11. a. Break-even in units = $90,000 ÷ ($70 – $40) = 3,000 units
   b. In dollars break-even = 3,000 × $70 = $210,000

12. a. Break-even point in rings = $345,000 ÷ ($600 – $300) = 1,150
   b. Break-even point in sales dollars = 1,150 × $600 = $690,000
   c. Break-even point $345,000 ÷ ($600 – $306) = 1,174 rings (rounded)
   d. Break-even point would be $339,000 ÷ ($600 – $300) = 1,130 rings

14. a. Break-even in units is $260,000 ÷ ($1,800 – $1,000) = 325 garden sheds.
   b. To earn a pre-tax profit of $200,000 = ($260,000 + $200,000) ÷ $800 = 575
      garden sheds
   c. To earn a pre-tax profit of $280,000 = ($260,000 + $280,000) ÷ $800 = 675
      garden sheds

15. a. Contribution margin per unit = Sales less variable costs
   $180 – ($30 + $25 + $17) = $108
   b. Contribution margin ratio = Contribution margin ÷ Sales
   $108 ÷ $180 = 60%
   c. Break-even in units is fixed costs ÷ Contribution margin per unit
   $62,640 ÷ $108 = 580 units
   d. Break-even in dollars is fixed costs ÷ Contribution margin ratio
   $62,640 ÷ 0.60 = $104,400
   e. To earn $51,840 in pre-tax profit, Austin Automotive must sell:
   ($62,640 + $51,840) ÷ $108 = 1,060 units

16. a. Contribution margin per unit = Sales less variable costs
   $180 – ($30 + $25 + $17) = $108
   b. Contribution margin ratio = Contribution margin ÷ Sales
   $108 ÷ $180 = 60%
   c. Break-even in units is fixed costs ÷ Contribution margin per unit
   $62,640 ÷ $108 = 580 units
   f. Break-even in dollars is fixed costs ÷ Contribution margin ratio
   $62,640 ÷ 0.60 = $104,400
g. To earn $51,840 in pre-tax profit, Austin Automotive must sell:
\[
\frac{(62,640 + 51,840)}{108} = 1,060 \text{ units}
\]

17. a. Convert after-tax to pre-tax profit: \( \$2,250,000 \div (1 - 0.35) = \$280,000 \)
The number of garden sheds that must be sold to generate $280,000 =
\[
\frac{(260,000 + 280,000)}{800} = 675 \text{ garden sheds.}
\]

b. Let R = revenue; then 0.08R = After-tax income desired
Before-tax income = \(0.08R \div (1 - 0.35) = 0.123R\)
Revenue – Variable costs – Fixed costs = Income before tax
Let X = Units sold
\[
\text{SP}(X) - \text{VC}(X) - FC = \text{Income before tax}
\]
\[
\$1,800X - \$1,000X = \$260,000 = 0.123(1,800)X
\]
\[
\$800X = \$260,000 = 221.4X
\]
\[
\$578.6X = \$260,000
\]
\[
X = 450 \text{ units (rounded) sold to earn 8 percent of revenue after tax}
\]
Amount of revenue = \(450 \times 1,800 = \$810,000\)

Check: \(\$810,000 \times 0.08 = \$64,800\) after-tax income needed (round to
\(\$65,000\)) \(\$64,800 \div 0.65 = \$99,692\) before-tax income (round to
\(\$100,000\)) \(\$1,800(450) - \$1,000(450) - \$260,000 = \$100,000\)
(before-tax income)
\[
\$100,000 - 0.35(100,000) = \$100,000 - \$35,000 = \$65,000
\]
\[
\$65,000 \div \$810,000 = 8\%
\]

