CHAPTER 16
THE BEHAVIOR OF COSTS

Changes from the Eleventh Edition

All changes to Chapter 16 were minor.

Approach

We have retained our approach of putting all C-V-P topics in a single chapter because many schools' marketing and management accounting core courses start simultaneously, and marketing likes to have break-even analysis covered early in the management accounting course. Also, if there are students in the course with work experience or, in the case of MBA courses, with some undergraduate cost accounting background, they will want to raise right away the more detailed and subtle cost behavior issues. Nevertheless, we have structured the chapter so that instructors wishing to retain the approach used in some earlier editions can do so simply by assigning only the sections preceding "Cost Assumptions" initially. Then the rest of the chapter can be assigned just before Chapter 26.

One of the common sources of confusion about fixed costs and variable costs is the fact that fixed costs are fixed in total but vary per unit, whereas variable costs vary in total, but are fixed per unit. It is important, therefore, that the discussion always be clear as to whether the context is total cost or unit cost. When talking about unit costs, I try to remember always to precede "fixed" with the adjective average.

The text takes the view that items of cost can be classified as essentially fixed, variable, semivariable, or step-function, and that semivariable costs can be classified into fixed and variable components. Students who wish to nitpick can point out items of cost for which these simple linear relationships do not hold, even within a relevant range, but the importance of these items should be played down. In practice, it is often sufficiently accurate to use only the fixed/variable dichotomy, especially for time horizons of a year or less. The student should not get the impression that the linear relationships described in the chapter are a gross oversimplification; they in fact fit many real-life situations within relevant (i.e., normal operating) ranges.

Cases

Hospital Supply, Inc., deals primarily with differential cost and revenue analysis. It is placed here for the instructor who wishes to alert students at the outset of the management accounting course that the full cost constructions studied in Chapters 17-19 are not useful for some kinds of management decisions.

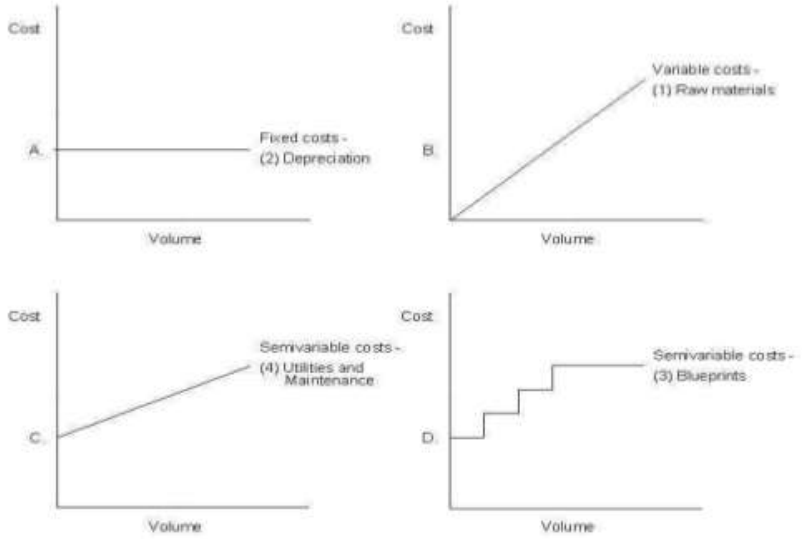
Prestige Telephone Company requires a student to understand the economics of a business, to use that understanding to forecast the potential change in income that would occur if various courses of action were selected, and to consider alternate reporting systems that can be used to highlight the factors that are important to management.

Bill French is a case on the construction of a profitgraph, raising practical problems about the validity of the data used for this purpose in a multi-product setting.

Problems

Problem 16-1

a. and b.



Problem 16-2: Doyle's Candy Company

a. Break-even volume = Fixed costs / Unit contribution
= $1,056,000 / $9.60 - $5.76
= $1,056,000 / $3.84 = 275,000 boxes

b. Current contribution margin percentage = $3.84 / $9.60 = 40%. In general, abbreviating contribution margin percentage as CMP, we have:

$$CMP = \frac{UR - UVC}{UR}$$

Solving for UR, this becomes:

$$UR = \frac{UVC}{1 - CMP}$$

With a 15% increase in variable production costs (to $5.52, giving total UVC of $6.48), the selling price per box is:

$$UR = \frac{\$6.48}{1 - .40} = \frac{\$6.48}{.60} = \$10.80$$

c. Projected income statement:

Revenues (390,000 x $9.60)	$3,744,000
Variable costs (390,000 x $5.76)	2,246,400
Contribution	1,497,600
Fixed costs	1,056,000
Income before tax	441,600
Taxes (40%)	176,640
Net income after tax	$ 264,960

In general, pretax I = (UR - UVC) • X - TFC. So in this case:

$$\begin{aligned} 441{,}600 &= (\$9.60 - 6.48) \bullet X - 1{,}056{,}000 \\ \$3.12 \bullet X &= \$1{,}497{,}600 \\ X &= 480{,}000 \text{ boxes} \\ TR &= 480{,}000 \text{ @ } \$9.60 = \$4{,}608{,}000 \end{aligned}$$

(Note that as long as the tax rate remains constant, it is irrelevant in answering this question.)

