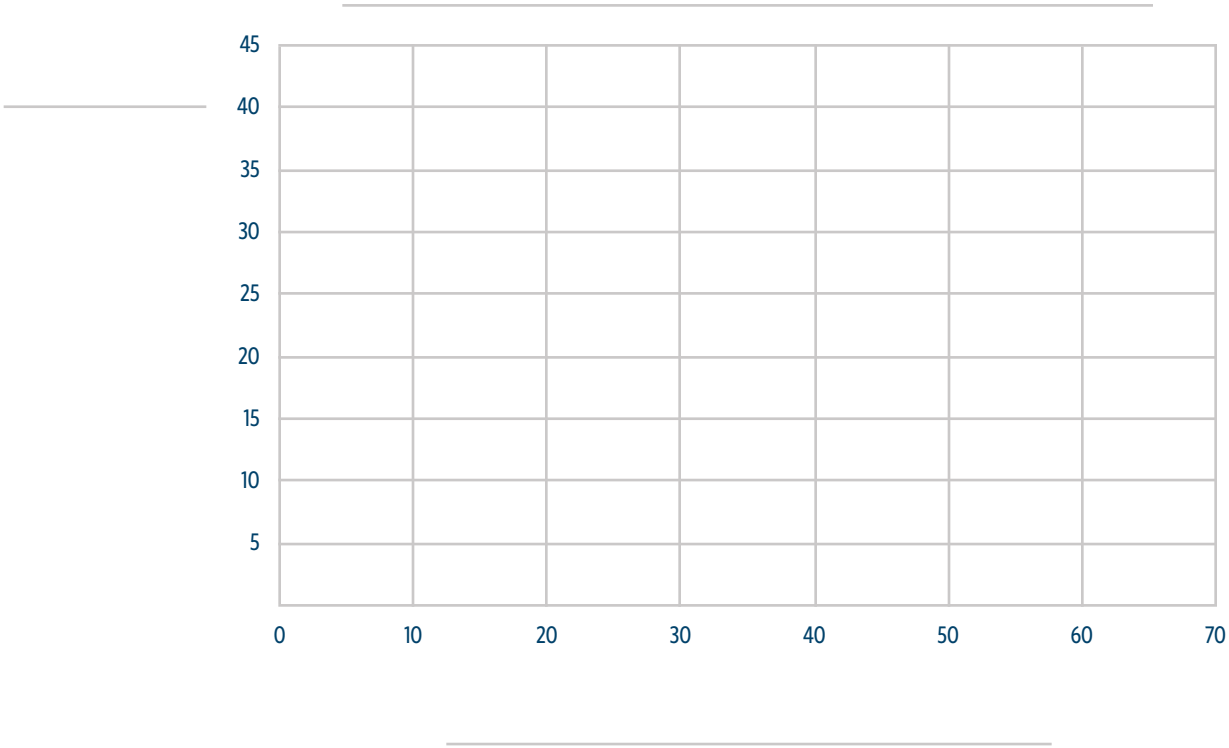
4. Between 1960 and 2020, when did California's population first exceed approximately 20 million?

5. Looking at the graph, predict when Georgia will have a population of about 20 million.

Part 3 – Work With Linear Models

For questions 1–4 below, use **Item 1: Five States' Growing Populations by the Numbers: 1960–2020** to plot the states' populations on the graph templates provided.

1. The linear equation for the following graph is: $y = 0.42x + 16$, meaning the predicted population for California = 0.42(year) + 16.

