

CHAPTER 21

DISCUSSION QUESTIONS

- Q21-1. Differential cost is the difference in the cost of alternative choices. The economist calls such costs marginal, and the engineer calls them incremental.
- Q21-2. Marginal cost (or differential cost) is the cost incurred by increasing the present output. The cost, therefore, would not have been incurred if the additional units had not been made. Marginal costing (or direct costing), on the other hand, is a costing approach in which only variable manufacturing costs are charged to products, and thus to inventory, while fixed manufacturing costs are treated as period costs and are charged off without becoming part of inventory costs.
- Q21-3. Incremental costs are important in decision making, because the least costly or most profitable alternative cannot be determined unless incremental costs are known. Incremental costs are the costs that must be incurred in order to complete an activity that is being considered. These costs must be known in order to compare each available alternative.
- Q21-4. Differential costs do not correspond to any possible accounting category, because they are oriented toward the future rather than the past and they treat product costs on a differential rather than a total cost basis. Furthermore, certain costs relevant for differential cost analysis (e.g., opportunity cost and imputed cost) are not recorded in the accounts. Conversely, certain costs recorded in the accounts (e.g., fixed costs that will remain unchanged) are irrelevant for differential cost analysis. The differential cost concept is a concept for cost analysis and not cost accumulation purposes.
- Q21-5. The flexible budget is useful in differential cost analyses, because the increments between each different level of output represent the cost that must be incurred if additional business is undertaken. As long as fixed costs remain constant under all rates of output, variable costs are always the differential costs. If fixed costs change in the flexible budget, differential costs will include the incremental element of fixed cost reflected in the flexible budget.
- Q21-6. Historical costs are usually irrelevant because they have been created by a past decision that cannot be changed by a future decision. Historical costs obtained from accounting records often include arbitrarily allocated fixed cost that may not be relevant to differential cost analysis.
- Q21-7. Variable cost is important because it can always be identified as a differential cost. However, differential costs may also include additional fixed costs.
- Q21-8. Sunk costs are irrecoverable costs that are not relevant to future decisions.
- Q21-9. A fixed cost would be relevant in deciding between alternatives if the fixed expenditure is an out-of-pocket cost required in order to undertake an alternative (e.g., the cost of renting equipment needed to provide sufficient capacity in deciding whether or not to accept an offer); or if a fixed expenditure can be avoided by undertaking an alternative (e.g., supervisory salaries that will be discontinued in the event of a plant closing).
- Q21-10. Opportunity costs are the measurable value of an opportunity bypassed by rejecting an alternative use of resources.
- Q21-11. Appendix Linear programming is a mathematical technique designed to assist decision makers in determining the allocation of resources that would be required to maximize or minimize the objective function; i.e., it is a tool that can be used by business managers to determine the mix of inputs necessary to maximize contribution margin or minimize cost. Linear programming is an algorithm that maximizes or minimizes a function of several variables subject to one or more constraints. The function being optimized and the constraints are assumed to be linear with respect to production activity.
- Q21-12. Appendix The unit costs used in linear programming problems are the traceable variable costs. Costs must be traceable to the product and variable with respect to production quantity

in order to affect changes in total production cost and total contribution margin when changes in production quantity and mix occur.

Q21-13. Appendix

- (a) The area bounded by the lines AB, BC, CD, and DA is called the solution space because it represents those quantities and combinations of standard and deluxe models that can be produced, given the available capacity of the grinding and polishing machines.
- (b) Triangle BCF represents those combinations of standard and deluxe models that could be produced by the polishing machines but not by the grinding machines. Triangle CDE represents the level of production that the grinding machines could attain, but not the polishing machines.
- (c) Point C denotes the optimum solution because any other level of attainable production will result in a smaller total contribution margin. It can be identified by computing the total contribution margin available from the production and sale of the combination of standard and deluxe models—denoted by each corner

point—and choosing the corner point with the largest total contribution margin. Alternatively, a series of CM lines can be constructed, which have a slope equal to -1 multiplied by the unit contribution margin available from the product identified by the horizontal axis, divided by the unit contribution margin available from the product identified by the vertical axis. The profit line farthest from the origin, point A, represents the greatest total contribution margin, and in this case, it passes through point C.

Q21-14. Appendix The simplex method is an iterative process that finds the optimum solution to a linear programming problem. The simplex method, which is based on matrix algebra, is a systematic way of evaluating each corner point in the feasible area. The process begins at the zero level of production and systematically moves from one corner point to another until the optimal solution is found. Each move provides the largest per unit improvement in the objective function. The process continues until the objective function can no longer be improved.

EXERCISES

E21-1

Sales ($\$1.80 \times 5\,000\text{ kg}$)		\$9,000
Cost to manufacture:		
Direct materials ($(\$0.60 + \$0.01) \times 5\,000\text{ kg}$)	\$3,050	
Direct labor ($\$0.50 \times 5\,000\text{ kg}$)	2,500	
Factory overhead:		
Indirect labor ($\$0.20 \times 5\,000\text{ kg}$)	1,000	
Power ($(\$600 \div 30,000) \times 5\,000\text{ kg}$)	100	
Supplies ($\$0.02 \times 5\,000\text{ kg}$)	100	
Maintenance and repair ($\$0.027 \times 5\,000\text{ kg}$)	135	
Depreciation ($\$3,000 \div 24\text{ months}$)	125	
Insurance ($\$0.007 \times 5\,000\text{ kg}$)	35	
Payroll taxes	<u>\$ 210</u>	
Cost of goods produced and sold		<u>7,255</u>
Gross profit contribution		\$1,745
Administrative expense		<u>150</u>
Profit contribution from accepting new business		<u><u>\$1,595</u></u>

E21-2

(1)	Estimated cost of the additional 100,000 units:	
	Materials ($(\$150,000/150,000\text{ units}) \times 100,000\text{ units}$)	\$100,000
	Direct labor ($(\$112,500/150,000\text{ units}) \times 100,000\text{ units}$)	75,000
	Variable factory overhead	
	($(\$75,000/150,000\text{ units}) \times 100,000\text{ units}$) or	
	($\$125,000\text{ at }100\%\text{ capacity} - \$75,000\text{ at }60\%\text{ capacity}$)	50,000
	Fixed factory overhead	
	($\$125,000\text{ at }100\%\text{ capacity} - \$100,000\text{ at }60\%\text{ capacity}$) ...	<u>25,000</u>
	Total differential cost of manufacturing the additional	
	100,000 units	<u><u>\$250,000</u></u>

(2) Total cost of producing 250,000 units in January:

	Budget for 150,000 Units	Differential Cost for 100,000 Units	Total Cost for 250,000 Units
Materials	\$150,000	\$100,000	\$250,000
Direct labor	112,500	75,000	187,500
Factory overhead:			
Variable	75,000	50,000	125,000
Fixed	<u>100,000</u>	<u>25,000</u>	<u>125,000</u>
Total cost	<u><u>\$437,500</u></u>	<u><u>\$250,000</u></u>	<u><u>\$687,500</u></u>

E21-2 (Concluded)**(3) Sales price required to achieve a 20% mark up on production cost:**

Production cost per unit ($\$687,500 \div 250,000$ units).....	\$2.75
Plus 20% mark up on cost ($\$2.75 \times 20\%$).....	<u>.55</u>
Sales price required to achieve 20% mark up on cost	<u><u>\$3.30</u></u>

E21-3

Revenue from the special sale (15,000 units \times \$12.50 each)		\$187,500
Less differential costs:		
Direct materials ($(\$20,000 \div 10,000 \text{ units}) \times 15,000 \text{ units}$)	\$30,000	
Direct labor ($(\$35,000 \div 10,000 \text{ units}) \times 15,000 \text{ units}$)	52,500	
Additional overtime premium on special order	10,000	
Variable factory overhead		
($(\$10,000 \div 10,000 \text{ units}) \times 15,000 \text{ units}$).....	15,000	
Additional fixed overhead from equipment rental.....	5,000	
Variable marketing expenses ($(\$20,000 \div 10,000 \text{ units}) \times 15,000 \text{ units}$)	<u>30,000</u>	
		<u>142,500</u>
Addition to annual company profit resulting from special sale		<u><u>45,000</u></u>

E21-4

No, Huntington should not accept Lufkin's offer because it would be \$5,000 cheaper to make the part.

Cost if purchased from Lufkin (10,000 × \$18).....		\$180,000
Cost if manufactured by Huntington:		
Direct materials.....	\$20,000	
Direct labor.....	55,000	
Variable factory overhead.....	45,000	
Rent from third party forgone if part manufactured	15,000	
Additional fixed factory overhead eliminated if part purchased from Lufkin (10,000 × \$4).....	40,000	<u>175,000</u>
Savings if part manufactured by Huntington		<u>\$ 5,000</u>

This solution assumes that a more profitable use of the facilities does not exist than that derived from the saving of \$5,000. Otherwise, it would be preferable to buy Part M-1 from Lufkin and use Huntington's facilities for the more profitable activity.

E21-5

The company should purchase the pistons from the outside supplier because it would cost \$6,000 less than manufacturing them at the Tucson plant.

