Chapter 11
Differential Analysis: The Key to Decision Making

Solutions to Questions

11-1 A relevant cost is a cost that differs in total between the alternatives in a decision.

11-2 An incremental cost (or benefit) is the change in cost (or benefit) that will result from some proposed action. An opportunity cost is the benefit that is lost or sacrificed when rejecting some course of action. A sunk cost is a cost that has already been incurred and that cannot be changed by any future decision.

11-3 No. Variable costs are relevant costs only if they differ in total between the alternatives under consideration.

11-4 No. Not all fixed costs are sunk—only those for which the cost has already been irrevocably incurred. A variable cost can be a sunk cost if it has already been incurred.

11-5 No. A variable cost is a cost that varies in total amount in direct proportion to changes in the level of activity. A differential cost is the difference in cost between two alternatives. If the level of activity is the same for the two alternatives, a variable cost will not be affected and it will be irrelevant.

11-6 No. Only those future costs that differ between the alternatives are relevant.

11-7 Only those costs that would be avoided as a result of dropping the product line are relevant in the decision. Costs that will not be affected by the decision are irrelevant.

11-8 Not necessarily. An apparent loss may be the result of allocated common costs or of sunk costs that cannot be avoided if the product is dropped. A product should be discontinued only if the contribution margin that will be lost as a result of dropping the product is less than the fixed costs that would be avoided. Even in that situation the product may be retained if it promotes the sale of other products.

11-9 Allocations of common fixed costs can make a product (or other segment) appear to be unprofitable, whereas in fact it may be profitable.

11-10 If a company decides to make a part internally rather than to buy it from an outside supplier, then a portion of the company's facilities have to be used to make the part. The company's opportunity cost is measured by the benefits that could be derived from the best alternative use of the facilities.

11-11 Any resource that is required to make products and get them into the hands of customers could be a constraint. Some examples are machine time, direct labor time, floor space, raw materials, investment capital, supervisory time, and storage space. While not covered in the text, constraints can also be intangible and often take the form of a formal or informal policy that prevents the organization from furthering its goals.

11-12 Assuming that fixed costs are not affected, profits are maximized when the total contribution margin is maximized. A company can maximize its total contribution margin by focusing on the products with the greatest amount of contribution margin per unit of the constrained resource.

11-13 Joint products are two or more products that are produced from a common input. Joint

costs are the costs that are incurred up to the split-off point. The split-off point is the point in the manufacturing process where joint products can be recognized as individual products.

11-14 Joint costs should not be allocated among joint products for decision-making purposes. If joint costs are allocated among the joint products, then managers may think they are avoidable costs of the end products. However, the joint costs will continue to be incurred as long as the process is run regardless of what is done with one of the end products. Thus, when making decisions about the end products, the joint costs are not avoidable and are irrelevant.

11-15 If the incremental revenue from further processing exceeds the incremental costs of further processing, the product should be processed further.

11-16 Most costs of a flight are either sunk costs, or costs that do not depend on the number of passengers on the flight. Depreciation of the aircraft, salaries of personnel on the ground and in the air, and fuel costs, for example, are the same whether the flight is full or almost empty. Therefore, adding more passengers at reduced fares when seats would otherwise be empty does little to increase the total costs of operating the flight, but increases the total contribution and total profit.

Chapter 11: Applying Excel

The completed worksheet is shown below.

	A	B	C	D	E
1	Chapter 11: Applying Excel				
2					
3	**Data**				
4	**Exhibit 11-7 Santa Maria Wool Cooperative**				
5	Cost of wool	$200,000			
6	Cost of separation process	$40,000			
7	Sales value of intermediate products at split-off point:				
8	Undyed coarse wool	$120,000			
9	Undyed fine wool	$150,000			
10	Undyed superfine wool	$60,000			
11	Costs of further processing (dyeing) intermediate products:				
12	Undyed coarse wool	$50,000			
13	Undyed fine wool	$60,000			
14	Undyed superfine wool	$10,000			
15	Sales value of end products:				
16	Dyed coarse wool	$160,000			
17	Dyed fine wool	$240,000			
18	Dyed superfine wool	$90,000			
19					
20	*Enter a formula into each of the cells marked with a ? below*				
21	**Example: Joint Product Costs and the Contribution Approach**				
22					
23	***Analysis of the profitability of the overall operation:***				
24	Combined final sales value		$ 490,000		
25	Less costs of producing the end products:				
26	Cost of wool	$ 200,000			
27	Cost of separation process	40,000			
28	Combined costs of dyeing	120,000	360,000		
29	Profit		$ 130,000		
30					
31	***Analysis of sell or process further:***				
32		*Coarse*	*Fine*	*Superfine*	
33		*Wool*	*Wool*	*Wool*	
34	Final sales value after further processing	$ 160,000	$ 240,000	$ 90,000	
35	Less sales value at the split-off point	120,000	150,000	60,000	
36	Incremental revenue from further processing	40,000	90,000	30,000	
37	Less cost of further processing (dyeing)	50,000	60,000	10,000	
38	Financial advantage (disadvantage) of further processing	$ (10,000)	$ 30,000	$ 20,000	
39					

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Chapter 11: Applying Excel (continued)

The completed worksheet, with formulas displayed, is shown below.

	A	B	C	D	E
1	Chapter 11: Applying Excel				
2					
3	**Data**				
4	**Exhibit 11-7 Santa Maria Wool Cooperative**				
5	Cost of wool	200000			
6	Cost of separation process	40000			
7	Sales value of intermediate products at split-off point:				
8	Undyed coarse wool	120000			
9	Undyed fine wool	150000			
10	Undyed superfine wool	60000			
11	Costs of further processing (dyeing) intermediate products:				
12	Undyed coarse wool	50000			
13	Undyed fine wool	60000			
14	Undyed superfine wool	10000			
15	Sales value of end products:				
16	Dyed coarse wool	160000			
17	Dyed fine wool	240000			
18	Dyed superfine wool	90000			
19					
20	*Enter a formula into each of the cells marked with a ? below*				
21	**Example: Joint Product Costs and the Contribution Approach**				
22					
23	***Analysis of the profitability of the overall operation:***				
24	Combined final sales value		=B16+B17+B18		
25	Less costs of producing the end products:				
26	Cost of wool	=B5			
27	Cost of separation process	=B6			
28	Combined costs of dyeing	=B12+B13+B14	=SUM(B26:B28)		
29	Profit		=C24-C28		
30					
31	***Analysis of sell or process further:***				
32		*Coarse*	*Fine*	*Superfine*	
33		*Wool*	*Wool*	*Wool*	
34	Final sales value after further processing	=B16	=B17	=B18	
35	Less sales value at the split-off point	=B8	=B9	=B10	
36	Incremental revenue from further processing	=B34-B35	=C34-C35	=D34-D35	
37	Less cost of further processing (dyeing)	=B12	=B13	=B14	
38	Financial advantage (disadvantage) of further processing	=B36-B37	=C36-C37	=D36-D37	
39					

... Chapter 11 Formulas Chapter 11 R ...

Chapter 11: Applying Excel (continued)

1. With the change in the cost of further processing undyed course wool, the result is:

	A	B	C	D	E
1	Chapter 11: Applying Excel				
2					
3	**Data**				
4	**Exhibit 11-7 Santa Maria Wool Cooperative**				
5	Cost of wool	$200,000			
6	Cost of separation process	$40,000			
7	Sales value of intermediate products at split-off point:				
8	Undyed coarse wool	$120,000			
9	Undyed fine wool	$150,000			
10	Undyed superfine wool	$60,000			
11	Costs of further processing (dyeing) intermediate products:				
12	Undyed coarse wool	$30,000			
13	Undyed fine wool	$60,000			
14	Undyed superfine wool	$10,000			
15	Sales value of end products:				
16	Dyed coarse wool	$160,000			
17	Dyed fine wool	$240,000			
18	Dyed superfine wool	$90,000			
19					
20	*Enter a formula into each of the cells marked with a ? below*				
21	**Example: Joint Product Costs and the Contribution Approach**				
22					
23	***Analysis of the profitability of the overall operation:***				
24	Combined final sales value		$ 490,000		
25	Less costs of producing the end products:				
26	Cost of wool	$ 200,000			
27	Cost of separation process	40,000			
28	Combined costs of dyeing	100,000	340,000		
29	Profit		$ 150,000		
30					
31	***Analysis of sell or process further:***				
32		*Coarse*	*Fine*	*Superfine*	
33		*Wool*	*Wool*	*Wool*	
34	Final sales value after further processing	$ 160,000	$ 240,000	$ 90,000	
35	Less sales value at the split-off point	120,000	150,000	60,000	
36	Incremental revenue from further processing	40,000	90,000	30,000	
37	Less cost of further processing (dyeing)	30,000	60,000	10,000	
38	Financial advantage (disadvantage) of further processing	$ 10,000	$ 30,000	$ 20,000	
39					

... Chapter 11 Requirement 1 Cha ...

With the reduction in the cost of further processing undyed coarse wool, it is now profitable to process undyed coarse wool into dyed coarse wool.

Chapter 11: Applying Excel (continued)

2. With the revised data, the worksheet should look like this:

	A	B	C	D	E
1	Chapter 11: Applying Excel				
2					
3	**Data**				
4	**Exhibit 11-7 Santa Maria Wool Cooperative**				
5	Cost of wool	$290,000			
6	Cost of separation process	$40,000			
7	Sales value of intermediate products at split-off point:				
8	Undyed coarse wool	$100,000			
9	Undyed fine wool	$110,000			
10	Undyed superfine wool	$90,000			
11	Costs of further processing (dyeing) intermediate products:				
12	Undyed coarse wool	$50,000			
13	Undyed fine wool	$60,000			
14	Undyed superfine wool	$10,000			
15	Sales value of end products:				
16	Dyed coarse wool	$180,000			
17	Dyed fine wool	$210,000			
18	Dyed superfine wool	$90,000			
19					
20	*Enter a formula into each of the cells marked with a ? below*				
21	**Example: Joint Product Costs and the Contribution Approach**				
22					
23	***Analysis of the profitability of the overall operation:***				
24	Combined final sales value		$ 480,000		
25	Less costs of producing the end products:				
26	Cost of wool	$ 290,000			
27	Cost of separation process	40,000			
28	Combined costs of dyeing	120,000	450,000		
29	Profit		$ 30,000		
30					
31	***Analysis of sell or process further:***				
32		*Coarse*	*Fine*	*Superfine*	
33		*Wool*	*Wool*	*Wool*	
34	Final sales value after further processing	$ 180,000	$ 210,000	$ 90,000	
35	Less sales value at the split-off point	100,000	110,000	90,000	
36	Incremental revenue from further processing	80,000	100,000	-	
37	Less cost of further processing (dyeing)	50,000	60,000	10,000	
38	Financial advantage (disadvantage) of further processing	$ 30,000	$ 40,000	$ (10,000)	
39					

... Chapter 11 Requirement 2 She ...

