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CHAPTER 2
THE NATURE OF COSTS

P 2-1: **Solution to Darien Industries** (10 minutes)
[Relevant costs and benefits]

Current cafeteria income		
Sales	$12,000	
Variable costs (40% × 12,000)	(4,800)	
Fixed costs	(4,700)	
Operating income		$2,500
Vending machine income		
Sales (12,000 × 1.4)	$16,800	
Darien's share of sales		
(.16 × $16,800)		2,688
Increase in operating income		$ 188

P 2-2: **Negative Opportunity Costs** (10 minutes)
[Opportunity cost]

Yes, when the most valuable alternative to a decision is a net cash outflow that would have occurred is now eliminated. The opportunity cost of that decision is negative (an opportunity benefit). For example, suppose you own a house with an in-ground swimming pool you no longer use or want. To dig up the pool and fill in the hole costs $3,000. You sell the house instead and the new owner wants the pool. By selling the house, you avoid removing the pool and you save $3,000. The decision to sell the house includes an opportunity benefit (a negative opportunity cost) of $3,000.

P 2-3: **Solution to NPR** (10 minutes)
[Opportunity cost of radio listeners]

The quoted passage ignores the opportunity cost of listeners' having to forego normal programming for on-air pledges. While such fundraising campaigns may have a low out-of-pocket cost to NPR, if they were to consider the listeners' opportunity cost, such campaigns may be quite costly.

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P 2-4: **Solution to Silky Smooth Lotions** (15 minutes)
[Break even with multiple products]

Given that current production and sales are: 2,000, 4,000, and 1,000 cases of 4, 8, and 12 ounce bottles, construct of lotion *bundle* to consist of 2 cases of 4 ounce bottles, 4 cases of 8 ounce bottles, and 1 case of 12 ounce bottles. The following table calculates the break-even number of lotion bundles to break even and hence the number of cases of each of the three products required to break even.

Per Case	**4 ounce**	**8 ounce**	**12 ounce**	**Bundle**
Price	$36.00	$66.00	$72.00	
Variable cost	$13.00	$24.50	$27.00	
Contribution margin	$23.00	$41.50	$45.00	
Current production	2000	4000	1000	
Cases per bundle	2	4	1	
Contribution margin per bundle	$46.00	$166.00	$45.00	$257.00
Fixed costs				$771,000
Number of bundles to break even				3000
Number of cases to break even	6000	12000	3000	

P 2-5: **Solution to J. P. Max Department Stores** (15 minutes)
[Opportunity cost of retail space]

	Home Appliances	Televisions
Profits after fixed cost allocations	$64,000	$82,000
Allocated fixed costs	7,000	8,400
Profits before fixed cost allocations	71,000	90,400
Lease Payments	72,000	86,400
Forgone Profits	– $1,000	$ 4,000

We would rent out the Home Appliance department, as lease rental receipts are more than the profits in the Home Appliance Department. On the other hand, profits generated by the Television Department are more than the lease rentals if leased out, so we continue running the TV Department. However, neither is being charged inventory holding costs, which could easily change the decision.

Also, one should examine externalities. What kind of merchandise is being sold in the leased store and will this increase or decrease overall traffic and hence sales in the other departments?

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P 2-6: **Solution to Vintage Cellars** (15 minutes)
[Average versus marginal cost]

a. The following tabulates total, marginal and average cost.

Quantity	Average Cost	Total Cost	Marginal Cost
1	$12,000	$12,000	
2	10,000	20,000	$8,000
3	8,600	25,800	5,800
4	7,700	30,800	5,000
5	7,100	35,500	4,700
6	7,100	42,600	7,100
7	7,350	51,450	8,850
8	7,850	62,800	11,350
9	8,600	77,400	14,600
10	9,600	96,000	18,600

b. Marginal cost intersects average cost at minimum average cost (MC=AC=$7,100). Or, at between 5 and 6 units AC = MC = $7,100.

c. At four units, the opportunity cost of producing and selling one more unit is $4,700. At four units, total cost is $30,800. At five units, total cost rises to $35,500. The incremental cost (i.e., the opportunity cost) of producing the fifth unit is $4,700.

d. Vintage Cellars maximizes profits ($) by producing and selling seven units.

Quantity	Average Cost	Total Cost	Total Revenue	Profit
1	$12,000	$12,000	$9,000	-$3,000
2	10,000	20,000	18,000	-2,000
3	8,600	25,800	27,000	1,200
4	7,700	30,800	36,000	5,200
5	7,100	35,500	45,000	9,500
6	7,100	42,600	54,000	11,400
7	7,350	51,450	63,000	11,550
8	7,850	62,800	72,000	9,200
9	8,600	77,400	81,000	3,600
10	9,600	96,000	90,000	-6,000

P 2-7: **Solution to ETB** (15 minutes)
[Minimizing average cost does not maximize profits]

a. The following table calculates that the average cost of the iPad bamboo case is minimized by producing 4,500 cases per month.

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	Monthly Production and Sales			
Production (units)	3,000	3,500	4,500	5,000
Total cost	$162,100	$163,000	$167,500	$195,000
Average cost	$54.03	$46.57	$37.22	$39.00

b. The following table calculates net income of the four production (sales) levels.

	Monthly Production and Sales			
Production (units)	3,000	3,500	4,500	5,000
Revenue	$195,000	$227,500	$292,500	$325,000
Total cost	162,100	163,000	167,500	195,000
Net income	$32,900	$64,500	$125,000	$130,000

Based on the above analysis, the profit maximizing production (sales) level is to manufacture and sell 5,000 iPad cases a month. Selecting the output level that minimizes average cost (4,500 cases) does not maximize profits.

P 2-8: Solution to Taylor Chemicals (15 minutes)
[Relation between average, marginal, and total cost]

a. Marginal cost is the cost of the next unit. So, producing two cases costs an additional $400, whereas to go from producing two cases to producing three cases costs an additional $325, and so forth. So, to compute the total cost of producing say five cases you sum the marginal costs of 1, 2, …, 5 cases and add the fixed costs ($500 + $400 + $325 + $275 + $325 + $1000 = $2825). The following table computes average and total cost given fixed cost and marginal cost.

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Quantity	Marginal Cost	Fixed Cost	Total Cost	Average Cost
1	$500	$1000	$1500	$1500.00
2	400	1000	1900	950.00
3	325	1000	2225	741.67
4	275	1000	2500	625.00
5	325	1000	2825	565.00
6	400	1000	3225	537.50
7	500	1000	3725	532.14
8	625	1000	4350	543.75
9	775	1000	5125	569.44
10	950	1000	6075	607.50

b. Average cost is minimized when seven cases are produced. At seven cases, average cost is $532.14.

c. Marginal cost always intersects average cost at minimum average cost. If marginal cost is above average cost, average cost is increasing. Likewise, when marginal cost is below average cost, average cost is falling. When marginal cost equals average cost, average cost is neither rising nor falling. This only occurs when average cost is at its lowest level (or at its maximum).

P 2-9: **Solution to Emrich Processing** (15 minutes)
[Negative opportunity costs]

Opportunity costs are usually positive. In this case, opportunity costs are negative (opportunity benefits) because the firm can avoid disposal costs if they accept the rush job.

The original $1,000 price paid for GX-100 is a sunk cost. The opportunity cost of GX-100 is -$400. That is, Emrich will increase its cash flows by $400 by accepting the rush order because it will avoid having to dispose of the remaining GX-100 by paying Environ the $400 disposal fee.

How to price the special order is another question. Just because the $400 disposal fee was built into the previous job does not mean it is irrelevant in pricing this job. Clearly, one factor to consider in pricing this job is the reservation price of the customer proposing the rush order. The $400 disposal fee enters the pricing decision in the following way: Emrich should be prepared to **pay** up to $399 less any out-of-pocket costs to get this contract.

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P 2-10: **Solution to Verdi Opera or Madonna?** (15 minutes)
[Opportunity cost of attending a Madonna concert]

If you attend the Verdi opera, you forego the $200 in benefits (i.e., your willingness to pay) you would have received from going to see Madonna. You also save the $160 (the costs) you would have paid to see Madonna. Since an avoided benefit is a cost and an avoided cost is a benefit, the opportunity cost of attending the opera (the value you forego by not attending the Madonna concert) is $40 – i.e., the net benefit foregone. Your willingness to pay $30 for the Verdi opera is unrelated to the costs and benefits of foregoing the Madonna concert.

P 2-11: **Solution to Dod Electronics** (15 minutes)
[Estimating marginal cost from average cost]

a. Dod should accept Xtron's offer. The marginal cost to produce the 10,000 chips is unknown. But since management is convinced that average cost is falling, this means that marginal cost is less than average cost. The only way that average cost of $35 can fall is if marginal cost is less than $35. Since Xtron is willing to pay $38 per chip, Dod should make at least $30,000 on this special order (10,000 x $3). This assumes (i) that average cost continues to fall for the next 10,000 units (i.e., it assumes that at, say 61,000 units, average cost does not start to increase), and (ii) there are no other costs of taking this special order.
b. Dod can't make a decision based on the information. Since average cost is increasing, we know that marginal cost is greater than $35 per unit. But we don't know how much larger. If marginal cost at the 60,001th unit is $35.01, average cost is increasing and if marginal cost of the 70,000th unit is less than $38, then DOD should accept the special order. But if marginal cost at the 60,001th unit is $38.01, the special order should be rejected.

P 2-12: **Solution to Napoli Pizzeria** (15 minutes)
[Break-even analysis]

a. The break-even number of servings per month is:

($300 – $75) ÷ ($3 – $1)
= ($225) ÷ ($2)
= 112.5 servings

b. To generate $1,000 after taxes Gino needs to sell 881.73 servings of espresso/cappuccino.

Profits after tax = [Revenues – Expenses] x (1– 0.35)
$1,000 = [$3N + $75 – $1N – $300] x (1– 0.35)
$1,000 = [$2N – $225] x .65
$1,000 ÷ .65 = $2N – $225

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$1,538.46 = $2N – $225
$2N = $1,763.46
N = 881.73

P 2-13: **Solution to JLT Systems** (20 minutes)
[Cost-volume-profit analysis]

a. Since we know that average cost is $2,700 at 200 unit sales, then Total Cost (TC) divided by 200 is $2,700. Also, since JLT has a linear cost curve, we can write, TC=FC+VxQ where FC is fixed cost, V is variable cost per unit, and Q is quantity sold and installed. Given FC = $400,000, then:

TC/Q = (FC+VxQ)/Q = AC
($400,000 + 200 V) / 200 = $2,700
$400,000 + 200 V = $540,000
200 V = $140,000
V = $700

b. Given the total cost curve from part a, a tax rate of 40%, and a $2,000 selling price, and an after-tax profit target of $18,000, we can write:

($2000 Q - $400,000 - $700 Q) x (1- 40%) = $18,000
1300 Q -400,000 = 18,000 / .60 = 30,000
1300 Q = 430,000
Q = 330.8

In other words, to make an after-tax profit of $18,000, JLT must have 330.8 sales and installs per month.

c. The simplest (and fastest way) to solve for the profit maximizing quantity given the demand curve is to write the profit equation, take the first derivative, set it to zero, and solve for Q.

Total Profit = (2600 - 2Q) Q -400,000 -700 Q
First derivative: 2600 - 4Q -700 = 0
4Q = 1900
Q = 475

The same solution is obtained if you set marginal revenue (where MR is 2600 - 4Q) equal to marginal cost (700), and again solve for Q, or

2600 - 4Q = 700
Q = 475

The more laborious solution technique is to use a spreadsheet and identify the profit maximizing price quantity combination.

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Quantity	Price	Revenue	Total Cost	Profit
250	$2,100	$525,000	$575,000	($50,000)
275	2,050	563,750	592,500	(28,750)
300	2,000	600,000	610,000	(10,000)
325	1,950	633,750	627,500	6,250
350	1,900	665,000	645,000	20,000
375	1,850	693,750	662,500	31,250
400	1,800	720,000	680,000	40,000
425	1,750	743,750	697,500	46,250
450	1,700	765,000	715,000	50,000
475	1,650	783,750	732,500	51,250
500	1,600	800,000	750,000	50,000
525	1,550	813,750	767,500	46,250
550	1,500	825,000	785,000	40,000

As before, we again observe that 475 sales and installs maximize profits.