Problem 16-3: Mike Solid's Pizzeria

a. Assuming that cost of food sold is the only item of variable expense, then:

$$\text{Break-even volume} = \frac{\text{Fixed Costs}}{\text{Unit Contribution}}$$

$$= \frac{\$241{,}360 - \$92{,}400}{\$8.50 - \$2.55^{*}} = \frac{\$148{,}960}{\$5.95}$$

$$= \underline{25{,}035 \text{ pizzas}}$$

*$308,000 / $8.50 = 36,235 pizzas: $92,400 / 36,235 = $2.55 per pizza variable costs.

b. Cash fixed costs = total fixed costs - depreciation = $148,960 - ($16,000 + $8,000) = $124,960. However, the depreciation tax shield ($24,000 x 30%) offsets $7,200 of these fixed costs, leaving $117,760 net cash fixed costs. Break-even volume, on a cash basis, then, is $117,760 ÷ $5.95 = 19,792 pizzas.

c. Cash generated by operations equals net income plus noncash expenses (here, only depreciation) $46,648 + $24,000 = $70,648, leaving $56,248 if Calderone withdraws $14,400 for his personal use.

d. The easiest way to approach this question is to treat the target pretax income as a fixed cost. Since the target income is $60,000, the target pretax income is $60,000 ÷ 70% = $85,713. Adding this to the $148,960 fixed costs gives a total of $234,673. So the required volume = $234,673 / $5.95 = 39,441 pizzas.

e. Most of the expenses are fixed. Therefore a large volume of sales is required before any profit is made. Once this point is reached (break-even), each sale contributes $5.95 to profits, a larger change in profits since profits begin at zero at this point while the $8.50 change in sales is a smaller proportion of sales because of the large amount of sales required to reach the break-even point.

f. The cash flow from operations will exceed his profits because $24,000 of the expense (depreciation) is not a current cash-consuming cost.

Cases

Case 16-1: Hospital Supply, Inc.[*]

Note: *This case is unchanged from the Eleventh Edition. If not used at this point, the case can be used with Chapter 26.*

Approach

The Hospital Supply case is placed in this chapter for those instructors who wish to expose students to alternative choice decisions and the related differential costing prior to getting into the details of full costing. Because in many programs the marketing and management accounting courses begin at the same time, this case also enables the accounting instructor to assist his or her colleagues in marketing by introducing break-even analysis at the start of the term; questions 1 and 4 can be used for this purpose.

The case is also useful for giving students a good understanding of the fixed/variable cost dichotomy. In particular, I think it worthwhile to emphasize to students that fixed costs may be "unitized" (i.e., allocated to individual units of product) for certain purposes, and that this allocation procedure may make such costs appear to be variable. Indeed, many students treat the $660 per unit fixed manufacturing overhead and $770 per unit fixed marketing costs as though they were variable costs, despite the fact that they are clearly labeled "fixed."

Finally, I use the case to introduce the concept of opportunity cost. Question 3 can be used in this way, as can question 5 if you postulate a scrap value for the obsolete hoists.

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[*]This teaching note was prepared by Professor James S. Reece based on solutions prepared by Professor Michael Maher.

Comments on Questions

Question 1

Total fixed costs (TFC) = fixed costs per unit times normal volume =($660 + $770)*3,000 = $4,290,000.
Contribution margin per unit = unit price minus unit variable costs = $4,350 - $2,070 = $2,280.

$$\text{Break-even volume} = \frac{\$4,290,000}{\$2,280} = 1,882 \text{ units}$$

$$\textit{Break-even sales} = \$4,290,000 / \left(\frac{\$4,350 - 2,070}{\$4,350} \right) = \$8,185,461$$

(actually, 1,882 *$4,350 = $8,186,700)

Question 2

Recommendation: Lowering prices reduces income. Other factors, such as the reduction of available capacity and the capacity and the impact on market share, could also affect the decision.

Impact:	*Before Price Reduction*	*After Price Reduction*	*Difference*
Price	$ 4,350	$ 3,850	$ (500)
Quantity	3,000	3,500	500
Revenue	$13,050,000	$13,475,000	$ 425,000
Variable mfg. costs	(5,385,000)	(6,282,500)	(897,500)
Variable mktg. costs	(825,000)	(962,500)	(137,500)
Contribution margin	6,840,000	6,230,000	(610,000)
Fixed mfg. costs	(1,980,000)	(1,980,000)	--
Fixed mktg. costs	(2,310,000)	(2,310,000)	--
Income	$ 2,550,000	$ 1,940,000	$(610,000)

Note that the differential contribution margin and differential income are the same.

Question 3

Recommendation: Don't accept contract

	Without Govt.		*With Government Contract*		
Impact:	*Contract*	*Regular*	*Government*	*Total*	*Difference*
Revenue	$17,400,000	$15,225,000	$1,420,000	$16,645,000	$(755,000)
Variable mfg.	(7,180,000)	(6,282,500)	(897,500)	(7,180,000)	–
Variable mktg. costs	(1,100,000)	(962,500)	--	(962,500)	137,500
Contribution margin	9,120,000	7,980,000	522,500	8,502,500	(617,500)
Fixed mfg. costs	(1,980,000)			(1,980,000)	–
Fixed mktg. costs	(2,310,000)			(2,310,000)	–
Income	$ 4,830,000			$ 4,212,500	$(617,500)

[1]Government revenue = (500 * $1,795) +.125 ($1,980,000) + $275,000 = $1,420,000, assuming the government's "share" of March fixed manufacturing costs is .125 (500/4,000).