The differential cost of manufacturing pistons at the Tucson plant:	
Direct materials.....	\$160,000
Direct labor.....	80,000
Variable factory overhead (20% × \$240,000)	48,000
Incremental fixed cost for machinery rental.....	30,000
Incremental fixed cost for additional supervisor	<u>40,000</u>
Total differential cost to manufacture 80,000 pistons	\$358,000
Cost to purchase 80,000 pistons from Wichita Machine Works (\$4.40 per piston × 80,000 pistons).....	<u>352,000</u>
Cost savings available from purchasing the pistons from the Wichita Machine Works rather than manufacturing them at the Tucson plant	<u>\$ 6,000</u>

E21-6

- (1) Yes, the sales manager's proposal to drop Tift from the product line and increase the production of Mift should be accepted because it will increase the company's income by \$4,000, determined as follows:

Contribution margin from sale of Tift:

Revenue from sale of Tift ($\$6 \times 7,000$ units)	\$42,000	
Less variable cost of manufacturing Tift:		
Materials ($\$2 \times 7,000$ units)	\$14,000	
Labor ($\$1 \times 7,000$ units)	7,000	
Variable factory overhead		
($\$1 \times 7,000$ units)	<u>7,000</u>	<u>28,000</u>
Gross contribution margin from sale of Tift	\$14,000	
Less variable marketing expense from sale of		
Tift ($\$1 \times 7,000$ units)	<u>7,000</u>	\$ 7,000

Contribution margin from sale of 4,000 additional units of Mift:

Revenue from sale of additional Mift		
($\$10 \times 4,000$ units)	\$40,000	
Less variable cost of manufacturing additional Mift:		
Materials ($\$2 \times 4,000$ units)	\$ 8,000	
Labor ($\$2 \times 4,000$ units)	8,000	
Variable factory overhead		
($\$1 \times 4,000$ units)	<u>4,000</u>	<u>20,000</u>
Gross contribution margin from		
sale of additional Mift	\$20,000	
Less variable marketing expense from		
sale of additional Mift ($\$1 \times 4,000$ units)	<u>4,000</u>	<u>16,000</u>
Additional contribution margin from converting capacity		
to production of 4,000 additional units of Mift.....		\$ 9,000
Additional advertising expense required to sell 4,000		
additional units of Mift.....		<u>5,000</u>
Additional income from dropping Tift from product line		
and converting capacity to production of		
4,000 additional units of Mift		<u>\$ 4,000</u>

E21-6 (Concluded)

- (2) Montreal should consider whether dropping Tift from the product line will result in decreased sales of Mift and Lift in the long run. For example, if the three products are complementary, customers may prefer to maintain only those sources of supply from which the full product line is available. The present ability to sell more Mift by dropping Tift may be a short-run condition. If this is a concern, the cost of resuming Tift production at a later date should also be considered.

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E21-7

	Silver Polish per Jar
Sales price	<u>\$4.00</u>
Grit 337 per jar (one fourth of \$1.60).....	\$.40
Other ingredients, labor, and variable factory overhead	2.50
Variable marketing cost.....	<u>.30</u>
Total variable cost.....	<u>\$3.20</u>
Contribution margin.....	\$.80
Opportunity cost from further processing rather than selling Grit 337 ($1/4 \times (\$2.00 - \$1.60)$).....	<u>.10</u>
Net contribution margin per unit.....	<u><u>\$.70</u></u>

$\$5,600$ avoidable fixed cost \div $\$.70 = 8,000$, the minimum number of jars of silver polish that must be sold to justify further processing of Grit 337.

E21-8

$$\begin{aligned}
 (1) \quad \text{Direct labor hours (DLH)} &= \frac{1,000,000 \text{ doses to be packaged}}{1,000 \text{ doses per DLH}} \\
 &= 1,000 \text{ DLH}
 \end{aligned}$$

Direct labor ($\$5 \times 1,000$ hours)	\$5,000
Variable factory overhead ($\$2 \times 1,000$ DLH)	2,000
Administrative expense.....	<u>1,000</u>
Total traceable out-of-pocket costs.....	<u><u>\$8,000</u></u>

$$\begin{aligned}
 \text{Minimum price per dose} &= \frac{\text{Total traceable out-of-pocket costs}}{1,000,000 \text{ doses}} \\
 &= \frac{\$8,000}{1,000,000} = \$0.008
 \end{aligned}$$

E21-8 (Concluded)

$$\begin{aligned}
 (2) \quad \text{Maximum allowable return before taxes} &= \frac{\text{Maximum return after taxes}}{(1 - \text{Tax Rate})} \\
 &= \frac{.09}{1 - .40} = \frac{.09}{.60} = .15 \text{ or } 15\% \\
 &= 2,500 \text{ units}
 \end{aligned}$$

Total traceable out-of-pocket costs (from requirement (1))....	\$ 8,000
Fixed factory overhead (\$5 × 1,000 DLH)	<u>5,000</u>
Total full cost.....	\$13,000
Maximum allowable return (15% × \$13,000).....	<u>1,950</u>
Total bid price.....	<u><u>\$14,950</u></u>

$$\begin{aligned}
 \text{Bid price per dose} &= \frac{\text{Total bid price}}{1,000,000 \text{ doses}} \\
 &= \frac{\$14,950}{1,000,000} = \$0.01495
 \end{aligned}$$

- (3) The factors that Hall Company should consider before deciding whether or not to submit a bid at the maximum allowable price include whether Hall has excess capacity, whether there are available jobs on which earnings might be greater, whether the maximum bid of \$.015 contributes toward covering the fixed costs, and whether this job could lead to more profitable business with Wyant in the future.
- (4) The competitive environment of the industry should have been considered by Wyant Memorial Hospital to determine whether or not a lower price could be obtained through competitive bidding. The hospital should also have considered that cost-plus pricing is not usually viewed uniformly by prospective bidders, is difficult to compute for products produced in “mass” quantity, and is better suited for products that are unique and high priced.

E21-9

Franchise fee collections per day:

Average gross revenues per franchise per day	\$ 500
Number of franchises.....	<u>x 420</u>
Total gross revenue.....	\$210,000
Franchise fee.....	<u>x .25</u>
Average daily franchise fee collections	<u>\$ 52,500</u>

First proposal (i.e., use local messenger service to collect and mail checks only):

Average daily franchise fee collections	\$ 52,500
Days saved	<u>x 2</u>
Total float saved.....	\$105,000
Before-tax opportunity cost.....	<u>x 15%</u>
Average annual savings.....	\$ 15,750
Less cost of messenger service	<u>20,000</u>
Annual reduction in income if proposal implemented	<u>\$ (4,250)</u>

Second proposal (i.e., use local messenger service with a lock-box arrangement):

Average daily franchise fee collections	\$ 52,500
Days saved	<u>x 5</u>
Total float saved.....	\$262,500
Before-tax opportunity cost.....	<u>x 15%</u>
Average annual savings.....	\$ 39,375
Less costs:	
Messenger service	\$20,000
Compensating balance (\$15,000 × 15%)	<u>2,250</u>
Annual increase in income if proposal implemented	<u>\$ 17,125</u>

E21-10**Silk-screen method:**

Prepare screen (1 1/2 hours × 20,000 circuit boards × \$6.50)	\$195,000	
Screen patterns (1/3 hour × 20,000 circuit boards × \$6.50)	<u>43,333</u>	
Total cost.....		\$238,333

AZ-17 process:

Labor (1/2 hour × 20,000 circuit boards × \$6.50)	\$65,000	
Monthly cost for materials and equipment rental and operation (\$4,000 × 12)	<u>48,000</u>	
Total cost.....		<u>113,000</u>

Annual savings from changing from silk-screen method to the new AZ-17 process.....		<u><u>\$125,333</u></u>
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E21-11 APPENDIX

Let M_A = marking board assembled in automated assembly department
 M_L = marking board assembled in labor assembly department
 T_A = tack board assembled in automated assembly department
 T_L = tack board assembled in labor assembly department

	<u>M_A</u>	<u>M_L</u>	<u>T_A</u>	<u>T_L</u>
Sales price per unit	<u>\$60.00</u>	<u>\$60.00</u>	<u>\$45.00</u>	<u>\$45.00</u>
Less variable costs:				
Direct materials:				
Base	\$ 6.00	\$ 6.00	\$ 6.00	\$ 6.00
Covering.....	14.50	14.50	7.75	7.75
Frame	8.25	8.25	8.25	8.25
Direct labor:				
Cutting Department	2.00	2.00	2.00	2.00
Assembly Department60	3.00	.60	3.00
Variable factory overhead:				
Cutting Department	2.45	2.45	2.45	2.45
Assembly Department	3.30	2.25	3.30	2.25
Variable marketing expenses	<u>3.00</u>	<u>3.00</u>	<u>3.00</u>	<u>3.00</u>
Total variable costs per unit	<u>\$40.10</u>	<u>\$41.45</u>	<u>\$33.35</u>	<u>\$34.70</u>
Contribution margin per unit.....	<u>\$19.90</u>	<u>\$18.55</u>	<u>\$11.65</u>	<u>\$10.30</u>

Objective function:

$$\text{Maximize CM} = \$19.90 M_A + \$18.55 M_L + \$11.65 T_A + \$10.30 T_L$$

Subject to:

.20	M_A	+	.20	M_L	+	.20	T_A	+	.20	T_L	<	30,000 DLH in Cutting
.05	M_A	+	.25	M_L	+	.05	T_A	+	.25	T_L	<	40,000 DLH in Assembly
.15	M_A	+	.15	M_L	+	.15	T_A	+	.15	T_L	<	25,000 MH in Cutting
0	M_A	+	.02	M_L	+	0	T_A	+	.02	T_L	<	1,500 MH in Labor Assembly
.05	M_A	+	0	M_L	+	.05	T_A	+	0	T_L	<	5,000 MH in Automated Assembly
1	M_A	+	1	M_L	+	0	T_A	+	0	T_L	>	30,000 units sales contract
0	M_A	+	0	M_L	+	1	T_A	+	1	T_L	>	30,000 units sales contract

E21-12 APPENDIX

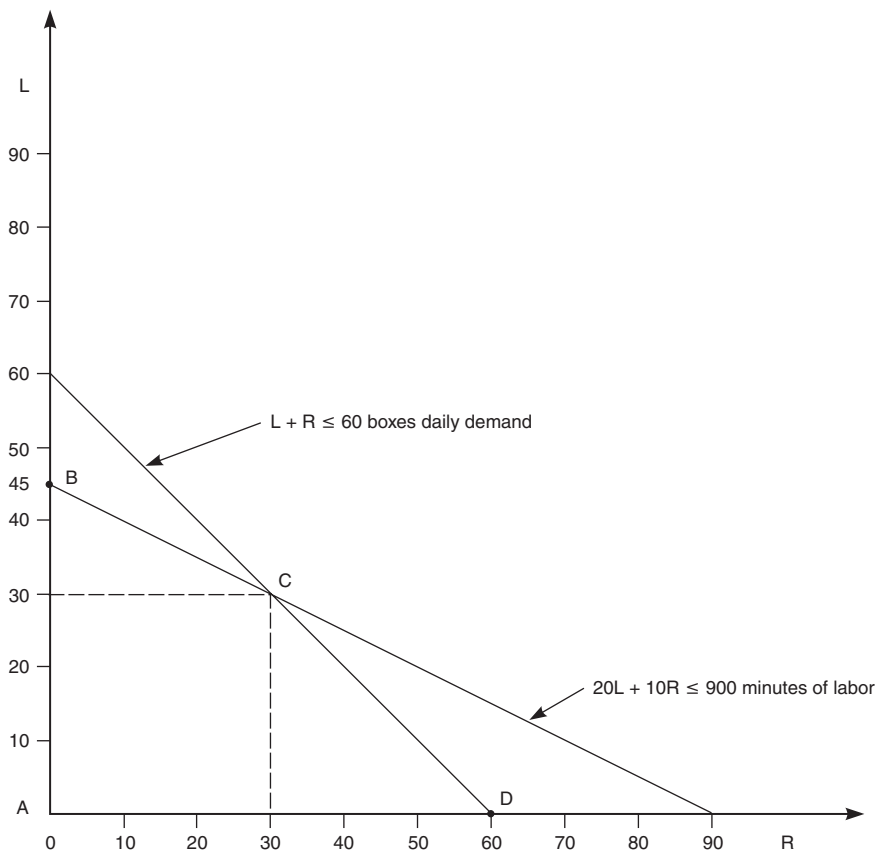
Let L = the number of legal pads
 R = the number of regular pads