P 2-14: **Solution to Volume and Profits** (15 minutes)
[Cost-volume-profit]

a. False.

b. Write the equation for firm profits:

$$\text{Profits} = P \times Q - (FC - VC \times Q) = Q(P - VC) - FC$$

$$= Q(P - VC) - (FC \div Q)Q$$

Notice that average fixed costs per unit (FC÷Q) falls as Q increases, but with more volume, you have more fixed cost per unit such that (FC÷Q) × Q = FC. That is, the decline in average fixed cost per unit is exactly offset by having more units.

Profits will increase with volume even if the firm has no fixed costs, as long as price is greater than variable costs. Suppose price is $3 and variable cost is $1. If there are no fixed costs, profits increase $2 for every unit produced. Now suppose fixed cost is $50. Volume increases from 100 units to 101 units. Profits increase from $150 ($2 ×100 - $50) to $152 ($2 × 101 - $50). The change in profits ($2) is the contribution margin. It is true that average unit cost declines from $1.50 ([100 × $1 + $50]÷100) to $1.495 ([101 × $1 + $50]÷101). However, this has nothing to do with the increase in profits. The increase in profits is due solely to the fact that the contribution margin is positive.

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Alternatively, suppose price is \$3, variable cost is \$3, and fixed cost is \$50. Contribution margin in this case is zero. Doubling output from 100 to 200 causes average cost to fall from \$3.50 ([100 × \$3 + \$50]÷100) to \$3.25 ([200 × \$3 + \$50]÷200), but profits are still zero.

P 2-15: Solution to American Cinema (20 minutes)
[Break-even analysis for an operating decision]

a. Both movies are expected to have the same ticket sales in weeks one and two, and lower sales in weeks three and four.

Let Q_1 be the number of tickets sold in the first two weeks, and Q_2 be the number of tickets sold in weeks three and four. Then, profits in the first two weeks, π_1, and in weeks three and four, π_2, are:

$$\pi_1 = .1(6.5Q_1) - \$2{,}000$$

$$\pi_2 = .2(6.5Q_2) - \$2{,}000$$

"I Do" should replace "Paris" if

$$\pi_1 > \pi_2, \text{ or}$$

$$.65Q_1 - 2{,}000 > 1.3Q_2 - 2{,}000, \text{ or}$$

$$Q_1 > 2Q_2.$$

In other words, they should keep "Paris" for four weeks unless they expect ticket sales in weeks one and two of "I Do" to be twice the expected ticket sales in weeks three and four of "Paris."

b. Taxes of 30 percent do not affect the answer in part (a).

c. With average concession profits of \$2 per ticket sold,

$$\pi_1 = .65Q_1 + 2Q_1 - 2{,}000$$

$$\pi_2 = 1.30Q_2 + 2Q_2 - 2{,}000$$

$\pi_1 > \pi_2$ if

$$2.65Q_1 > 3.3Q_2$$

$$Q_1 > 1.245Q_2$$

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Now, ticket sales in the first two weeks need only be about 25 percent higher than in weeks three and four to replace "Paris" with "I Do."

P 2-16: **Solution to Home Auto Parts** (20 minutes)
[Opportunity cost of retail display space]

a. The question involves computing the opportunity cost of the special promotions being considered. If the car wax is substituted, what is the forgone profit from the dropped promotion? And which special promotion is dropped? Answering this question involves calculating the contribution of each planned promotion. The opportunity cost of dropping a planned promotion is its forgone contribution: (retail price less unit cost) × volume. The table below calculates the expected contribution of each of the three planned promotions.

Planned Promotion Displays For Next Week			
	End-of-Aisle	Front Door	Cash Register
Item	Texcan Oil	Wiper blades	Floor mats
Projected volume (week)	5,000	200	70
Sales price	69¢/can	$9.99	$22.99
Unit cost	62¢	$7.99	$17.49
Contribution margin	7¢	$2.00	$5.50
Contribution (margin × volume)	$350	$400	$385

Texcan oil is the promotion yielding the lowest contribution and therefore is the one Armadillo must beat out. The contribution of Armadillo car wax is:

Selling price	$2.90
less: Unit cost	$2.50
Contribution margin	$0.40
× expected volume	800
Contribution	$ 320

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Clearly, since the Armadillo car wax yields a lower contribution margin than all three of the existing planned promotions, management should not change their planned promotions and should reject the Armadillo offer.

b. With 50 free units of car wax, Armadillo's contribution is:

Contribution from 50 free units (50 × $2.90)			$145
Contribution from remaining 750 units:			
Selling price	$2.90		
less: Unit cost	$2.50		
Contribution margin		$0.40	
× expected volume		750	300
Contribution			$445

With 50 free units of car wax, it is now profitable to replace the oil display area with the car wax. The opportunity cost of replacing the oil display is its forgone contribution ($350), whereas the benefits provided by the car wax are $445.

Additional discussion points raised

(i) This problem introduces the concept of the opportunity cost of retail shelf space. With the proliferation of consumer products, supermarkets' valuable scarce commodity is shelf space. Consumers often learn about a product for the first time by seeing it on the grocery shelf. To induce the store to stock an item, food companies often give the store a number of free cases. Such a giveaway compensates the store for allocating scarce shelf space to the item.

(ii) This problem also illustrates that retail stores track contribution margins and volumes very closely in deciding which items to stock and where to display them.

(iii) One of the simplifying assumptions made early in the problem was that the sale of the special display items did not affect the unit sales of competitive items in the store. Suppose that some of the Texcan oil sales came at the expense of other oil sales in the store. Discuss how this would alter the analysis.

P 2-17: Solution to Stahl Inc. (25 minutes)
[Finding unknown quantities in cost-volume-profit analysis]

The formula for the break-even quantity is

Break-even Q = Fixed Costs / (P - V)
where: P = price per unit

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V = variable cost per unit

Substituting the data into this equation yields

24,000 = F / (P - 12)
F = 24,000 P - 288,000 (1)

From the after tax data we can write down the following equation:

Profits after tax = (1-T) (P Q - V Q - Fixed Cost)
Where T = tax rate = 0.30

33,600 = (1 - 0.30) (30,000 P - 30,000 V - F)
33,600 = 0.70 (30,000 P - 30,000 x 12 - F)
48,000 =30,000 P - 360,000 - F

Substituting in eq. (1) from above yields:

48,000 =30,000 P - 360,000 - (24,000 P - 288,000)
408,000 =30,000 P - 24,000 P + 288,000
P = $20

Substituting P = $20 back into eq. (1) from above yields:
F = 24,000 x 20 - 288,000
F = $192,000

P 2-18: **Solution to Affording a Hybrid** (20 minutes)
[Break-even analysis]

a. The $1,500 upfront payment is irrelevant since it applies to both alternatives. To find the break-even mileage, *M*, set the monthly cost of both vehicles equal:

$$\$499 + M\left(\frac{\$3.00}{50}\right) = \$399 + M\left(\frac{\$3.00}{25}\right)$$

$$\$100 = M(.12 - .06)$$

$$\mathbf{M} = \$100/.06 = 1{,}666.66 \text{ miles per month}$$

Miles per year = $1{,}666.66 \times 12 = 20{,}000$

b. $$\$499 + M\left(\frac{\$4.00}{50}\right) = 399 + M\left(\frac{\$4.00}{25}\right)$$

$$\$100 = M(.16 - .08)$$

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M = \$100/.08 = 1,250 miles per month

Miles per year = 1,250 × 12 = 15,000 miles per year

P 2-19: Solution to Easton Diagnostics (20 minutes)
[Break-even and operating leverage]

a. As computed in the following table, if the proposal is accepted, the break-even point falls from 7,000 blood samples to 6,538 samples as computed in the following table:

	Current Equipment	Proposed equipment
Price	\$750	\$750
Variable costs:		
Direct labor	175	175
Direct material	125	135
Royalty fee	150	180
Total variable costs	\$450	\$490
Fixed costs:		
Lease	\$1,600,000	\$1,200,000
Supervision	400,000	400,000
Occupancy costs	100,000	100,000
Fixed costs	\$2,100,000	\$1,700,000
Contribution margin	\$300	\$260
Break-even	7,000	6,538

b. The table below shows that at an annual volume of 10,300 blood samples, Easton makes \$12,000 more by staying with its existing equipment than by accepting the competing vendor's proposal. However, such a recommendation ignores the fact that staying with the existing lease adds \$400,000 of operating leverage to Easton compared to the vendor's proposal, thereby increasing the chance of financial distress. If Easton has sufficient net cash flow that the chance of financial distress is very remote, then there is no reason to worry about the higher operating leverage of the existing lease and management should reject the proposal. However, if Easton's net cash flow has significant variation such that financial distress is a concern, then the proposed equipment lease that lowers operating leverage by \$400,000 should be accepted if the expected costs of financial distress fall by more than \$12,000 per year.

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	Current Equipment	Proposed equipment
Price	$750	$750
Total variable costs	450	490
Contribution margin	$300	$260
Fixed costs	$2,100,000	$1,700,000
Annual volume	10,300	10,300
Total profit	$990,000	$978,000

P2-20: **Solution to Spa Salon** (20 minutes)
[Break-even analysis with two products]

The problem states that the Spa performed 90 massages and 30 manicures last month. From these data and the revenue numbers we can compute the price of a massage is $90 ($8,100 / 90) and the price of a manicure is $50 ($1,500 /30). Similarly, the variable cost of a massage is $40 ($3,600/90) and a manicure is $20 ($600/30), respectively.

Since one out of every three massage clients also purchases a manicure, a bundle of products consists of 3 massages and one manicure (with revenues of $320 = 3 × $90 + $50 and variable cost of $140 = 3 × $40 + 20).

We can now compute the break-even number of bundles as

Break-even bundles = FC/(P-VC) = $7,020/($320-$140)
= 39 bundles

39 bundles consists of 39 × 3 massages = 117 massages
39 bundles consists of 39 × 1 manicures = 39 manicures

To check these computations, prepare an income statement using 117 massages and 39 manicures

Massage revenue (117 × $90)	$10,530	
Manicure revenue (39 × $50)	1,950	
Total revenue		$12,480
Massage variable cost (117 × $40)	4680	
Manicure variable cost (39 × $20)	780	
Fixed cost	7,020	
Total costs		$12,480
Profit		$0

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P 2-21: Solution to Manufacturing Cost Classification (20 minutes)
[Period versus product costs]

	Period Cost	Product Cost	Direct Labor	Direct Material	Over-head
Advertising expenses for DVD	x				
Depreciation on PCs in marketing dept.	x				
Fire insurance on corporate headquarters	x				
Fire insurance on plant		x			x
Leather carrying case for the DVD		x		x	
Motor drive (externally sourced)		x		x	
Overtime premium paid assembly workers		x			x
Plant building maintenance department		x			x
Plant security guards		x			x
Plastic case for the DVD		x		x	
Property taxes paid on corporate office	x				
Salaries of public relations staff	x				
Salary of corporate controller	x				
Wages of engineers in quality control dept.		x			x
Wages paid assembly line employees		x	x		
Wages paid employees in finished goods warehouse	x				

P 2-22: Solution to Australian Shipping (20 minutes)
[Negative transportation costs]

a. Recommendation: The ship captain should be indifferent (at least financially) between using stone or wrought iron as ballast. The total cost (£550) is the same.

Stone as ballast

Cost of purchasing and loading stone	£40
Cost of unloading and disposing of stone	15
	£55
Ton required	× 10
Total cost	£550

Wrought iron as ballast

Number of bars required:	
10 tons of ballast × 2,000 pounds/ton	20,000 pounds
Weight of bar	÷ 20 pounds/bar
	1,000 bars
Loss per bar (£1.20 – £0.90)	£0.30
× number of bars	1,000
	£300
Cost of loading bars (£15 ×10)	150
Cost of unloading bars (£10 ×10)	100

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Total cost	£550

b. The price is lower in Sydney because the supply of wrought iron relative to demand is greater in Sydney because of wrought iron's use as ballast. In fact, in equilibrium, ships will continue to import wrought iron as ballast as long as the relative price of wrought iron in London and Sydney make it cheaper (net of loading and unloading costs) than stone.