Chapter 11: Applying Excel (continued)

a. The profit of the overall operation is now $30,000 if all intermediate products are processed into final products.

b. The financial advantage (disadvantage) from further processing each intermediate product is shown below.

	Coarse Wool	Fine Wool	Superfine Wool
Financial advantage (disadvantage) from further processing	$30,000	$40,000	$(10,000)

c. To maximize profit, the company should process undyed coarse wool into dyed coarse wool and undyed fine wool into dyed fine wool. However, undyed superfine wool should be sold as is rather than processed into dyed superfine wool. If this plan is followed, the overall profit of the company should be $40,000 as shown below:

Combined sales value ($180,000 + $210,000 + $90,000).....		$480,000
Less costs of producing the end products:		
Cost of wool	$290,000	
Cost of separation process	40,000	
Combined costs of dyeing ($50,000 + $60,000).....	110,000	440,000
Profit.....		$ 40,000

The Foundational 15

1. The total traceable fixed manufacturing overhead for Alpha and Beta is computed as follows:

	Alpha	*Beta*
Traceable fixed overhead per unit (a)	$16	$18
Level of activity in units (b)	100,000	100,000
Total traceable fixed overhead (a) × (b) ..	$1,600,000	$1,800,000

2. The total common fixed expenses is computed as follows:

	Alpha	*Beta*
Common fixed expenses per unit (a)	$15	$10
Level of activity in units (b)	100,000	100,000
Total common fixed expenses (a) × (b) ...	$1,500,000	$1,000,000

The company's total common fixed expenses would be $2,500,000.

3. The financial advantage of accepting the order is computed as follows:

	Per Unit	*Total 10,000 units*
Incremental revenue.....	$80	$800,000
Incremental costs:		
Variable costs:		
Direct materials.....	30	300,000
Direct labor.....	20	200,000
Variable manufacturing overhead...	7	70,000
Variable selling expenses.....	12	120,000
Total variable cost.....	$69	690,000
Financial advantage of accepting the order		$110,000

The Foundational 15 (continued)

4. The financial (disadvantage) is computed as follows:

	Per Unit	*Total 5,000 units*
Incremental revenue	$39	$195,000
Incremental costs:		
Variable costs:		
Direct materials	12	60,000
Direct labor	15	75,000
Variable manufacturing overhead	5	25,000
Variable selling expenses	8	40,000
Total variable cost	$40	200,000
Financial (disadvantage) of accepting the order		$ (5,000)

5. The financial (disadvantage) is computed as follows:

Incremental revenue (10,000 units × $80 per unit) (a)		$800,000
Incremental variable costs:		
Direct materials (5,000 units × $30 per unit)	$150,000	
Direct labor (5,000 units × $20 per unit)	100,000	
Variable manufacturing overhead (5,000 units × $7 per unit)	35,000	
Variable selling expenses (5,000 units × $12 per unit)	60,000	
Total incremental variable cost (b)		345,000
Foregone sales to regular customers (5,000 units × $120 per unit) (c)		600,000
Financial (disadvantage) of accepting the order (a) – (b) – (c)		$(145,000)

Note to instructors: There will be additional sales of 10,000 units to the new customer, but because sales to existing customers will decline by 5,000 units, the net effect will be to increase production and sales by 5,000 units.

The Foundational 15 (continued)

6. The financial (disadvantage) of dropping the Beta product line is computed as follows:

Contribution margin lost if the Beta product line is dropped*	$(3,600,000)
Traceable fixed manufacturing overhead	1,800,000
Financial (disadvantage) if Beta is dropped	$(1,800,000)

* Beta's contribution margin per unit is $40 (= $80 − $40). Therefore, the decrease in contribution margin if Beta is dropped would be $3,600,000 (= 90,000 units × $40 per unit).

Note to instructors: Emphasize that the traceable fixed manufacturing overhead is avoidable and the common fixed expenses are not.

7. The financial advantage of dropping the Beta product line is computed as follows:

Contribution margin lost if the Beta product line is dropped*	$(1,600,000)
Traceable fixed manufacturing overhead	1,800,000
Financial advantage if Beta is dropped	$ 200,000

* Beta's contribution margin per unit is $40 ($80 − $40). Therefore, the decrease in contribution margin if Beta is dropped would be $1,600,000 (= 40,000 units × $40 per unit).

8. The financial advantage of dropping the Beta product line is computed as follows:

Contribution margin lost if the Beta product line is dropped*	$(2,400,000)
Traceable fixed manufacturing overhead	1,800,000
Contribution margin on additional Alpha sales**	765,000
Financial advantage if Beta is dropped	$ 165,000

* Beta's contribution margin per unit is $40 (= $80 − $40). Therefore, the decrease in contribution margin if Beta is dropped would be $2,400,000 (= 60,000 units × $40 per unit).

** Alpha's contribution margin per unit is $51 ($120 − $69). Therefore, the increase in Alpha's contribution margin if Beta is dropped would

be $765,000 (= 15,000 units × $51 per unit).

The Foundational 15 (continued)

9. The financial (disadvantage) of buying 80,000 Alphas from a supplier rather than making them is computed as follows:

	Make	*Buy*
Cost of purchasing (80,000 units × $80 per unit)		$6,400,000
Direct materials (80,000 units × $30 per unit)	$2,400,000	
Direct labor (80,000 units × $20 per unit)	1,600,000	
Variable manufacturing overhead (80,000 units × $7 per unit)	560,000	
Traceable fixed manufacturing overhead (100,000 units × $16 per unit)	1,600,000	
Total costs	$6,160,000	$6,400,000
Financial (disadvantage) of buying 80,000 Alphas from a supplier	$(240,000)	

Note to instructors: Emphasize that the variable selling expenses are irrelevant to this decision because they will be incurred regardless of whether the company makes or buys its Alphas.

10. The financial advantage of buying 50,000 Alphas from a supplier rather than making them is computed as follows:

	Make	*Buy*
Cost of purchasing (50,000 units × $80 per unit)		$4,000,000
Direct materials (50,000 units × $30 per unit)	$1,500,000	
Direct labor (50,000 units × $20 per unit	1,000,000	
Variable manufacturing overhead (50,000 units × $7 per unit)	350,000	
Traceable fixed manufacturing overhead	1,600,000	
Total costs	$4,450,000	$4,000,000
Financial advantage of buying 50,000 Alphas from the supplier	$450,000	

The Foundational 15 (continued)

Note to instructors: Emphasize that the variable selling expenses are irrelevant to this decision in requirement 10 because they will be incurred regardless of whether the company makes or buys its Alphas.

11. The pounds of raw material per unit are computed as follows:

	Alpha	*Beta*
Direct material cost per unit (a)	$30	$12
Cost per pound of direct materials (b)	$6	$6
Pounds of direct materials per unit (a) ÷ (b)	5	2

12. The contribution margins per pound of raw materials are computed as follows:

	Alpha	*Beta*
Selling price per unit.....	$120	$80
Variable cost per unit.....	69	40
Contribution margin per unit (a)	$ 51	$40
Pounds of direct material required to produce one unit (b)	5 pounds	2 pounds
Contribution margin per pound (a) ÷ (b)	$10.20 per pound	$20.00 per pound

13. The optimal number of units to produce would be computed as follows:

Product	*Pounds Per Unit*	*Units Produced*	*Total Pounds*
Beta.....	2	60,000	120,000
Alpha	5	8,000	40,000
Total pounds available.....			160,000

The company should produce Beta first because it earns the highest contribution margin per pound of raw materials. After customer demand for Beta has been satisfied by producing 60,000 units, there are 40,000 pounds of raw materials remaining to use for making Alphas. Since each Alpha requires 5 pounds of raw materials, the company would be able to produce 8,000 Alphas (40,000 pounds ÷ 5 pounds per unit) before running out of raw materials.

The Foundational 15 (continued)

14. The total contribution margin would be computed as follows:

	Alpha	*Beta*
Number of units produced (a).....	8,000	60,000
Contribution margin per unit (b)	$51	$40
Total contribution margin (a) × (b).....	$408,000	$2,400,000

The company's total contribution margin would be $2,808,000 ($408,000 + $2,400,000).

15. The maximum price per pound is computed as follows:

	Alpha
Regular direct material cost per pound	$ 6.00
Contribution margin per pound of direct materials	10.20
Maximum price to be paid per pound.....	$16.20

Because the company has satisfied all demand for Betas, it would use additional raw materials to produce Alphas.

Exercise 11-1 (15 minutes)

	Case A		*Case B*	
Item	*Relevant*	*Irrelevant*	*Relevant*	*Irrelevant*
a. Sales revenue	X			X
b. Direct materials	X		X	
c. Direct labor	X			X
d. Variable manufacturing overhead	X			X
e. Depreciation— Model B100 machine		X		X
f. Book value— Model B100 machine		X		X
g. Disposal value— Model B100 machine		X	X	
h. Market value—Model B300 machine (cost)..	X		X	
i. Fixed manufacturing overhead (general)		X		X
j. Variable selling expense	X			X
k. Fixed selling expense....	X			X
l. General administrative overhead	X			X

Exercise 11-2 (30 minutes)

1. The financial (disadvantage) of discontinuing the racing bikes is computed as follows:

Lost contribution margin		$(27,000)
Fixed costs that can be avoided:		
Advertising, traceable	$ 6,000	
Salary of the product-line manager	10,000	16,000
Financial (disadvantage) of discontinuing the Racing Bikes		$(11,000)

The depreciation of the special equipment is a sunk cost and is not relevant to the decision. The common costs are allocated and will continue regardless of whether or not the racing bikes are discontinued; thus, they are not relevant to the decision.