Objective function:

$$\text{Maximize CM} = \$18L + \$12R$$

Subject to:

$$\begin{aligned} 20L + 10R &\leq 900 \text{ minutes labor} \\ &\quad (2 \text{ people} \times 7.5 \text{ hour} \times 60 \text{ minutes}) \\ L + R &\leq 60 \text{ boxes daily maximum demand} \\ &\quad (300 \text{ boxes per week} \div 5 \text{ work days}) \end{aligned}$$



$A = (L = 0, R = 0)$	$=$	$(\$18)(0) + (\$12)(0)$	$=$	$\$0 \text{ CM}$
$B = (L = 45, R = 0)$	$=$	$(\$18)(45) + (\$12)(0)$	$=$	$\$810 \text{ CM}$
$C = (L = 30, R = 30)$	$=$	$(\$18)(30) + (\$12)(30)$	$=$	$\$900 \text{ CM} \leftarrow \text{Maximum CM}$
$D = (L = 0, R = 60)$	$=$	$(\$18)(0) + (\$12)(60)$	$=$	$\$720 \text{ CM}$

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E21-13 APPENDIX

Graphic method:

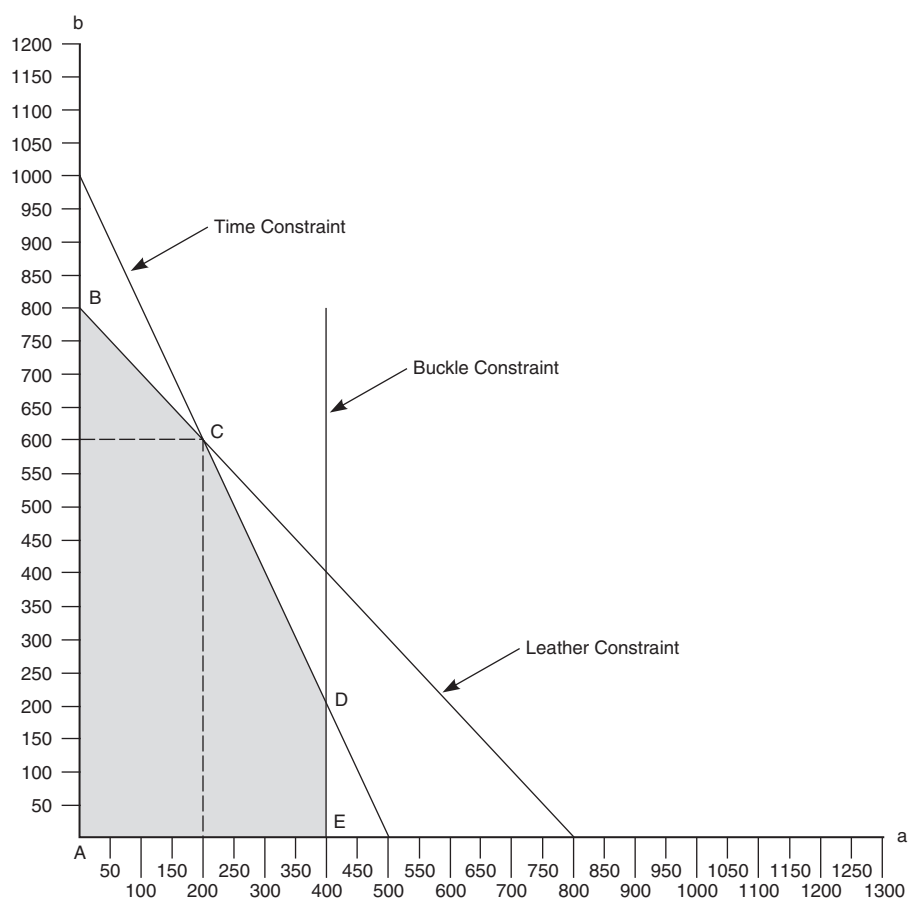
Objective function: Maximize $CM = 4a + 3b$

$$\begin{array}{rclcl} \text{Constraints:} & 2a & + & b & \leq & 1,000 \\ & a & + & b & \leq & 800 \\ & a & & & \leq & 400 \end{array}$$

Time
Leather
Buckles

When: $a = 0$
 $b = 1,000$ Time
 $b = 800$ Leather
 No b Buckles

When: $b = 0$:
 $a = 500$
 $a = 800$
 $a = 400$



Trying values at each of the corner points:

$$\begin{array}{lcl} A = (a = 0, & b = 0); & 4(0) + 3(0) = \$0 \quad CM \\ B = (a = 0, & b = 800); & 4(0) + 3(800) = \$2,400 \quad CM \\ C = (a = 200, & b = 600); & 4(200) + 3(600) = \$2,600 \quad CM \leftarrow \\ D = (a = 400, & b = 200); & 4(400) + 3(200) = \$2,200 \quad CM \\ E = (a = 400, & b = 0); & 4(400) + 3(0) = \$1,600 \quad CM \end{array}$$

Optimum combination would be 200 a and 600 b

$$200(4) + 600(3) = \$2,600 \quad CM$$

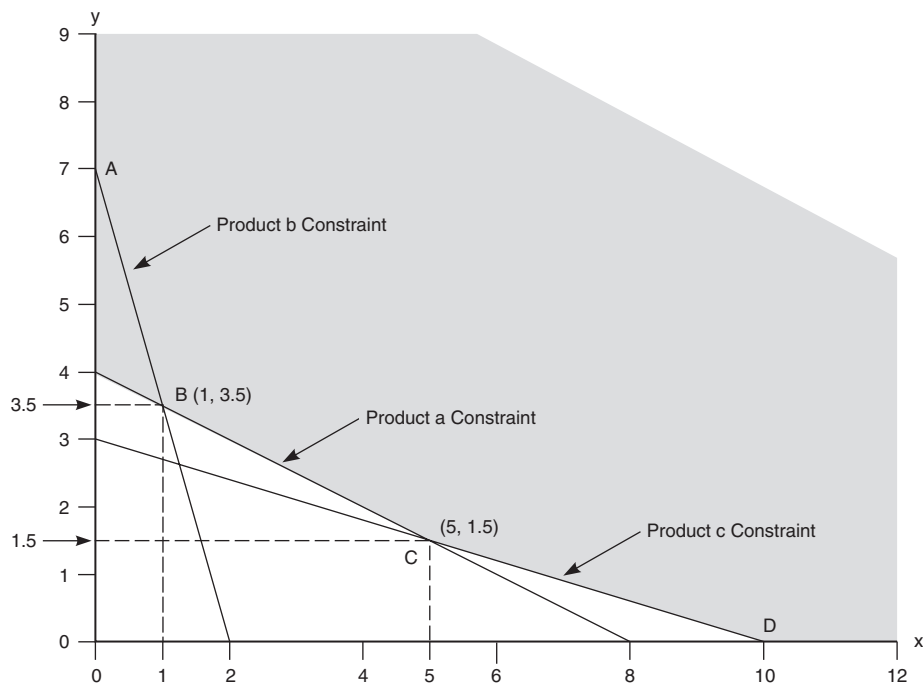
E21-14 APPENDIX

Graphic method:

Cost function is: Minimize $C = \$3x + \$4y$

Subject to constraints:

$$\begin{array}{rclclcl}
 4x & + & 8y & \geq & 32 \\
 7x & + & 2y & \geq & 14 \\
 1.5x & + & 5y & \geq & 15
 \end{array}$$



Possible solutions:

Points	x	y	3x	4y	3x + 4y
A	0	7	0	28	\$28
B	1	3.5	3	14	17
C	5	1.5	15	6	21
D	10	0	30	0	30

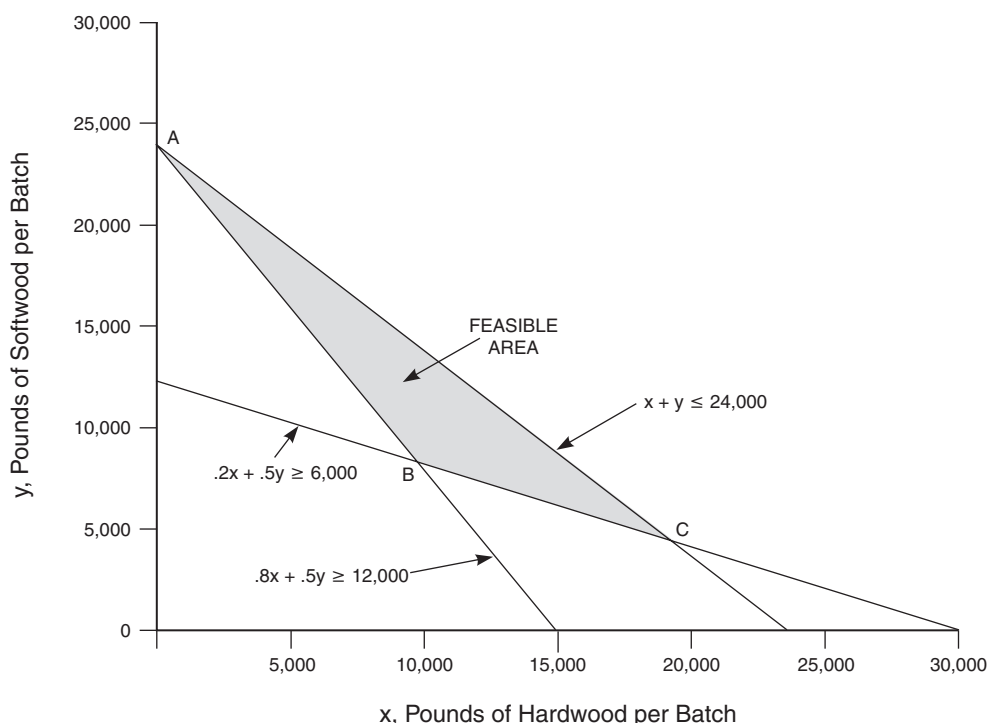
→ Optimum solution: Use 1 ton of x and 3.5 tons of y for a minimum total cost of \$17