P 2-23: Solution to iGen3 (20 minutes)
[Cost-volume-profit and break-even on a lease contract]

a and b. Break-even number of impressions under Options A and B:

	Option A	**Option B**
Monthly fixed lease cost	$10,000	$0
Labor/month	5,000	5,000
Total fixed cost/month	$15,000	$5,000
Variable lease cost/impression	$0.01	$0.03
Ink/impression	0.02	0.02
Total variable cost	$0.03	$0.05
Price/impression	$0.08	$0.08
Contribution margin/impression	$0.05	$0.03
Break-even number of impressions	300,000	166,667

c. The choice of Option A or B depends on the expected print volume ColorGrafix forecasts. Choosing among different cost structures should not be based on break-even but rather which one results in lower total cost. Notice the two options result in equal cost at 500,000 impressions:

$$\begin{aligned} \$15{,}000 + \$0.03\,Q &= \$5{,}000 + \$0.05\,Q \\ \$10{,}000 &= \$0.02 \\ Q &= 500{,}000 \end{aligned}$$

Therefore, if ColorGrafix expects to produce more than 500,000 impressions it should choose Option A and if fewer than 500,000 impressions are expected ColorGrafix should choose Option B.

d. At 520,000 expected impressions, Option A costs $30,600 ($15,000 + .03 × 520,000), whereas Option B costs $31,000 ($5,000 + .05 × 520,000). Therefore, Option A costs $400 less than Option B. However, Option A generates much more operating leverage ($10,000/month), thereby increasing the expected costs of financial distress (and bankruptcy). Since ColorGrafix has substantial financial

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leverage, they should at least consider if it is worth spending an additional $400 per month and choose Option B to reduce the total amount of leverage (operating and financial) in the firm. Without knowing precisely the magnitude of the costs of financial distress, one can not say definitively if the $400 additional cost of Option B is worthwhile.

P 2-24: **Solution to Adapt, Inc.** (20 minutes)
[Cost-volume-profit and operating leverage]

a. NIAT = (PQ – VQ –F)(1-T) and (PQ – VQ) / PQ = 70%

Where:
NIAT = Net income after taxes
P = Price
Q= Quantity
V= variable cost per unit
F = Fixed cost
T= Tax rate

$$
\begin{aligned}
\$1.700 &= (\$6.200 - VQ - F)\,(1 - 0.4) \\
2.833 &= 6.200 - VQ - F \\
(PQ - VQ) / PQ &= 70\% \\
1 - VQ / PQ &= .70 \\
VQ / PQ &= .30 \\
VQ &= .30\,PQ = .30(6.200) = 1.860 \\
2.833 &= 6.200 - 1.860 - F \\
F &= 1.507
\end{aligned}
$$

b. Knowing DigiMem's fixed costs informs Adapt, Inc. about DigiMem's operating leverage. Knowing DigiMem's operating leverage helps Adapt design pricing strategies in terms of how DigiMem is likely to respond to price cuts. The higher DigiMem's operating leverage, the more sensitive DigiMem's cash flows are to downturns. If DigiMem has a lot of operating leverage, they will not be able to withstand a long price war. Also, knowing DigiMem's fixed costs is informative about how much capacity they have and hence what types of strategies they may be pursuing in the future.

P 2-25: **Solution to Tesla Motors** (30 minutes)
[Estimating fixed and variable costs from public data]

a. From the problem we are given the number of cars per month to break-even (400) and the loss generated at 200 cars per month. We first must convert these weekly output figures to quarterly amounts:

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200 cars per week = 2500 cars per quarter (200 × 50 ÷ 4)
400 cars per week = 5000 cars per quarter (400 × 50 ÷ 4)

Using these quarterly production data we can write down the following two equations based on last month's loss and the break-even condition:

(P-V) × Q – FC = profits/loss
($75,000-V) × 2,500 – FC = -$49,000,000 (1)
($75,000-V) × 5,000 – FC = $0 (2)

Subtracting equation (1) from equation (2) yields:
($75,000-V) × 2,500 = $49,000,000 (3)
$187,500,000 -2500 V = $49,000,000
-2500 V = -$138,500,000
V = $55,400
Substituting V= $55,400 into equation (2) and solving for FC yields:
($75,000 - $55,400) × 2,500 – FC = 0
FC = $98,000,000 per quarter

b. My firm would be interested in knowing about Tesla's fixed and variable cost structure for a couple of reasons. If we decide to enter the high performance luxury battery-powered car market and compete head-to-head with Tesla, knowing their variable cost per car gives us valuable competitive information in terms of how low Tesla can price their cars and still cover their variable costs. Knowing Tesla's fixed costs helps us estimate what the fixed costs we will need to make each quarter to produce electric cars.

P 2-26: **Solution to Oppenheimer Visuals** (25 minutes)
[Choosing the optimum technology and "all costs are variable in the long run"]

a. The following table shows that Technology 2 yields the highest firm value:

			Technology 1		Technology 2	
Q	Price	Revenue	Total cost	Profit	Total cost	Profit
60	$760	$45600	$46000	$-400	$40000	$5600
65	740	48100	47000	1100	42000	6100
70	720	50400	48000	2400	44000	6400
75	700	52500	49000	3500	46000	6500
80	680	54400	50000	4400	48000	6400
85	660	56100	51000	5100	50000	6100
90	640	57600	52000	5600	52000	5600
95	620	58900	53000	5900	54000	4900
100	600	60000	54000	6000	56000	4000

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105	580	60900	55000	5900	58000	2900
110	560	61600	56000	5600	60000	1600

b. They should set the price at $700 per panel and sell 75 panels per day.

c. The fixed cost of technology 2 of $16,000 per day was chosen as part of the profit maximizing production technology. Oppenheimer could have chosen technology 1 and had a higher fixed cost and lower variable cost. But given the demand curve the firm faces, they chose technology 2. So, at the time they selected technology 2, the choice of fixed costs had not yet been determined and was hence "variable" at that point in time.

P 2-27: Solution to Eastern University Parking (25 minutes)
[Opportunity cost of land]

The University's analysis of parking ignores the opportunity cost of the land on which the surface space or parking building sits. The $12,000 cost of an enclosed parking space is the cost of the structure only. The $900 cost of the surface space is the cost of the paving only. These two numbers do not include the opportunity cost of the land which is being consumed by the parking. The land is assumed to be free. Surface spaces appear cheaper because they consume a lot more "free" land. A parking garage allows cars to be stacked on top of each other, thereby allowing less land to be consumed. The correct analysis would impute an opportunity cost to each potential parcel of land on campus, and then build this cost into both the analysis and parking fees. The differential cost of each parcel would take into account the additional walking time to the center of campus. Remote lots would have a lower opportunity cost of land and would provide less expensive parking spaces.

Another major problem with the University's analysis is that parking prices should be set to allocate a scarce resource to those who value it the highest. If there is an excess demand for parking (i.e., queues exist), then prices should be raised to manage the queue and thereby allocate the scarce resource. Basing prices solely on costs does not guarantee that any excess supply or demand is eliminated.

Other relevant considerations in the decision to build a parking garage include:

1. The analysis ignores the effect of poor/inconvenient parking on tuition revenues.
2. Snow removal costs are likely lower, but other maintenance costs are likely to be higher with a parking garage.

The most interesting aspect of this question is "Why have University officials systematically overlooked the opportunity cost of the land in their decision-making process?" One implication of past University officials' failure to correctly analyze the parking situation is the "dumb-administrator" hypothesis. Under this scenario, one

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concludes that all past University presidents were ignorant of the concept of opportunity cost and therefore failed to assign the "right" cost to the land.

The way to understand why administrators will not build a parking garage is to ask what will happen if a garage is built and priced to recover cost. The cost of the covered space will be in excess of $1,200 per year. Those students, faculty, and staff with a high opportunity cost of their time (who tend to be those with higher incomes) will opt to pay the significantly higher parking fee for the garage. Lower-paid faculty will argue the inequity of allowing the "rich" the convenience of covered parking while the "poor" are relegated to surface lots. Arguments will undoubtedly be made by some constituents that parking spots should not be allocated using a price system which discriminates against the poor but rather parking should be allocated based on "merit" to be determined by a faculty committee. Presidents of universities have risen to their positions by developing a keen sense of how faculty, students, and staff will react to various proposals. An alternative to the "dumb-administrator" hypothesis is the "rational self-interested administrator" hypothesis. Under this hypothesis, the parking garage is not built because the administrators are unwilling to bear the internal political ramifications of such a decision.

Finally, taxes play an important role in the University's decision not to build a parking garage. If faculty are to pay the full cost of the garage, equilibrium wage rates will have to rise to make the faculty member as well off at Eastern University paying for parking than at another university where parking is cheaper. Because employees are unable to deduct parking fees from their taxes, the University will have to increase salaries by the amount of the parking fees plus the taxes on the fees to keep the faculty indifferent about staying or leaving the University. Therefore, a parking garage paid for by the faculty (which means paid by the University) causes the government to raise more in taxes. The question then comes down to: is the parking garage the best use of the University's resources?

P2-28: **Solution to GRC** (30 minutes)
[Choosing alternative technologies with different operating leverage]

a. The two technologies have different operating leverages. In order to address which technology to choose, first compute each technology's fixed and variable cost. Select any two average costs from the table in the problem and solve for the FC and VC. For Hi Automation:

$365 = FC / 5 + VC	(definition of avg cost when Q=5)
$245 = FC / 10 + VC	(definition of avg cost when Q=10)
120 = FC / 5 - FC / 10	(subtract the 2nd eqn from the 1st eqn)
1200 = 2 FC - FC	(multiple each side by 10)
FC = $1,200	(solve for FC)
365 = 1200 / 5 + VC	(substitute FC=1200 into 1st eqn)
365 = 240 +VC	
VC = $125	

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Use the same approach to compute the FC and VC for Low Automation:

$295 = FC / 5 + VC	(definition of avg cost when Q=5)
$285 = FC / 10 + VC	(definition of avg cost when Q=10)
10 = FC / 5 - FC / 10	(subtract the 2nd eqn from the 1st eqn)
100 = 2 FC - FC	(multiple each side by 10)
FC = $100	(solve for FC)
295 = 100 / 5 + VC	(substitute FC=1200 into 1st eqn)
295 = 20 +VC	
VC = $275	

Since each technology has a different cost structure, each technology will have a different profit maximizing price-quantity relation. To see this, the following table computes the profits for each technology at various production levels:

Price	Quantity	Revenue	Total Cost Hi Auto	Profits Hi Auto	Total Cost Low Auto	Profits Low Auto
440	3	1320	1575	-255	925	395
420	4	1680	1700	-20	1200	480
400	5	2000	1825	175	1475	525
380	6	2280	1950	330	1750	530
360	7	2520	2075	445	2025	495
340	8	2720	2200	520	2300	420
320	9	2880	2325	555	2575	305
300	10	3000	2450	550	2850	150
280	11	3080	2575	505	3125	-45
260	12	3120	2700	420	3400	-280

From this table, we see that if Hi Auto is chosen, it yields a maximum profit of $555,000 whereas if Low auto is chosen, it yields a maximum profit of $530,000. Hi Auto yields $25,000 more profit than Low Auto. In this simplified problem where there is no uncertainty, GRC should adopt the Hi Auto technology.

If there is substantial risk in this wind turbine venture (as there likely will be), then GRC should consider the Lo Auto option because it lowers GRC's fixed cost structure, thereby reducing GRC's operating risk. Less operating leverage, like lower financial leverage, reduces the expected costs of financial distress. Lowering profits by $25,000 via Low Auto may be a cheap way to reduce operating risk.

NOTE: If the demand curve is used instead of the table, the profit maximizing quantity for Hi Auto is 9.375 machines and 5.625 machines for Lo Auto. At these output levels, Hi Auto yields total profits of $557,813 and Lo Auto yields total profits of $532,813. The difference is still $25,000.

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b. If Hi Auto is selected, then GRC should set the price of each gear machine at $320,000 and sell 9 machines per year. If Low Auto is selected, then GRC should set the price of each gear machine at $380,000 and sell 6 machines per year.

NOTE: If the demand curve is used instead of the table, the profit maximizing price for Hi Auto is $312,500 (500-20 x 9.375 machines) and $387,500 (500 - 20 x 5.625 machines) for Lo Auto.