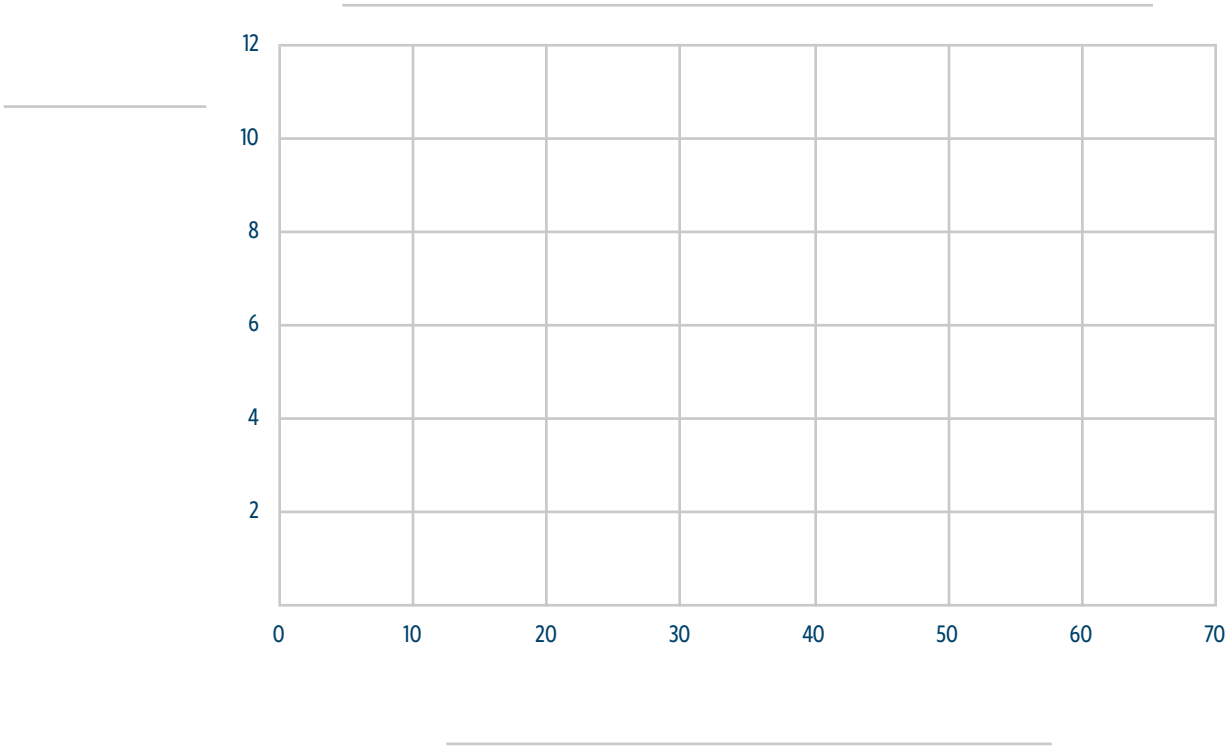


   a. Write the coordinates of the *y*-intercept here: _____

   b. Write the slope here: _____

   c. According to the estimated line of best fit, in 1960 (when *x* equals 0), California's population was approximately _____ million, and it has grown by an average of _____ million per year.

2. The linear equation for the following graph is: $y = 0.12x + 3.4$, meaning the predicted population for Georgia = 0.12(year) + 3.4.

