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15.963 Management Accounting and Control
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15.963 Managerial Accounting and Control

Spring 2007

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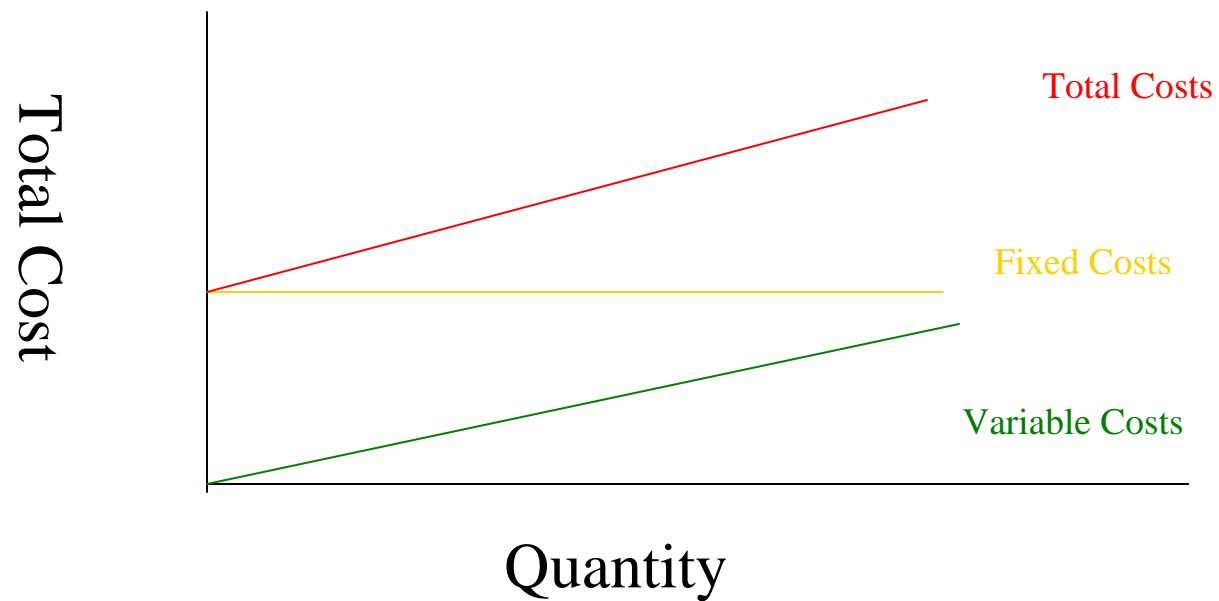