P 2-29: Solution to Mastich Counters (25 minutes)
[Opportunity cost to the firm of workers deferring vacation time]

At the core of this question is the opportunity cost of workers deferring vacation.

The new policy was implemented because management believed it was costing the firm too much money when workers left with accumulated vacation and were paid. However, these workers had given Mastich in effect a loan. By not taking their vacation time as accrued, they stayed in their jobs and worked, allowing Mastich to increase its output without hiring additional workers, and without reducing output or quality. Mastich was able to produce more and higher quality output with fewer workers. Suppose a worker is paid $20 per hour this year and $20.60 next year. By deferring one vacation hour one year, the worker receives $20.60 when the vacation hour is taken next year. As long as average worker salary increases are less than the firm's cost of capital, the firm is better off by workers accumulating vacation time. The firm receives a loan from its workers at less than the firm's cost of capital.

Under the new policy, and especially during the phase-in period, Mastich has difficulty meeting production schedules and quality standards as more workers are now on vacation at any given time. To overcome these problems, the size of the work force will have to increase to meet the same production/quality standards. If the size of the work force stays the same, but more vacation time is taken, output/quality will fall.

Manager A remarked that workers were refreshed after being forced to take vacation. This is certainly an unintended benefit. But it also is a comment about how some supervisors are managing their people. If workers are burned out, why aren't their supervisors detecting this and changing job assignments to prevent it? Moreover, how is burnout going to be resolved after the phase-in period is over and workers don't have excess accumulated vacation time?

The new policy reduces the workers' flexibility to accumulate vacation time, thereby reducing the attractiveness of Mastich as an employer. Everything else equal, workers will demand some offsetting form of compensation or else the quality of Mastich's work force will fall.

Many of the proposed benefits, namely reducing costs, appear illusory. The opportunity costs of the new policy are reduced output, schedule delays, and possible quality problems. If workers under the new policy were forfeiting a significant number of vacation hours, these lost hours "profit" the firm. But, as expected from rational workers, very few vacation hours are being forfeited (as mentioned by Manager C).

However, there is one very real benefit of the new policy – less fraud and embezzlement. One key indicator of fraud used by auditors is an employee who never takes a vacation. Forced vacations mean other people have to cover the person's job.

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During these periods, fraud and embezzlement often are discovered. Another benefit of this new policy is it reduces the time employees will spend lobbying their supervisors for extended vacations (in excess of three to four weeks). Finally, under the existing policy, employees tend to take longer average vacations (because workers have more accumulated vacation time). When a worker takes a long vacation, it is more likely the employee's department will hire a temporary or "float" person to fill in. With shorter vacations, the work of the person on vacation is performed by the remaining employees. Thus, the new policy reduces the slack (free time) of the work force and results in higher productivity.

P 2-30: **Solution to Prestige Products** (30 minutes)
[Effect of different technologies on break-even points]

a and b.

Technology	German	Swedish
Selling price	$12.00	$12.00
Variable cost	8.00	6.00
Contribution margin	$4.00	$6.00
Fixed cost	$500,000	$900,000
Break-even units (fixed cost/contribution margin)	125,000	150,000

c. It depends. The two technologies yield identical costs at 200,000 units:

$500,000 + $8 Q = $900,000 + $6 Q

Or, Q = 200,000

So, if annual sales are expected to be above 200,000 units, Prestige should lease the Swedish equipment and if sales are expected to be below 200,000 units Prestige should lease the German equipment. However, even if expected annual sales are slightly below 200,000 units, the Swedish equipment has higher capacity and can meet sales in excess of the German machine capacity of 215,000 units. Therefore, it is not enough to know just what expected annual sales will be, but also its standard deviation.

d. See below:

Technology	German	Swedish
Expected volume	180,000	180,000
Variable cost/unit	8.00	6.00
Total variable cost	$1,440,000	$1,080,000
Fixed cost	500,000	900,000
Total cost	$1,940,000	$1,980,000
Expected volume	180,000	180,000

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Average cost	$10.78	$11.00

e. Operating leverage is the amount of fixed costs in the firm's cost structure. One way to measure operating leverage is the ratio of fixed to total cost. The higher the firm's operating leverage, the greater the variability of the firm's net income to changes in volumes. Firms with little operating leverage can cut variable costs as volume declines, and because these firms have little fixed costs, net income remains positive. So, operating leverage affects the firm's risk, bankruptcy likelihood, and hence firm value.

P 2-31: Solution to JLE Electronics (25 minutes)
[Maximize contribution margin per unit of scarce resource]

Notice that the new line has a maximum capacity of 25,200 minutes (21 ×20 × 60) which is less than the time required to process all four orders. The profit maximizing production schedule occurs when JLE selects those boards that have the largest contribution margin per minute of assembly time. The following table provides the calculations:

	CUSTOMERS			
	A	**B**	**C**	**D**
Price	$38	$42	$45	$50
Variable cost per unit	23	25	27	30
Contribution margin	$15	$17	$18	$20
Number of machine minutes	3	4	5	6
Contribution margin/minute	5	4.25	3.6	3.33

Customers A, B, and C provide the highest contribution margins per minute and should be scheduled ahead of customer D.

	CUSTOMERS			
	A	**B**	**C**	**D**
Number of boards requested	2500	2300	1800	1400
Number of boards scheduled to be produced in the next 21 days	2500	2300	1700*	0

* 1700 [25,200 – (2,500 × 3) – (2,300 × 40]/5

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P 2-32: **Solution to News.com** (25 minutes)
[Break-even and operating leverage increases risk]

a. and b. Break-even number of hits:

	NetCom	Globalink
Price	$0.05	$0.05
Variable cost	0.01	0.02
Contribution margin	$0.04	$0.03
Fixed cost	$3,000	$2,000
Break-even number of hits	75,000	66,667

c. The choice among ISPs depends on the expected number of hits. The two ISP's have the same cost at 100,000 hits per month:

$$\$3,000 + \$0.01Q = \$2,000 + \$0.02Q$$

$$Q = 100,000$$

If the number of hits exceeds 100,000 per month, NetCom is cheaper. If the number of hits is less than 100,000, Globalink is cheaper.

d. If demand fluctuates with general economy-wide factors, then the risk of News.com is not diversifiable and the variance (and covariance) of the two ISP's will affect News.com's risk. For example, the table below calculates News.com's profits if they use NetCom or Globalink and demand is either high or low. Notice that News.com has the same expected profits ($1,000 per month) from using either ISP. However, the variance of profits (and hence risk) is higher under Net.Com than under Globalink. Therefore, News.com should hire Globalink. Basically, with lower fixed costs, but higher variable costs per hit, News.com's profits don't fluctuate as much with Globalink as they do with Net.Com.

	NetCom	NetCom	Globalink	Globalink
Hits	50,000	150,000	50,000	150,000
Revenue	$2,500	$7,500	$2,500	$7,500
Fixed Cost	3,000	3,000	2,000	2,000
Variable Cost	500	1,500	1,000	3,000
Profits	-$1,000	$3,000	-$500	$2,500
Expected profits	$1,000		$1,000	

P 2-33: **Solution to Rowe Waste Removal (A)** (35 minutes)
[Break-even vs. maximizing profits]

a. Fixed costs are given in the problem to be $54,000 per month. Variable cost per 25-unit apartment complex consists of the leased dumpster of $200 per month

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plus the landfill cost that varies with the number of apartment complexes ($1750 per truckload consisting of ten 25-unit apartment complex or $175 per complex). But since each complex is visited four times each month, each complex generates 4 × $175 or $700 per month. So variable cost per complex is $900 per month.

b. The following table calculates profits at the various price-quantity combinations and shows that the profit maximizing price-quantity combination is $1,450 and 125 customers.

No. of Customers	Price	Revenue	Variable Cost	Fixed Cost	Total Cost	Profit
100	$1560	$156,000	$90,000	$54,000	$144,000	$12,000
105	1538	161,490	94,500	54,000	148,500	12,990
110	1516	166,760	99,000	54,000	153,000	13,760
115	1494	171,810	103,500	54,000	157,500	14,310
120	1472	176,640	108,000	54,000	162,000	14,640
125	1450	181,250	112,500	54,000	166,500	14,750
130	1428	185,640	117,000	54,000	171,000	14,640
135	1406	189,810	121,500	54,000	175,500	14,310
140	1384	193,760	126,000	54,000	180,000	13,760
145	1362	197,490	130,500	54,000	184,500	12,990

Instead of using a spreadsheet, one can write down the equation for profits, substitute in the demand curve for P, and find its optimum by taking the derivative with respect to quantity and setting it to zero:

Profit = PQ – 900Q - $54,000

Demand curve

P = 2000 – 4.4Q

Profits = (2000 – 4.4Q) × Q – 900Q - $54,000

Profits = 2000Q – 4.4 Q^2 – 900Q - $54,000

Derivative of the profit equation

2000 – 8.8 Q – 900 = 0

8.8 Q = 1100

Q* = 125

P* = 2000 – 4.4 × 125

P* = $1,450

Maximum profit

Max Profit = PQ – 900Q - $54,000

Max Profit = $1,450 × 125 – 900×125 - $54,000

Max Profit = $181,250 – $112,500 - $54,000

Max Profit = $14,750

c. The profit maximizing price from part (b) is $1,450. The break-even quantity at this price is given by:

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Break-even quantity = Fixed cost ÷ contribution margin
= $54,000 ÷ ($1,450 - $900)
= 98.18 25-unit apartment complexes

d. The profit maximizing price does not change ($1,450) because the $6,000 per month of additional fixed cost ($72,000 ÷ 12 months) does represent additional marginal cost. Profits are lower by the $6,000 per month and will be $8,750 per month. Break-even at the price of $1,450 becomes:

Break-even quantity = ($54,000 + $6,000) ÷ ($1,450 - $900)
= 109.10 25-unit apartment complexes

e. The profit maximizing price is determined by finding the price where marginal revenue equals marginal cost. The additional fixed cost of $6,000 is not a marginal cost, and hence does not alter the profit maximizing price. However, fixed costs do enter the pricing decision to determine whether to sell the service or not. Since Rowe is still generating positive profits of $8,750 per month, Rowe should still enter the apartment refuse collection business. Break-even quantity at a price of $1,450 is higher because fixed costs are higher.

P 2-34: Solution to Littleton Imaging (25 minutes)
[Break-even analysis]

a. Break-even:

Fee	$250
Film	-55
Lease	-45
Contribution margin	$150
Fixed costs per month:	
Office rent	$1,400
Receptionist	2,400
2 technicians	6,400
CAT scanner lease	1,200
Office furniture, telephone & equipment	600
Radiologist	15,000
Total	$27,000
Break-even (fixed cost/contribution margin)	180

b. To calculate the number of sessions required to yield an after-tax profit of $5,000 (with a 40 percent tax rate), solve the following equation for Q (number of sessions):

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$5,000 = (CM × Q – FC) × (1-T)
$5,000 / 0.60 + FC = CM × Q

Or,

Q = ($5,000 / .060 + FC) / CM
Q = ($8,333.33 + $27,000) / $150
Q = $35,333.33 / $150
Q = 235.56 sessions

c. To calculate the break-even price, given Dr. Gu expects to conduct 200 sessions per month, solve the following equation for F (fee per session):

200 × F = $55 × 200 + $45 × 200 + $27,000
200 × F = $100 × 200 + $27,000
200 × F = $20,000 + $27,000
F = $47,000 / 200
F = $235

P 2-35: Solution to Candice Company (30 minutes)
[Break-even analysis of new technologies]

a. $$\text{Break-even units} = \frac{\text{Total fixed costs}}{\text{Unit contribution margin}}$$

	Method A		Method B	
Selling price		$30.00		$30.00
Variable costs:				
Raw materials	$5.00		$5.60	
Direct labor	6.00		7.20	
Variable overhead	3.00		4.80	
Variable selling	2.00	16.00	2.00	19.60
Contribution margin		$14.00		$10.40
Traceable fixed manufacturing costs		$2,440,000		$1,320,000
Incremental selling expenses		500,000		500,000
Total fixed costs		$2,940,000		$1,820,000
Divided by:				
Contribution margin		$ 14.00		$ 10.40
Break-even units		210,000		175,000

b. The choice of production methods depends on the level of expected sales. Candice Company would be indifferent between the two manufacturing methods at the volume (x) for which total costs are equal.