A shorter approach to question 3 (but harder for some students to understand) is this:

Forgone contribution (equals forgone income, as was illustrated by question 2) on regular sales if government contract is accepted	500 * $2,280 = $1,140,000
Income from government contract:	
Fixed fee	275,000
Share of fixed mfg. costs (1/8 * $1,980,000)	247,500
	522,500
Differential income if contract accepted	$(617,500)

Question 4

Minimum price = variable mfg costs + shipping costs + order costs
= $1,795 + $410 + $22,000/1,000 = $2,227

At this price per unit, the $2,227,000 of differential costs caused by the 1,000-unit order will just be uncovered. Some students solve for this price using the break-even formula (UR = unit revenue):

$$\frac{TCF}{UR - UVC = Q}$$

$$\frac{22{,}000}{UR - 2{,}205 = 1{,}000 \text{ units}}$$

$$\$22{,}000 = 1{,}000UR - \$2{,}205{,}000$$

$$\$2{,}227{,}000 = 1{,}000UR$$

$$\$2{,}227 = UR$$

Question 5

The manufacturing costs are sunk; therefore, any price in excess of the differential costs of selling the hoists will add to income. In this case, those differential costs are apparently the $275 per unit variable marketing costs, since the hoists are to be sold through regular channels; thus the minimum price is $275. (If the instructor wishes to reinforce the concept of opportunity cost, the most general answer to this question is that the price should exceed the sum of (1) the differential marketing costs and (2) the potential scrap proceeds, which are an opportunity cost of selling the hoists rather than scrapping them.) This assumes, however, that sale of these "obsolete" hoists will not cut into sales of the current model. If this assumption is not valid, then the contribution margin on any "cannibalized" sales must be taken into account.

Question 6

What price is equivalent to in-house cost of production?

	All Production In-house	*1,000 Units Contracted*
Total revenue	$13,050,000	$13,050,000
Total variable manufacturing costs	(5,385,000)	(3,590,000)
Total variable marketing costs	(825,000)	(770,000)
Total contribution margin	6,840,000	8,690,000
Total fixed manufacturing costs	(1,980,000)	(1,386,000)
Total fixed marketing costs	2,310,000	(2,310,000)
Payment to contractor	--	X
Income	$ 2,550,000	$ 4,994,000 - X

$4,994,000 - X = $2,550,000
X = $2,444,000 or $2,444 per unit maximum purchase price

Therefore, a $2,475 purchase price is not acceptable; it would decrease income by $31,000 [($2,475 - $2,444) * 1,000].

A shorter (but more difficult) approach uses the concept of opportunity costs:

Variable manufacturing cost	$1,795
Variable marketing opportunity cost ($275 - $220)	55
Fixed manufacturing opportunity cost	594*
Equivalent in-house cost	$2,444

*($1,980,000 - $1,386,000)/1,000 units

Question 7

	3,000 Regular Hoists Produced In-house	*Contract 1,000 Regular Hoists and Produce 800 Modified Hoists*			
		Regular (In)	*Regular (Out)*	*Modified*	*Total*
Revenue	$13,050,000	$8,700,000	$4,350,000	$3,960,000	$17,010,000
Variable mfg. costs	(5,385,000)	(3,590,000)	--	(2,420,000)	(6,010,000)
Variable mktg. costs	(825,000)	(550,000)	(220,000)	(440,000)	(1,210,000)
Contribution margin	6,840,000	4,560,000	4,130,000	1,100,000	9,790,000
Fixed mfg. costs	(1,980,000)				(1,980,000)
Fixed mktg. costs	(2,310,000)				(2,310,000)
Payment to contractor	--	--	(X)	--	(X)
Income	$ 2,550,000				$5,500,000 - X

Maximum payment = $2,950,000. Now the proposal should be accepted as a price of $2,475.

Case 16-3: Bill French

Note: *This case is unchanged from the Eleventh Edition.*

Approach

This case requires quite a few calculations, but it is a good case for introducing students to the uses and limitations of break-even analysis. It can be used to discuss many of the hidden assumptions involved in such an approach. Some instructors also find it a good vehicle for discussing some of the human problems arising when a young, well-educated person begins working in a business. Finally, at The University of Michigan we have found it useful to defer this case until Chapter 26, when we teach several cases on linear programming: Bill French can be used as an introductory case to raise the issue of what product mix is optimal given resource and/or sales volume constraints.

Comments on Questions

Question 1

There is undoubtedly a long list of assumptions that can be related to this, or any, break-even analysis. Part of the problem of dealing with analyses of this sort is that they take on the characteristic of being static even though the form of presentation might lead one to believe that here is a moving, dynamic analysis that allows for a variety of changed conditions. To an extent this is true; but there are many conditions that are assumed to be constant. It is to the assumed constants that the students must ultimately direct their attention. For instance:

1. French has had to assume that the variability of the variable costs is constant. French has thus assumed a relatively constant level of efficiency for machines and direct labor over all portions of the range of operations. Whether or not this is a valid assumption in a practical sense is highly questionable.