Cost Terminology

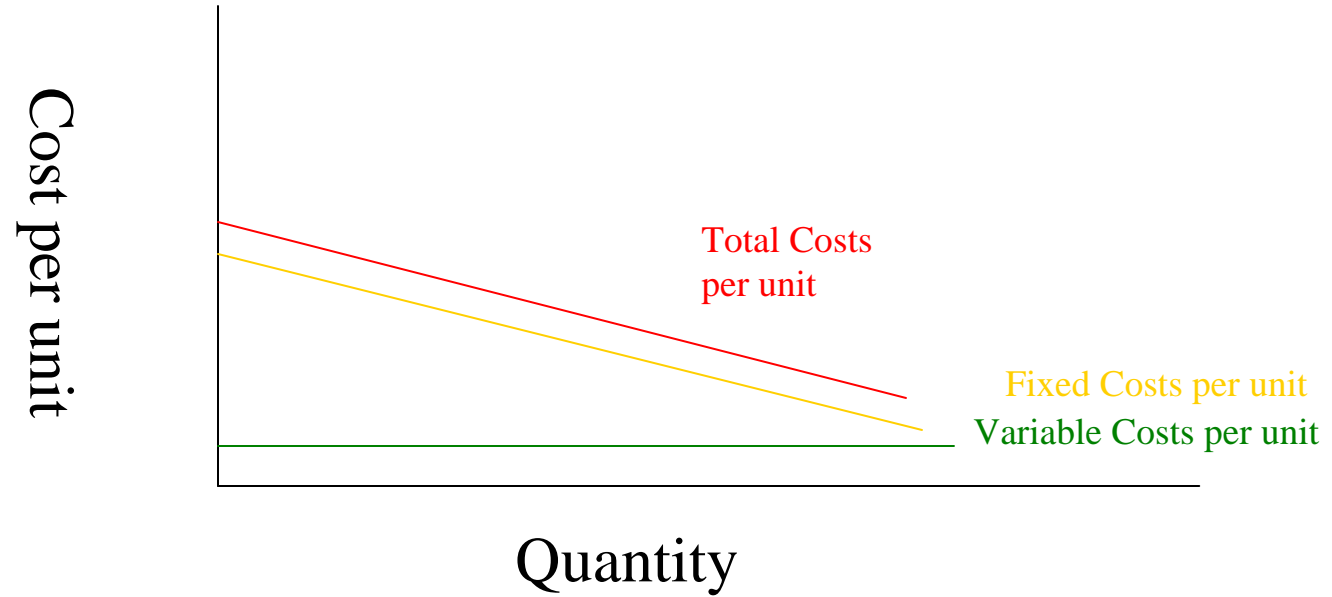
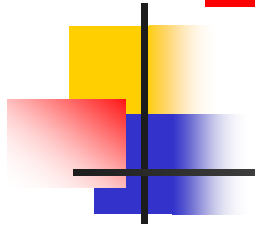


- Cost object:
Object for which cost is desired, e.g., transmission, car, plant, division.
- Cost behavior, with respect to output volume:
Variable, Fixed, Mixed, Step.

Cost behavior



Per unit costs



Cost Terminology



- Long run vs. short run cost behavior
- Relevant range
- Cost assignment:
Direct vs. Indirect
- Direct costs can be traced to cost object in a non-arbitrary and cost-effective manner.
- Indirect costs are also called overhead. These are non-traceable costs.



Cost Classification: Service Sector

- Consumer Focus is a marketing research firm that organizes focus groups for consumer-product companies.
 - Each focus group has eight individuals who are paid \$50 per session to provide comments on new products.
 - These focus groups meet in hotels and are led by a trained, independent, marketing specialist hired by Consumer Focus.
 - Each specialist is paid a fixed retainer to conduct a minimum number of sessions and a per session fee of \$2,000.
 - A Consumer Focus staff member attends each session to ensure that all the logistical aspects run smoothly.



Cost Classification: Service Sector

- Classify each of the following cost items as:
 - Direct or indirect costs with respect to each individual focus group.
 - Variable or fixed costs with respect to how the total costs of Consumer Focus change as the number of focus groups conducted changes.
 - (If in doubt, select on the basis of whether the total costs will change substantially if there is a large change in the number of groups conducted.)



Cost Classification: Service Sector

- Cost Item:
 - Payments to individuals in each focus group to provide comment on new products.
 - Direct
 - Variable
 - Annual subscription of Consumer Focus to Consumer Reports magazine.
 - Indirect
 - Fixed
 - Phone calls made by Consumer Focus staff member to confirm individuals will attend a focus group session (Records of individual calls are not kept).
 - Indirect
 - Variable



Cost Classification: Service Sector

- Cost Item:
 - Retainer paid to focus group leader to conduct 20 focus groups per year on new medical products.
 - Indirect
 - Fixed
 - Meals provided to participants in each focus group.
 - Direct
 - Variable
 - Lease payments by Consumer Focus for corporate office.
 - Indirect
 - Fixed



Cost Classification: Service Sector

- Cost Item:
 - Cost of tapes used to record comments made by individuals in a focus group session (These tapes are sent to the company whose products are being tested).
 - Direct
 - Variable
 - Gasoline costs of Consumer Focus staff for company-owned vehicles (staff members submit monthly bills with no mileage breakdowns).
 - Indirect
 - Variable



Cost Classification

- Takeaways:
 - In classifying costs as direct or indirect, keep cost object in mind;
 - Immaterial (small) costs can be classified as indirect;
 - One rule of thumb for classification: ask who should pay (e.g., overtime premium, machine downtime)?