Alternative Solution:

	Current Total	*Total If Racing Bikes Are Dropped*	*Difference: Net Operating Income Increase or (Decrease)*
Sales	$300,000	$240,000	$(60,000)
Variable expenses	120,000	87,000	33,000
Contribution margin	180,000	153,000	(27,000)
Fixed expenses:			
Advertising, traceable	30,000	24,000	6,000
Depreciation on special equipment*	23,000	23,000	0
Salaries of product-line managers	35,000	25,000	10,000
Common allocated costs	60,000	60,000	0
Total fixed expenses	148,000	132,000	16,000
Net operating income	$ 32,000	$ 21,000	$(11,000)

*Includes pro-rated loss on the special equipment if it is disposed of.

Exercise 11-2 (continued)

2. No, production and sale of the racing bikes should not be discontinued.

3. The segmented report can be improved by eliminating the allocation of the common fixed expenses. Following the format introduced in Chapter 6 for a segmented income statement, a better report would be:

	Total	*Dirt Bikes*	*Mountain Bikes*	*Racing Bikes*
Sales	$300,000	$90,000	$150,000	$60,000
Variable manufacturing and selling expenses	120,000	27,000	60,000	33,000
Contribution margin	180,000	63,000	90,000	27,000
Traceable fixed expenses:				
Advertising	30,000	10,000	14,000	6,000
Depreciation of special equipment	23,000	6,000	9,000	8,000
Salaries of the product-line managers	35,000	12,000	13,000	10,000
Total traceable fixed expenses	88,000	28,000	36,000	24,000
Product line segment margin	92,000	$35,000	$ 54,000	$ 3,000
Common fixed expenses	60,000			
Net operating income	$ 32,000			

Exercise 11-3 (30 minutes)

1.

	Make	*Buy*
Cost of purchasing (15,000 units × $35 per unit)		$525,000
Direct materials (15,000 units × $14 per unit)	$210,000	
Direct labor (15,000 units × $10 per unit)	150,000	
Variable manufacturing overhead (15,000 units × $3 per unit)	45,000	
Traceable fixed manufacturing overhead (15,000 units × $2 per unit)[1]	30,000	
Total costs	$435,000	$525,000
Financial (disadvantage) of buying the carburetors		$(90,000)

[1] Only the supervisory salaries of $2 per unit (= $6 per unit × 1/3) can be avoided if the carburetors are purchased. The remaining book value of the special equipment is a sunk cost; hence, the $4 per unit depreciation expense (= $6 × 2/3) per unit is not relevant to this decision.

2. Based on these data, the company should reject the offer and should continue to produce the carburetors internally.

3.

	Make	*Buy*
Cost of purchasing (see requirement 1)		$525,000
Cost of making (see requirement 1)	$435,000	
Opportunity cost—segment margin foregone on a potential new product line	150,000	
Total cost	$585,000	$525,000
Financial advantage of buying the carburetors		$60,000

4. Given the new assumption, the company should accept the offer and purchase the carburetors from the outside supplier.

Exercise 11-4 (15 minutes)

1. Only the incremental costs and benefits are relevant. In particular, only the variable manufacturing overhead and the cost of the special tool are relevant overhead costs in this situation. The other manufacturing overhead costs are fixed and are not affected by the decision.

	Per Unit	*Total for 20 Bracelets*
Incremental revenue	$169.95	$3,399.00
Incremental costs:		
Variable costs:		
Direct materials	$ 84.00	1,680.00
Direct labor	45.00	900.00
Variable manufacturing overhead	4.00	80.00
Special filigree	2.00	40.00
Total variable cost	$135.00	2,700.00
Fixed costs:		
Purchase of special tool		250.00
Total incremental cost		2,950.00
Financial advantage of accepting the special order		$ 449.00

2. Even though the price for the special order is below the company's regular price for such an item, the company would be better off accepting the order. This conclusion would not necessarily follow if the special order affected the regular selling price of bracelets or if it required the use of a constrained resource.

Exercise 11-5 (20 minutes)

1. The most profitable use of the constrained resource is determined by the contribution margin per unit of the constrained resource. In part 1, the constrained resource is time on the plastic injection molding machine. Therefore, the analysis would proceed as follows:

	Ski Guard	*Golf Guard*	*Fishing Guard*
Selling price per unit.....	$200	$300	$255
Variable cost per unit.....	60	140	55
Contribution margin per unit (a) .	$140	$160	$200
Plastic injection molding machine processing time required to produce one unit (b)	2 minutes	5 minutes	4 minutes
Contribution margin per unit of the constrained resource (a) ÷ (b).....	$70 per minute	$32 per minute	$50 per minute

2. Production of the Ski Guard product would be the most profitable use of the constrained resource which is, in this case, time on the plastic injection molding machine. The contribution margin per minute is $70 for this product, which is larger than for the other two products.

3. In this part, the constraint is the available pounds of plastic pellets.

	Ski Guard	*Golf Guard*	*Fishing Guard*
Selling price per unit.....	$200	$300	$255
Variable cost per unit.....	60	140	55
Contribution margin per unit (a) .	$140	$160	$200
Pounds of plastic pellets required to produce one unit (b)	7 pounds	4 pounds	8 pounds
Contribution margin per unit of the constrained resource (a) ÷ (b).....	$20 per pound	$40 per pound	$25 per pound

4. In this case, production of the Golf Guard would be the most profitable use of the constrained resource. The contribution margin per unit of the constrained resource for this product is $40, which is larger than for the other two products.

Exercise 11-5 (continued)

5. The Fishing Guard product has the largest unit contribution margin, but it is not the most profitable use of the constrained resource in either case above. This happens because the Fishing Guard uses more of the constrained resources in proportion to its contribution margin than the other two products. In other words, more of the other products can be produced for a given amount of the constrained resource and this more than makes up for their lower contribution margins.

Exercise 11-6 (20 minutes)

1. The value of relaxing the constraint can be determined by computing the contribution margin per unit of the constrained resource:

	Sofa
Selling price per unit	$1,800
Variable cost per unit	1,200
Contribution margin per unit (a)	$ 600
Upholstery shop time required to produce one unit (b)	10 hours
Contribution margin per unit of the constrained resource (a) ÷ (b)	$60 per hour

   The company should be willing to pay an overtime rate of up to $60 per hour to keep the upholstery shop open after normal working hours.

2. To answer this question, it is desirable to compute the contribution margin per unit of the constrained resource for the Love Seat:

	Love Seat
Selling price per unit	$1,500
Variable cost per unit	1,000
Contribution margin per unit (a)	$ 500
Upholstery shop time required to produce one unit (b)	5 hours
Contribution margin per unit of the constrained resource (a) ÷ (b)	$100 per hour

   The additional contribution margin per hour earned by hiring the nearby company is $55 ($100 – $45).

3. The offer by the nearby upholstering company to upholster furniture for $45 per hour should be accepted. The time would be used to upholster Loveseats. If this increases the total production and sales of Loveseats, the time would be worth $100 per hour—a net gain of $55 per hour. If Loveseats are already being produced up to demand, then having these units upholstered in the other company would free up capacity to produce more of the other two product-lines. In both cases, the additional time is worth more than $45 per hour.

Exercise 11-7 (10 minutes)

1. The financial advantage (disadvantage) of further processing each product is calculated as follows:

	A	*B*	*C*
Selling price after further processing	$20	$13	$32
Selling price at the split-off point	16	8	25
Incremental revenue per pound or gallon	$ 4	$ 5	$ 7
Total quarterly output in pounds or gallons	× 15,000	× 20,000	× 4,000
Total incremental revenue	$60,000	$100,000	$28,000
Total incremental processing costs	63,000	80,000	36,000
Financial advantage (disadvantage) of further processing	$(3,000)	$ 20,000	$(8,000)

2. Products A and C should be sold at the split-off point. Only product B should be processed further.

Exercise 11-8 (30 minutes)

1.

	A	*B*	*C*
(1) Contribution margin per unit	$54	$100	$60
(2) Direct material cost per unit	$24	$80	$32
(3) Direct material cost per pound	$8	$8	$8
(4) Pounds of material required per unit (2) ÷ (3)	3	10	4
(5) Contribution margin per pound (1) ÷ (4)	$18	$10	$15

2. If the company has unlimited demand for all three products, it should concentrate all of its available material on product A, which would yield the highest total contribution margin of $108,000 computed as follows:

	A	*B*	*C*
Contribution margin per pound (above)	$ 18	$ 10	$ 15
Pounds of material available	× 6,000	× 6,000	× 6,000
Total contribution margin	$108,000	$60,000	$90,000

Although product A has the lowest contribution margin per unit and the second lowest contribution margin ratio, it is preferred over the other two products because it has the highest contribution margin per pound of material, and material is the company's constrained resource.

3. If customer demand is limited to 500 units per product the maximum contribution margin of $82,000 is computed as follows:

	A	*B*	*C*	*Total*
Contribution margin per pound (above)	$ 18	$ 10	$ 15	
Pounds of material used	× 1,500	× 2,500	× 2,000	
Total contribution margin	$27,000	$25,000	$30,000	$82,000

Product A would be produced first because it earns the highest contribution margin per pound. Since Product A has customer demand of 500 units, it would consume 1,500 pounds of material (= 500 units × 3 pounds per unit). Product C, which also has customer demand of 500 units, would be produced next because it has the second highest contribution margin per pound. It would consume 2,000 pounds of material (= 500 units × 4 pounds per unit). Since Products A and C consume a total of 3,500 pounds of material (= 1,500 pounds + 2,000 pounds = 3,500 pounds), it leaves 2,500 pounds available (= 6,000 pounds – 3,500 pounds) for making the least profitable product, which is Product B.