2. Similarly, there is an assumption that the fixed costs are truly fixed over the full range of operations that has been pictured. In fact, some fixed costs are likely to be step functions over this range.

3. The calculation of a break-even point based on sales assumes that there will be a reasonably constant relationship between the production and the sales pattern. Were this not the case, the spread between the patterns would lead to an incurrence of costs to be carried in inventory, and the full contribution suggested by the chart may not be realized.

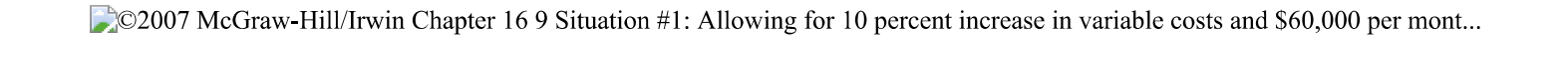
4. Along somewhat the same vein, the assumption (and a basic one in either aggregate or product-line analyses) that the sales mix will remain constant is a crucial one.

5. And, obviously, there is considerable reliance in French's analysis that sales prices will remain constant.

Considering the objections of the participants at the meeting, it is easy to see where French's failure to make explicit his assumptions got him into the position of appearing to be a naive, inexperienced "whiz kid."

Question 2

Calculation of various break-even points:



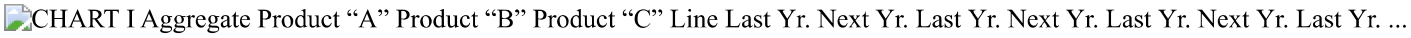
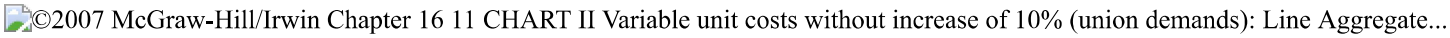


CHART I Aggregate Product “A” Product “B” Product “C” Line Last Yr. Next Yr. Last Yr. Next Yr. Last Yr. Next Yr. Last Yr. ...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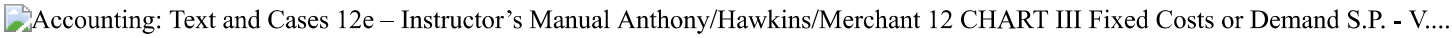
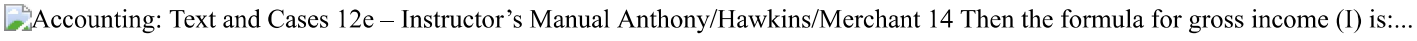

Accounting: Text and Cases 12e – Instructor’s Manual Anthony/Hawkins/Merchant 12 CHART III Fixed Costs or Demand S.P. - V....

 ©2007 McGraw-Hill/Irwin Chapter 16 13 Students find this "discrepancy" puzzling. Usually a number of students make the int...



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3. 3. ©2007 McGraw-Hill/Irwin Chapter 16 3 Problem 16-2: Doyle's Candy Company a. Break-even volume = Fixed costs / Unit contribution = $1,056,000 / $9.60 - $5.76 = $1,056,000 / $3.84 = 275,000 boxes b. Current contribution margin percentage = $3.84 / $9.60 = 40%. In general, abbreviating contribution margin percentage as CMP, we have: UR UVCUR CMP □ □ Solving for UR, this becomes: CMP1 UVC UR □ □ With a l5% increase in variable production costs (to $5.52, giving total UVC of $6.48), the selling price per box is: 80.10$ 60. 48.6$ 40.1 48.6$ UR □□ □ □ c. Projected income statement: Revenues (390,000 x $9.60).....$3,744,000 Variable costs (390,000 x $5.76) .....2,246,400 Contribution .....1,497,600 Fixed costs.....1,056,000 Income before tax.....441,600 Taxes (40%).....176,640 Net income after tax .....$ 264,960 In general, pretax I = (UR - UVC) • X - TFC. So in this case: 441,600 = ($9.60 – 6.48) • X - 1,056,000 $3.12 • X = $1,497,600 X = 480,000 boxes TR = 480,000 @ $9.60 = $4,608,000 (Note that as long as the tax rate remains constant, it is irrelevant in answering this question.) Problem 16-3: Mike Solid's Pizzeria a. Assuming that cost of food sold is the only item of variable expense, then: onContributiUnit CostsFixed meeven voluBreak □□ 95.5$ 960,148$ *55.2$50.8$ 400,92$360,241$ □ □ □ □ = 25,035 pizzas *$308,000 / $8.50 = 36,235 pizzas: $92,400 / 36,235 = $2.55 per pizza variable costs.