Cost Classification: Manufacturing Sector

- The Fremont, California, plant of New United Motor Manufacturing, Inc. (NUMMI), a joint venture of General Motors and Toyota, assembles two types of cars (Corollas and Geo Prisms).
 - Separate assembly lines are used for each type of car.

- Classify each of the following cost items as:
 - Direct or indirect (D or I) costs with respect to the total number of cars each type assembled (Corolla or Geo Prism).

 - Variable or fixed (V or F) costs with respect to how the total costs of the plant change as the total number of cars of each type assembled changes.



Cost Classification: Manufacturing Sector

- Cost Item:
 - Cost of tires used on Geo Prisms.
 - Direct
 - Variable
 - Salary of public relations manager of NUMMI plant.
 - Indirect
 - Fixed
 - Annual awards dinner for Corolla suppliers.
 - Direct
 - Fixed



Cost Classification: Manufacturing Sector

- Cost Item:
 - Salary of engineer who monitors design changes on Geo Prism.
 - Direct
 - Fixed
 - Freight costs of Corolla engines shipped from Toyota City, Japan, to Fremont, California.
 - Direct
 - Variable
 - Electricity costs of NUMMI plant (single bill covers entire plant).
 - Indirect
 - Variable



Cost Classification: Manufacturing Sector

- Cost Item:
 - Wages paid to temporary assembly-line workers hired in periods of high production (paid on hourly basis).
 - Direct
 - Variable
 - Annual fire-insurance policy cost for NUMMI plant.
 - Indirect
 - Fixed



Cost Concepts

- Contribution margin (CM) = total revenue – total variable cost
 - Contribution margin per unit (UCM)
- Gross margin (GM) = total revenues (TR) – cost of goods sold (COGS)
- Manufacturing costs are direct materials, direct labor and manufacturing overhead.
- Marketing, selling and administrative costs are not manufacturing costs. These are operating costs.
- Operating income (OI) = GM – operating costs = CM – fixed costs (FC)
- Breakeven quantity or revenue is units sold, or revenues earned, such that $OI = 0 = (UCM \cdot q) - FC$
 - $q = FC / UCM$



Gross Margin and Contribution Margin

- Foreman Fork, Inc.'s income statement for 2005 on production and sales of 200,000 units is as follows:

■ Revenues	\$2,600,000
■ <u>Costs of Goods Sold</u>	<u>\$1,600,000</u>
■ Gross Margin	\$1,000,000
■ <u>Marketing and Distribution Costs</u>	<u>\$1,150,000</u>
■ Operating Income (Loss)	\$(150,000)

- Foreman's fixed manufacturing costs are \$500,000 and variable marketing and distribution costs are \$4 per unit.



Gross Margin and Contribution Margin

- Calculate Foreman's variable manufacturing costs per unit for 2005.

■ Cost of Good Sold	\$1,600,000
■ <u>Fixed Manufacturing Costs</u>	<u>\$500,000</u>
■ Variable Manufacturing Costs	\$1,100,000

- Variable Manufacturing Costs per Unit = $\$1,100,000 / 200,000 = \5.50

- Calculate Foreman's fixed marketing and distribution costs for 2005.

■ Total Marketing and Distribution Costs	\$1,150,000
■ <u>Variable Marketing and Distribution (200,000 x \$4)</u>	<u>\$800,000</u>
■ Fixed Marketing and Distribution Costs	\$350,000



Gross Margin and Contribution Margin

- Foreman's gross margin per unit is \$5 ($\$1,000,000 / 200,000$ units).
- Sam Hogan, Foreman's president, believes that if production and sales had been 230,000 units, the company would have covered the \$1,150,000 of marketing and distribution costs ($\$1,150,000 / \$5 = 230,000$) and enabled Foreman to break even for the year.