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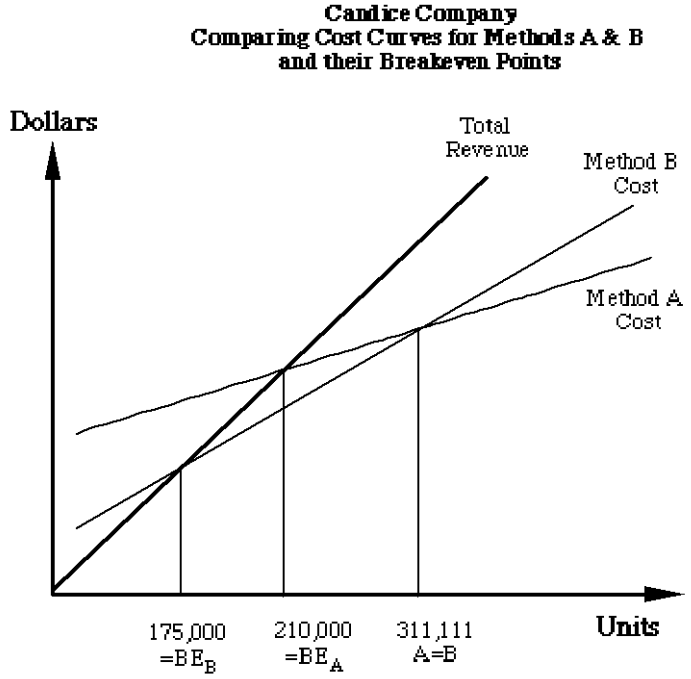
$$\$16x + \$2,940,000 = \$19.60x + \$1,820,000$$

$$\$3.60x = \$1,120,000$$

$$x = 311,111 \text{ units}$$

In a world of certainty, if management expects to produce fewer than 311,111 units it would choose method B. Above 311,111 units they would prefer method A. The figure below illustrates this situation. The two break-even points for the two manufacturing methods occur at 210,000 and 175,000 units. However, it is the point where the two cost curves intersect (311,111 units) that is relevant. Method B has lower total costs up to 311,111 units and then method A has lower costs beyond this volume.

With uncertainty, the problem becomes more complicated because the two methods affect operating leverage differently. Operating leverage affects risk, cost of capital, and expected tax payments (to the extent that marginal tax rates vary with profits). Basically, the production method with the lower break-even volume has the lower systematic risk and thus the lower discount rate.[1]

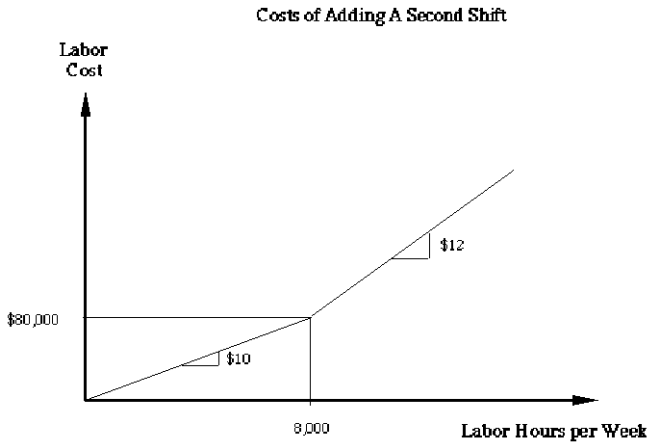


P 2-36: Solution to Cost Behavior Patterns (30 minutes)
[Graphing cost behavior patterns]

[1] P. Lederer and V. Singhal, "Effect of Cost Structure and Demand Risk in Justification of New Technologies," *Journal of Manufacturing and Operations Management* 1 (1988), pp. 339-371.

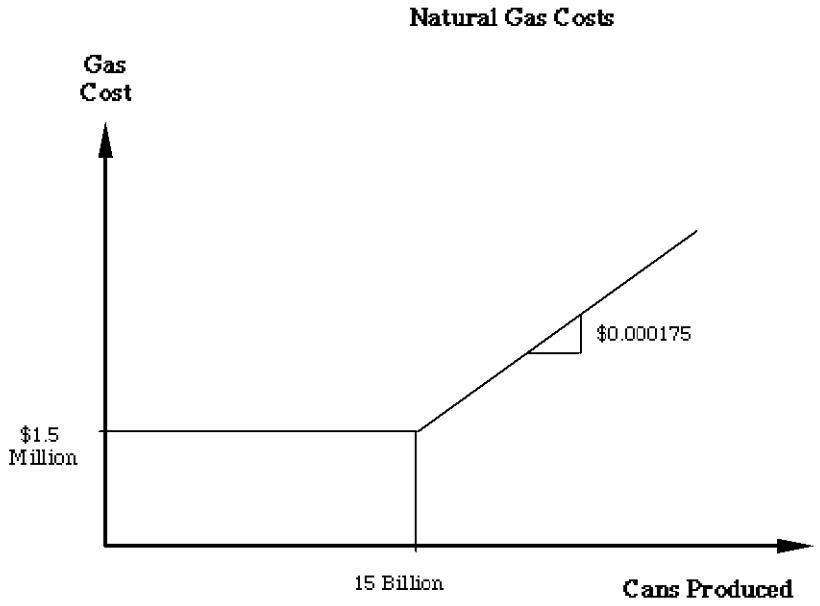
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a.



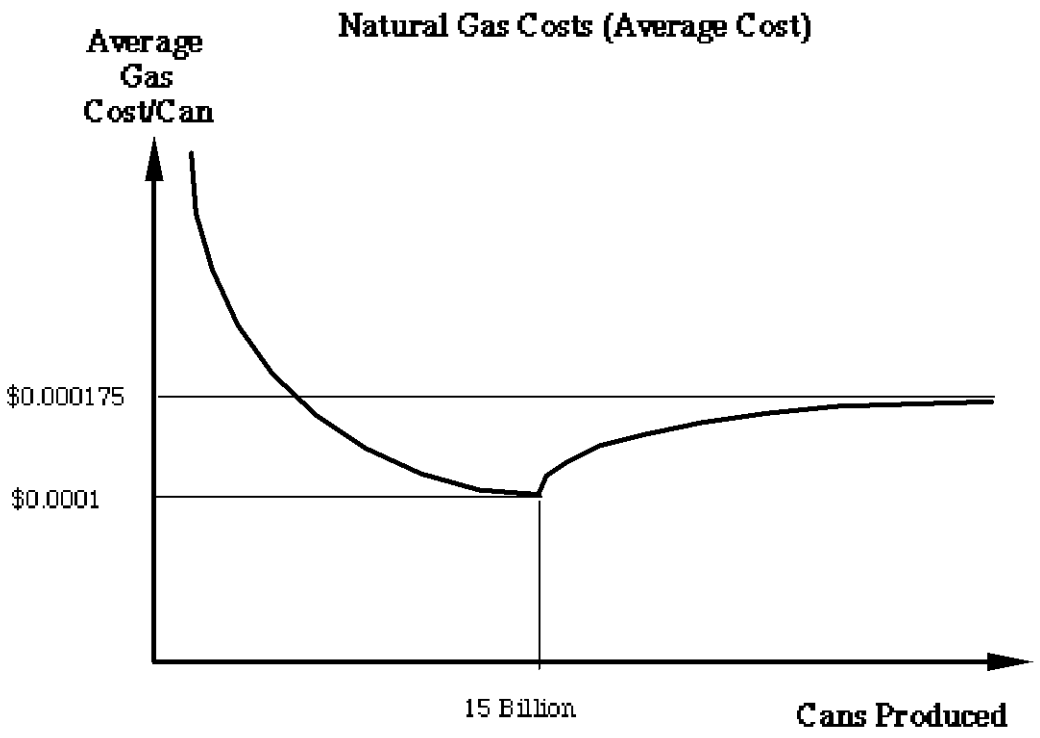
b.

1000 cans	=	ten cubic feet of gas
100 cans	=	one cubic foot of gas
1 can	=	0.01 cu.ft
Marginal cost/can	=	0.01cu.ft/can × $0.175/cu.ft = $0.00175

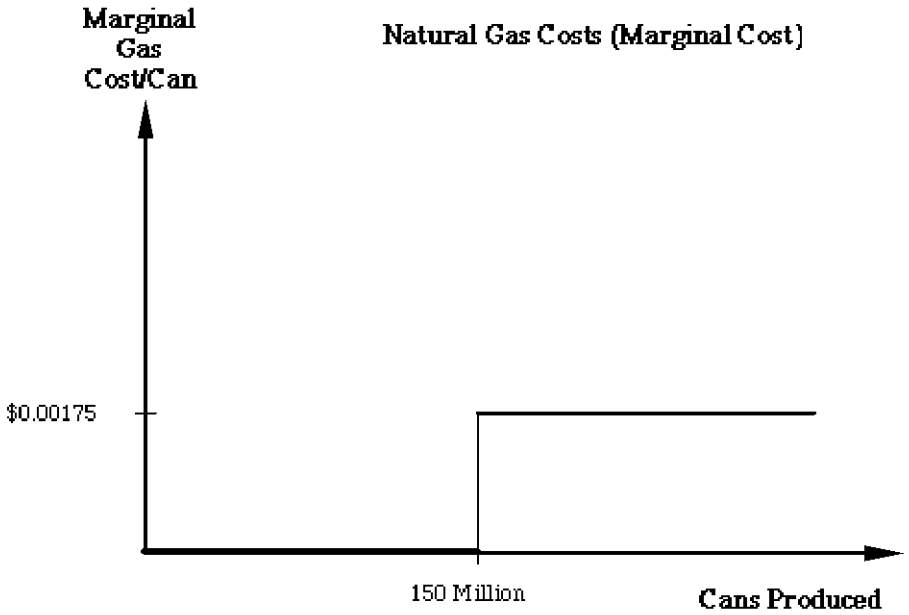


c. The question does not specify whether to plot marginal gas cost per can or average gas cost per can. Therefore, there are two possible answers.

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Marginal gas cost per can is:



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P 2-37: Solution to Royal Holland Line (30 minutes)
[Break-even analysis]

a. Before the break-even point can be calculated, the variable cost per passenger is computed as:

$$\text{Variable cost per passenger} = \frac{\$324,000}{1,200}$$

$$= \$270$$

$$\text{Contribution margin per passenger} = \$1,620 - \$270$$

$$= \$1,350$$

$$\text{Break-even number of passengers} = \frac{\text{Fixed cost}}{\text{Contribution margin}}$$

$$= \frac{\$607,500}{1,350}$$

$$= 450 \text{ passengers}$$

b. The cost of the ship itself is not included. The weekly opportunity cost of the Mediterranean cruise is not using the ship elsewhere. One alternative use is to sell the ship and invest the proceeds. Since no other information is provided regarding alternative uses of the ship and assuming there are no capital gains taxes on the sale proceeds, the weekly opportunity cost of the ship is:

Sales proceeds	$371,250,000
× Interest rate	10%
	$37,125,000
÷ number of weeks/year	50
Weekly opportunity cost	$ 742,500

c. The revised break-even including the cost of the ship:

$$\text{Total fixed costs} = \$607,500 + 742,500$$

$$= \$1,350,000$$

$$\text{Break-even} = \frac{\$1,350,000}{1,350} = 1,000 \text{ passengers}$$

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d. Let C = contribution margin from additional sales

$$900 = \frac{1,350,000}{1,350 + C}$$

$$900(1,350 + C) = 1,350,000$$

$$900C = 1,350,000 - 1,350 \times 900$$

$$C = \frac{1,350,000}{900} - 1,350$$

$$C = \$150$$

Additional purchases per passenger $= \frac{\$150}{.5} = \$300.$

P 2-38: Solution to Roberts Machining (30 minutes)
[Describing the opportunity set and determining opportunity costs]

a. The opportunity set consists of:

1. Use die to produce #1160 racks and then scrap the die.
2. Use die to produce #1160 racks, but do not scrap the die.
3. Do not produce #1160 racks. Scrap the die immediately.
4. Sell the die to Easton.
5. Do not produce and do not scrap die.

b. Cash flows of each alternative (assuming GTE does not sue Roberts for breaching contract and ignoring discounting):

1. Use die to produce #1160 racks and then scrap the die

Accounting profit	$358,000
Add back cost of die	49,000
Scrap	6,800
Net cash flow	$413,800

2. Use die to produce #1160 racks, but do not scrap the die

Accounting profit	$358,000
Add back cost of die	49,000
Net cash flow	$407,000

3. Do not produce #1160 racks. Scrap the die immediately

Net cash flow	$6,800

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4. Sell the die to Easton

Payment from Easton	$588,000
Less lost future profits	-192,000
Net cash flow	$396,000

5. Do not produce and do not scrap die

Net cash flow	$0

c. Opportunity cost of each alternative:

1. Use die to produce #1160 racks and then scrap the die	$407,000
2. Use die to produce #1160 racks, but do not scrap the die	$413,800
3. Do not produce $1160 racks. Scrap the die immediately	$413,800
4. Sell the die to Easton	$413,800
5. Do not produce and do not scrap die	$413,800

d. Roberts should reject Easton's offer and produce the #1160 rack as specified in its contract. This alternative has the lowest opportunity cost (or equivalently, it has the greatest net cash flow).