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5. 5. ©2007 McGraw-Hill/Irwin Chapter 16 5 Comments on Questions Question 1 Total fixed costs (TFC) = fixed costs per unit times normal volume =($660 + $770)*3,000 = $4,290,000. Contribution margin per unit = unit price minus unit variable costs = $4,350 - $2,070 = $2,280. units1,882 280,2$ $4,290,000 meeven voluBreak □□□ 461,185,8$ 350,4$ 2,070-$4,350 /$4,290,000sales □□ □ □ □ □ □ □□ evenBreak (actually, 1,882 *$4,350 = $8,186,700) Question 2 Recommendation: Lowering prices reduces income. Other factors, such as the reduction of available capacity and the capacity and the impact on market share, could also affect the decision. Impact: Before Price Reduction After Price Reduction Difference Price .....$ 4,350 $ 3,850 $ (500) Quantity .....3,000 3,500 500 Revenue .....$13,050,000 $13,475,000 $ 425,000 Variable mfg. costs .....(5,385,000) (6,282,500) (897,500) Variable mktg. costs.....(825,000) (962,500) (137,500) Contribution margin.....6,840,000 6,230,000 (610,000) Fixed mfg. costs.....(1,980,000) (1,980,000) -- Fixed mktg. costs .....(2,310,000) (2,310,000) -- Income.....$ 2,550,000 $ 1,940,000 $(610,000) Note that the differential contribution margin and differential income are the same. Question 3 Recommendation: Don't accept contract Impact: Without Govt. Contract With Government Contract Regular Government Total Difference Revenue .....$17,400,000 $15,225,000 $1,420,000 $16,645,000 $(755,000) Variable mfg. .....(7,180,000) (6,282,500) (897,500) (7,180,000) -- Variable mktg. costs.....(1,100,000) (962,500) -- (962,500) 137,500 Contribution margin.....9,120,000 7,980,000 522,500 8,502,500 (617,500) Fixed mfg. costs.....(1,980,000) (1,980,000) -- Fixed mktg. costs .....(2,310,000) (2,310,000) -- Income.....$ 4,830,000 $ 4,212,500 $(617,500) 1 Government revenue = (500 * $1,795) +.125 ($1,980,000) + $275,000 = $1,420,000, assuming the government's "share" of March fixed manufacturing costs is .125 (500/4,000).
6. 6. Accounting: Text and Cases 12e – Instructor's Manual Anthony/Hawkins/Merchant 6 A shorter approach to question 3 (but harder for some students to understand) is this: Forgone contribution (equals forgone income, as was illustrated by question 2) on

regular sales if government contract is accepted .....500 * $2,280 = $1,140,000 Income from government contract: Fixed fee .....275,000 Share of fixed mfg. costs (1/8 * $1,980,000).....247,500 522,500 Differential income if contract accepted.....$(617,500) Question 4 Minimum price = variable mfg costs + shipping costs + order costs = $1,795 + $410 + $22,000/1,000 = $2,227 At this price per unit, the $2,227,000 of differential costs caused by the 1,000-unit order will just be uncovered. Some students solve for this price using the break-even formula (UR = unit revenue): QUVCUR TCF □□ units1,0002,205UR 22,000 □□ $22,000 = 1,000UR - $2,205,000 $2,227,000 = 1,000UR $2,227 = UR Question 5 The manufacturing costs are sunk; therefore, any price in excess of the differential costs of selling the hoists will add to income. In this case, those differential costs are apparently the $275 per unit variable marketing costs, since the hoists are to be sold through regular channels; thus the minimum price is $275. (If the instructor wishes to reinforce the concept of opportunity cost, the most general answer to this question is that the price should exceed the sum of (1) the differential marketing costs and (2) the potential scrap proceeds, which are an opportunity cost of selling the hoists rather than scrapping them.) This assumes, however, that sale of these "obsolete" hoists will not cut into sales of the current model. If this assumption is not valid, then the contribution margin on any "cannibalized" sales must be taken into account.

7. 7. ©2007 McGraw-Hill/Irwin Chapter 16 7 Question 6 What price is equivalent to in-house cost of production? All Production In-house 1,000 Units Contracted Total revenue .....$13,050,000 $13,050,000 Total variable manufacturing costs.....(5,385,000) (3,590,000) Total variable marketing costs.....(825,000) (770,000) Total contribution margin .....6,840,000 8,690,000 Total fixed manufacturing costs.....(1,980,000) (1,386,000) Total fixed marketing costs.....2,310,000 (2,310,000) Payment to contractor.....-- _____X Income.....$ 2,550,000 $ 4,994,000 - X $4,994,000 - X = $2,550,000 X = $2,444,000 or $2,444 per unit maximum purchase price Therefore, a $2,475 purchase price is not acceptable; it would decrease income by $31,000 [($2,475 - $2,444) * 1,000]. A shorter (but more difficult) approach uses the concept of opportunity costs: Variable manufacturing cost.....$1,795 Variable marketing opportunity cost ($275 - $220).....55 Fixed manufacturing opportunity cost.....594* Equivalent in-house cost.....$2,444 *($1,980,000 - $1,386,000)/1,000 units Question 7 3,000 Regular Hoists Produced In-house Contract 1,000 Regular Hoists and Produce 800 Modified Hoists Regular (In) Regular (Out) Modified Total Revenue .....$13,050,000 $8,700,000 $4,350,000 $3,960,000 $17,010,000 Variable mfg. costs .....(5,385,000) (3,590,000) -- (2,420,000) (6,010,000) Variable mktg. costs.....(825,000) (550,000) (220,000) (440,000) (1,210,000) Contribution margin.....6,840,000 4,560,000 4,130,000 1,100,000 9,790,000 Fixed mfg. costs.....(1,980,000) (1,980,000) Fixed mktg. costs .....(2,310,000) (2,310,000) Payment to contractor .....-- -- (X) -- (X) Income.....$ 2,550,000 $5,500,000 - X Maximum payment = $2,950,000. Now the proposal should be accepted as a price of $2,475.