Gross Margin and Contribution Margin

- Calculate Foreman's operating income if production and sales equal 230,000 units.
 - Selling Price = $\$2,600,000 / 200,000 = \13
 - Contribution Margin per Unit =
 - = Selling Price – Variable Cost
 - = $\$13 - \$5.50 - \$4.00$
 - = $\$3.50$
 - Operating Income =
 - = UCM x quantity – Fixed Costs
 - = $\$3.50 \times 230,000 - \$500,000 - \$350,000$
 - = $-\$45,000$



Gross Margin and Contribution Margin

- Why is Sam Hogan wrong?
 - He has interpreted gross margin as if it were all variable – in fact, GM per unit will increase to \$5.33 (from \$5)
 - He has interpreted marketing and distribution costs as all fixed – in fact, total variable marketing costs will rise to \$920k (from \$800k)
 - Both the manufacturing costs and the marketing and distribution costs contain fixed and variable components.



Gross Margin and Contribution Margin

- Takeaways from this example:
 - decompose costs into variable and fixed to conduct analysis – CM approach better than GM income statement;
 - Unit costs are misleading (because of FC and relevant range) – use total costs, not unit costs, in analysis.

CVP Analysis, Income Taxes, Sensitivity



- Almo Company manufactures and sells adjustable canopies that attach to motor homes.

- For its 2006 budget, Almo estimates the following:
 - Selling price \$400
 - Variable Cost per Canopy \$200
 - Annual Fixed Costs \$100,000
 - Net Income \$240,000
 - Income Tax Rate 40%



CVP Analysis, Income Taxes, Sensitivity

- If no changes are made to the selling price or cost structure, determine the number of units that Almo Company must sell:

- To break even.

■ Revenue	=	Variable Costs + Fixed Costs
■ $\$400 \times Q$	=	$\$200 \times Q + \$100,000$
■ $\$200 \times Q$	=	$\$100,000$
■ Q	=	500 units

- To break even, Almo Company must sell 500 units.
- This amount represents the point where revenues equal total costs.



CVP Analysis, Income Taxes, Sensitivity

- If no changes are made to the selling price or cost structure, determine the number of units that Almo Company must sell:

- To achieve its net income objective.

■ Revenues	=	Variable Costs + Fixed Costs + EBT
■ \$400 x Q	=	\$200 x Q + \$100,000 + \$240,000 / (1 - 40%)
■ \$200 x Q	=	\$100,000 + \$400,000
■ Q	=	2,500 units

- $EBT = \text{Earnings Before Taxes} = \text{Net Income} / (1 - \text{Tax Rate})$

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



CVP Analysis, Income Taxes, Sensitivity

- What is the budgeted margin of safety?
 - Budgeted quantity – breakeven quantity =
 $2500 - 500 = 2000$ or 80%
 - This suggests low sales risk.



CVP Analysis, Income Taxes, Sensitivity

- The May income statement reported that sales were not meeting expectations.
- For the first five months of the year, only 350 units had been sold at the established price, with variable costs as planned, and it was clear that the net income projection for 2006 would not be reached unless some actions were taken.
- A management committee presented the following mutually exclusive alternatives to the president:



CVP Analysis, Income Taxes, Sensitivity

- Reduce the selling price by \$40. The sales organization forecasts that at this significantly reduced price, 2,700 units can be sold during the remainder of the year.
 - Total fixed costs and variable cost per unit will stay as budgeted.
- Lower variable cost per unit by \$10 through the use of less-expensive direct materials and slightly modified manufacturing techniques.
 - The selling price will also be reduced by \$30, and sales of 2,200 units are expected for the remainder of the year.
- Reduce fixed costs by \$10,000 and lower the selling price by 5%.
 - Variable cost per unit will be unchanged.
 - Sales of 2,000 units are expected for the remainder of the year.