P 2-39: **Solution to Fuller Aerosols** (30 minutes)
[Break-even and production planning with capacity constraints]

a. Break-even volumes

Fuller Aerosols
Break-even Volumes

	AA143	AC747	CD887	FX881	HF324	KY662
Fixed cost	$900	$240	$560	$600	$1,800	$600
Price	$37.00	$54.00	$62.00	$21.00	$34.00	$42.00
Variable cost	28.00	50.00	48.00	17.00	28.00	40.00
Contribution margin	$9.00	$4.00	$14.00	$4.00	$6.00	$2.00
Break-even volume	100	60	40	150	300	300

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b. With 70 hours (or 4200 minutes) of capacity per week, all the products can be manufactured. However, since only 200 cases of KY662 are ordered and KY662 has a break-even quantity of 300 cases, KY662 should not be produced even though there is excess capacity (4200 minutes).

Fuller Aerosols
Minutes on the Fill Line to Produce All Products

	AA143	AC747	CD887	FX881	HF324	KY662	Total Minutes
Fill time per case (minutes)	3	4	5	2	3	4	
Cases ordered	300	100	50	200	400	200	
Minutes	900	400	250	400	1200	800	3950

An aerosol product should only be produced if its contribution margin times the number of units sold exceeds its fixed costs.

Fuller Aerosols
Break-even Volumes

	AA143	AC747	CD887	FX881	HF324	KY662
Contribution margin	$9.00	$4.00	$14.00	$4.00	$6.00	$2.00
Cases ordered	300	100	50	200	400	200
Contribution	$2,700	$400	$700	$800	$2400	$400
Fixed cost	900	240	560	600	1,800	600
Profit (loss)	$1,800	$160	$140	$200	$600	-$200

c. Given a capacity constraint on the aerosol fill line, products should be produced that maximize total profits (including the fixed costs). The following table lists the order in which the products should be produced and the quantity of each produced. Products AA143, AC747, FX881, and HF324 are produced to meet demand. After producing these four products to meet demand, 100 minutes remain to produce 20 cases out of the 100 cases ordered of CD887. Making 20 cases of CD887 is below CD887's break-even volume of 40 cases, so no CD887 should be produced. And KY662 is not produced because it does not cover its fixed costs at the number of cases demanded (200). The following table derives the solution.

Fuller Aerosols
Production Schedule with Only 3,000 Minutes (50 hours × 60 minutes/hour) of Fill Line Time

	AA143	AC747	CD887	FX881	HF324	KY662	Minutes Available
Fill time per case (minutes)	3	4	5	2	3	4	
Cases ordered	300	100	50	200	400	200	
Minutes	900	400	250	400	1200	800	
Profit (loss) (from part a)	$1,800	$160	$140	$200	$600	-$200	

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Most to least profitable product	1	4	5	3	2	6	
Total minutes available							3,000
Minutes used to meet demand for AA143	900						2,100
Minutes used to meet demand forHF324					1200		900
Minutes used to meet demand for FX881				400			500
Minutes used to meet demand for AC747		400					100
Minutes available to meet demand for CD887			100				100
Cases of CD887 that can be manufactured			20				
Break-even volume	100	60	40	150	300	300	
Cases manufactured	300	100	0	200	400	0	

[Acknowledgement: I thank Nick Ripstein, a student at Concordia University, Nebraska and Professor Stan Obermueller for providing a corrected version of the solution].

P 2-40: **Solution to Happy Feet** (30 minutes)
[Break-even and operating leverage]

a. Break-even sales is calculated using the following formula:

Profits = 0 = Revenues – cost of goods sold – fixed costs

0 = R – 0.5R - $63,000 - .03R

0.47 = $63,000

R = $134,042.55

b. Dr. Zang should probably accept the revised lease agreement. The following table shows that she actually makes less money ($750 per month) at her expected sales level of $150,000 per month if she accepts the revised rental agreement of $1,000 per month plus 12.5 percent of sales. However, the revised lease agreement reduces her risk of bankruptcy.

	$13,333 + 3% Lease	**$1,000 + 12.5% Lease**
Revenues	$150,000	$150,000
Cost of goods sold	75,000	75,000
Fixed rent	13,333	1,000
Lease fee as % of sales	4,500	18,750

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Interest on bank loan	11,667	10,500
Other costs	38,000	38,000
Profits	$7,500	$6,750

Note that depreciation on the store improvements are excluded from the calculation of profits since we are really interested in looking at cash flows from the business. Besides, depreciation is the same under both lease agreements, and hence does not affect the decision.

The slightly lower profit of $750 per month is a fairly low price to pay to lower the venture's operating leverage by making the landlord a pseudo partner in Happy Feet. The following table illustrates the effect on profits if revenues fluctuate between Dr. Zang's $80,000 and $220,000 estimates.

	$13,333 + 3% Lease		**$1,000 + 12.5% Lease**	
Revenues	$80,000	$220,000	$80,000	$220,000
Cost of goods sold	40,000	110,000	40,000	110,000
Fixed rent	13,333	13,333	1,000	1,000
Lease fee % of sales	2,400	6,600	10,000	27,500
Interest on bank loan	11,667	11,667	10,500	10,500
Other costs	38,000	38,000	38,000	38,000
Profits	-$25,400	$40,400	-$19,500	$33,000

Here we see that if sales are only $80,000, the revised lease results in a smaller loss (-$19,500) than under the original lease (-$25,400). If sales are $220,000, the store generates $7,400 more under the original lease than the revised lease. But given Dr. Zang's limited working capital, the roughly $5,000 smaller loss when sales are low could be important, especially if there are a number of months of low sales until the store becomes established. Moreover, if the sales are substantially above Dr. Zang's estimates, the lease can be renegotiated in three years.

P 2-41: **Solution to Digital Convert** (30 minutes)
[Operating leverage and the cost of financial distress]

a. Profits are maximized at a wholesale price of $1,240 and a quantity of 20 units as calculated in the following table:

Quantity	**Price**	**Variable Cost**	**Fixed Cost**	**Profit**
19	1,278	480	0	15,162
20	1,240	480	0	15,200
21	1,202	480	0	15,162
22	1,164	480	0	15,048
23	1,126	480	0	14,858
24	1,088	480	0	14,592

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25	1,050	480	0	14,250
26	1,012	480	0	13,832

Maximum profits $15,200

b. If DC adopts the new technology, profits are maximized at a wholesale price of $1,050 and a quantity of 25 units as calculated in the following table:

Quantity	Price	Variable Cost	Fixed Cost	Profit
19	1,278	100	7,000	15,382
20	1,240	100	7,000	15,800
21	1,202	100	7,000	16,142
22	1,164	100	7,000	16,408
23	1,126	100	7,000	16,598
24	1,088	100	7,000	16,712
25	1,050	100	7,000	16,750
26	1,012	100	7,000	16,712

Maximum profits $16,750

c. The following table shows that adopting the new sensor manufacturing technology does not maximize DC's total profits after considering the expected cost of financial distress. Adopting the new technology lowers the value of DC by $12,800. In other words, DC should stay with its current manufacturing technology.

Monthly profits from the new technology	$16,750
Monthly profits from the existing technology	15,200
Incremental profits from the new technology	$1,550
Number of months the new technology must be leased	×24
Incremental profits over the next 24 months	$37,200
Cost of financial distress	$500,000
Increase in likelihood of financial distress over 24 months	×10%
Increase in expected cost of financial distress	$50,000
Expected total profits (loss) of new technology	($12,800)

P 2-42: Solution to APC Electronics (35 minutes)
[Accounting versus opportunity cost]

a. The hourly cost of operating each of the four lines is calculate in the following table:

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	LINE I	LINE II	LINE III	LINE IV
Equipment depreciation	$840,000	$1,300,000	$480,000	$950,000
Occupancy costs	213,000	261,000	189,000	237,000
Total annual line costs	$1,053,000	$1,561,000	$669,000	$1,187,000
Expected hours of operations	1,800	2,200	1,600	2,000
Operating cost per hour	$585.00	$709.55	$418.13	$593.50

b. If APC accepts this special order from Healthtronics, APC will record cost of goods sold of:

Set-up labor*	$160
Assembly labor**	3,192
Line cost***	17,550
Total cost	$20,902

*4 ×$40
** 3 × 14 × $28 + 3 x 16 × $42
*** 30 × $585

Even though line costs are fixed costs, they are still product costs and hence charged to inventory and then cost of goods sold when they are shipped.

c. APC's out of pocket costs for this special order consist of the set-up labor ($160) plus the assembly labor ($3,192) or $3,352.

d. The opportunity cost of the Healthtonics special order:

Healthtonics:		**Total**
Set-up labor		
Hours	4	
Cost per hour	$40	$160
Assembly labor		
Number of technicians	3	
Hours during the day	14	
Cost per hour	28	1,176
Number of technicians	3	
Hours during the evening	16	
Cost per hour	$42	2,016
SonarTech:		
Tear-down time		
Hours	2	
Cost per hour	$40	80
Set-up labor		
Hours	6	
Cost per hour	$40	240

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Overtime costs		
Number of technicians	4	
Hours	14	
Overtime rate ($14/hour)	$14	784
Additional Freight		2,300
Total cost		$6,756

P 2-43: **Solution to Amy's Boards** (35 minutes)
[Break-even analysis — short-run versus long-run]

The major goals of this problem are to demonstrate how fixed costs first become fixed and second to illustrate the relation between fixed costs and capacity. Before the snow boards are purchased in part (a), they are a variable cost. (In the long run, all costs are variable.) However, once purchased, the boards are a fixed cost. The number of boards purchased determines the shop's total capacity, which is fixed, until she either buys more boards or sells used boards.

a. Number of boards to break-even:

Fixed Costs	
Store rent (net of sublet, $7,200 - $1,600)	$ 5,600
Salaries, advertising, office expense	26,000
	$31,600
Contribution margin per board per year:	
Revenue per week	$75
Refurbishing cost	-7
Contribution margin per board per week	$68
×number of weeks	20
Seasonal contribution margin from 100% rental	$1,360
× likelihood of rental	80%
Expected seasonal contribution margin per board	$1,088
Net cost per board ($550 – $250)	300
Net contribution per board per year	$ 788
Break-even number of boards ($31,600 ÷ $788)	40.10

b. Expected profit with 50 boards:

Expected seasonal contribution margin per board (from part a)	$ 1,088
× number of boards	50
Expected contribution margin	$54,400
Less:	
Cost of boards ($300 × 50)	(15,000)
Fixed costs	(31,600)
Expected profit	$ 7,800

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c. Break-even number of rentals with 50 boards:

Total fixed costs	
Store rent	$ 5,600
Salaries, advertising, and office expense	26,000
Boards and boots (net of resale, $300 × 50)	15,000
	$46,600
Contribution margin per board per week	$68
Break-even number of rentals $\frac{\$46,600}{\$68}$	685.29
Total possible number of rentals (50 boards × 20 weeks)	1,000
Break-even fraction of boards rented each week	68.5%

d. In the long run, all costs are variable. However, once purchased, the boards are a fixed cost. The reason for the difference is Amy has about ten more boards than the break-even number calculated in part (a). In part (a), before the boards are purchased, they are a variable cost. She can buy any number of boards she wants and pay a proportionately higher cost for them and rent them all 80 percent of the time. Therefore the cost of the boards is a variable cost with respect to the number of rentals. It is subtracted from the revenue in calculating the contribution margin per board. Once you buy the boards, their cost becomes fixed. Instead of being included in calculating contribution margin, it is included in the fixed cost (numerator of the break-even volume).