Exercise 11-8 (continued)

4. Assuming Barlow has customer demand of 500 units per product line and that it has already used its 6,000 pounds in an optimal fashion, any additional raw materials would have to be used to make more of Product B. Thus, the company should be willing to pay up to $18 per pound ($8 usual price plus $10 contribution margin per pound) to manufacture more product B.

Exercise 11-9 (15 minutes)

1. The financial advantage is computed as follows:

	Per Unit	*15,000 Units*
Incremental sales	$14.00	$210,000
Incremental costs:		
Direct materials	5.10	76,500
Direct labor	3.80	57,000
Variable manufacturing overhead	1.00	15,000
Variable selling and administrative	1.50	22,500
Total incremental costs	11.40	171,000
Financial advantage of accepting the special order	$ 2.60	$ 39,000

   The fixed costs are not relevant to the decision because they will be incurred regardless of whether the special order is accepted or rejected.

2. The relevant cost is $1.50 (the variable selling and administrative expenses). All other variable costs are sunk because the units have already been produced. The fixed costs are not relevant because they will not change in total as a consequence of the price charged for the left-over units.

Exercise 11-10 (15 minutes)

The financial advantage of making the 40,000 starters is computed as follows:

	Make	*Buy*
Cost of purchasing (40,000 units × $8.40 per unit)		$336,000
Direct materials (40,000 units × $3.10 per unit)	$124,000	
Direct labor (40,000 units × $2.70 per unit)	108,000	
Variable manufacturing overhead (40,000 units × $0.60 per unit)	24,000	
Supervision	60,000	
Total costs	$316,000	$336,000
Financial advantage of making the starters		$20,000

Exercise 11-11 (20 minutes)

The financial advantage of accepting the supplier's offer is computed as follows:

	Make	*Buy*
Cost of purchasing (30,000 units × $21.00 per unit)		$630,000
Direct materials (30,000 units × $3.60 per unit)	$108,000	
Direct labor (30,000 units × $10.00 per unit)	300,000	
Variable manufacturing overhead (30,000 units × $2.40 per unit)	72,000	
Fixed manufacturing overhead (30,000 units × $3.00 per unit*)	90,000	
Rent (Opportunity cost)	80,000	
Total costs	$650,000	$630,000
Financial advantage of accepting the offer	$20,000	

* The remaining $6 of fixed overhead cost ($9 per unit × 2/3 = $6 per unit) would not be relevant, because it will continue regardless of whether the company makes or buys the parts.

Exercise 11-12 (15 minutes)

1. The contribution margin per pound of the constraining resource for each product is computed as follows:

	Product A	*Product B*	*Product C*
(1) Direct materials required per unit	$24	$15	$9
(2) Cost per pound	$3	$3	$3
(3) Pounds required per unit (1) ÷ (2)	8	5	3
(4) Contribution margin per unit	$32	$14	$21
(5) Contribution margin per pound of materials used (4) ÷ (3)	$4.00	$2.80	$7.00

2. The company should accept orders first for Product C, second for Product A, and third for Product B.

   Because Product C uses the least amount of material per unit of the three products, and because it is the most profitable of the three in terms of its use of materials, some students will immediately assume that this is an infallible relationship. That is, they will assume that the way to spot the most profitable product is to find the one using the least amount of the constrained resource. The way to dispel this notion is to point out that Product A uses more material (the constrained resource) than Product B, but yet it is preferred over Product B. *The key factor is not how much of a constrained resource a product uses, but rather how much contribution margin the product generates per unit of the constrained resource.*

3. If customer demand is limited to 800 units per product, the maximum contribution margin of $27,200 is computed as follows:

	A	*B*	*C*	*Total*
Contribution margin per pound (above)	$ 4.00	$ 2.80	$ 7.00	
Pounds of material used	× 2,600	× 0	× 2,400	
Total contribution margin	$10,400	$ 0	$16,800	$27,200

Exercise 11-12 (continued)

3. Product C would be produced first because it earns the highest contribution margin per pound. Given that Product C has customer demand of 800 units, it would consume 2,400 pounds of material (= 800 units × 3 pounds per unit). Product A, which also has customer demand of 800 units, would be produced next because it has the second highest contribution margin per pound. It would consume the remaining 2,600 pounds of material (= 325 units × 8 pounds per unit). Since Products C and A consume a total of 5,000 pounds of material (2,400 pounds + 2,600 pounds), it leaves zero pounds available for making the least profitable product, which is Product B.

Exercise 11-13 (10 minutes)

1. The financial advantage of further processing X15 is computed as follows:

Sales value after further processing (7,000 units × $12 per unit)	$84,000
Sales value at the split-off point (7,000 units × $9 per unit)	63,000
Incremental revenue from further processing	21,000
Cost of further processing	9,500
Financial advantage of further processing	$11,500

   The $60,000 cost incurred up to the split-off point is not relevant in a sell or process further analysis.

2. Yes, the company should process product X15 beyond the split-off point.

Exercise 11-14 (20 minutes)

1. Average fixed cost per mile ($3,200* ÷ 10,000 miles) $0.32
   Variable operating cost per mile 0.14
   Average cost per mile $0.46

   * Depreciation $1,600
   Insurance 1,200
   Garage rent 360
   Automobile tax and license 40
   Total $3,200

2. The variable operating cost is relevant in this situation. The depreciation is not relevant because it is a sunk cost. However, any decrease in the resale value of the car due to its use is relevant. The automobile tax and license costs would be incurred whether Kristen decides to drive her own car or rent a car for the trip during spring break and therefore are irrelevant. It is unlikely that her insurance costs would increase as a result of the trip, so they are irrelevant as well. The garage rent is relevant only if she could avoid paying part of it if she drives her own car.

3. When figuring the incremental cost of the more expensive car, the relevant costs include the purchase price of the new car (net of the resale value of the old car) and the increases in the fixed costs of insurance and automobile tax and license. The original purchase price of the old car is a sunk cost and therefore is irrelevant. The variable operating cost would be the same and therefore is irrelevant. (Students are inclined to think that variable costs are always relevant and fixed costs are always irrelevant in decisions. This requirement helps to dispel that notion.)

Exercise 11-15 (30 minutes)

The financial (disadvantage) of discontinuing the bilge pump product line is computed as follows:

Contribution margin lost if the line is dropped.....		$(460,000)
Fixed costs that can be avoided:		
Advertising (for the bilge pump product line) ...	$270,000	
Salary of the product-line manager	32,000	
Insurance on inventories.....	8,000	310,000
Financial (disadvantage) of dropping the line.....		$(150,000)

The same solution can be obtained by preparing comparative income statements:

	Keep Product Line	*Drop Product Line*	*Difference: Net Operating Income Increase or (Decrease)*
Sales	$850,000	$ 0	$(850,000)
Variable expenses:			
Variable manufacturing expenses....	330,000	0	330,000
Sales commissions.....	42,000	0	42,000
Shipping.....	18,000	0	18,000
Total variable expenses	390,000	0	390,000
Contribution margin	460,000	0	(460,000)
Fixed expenses:			
Advertising (for the bilge pump product line)	270,000	0	270,000
Depreciation of equipment	80,000	80,000	0
General factory overhead	105,000	105,000	0
Salary of product-line manager.....	32,000	0	32,000
Insurance on inventories.....	8,000	0	8,000
Purchasing department.....	45,000	45,000	0
Total fixed expenses.....	540,000	230,000	310,000
Net operating loss.....	$ (80,000)	$(230,000)	$(150,000)

Exercise 11-16 (30 minutes)

1. The relevant costs of a hunting trip would be:

Travel expense (100 miles @ $0.21 per mile)	$21
Shotgun shells	20
One bottle of whiskey	15
Total	$56

   This answer assumes that Bill would not be drinking the bottle of whiskey if he stayed home. It also assumes that the resale values of the camper, pickup truck, and boat are not affected by taking one more hunting trip.

   The money lost in the poker game is not relevant because Bill would have played poker even if he did not go hunting. He plays poker every weekend.

   The other costs are sunk at the point at which the decision is made to go on another hunting trip.

2. If Bill gets lucky and bags another two ducks, all of his costs are likely to be the same as they were on his last trip. Therefore, it doesn't cost him anything to shoot the last two ducks. If he were to use more shotgun shells to kill more ducks, then he would incur additional costs related to the shotgun shells. However, in this particular case he bagged two more ducks than on his prior trip using the same number of shotgun shells.

3. In a decision of whether to give up hunting entirely, more of the costs listed by John are relevant. If Bill did not hunt, he would not need to pay for: gas, oil, and tires; shotgun shells; the hunting license; and the whiskey. In addition, he would be able to sell his camper, equipment, boat, and possibly pickup truck, the proceeds of which would be considered relevant in this decision. The original costs of these items are not relevant, but their resale values are relevant.

   These three requirements illustrate the slippery nature of costs. A cost that is relevant in one situation can be irrelevant in the next. None of the costs are relevant when we compute the cost of bagging two additional ducks; some of them are relevant when we compute the cost of a hunting trip; and more of them are relevant when we consider the possibility of giving up hunting.

Exercise 11-17 (10 minutes)

Contribution margin lost if the Linens Department is dropped:	
Lost from the Linens Department	$(600,000)
Lost from the Hardware Department (10% × $2,100,000)	(210,000)
Total lost contribution margin	(810,000)
Fixed costs that can be avoided ($800,000 – $340,000)	460,000
Financial (disadvantage) of discontinuing the Linens Department	$(350,000)

Problem 11-18 (60 minutes)

1. Selling price per unit $32
   Variable expenses per unit ..... 18 *
   Contribution margin per unit $14

   *$10.00 + $4.50 + $2.30 + $1.20 = $18.00

   Increased sales in units (60,000 units × 25%) 15,000
   Contribution margin per unit ..... × $14
   Incremental contribution margin $210,000
   Less added fixed selling expenses 80,000
   Financial advantage of the investment $130,000

   Yes, the increase in fixed selling expenses would be justified.