CVP Analysis, Income Taxes, Sensitivity

- Determine which alternative Almo should select to achieve its net income objective.

- Alternative 1

- Revenues = $(\$400 \times 350) + (\$360 \times 2,700) = \$1,112,000$
- Variable Costs = $\$200 \times 3,050 = \$610,000$
- Operating Income = $\$1,112,000 - \$610,000 - \$100,000 = \$402,000$
- Net Income = $\$402,000 * (1 - 40\%) = \$241,000$



CVP Analysis, Income Taxes, Sensitivity

- Determine which alternative Almo should select to achieve its net income objective.

- Alternative 2

■ Revenues	=	$(\$400 \times 350) + (\$370 \times 2,200) = \$954,000$
■ Variable Costs	=	$\$200 \times 350 + \$190 \times 2,200 = \$488,000$
■ Operating Income	=	$\$954,000 - \$488,000 - \$100,000 = \$366,000$
■ Net Income	=	$\$366,000 * (1 - 40\%) = \$219,600$



CVP Analysis, Income Taxes, Sensitivity

- Determine which alternative Almo should select to achieve its net income objective.

- Alternative 3

- Revenues = $(\$400 \times 350) + (\$380 \times 2,000) = \$900,000$

- Variable Costs = $\$200 \times 2,350 = \$470,000$

- Operating Income = $\$900,000 - \$470,000 - \$90,000 = \$340,000$

- Net Income = $\$340,000 * (1 - 40\%) = \$204,000$



CVP Analysis, Income Taxes, Sensitivity

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



Sales Mix: Three Products

- The Ronowski Company has three product lines of belts – A, B, and C – priced at \$6, \$5 and \$7, respectively.
- Variable costs per unit are \$3, \$3 and \$6, respectively.
- The president foresees sales in the coming period of 20,000 units of A, 100,000 units of B, and 80,000 units of C.
- The company's fixed costs for the period are \$255,000.



Sales Mix: Three Products

- What is the company's breakeven point in units?
 - Assume a constant sales mix (1,5,4), and calculate the CM for the bundle: $(1,5,4) * (3,2,1)' = \$17$
 - Calculate breakeven for the bundle:
 - $255k / 17 = 15k$ bundles
 - Now unbundle to obtain breakeven units:
 - $15k * (1,5,4) = (15k, 75k, 60k)$



Sales Mix: Three Products

- If projected sales (or the sales mix) were 20,000 units of A, 80,000 units of B and 100,000 units of C, how would breakeven be affected?
 - Breakeven point increases because the new mix contains less of the higher contribution margin per unit product B and more of the lower contribution margin per unit product C.
 - You give up CM of \$40k on B, and only gain \$20k on C.



Uncertainty, CVP Analysis

- Angela Brady is considering promoting a world championship fight for boxer Mike Foreman.
- Brady will receive \$16 for every cable-TV home that subscribes to the event.
- She will pay Foreman 25% of each \$16 fee and a fixed \$2 million.
- In addition, she will incur fixed costs of \$1 million and variable costs of \$2 per cable-TV home that subscribes to this event.
- All ticket revenues from the fight go to the operator of the casino where the fight will take place.



Uncertainty, CVP Analysis

- The pay-per-view audience for such an event is uncertain, but Brady estimates the following probability distribution for it:

<u>Pay-Per-View Audience</u>	<u>Probability</u>
■ 100,000	5%
■ 200,000	10%
■ 300,000	30%
■ 400,000	35%
■ 500,000	15%
■ 1,000,000	5%



Uncertainty, CVP Analysis

- Based on the expected audience size, would you recommend Brady proceed with the plans for the fight?