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P 2-44: **Solution to Blue Sage Mountain** (35 minutes)
[Costs and pricing decisions-Appendix A]

a. Table of prices, quantities, revenues, costs, and profits:

Quantity	Price	Total Revenue	Total Cost	Total Profit
100	$510	$51,000	$79,000	-$28,000
200	490	98,000	88,000	10,000
300	470	141,000	97,000	44,000
400	450	180,000	106,000	74,000
500	430	215,000	115,000	100,000
600	410	246,000	124,000	122,000
700	390	273,000	133,000	140,000
800	370	296,000	142,000	154,000
900	350	315,000	151,000	164,000
1,000	330	330,000	160,000	170,000
1,100	310	341,000	169,000	172,000
1,200	290	348,000	178,000	170,000
1,300	270	351,000	187,000	164,000
1,400	250	350,000	196,000	154,000
1,500	230	345,000	205,000	140,000
1,600	210	336,000	214,000	122,000
1,700	190	323,000	223,000	100,000
1,800	170	306,000	232,000	74,000
1,900	150	285,000	241,000	44,000
2,000	130	260,000	250,000	10,000

b. Profits are maximized when the price is set at $310 and 1,100 boards are sold.

c. If fixed costs fall from $70,000 to $50,000, prices should not be changed because a price of $310 and 1,100 boards continue to maximize profits as illustrated below:

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Quantity	Price	Total Revenue	Total Cost	Total Profit
100	$510	$51,000	$59,000	-$8,000
200	490	98,000	68,000	30,000
300	470	141,000	77,000	64,000
400	450	180,000	86,000	94,000
500	430	215,000	95,000	120,000
600	410	246,000	104,000	142,000
700	390	273,000	113,000	160,000
800	370	296,000	122,000	174,000
900	350	315,000	131,000	184,000
1,000	330	330,000	140,000	190,000
1,100	310	341,000	149,000	192,000
1,200	290	348,000	158,000	190,000
1,300	270	351,000	167,000	184,000
1,400	250	350,000	176,000	174,000
1,500	230	345,000	185,000	160,000
1,600	210	336,000	194,000	142,000
1,700	190	323,000	203,000	120,000
1,800	170	306,000	212,000	94,000
1,900	150	285,000	221,000	64,000
2,000	130	260,000	230,000	30,000

d. If variable costs fall from $90 to $50 per board, prices should be lowered to $290 per board to maximize profits as illustrated below:

Quantity	Price	Total Revenue	Total Cost	Total Profit
100	$510	$51,000	$75,000	-$24,000
200	490	98,000	80,000	18,000
300	470	141,000	85,000	56,000
400	450	180,000	90,000	90,000
500	430	215,000	95,000	120,000
600	410	246,000	100,000	146,000
700	390	273,000	105,000	168,000
800	370	296,000	110,000	186,000
900	350	315,000	115,000	200,000
1,000	330	330,000	120,000	210,000
1,100	310	341,000	125,000	216,000
1,200	290	348,000	130,000	218,000
1,300	270	351,000	135,000	216,000
1,400	250	350,000	140,000	210,000
1,500	230	345,000	145,000	200,000
1,600	210	336,000	150,000	186,000
1,700	190	323,000	155,000	168,000
1,800	170	306,000	160,000	146,000
1,900	150	285,000	165,000	120,000
2,000	130	260,000	170,000	90,000

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Case 2–1: Solution to Old Turkey Mash (50 minutes)
[Period versus Product Costs]

a. This question involves whether the costs incurred in the aging process (oak barrels and warehousing costs) are period costs (and written off) or product costs (and capitalized as part of the inventory value). The table below shows the effect on income of capitalizing all the warehousing costs and then writing them off when the whiskey is sold.

	Base Year	Year 1	Year 2	Year 3
Revenues	$6,000,000	$6,000,000	$6,000,000	$6,000,000
less:				
Cost of Goods Sold:				
bbls distilled @ $100/bbl	$1,000,000	$1,000,000	$1,000,000	$1,000,000
Oak barrels	750,000	750,000	750,000	750,000
Warehouse rental	1,000,000	1,000,000	1,000,000	1,000,000
Warehouse direct costs	2,500,000	2,500,000	2,500,000	2,500,000
Net Income before taxes	$ 750,000	$ 750,000	$ 750,000	$ 750,000
Income taxes (30%)	225,000	225,000	225,000	225,000
Net Income after taxes	$ 525,000	$ 525,000	$ 525,000	$ 525,000
Increase in income from capitalizing aging costs	$000	$203,000	$504,000	$903,000

Since all the additional expansion costs are now being capitalized into inventory, profits are higher by the amount of the capitalized costs less the increase in taxes.

b. The present financial statements based on treating aging cost as period costs show an operating loss. This loss more closely represents the operating cash flows of the firm. Unless the bank is dumb, the bank will want to see a statement of cash flows in addition to the income statement. If the firm computes net income with the aging costs treated as product costs, net income is higher. But is the banker really fooled?

If the firm is able to sell the additional production as it emerges from the aging process, then the following income statements will result for years 3 to 10:

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	Year 3	Year 4	Year 5	Year 6	Year 7
Revenues	$6,000,000	$6,000,000	$6,000,000	$7,200,000	$8,400,000
less:					
Cost of Goods Sold:					
(gallons sold × $2.50)	1,000,000	1,000,000	1,000,000	1,200,000	1,400,000
Oak barrels	1,200,000	1,350,000	1,500,000	1,500,000	1,500,000
Warehouse rental	1,240,000	1,400,000	1,600,000	1,760,000	1,880,000
Warehouse direct costs	3,100,000	3,500,000	4,000,000	4,400,000	4,700,000
Net Income before taxes	(540,000)	(1,250,000)	(2,100,000)	(1,660,000)	(1,080,000)
Income taxes (30%)	162,000	375,000	630,000	498,000	324,000
Net Income after taxes	($ 378,000)	($ 875,000)	($1,470,000)	($1,162,000)	($ 756,000)

	Year 8	Year 9	Year 10
Revenues	$9,600,000	$10,800,000	$12,000,000
less:			
Cost of Goods Sold:			
(gallons sold × $2.50)	1,600,000	1,800,000	2,000,000
Oak barrels	1,500,000	1,500,000	1,500,000
Warehouse rental	1,960,000	2,000,000	2,000,000
Warehouse direct costs	4,900,000	5,000,000	5,000,000
Net Income before taxes	(360,000)	500,000	1,500,000
Income taxes (30%)	108,000	(150,000)	(450,000)
Net Income after taxes	($ 252,000)	$ 350,000	$1,050,000

Notice that by year 10, the firm's profits are twice what the old base profits were. Ultimately, the decision by the banker to continue lending to Old Turkey will depend on the banker's expectation that the additional production will be sold, not on how the accounting profits are recognized on the books.

The decision to report aging costs as product costs depends on the following questions:

- Will taxes be affected? If the treatment of aging costs is changed for reporting purposes, will the IRS require the firm to use the same method for taxes? If so, this will increase the firm's tax liability and further increase the cash drain the firm faces. Therefore, expert tax advice is needed.
- Will the bank be fooled by the positive income numbers even though a cash drain is occurring? The bank's decision to continue to lend to the firm depends on its assessment of the firm's ultimate ability to sell the increased quantities produced at the same or higher prices. Independent of how the firm reports its current earnings, the wisdom of the decision to double production depends on whether the overseas markets for the product exist.
- The bank may in fact want the firm to treat aging costs as product costs and thereby increase reported profits to satisfy bank regulatory reviews. Regulators look closely at outstanding loans and the documentation provided by the borrowers to their banks. Submitting income statements with reported losses may cause the regulators to question this loan, thereby imposing costs on the bank.

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Advice: First, find out if the firm can continue to write off aging costs as period expenses for taxes while capitalizing these costs for financial reporting purposes. If the tax rules are such that the firm can keep separate books, then take both sets of income statements and the cash flow statements to the bank and find out which set of statements they feel more accurately reflects the firm's financial condition.

Case 2-2: Solution to Mowerson Division (60 minutes)
[Opportunity cost of make/buy decisions]

In this problem, specific identification of opportunity costs is required.

a. Joseph Wright should have analyzed the costs and savings that Mowerson would realize for a period greater than one year (2007). For instance, Wright should have considered the fact that Mowerson expects production volume to steadily increase over the next three years. Under these circumstances, the difference between Mowerson's standard cost for manufacturing PCBs and Tri-Star's price for PCBs becomes increasingly important. A decision of this type is dependent on events in the future, i.e., differing income streams, production plans, and production capabilities. Furthermore, this is a long-term decision, which means that more than one year should be considered. Once Mowerson dismisses the assembly technicians, it would not be able to rehire them immediately. By incorporating more than 2007 costs and revenues, Mowerson should also use discounted cash flow techniques to recognize the time value of money.

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b.

	(i) Appropriate/Inappropriate		(ii) Correct/Incorrect
1.	Appropriate. Mowerson will no longer have to pay these wages.	1.	Correct. This is the cost associated with the 40 technicians who will no longer work at Mowerson.
2.	Inappropriate. The Assembly Supervisor will continue to be employed by Mowerson for two years.	2.	Incorrect. Cost will continue to be incurred by Mowerson and only the amount should be included in Wright's analysis, that is salary less the benefits provided by the supervisor.
3.	Appropriate but only to the extent of the outside rental space. The cost associated with the main plant floor space is inappropriate because Mowerson is still using this space.	3.	Incorrect. Only the amount related to the outside rental space (1,000 × $9.50 = $9,500) should be included. The cost associated with the floor space in the main plant will continue.
4.	Inappropriate. Although the purchasing clerk is on temporary assignment to a special project, the clerk's employment at Mowerson will continue.	4.	Incorrect. There will be no savings associated with the purchasing clerk, except for any value added by the clerk to the special project.
5.	Appropriate. Mowerson will realize this savings from the reduction in purchase orders issued.	5.	Correct based on the information provided.
6.	Inappropriate. Mowerson has included the cost of incoming freight in direct material cost and Tri-Star has included the cost of delivery in its price. Therefore, any differential in freight expense is accounted for in Item 7.	6.	Incorrect. Any savings or additional costs associated with freight expense will be included in Item 7.
7.	Appropriate. Any differential between the in-house cost to manufacture and the purchase cost should be accounted for in Wright's analysis.	7.	Incorrect. The correct amount should be $2,975,000 [($60.00–30.25) × 100,000]. The only relevant manufacturing costs are direct material ($24.00) and variable overhead ($6.25) as fixed overhead will continue to be incurred irrespective of the decision and direct labor costs have already been considered as a savings in Item 1.
8.	Appropriate. The junior engineer represents an addition to the staff.	8.	Correct based on the information provided.
9.	Appropriate. The quality control inspector represents an addition to the staff.	9.	Correct based on the information provided.

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10. Appropriate. The increase in the safety stock represents additional cost to Mowerson.

10. Incorrect. Mowerson currently maintains a safety stock of 1,800 boards so a more correct amount is $4,800 as calculated below. However, the correct safety stock level really cannot be determined without knowing the consequences of a stockout, i.e., the cost of a stockout must be compared to the additional storage cost.