E21-15 APPENDIX

Let x = pounds of hardwood per batch
 y = pounds of softwood per batch

$$\begin{aligned}\text{Subject to: } x + y &\leq 24,000 \\ .8x + .5y &\geq 12,000 \\ .2x + .5y &\geq 6,000\end{aligned}$$

Minimize: $C = .50X + .40Y$



Corner point B values:

$$\begin{aligned}.2x + .5y &= 6,000 \\ .8x + .5y &= 12,000 \\ \hline .6x &= 6,000 \\ x &= 10,000\end{aligned}$$

Substitute:

$$\begin{aligned}.2(10,000) + .5y &= 6,000 \\ .5y &= 4,000 \\ y &= 8,000\end{aligned}$$

Corner point C values:

$$\begin{aligned}.2x + .5y &= 6,000 \\ x + y &= 24,000\end{aligned}$$

Multiply by 2: $.4x + y = 12,000$

$$\begin{aligned}.4x + y &= 12,000 \\ x + y &= 24,000 \\ \hline .6x &= 12,000 \\ x &= 20,000\end{aligned}$$

Substitute:

$$\begin{aligned}.2(20,000) + .5y &= 6,000 \\ .5y &= 2,000 \\ y &= 4,000\end{aligned}$$

Trying values at each of the corner points:

$$\begin{aligned}A &= (x = 0, y = 24,000); \$.50(0) + \$.40(24,000) = \$9,600C \\ B &= (x = 10,000, y = 8,000); \$.50(10,000) + \$.40(8,000) = \$8,200C \leftarrow \\ C &= (x = 20,000, y = 4,000); \$.50(20,000) + \$.40(4,000) = \$11,600C\end{aligned}$$

Optimal solution: 10,000 pounds of hardwood per batch and 8,000 pounds of softwood per batch results in a cost equal to the \$8,200 standard per batch

PROBLEMS

P21-1

- (1) The differential cost analysis for the Glasgow Industries' order for 120,000 valves follows:

Incremental revenue (\$19 per unit × 120,000 units)		\$2,280,000
Incremental costs:		
Variable costs:		
Direct materials (\$5 per unit × 120,000 units)	\$ 600,000	
Direct labor (\$6 per unit × 120,000 units)	720,000	
Variable overhead (\$6 × 1/2 hour per unit × 120,000 units)	360,000	
Shipping expense (\$1 per unit × 120,000 units)	<u>120,000</u>	
Total variable costs	\$1,800,000	
Fixed costs:		
Supervisory and clerical costs (120,000 ÷ 30,000 per month × \$12,000 per month)	<u>48,000</u>	<u>1,848,000</u>
Increment to pretax profit as a result of accepting the offer		<u><u>\$432,000</u></u>

- (2) The minimum unit sales price that Sommers could accept without reducing net income must cover all differential costs (i.e., the variable costs plus the out-of-pocket fixed costs). Therefore, the minimum sales price per unit would be:

Variable cost per unit:	
Direct materials	\$ 5.00
Direct labor	6.00
Variable overhead (\$6 per hour × 1/2 hour per unit)	3.00
Shipping expense	1.00
Additional fixed cost per unit:	
Supervisory and clerical costs (\$12,000 total cost ÷ 30,000 units)	<u>.40</u>
Minimum unit sales price	<u><u>\$15.40</u></u>

P21-1 (Concluded)

- (3) Sommers Company management should consider the following factors before accepting the Glasgow Industries order.
- The effect of the special order on Sommers' sales to other customers at the regular sales price.
 - The possibility of establishing contacts in the international marketplace as a result of the sales to Glasgow Industries, which could lead to market expansion.
 - The wear and tear on machinery that might increase maintenance and repairs and result in a premature replacement of the machinery.
 - Possible retaliation by competitors who may learn of Sommers' deep price-cutting action, including risk of a price war that would disrupt regular selling prices.

P21-2

(1) Impact on net income if APA accepts bid:			
Submitted bid			\$165,000
Less sales commission			<u>16,500</u>
Net sales			\$148,500
Variable costs:			
Direct materials	\$29,200		
Direct labor	56,000		
Variable factory overhead (30% of direct labor)*	<u>16,800</u>		<u>102,000</u>
Contribution margin			\$ 46,500
Income tax (40%)			<u>18,600</u>
Increase in net income			<u>\$ 27,900</u>

*The factory overhead rate is 50% of direct labor dollars. Based on the experience for the fiscal year ended September 30, the rate due to the variable factory overhead cost is 30% ($\$2,250 \div \$7,500$).

(2) Framar would realize a positive contribution margin of \$12,300 before income tax, increasing net income by \$7,380, if the \$127,000 counteroffer is accepted:			
Counteroffer			\$127,000
Sales commission			<u>12,700</u>
Net sales			\$114,300
Variable manufacturing costs (from requirement (1))			<u>102,000</u>
Contribution margin			\$ 12,300
Income tax (40%)			<u>4,920</u>
Increase in net income			<u>\$ 7,380</u>

P21-2 (Concluded)

- (3) The lowest price that Framar could quote on this machinery without reducing its net income is \$113,333 ($\$102,000 \div .9$). This bid would cover exactly the sum of the variable manufacturing costs (\$102,000) and the 10% sales commission, thereby resulting in no increase in contribution margin and no income tax.
- (4) If Framar Inc. accepted all of its work at prices similar to the \$127,000 counteroffer, a loss situation could result. The analyses for requirements (1), (2), and (3) were short-run decisions in situations in which Framar had excess capacity. Consequently, the analyses concentrated on covering only the differential variable cost. However, when all orders are considered, Framar must cover both its variable and its fixed costs. A bid for all work similar to the one for \$127,000 would not cover Framar's fixed cost.

Calculations restating the most recent entire fiscal year on the \$127,000 price/variable cost relationship are as follows 000s omitted):

Sales ($\$15,750 \times 1.245$)*		\$19,609
Less commission.....		<u>1,961</u>
		\$17,648
Expenses (per income statement for year ended 9/30):		
Variable cost	\$15,750	
Fixed cost.....	<u>2,250</u>	<u>18,000</u>
		<u>\$ (352)</u>

*Annual variable costs:

Direct materials	\$ 6,000
Direct labor	7,500
Variable factory overhead.....	<u>2,250</u>
	<u>\$15,750</u>

$$\text{Markup on variable costs} = \frac{\$127,000}{\$102,000} = 1.245$$

P21-3

(1) An analysis comparing costs of each alternative:

(a) Schedule overtime hours:

	Overtime Hours Required
May	1,000
June	2,000
July	2,000
August	2,500
September	2,500
October	2,000
	<u>12,000</u>
Inefficiency (5%)	<u>600</u>
Total overtime hours	<u><u>12,600</u></u>

Additional labor costs ($12,600 \times \$6 \times 1.5$)	\$113,400
Related fringe benefits ($\$113,400 \times .10$)	<u>11,340</u>
Differential cost if overtime is scheduled	<u><u>\$124,740</u></u>

(b) Hire temporary workers:

Extra hours required	12,000
Inefficiency factor (25%)	<u>3,000</u>
Total hours required	15,000
Hourly rate for temporary workers	<u>x \$6</u>
Differential cost if temporary workers hired	<u><u>\$ 90,000</u></u>

There are no fringe benefit costs with temporary workers.

P21-3 (Continued)

- (c) Expand labor force and schedule level production of 10,000 units per month: If the labor force is expanded so that level production can be scheduled, Valbec will produce 10,000 doll house units per month, requiring 5,000 direct labor hours. This means that 12,000 additional regular direct labor hours will be required during 20A with no scheduled overtime or need for temporary workers, as shown below:

	<u>Requirements</u>	
	<u>Month</u>	<u>Annual</u>
Forecast production in units.....	<u>10,000</u>	<u>120,000</u>
Direct labor hours required.....	5,000	60,000
Former direct labor constraint in hours	<u>4,000</u>	<u>48,000</u>
Additional regular hours in 20A.....	<u>1,000</u>	<u>12,000</u>
Direct labor costs:		
Regular time (12,000 × \$6).....	\$72,000	
Related fringe benefits (\$72,000 × .20).....	<u>14,400</u>	\$86,400
Additional inventory carrying costs (refer to the schedule of inventory levels below):		
Average monthly inventory with overtime or temporary workers	13,846	
Average monthly inventory with level production.....	<u>16,231</u>	
Difference	2,385	
Estimated annual cost of carrying inventory per unit	× <u>\$1</u>	<u>2,385</u>
Differential costs if level production is used		<u>\$88,785</u>

P21-3 (Concluded)

Schedule of Inventory Levels

Last Day of Month	Use Overtime or Temporary	Level Production			
	Workers*	Beginning*	Production	Sales	Ending*
December	8,000				8,000
January	8,000	8,000	10,000	8,000	10,000
February	8,000	10,000	10,000	8,000	12,000
March	8,000	12,000	10,000	8,000	14,000
April	8,000	14,000	10,000	8,000	16,000
May	10,000	16,000	10,000	8,000	18,000
June	12,000	18,000	10,000	10,000	18,000
July	12,000	18,000	10,000	12,000	16,000
August	13,000	16,000	10,000	12,000	14,000
September	13,000	14,000	10,000	13,000	11,000
October	12,000	11,000	10,000	13,000	8,000
November	8,000	8,000	10,000	12,000	6,000
December	8,000	6,000	10,000	8,000	8,000
	<u>128,000</u>				<u>159,000</u>
Average per month excluding safety stock (divide by 13)	9,846				12,231
Safety stock	<u>4,000</u>				<u>4,000</u>
Average monthly inventory	<u>13,846</u> units				<u>16,231</u> units

*Excludes safety stock of 4,000 doll house units.