2. Variable manufacturing cost per unit ..... $16.80 *
   Import duties per unit 1.70
   Permits and licenses ($9,000 ÷ 20,000 units) 0.45
   Shipping cost per unit 3.20
   Break-even price per unit $22.15

   *$10 + $4.50 + $2.30 = $16.80

3. The relevant cost is $1.20 per unit, which is the variable selling expense per Dak. Because the irregular units have already been produced, all production costs (including the variable production costs) are sunk. The fixed selling expenses are not relevant because they will be incurred whether or not the irregular units are sold. Depending on how the irregular units are sold, the variable expense of $1.20 per unit may not even be relevant. For example, the units may be disposed of through a liquidator without incurring the normal variable selling expense.

4. If the plant operates at 30% of normal levels, then only 3,000 units will be produced and sold during the two-month period:

   60,000 units per year × 2/12 years = 10,000 units
   10,000 units × 30% = 3,000 units produced and sold

Problem 11-18 (continued)

Given this information, the simplest approach to solving 4a, 4b, and 4c is:

Contribution margin lost if the plant is closed (3,000 units × $14 per unit)		$(42,000)
Fixed costs that can be avoided if the plant is closed:		
Fixed manufacturing overhead cost ($300,000 × 2/12 = $50,000; $50,000 × 40%)	$20,000	
Fixed selling cost ($210,000 × 2/12 = $35,000; $35,000 × 20%)	7,000	27,000
Financial (disadvantage) of closing the plant		$(15,000)

Some students will take a longer approach such as that shown below:

	Continue to Operate	*Close the Plant*
Sales (3,000 units × $32 per unit)	$ 96,000	$ 0
Variable expenses (3,000 units × $18 per unit)	54,000	0
Contribution margin	42,000	0
Fixed expenses:		
Fixed manufacturing overhead cost:		
$300,000 × 2/12	50,000	
$300,000 × 2/12 × 60%		30,000
Fixed selling expense:		
$210,000 × 2/12	35,000	
$210,000 × 2/12 × 80%		28,000
Total fixed expenses	85,000	58,000
Net operating income (loss)	$(43,000)	$(58,000)

4d. The company should not close the plant for two months because it will be $15,000 worse off if it closes.

Problem 11-18 (continued)

5. The relevant costs are those that can be avoided by purchasing from the outside supplier. These costs are:

Variable manufacturing cost per unit.....	$16.80
Fixed manufacturing overhead cost ($300,000 × 75% = $225,000; $225,000 ÷ 60,000 units)	3.75
Variable selling expense	0.40
Total avoidable cost per unit	$20.95

To be acceptable, the outside supplier's price must be *less* than $20.95 per unit.

Problem 11-19 (60 minutes)

1. The financial (disadvantage) of discontinuing the Housekeeping program is calculated as follows:

Contribution margin lost if the Housekeeping program is dropped		$(80,000)
Fixed costs that can be avoided:		
Liability insurance	$15,000	
Program administrator's salary	37,000	52,000
Financial (disadvantage) of discontinuing the Housekeeping program		$(28,000)

Depreciation on the van is a sunk cost and the van has no salvage value since it would be donated to another organization. The general administrative overhead is allocated and none of it would be avoided if the program were dropped; thus it is not relevant to the decision.

The same result can be obtained with the alternative analysis below:

	Current Total	*Total If House-keeping Is Dropped*	*Difference: Net Operating Income Increase or (Decrease)*
Revenues	$900,000	$660,000	$(240,000)
Variable expenses	490,000	330,000	160,000
Contribution margin	410,000	330,000	(80,000)
Fixed expenses:			
Depreciation*	68,000	68,000	0
Liability insurance	42,000	27,000	15,000
Program administrators' salaries	115,000	78,000	37,000
General administrative overhead	180,000	180,000	0
Total fixed expenses	405,000	353,000	52,000
Net operating income (loss)	$ 5,000	$(23,000)	$ (28,000)

*Includes pro-rated loss on disposal of the van if it is donated to a charity.

Problem 11-19 (continued)

2. To give the administrator of the entire organization a clearer picture of the financial viability of each of the organization's programs, the general administrative overhead should not be allocated. It is a common cost that should be deducted from the total program segment margin. A better income statement would be:

	Total	*Home Nursing*	*Meals On Wheels*	*House-keeping*
Revenues	$900,000	$260,000	$400,000	$240,000
Variable expenses	490,000	120,000	210,000	160,000
Contribution margin	410,000	140,000	190,000	80,000
Traceable fixed expenses:				
Depreciation	68,000	8,000	40,000	20,000
Liability insurance	42,000	20,000	7,000	15,000
Program administrators' salaries	115,000	40,000	38,000	37,000
Total traceable fixed expenses	225,000	68,000	85,000	72,000
Program segment margins	185,000	$ 72,000	$105,000	$ 8,000
General administrative overhead	180,000			
Net operating income	$ 5,000			

Problem 11-20 (15 minutes)

1.

	Per 16-Ounce T-Bone
Sales from further processing:	
Sales price of one filet mignon (6 ounces × $12.00 per pound ÷ 16 ounces per pound)	$4.50
Sales price of one New York cut (8 ounces × $8.80 per pound ÷ 16 ounces per pound)	4.40
Total revenue from further processing	8.90
Less sales revenue from one T-bone steak	7.95
Incremental revenue from further processing	0.95
Less cost of further processing	0.55
Financial advantage of further processing	$0.40

2. The T-bone steaks should be processed further into the filet mignon and the New York cut. The $4.15 "profit" per pound shown in the text is not relevant to the decision because it contains allocated joint costs. The company will incur the joint costs regardless of whether the T-bone steaks are sold outright or processed further; thus, this cost should be ignored in the decision.

Problem 11-21 (30 minutes)

1. Contribution margin lost if the flight is discontinued		$(12,950)
Flight costs that can be avoided if the flight is discontinued:		
Flight promotion	$ 750	
Fuel for aircraft	5,800	
Liability insurance (1/3 × $4,200)	1,400	
Salaries, flight assistants	1,500	
Overnight costs for flight crew and assistants	300	9,750
Financial (disadvantage) of discontinuing the flight		$ (3,200)

The following costs are not relevant to the decision:

Cost	*Reason*
Salaries, flight crew	Fixed annual salaries, which will not change.
Depreciation of aircraft	Sunk cost.
Liability insurance (two-thirds)	Two-thirds of the liability insurance is unaffected by this decision.
Baggage loading and flight preparation	This is an allocated cost that will continue even if the flight is discontinued.

Problem 11-21 (continued)

Alternative Solution:

	Keep the Flight	*Drop the Flight*	*Difference: Net Operating Income Increase or (Decrease)*
Ticket revenue	$14,000	$ 0	$(14,000)
Variable expenses	1,050	0	1,050
Contribution margin	12,950	0	(12,950)
Less flight expenses:			
Salaries, flight crew	1,800	1,800	0
Flight promotion	750	0	750
Depreciation of aircraft	1,550	1,550	0
Fuel for aircraft	5,800	0	5,800
Liability insurance	4,200	2,800	1,400
Salaries, flight assistants	1,500	0	1,500
Baggage loading and flight preparation	1,700	1,700	0
Overnight costs for flight crew and assistants at destination	300	0	300
Total flight expenses	17,600	7,850	9,750
Net operating loss	$ (4,650)	$ (7,850)	$ (3,200)

2. The goal of increasing the seat occupancy could be obtained by eliminating flights with a lower-than-average seat occupancy. By eliminating these flights and keeping the flights with a higher-than-average seat occupancy, the overall average seat occupancy for the company as a whole would be improved. This could reduce profits in at least two ways. First, the flights that are eliminated could have contribution margins that exceed their avoidable costs (such as in the case of flight 482 in requirement 1). If so, then eliminating these flights would reduce the company's total contribution margin more than it would reduce total costs, and profits would decline. Second, these flights might be acting as "feeder" flights, bringing passengers to cities where connections to more profitable flights are made.

Problem 11-22 (30 minutes)

1. Because the fixed costs will not change as a result of the order, they are not relevant to the decision. The cost of the new machine is relevant, and this cost will have to be recovered by the current order because there is no assurance of future business from the retail chain.

	Unit	*Total— 5,000 units*
Sales from the order ($50 × 84%)	$42	$210,000
Less costs associated with the order:		
Direct materials	15	75,000
Direct labor	8	40,000
Variable manufacturing overhead	3	15,000
Variable selling expense ($4 × 25%)	1	5,000
Special machine ($10,000 ÷ 5,000 units)	2	10,000
Total costs	29	145,000
Financial advantage of accepting the order	$13	$ 65,000

2. Sales from the order:

Reimbursement for production costs (variable production costs of $26 plus fixed overhead cost of $9 = $35 per unit; $35 per unit × 5,000 units)	$175,000
Fixed fee ($1.80 per unit × 5,000 units)	9,000
Total revenue	184,000
Less incremental costs—variable production costs ($26 per unit × 5,000 units)	130,000
Financial advantage of accepting the order	$ 54,000

3. Sales:

From the U.S. Army (above)	$184,000
Lost sales from regular channels ($50 per unit × 5,000 units)	(250,000)
Net decrease in revenue	(66,000)
Less variable selling expenses avoided if the Army's order is accepted ($4 per unit × 5,000 units)	20,000
Financial (disadvantage) of accepting the order	$(46,000)

Note: This answer assumes that regular customers will return after this one-time special order rather than buy from a competitor in the future.