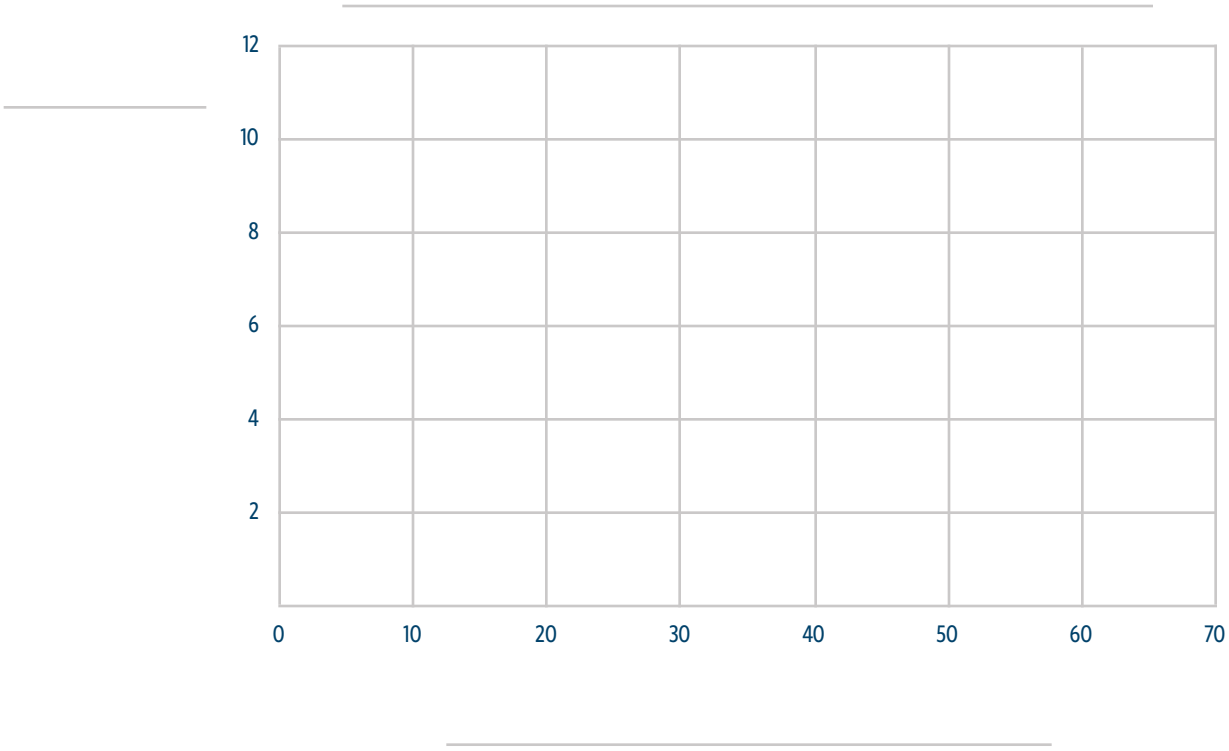


a. Write the coordinates of the *y*-intercept here: _____

b. Write the slope here: _____

c. According to the estimated line of best fit, in 1960 (when *x* equals 0), Georgia's population was approximately _____ million, and it has grown by an average of _____ million per year.

3. The linear equation for the following graph is: $y = 0.03x + 8.3$, meaning the predicted population for Michigan = 0.03(year) + 8.3.