18. a. Convert the after-tax income to pre-tax desired income:
\(\$135,800 \div (1 - 0.3) = \$194,000\)
The number of units required to earn an after-tax profit of $135,800:
\(\$62,640 + 194,000 \div 108 = 2,376.3 \text{ or } 2,376 \text{ units}\)

b. Convert the after-tax to pre-tax profit:
\(\$7.20 \div 180 = 0.04\), or 4%; \(0.04 \div (1 - 0.30) = 5.7\%\) of sales
A pre-tax return on sales of 5.7 percent is required to generate an after-tax
profit of $7.20 per unit
Let R = the Level of revenue that generates a pre-tax return of 5.7%:
\[
\text{Variable costs} = (30 + 25 + 17) \div 180 = 0.4, \text{ or } 0.4R
\]
\[
R - 62,640 = 0.4R = 0.057R
\]
\[
0.543R = 62,640
\]
\[
R = 115,359
\]
\[
115,359 \div 180 = 640.88 \text{ or } 641 \text{ units (rounded)}
\]

19. Let Y = Level of sales generating income equal to 30% of sales, then:
\[
Y = 0.60Y - (25,000 \text{ per month } \times 12 \text{ months}) = 0.30Y
\]
\[
0.10Y = 300,000
\]
\[
Y = 3,000,000
\]

Since existing sales are $2,250,000, sales would need to increase by \(3,000,000 -
\$2,250,000 = \$750,000\).
20. a. First, convert the desired after-tax income to a pre-tax desired income:
   
   \[
   \frac{\$600,000}{1 - 0.40} = \$1,000,000
   \]
   
   Note that total variable costs per unit = $3,000, and total fixed costs = $370,000.

   Next, let \( P \) represent the number of golf carts that must be sold to generate $1,000,000 in pre-tax income:
   
   \[
   \begin{align*}
   5,000P - 3,000P - 370,000 &= 1,000,000 \\
   2,000P &= 1,370,000 \\
   P &= 685 \text{ golf carts}
   \end{align*}
   \]

b. Find after-tax equivalent of 20%: 20% ÷ (1 − 0.40) = 33.33%

Variable costs as a percentage of sales: $3,000 ÷ $5,000 = 60%

Let \( R \) = Level of revenue that generates a pre-tax return of 33.33%:

\[
\begin{align*}
R - 0.6R - 370,000 &= 0.3333R \\
0.0667R &= 370,000 \\
R &= 5,547,226
\end{align*}
\]

Proof: Sales $5,547,226

\[
\begin{align*}
\text{Variable costs (60\%)} & \quad (3,328,336) \\
\text{Contribution margin} & \quad 2,218,890 \\
\text{Fixed costs} & \quad (370,000) \\
\text{Income before tax} & \quad 1,848,890 \\
\text{Income tax (40\%)} & \quad (739,556) \\
\text{Net income} & \quad 1,109,334 \\
\end{align*}
\]

$1,109,334 ÷ $5,547,226 = 20%

22. a. $1,450 ÷ $0.50 = 2,900 passengers per day

i. Break-even: $2,000 ÷ 2,900 = $0.69 (rounded) per passenger

   Earn $250: ($2,000 + $250) ÷ 2,900 = $0.78 (rounded)

ii. Total variable cost = $2,000 − ($2,000 × 0.80) = $400

   Variable cost per passenger = $400 ÷ 2,900 = $0.14 (rounded)

   Profit if fare is $0.60 = (2,900 × 0.90 × $0.60) − (2,900 × 0.9 × $0.14) − $1,600 = $(399.40)

   Current loss = $1,450 − $2,000 = $(550)

   County will be better off by $(399.40) − $(550) = $150.60.

iii. At a fare of $0.70:

   (2,900 × $0.70 × 0.95) − (2,900 × $0.14 × 0.95) − $1,600 = $(57.20)

   The county would incur a slight loss at a fare of $0.70.

