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CHAPTER 3 Distinguishing Between Direct Variation and Other Linear Models

All direct variation is linear, but not all linear models represent direct variation. Direct variation is the special case of a linear model $y = mx + b$ where the y-intercept (the constant term b) equals 0.

EXAMPLE 1 Identify linear and direct variation relations

For each of the following, state whether the relation is linear, and if so, whether it represents direct variation.

a. $y = 3x - 6$ **b.** $y = 9x$ **c.** $y = \frac{5}{x}$

d. $x - 2y = 0$ **e.** $y + x = 4$

Solution:

a. $y = 3x - 6$ is a linear equation in slope-intercept form, so it is a linear model. However, the y-intercept is not 0, so this is not an instance of direct variation.

b. $y = 9x$ is a linear slope-intercept equation with $m = 9$ and $b = 0$. This is a linear relation that represents direct variation.

c. $y = \frac{5}{x}$ is not a linear equation. It cannot be written in either form $ax + bx = c$ or $y = mx + b$.

d. $x - 2y = 0$ can be rewritten as $y = \frac{1}{2}x$. This is a linear slope-intercept equation with $m = \frac{1}{2}$ and $b = 0$. So this is a linear relation that represents direct variation.

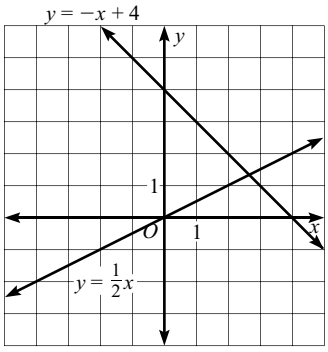
e. $y + x = 4$ can be rewritten as $y = -x + 4$. This is a linear equation in slope-intercept form, but b equals 4, not 0. So this is not an instance of direct variation. ■

Graphically, a relation of direct variation appears as a straight line that passes through the origin.

EXAMPLE 2 Identify direct variation graphically

Use the graphs of the equations in parts d and e of Example 1 to show that one represents direct variation and the other does not.

Solution:



The graph of $x - 2y$, or $y = \frac{1}{2}x$, passes through the origin, so this is an instance of direct variation. By contrast, the graph of $y + x = 4$, or $y = -x + 4$, does not pass through the origin, so this is not direct variation. ■

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CHAPTER 3

Distinguishing Between Direct Variation and Other Linear Models *continued*

Practice

For each of the following, state whether the relation is linear, and if so, whether it represents direct variation.

1. $y - 3x = 7$
2. $y = 3x - 6$
3. $5x + y = 0$
4. $y = 4x^2$
5. $xy = 8$
6. $\frac{y}{x} = 10$

For each of the following, write an appropriate equation and state whether the linear relation represents direct variation.

7. A trip to the gas station costs \$2.78 times the number of gallons pumped.
8. An automobile repair costs \$178 for the part plus \$65 per hour for labor.
9. The total number of pixels on a computer screen is determined by the area and the fact that the resolution is 9216 pixels per square inch.
10. **Challenge** An electric motor needs 1 ampere of current for every 120 watts of power produced, plus 0.5 amperes of current to run the control circuitry and instrument panel.