8. 8. Accounting: Text and Cases 12e – Instructor's Manual Anthony/Hawkins/Merchant 8 Case 16-3: Bill French Note: This case is unchanged from the Eleventh Edition. Approach This case requires quite a few calculations, but it is a good case for introducing students to the uses and limitations of break-even analysis. It can be used to discuss many of the hidden assumptions involved in such an approach. Some instructors also find it a good vehicle for discussing some of the human problems arising when a young, well-educated person begins working in a business. Finally, at The University of Michigan we have found it useful to defer this case until Chapter 26, when we teach several cases on linear programming: Bill French can be used as an introductory case to raise the issue of what product mix is optimal given resource and/or sales volume constraints. Comments on Questions Question 1 There is undoubtedly a long list of assumptions that can be related to this, or any, break-even analysis. Part of the problem of dealing with analyses of this sort is that they take on the characteristic of being static even though the form of presentation might lead one to believe that here is a moving, dynamic analysis that allows for a variety of changed conditions. To an extent this is true; but there are many conditions that are assumed to be constant. It is to the assumed constants that the students must ultimately direct their attention. For instance: 1. French has had to assume that the variability of the variable costs is constant. French has thus assumed a relatively constant level of efficiency for machines and direct labor over all portions of the range of operations.

Whether or not this is a valid assumption in a practical sense is highly questionable. 2. Similarly, there is an assumption that the fixed costs are truly fixed over the full range of operations that has been pictured. In fact, some fixed costs are likely to be step functions over this range. 3. The calculation of a break-even point based on sales assumes that there will be a reasonably constant relationship between the production and the sales pattern. Were this not the case, the spread between the patterns would lead to an incurrence of costs to be carried in inventory, and the full contribution suggested by the chart may not be realized. 4. Along somewhat the same vein, the assumption (and a basic one in either aggregate or product-line analyses) that the sales mix will remain constant is a crucial one. 5. And, obviously, there is considerable reliance in French's analysis that sales prices will remain constant. Considering the objections of the participants at the meeting, it is easy to see where French's failure to make explicit his assumptions got him into the position of appearing to be a naive, inexperienced "whiz kid." Question 2 Calculation of various break-even points:

9. 9. ©2007 McGraw-Hill/Irwin Chapter 16 9 Situation #1: Allowing for 10 percent increase in variable costs and $60,000 per month increase in fixed costs, but not holding any dividend or retention requirements against operations, a simple break-even calculation (neither profit nor loss) comes out to be: Fixed costs of operating .....$3,690,000 Aggregate variable unit income, Chart 1, line 3 minus line 5 .....$3.23 Break-even units required, $3,690,000 / $3.23.....1,142,000 units Ratio of variable income to sales, V.I. = $3.23; S. P. = $6.95.....4647 Break-even dollar volume required, $3,690,000 / 0.4647 .....$7,940,000 Situation #2: No allowance for 10 percent increase in variable costs, no dividend requirement, no earnings retention goal. In short, allow for change in product mix, for increased fixed costs, and change in "C" sales price□then calculate point of no profit-no loss. Fixed costs of operating.....$3,690,000 Aggregate unit variable income, Chart A, line 5.....$3.56 Break-even units required, $3,690,000 / $3.56.....1,036,500 units Ratio of variable income to sales, SP. = $6.95, V.I. = $3.56.....5122 Break-even dollar volume required, $3,690,000 / .5122.....$7,204,000
10. 10. CHART I Aggregate Product “A” Product “B” Product “C” Line Last Yr. Next Yr. Last Yr. Next Yr. Last Yr. Next Yr. Last Yr. Next Yr. Unit Capacity .....1 2,000,000 2,000,000 Unit Achievement .....2 1,500,000 1,750,000 600,000 400,000 400,000 400,000 500,000 950,000 Unit Sales Price.....3 $7.20 $6.95 $10.00 $10.00 $9.00 $9.00 $2.40 $4.80 Total Sales Revenue.....4 $10,800,000 $12,160,000 $6,000,000 $4,000,000 $3,600,000 $3,600,000 $1,200,000 $4,560,000 Variable Unit Cost .....5 $4.50 $3.72 $7.50 $8.25 $3.75 $4.125 $1.50 $1.65 Total Variable Cost.....6 $6,750,000 $6,517,500 $4,500,000 $3,300,000 $1,500,000 $1,650,000 $750,000 $1,567,500 Fixed Costs .....7 $2,970,000 $3,690,000 $960,000 $960,000 $1,560,000 $1,560,000 $450,000 $1,170,000 Income .....8 $1,080,000 $1,952,500 $540,000 $(260,000) $540,000 $390,000 -0- $1,822,500 Income Taxes (50%).....9 $540,000 $976,250 $270,000 $(130,000) $270,000 195,000 -0- $911,250 Dividends.....10 $300,000 $450,000 Retained .....11 $240,000 $526,250 Changes incorporated in modification of Exhibit 3: (1) Volume of Product "A" reduced by one third, (2) Volume of Product "C" increased by 450,000 units, (3) Selling price of Product "C" doubled, (4) Variable cost per unit, by individual product lines, is increased by 10% of old level, (5) Fixed costs increased by $720,000 and charged (arbitrarily) against Product "C", (6) Taxes are charged at 50%, (7) Dividends are budgeted (regular plus special) at $450,000. Comments on derivation of figures in Chart 1: (a) Aggregate unit selling price obtained by cross-adding line 4 (unit sales, revenue for "A," "B," and "C"), cross-adding line 2 (units sold for “A,” “B,” and “C”), and dividing the sum for line 4 by the sum for line 2. Line 3 does not, obviously, cross-add. (In class, I also derive the $6.95 amount as the weighted average of the three individual prices, using product mix proportions as the weights.) (b) Variable unit cost in aggregate obtained by cross-adding line 6 (total variable cost for "A," "B," and "C"), cross-adding line 2 (units sold for "A," "B," and "C"), and dividing the sum for line 6 by the sum for line 2. Line 5 does not, obviously, cross-add. (Again, l also derive this as a weighted average.)
11. 11. ©2007 McGraw-Hill/Irwin Chapter 16 11 CHART II Variable unit costs without increase of 10% (union demands): Line Aggregate "A" "B" "C" Variable unit costs.....1 $3.39 $7.50 $3.75 $l.50 Units expected next year.....2 1,750,000 400,000 400,000 950,000 Total variable costs expected.....3 $5,925,000 $3,000,000 $l,500,000 $1,425,000 Selling price per