   At a fare of $0.90:

   (2,900 × $0.90 × 0.90) − (2,900 × $0.14 × 0.90) − $1,600 = $383.60

   The company would first make a profit when the fare is set at $0.90.

iv. Increasing volume will help improve profitability only if the volume change increases total contribution margin. Because an increase in volume can often
be achieved only with a decrease in price, the change in contribution margin may be negative rather than positive.

23. a. Current sales volume for both companies = $2,000,000 ÷ $40 = 50,000
New selling price $40 – (0.3 × $40) = $28; Variable costs = $1,400,000 ÷ 50,000 = $28
Ainsley: (50,000 × 1.60 × $28) – (50,000 × 1.60 × $28) – $0 = $0
Bard: (50,000 × 1.60 × $28) – (50,000 × 1.60 × $0) – $1,400,000 = $840,000
This strategy is best used by Bard.

b. New selling price: $40 × 1.3 = $52
Ainsley: (50,000 × 0.85 × $52) – (50,000 × 0.85 × $28) – $0 = $1,020,000
Bard: (50,000 × 0.85 × $52) – (50,000 × 0.85 × $0) – $1,400,000 = $810,000
This strategy is best used by Ainsley.

c. Ainsley: (65,000 × $40) – (65,000 × $28) – $200,000 = $580,000
Bard: (65,000 × $40) – (65,000 × $0) – $1,600,000 = $1,000,000
This strategy is best used by Bard.

24. a. CM per unit of sales mix = ($3 × 8) + (1 × $6) = $30
Break-even = $180,000 × $30 = 6,000 units of sales mix, or 18,000 wallets
and 6,000 money clips
Total revenue = (18,000 × $30) + (6,000 × $15) = $630,000

b. Sales mix units = ($180,000 + $150,000) ÷ $30 = 11,000 = 33,000 wallets and
11,000 money clips
Total revenue = (33,000 × $30) + (11,000 × $15) = $1,155,000

c. Equivalent pre-tax profit = $150,000 ÷ (1 – 0.40) = $250,000
Sales mix units = ($180,000 + $250,000) ÷ $30 = 14,333.33 = 43,000 wallets
and 14,333 money clips
Total revenue = (43,000 × $30) + (14,333 × $15) = $1,504,995

d. Units of sales mix = $1,155,000 ÷ [(5 × $30) + (2 × $15)] = 6,417 (rounded) = 32,085 wallets and 12,834 money clips
Income = (32,085 × $8) + (12,834 × $6) – $180,000 = $153,684

The sales mix shifted such that the ratio of wallets to money clips declined, and the break-even point was reduced because money clips have a higher contribution margin ratio than money clips. Hence, at a sales level of $1,155,000, more contribution margin is generated at the actual sales mix than at the planned sales mix.

25. a. Fixed costs ÷ Contribution margin = Break-even point in units
$1,080,000,000 ÷ [(3 × $300) + (5 × $700) + (2 × $1,000)] =
$1,080,000,000 ÷ $6,400 = 168,750 bags

Mod = 3 × 168,750 = 506,250 units × $2,200 = $1,113,750,000
Rad = 5 × 168,750 = 843,750 units × $3,700 = 3,121,875,000
X-treme = 2 × 168,750 = 337,500 units × $6,000 = 2,025,000,000
Revenue to break-even = $6,260,625,000
b. Convert after-tax to pre-tax income. $1,000,000,000 ÷ (1 – 0.5) = $2,000,000,000
   
   $2,000,000,000 + $1,080,000,000 ÷ $6,400 = 481,250 bags

   Mod = 3 × 481,250 = 1,443,750 units × $2,200 = 3,176,250,000
   Rad = 5 × 481,250 = 2,406,250 units × $3,700 = 8,903,125,000
   X-treme = 2 × 481,250 = 962,500 units × $6,000 = 5,775,000,000
   Total revenue needed = 17,854,375,000

   This change will increase the number of units required to break even because fewer units of Rad and X-treme, which have the greatest contribution margin, are being sold and more units of Mod, which has the lowest contribution margin, are being sold.

