

CHAPTER 7

Linear Models and Graphs of Nonlinear Models

Section 7.1 Variation

Solutions to Odd-Numbered Exercises

1. $I = kV$ 3. $V = kt$ 5. $u = kv^2$ 7. $p = \frac{k}{d}$
9. $P = \frac{k}{\sqrt{1+r}}$ 11. $A = klt$ 13. $P = \frac{k}{V}$ 15. The area of a triangle varies jointly as the base and height.
17. The area of a rectangle varies jointly as the length and the width. 19. The volume of a right circular cylinder varies jointly as the square of the radius and the height. 21. The average speed varies directly as the distance and inversely as the time.
23. $s = kt$
 $20 = k(4)$
 $5 = k$
 $s = 5t$
25. $F = kx^2$
 $500 = k(40)^2$
 $\frac{500}{1600} = k$
 $\frac{5}{16} = k$
 $F = \frac{5}{16}x^2$
27. $H = ku$
 $100 = k(40)$
 $\frac{100}{40} = k$
 $\frac{5}{2} = k$
 $H = \frac{5}{2}u$
29. $n = \frac{k}{m}$
 $32 = \frac{k}{1.5}$
 $48 = k$
 $n = \frac{48}{m}$
31. $g = \frac{k}{\sqrt{z}}$
 $\frac{4}{5} = \frac{k}{\sqrt{25}}$
 $4 = k$
 $g = \frac{4}{\sqrt{z}}$
33. $F = kxy$
 $500 = k(15)(8)$
 $\frac{500}{120} = k$
 $\frac{25}{6} = k$
 $F = \frac{25}{6}xy$
35. $d = k\left(\frac{x^2}{r}\right)$
 $3000 = k\left(\frac{10^2}{4}\right)$
 $3000 = k(25)$
 $120 = k$
 $d = \frac{120x^2}{r}$
37. (a) $R = kx$
 $3875 = k(500)$
 $7.75 = k$
 $R = 7.75x$
 $R = 7.75(635)$
 $R = \$4921.25$ (b) Price per unit

$$\begin{aligned}
 39. \text{ (a)} \quad d &= kF \\
 5 &= k(50) \\
 \frac{5}{50} &= k \\
 \frac{1}{10} &= k
 \end{aligned}$$

$$\begin{aligned}
 \text{(b)} \quad d &= \frac{1}{10}F \\
 1.5 &= \frac{1}{10}F \\
 15 \text{ pounds} &= F
 \end{aligned}$$

$$\begin{aligned}
 d &= \frac{1}{10}F \\
 d &= \frac{1}{10}(20) \\
 d &= 2 \text{ inches}
 \end{aligned}$$

$$\begin{aligned}
 41. \quad d &= kF \\
 7 &= k(10.5) \\
 \frac{7}{10.5} &= k \\
 \frac{70}{105} &= k \\
 \frac{2}{3} &= k \\
 12 &= \frac{2}{3}F
 \end{aligned}$$

$$18 \text{ pounds} = F$$

$$\begin{aligned}
 43. \quad v &= kt \\
 96 &= k(3) \\
 32 &= k \\
 \text{acceleration} &= 32 \text{ ft/sec}^2
 \end{aligned}$$

$$\begin{aligned}
 45. \quad d &= ks^2 \\
 75 &= k(30)^2 \\
 \frac{75}{900} &= k \\
 \frac{1}{12} &= k \\
 d &= \frac{1}{12}(50)^2 \\
 d &= 208.\bar{3} \text{ feet}
 \end{aligned}$$

$$\begin{aligned}
 47. \quad F &= ks^2 \\
 F &= k(2s)^2 \\
 F &= 4ks^2 \\
 F &= 4(ks^2) \\
 F &\text{ will change by a factor of 4.}
 \end{aligned}$$

$$\begin{aligned}
 49. \quad p &= kA \\
 9\text{-inch: } 6.78 &= k(\pi)(4.5)^2 \\
 6.78 &= 20.25\pi k \\
 \frac{6.78}{20.25\pi} &= k \\
 0.106575 &\approx k
 \end{aligned}$$

$$\begin{aligned}
 12\text{-inch: } 9.78 &= k(\pi)(6)^2 \\
 9.78 &= 36\pi k \\
 \frac{9.78}{36\pi} &= k \\
 0.0864745 &\approx k
 \end{aligned}$$

$$\begin{aligned}
 15\text{-inch: } 12.18 &= k(\pi)(7.5)^2 \\
 12.18 &= 56.25\pi k \\
 \frac{12.18}{56.25\pi} &= k \\
 0.068923 &\approx k
 \end{aligned}$$

No, the price of the pizza is not directly proportional to its area. The 15-inch pizza at \$12.18 is the best buy.

$$\begin{aligned}
 51. \quad x &= \frac{k}{p} \\
 800 &= \frac{k}{5} \\
 4000 &= k \\
 x &= \frac{4000}{6} \\
 x &= 666.\bar{6} \approx 667 \text{ units}
 \end{aligned}$$

$$\begin{aligned}
 53. \quad W_m &= k \cdot W_e & W_m &= \frac{1}{6} \cdot W_e \\
 60 &= k \cdot 360 & 54 &= \frac{1}{6} \cdot x \\
 k &= \frac{1}{6} & x &= 324 \text{ pounds}
 \end{aligned}$$

55. $I = \frac{k}{d^2}$

$$I = \frac{k}{18^2} \quad I = \frac{k}{36^2}$$

$$I = \frac{k}{324} \quad I = \frac{k}{1296}$$

I will change by a factor of $\frac{324}{1296}$ or $\frac{1}{4}$.