unit....4 $6.95 $10.00 $9.00 $4.80 Variable unit income (contribution)....5 $3.56 $2.50 $5.25 $3.30 Variable total income (contribution)....6 $6,235,000 $l,000,000 $2,100,000 $3,135,000 Derivation: Line l—from Exhibit 3, for individual products Line 2—from Chart I, line 2 (next year) Line l —(aggregate)line 3 (ag.) / 2 (ag.) Line 4—from Chart 1, line 3 (next year) Line 5—line 4 minus line 1 (except aggregate) Line 5 —(aggregate) line 6 (ag.) / 2 (ag.) which then equals line 4 (ag.) minus line 1 (ag.) Situation #3: Calculation of a break-even point under changed conditions of cost, both variable and fixed, and volume and selling price that will, after tax, provide exactly what has been provided with no extras. Coverage required: Fixed costs....$3,690,000 Regular dividends....600,000 (pretax) Earnings retention....300,000 (pretax) Required ....$4,590,000 Aggregate unit variable income (situation #1) ....$3.23 Break-even units required....1,421,000 Ratio of variable income to sales (situation #1) ....4647 Beak-even dollar volume required ....$9,877,000 In a manner similar to the procedure used in the first three situations here, the student can make break- even approximations under a variety of assumed conditions and for the several products either individually or in the aggregate. Chart III is a capsule summary of some possible calculations.

12. 12. Accounting: Text and Cases 12e – Instructor's Manual Anthony/Hawkins/Merchant 12 CHART III Fixed Costs or Demand S.P. - V.C.= V.I. B.E. Units Required V.I. / S.P. B.E. $ Volume Required a Situation #1....$3,690,000 $3.23 1,142,000 .4647 $7,940,000 b Situation #2....$3,690,000 $3.56 1,036,500 .5122 $7,204,000 c Situation #3....$4,590,000 $3.23 1,421,000 .4647 $9,877,000 d No extra dividend; no union increase; increased fixed costs; retain (A.T.) $150,000....$4,590,000 $3.56 1,289,000 .5122 $8,961,000 e Pay extra dividend; no union in increase; increased fixed costs; retain (A.T.) $150,000....$4,890,000 $3.56 1,374,000 .5122 $9,547,000 f Allow union increase; pay no extra dividend; increased fixed costs; retain (A.T.) $150,000....$4,590,000 $3.23 1,421,000 .4647 $9,877,000 g Pay extra dividend and union increase; increase fixed costs; retain (A.T.) $150,000....$4,890,000 $3.23 1,514,000 .4647 $10,523,000 Question 3 Two points (in addition to factors already mentioned) should be recognized by the student considering a shift of capacity from product "A" to "C": 1. While the ratio of variable income to sales price is much higher for "C" than for "A" (66% against 18%), this is in part compensated for by the lower sales price of "C." 2. While the per unit dollar contribution for "C" is higher than for "A" ($3.15 against $1.75), the number of units that can be sold is a critical factor. Since the "A" contribution is 56 percent of the "C" contribution, this would mean that the company can afford to gain in "C" units only 56 percent of the number of "A" units that it gives up. Similarly, in viewing the amount of capacity that can be added for "C," we must consider (in addition to the compelling factors that do not come directly under the cost-revenue measurement) the amount of variable income available to pay for the added capacity and to return a reasonable profit at the same time. Here the analysis wanders into the area of return on investment, but the student may wish to sketch out some figures. On the basis of a per unit contribution of $3.15 from "C," an addition that would yield 100,000 additional units of "C" annually must not cost more than about $300,000 by the time amortization and profit (at a proper rate of return) are considered. Question 4 Based on the numbers of Exhibit 3, the individual product break-even volumes are as follows: Pdt. "A" Pdt. "B" Pdt. "C" $960,000 $1,560,000 $450,000 $10.00 - $7.50 = 384,000 units or $3,840,000 $9.00 - $3.75 = 297,143 units or $2,674,000 $2.40 - $1.50 = 500,000 units or $1,200,000 $7,714,000orunits1,181,143 Versus 1,100,000 units or $7,920,000 on an aggregate basis.