Alternative (c) affords the lowest estimated differential cost.

- (2) There are several noncost factors, or factors that are difficult to cost, that Valbec should consider in conjunction with the cost analysis of the three alternative courses of action. Relevant factors include:
- (a) Consider the degree to which Valbec's regular labor force is willing to work overtime.
 - (b) The labor force may plan on overtime pay as part of their normal work situation. If wages should be reduced because overtime is not scheduled, due to the use of temporary workers or an expanded labor force, then the morale of the labor force could deteriorate, laborers might seek work elsewhere, laborers might seek base pay increases, or the labor force might decrease its efficiency.
 - (c) Overtime does provide a certain degree of flexibility, should sales volume and patterns not occur according to the forecasted plan.
 - (d) If the labor force is to be expanded, Valbec must be sure there is an adequate supply of skilled workers.

P21-4

Group I production costs:

Materials ($\$3.27 \div 25$)	\$.131
Labor ($(\$9.48 \times 2.5) \div 25$)948
Variable factory overhead ($\$.948 \times 150\%$).....	<u>1.422</u>
Total variable unit cost	<u>\$ 2.501</u>
Total variable cost ($\$2.501 \times (3 + 2) \times 2,000$)	\$ 25,010
Additional fixed factory overhead	<u>7,040</u>
	<u>\$ 32,050</u>

Group II production costs:

Materials ($\$3.60 \div 20$)	\$.180
Labor ($(\$12.16 \times 2) \div 20$)	1.216
Variable factory overhead ($\$1.216 \times 150\%$).....	<u>1.824</u>
	<u>\$ 3.220</u>

Total variable cost ($\$3.220 \times (2 + 2 + 4) \times 2,000$)	\$ 51,520
Additional fixed factory overhead	<u>6,000</u>
	<u>\$ 57,520</u>

Sales ($\$60 \times 2,000$)	<u>\$120,000</u>
-------------------------------------	------------------

Group I costs:

Outside suppliers:

Dissection knives ($\$3.20 \times 3 \times 2,000$)	\$19,200
Scalpels ($\$3.30 \times 2 \times 2,000$)	<u>13,200</u>
	<u>\$32,400</u>
Group I production costs (computed above)	<u>\$32,050</u> } \$ 32,050

Group II costs:

Outside suppliers:

Scissors ($\$3.00 \times 2 \times 2,000$)	\$12,000
Tweezers ($\$2.97 \times 2 \times 2,000$)	11,880
Clamps ($\$3.28 \times 4 \times 2,000$)	<u>26,240</u>
	<u>\$50,120</u>
Group II production costs (computed above)	<u>\$57,520</u> } 50,120

Glass slides ($\$.03 \times 100 \times 2,000$)	6,000
Cover slips ($\$.01 \times 400 \times 2,000$)	8,000
Cases ($\$6 \times 2,000$)	12,000
Subassembly costs ($\$3 \times 2,000$)	<u>6,000</u>
Total production costs	<u>\$114,170</u>
Operating profit contribution	<u>\$ 5,830</u>

P21-4 (Concluded)

Production of Group I components is less costly than purchasing from outsiders, and purchasing Group II components from outsiders is less costly than producing them. However, the estimated operating profit contribution is only marginally positive (\$5,830 or 4.9% of the estimated sales figure) and any necessary additional marketing cost related to the dissection instrument sets would further reduce the expected profit contribution.

Present annual fixed factory overhead is excluded from the differential cost analysis, because these costs will be incurred whether or not the sets are marketed.

Based on the information assembled by the study team, the proposal has little merit.

P21-5

- (1) The lowest price Chemco should bid for a one-time special order of 25,000 pounds (25 lots) would be \$34,750, which is equal to the variable costs of the order, determined as follows:

Direct materials:

On a one-time-only special order, chemicals used in manufacturing the firm's main product have a relevant cost of their expected future cost, represented by the current market price per pound. Chemicals not used in current production have a relevant cost of their value to the firm. CW-3 (400 pounds per lot × 25 lots) = 10,000 pounds.

Substitute CN-5 on a one-for-one basis to its total of 5,500 pounds.

The relevant cost is the salvage value	\$ 500
The remaining 4,500 pounds would be CW-3 at the relevant cost of \$.90 per pound, its expected future cost.....	4,050
JX-6 (300 pounds per lot × 25 lots × \$.60 per pound)	4,500
MZ-8 (200 pounds per lot × 25 lots × \$1.60 per pound)....	8,000
BE-7 (100 pounds per lot × 25 lots × (\$.65 cost per pound – \$.10 handling per pound)).....	<u>1,375</u>
Total direct materials cost	<u>\$18,425</u>

Direct labor:

(60 DLH per lot × 25 lots) = 1,500 DLH

Because only 800 DLH can be scheduled during regular time this month, overtime would have to be used for the remaining 700 hours; therefore, overtime is a relevant cost for this order.

1,500 DLH × \$7.00 per DLH at regular time rate	\$10,500
700 DLH × \$3.50 overtime premium per DLH	<u>2,450</u>
Total direct labor cost	<u>\$12,950</u>

Factory overhead:

This special order will not increase fixed factory overhead cost, and it is not an order for a continuing project that should contribute to the recovery of fixed factory overhead. Therefore, the fixed factory overhead is not relevant, and the relevant factory overhead charge is the variable factory overhead rate.

1,500 DLH × \$2.25 variable factory overhead rate.....	<u>\$ 3,375</u>
Total differential cost of manufacturing this special order and the minimum bid price for the order	<u>\$34,750</u>

P21-5 (Concluded)

- (2) Calculation of the price for recurring orders of 25,000 pounds (25 lots) follows:
Direct materials:

Because of the possibility of future orders, all raw materials must be charged at their expected future cost, represented by the current market price per pound.

CW-3 (400 pounds per lot × 25 lots × \$.90 per pound)	\$ 9,000
JX-6 (300 pounds per lot × 25 lots × \$.60 per pound)	4,500
MZ-8 (200 pounds per lot × 25 lots × \$1.60 per pound)....	8,000
BE-7 (100 pounds per lot × 25 lots × \$.65 per pound)	<u>1,625</u>
Total direct materials cost	<u>\$23,125</u>

Direct labor:

60% of the production of a batch (900 DLH) can be done on regular time; the remaining 600 DLH directly cause overtime to be incurred and are, thus, a relevant cost of this new product.

1,500 DLH × \$7.00 regular rate per DLH	\$10,500
600 DLH × \$3.50 overtime premium per DLH	<u>2,100</u>
Total direct labor cost	<u>\$12,600</u>

Factory overhead:

All new products should contribute to the recovery of fixed factory overhead as well as cover all variable costs. Therefore, the overhead charge would be the full overhead rate.

1,500 DLH × \$6.00 per DLH	<u>\$ 9,000</u>
Full manufacturing cost	\$44,725
Markup of 25% on cost (\$44,725 × .25)	<u>11,181</u>
Full manufacturing cost plus 25% markup	<u><u>\$55,906</u></u>

P21-6

	<u>Present Capacity</u>	<u>Additional Capacity</u>	<u>Total</u>
Sales:			
50,000 × \$10	\$500,000		
25,000 × \$10	<u> </u>	<u>\$250,000</u>	<u>\$750,000</u>
Variable expenses:			
Direct materials:			
50,000 × \$2	\$100,000		
25,000 × (\$2 × .94)		\$ 47,000	
50,000 × (\$2 × .06)		(6,000)	\$141,000
Direct labor (\$4 × 1.05)			\$4.20
Factory overhead			<u>1.30</u>
			<u>\$5.50</u>
50,000 × \$5.50	275,000		
25,000 × \$5.50		137,500	412,500
Marketing expense	<u>12,000</u>	<u>6,000</u>	<u>18,000</u>
Total variable expense	<u>\$387,000</u>	<u>\$184,500</u>	<u>\$571,500</u>
Contribution margin	<u>\$113,000</u>	<u>\$ 65,500</u>	<u>\$178,500</u>
Fixed expenses:			
Factory overhead	\$ 72,500	\$ 15,000	\$ 87,500
Marketing expense	11,000		
Increase in advertising (\$11,000 × .10 × .25)		275	11,275
Additional plant depreciation:			
\$260,000 ÷ 25 yrs. = \$10,400			
\$ 84,000 ÷ 20 yrs. = <u>4,200</u>			
			<u>\$14,600</u>
\$14,600 × .95* =	<u> </u>	<u>13,870</u>	<u>13,870</u>
Total fixed expense	<u>\$ 83,500</u>	<u>\$ 29,145</u>	<u>\$112,645</u>
Operating income	<u>\$ 29,500</u>	<u>\$ 36,355</u>	<u>\$ 65,855</u>

*5% allocated to inventories.

The expected operating income from additional capacity (\$36,355) should be evaluated as to whether or not it is a satisfactory return on the additional capital investment of \$344,000 (\$260,000 + \$84,000) (See Chapters 23 and 24).