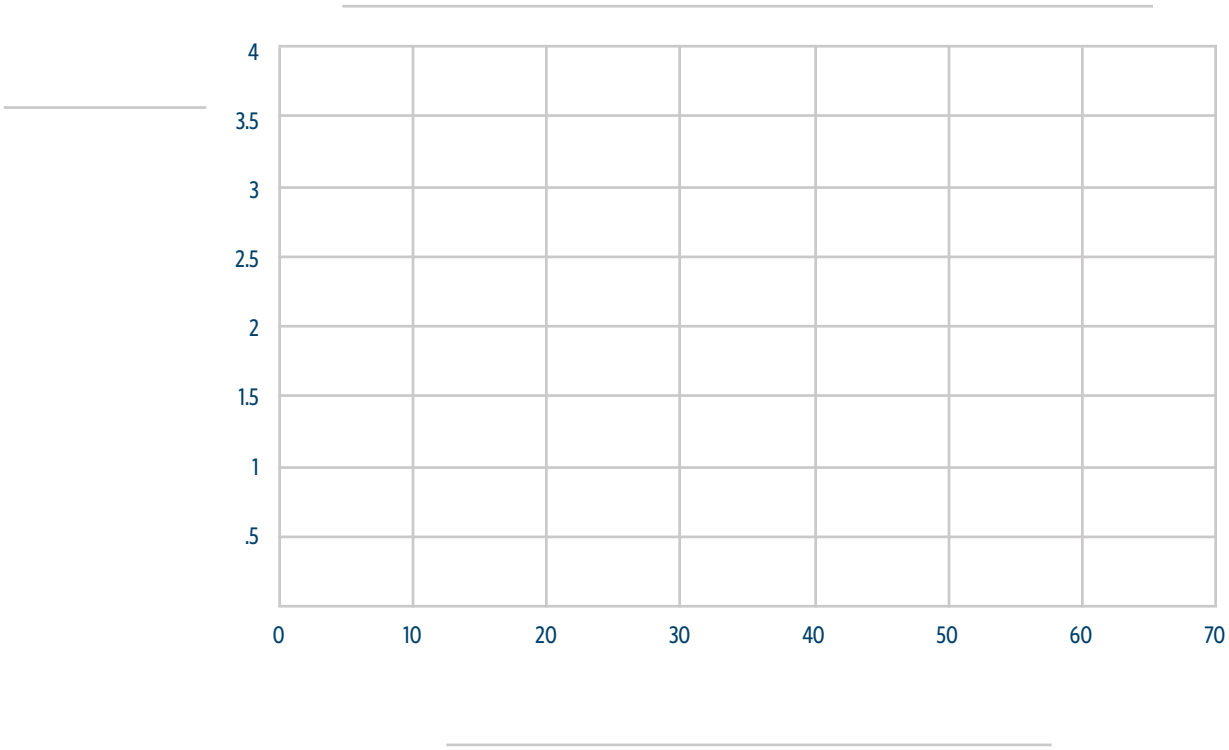


a. Write the coordinates of the *y*-intercept here: _____

b. Write the slope here: _____

c. According to the estimated line of best fit, in 1960 (when *x* equals 0), Michigan's population was approximately _____ million, and it has grown by an average of _____ million per year.

4. The linear equation for the following graph is: $y = 0.01x + 0.6$, meaning the predicted population for New Hampshire = 0.01(year) + 0.6.

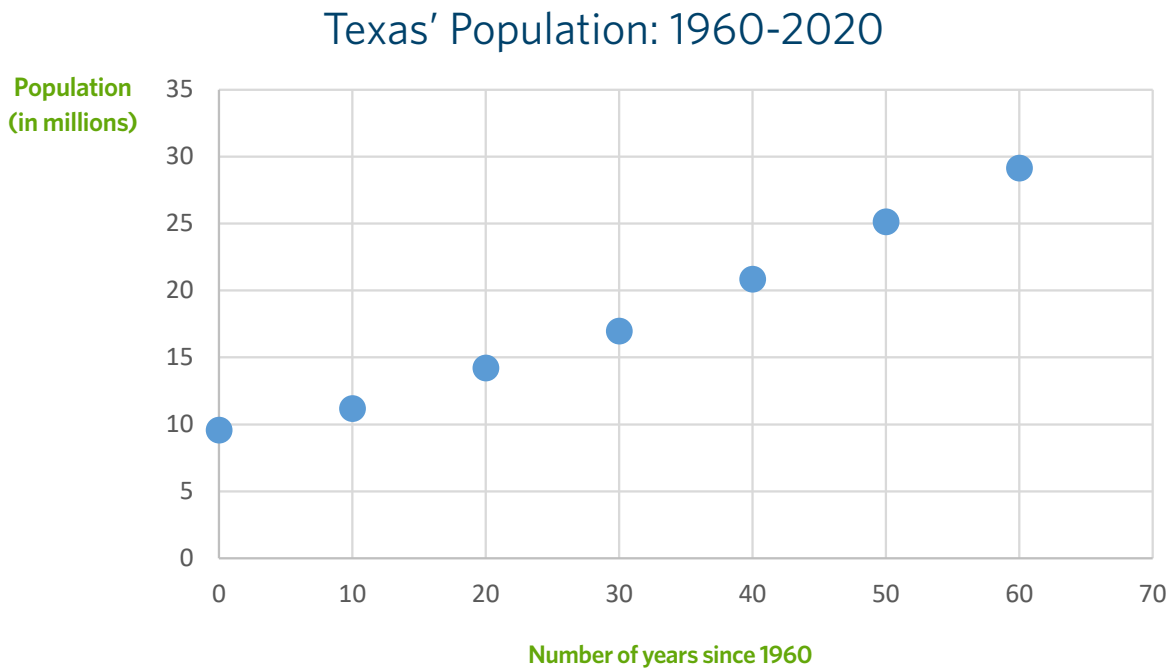


a. Write the coordinates of the *y*-intercept here: _____

b. Write the slope here: _____

c. According to the estimated line of best fit, in 1960 (when *x* equals 0), New Hampshire's population was approximately _____ million, and it has grown by an average of _____ million per year.