13. 13. ©2007 McGraw-Hill/Irwin Chapter 16 13 Students find this "discrepancy" puzzling. Usually a number of students make the intuitively reasonable speculation that the discrepancy is caused by fixed costs not being assigned "correctly" to the three products; they surmise that if total fixed costs were allocated to products based on, say, unit marginal income or total revenues, the individual break-even volumes would add to the aggregate break-even volume. These reasonable speculations, however, are not true. I once proved mathematically that the sum of the individual break-evens will equal the aggregate if and only if all products have equal marginal incomes per unit (i.e., equal unit contributions). But that obviously is not an interesting case, because product mix is irrelevant in such a case. Although we have not yet covered joint cost allocations, I suggest to students that reasonable cost accountants could differ on the "correct" assignment of fixed costs in Exhibit 3 to individual produce, thus casting doubt on the usefulness of break-even volumes for individual products if significant joint fixed costs are involved. I now suggest the conceptually correct way to consider the multiproduct situation. For purposes of graphical illustration, assume a company has only two products, with these characteristics: Product1 Product2 Unit pace (pi)....$ 5 $ 7 Unit variable cost (vi)....$ 2 $ 3 Unit contribution (ci)....$ 3 $ 4 Direct fixed costs(Fi)) ....$15,000 $25,000 Joint fixed

costs(Fi).....$20,900 Sales volume(xi).....Xl X2 EXHIBIT A

14. 14. Accounting: Text and Cases 12e – Instructor's Manual Anthony/Hawkins/Merchant 14 Then the formula for gross income (I) is: I =)XV(P 1 1 1 □□□□□ – F1 + j2222 F-Fx)v(p □□□□□ Pdt. 1 □□□□□Contrib. Pdt. 2 □□□□□Contrib. Pdt. 1 "Direct" Margin Pdt. 2 "Direct" margin Or, for the illustrative numbers, I = 3x1 + 4x2 – 60,000 (x1,x2 > 0) This makes it clear that instead of a break-even volume, there are virtually infinite x1, x2 combinations (i.e., product mixes) that will make I = 0 (or make I = any amount). Graphically, we have a series of "isoprofit" lines, one line for each value of I, the slope of which is a function of the relative per-unit contributions. The isoprofit line for I = 0 shows all break-even product mixes. (See Exhibit A, above.) The instructor can push to this point, whether or not linear programming is to be taught. If teaching LP, the example can now be extended by adding a couple of resource constraint lines to the diagram, and asking students to think about profit maximization in that context before the Trammel Snowmobile case. Question 5 There are really two aspects of the "usefulness" question. One is, what kinds of decisions will be influenced by a break-even analysis; the other is, what insights into operations are gained in the analysis that precedes constructing a break-even chart, even if the chart itself is not used much after it is prepared? In my opinion, the break-even chart and the cost analysis required in order to prepare it are more useful for clarifying cost-volume relationships than for identifying the break-even volume per se. Nevertheless, there are certain decisions for which this type of analysis can be explicitly used; for example: 1. Given a certain complement of professional staff, how many hours of professional time at standard billing rates must a CPA firm (or any other professional services firm) bill in order to break even (i.e., recover professional salaries, support salaries, and other overhead costs)? 2. How many additional units of sales (or sales dollars) must a 30-second ad on the Super Bowl telecast generate in order for the ad "to pay for itself"? 3. Given projected costs of a new commercial aircraft and an estimate of the price per plane that airlines will be willing to pay, what is the break-even volume? Is it likely that the aircraft manufacturer can in fact sell more than that number of planes? 4. If the price of a product is reduced 10 percent, how many more units must be sold to earn the same profit as at the current price? It is also important that break-even analysis not be oversold. For example, I feel that students sometimes get the impression from their marketing course that a new product introduction decision would be based on a break-even analysis. Since many such introductions require significant working capital (and perhaps fixed asset) investments, capital budgeting techniques should be used, not break-even analysis. However, as suggested by example 3 above, a break-even analysis may provide a "quick-and-dirty" look at whether it is worthwhile to go ahead and develop a full-blown discounted cash flow analysis.

Accounting Text and Cases 12 Ed. Chapter 11
Gaurav Dutta

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Accounting Text and Cases 12 Ed. Chapter 2
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Case 16-1 Hospital Supply, Inc (The Behaviour of Costs)
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