P21-7

(1)

MARX CORPORATION
Boston Plant
Computation of Number of Units of Xoff Required To Cover
Fixed Factory Overhead and Fixed Regional Promotional Costs

	Total (000s omitted)	Per Unit
Sales	<u>\$2,200</u>	<u>\$20</u>
Variable factory costs:		
Direct materials	\$ 550	\$5
Direct labor	660	6
Variable factory overhead	<u>440</u>	<u>4</u>
Total variable cost	<u>\$1,650</u>	<u>\$15</u>
Contribution margin	<u>\$ 550</u>	<u>\$ 5</u>

Units required to cover fixed factory overhead and fixed regular promotional costs:

$$\frac{(\$700,000 + \$100,000)}{\$5 \text{ contribution margin}} = 160,000 \text{ units of Xoff}$$

(2)

MARX CORPORATION
Schedule of Budgeted Contribution Margin and Operating Income
If Boston Operations Are Expanded Under Plan A

	(000s omitted)		
	Total	Boston	Chicago
Sales	<u>\$7,400</u>	<u>\$3,400</u>	<u>\$4,000</u>
Variable factory costs:			
Direct materials	\$1,850	\$ 850	\$1,000
Direct labor	2,020	1,020	1,000
Variable factory overhead	<u>1,380</u>	<u>680</u>	<u>700</u>
Total variable cost	<u>\$5,250</u>	<u>\$2,550</u>	<u>\$2,700</u>
Contribution margin	<u>\$2,150</u>	<u>\$ 850</u>	<u>\$1,300</u>
Fixed costs:			
Fixed factory overhead	\$1,600	\$ 700	\$ 900
Regional promotional cost	<u>320</u>	<u>220</u>	<u>100</u>
Total fixed cost	<u>\$1,920</u>	<u>\$ 920</u>	<u>\$1,000</u>
Plant operating income	\$ 230	\$ (70)	\$ 300
Allocated home office cost	<u>310</u>	<u>142*</u>	<u>168**</u>
Operating income (loss)	<u>\$ (80)</u>	<u>\$ (212)</u>	<u>\$ 132</u>

* $\frac{\$3,400 \text{ Boston sales}}{\$7,400 \text{ Total sales}} \times \$310 \text{ Home office cost} = \142

** $\frac{\$4,000 \text{ Chicago sales}}{\$7,400 \text{ Total sales}} \times \$310 \text{ Home office cost} = \168

P21-7 (Continued)

MARX CORPORATION
Schedule of Budgeted Contribution Margin and Operating Income
If Boston Plant Is Closed and Chicago Operations Are Expanded
Under Plan B

	Chicago Operations <u>(000s omitted)</u>
Sales	<u>\$6,200</u>
Variable factory costs:	
Direct materials	\$1,550
Direct labor	1,550
Variable factory overhead.....	<u>1,085</u>
Total variable factory cost	<u>\$4,185</u>
Contribution margin	<u>\$2,015</u>
Fixed costs:	
Fixed factory overhead	\$ 950
Regional promotional cost	<u>200</u>
Total fixed cost	<u>\$1,150</u>
Plant operating income	\$ 865
Allocated home office cost	<u>310</u>
Operating income	<u><u>\$ 555</u></u>

P21-7 (Concluded)

MARX CORPORATION
Schedule of Budgeted Contribution and Operating Income
If Boston Plant Is Closed and Royalty Agreement Is Contracted
Under Plan C

	(000s omitted)		
	<u>Total</u>	<u>Boston</u>	<u>Chicago</u>
Revenues:			
Sales	\$4,000		\$4,000
Royalties	<u>275</u>	<u>\$275</u>	
Total revenues	<u>\$4,275</u>	<u>\$275</u>	<u>\$4,000</u>
Variable factory costs:			
Direct materials	\$1,000		\$1,000
Direct labor	1,000		1,000
Variable factory overhead	<u>700</u>		<u>700</u>
Total variable factory cost	<u>\$2,700</u>		<u>\$2,700</u>
Contribution margin	<u>\$1,575</u>	<u>\$275</u>	<u>\$1,300</u>
Fixed costs:			
Fixed factory overhead	\$ 950	\$ 50	\$ 900
Regional promotional cost	<u>200</u>	<u>100</u>	<u>100</u>
Total fixed cost	<u>\$1,150</u>	<u>\$150</u>	<u>\$1,000</u>
Plant operating income and royalties	\$ 425	\$125	\$ 300
Allocated home office cost	<u>310</u>		<u>310</u>
Operating income (loss)	<u><u>\$ 115</u></u>	<u><u>\$125</u></u>	<u><u>\$ (10)</u></u>

P21-8

Source: *Management Accounting Campus Report* (Montvale, N.J.: Institute of Management Accountants (formerly National Association of Accountants), Spring, 1987), pp. 4–5. Copyright Spring, 1987, by Institute of Management Accountants (formerly National Association of Accountants). All rights reserved. Reprinted by permission.

Lex Glass Company should implement the proposed plan to purchase silica in the discount quantity. The annual savings from implementation of the plan would be \$48,150, determined as follows:

Annual cost with quantity discount plan:

Interest expense to finance carrying inventory:

Average level of inventory in tons:

Lex Glass's requirements	10,000	
Requirements of other manufacturers ((300,000 ÷ 12 months ÷ 2) average + (300,000 ÷ 12 months ÷ 2) minimum).....	<u>25,000</u>	35,000
Price per ton with discount	<u>× \$1.80</u>	
Total average cost of inventory.....	\$63,000	
Rate of interest to carry inventory	<u>× 5%</u>	\$ 3,150

Cost of purchasing inventory (420,000 tons × \$1.80) 756,000

Additional costs to carry additional inventory:

Labor	\$20,000	
Administrative expenses	10,000	
Lost revenue from rental of warehouse required to store additional inventory	<u>10,000</u>	<u>40,000</u>
		\$799,150

Less revenue from the sale of silica to other
manufacturers (300,000 tons × \$2 per ton) 600,000

Annual cost of quantity discount plan \$199,150

Annual cost without quantity discount plan:

Interest expense to finance inventory:

Average level of inventory in tons.....	10,000	
Price per ton without discount	<u>× \$2.00</u>	
Total average cost of inventory	\$20,000	
Rate of interest to carry inventory	<u>× 5%</u>	
Interest expense	\$ 1,000	
Cost of purchasing silica (120,000 tons × \$2)	<u>240,000</u>	<u>241,000</u>

Annual cost savings available by implementing
quantity discount plan \$(41,850)

P21-9

(1)

	Plain Paper	Colored Paper		Glossy Paper	
	Bulk	Bulk	First Class	First Class	Late First Class
Gross revenue potential	<u>\$1,200,000</u>	<u>\$2,000,000</u>	<u>\$2,200,000</u>	<u>\$2,500,000</u>	<u>\$2,200,000</u>
Brochure and mailing costs:					
Design.....	\$ 300	\$ 1,000	\$ 1,000	\$ 3,000	\$ 3,000
Typesetting.....	100	800	800	2,000	2,000
Paper cost ¹	10,000	16,000	16,000	36,000	36,000
Printing cost ²	6,000	20,000	20,000	80,000	80,000
Postage ³	80,000	80,000	520,000	520,000	520,000
Handling ⁴	20,000	20,000	20,000	40,000	40,000
Total cost	<u>\$ 116,400</u>	<u>\$ 137,800</u>	<u>\$ 577,800</u>	<u>\$ 681,000</u>	<u>\$ 681,000</u>
Net revenue potential.....	<u>\$1,083,600</u>	<u>\$1,862,200</u>	<u>\$1,622,200</u>	<u>\$1,819,000</u>	<u>\$1,519,000</u>

¹Paper cost:

Plain: \$.005/unit x 2,000,000 units = \$10,000

Colored: \$.008/unit x 2,000,000 units = \$16,000

Glossy: \$.018/unit x 2,000,000 units = \$36,000

³Postage:

Bulk: \$.04/unit x 2,000,000 units = \$80,000

First class: \$.26/unit x 2,000,000 units = \$520,000

²Printing cost:.....

Plain: \$.003/unit x 2,000,000 units = \$6,000

Colored: \$.010/unit x 2,000,000 units = \$20,000

Glossy: \$.040/unit x 2,000,000 units = \$80,000

⁴Handling:

Plain and colored: \$.01/unit x 2,000,000 units = \$20,000

Glossy: \$.02/unit x 2,000,000 units = \$40,000

P21-9 (Concluded)**(2) Net revenue potential:**

The colored paper brochure provides the most net revenue if it can be mailed at bulk mail rates; however, there is a risk of earning only the third best revenue if it must be mailed first class. The glossy paper, if it can be mailed on time, produces the second largest amount of net revenue; however, the ranking slips to the fourth best net revenue if it is mailed late. The plain paper bulk mail brochure has a substantially lower net revenue than any of the other alternatives.

Image as a well-run organization:

The image would be based upon comparison of two things related to the mail campaign—the quality of the brochure (appearance) and the arrival of the brochure immediately following the radio and television coverage. The glossy brochure, if it arrives on time, would probably convey the best image; however, there is some risk that it would not arrive on a timely basis. The colored paper brochure would be the next best in terms of quality, but the bulk mail alternative raises some risk of a timely receipt of the brochures by the potential donors. The plain paper brochure would be the poorest quality, and because it is to be sent bulk mail, it runs the additional risk of not being delivered on a timely basis.

Image as a fiscally responsible organization:

The image of fiscal responsibility will be based on a comparison of potential donors' perceptions regarding the cost of the brochure and cost of the mailing. The glossy brochure mailed first class may be perceived as an extravagance by the potential donors. At the other extreme, the potential donors may conclude that the plain paper bulk mail alternative is an indication that the organization is unwilling to devote adequate financial resources to the fund-raising efforts.

The foundation staff must weigh the consequences of each of the alternatives and the risks associated with them on the three criteria to select a specific alternative. The staff has good information on net revenue potential, but needs to obtain information on the effects of the quality of the brochure, the timeliness of the mailing, and the type of mailing on potential donors' opinions as to what is a well-run and fiscally responsible organization.

P21-10

(1)

JUSTA CORPORATION
Quarterly Income Statement

	<u>Total</u>	<u>Local</u>	<u>Regional</u>
Sales	\$1,300,000	\$1,000,000	\$300,000
Variable expenses:			
Manufacturing (Schedule A)	\$ 820,000	\$ 630,000	\$190,000
Marketing (Schedule B)	31,000	24,000	7,000
Total variable expense	\$ 851,000	\$ 654,000	\$197,000
Contribution margin	\$ 449,000	\$ 346,000	\$103,000
Separable fixed marketing expense	74,000	36,000	38,000
Net market contribution	\$ 375,000	\$ 310,000	\$ 65,000
Common fixed expenses:			
Manufacturing (\$1,010,000 – \$820,000)	\$ 190,000		
Administrative	52,000		
Total common fixed expense	\$ 242,000		
Operating income	\$ 133,000		

Schedule A—Variable Manufacturing Expenses

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Product	%	Local Sales	Local Variable Expenses (2) × (3)	Regional Sales	Regional Variable Expenses (2) × (5)	Total Variable Expenses (4) + (6)
A	60	\$400,000	\$240,000	\$100,000	\$ 60,000	\$300,000
B	70	300,000	210,000	100,000	70,000	280,000
C	60	300,000	180,000	100,000	60,000	240,000
Total			<u>\$630,000</u>		<u>\$190,000</u>	<u>\$820,000</u>

Schedule B—Variable Marketing Expenses

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Product	%	Local Sales	Local Variable Expenses (2) × (3)	Regional Sales	Regional Variable Expenses (2) × (5)	Total Variable Expenses (4) + (6)
A	3	\$400,000	\$12,000	\$100,000	\$3,000	\$15,000
B	2	300,000	6,000	100,000	2,000	8,000
C	2	300,000	6,000	100,000	2,000	8,000
Total			<u>\$24,000</u>		<u>\$7,000</u>	<u>\$31,000</u>

Separable fixed marketing expense computation:	<u>Local</u>	<u>Regional</u>
Total marketing expense	\$60,000	\$45,000
Less variable (Schedule B)	24,000	7,000
Fixed marketing expense	<u>\$36,000</u>	<u>\$38,000</u>

P21-10 (Concluded)

- (2) No. The regional market should not be dropped. The regional market sales are adequate to cover variable expense and separable fixed expense of the regional market and contribute \$65,000 toward the recovery of the \$242,000 common fixed expense and operating income.