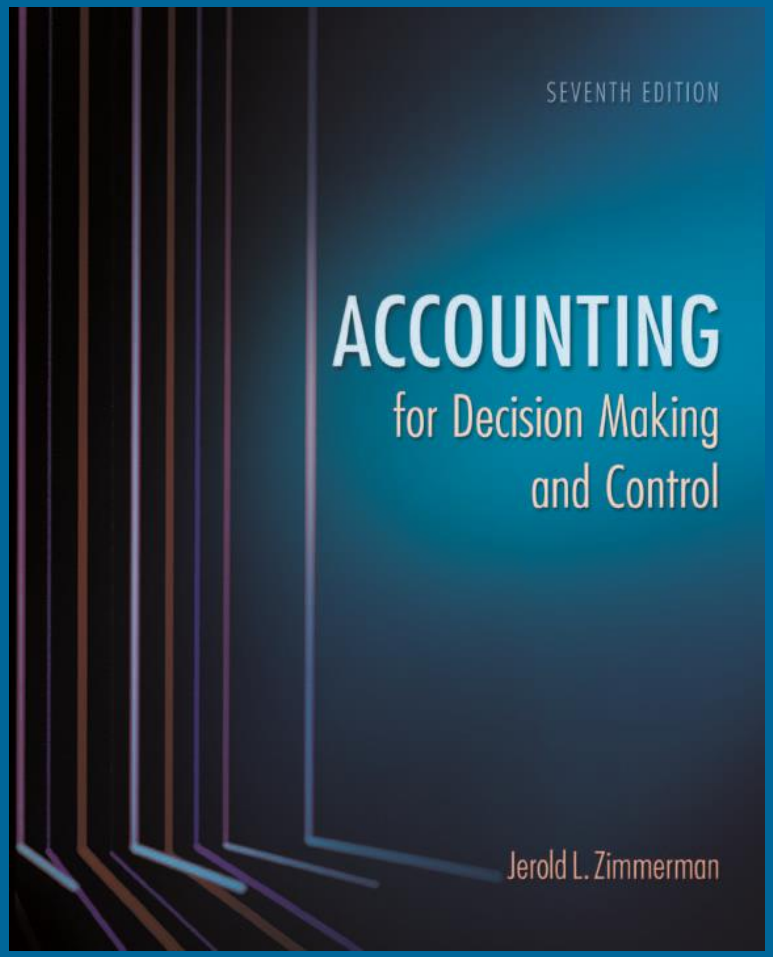
Percentage of Time Tri-Star Deliveries Will be Late	Probability (1)	Safety Stock of PCBs (2)	Expected Value (1) × (2)
4%	.30	2,500	750
6%	.40	4,000	1,600
8%	.25	6,000	1,500
10%	.05	7,000	350

New safety stock level	4,200
Current level	1,800
Increase in safety stock	2,400
Cost per unit	$2
Additional cost	$4,800

c. In evaluating its manufacturing decision, Mowerson should consider information about Tri-Star's:

- financial stability
- credit rating
- reputation for product quality and ability to meet quoted deliveries
- potential price increases in the future
- capacity levels
- competition, i.e., other potential sources of supply besides Tri-Star.

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Chapter Two

The Nature of Costs

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Opportunity Costs - Defined

Opportunity set: Set of alternative actions available to decision maker

Opportunity cost: Benefits forgone by choosing one alternative from the opportunity set rather than the best non-selected alternative

Example

Opportunity Set = {A, B, C}

Alternative	*Benefits*	*Opportunity Cost*
A	$108,000	$107,000 = Alternative B
B	$107,000	$108,000 = Alternative A
C	$106,500	$108,000 = Alternative A

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Opportunity Costs - Characteristics

Opportunity costs:

- include tangible and intangible benefits
- measured in cash equivalents
- rely on estimates of future benefits
- useful for decision making

Accounting expenses:

- costs consumed to generate revenues
- rely on historical costs of resources actually expended
- designed to match expenses to revenues
- useful for control

See opportunity cost examples

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Sunk Costs and Opportunity Costs

Sunk Costs: Costs which were incurred in the past and cannot be changed no matter what future action is taken.

Sunk costs are totally irrelevant for decision making and are excluded from opportunity costs.

Sunk costs might be useful for control purposes.

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Relevant Costs and Opportunity Costs

- Often the term "relevant cost" described as "expected future costs that will differ under alternatives."
- Opportunity costs is a well-defined, fundamental concept in economics that encompasses "relevant cost."
- Thus only "opportunity cost" will be used in the text.

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The Costs of SOX – the Sarbanes-Oxley Act of 2002

- The Public Company Accounting Reform and Investor Protection Act
- Direct costs of compliance expected to grow to $8 billion in 2005
- Other costs include
  - Increases as large as 50% in director's fees and premiums for directors and officer insurance policies
  - Innovative projects are being abandoned due to risk and/or delayed due to time spent on compliance

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Cost Variation – Definitions

Fixed Costs: Costs incurred when there is no production. A fixed cost is *not* an opportunity cost of the decision to change the level of output. (On a cost graph, the fixed costs are the total costs when production is zero.)

Marginal cost: Opportunity cost of producing one more unit, or the opportunity cost of producing the last unit. (On a cost curve graph, the marginal cost is the slope of the tangent at one particular production level.)

Average cost: *Total* opportunity costs divided by number of units produced. (On a cost curve graph, the average cost is the slope of the line drawn from the origin to total cost for a particular production level.)

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Cost Variation - Linear Approximation

TC = FC + (VC $\times$ Q) for Q in relevant range

Approximation: Total opportunity costs (TC) are a linear function of quantity (Q) produced over a relevant range.

Variable Cost (VC): Cost to produce one more unit. Variable cost is a linear approximation of marginal opportunity costs.

Fixed Cost (FC): Predicted total costs with no production (Q=0).

Relevant Range: Range of production quantity (Q) where a constant variable cost is a reasonable approximation of opportunity cost.

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Cost Variation - Cost Drivers

Cost driver: Measure of physical activity most highly associated with total costs in an activity center.

Examples of cost drivers:

- Quantity produced
- Direct labor hours
- Number of set-ups
- Number of different orders processed

Use different activity drivers for different decisions. Costs could be fixed, variable, or semivariable in different situations.

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C-V-P Analysis - Definitions

Cost-Volume-Profit (C-V-P) analysis can be useful for production and marketing decisions.

Contribution margin equals price per unit minus variable cost per unit: CM = (P – VC).

Total contribution margin equals total revenue minus total variable costs: (CM × Q) = (P - VC) × Q.

See Self-Study Problem 1.

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C-V-P Analysis - Breakeven Point

Breakeven point Q_{BE} is the number of units that must be sold at price P such that total revenues (TR) equal total costs (TC).

TR	=	TC
$(P \times Q_{BE})$	=	$[FC + (VC \times Q_{BE})]$
$[(P - VC) \times Q_{BE}]$	=	FC
Q_{BE}	=	$[FC \div (P - VC)]$
Q_{BE}	=	$(FC \div CM)$

At breakeven, the total contribution margin equals fixed costs.

$(CM \times Q_{BE})$	=	FC

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C-V-P: Target Profit Without Taxes

Define $Profit_T$ = Target Profit. Assume tax rate $t = 0$. Solve for Q_T

$$\text{Total Revenue} - \text{Total Costs} = Profit_T$$

$$\{(P \times Q_T) - [(VC \times Q_T) - FC]\} = Profit_T$$

$$\{[(P - VC) \times Q_T] - FC\} = Profit_T$$

$$[(CM \times Q_T) - FC] = Profit_T$$

$$(CM \times Q_T) = (Profit_T + FC)$$

$$Q_T = [(Profit_T + FC) \div CM]$$

At breakeven, $Profit_T = 0$; and $Q_{BE} = [(0 + FC) \div CM$

See Self Study Problem 2.

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C-V-P: Profit Before *and* After Tax

Given income tax rate t, such that $0<t<1$.

Profit after tax = [(Profit before tax) - (Profit before tax $\times$ t)]

Profit after tax = [(Profit before tax) $\times$ (1 - t)]

Profit before tax = [Profit after tax $\div$ (1 - t)]

(1 - t) = factor to multiply before-tax dollars to yield after-tax dollars

[1 $\div$ (1 - t)] = factor to multiply after-tax dollars to yield before-tax dollars

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C-V-P: Target Profit with Taxes

Define Profit_T = Target Profit after taxes. Assume tax rate t such that $0 < t < 1$

Solve for Q_T

$$[(\text{Profit before taxes}) \times (1 - t)] = \text{Profit}_T$$
$$\{[(P - VC) \times Q_T - FC] \times (1 - t)\} = \text{Profit}_T$$
$$[(P - VC) \times Q_T) - FC] = [\text{Profit}_T \div (1 - t)]$$
$$[(P - VC) \times Q_T] = \{[\text{Profit}_T \div (1 - t)] + FC\}$$
$$(CM \times Q_T) = \{[\text{Profit}_T \div (1 - t)] + FC\}$$
$$Q_T = [\{[\text{Profit}_T \div (1 - t)] + FC\} \div CM]$$

When the target quantity is achieved the total contribution margin ($CM \times Q_T$) equals the sum of before-tax profits and fixed costs.

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C-V-P: Assumptions

Assumptions of simple linear C-V-P analysis:

- Price does not vary with quantity
- Variable cost per unit does not vary with quantity
- Fixed costs are known
- The analysis is limited to a single product
- All output is sold
- Tax rates are constant for profits or losses
- Does not consider risk or time value of money

More advanced estimation techniques are used if the limitations of simple C-V-P are violated.

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Multiple Products

- When there are multiple products for a single company you must assume a known and constant sales mix.
- Then a break-even number of bundles can be calculated.
- By knowing the sales mix, the volume of individual product sales can be determined.

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Multiple Products - An Example

This is similar to the example in the text for additional practice.

A winery sells two types of wines: Riesling and Chenin Blanc. The following table summarizes prices and variable costs of the winery that has fixed costs of $800,000.

	Riesling	Chenin Blanc
Price per case	$120	$ 90
Variable cost per case	60	36
Contribution margin per case	$ 60	$ 54

For every case of Reisling sells, two cases of Chenin Blanc are produced. How many *bundles* are needed to breakeven? And then, how many cases of each type of wine are in that breakeven volume?

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Multiple Products - Example: A Solution

$$\text{Break-even number of bundles} = \frac{\text{Fixed Costs}}{\text{Contribution Margin (per bundle)}}$$

Contribution Margin per bundle is [(1x $60) + (2 x $54)] = $168

$$\text{Thus breakeven number of bundles} = \frac{\$800{,}000}{\$168} = 4{,}761.9 \text{ bundles}$$

As with normal breakeven, you must round up regardless of the fraction. We are assuming we cannot sell less than a full case. Thus, the number of cases of Reisling at breakeven is (1 x 4,762) or 4,762. And the number of cases of Chenin Blanc at breakeven is (2 x 4,762) or 9,524.

Always check your answers.

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C-V-P: Operating Leverage

Operating leverage: ratio of fixed costs to total costs

Firms with high operating leverage have:

- rapid increases in profits when sales expand
- rapid increases in losses when sales fall
- greater variability in cash flow
- greater risk

Knowledge of a competitor's cost structure is valuable strategic information in designing marketing campaigns.

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Opportunity Costs Versus Accounting Costs

Recording

Accounting cost: Record after decision implemented
Opportunity cost: Estimate before decision made

Time perspective

Accounting: Backward-looking (historical)
Opportunity: Forward-looking (future projections)

Link to financial statements

Accounting: direct link - Assets are unexpired costs.
Opportunity: no direct link

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Accounting Costs: Product vs. Period Costs

Product Costs

- Accounting costs related to the purchase or manufacture of goods
- Accumulated in inventory accounts (asset)
- Expensed when sold (cost of goods sold)
- Include fixed and variable cost of goods

Period Costs

- All accounting costs not included in product costs
- Expensed in period incurred
- Include fixed and variable selling and administrative expenses

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Accounting Costs: Direct vs. Overhead Costs

Direct Costs

- Costs easily traced to product or service produced or sold.
- Include direct materials (materials used in making product)
- Include direct labor (cost of laborers making product)
- Direct costs are usually variable.

Overhead Costs

- Costs that cannot be directly traced to product or service produced or sold.
- Include general manufacturing (supervisors, maintenance, depreciation, etc.).
- Include other administrative, marketing, interest, and taxes.
- Overhead costs are primarily fixed with respect to number of units produced or sold, but may include some variable costs related to number of units produced or sold.

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Cost Estimation Methods

Account Classification

- Each account in financial accounting system is classified as fixed or variable.
- Method is simple, but not precise.

Motion and Time Studies

- Estimate to perform each work activity efficiently under standard conditions.
- Expensive to conduct study.
- Should be redone as conditions and processes change.

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Appendix A: Costs and the Pricing Decision

- Consider two different conditions:
  - Firm is a "price taker."
  - Firm has "market power."
- "Price takers" use cost data to determine whether to produce and if so how much. They have no real influence on price.
- "Market power" firms consider the price sensitivity of customers in choosing markups in "cost-plus pricing."

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