Section 1.4
Modeling with Linear Functions

Objectives

1. Find a linear function that models a real-world application.
2. Explain the significance of the slope and the x- and y-intercepts for an application.

<u>Linear model</u>- A model that is generate to describe a set of data.

Example: A monthly cell phone bill is \$20.00 per month plus \$0.10 per minute of telephone use. Express the amount of the bill as a linear function of the number of minutes of use.

x = # of minutes used

$f(x)$ = monthly bill

+1

x	$f(x)$	
0	20	+.10
1	20.10	+.10
2	20.20	+.10
3	20.30	

fixed

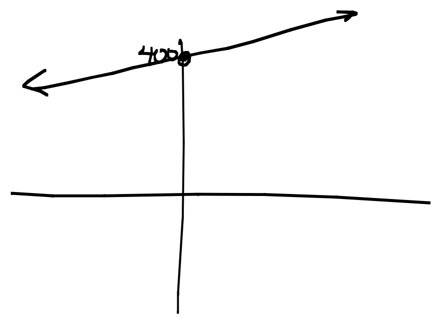
$$\boxed{f(x) = 0.10x + 20}$$

Example: The cost to print a brochure is \$400 (the fixed cost) plus \$2 for each brochure. Express the total cost of printing brochures as a linear function of the number of brochures produced.

x = # of brochures printed

x	$f(x)$
0	400
1	402
2	404
3	406

$$f(x) = \underline{2}x + \underline{400}$$



Example: A certain model of car cost \$18,000 in 2002. Since then, it has depreciated \$2000 per year. Express the value of the car as a linear function of time after purchase.

x = years since 2002

x	$f(x)$
0	18,000
1	16,000
2	14,000
3	12,000

$$f(x) = 18{,}000 - 2000x$$

$$-2000x + 18{,}000$$

Example: A certain type of car cost \$18,000 when purchased in 2002. Its value was \$14,000 in 2004. Express the value of the car as a linear function of time after purchase.

x = years since 2002

x	f(x)
0	18,000
1	16,000
2	14,000

point 1 → (0, 18,000): x_1, y_1

(2, 14,000): x_2, y_2

$$m = \frac{14{,}000 - 18{,}000}{2 - 0}$$

$$= -2000$$

point-slope form

$$y - y_1 = m(x - x_1)$$

$$y - 18{,}000 = -2000(x - 0)$$

$$y - 18{,}000 = -2000x$$

$$+18{,}000 \qquad +18{,}000$$

$$y = -2000x + 18{,}000$$

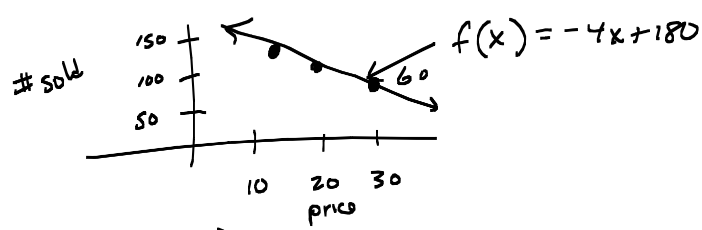
$$f(x) = -2000x + 18{,}000$$

Example: At a price of \$20 each, 100 t-shirts will be sold. At a price of \$15, 120 t-shirts will be sold. Express the number of t-shirts sold as a linear function of the price per t-shirt.

x	f(x)
$x_1 = 20$	$100 = y_1$
$x_2 = 15$	$120 = y_2$

x = price

f(x) = # sold



$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{120 - 100}{15 - 20} = -4$$

$$y - y_1 = m(x - x_1)$$

$$y - 100 = -4(x - 20)$$

$$y - 100 = -4x + 80$$

$$+100 \qquad +100$$

$$\boxed{y = -4x + 180}$$

Linear Models Using Curve-Fitting

We will be using the graphing calculator to fit a linear model to data points (regression).

Example: The following table lists the population of U.S. residents who are 65 years of age or older, in millions.

Year	Population 65 or older
1990	29.6
1995	31.7
2000	32.6
2003	34.2

a. Construct a scatter plot and fit a linear function to this set of values.

b. Use this function to predict the number of people over 65 in the year 2008.

Example: The following table lists data on the median household income in the United States for selected years from 1950 through 2003.

Year	1989	2000	2002	2003
Median Income	30,056	41,994	43,349	44,368

a. Construct a scatter plot and fit a linear function to this set of values, using number of years since 1989 as the independent variable.

b. Use the function to predict the year in which the median salary will be $46,000.

Homework: Section 1.4: 29, 30, 32, 36, 39, 40, 41, 43, 47, 51, 53