- Expected Audience =

100,000 x 5% +	= 5,000
200,000 x 10% +	= 20,000
300,000 x 30% +	= 90,000
400,000 x 35% +	= 140,000
500,000 x 15% +	= 75,000
<u>1,000,000 x 5%</u>	<u>= 50,000</u>
	= 380,000



Uncertainty, CVP Analysis

- What is the breakeven number of subscriber homes?
 - Selling Price = \$16
 - Variable Cost = \$4 + \$2 = \$6
 - Contribution Margin = \$10

 - Fixed Costs = \$2,000,000 + \$1,000,000 = \$3,000,000

 - Breakeven Number of Subscribers = FC/UCM
= \$3,000,000 / \$10
= 300,000 Homes



Uncertainty, CVP Analysis

- Based on the expected audience size, would you recommend Brady proceed with the plans for the fight?
 - Brady's expected audience size of 380,000 homes is more than 25% larger than the breakeven audience size of 300,000 homes.
 - So, if she is confident of the assumed probability distribution, she has a good margin of safety, and should proceed with her plans for the fight.
 - She will only lose money if the pay-per-view audience is 100,000 or 200,000, which together have a 15% probability of occurring.



CVP Analysis, Decision Making

- Tocchet Company manufactures CB1, a citizens band radio.
- The company's plant has an annual capacity of 50,000 units.
- Tocchet currently sells 40,000 units at a price of \$105.
- It has the following cost structure:

■ Variable Manufacturing Cost per Unit	\$45
■ Fixed Manufacturing Costs	\$800,000
■ Variable Marketing and Distribution Cost per Unit	\$10
■ Fixed Marketing and Distribution Costs	\$600,000



CVP Analysis, Decision Making

- Tocchet's Current Operating Income:

■ Revenues	= \$105 x 40,000	= \$4,200,000
■ <u>Variable Costs</u>	= \$55 x 40,000	= <u>\$2,200,000</u>
■ Contribution Margin		= \$2,000,000
■ <u>Fixed Costs</u>		= <u>\$1,400,000</u>
■ Operating Income		= \$600,000



CVP Analysis, Decision Making

- The Manufacturing Department proposes changes in the manufacturing process to add new features to the CB1 product.
- These changes will increase fixed manufacturing costs by \$100,000 and variable manufacturing costs per unit by \$2.
- At its current sales quantity of 40,000 units, compute the minimum selling price that will allow Tocchet to add these new features and maintain its operating income.
- What is the quickest way to compute this?



CVP Analysis, Decision Making

- CM approach: think of the operating income as a fixed cost paid to oneself;
- Then $UCM = \$2.1m / 40k = \52.50 ;
- $Price = UCM + UVC = \$52.50 + \57
- Tocchet will consider adding the new features provided the selling price is at least \$109.50 per unit.
- More generally, breakeven quantity=
$$[(NI/(1-t)) + FC] / UCM$$



Summary

- Today we have talked about:
 - Direct and indirect costs w.r.t. a given cost object
 - Cost behavior – remember fixed costs; avoid unit total costs
 - Contribution margin approach is useful for decision making
 - Breakeven quantity provides a measure of sales risk



CVP Analysis, Decision Making

- The Marketing Department indicates that decreasing the selling price to \$99 would increase sales to 50,000 units.
- This strategy will require Tocchet to increase its fixed marketing and distribution costs.



CVP Analysis, Decision Making

- Calculate the maximum increase in fixed marketing and distribution costs that will allow Tocchet to reduce the selling price to \$99 and maintain its operating income.
 - Let the fixed marketing and distribution costs be F. We then calculate F when operating income is \$600,000 and the selling price is \$99.
 - $(\$99 \times 50,000) - (\$55 \times 50,000) - F = \$600,000$
 $\$4,950,000 - \$2,750,000 - F = \$600,000$
 $\$4,950,000 - \$2,750,000 - \$600,000 = F$
 $\$1,600,000 = F$
 - Hence, the maximum increase in fixed marketing and distribution costs that will allow Tocchet to reduce the selling price and maintain \$600,000 in operating income is \$200,000 (= \$1,600,000 – \$1,400,000).