Problem 11-23 (60 minutes)

1. The starting point for answering requirement 1 is separating the manufacturing overhead per unit of $1.40 into its variable and fixed components. The variable manufacturing overhead per box of Chap-Off would be $0.50, as shown below:

Total manufacturing overhead cost per box of Chap-Off	$1.40
Less fixed portion ($90,000 ÷ 100,000 boxes)	0.90
Variable overhead cost per box	$0.50

   The avoidable manufacturing cost per box of Chap-Off is computed as follows:

Cost avoided by purchasing the tubes:	
Direct materials ($3.60 × 25%)	$0.90
Direct labor ($2.00 × 10%)	0.20
Variable manufacturing overhead ($0.50 × 10%)	0.05
Avoidable manufacturing cost per box of Chap-Off	$1.15

2. The financial (disadvantage) per box of Chap-Off is computed as follows:

Avoidable manufacturing cost per box of Chap-Off	$ 1.15
Less price paid to supplier	1.35
Financial (disadvantage) per box of Chap-Off	$(0.20)

3. The financial (disadvantage) of outsourcing 100,000 boxes of Chap-Off is computed as follows:

Number of boxes (a)	100,000
Financial (disadvantage) per box of Chap-Off (b)	$(0.20)
Financial (disadvantage) in total (a) × (b)	$(20,000)

4. Silven should make the tubes because the price paid to the supplier ($1.35) exceeds the avoidable manufacturing cost per unit ($1.15).

Problem 11-23 (continued)

5. The maximum purchase price would be $1.15 per box. The company would not be willing to pay more than this amount because the $1.15 represents the cost of producing one box of tubes internally. To make purchasing the tubes attractive, however, the purchase price should be *less than* $1.15 per box.

6. At a volume of 120,000 boxes, the company should buy the tubes. The computations are:

Cost of making 120,000 boxes of tubes:	
120,000 boxes × $1.15 per box	$138,000
Rental cost of equipment	40,000
Total cost	$178,000
Cost of buying 120,000 boxes of tubes:	
120,000 boxes × $1.35 per box	$162,000

Thus, buying the tubes provides a financial advantage of $16,000 (= $178,000 – $162,000) per year.

7. Under these circumstances, the company should make 100,000 boxes of tubes and purchase the remaining 20,000 boxes of tubes from the outside supplier. The costs would be as follows:

Cost of making: 100,000 boxes × $1.15 per box	$115,000
Cost of buying: 20,000 boxes × $1.35 per box	27,000
Total cost	$142,000

8. Management should take into account at least the following additional factors:
   - The ability of the supplier to meet required delivery schedules.
   - The quality of the tubes purchased from the supplier.
   - Alternative uses of the capacity that would be used to make the tubes.
   - The ability of the supplier to supply tubes if volume increases in future years.
   - The problem of finding an alternative source of supply if the supplier proves to be undependable.

Problem 11-24 (45 minutes)

1. Product RG-6 has a contribution margin of $8 per unit (= $22 – $14). If the plant closes, this contribution margin will be lost on the 16,000 units (= 8,000 units per month × 2 months) that could have been sold during the two-month period. However, the company will be able to avoid some fixed costs as a result of closing down. The analysis is:

Contribution margin lost by closing the plant for two months ($8 per unit × 16,000 units).....		$(128,000)
Costs avoided by closing the plant for two months:		
Fixed manufacturing overhead cost ($45,000 per month × 2 months).....	$90,000	
Fixed selling costs ($30,000 per month × 10% × 2 months)	6,000	96,000
Start-up costs at the end of the shutdown.....		(8,000)
Financial (disadvantage) of closing the plant		$ (40,000)

2. No, the company should not close the plant; it should continue to operate at the reduced level of 8,000 units produced and sold each month. Closing will result in a $40,000 greater loss over the two-month period than if the company continues to operate. An additional factor is the potential loss of goodwill among the customers who need the 8,000 units of RG-6 each month. By closing down, the needs of these customers will not be met (no inventories are on hand), and their business may be permanently lost to another supplier.

Problem 11-24 (continued)

Alternative Solution:

	Plant Kept Open	*Plant Closed*	*Difference: Net Operating Income Increase or (Decrease)*
Sales (8,000 units × $22 per unit × 2)	$ 352,000	$ 0	$(352,000)
Variable expenses (8,000 units × $14 per unit × 2)	224,000	0	224,000
Contribution margin	128,000	0	(128,000)
Less fixed costs:			
Fixed manufacturing overhead costs ($150,000 × 2)	300,000	210,000	90,000
Fixed selling costs ($30,000 × 2)	60,000	54,000 *	6,000
Total fixed costs	360,000	264,000	96,000
Net operating loss before start-up costs	(232,000)	(264,000)	(32,000)
Start-up costs	0	(8,000)	(8,000)
Net operating loss	$(232,000)	$(272,000)	$ (40,000)

* $30,000 × 90% = $27,000; $27,000 × 2 = $54,000

Problem 11-24 (continued)

3. Birch Company will be indifferent if it can sell 11,000 units over the two-month period. The computations are:

Cost avoided by closing the plant for two months (see above)	$96,000
Less start-up costs	8,000
Net avoidable costs	$88,000

$$\frac{\text{Net avoidable costs}}{\text{Per unit contribution margin}} = \frac{\$88{,}000}{\$8 \text{ per unit}} = 11{,}000 \text{ units}$$

Verification:

	Operate at 11,000 Units for Two Months	*Close for Two Months*
Sales (11,000 units × $22 per unit)	$ 242,000	$ 0
Variable expenses (11,000 units × $14 per unit)	154,000	0
Contribution margin	88,000	0
Fixed expenses:		
Manufacturing overhead ($150,000 and $105,000, × 2)	300,000	210,000
Selling ($30,000 and $27,000, × 2)	60,000	54,000
Total fixed expenses	360,000	264,000
Start-up costs	0	8,000
Total costs	360,000	272,000
Net operating loss	$(272,000)	$(272,000)

Problem 11-25 (60 minutes)

1.

	Debbie	*Trish*	*Sarah*	*Mike*	*Sewing Kit*
Direct labor cost per unit (a) ...	$6.40	$4.00	$11.20	$8.00	$3.20
Direct labor rate per hour (b) ..	$16.00	$16.00	$16.00	$16.00	$16.00
Direct labor hours per unit (a) ÷ (b).....	0.40	0.25	0.70	0.50	0.20

2.

	Debbie	*Trish*	*Sarah*	*Mike*	*Sewing Kit*
Variable overhead per hour (a)	$2.00	$2.00	$2.00	$2.00	$2.00
Direct labor hours per unit (b) .	0.40	0.25	0.70	0.50	0.20
Variable overhead per unit (a) × (b).....	$0.80	$0.50	$1.40	$1.00	$0.40

3.

	Debbie	*Trish*	*Sarah*	*Mike*	*Sewing Kit*
Selling price.....	$16.70	$7.50	$26.60	$14.00	$ 9.60
Variable costs:					
Direct materials	4.30	1.10	6.44	2.00	3.20
Direct labor	6.40	4.00	11.20	8.00	3.20
Variable overhead	0.80	0.50	1.40	1.00	0.40
Total variable costs.....	11.50	5.60	19.04	11.00	6.80
Contribution margin (a)	$ 5.20	$1.90	$ 7.56	$ 3.00	$ 2.80
Direct labor hours per unit (b) .	0.40	0.25	0.70	0.50	0.20
Contribution margin per DLH (a) ÷ (b).....	$13.00	$7.60	$10.80	$ 6.00	$14.00

Problem 11-25 (continued)

4. The first step is to compute how many direct labor-hours would be committed to each of the five products as follows:

Amount of constrained resource available	130,000 hours
Less: Hours required for production of 325,000 units of the Sewing Kit @ 0.20 hours per unit	65,000 hours
Remaining constrained resource available	65,000 hours
Less: Hours required for production of 50,000 units of the Debbie doll @ 0.40 hours per unit	20,000 hours
Remaining constrained resource available	45,000 hours
Less: Hours required for production of 35,000 units of the Sarah doll @ 0.70 hours per unit	24,500 hours
Remaining constrained resource available	20,500 hours
Less: Hours required for production of 42,000 units of the Trish doll @ 0.25 hours per unit.....	10,500 hours
Remaining constrained resource available	10,000 hours
Less: Hours required for production of 20,000 units of the Mike doll @ 0.50 hours per unit.....	10,000 hours
Remaining constrained resource available	0 hours

The second step is to multiple the direct labor-hours committed to each product by its respective contribution margin per direct labor-hour as shown below:

	Sewing Kit	*Debbie*	*Sarah*	*Trish*	*Mike*
Contribution margin per DLH (a)	$14.00	$13.00	$10.80	$7.60	$6.00
DLH committed to each product (b)	65,000	20,000	24,500	10,500	10,000
Total contribution margin (a) × (b)	$910,000	$260,000	$264,600	$79,800	$60,000

The highest total contribution margin that the company can earn is $1,574,400 (= $910,000 + $260,000 + $264,600 + $79,800 + $60,000).

Problem 11-25 (continued)

5. Because the additional capacity would be used to produce the Mike doll, the company should be willing to pay up to $22 per hour ($16 per hour usual rate plus $6 contribution margin per hour) for added labor time.

6. Additional output could be obtained in a number of ways including working overtime, adding another shift, expanding the workforce, contracting out some work to outside suppliers, and eliminating wasted labor time in the production process. The first four methods are costly, but the last method can add capacity at very low cost.

   Note: Some would argue that direct labor is a fixed cost in this situation and should be excluded when computing the contribution margin per unit. However, when deciding which products to emphasize, no harm is done by misclassifying a fixed cost as a variable cost—providing that the fixed cost is the constraint. If direct labor were removed from the variable cost category, the net effect would be to bump up the contribution margin per direct labor-hour by $8 for each of the products. The products will be *ranked* exactly the same—in terms of the contribution margin per unit of the constrained resource—whether direct labor is considered variable or fixed. However, this only works when the fixed cost is the cost of the constraint itself.

Problem 11-26 (60 minutes)

1. and 2.