5. Using a ruler, draw a line of best fit on the following graph.



a. Approximately where does your line intersect the vertical axis?

b. Interpret your estimated *y*-intercept in the context of the data.

c. Using rise ÷ run, what is the estimated slope of your line?

d. Interpret this slope in the context of the data.

Part 4 – Apply What You Learned About Linear Models

Refer to the state graphs you just reviewed to answer the following questions in context.

1. What does "*x*" stand for?

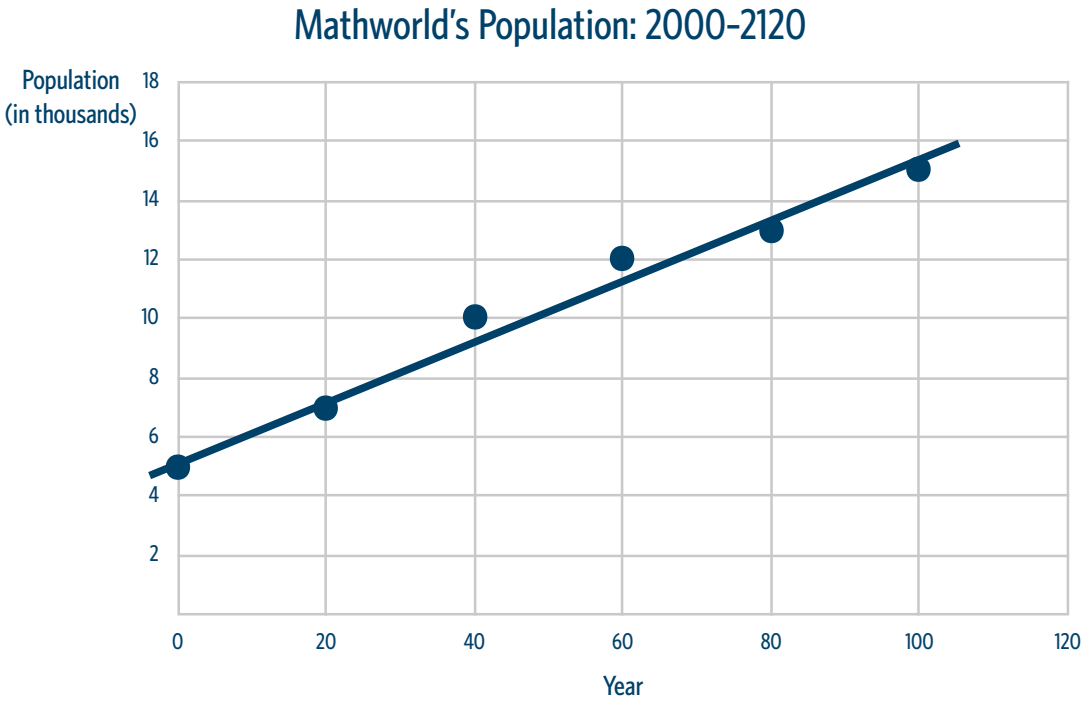
2. What does "*y*" stand for?

3. If the *y*-intercept for a state graph were 7, what would that mean?

4. If the slope of a line of best fit on a state graph were 0.6, what would that mean?

Use the following graph, showing the population growth of a mythical village called Mathworld, to complete the prompts that follow.

5. The equation of the line of best fit is $y = 0.1x + 5$. Determine the y-intercept and slope, and interpret them in the context of the data.



Coordinates of the y-intercept: _____

Slope: _____

Interpretation: _____

6. Imagine that you have just presented this graph to an audience in a report about Mathworld. Write three questions your audience could ask you, and provide the answer for each in the table below.

Question	Answer
1.	1.
2.	2.
3.	3.