If the regional market is dropped, the local market contribution margin must absorb its own separable fixed marketing expense plus all common fixed expense as shown below:

Contribution margin.....	\$346,000
Separable fixed marketing expense	<u>36,000</u>
Net market contribution.....	\$310,000
Total common fixed expense	<u>242,000</u>
Operating income	<u>\$ 68,000</u>

Thus the corporation operating income declines from \$133,000 to \$68,000. This \$65,000 reduction is the amount of the contribution loss from the regional market.

(3)

JUSTA CORPORATION
Quarterly Income Statement

	<u>Total</u>	<u>Product A</u>	<u>Product B</u>	<u>Product C</u>
Sales	<u>\$1,300,000</u>	<u>\$500,000</u>	<u>\$400,000</u>	<u>\$400,000</u>
Variable expense:				
Manufacturing				
(Schedule A)*	\$820,000	\$300,000	\$280,000	\$240,000
Marketing				
(Schedule B)*	<u>31,000</u>	<u>15,000</u>	<u>8,000</u>	<u>8,000</u>
Total variable expense.....	<u>\$ 851,000</u>	<u>\$315,000</u>	<u>\$288,000</u>	<u>\$248,000</u>
Contribution margin.....	<u>\$ 449,000</u>	<u>\$185,000</u>	<u>\$112,000</u>	<u>\$152,000</u>
Fixed expenses:				
Manufacturing	\$ 190,000			
Marketing	74,000			
Administrative	<u>52,000</u>			
Total fixed expense.....	<u>\$ 316,000</u>			
Operating income.....	<u>\$ 133,000</u>			

*Schedules A & B are in the requirement (1) solution.

- (4) When the new product replaces Product C, the minimum contribution margin per quarter must be at least \$162,000 (the present contribution margin of Product C + \$10,000 of new fixed expense) in order for Justa Corporation to be no worse off financially than it is currently. This contribution margin will still provide operating income of \$133,000.

CASES

C21-1

- (1) \$21 per unit, a total of \$210,000 for 10,000 units, is the lowest price the company could accept without reducing budgeted income of the coming quarter. At any lower price, the special order would add more to costs than it adds to revenues, reducing the coming quarter's budgeted operating income. The price is calculated to equal the relevant costs of filling the special order. First, calculate the following per-unit variable costs of *regular* units:

Budgeted manufacturing costs for the quarter	\$5,400,000
Less: Budgeted fixed cost (3 mo. × \$1,400,000)	<u>4,200,000</u>
Budgeted variable manufacturing costs	\$1,200,000
Budgeted volume of regular business	÷ <u>100,000</u> units
Budgeted variable manuf. cost per <i>regular</i> unit	<u><u>\$ 12.00</u></u>
Budgeted selling & admin. costs for the quarter	\$3,200,000
Less: Budgeted fixed cost (3 mo. × \$900,000)	<u>2,700,000</u>
Budgeted variable S & A costs for the quarter	\$ 500,000
Budgeted volume of regular business	÷ <u>100,000</u> units
Budgeted variable S & A cost per regular unit	\$ 5.00
Regular sales commission (5% of \$90 price)	<u>4.50</u>
Budgeted S & A cost per unit, excl. commission	<u><u>\$.50</u></u>

The case states how much to add to the regular direct material and direct labor cost. Two other adjustments must be calculated: (1) The saw is needed for only two months. At a rental of \$5,500 per month, its cost totals \$11,000 for the special order, or \$1.10 per unit. (2) Variable overhead per special unit is triple that of a regular unit, and the case states that this applies to total variable overhead and to the variable overhead of the cut-off operation. The *total* variable overhead cost of a regular unit is \$2.50, and variable overhead of the regular cut-off operation is a part of that total, so the entire \$2.50 is tripled for the special order (and no separate adjustment is needed specifically for the cut-off operation). The \$2.50 is included already in the budgeted costs of regular units, so the adjustment needed to cost the special order is an *additional* \$5.00 per unit $[(3 \times \$2.50) - \$2.50]$, or a total adjustment of \$50,000 for the special order.

Sufficient capacity must be available for the special order. (Otherwise, accepting it would require canceling some regular order(s), and an opportunity cost equal to the lost contribution margin on cancelled orders would be a relevant cost of the special order.) Grinding-machine capacity is limited to 60,000 regular units per month, so the quarter's capacity is 180,000 regular units, and the budgeted volume of 100,000 regular units leaves available capacity equivalent to 80,000 regular units. Each special-order unit uses triple the grinding time of a regular unit, so 10,000 special units require the equivalent of 30,000 regular units' grinding time, well within the 80,000 regular units of available capacity.

C21-1 (Concluded)

		Special Order Relevant Cost Analysis	
		<u>Total</u>	<u>per unit</u>
Units		<u>10,000</u>	<u>1</u>
Relevant costs of special order:			
Regular manufacturing costs	\$120,000		\$12.00
Regular selling & administrative costs, excluding commission	5,000		.50
Additional costs of special order:			
Direct material	20,000		2.00
Direct labor	—		—
Variable overhead.....	50,000		5.00
Saw rental (2 mo. × \$5,500)	11,000		1.10
Metallurgist's fee	<u>4,000</u>		<u>.40</u>
Relevant costs of special order	<u>\$210,000</u>		<u>\$21.00</u>

The relevant cost of \$21 per special unit, although considerably higher than that of a regular unit, is far below the regular selling price of \$90. This is because the company's costs are predominately fixed costs, presumably due to high levels of automation. The company will try to negotiate as high a price as possible, but the \$21 figure should be regarded as an absolute minimum.

(2) Nonquantitative factors to consider include the following:

(a) Effects on regular sales

Is the customer who placed the special order a new customer? If so, will they become a regular customer provided the special order is successful?

Will that customer always demand large price discounts?

Will (or does) the customer use a large quantity of the regular product and pay the full regular price for it?

Will regular customers learn of the special, low price? If so, will they demand large price discounts on their future orders?

Will this special, low price start a price war that can erode regular prices?

(b) Effects on employees and community

Will the special materials and equipment affect levels of safety, environmental pollution, and noise in the company's plant?

Will employees and managers gain valuable new skills and knowledge by producing the special order? (The case states that this is the company's first opportunity to produce and sell this particular type of product.)

Will the special order's effect on total production volume enable the company to avoid laying off valued employees in the coming quarter?

(c) Strategic effects (market share, growth, innovation, etc.)

Does the special order product represent a new or fast-growing market?

Are there learning-curve effects or other advantages to be gained from adding the new type of product sooner rather than later?

Are prices and profit margins on this type of product expected to improve, or is it a mature product likely to decline soon?

C21-2

- (1) Continuing to obtain covers from its own Denver Cover Plant would allow Big-Auto to maintain its current level of control over the quality of the covers and the timing of their delivery. Keeping the Denver Cover Plant open also allows Big-Auto more flexibility than purchasing the covering from outside suppliers. Big-Auto could more easily alter the coverings' design and change the quantities produced, especially if long-term contracts are required with outside suppliers. Big-Auto should also consider the economic impact that closing Denver Cover will have on the community and how this might affect Big-Auto's other operations in the region. In addition, relations with the workforce at other plants could be affected by news of a closing and layoffs at Denver Cover.
- (2) (a) The following recurring annual budgeted costs can be avoided by closing the Denver Cover Plant:

Materials		\$12,000,000	
Direct labor		13,000,000	
Indirect costs:			
Supervision.....	\$3,000,000		
Indirect labor.....	4,000,000		
Differential pension expense			
(\$4,000,000 – \$3,000,000).....		<u>1,000,000</u>	<u>8,000,000</u>
			<u><u>\$33,000,000</u></u>

- (b) The following recurring annual budgeted costs are not relevant to the decision to close the Denver Cover Plant:

Depreciation—equipment.....	\$ 5,000,000
Depreciation—building	3,000,000
Continuing pension expenses	3,000,000
Plant manager and staff	2,000,000
Corporate allocation	<u>6,000,000</u>
	<u><u>\$19,000,000</u></u>

The depreciation amounts are not relevant to the decision because they represent portions of sunk costs that are being written off during 20A. Three-fourths of the annual pension expense (\$3,000,000) is not relevant because it would continue whether or not the plant is closed. The amount for plant manager and staff is not relevant because Vosilo and his staff would continue with Big-Auto and administer the three remaining plants. The corporate allocation is not relevant because this represents non-avoidable costs, incurred outside Denver Cover, that are assigned to the plant.

C21-2 (Concluded)

- (c) The following nonrecurring costs would arise due to the closing of the Denver Cover Plant:

Termination charges on cancelled material orders	
(\$12,000,000 × 15%)	\$1,800,000
Employment assistance	<u>1,000,000</u>
	<u><u>\$2,800,000</u></u>

These two costs are relevant to the decision because they are incurred only if the Denver Cover Plant is closed. Consequently, they can be avoided if the plant is not closed.

- (d) Items not specifically mentioned in the case that should be considered by Big-Auto before making a decision include:
- (i) The disposal value or alternate uses of the plant.
 - (ii) Any income tax implications; including the income tax rates applicable to gain or loss on the sales of plant and machinery, cost of losing depreciation tax shields, any depreciation and investment tax credit recapture, etc.
 - (iii) Outside supplier's prices in future years.
 - (iv) Cost to manufacture coverings at the Denver Cover Plant in future years.