The avoided employee salaries and employment taxes are computed as follows:

Sales salaries	$70,000
Delivery salaries	4,000
Store management salaries	9,000
Salary of new manager	11,000
General office salaries	6,000
Total employee salaries avoided	100,000
Employment tax rate	× 15%
Total employment taxes avoided	$15,000

3. The simplest approach to the solution is:

Gross margin lost if the store is closed		$(316,800)
Costs that can be avoided:		
Employee salaries (see requirement 1)	$100,000	
Employment taxes (see requirement 2)	$15,000	
Direct advertising	51,000	
Store rent	85,000	
Insurance on inventories ($7,500 × 2/3)	5,000	
Utilities	31,000	287,000
Financial (disadvantage) of closing the North Store		$ (29,800)

Problem 11-26 (continued)

Alternative Solution (Total cost approach):

	North Store Kept Open	*North Store Closed*	*Difference: Net Operating Income Increase or (Decrease)*	
Sales	$720,000	$ 0	$(720,000)	
Cost of goods sold	403,200	0	403,200	
Gross margin	316,800	0	(316,800)	
Selling and administrative expenses:				
Selling expenses:				
Sales salaries	70,000	0	70,000	
Direct advertising	51,000	0	51,000	
General advertising	10,800	10,800	0	
Store rent	85,000	0	85,000	
Depreciation of store fixtures	4,600	4,600	0	
Delivery salaries	7,000	3,000	4,000	
Depreciation of delivery equipment	3,000	3,000	0	
Total selling expenses	231,400	21,400	210,000	
Administrative expenses:				
Store management salaries	21,000	12,000	9,000	
Salary of new manager	11,000	0	11,000	
General office salaries	12,000	6,000	6,000	
Insurance on fixtures and inventory	7,500	2,500	5,000	
Utilities	31,000	0	31,000	
Employment taxes	18,150	3,150	15,000	*
General office—other	18,000	18,000	0	
Total administrative expenses	118,650	41,650	77,000	
Total operating expenses	350,050	63,050	287,000	
Net operating income (loss)	$(33,250)	$(63,050)	$ (29,800)	

*See the computation on the prior page.

Problem 11-26 (continued)

4. Based on the data in requirement (3), the North Store should not be closed. The company would be $29,800 worse off per quarter if it closed the North Store. If the store space cannot be subleased or the lease broken without penalty, a decision to close the store would become even less viable. If the $85,000 rent cannot be avoided and the North Store is closed, the financial (disadvantage) of closing the North Store would grow from $(29,800) to $(114,800) per quarter.

5. Under these circumstances, the North Store should be closed. The computations are as follows:

Gross margin lost if the North Store is closed (see requirement 3)	$(316,800)
Gross margin gained from the East Store: $720,000 × 1/4 = $180,000; $180,000 × 45%* = $81,000	81,000
Net operating loss in gross margin	(235,800)
Less costs that can be avoided if the North Store is closed (see requirement 3)	287,000
Financial advantage of closing the North Store	$ 51,200

*The East Store's gross margin percentage is:
$486,000 ÷ $1,080,000 = 45%

Problem 11-27 (60 minutes)

1. The incremental revenue per jar from further processing of the Grit 337 is:

Selling price of the silver polish, per jar	$4.00
Selling price of 1/4 pound of Grit 337 ($2.00 ÷ 4)	0.50
Incremental revenue per jar	$3.50

2. The incremental contribution margin per jar:

Incremental revenue per jar		$3.50
Incremental variable costs per jar:		
Other ingredients	$0.65	
Direct labor	1.48	
Variable manufacturing overhead (25% × $1.48)	0.37	
Variable selling costs (7.5% × $4.00)	0.30	
Total incremental variable cost per jar		2.80
Incremental contribution margin per jar		$0.70

The $1.60 cost per pound (= $0.40 per 1/4 pound) required to produce the Grit 337 would not be relevant in this computation because it is incurred regardless of whether the Grit 337 is further processed into silver polish or sold outright.

Problem 11-27 (continued)

3. Only the cost of advertising and the cost of the production supervisor are avoidable if production of the silver polish is discontinued. Therefore, the number of jars of silver polish that must be sold each month to justify continued processing of the Grit 337 into silver polish is:

Production supervisor.....	$3,000
Advertising—direct.....	4,000
Avoidable fixed costs.....	$7,000

$$\frac{\text{Avoidable fixed costs}}{\text{Incremental CM per jar}} = \frac{\$7{,}000}{\$0.70 \text{ per jar}} = 10{,}000 \text{ jars per month}$$

If 10,000 jars of silver polish can be sold each month, the company would be indifferent between selling it or selling all of the Grit 337 as a cleaning powder. If the sales of the silver polish are greater than 10,000 jars per month, then continued processing of the Grit 337 into silver polish would be advisable because the company's total profits will be increased. If the company can't sell at least 10,000 jars of silver polish each month, then production of the silver polish should be discontinued.

4. and 5.

The financial advantage (disadvantage) is computed as follows:

	9,000 jars	*11,500 jars*
Incremental contribution margin per jar (a).	$0.70	$0.70
Number of jars sold (b).....	9,000	11,500
Incremental contribution margin (a) × (b) ..	$6,300	$8,050
Incremental contribution margin	$6,300	$8,050
Less avoidable fixed costs.....	7,000	7,000
Financial advantage (disadvantage).....	$ (700)	$1,050

Problem 11-28 (60 minutes)

1. The financial advantage of accepting the supplier's offer is computed as follows:

	Make	*Buy*
Cost of purchasing (60,000 units × $18 per unit)		$1,080,000
Direct materials (60,000 units × $10.35 per unit)	$ 621,000	
Direct labor (60,000 units × $4.27 per unit)	256,200	
Variable manufacturing overhead (60,000 units × $1.12 per unit)	67,200	
Supervision	45,000	
Rent	135,800	
Total costs	$1,125,200	$1,080,000
Financial advantage of accepting the offer		$45,200

Note: The $2.80 per drum general overhead cost is not relevant to the decision because this cost will be the same regardless of whether the company decides to make or buy the drums. Also, the depreciation of $1.60 per drum is not a relevant cost because it represents a sunk cost (in addition to the fact that the old equipment is worn out and must be replaced). The cost of supervision is relevant to the decision because this cost can be avoided by buying the drums.

Problem 11-28 (continued)

2. The financial advantage (disadvantage) of accepting the supplier's offer is computed as follows:

	Make	*Buy*
Cost of purchasing (80,000 units × $18 per unit)		$1,440,000
Direct materials (80,000 units × $10.35 per unit)	$ 828,000	
Direct labor (80,000 units × $4.27 per unit)	341,600	
Variable manufacturing overhead (80,000 units × $1.12 per unit)	89,600	
Supervision	45,000	
Rent	135,800	
Total costs	$1,440,000	$1,440,000
Financial advantage (disadvantage) of accepting the offer		$0

Note: The company would be indifferent between the two alternatives if 80,000 drums were needed each year.

3. The financial (disadvantage) of accepting the supplier's offer is computed as follows:

	Make	*Buy*
Cost of purchasing (100,000 units × $18 per unit)		$1,800,000
Direct materials (100,000 units × $10.35 per unit)	$1,035,000	
Direct labor (100,000 units × $4.27 per unit)	427,000	
Variable manufacturing overhead (100,000 units × $1.12 per unit)	112,000	
Supervision	45,000	
Rent	135,800	
Total costs	$1,754,800	$1,800,000
Financial (disadvantage) of accepting the offer	$(45,200)	

The company should rent the new equipment and make the drums if 100,000 units per year are needed.

Problem 11-28 (continued)

4. Other factors that the company should consider include:
   - Will volume in future years increase, or will it remain constant at 60,000 units per year? (If volume increases, then renting the new equipment becomes more desirable, as shown in the computations above.)
   - Can quality control be maintained if the drums are purchased from the outside supplier?
   - Will costs for materials and labor increase in future years?
   - Will the outside supplier dependably meet shipping schedules?
   - Can the company begin making the drums again if the supplier proves to be undependable? Are there alternative suppliers?
   - What is the labor outlook in the supplier's industry (e.g., are frequent labor strikes likely)?
   - If the outside supplier's offer is accepted and the need for drums increases in future years, will the supplier have the added capacity to provide more than 60,000 drums per year?
   - Will the rental cost of the equipment change in the future?

Case (45 minutes)

1. As much yarn as possible should be processed into sweaters. Products should be processed further so long as the added revenues from further processing are greater than the added costs. In this case, the added revenues and costs are:

		Per Sweater
Added revenue ($30.00 – $20.00)		$10.00
Added costs:		
Buttons, thread, lining	$2.00	
Direct labor	5.80	7.80
Financial advantage		$ 2.20

2. The company should process the wool yarn into sweaters because the company will gain $2.20 in contribution margin for each spindle of yarn that is further processed into a sweater. The fixed manufacturing overhead costs are not relevant to the decision because they will be the same regardless of whether the yarn is sold or processed further. In addition, we must omit the $16.00 cost of manufacturing the yarn because this cost will be incurred whether the yarn is sold as is or is used in sweaters.

3. The lowest price the company should accept is $27.80 per sweater. The simplest approach to this answer is:

Present selling price per sweater	$30.00
Less added contribution margin being realized on each sweater sold	2.20
Minimum selling price per sweater	$27.80

   A more involved approach to the same answer is to reason as follows:

   If the wool yarn is sold outright, then the company will realize a contribution margin of $9.40 per spindle:

	Per Spindle	
Selling price		$20.00
Variable expenses:		
Raw wool	$7.00	
Direct labor	3.60	10.60
Contribution margin		$ 9.40

Case (continued)

This $9.40 is an opportunity cost. The price of the sweaters must be high enough to cover this opportunity cost. In addition, the company must be able to cover all of its variable costs from the time the raw wool is purchased until the sweater is completed. Therefore, the minimum price is:

Variable costs of producing a spindle of yarn:		
Raw wool	$7.00	
Direct labor	3.60	$10.60
Added variable costs of producing a sweater:		
Buttons, etc.	2.00	
Direct labor	5.80	7.80
Total variable costs		18.40
Opportunity cost—contribution margin if the yarn is sold outright		9.40
Minimum selling price per sweater		$27.80

Ethics Challenge (90 minutes)

1. The original cost of the facilities at Clayton is a sunk cost and should be ignored in any decision. The decision being considered here is whether to continue operations at Clayton. The only relevant costs are the future facility costs that would be affected by this decision. If the facility were shut down, the Clayton facility has no resale value. In addition, if the Clayton facility were sold, the company would have to rent additional space at the remaining processing centers. On the other hand, if the facility were to remain in operation, the building should last indefinitely, so the company does not have to be concerned about eventually replacing it. Essentially, there is no real cost at this point of using the Clayton facility despite what the financial performance report indicates. Indeed, it might be a better idea to consider shutting down the other facilities because the rent on those facilities might be avoided.