59. (a) $I = Krt$

$$202.50 = K(0.09)(3) \quad I = 750rt$$

$$202.50 = K(0.27) \quad I = 750(0.09)(4)$$

$$750 = K \quad I = \$270$$

(b) K is the principal or the amount of investment.

57. $p = \frac{k}{t}$

$$38 = \frac{k}{3}$$

$$114 = k$$

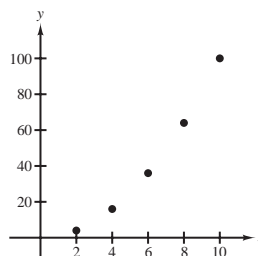
$$\text{So, } p = \frac{114}{t}$$

$$p = \frac{114}{6.5}$$

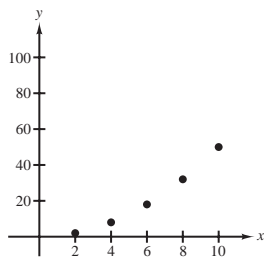
$$p = 17.5\%$$

 61.

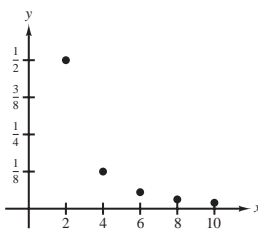
x	2	4	6	8	10
$y = kx^2$	4	16	36	64	100


 63.

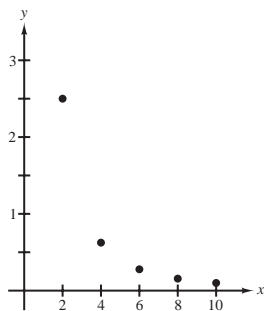
x	2	4	6	8	10
$y = kx^2$	2	8	18	32	50


 65.

x	2	4	6	8	10
$y = \frac{k}{x^2}$	$\frac{1}{2}$	$\frac{1}{8}$	$\frac{1}{18}$	$\frac{1}{32}$	$\frac{1}{50}$


 67.

x	2	4	6	8	10
$y = \frac{k}{x^2}$	$\frac{5}{2}$	$\frac{5}{8}$	$\frac{5}{18}$	$\frac{5}{32}$	$\frac{1}{10}$


 69.

x	10	20	30	40	50
y	$\frac{2}{5}$	$\frac{1}{5}$	$\frac{2}{15}$	$\frac{1}{10}$	$\frac{2}{25}$

$$\frac{2}{5} = \frac{k}{10} \quad \frac{1}{5} = \frac{k}{20}$$

$$4 = k \quad 4 = k$$

Using any two pairs of numbers, k is 4.

71.

x	10	20	30	40	50
y	-3	-6	-9	-12	-15

$$-3 = k \cdot 10 \quad -6 = k \cdot 20$$

$$-\frac{3}{10} = k \quad -\frac{6}{20} = k$$

$$-\frac{3}{10} = k$$

Using any two pairs of numbers, k is $-\frac{3}{10}$.

75. $y = kx^2$

$$y = k(2x)^2$$

$$y = k(4x^2)$$

$$y = 4kx^2$$

y will quadruple.

Section 7.2 Graphs of Linear Inequalities

1. $x - 2y < 4$

(a) $0 - 2(0) \stackrel{?}{<} 4$

$$0 < 4$$

$(0, 0)$ is a solution.

(c) $3 - 2(4) \stackrel{?}{<} 4$

$$3 - 8 < 4$$

$$-5 < 4$$

$(3, 4)$ is a solution.

(b) $2 - 2(-1) \stackrel{?}{<} 4$

$$2 + 2 < 4$$

$$4 \not< 4$$

$(2, -1)$ is not a solution.

(d) $5 - 2(1) \stackrel{?}{<} 4$

$$5 - 2 < 4$$

$$3 < 4$$

$(5, 1)$ is a solution.

3. $3x + y \geq 10$

(a) $3(1) + 3 \stackrel{?}{\geq} 10$

$$9 \not\geq 10$$

$(1, 3)$ is not a solution.

(c) $3(3) + 1 \stackrel{?}{\geq} 10$

$$10 \geq 10$$

$(3, 1)$ is a solution.

(b) $3(-3) + 1 \stackrel{?}{\geq} 10$

$$-8 \not\geq 10$$

$(-3, 1)$ is not a solution.

(d) $3(2) + 15 \stackrel{?}{\geq} 10$

$$21 \geq 10$$

$(2, 15)$ is a solution.