3-28 (30 min.) Sales mix, new and upgrade customers.

1.

	New Customers	Upgrade Customers
USP	$210	$120
UVC	90	40
UCM	120	80

Let S = Number of upgrade customers
$1.5S$ = Number of new customers
Revenues – Variable costs – Fixed costs = Operating income
$[\$210\ (1.5S) + \$120S] - [\$90\ (1.5S) + \$40S] - \$14{,}000{,}000 = OI$
$\$435S - \$175S - \$14{,}000{,}000 = OI$
Breakeven point is 134,616 units when OI = 0

$$\begin{aligned} \$260S &= \$14{,}000{,}000 \\ S &= 53{,}846 \\ 1.5S &= 80{,}770 \\ & 134{,}616 \end{aligned}$$

Check

Revenues ($\$210 \times 80{,}770$; $\$120 \times 53{,}846$)	$23,423,220
Variable costs ($\$90 \times 80{,}770$; $\$40 \times 53{,}846$)	9,423,140
Contribution margin	14,000,080
Fixed costs	14,000,000
Operating income (subject to rounding)	$ 0

2. When 200,000 units are sold, mix is:

New customers ($60\% \times 200{,}000$)	120,000
Upgrade customers ($40\% \times 200{,}000$)	80,000

Revenues ($\$210 \times 120{,}000$; $\$120 \times 80{,}000$)	$34,800,000
Variable costs ($\$90 \times 120{,}000$; $\$40 \times 80{,}000$)	14,000,000
Contribution margin	20,800,000
Fixed costs	14,000,000
Operating income	$ 6,800,000

3a. Let S = Number of upgrade customers
then S = Number of new customers

$[\$210S + \$120S] - [\$90S + \$40S] - \$14{,}000{,}000 = OI$

$$\begin{aligned} 330S - 130S &= \$14{,}000{,}000 \\ 200S &= \$14{,}000{,}000 \\ S &= 70{,}000 \\ S &= 70{,}000 \\ & 140{,}000 \text{ units} \end{aligned}$$

Check

Revenues ($210 × 70,000; $120 × 70,000)	$23,100,000
Variable costs ($90 × 70,000; $40 × 70,000)	9,100,000
Contribution margin	14,000,000
Fixed costs	14,000,000
Operating income	$ 0

3b. Let S = Number of upgrade customers
then $9S$ = Number of new customers

$[\$210 (9S) + \$120S] – [\$90 (9S) + \$40S] – \$14,000,000 = OI$

$2{,}010S – 850S = \$14{,}000{,}000$

$1{,}160S = \$14{,}000{,}000$

$S = 12{,}069$

$9S = 108{,}621$

120,690 units

Check

Revenues ($210 × 108,621; $120 × 12,069)	$24,258,690
Variable costs ($90 × 108,621; $40 × 12,069)	10,258,650
Contribution margin	14,000,040
Fixed costs	4,000,000
Operating income (subject to rounding)	$ 0

3c. As Zapo increases its percentage of new customers, which have a higher contribution margin per unit than upgrade customers, the number of units required to break even decreases:

	New Customers	Upgrade Customers	Breakeven Point
Requirement 3(a)	50%	50%	140,000
Requirement 1	60	40	134,616
Requirement 3(b)	90	10	120,690

3-30 (20 min.) Gross margin and contribution margin.

1a.	Cost of Goods Sold	$1,600,000
	Fixed Manufacturing Costs	500,000
	Variable Manufacturing Costs	$1,100,000

Variable manufacturing costs per unit = $1,100,000 ÷ 200,000 = $5.50 per unit

1b.	Total marketing and distribution costs	$1,150,000
	Variable marketing and distribution (200,000 × $4)	800,000
	Fixed marketing and distribution costs	$ 350,000

2. Selling price = $2,600,000 ÷ 200,000 units = $13 per unit

$$\text{Contribution margin per unit} = \text{Selling price} - \text{Variable manufacturing costs per unit} - \text{Variable marketing and distribution costs per unit}$$
$$= \$13 - \$5.50 - \$4.00 = \$3.50$$

$$\text{Operating income} = \left(\text{Contribution margin per unit} \times \text{Sales quantity}\right) - \text{Fixed manufacturing costs} - \text{Fixed marketing and distribution costs}$$
$$= (\$3.50 \times 230{,}000) - \$500{,}000 - \$350{,}000$$
$$= -\$45{,}000$$

Foreman has confused gross margin with contribution margin. He has interpreted gross margin as if it was all variable, and interpreted marketing and distribution costs as all fixed. In fact, the manufacturing costs, subtracted from sales to calculate gross margin, and marketing and distribution costs contain both fixed and variable components.

3. Breakeven point in units $= \dfrac{\text{Fixed manufacturing, marketing and distribution costs}}{\text{Contribution margin per unit}}$

$= \dfrac{\$850{,}000}{\$3.50} = 242{,}858$ units (rounded up)

Breakeven point in revenues $= 242{,}858 \times \$13 = \$3{,}157{,}154.$

3-38 (30 min.) CVP analysis, income taxes, sensitivity.

1a. In order to break even, Almo Company must sell 500 units. This amount represents the point where revenues equal total costs.

Let Q denote the quantity of canopies sold.

Revenue	=	Variable costs + Fixed costs
\$400Q	=	\$200Q + \$100,000
\$200Q	=	\$100,000
Q	=	500 units

The calculation can also be expressed as

Breakeven	=	Fixed Costs ÷ Contribution margin per unit
	=	\$100,000 ÷ \$200
	=	500 units

1b. In order to achieve its net income objective, Almo Company must sell 2,500 units. This amount represents the point where revenues equal total costs plus the corresponding operating income objective to achieve net income of \$240,000.