<table>
<thead>
<tr>
<th>Scooter</th>
<th>Contribution Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mod</td>
<td>5 × $300 = $1,500</td>
</tr>
<tr>
<td>Rad</td>
<td>4 × $700 = 2,800</td>
</tr>
<tr>
<td>X-treme</td>
<td>1 × $1,000 = 1,000</td>
</tr>
<tr>
<td>Total</td>
<td>$5,300</td>
</tr>
</tbody>
</table>

   Now the contribution margin is $5,300 per bag, which is less than the contribution margin per bag of $6,400 in (a) above.

d. If Green Rider sells more of its scooters with the greatest contribution margin (X-treme) and fewer of the scooters with the lowest contribution margin (Mod), then fewer scooters would be needed to be sold to break even.

26. a. Break-even is $264,000 ÷ ($9.60 – $7.60) = 132,000 bushels

   132,000 bushels × $9.60 = $1,267,200
   Bushels per acre = 132,000 ÷ 1,200 = 110 bushels per acre

   b. Bushels sold – Break-even bushels = Margin of safety
   
   174,000 – 132,000 = 42,000 bushels
   
   (174,000 × $9.60) – $1,267,200 = $403,200
   $403,200 ÷ $1,670,400 = 24.1%

31. a. Each “bag” contains one unit of liquid and two units of spray. Thus, each bag generates contribution margin of: (1 × $10) + (2 × $5) = $20.

   The break-even point would be: $100,000 ÷ $20 = 5,000 bags. Since each bag contains two units of spray, at the break-even point 5,000 × 2 or 10,000 units of spray must be sold.

   i. At the break-even point, Total CM = Total FC; and the CM per unit would be $1,600 ÷ 4,000 = $0.40. If one unit is sold beyond the break-even point, net income would rise by $0.40.

   ii. $10X – 0.40($10X) – $216,000 = 0.25($10X)

   $3.50X = $216,000

   X = 61,715 units (rounded)

   iii. In units: 3,200 – 2,800 = 400 units

   In dollars: 400 units × $65 per unit = $26,000
38. a. Total variable cost = $28 + $12 + $8 = $48
Contribution margin per unit = $70 – $48 = $22 per unit
Contribution margin ratio = $22 ÷ $70 = 31.4% (rounded)
Total fixed costs = $10,000 + $24,000 = $34,000
Break-even point in units = $34,000 ÷ $22 per unit = 1,545 units (rounded)
Break-even point in dollars = $34,000 ÷ 0.314 = $108,280 (rounded)

b. ($40,000 + $34,000) ÷ 0.314 = $235,669 (rounded)

($235,669 ÷ $70) = 3,367 units (rounded)

c. Convert after-tax earnings to pre-tax earnings: $40,000 ÷ (1 – 0.40) = $66,667
Required sales = ($66,667 + $34,000) ÷ 0.314 = $320,596 (rounded)
$320,596 ÷ $70 = 4,580 units (rounded)

d. Convert the after-tax rate of earnings to a pre-tax rate of earnings:
[20% ÷ (1 – 0.40)] = 33.33%
Because the CM% is only 31.4%, no level of sales would generate net income equal to, on a pre-tax basis, 33.33% of sales.

e. Variable cost savings (5,000 × $6.00) $ 30,000
Additional fixed costs (40,000)
Decrease in profit $(10,000)

The company should not buy the new sewing machine.

f. Existing CM per unit = $22
CM under proposal = ($70 × 0.90) – $48 = $15
Total CM under proposal (3,000 × 1.30 × $15) $ 58,500
Existing CM (3,000 × $22) (66,000)
Change in CM $ (7,500)
Change in fixed costs $(10,000)
Change in net earnings before taxes $(17,500)

No, these two changes should not be made because they would lower pre-tax profits by $17,500 relative to existing levels.