Item 1: Five States' Growing Populations by the Numbers: 1960–2020

	1960	1970	1980	1990	2000	2010	2020
California	15,717,204	19,953,134	23,667,902	29,760,021	33,871,648	37,253,956	39,538,223
Georgia	3,943,116	4,589,575	5,463,105	6,478,216	8,186,453	9,687,653	10,711,908
Michigan	7,823,194	8,875,083	9,262,078	9,295,297	9,938,444	9,883,640	10,077,331
New Hampshire	606,921	737,681	920,610	1,109,252	1,235,786	1,316,470	1,377,529
Texas	9,579,677	11,196,730	14,229,191	16,986,510	20,851,820	25,145,561	29,145,505

www.census.gov/data/tables/time-series/dec/popchange-data-text.html

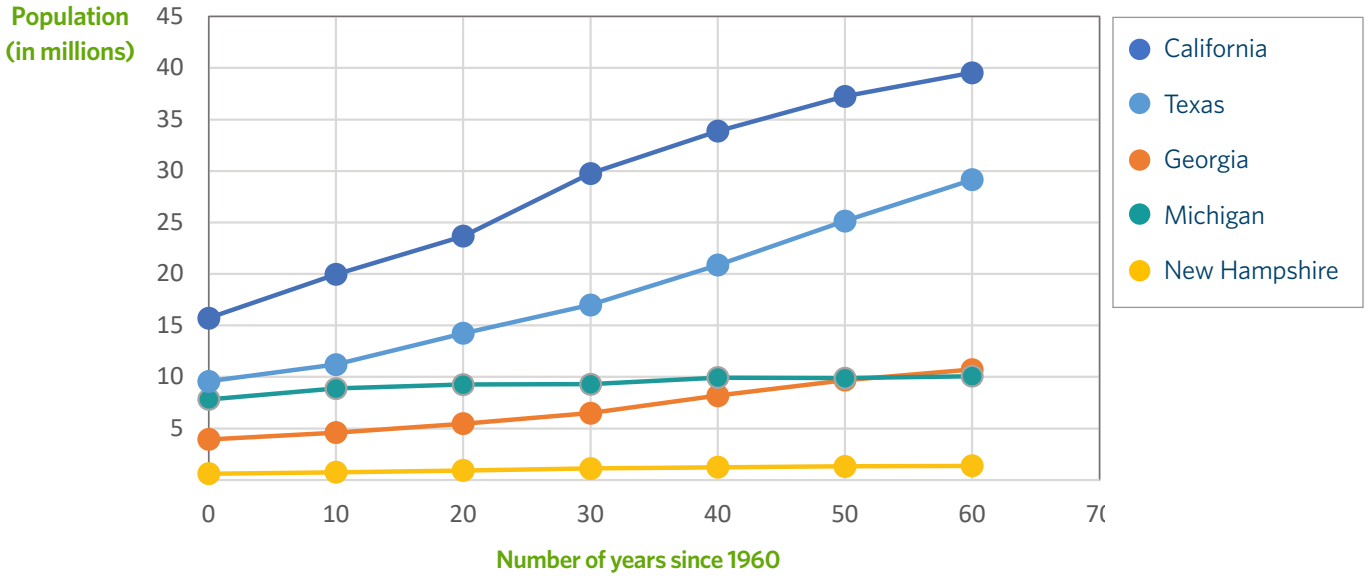
Click on the link above to view the source data online.

In modeling, we sometimes change the format of numbers so they are easier to work with. Here are the same data written as rounded numbers in the hundred thousands:

	0	10	20	30	40	50	60
California	157	200	237	298	339	373	395
Georgia	39	46	55	65	82	97	107
Michigan	78	89	93	93	99	99	101
New Hampshire	6	7	9	11	12	13	14
Texas	96	112	142	170	209	251	291

Item 2: Five States' Growing Populations in a Graph: 1960–2020

Decennial Population Data for Five U.S. States: 1960-2020



www.census.gov/data/tables/time-series/dec/popchange-data-text.html

Click on the link above to view the source data online.