Revenue	=	Variable costs + Fixed costs + Operating income
\$400Q	=	\$200Q + \$100,000 + [\$240,000 ÷ (1 – 0.4)]

$$\$400\,Q = \$200Q + \$100{,}000 + \$400{,}000$$
$$Q = \underline{2{,}500}\text{ units}$$

2. To achieve its net income objective, Almo Company should select the first alternative where the sales price is reduced by $40, and 2,700 units are sold during the remainder of the year. This alternative results in the highest net income and is the only alternative that equals or exceeds the company's net income objective. Calculations for the three alternatives are shown below.

Alternative 1

Revenues = ($400 × 350) + ($360 × 2,700) = $1,112,000
Variable costs = $200 × 3,050 = $610,000
Operating income = $1,112,000 – $610,000 – $100,000 = $402,000
Net income = $402,000 × (1 – 0.4) = $241,200

Alternative 2

Revenues = ($400 × 350) + ($370 × 2,200) = $954,000
Variable costs = ($200 × 350) + ($190 × 2,200) = $488,000
Operating income = $954,000 – $488,000 – $100,000 = $366,000
Net income = $366,000 × (1 – 0.4) = $219,600

Alternative 3

Revenues = ($400 × 350) + ($380 × 2,000) = $900,000
Variable costs = $200 × 2,350 = $470,000
Operating income = $900,000 – $470,000 – $90,000 = $340,000
Net income = $340,000 × (1 – 0.4) = $204,000

3-40 (15–25 min.) Sales mix, three products.

1. Let A = Number of units of A to break even
5A = Number of units of B to break even
4A = Number of units of C to break even

Contribution margin – Fixed costs = Zero operating income

$$\$3A + \$2(5A) + \$1(4A) - \$255{,}000 = 0$$
$$\$17A = \$255{,}000$$
$$A = 15{,}000\text{ units of A}$$
$$5A = 75{,}000\text{ units of B}$$
$$4A = 60{,}000\text{ units of C}$$
$$\text{Total} = 150{,}000\text{ units}$$

2. Contribution margin:

A: 20,000 × $3	$ 60,000	
B: 100,000 × $2	200,000	
C: 80,000 × $1	80,000	
Contribution margin		$340,000

Fixed costs		255,000
Operating income		$ 85,000

3. Contribution margin

A: 20,000 × $3	$ 60,000	
B: 80,000 × $2	160,000	
C: 100,000 × $1	100,000	
Contribution margin		$320,000
Fixed costs		255,000
Operating income		$ 65,000

Let A = Number of units of A to break even
4A = Number of units of B to break even
5A = Number of units of C to break even

Contribution margin – Fixed costs = Breakeven point

$$\$3A + \$2(4A) + \$1(5A) - \$255,000 = 0$$
$$\$16A = \$255,000$$
$$A = 15,938 \text{ units of A (rounded)}$$
$$4A = 63,752 \text{ units of B}$$
$$5A = 79,690 \text{ units of C}$$
$$\text{Total} = 159,380 \text{ units}$$

Breakeven point increases because the new mix contains less of the higher contribution margin per unit, product B, and more of the lower contribution margin per unit, product C.

3-44 (30-40 min.) CVP analysis, income taxes.

1. Revenues – Variable costs – Fixed costs $= \dfrac{\text{Target net income}}{1 - \text{Tax rate}}$

Let X = Net income for 2000

$$20,000(\$25.00) - 20,000(\$13.75) - \$135,000 = \frac{X}{1 - 0.40}$$
$$\$500,000 - \$275,000 - \$135,000 = \frac{X}{0.60}$$
$$\$300,000 - \$165,000 - \$81,000 = X$$
$$X = \$54,000$$

2. Let Q = Number of units to break even
$\$25.00Q - \$13.75Q - \$135,000 = 0$
$Q = \$135,000 \div \$11.25 = 12,000$ units

3. Let X = Net income for 2001

$$22,000(\$25.00) - 22,000(\$13.75) - (\$135,000 + \$11,250) = \frac{X}{1 - 0.40}$$

$$\$550{,}000 - \$302{,}500 - \$146{,}250 = \frac{X}{0.60}$$

$$\$101{,}250 = \frac{X}{0.60}$$

$$X = \$60{,}750$$

4. Let Q = Number of units to break even with new fixed costs of $146,250

$$\$25.00Q - \$13.75Q - \$146{,}250 = 0$$
$$Q = \$146{,}250 \div \$11.25 = 13{,}000 \text{ units}$$
$$\text{Revenues} = 13{,}000 \times \$25.00 = \$325{,}000$$

Alternatively, the computation could be $146,250 divided by the contribution margin percentage of 45% to obtain $325,000.

5. Let S = Required sales units to equal 2000 net income

$$\$25.00S - \$13.75S - \$146{,}250 = \frac{\$54{,}000}{0.6}$$
$$\$11.25S = \$236{,}250$$
$$S = 21{,}000 \text{ units}$$
$$\text{Revenues} = 21{,}000 \text{ units} \times \$25.00 = \$525{,}000$$

6. Let A = Amount spent for advertising in 2001

$$\$550{,}000 - \$302{,}500 - (\$135{,}000 + A) = \frac{\$60{,}000}{0.6}$$
$$\$550{,}000 - \$302{,}500 - \$135{,}000 - A = \$100{,}000$$
$$\$550{,}000 - \$537{,}500 = A$$
$$A = \$12{,}500$$