41. a. Total sales price per bag:
   Commercial ($5,600 × 1) $5,600
   Residential ($1,800 × 3) 5,400 $11,000
Total variable costs per bag:
   Commercial ($3,800 × 1) $3,800
   Residential ($1,000 × 3) 3,000 (6,800)
Total contribution margin $ 4,200

Break-even point in units = $8,400,000 ÷ $4,200 = 2,000 bags
   Commercial: 2,000 × 1 = 2,000 mowers
   Residential: 2,000 × 3 = 6,000 mowers

b. ($8,400,000 + $1,260,000) ÷ $4,200 = 2,300 bags
Commercial: $2,300 \times 1 = 2,300$ mowers
Residential: $2,300 \times 3 = 6,900$ mowers

c. Pre-tax equivalent of $1,008,000$ after-tax $= 1,008,000 \div (1 - 0.40) = 1,680,000$
\[(8,400,000 + 1,680,000) \div 4,200 = 2,400 \text{ bags}\]
Commercial: $2,400 \times 1 = 2,400$ mowers
Residential: $2,400 \times 3 = 7,200$ mowers

d. Let $X =$ number of bags that must be sold to produce pre-tax earnings equaling 12 percent of sales revenue, then:
\[4,200X - 8,400,000 = 0.12(11,000X)\]
\[X = 2,917 \text{ bags (rounded)}\]
Commercial: $2,917 \times 1 = 2,917$ mowers
Residential: $2,917 \times 3 = 8,751$ mowers

e. Convert the after-tax return to a pre-tax rate of return:
\[0.08 \div (1 - 0.40) = 13\% \text{ (rounded)}\]
\[4,200X - 8,400,000 = 0.13(11,000X)\]
\[X = 3,032 \text{ bags (rounded)}\]
Commercial: $3,032 \times 1 = 3,032$ mowers
Residential: $3,032 \times 3 = 9,096$ mowers

42. a.

<table>
<thead>
<tr>
<th></th>
<th>Ducks</th>
<th>Ducklings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$24.00</td>
<td>$12.00</td>
</tr>
<tr>
<td>Variable costs</td>
<td>$(12.00)$</td>
<td>$(8.00)$</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>$12.00</td>
<td>$4.00</td>
</tr>
<tr>
<td>Mix</td>
<td>$\times 1$</td>
<td>$\times 5$</td>
</tr>
<tr>
<td>Total contribution margin</td>
<td>$12.00</td>
<td>$20.00</td>
</tr>
</tbody>
</table>

The average contribution margin ratio is $32 \div 84 = 38.1\%$ (rounded)

b. Break-even point $= 288,000 \div 32 = 9,000$ bags per year or 750 bags a month
   Ducks: $750 \times 1 = 750$ per month
   Ducklings: $750 \times 5 = 3,750$ per month

c. Target profit is $96,000 \times 12 = 1,152,000$
\[(288,000 + 1,152,000) \div 32 = 45,000 \text{ bags per year or 3,750 bags a month.}\]
   Ducks: $3,750 \times 1 = 3,750$ per month
   Ducklings: $3,750 \times 5 = 18,750$ per month

d. Target profit after tax is $31,680.$
Pre-tax profit is $31,680 \div (1 - 0.40) = 52,800$ monthly or $633,600$ per year.
Break-even $= (633,600 + 288,000) \div 48 = 19,200$ bags per year, or 1,600 per month

<table>
<thead>
<tr>
<th>Units</th>
<th>Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Ducks (19,200 × $24) 19,200 $ 460,800
Ducklings (19,200 × 9 × $12) 172,800 2,073,600
Total $2,534,400

\[
\text{e. } \left( \frac{[288,000 + (8,500 \times 12)]}{[12 + (8 \times 5)]} \right) = \frac{288,000 + 102,000}{52} = 7,500
\]

Yes, the company would want to make the change because the break-even point is reduced from 9,000 mix units to 7,500 mix units.