C21-3

- (1) Factors Calco should consider, before entering the consumer products market, follow:
- the product's contribution margin and break-even point
 - consumer demand for the product in the short run and long run
 - the company's ability to produce the quantity needed in the short and long run
 - the company's lack of experience in the consumer market and the need for different marketing techniques for products sold in the consumer markets
 - quality of the competition
 - the impact of the decision on employees, and the effect of the diversion of Calco management effort on total business
- (2) Alteration of financial forecasts for use in deciding between the alternatives:

	<u>Calco's Marketing Department</u>	<u>Jasco</u>
Income before income tax.....	\$ 225,000	\$ 190,000
Add fixed manufacturing cost:		
100,000-unit level	750,000	
120,000-unit level		900,000
Add share of current Marketing Department's management costs.....	<u>100,000</u>	
Operating margin	<u>\$1,075,000</u>	<u>\$1,090,000</u>

Instead of a difference of \$35,000 income (\$225,000 – \$190,000) favoring Calco, the new calculation shows a \$15,000 operating margin (\$1,075,000 – \$1,090,000) favoring Jasco. The financial difference is slight, adding significance to the reliability of the financial estimates as well as to the relevance of nonquantitative factors.

- (3) One can only speculate about the reliability of the two proposals. The fact that Jasco has experience in the consumer market is significant in predicting success or failure of the project, but not necessarily for the estimates for the expected benefits of the marketing program or the associated costs. It should be remembered that the Jasco people recently lost their jobs and may be trying especially hard to look good.

Similarly, Calco's Marketing Department may be biased in its estimates in an effort to avoid elimination of existing employee positions.

Manufacturing costs are the same because Calco will manufacture the product. The sales price differs and an explanation of the 5% (\$5 per \$100 of sales) difference in the sales commission rate is not given. Calco's inclusion of assigned Marketing Department management costs is perhaps an attempt to hedge its estimates.

C21-3 (Concluded)

- (4) Significant nonquantitative factors that Calco's management should consider include:
- (a) impact of the decision on Calco's present work force; i.e., morale loss of remaining employees if layoffs happen versus the ability of retained employees to work effectively in the new market,
 - (b) abilities and expectations of employees from Jasco, if Jasco is selected,
 - (c) the possible diversion of Calco top management effort from its regular line of business, if it does not hire experienced talent.

No single item may in itself be important enough to warrant selection of one alternative over another. The information presented in the case is limited and does not give an indication that any one nonquantitative factor is more important than any other. However, any one of the factors could be sufficiently significant. For instance, the impact of eliminating Calco's Marketing Department positions, if Jasco is acquired, is perhaps the biggest single nonquantitative factor for consideration. Since these new employees displace existing Calco employees, the management process could be hampered by serious human relations problems.

C21-4

- (1) (a) The product-line income statement for Precision Gauge Corporation is presented on a full costing basis and, consequently, is not suitable for analysis and decision making. The fact that the statement does not distinguish between variable and fixed costs hinders any analysis of the impact of volume changes on profits. In addition, the statement does not distinguish between costs that are directly related (traceable) to a product line from those that are shared among all products.
- (b) An alternative income statement format that would be more suitable for analysis and decision making would incorporate the contribution approach to costing. Expenses would be classified in terms of variability and controllability; such as, variable manufacturing, variable selling and administrative, direct fixed controllable by segment (discretionary), direct fixed controllable by others (committed), and common fixed. The common fixed costs would not be assigned to the product lines because such an allocation would be arbitrary. The contribution approach is more suitable for analysis and decision making because there is a meaningful segregation of costs.

C21-4 (Continued)

- (2) (a) The suggested discontinuance of the T-gauges would be cost effective, but the suggestions relating to D-gauges and P-gauges would not be cost effective. These conclusions are based on the following quarterly differential cost analysis.

	<u>D-gauge</u>	<u>P-gauge</u>	<u>T-gauge</u>
Unit sales price	<u>\$90</u>	<u>\$200</u>	<u>\$180</u>
Unit variable costs:			
Direct materials.....	\$17	\$ 31	\$ 50
Direct labor.....	20	40	60
Variable factory overhead.....	30	45	60
Selling expenses.....	<u>4</u>	<u>10</u>	<u>10</u>
Total variable costs	<u>\$71</u>	<u>\$126</u>	<u>\$180</u>
Unit contribution margin.....	\$19	\$ 74	\$ 0
Increase (decrease) in units suggested:			
D-gauge (\$900,000 sales ÷			
\$90 price) × .50.....	× (5,000)		
P-gauge (\$1,600,000 sales ÷			
\$200 price) × .15.....		× 1,200	
T-gauge (\$900,000 sales ÷ \$180			
price) × 1.0.....			×(5,000)
Increase (decrease) in total			
contribution margin.....	\$(95,000)	\$88,800	\$0
Decrease (increase) in fixed costs:			
D-gauge, \$100,000 – \$20,000	80,000		
P-gauge.....		(100,000)	
T-gauge			<u>40,000</u>
Increase (decrease) in segment			
contribution.....	<u>\$(15,000)</u>	<u>\$(11,200)</u>	<u>\$40,000</u>

- (b) Yes. The president was correct in eliminating the T-gauges. The T-gauge sales price covers only its variable cost and does not contribute anything to the recovery of fixed factory overhead or promotion costs. Thus, the T-gauge has a zero contribution margin.

C21-4 (Concluded)

- (c) Yes. The president was correct in promoting the P-gauge line rather than the D-gauge line because the unit contribution margin and contribution margin per labor dollar is greater for the P-gauge line than the D-gauge line, determined as follows:

	<u>D-gauge</u>	<u>P-gauge</u>
Unit contribution margin (see (a))	\$19.00	\$74.00
Contribution margin per labor dollar		
\$19 contribution margin ÷ \$20 labor95	
\$74 contribution margin ÷ \$40 labor		1.85

However, the president's decisions regarding promotion expense do not seem well conceived. The decreased promotion on the D-gauge line and the increased promotion on the P-gauge line do not produce sufficient contribution margin to offset the promotion costs.

- (d) No. The proposed course of action does not make effective use of Precision's capacity. The 15% increase in production volume on the P-gauge line will not require all of the capacity that has been released by discontinuing the T-gauge line and reducing the D-gauge line by 50%.
- (3) Yes. The non-quantitative factors that Precision should consider before it decides whether to drop the T-gauge line include:
- (a) Customer relations—the sale of D-gauges and P-gauges may be related to the sale of T-gauges (i.e., Precision may need a complete line of gauges desired by many customers in order to maintain sales demand for D-gauges and P-gauges).
 - (b) Labor relations—reducing employment may create labor (personnel) problems.

C21-5 APPENDIX

(1) Let x = rolls of commercial carpet

y = rolls of residential carpet

Heavy duty fiber constraint: $80x + 40y = 42,000$ lbs.

Regular fiber constraint: $20x + 40y = 24,000$ lbs.

Solving by simultaneous equations:

$$80x + 40y = 42,000$$

$$20x + 40y = 24,000$$

$$60x = 18,000$$

$$x = 300 \text{ rolls of commercial carpet}$$

$$80(300) + 40y = 42,000$$

$$24,000 + 40y = 42,000$$

$$40y = 18,000$$

$$y = 450 \text{ rolls of residential carpet}$$

(2) Leastan cannot manufacture these quantities of commercial and residential carpeting, because the direct labor constraint will be exceeded:

Labor constraint: $15x + 15y = 10,500$

Using the requirement (1) solution:

$15(300) + 15(450) = 11,250$, which exceeds the direct labor hour constraint of 10,500 by 750 hours.

(3) Linear programming is a mathematical model for solving two or more unknowns in two or more equations. Linear programming is used to determine a mix of products that will maximize the contribution margin or minimize costs by identifying the inputs, outputs, and their related assumptions and limitations (constraints) and combining them in the model. Linear programming can be used to allocate limited facilities and resources among their many alternative uses in such a way that optimum benefit is derived from their utilization.

C21-5 APPENDIX (Concluded)

(4)

	<u>Commercial</u>	<u>Residential</u>
Sales price per unit	\$1,000	\$800
Less variable cost per unit:		
Heavy duty fiber.....	\$ 240	\$120
Regular fiber.....	40	80
Direct labor.....	150	150
Variable factory overhead.....	<u>90</u>	<u>90</u>
	<u>\$ 520</u>	<u>\$440</u>
Contribution margin per unit.....	<u><u>\$ 480</u></u>	<u><u>\$360</u></u>

Let x = rolls of commercial carpet
 y = rolls of residential carpet
 c = pounds of scrap of heavy duty fiber
 d = pounds of scrap of regular fiber

Objective function:

Maximize $CM = 480x + 360y + .25c + .25d$

Constraints:

$80x + 40y + c = 42,000$ pounds of heavy duty fiber
 $20x + 40y + d = 24,000$ pounds of regular fiber
 $15x + 15y \leq 10,500$ direct labor hours

C21-6 APPENDIX

- (1) The linear programming model starts with an objective or goal to be achieved subject to a set of limiting factors, called constraints. The linear programming model allows the user to optimize (maximize or minimize) the objective function subject to the constraints. The central assumption in all linear programming models is linearity. The linearity assumption means that the objective function and the constraints in the model can be expressed in the form of linear equations. The constraints can be in the form of strict equalities, upper bounds (less than or equal to constraints), and lower bounds (greater than or equal to constraints).
- (2) Linear programming methods are applied mainly to allocation problems, i.e., allocating scarce resources among alternative uses according to some objective. The scarce resources for a business firm may include personnel, material, equipment, or capital. The objective function may take the form of profit maximization or some other measure of desired benefit. In this particular case, linear programming is appropriate because the firm of Miller, Lombardi, and York has an objective in the form of profit maximization subject to restricted resources, i.e., staff available in the short run is restricted in each area.
- (3) The following data would be needed to develop the linear programming model for Miller, Lombardi, and York:

 - (a) Total management hours available in each category of service provided.
 - (b) Total hours available for each category of service provided by each type of staff person, i.e., experienced and without experience.
 - (c) Number of microcomputers and hours available.
 - (d) Billing rates for management and staff.
- (4) R. Oliva should consider the following alternative objectives before making the staff allocations:

 - (a) Maximize the computer hours available.
 - (b) Minimize total variable costs consistent with maintaining a high level of professional service.
 - (c) Nonquantitative objectives such as the preferences of individuals in management to be in specific areas of service.