   The costs that are relevant in the decision to shut down the Clayton facility are:

Increase in rent at Billings and Great Falls	$(600,000)
Decrease in local administrative expenses	90,000
Financial (disadvantage) of closing the Clayton facility	$(510,000)

   In addition, there would be costs of moving the equipment from Clayton and there might be some loss of sales due to disruption of services. In sum, closing down the Clayton facility would almost certainly lead to a decline in BSC's profits.

2. Haley's self-interest is to focus on the performance report that probably plays an instrumental role in how her boss evaluates her performance. So, even though closing down the Clayton facility would result in a decline in overall company profits, from Haley's standpoint it would result in an improved performance report (as shown on the next page) for the Rocky Mountain Region.

   Keep in mind that this report would not include the write-off from closing the Clayton facility because the loss associated with this write-off would not be included in net *operating* income. Also, keep in mind that this report ignores the costs of moving equipment and the potential loss of revenues from disrupting service to customers.

Ethics Challenge (continued)

Financial Performance
After Shutting Down the Clayton Facility
Rocky Mountain Region

	Total
Sales	$50,000,000
Selling and administrative expenses:	
Direct labor	32,000,000
Variable overhead	850,000
Equipment depreciation	3,900,000
Facility expense*	2,300,000
Local administrative expense**	360,000
Regional administrative expense	1,500,000
Corporate administrative expense	4,750,000
Total operating expense	45,660,000
Net operating income	$ 4,340,000

* $2,800,000 – $1,100,000 + $600,000 = $2,300,000
** $450,000 – $90,000 = $360,000

If the Clayton facility is shut down, BSC's profits will decline, employees will lose their jobs, and customers will at least temporarily suffer some decline in service. Therefore, Romeros is willing to sacrifice the interests of the company, its employees, and its customers just to make her performance report look better.

While Romeros is not a management accountant, the Standards of Ethical Conduct for Management Accountants still provide useful guidelines. By recommending closing the Clayton facility, Romeros will have to violate the Credibility Standard, which requires the disclosure of all relevant information that could reasonably be expected to influence an intended user's understanding of the reports, analyses, or recommendation. Presumably, if the corporate board were fully informed of the consequences of this action, they would disapprove.

In sum, it is difficult to describe the recommendation to close the Clayton facility as ethical behavior. In Romeros' defense, however, it is not fair to hold her responsible for the mistake made by her predecessor.

Ethics Challenge (continued)

It should be noted that the performance report required by corporate headquarters is likely to lead to other problems such as the one illustrated here. The arbitrary allocations of corporate and regional administrative expenses to processing centers may make other processing centers appear to be unprofitable even though they are not. In this case, the problems created by these arbitrary allocations were compounded by using an irrelevant facilities expense figure on the performance report.

3. Prices should be set ignoring the depreciation on the Clayton facility. As argued in part (1) above, the real cost of using the Clayton facility is zero. Any attempt to recover the sunk cost of the original cost of the building by charging higher prices than the market will bear will lead to less business and lower profits.

Analytical Thinking (120 minutes)

1. The product margins computed by the accounting department for the drums and bike frames should not be used in the decision of which product to make. The product margins are lower than they should be due to the presence of allocated fixed common costs that are irrelevant in this decision. Moreover, even after the irrelevant costs have been removed, what matters is the profitability of the two products in relation to the amount of the constrained resource—welding time—that they use. A product with a very low margin may be desirable if it uses very little of the constrained resource. In short, the financial data provided by the accounting department are useless and potentially misleading for making this decision.

2. Assuming direct labor is a fixed cost, the contribution margin per unit for each product is calculated as follows:

		Manufactured	
	Purchased WVD Drums	*WVD Drums*	*Bike Frames*
Selling price	$149.00	$149.00	$239.00
Variable costs:			
Direct materials	138.00	52.10	99.40
Variable manufacturing overhead	0.00	1.35	1.90
Variable selling and administrative	0.75	0.75	1.30
Total variable cost	138.75	54.20	102.60
Contribution margin	$ 10.25	$ 94.80	$136.40

3. Assuming direct labor is a fixed cost, the contribution margin per welding machine hour for each product is calculated as follows:

	Manufactured	
	WVD Drums	*Bike Frames*
Contribution margin per unit (above) (a)	$94.80	$136.40
Welding hours per unit (b)	0.4 hour	0.5 hour
Contribution margin per welding hour (a) ÷ (b)	$237.00 per hour	$272.80 per hour

Analytical Thinking (continued)

4. Because the contribution margin per unit of the constrained resource (i.e., welding time) is larger for the bike frames than for the WVD drums, the frames make the most profitable use of the welding machine (assuming direct labor is a fixed cost). Consequently, the company should manufacture as many bike frames as possible up to demand and then use any leftover capacity to produce WVD drums. Buying the drums from the outside supplier can fill any remaining unsatisfied demand for WVD drums. The necessary calculations are carried out below.

	(a)	*(b)*	*(c)*	*(a) × (c)*		*(a) × (b)*
	Quantity	*Unit Contri-bution Margin*	*Welding Time per Unit*	*Total Welding Time*	*Balance of Welding Time*	*Total Contri-bution*
Total hours available.....					2,000	
Bike frames produced.....	1,600	$136.40	0.5	800	1,200	$218,240
WVD Drums—make.....	3,000	$94.80	0.4	1,200	0	284,400
WVD Drums—buy	3,000	$10.25				30,750
Total contribution margin						533,390
Less: Contribution margin from present operations: 5,000 drums × $94.80 CM per drum...						474,000
Increased contribution margin and net operating income.....						$ 59,390

Analytical Thinking (continued)

5. Assuming direct labor is a variable cost, the contribution margin per unit for each product is calculated as follows:

		Manufactured	
	Purchased WVD Drums	*WVD Drums*	*Bike Frames*
Selling price	$149.00	$149.00	$239.00
Variable costs:			
Direct materials	138.00	52.10	99.40
Direct labor	0.00	3.60	28.80
Variable manufacturing overhead	0.00	1.35	1.90
Variable selling and administrative	0.75	0.75	1.30
Total variable cost	138.75	57.80	131.40
Contribution margin	$ 10.25	$ 91.20	$107.60

6. Assuming direct labor is a variable cost, the contribution margin per welding hour for each product is calculated as follows:

	Manufactured	
	WVD Drums	*Bike Frames*
Contribution margin per unit (above) (a)	$91.20	$107.60
Welding hours per unit (b)	0.4 hour	0.5 hour
Contribution margin per welding hour (a) ÷ (b)	$228.00 per hour	$215.20 per hour

When direct labor is assumed to be a variable cost, the conclusion is reversed from the case in which direct labor is assumed to be a fixed cost—the WVD drums appear to be a better use of the constraint than the bike frames. The assumption about the behavior of direct labor really does matter.

Analytical Thinking (continued)

7. Assuming direct labor is a variable cost, the optimal product mix and increase in net operating income is computed as follows:

	(a)	*(b)*	*(c)*	*(a) × (c)*		*(a) × (b)*
	Quantity	*Unit Contribution Margin*	*Welding Time per Unit*	*Total Welding Time*	*Balance of Welding Time*	*Total Contribution*
Total hours available.....					2,000	
WVD Drums—make.....	5,000	$91.20	0.4	2,000	0	$456,000
Bike frames produced.....	0	$107.60	0.5	0	0	0
WVD Drums—buy	1,000	$10.25				10,250
Total contribution margin						466,250
Less: Contribution margin from present operations: 5,000 drums × $91.20 CM per drum....						456,000
Increased contribution margin and net operating income.....						$ 10,250

Analytical Thinking (continued)

8. The case strongly suggests that direct labor is fixed: "The bike frames could be produced with existing equipment and personnel." Nevertheless, it would be a good idea to examine how much labor time is really needed under the two opposing plans.

	Production	*Direct Labor-Hours Per Unit*	*Total Direct Labor-Hours*
Plan 1:			
Bike frames.....	1,600	1.6*	2,560
WVD drums	3,000	0.2**	600
			3,160
Plan 2:			
WVD drums	5,000	0.2**	1,000

* $28.80 ÷ $18.00 per hour = 1.6 hour
** $3.60 ÷ $18.00 per hour = 0.2 hour

Some caution is advised. Plan 1 assumes that direct labor is a fixed cost. However, this plan requires 2,160 more direct labor-hours than Plan 2 and the present situation (3,160 DLHs – 1,000 DLHs = 2,160 DLHs). At 40 hours per week a typical full-time employee works about 1,900 hours a year, so the added workload is equivalent to more than one full-time employee. Does the plant really have that much idle time at present? If so, and if shifting workers over to making bike frames would not jeopardize operations elsewhere, then Plan 1 is indeed the better plan. However, if taking on the bike frame as a new product would lead to pressure to hire another worker, more analysis is in order. It is still best to view direct labor as a fixed cost, but taking on the frames as a new product could lead to a jump in fixed costs of about $34,200 (1,900 hours × $18 per hour)—assuming that the remaining 260 hours (= 2,160 hours – 1,900 hours) could be made up using otherwise idle time. See the additional analysis on the next page.

Analytical Thinking (continued)

Contribution margin from Plan 1:	
Bike frames produced (1,600 × $136.40).....	218,240
WVD Drums—make (3,000 × $94.80)	284,400
WVD Drums—buy (3,000 × $10.25).....	30,750
Total contribution margin	533,390
Less: Additional fixed labor costs	34,200
Net effect of Plan 1 on net operating income	$499,190
Contribution margin from Plan 2:.....	
WVD Drums—make (5,000 × $94.80)	$474,000
WVD Drums—buy (1,000 × $10.25).....	10,250
Net effect of Plan 2 on net operating income	$484,250

If an additional direct labor employee would have to be hired, Plan 1 is still optimal.