

STUDY UNIT EIGHTEEN

COST BEHAVIOR AND DEFINITIONS

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This is the first of three study units relating to cost measurement. This subunit contains a glossary of cost-related terms. Several of the definitions are from Statement on Management Accounting (SMA) 2A, a publication of the Institute of Management Accountants (IMA). Other topics covered include absorption vs. variable costing and cost-volume-profit analysis.

18.1 COST MEASUREMENT TERMINOLOGY

1. Manufacturing vs. Nonmanufacturing

- a. The **costs of manufacturing** a product can be classified as one of three types:
 - 1) **Direct materials (DM)** are those tangible inputs to the manufacturing process that can practicably be traced to the product, e.g., sheet metal welded together for a piece of heavy equipment.
 - a) All costs of bringing raw materials to the production line, e.g., transportation-in, are included in the cost of direct materials.
 - 2) **Direct labor (DL)** is the cost of human labor that can practicably be traced to the product, e.g., the wages of the welder.
 - 3) **Manufacturing overhead (OH)** consists of all costs of manufacturing that are not direct materials or direct labor.
 - a) **Indirect materials** are tangible inputs to the manufacturing process that cannot practicably be traced to the product, e.g., the welding compound used to put together a piece of heavy equipment.
 - b) **Indirect labor** is the cost of human labor connected with the manufacturing process that cannot practicably be traced to the product, e.g., the wages of assembly line supervisors and janitorial staff.
 - c) **Factory operating costs**, such as utilities, real estate taxes, insurance, depreciation on factory equipment, etc.
- b. Manufacturing costs are often grouped into the following classifications:
 - 1) **Prime cost** equals direct materials plus direct labor, i.e., those costs directly attributable to a product. (DM + DL)
 - 2) **Conversion cost** equals direct labor plus manufacturing overhead, i.e., the costs of converting raw materials into the finished product. (DL + OH)
- c. Operating a manufacturing concern requires the incurrence of **nonmanufacturing costs**:
 - 1) **Selling (marketing) costs** are those costs incurred in getting the product from the factory to the consumer, e.g., sales personnel salaries and product transportation.
 - 2) **Administrative expenses** are those costs incurred by a company not directly related to producing or marketing the product, e.g., executive salaries and depreciation on the headquarters building.

2. Product vs. Period

- a. One of the most important classifications a managerial accountant can make is whether to capitalize costs in finished goods inventory or to expense them as incurred.
- 1) **Product costs** (also called inventoriable costs) are capitalized as part of finished goods inventory. They eventually become a **component of cost of goods sold**.
 - 2) **Period costs** are expensed as incurred, i.e., they are not capitalized in finished goods inventory and are thus **excluded from cost of goods sold**.
- b. This distinction is crucial because of the required treatment of manufacturing costs for external financial reporting purposes.
- 1) **Under GAAP**, all manufacturing costs (direct materials, direct labor, variable overhead, and fixed overhead) must be treated as product costs, and all selling and administrative (S&A) costs must be treated as period costs.
 - a) This approach is called **absorption costing** (also called full costing).
 - 2) For **internal reporting**, a more informative accounting treatment is often to capitalize only variable manufacturing costs as product costs, and treat all other costs (variable S&A and the fixed portion of both production and S&A expenses) as period costs.
 - a) This approach is called **variable costing** (also called direct costing).
 - 3) The following table summarizes these two approaches:

	Absorption Costing (Required under GAAP)	Variable Costing (For internal reporting only)
Product Costs (Included in Cost of Goods Sold)	Variable production costs	
	Fixed production costs	
Period Costs (Excluded from Cost of Goods Sold)		Fixed production costs
	Variable S&A expenses	
	Fixed S&A expenses	

- a) These treatments are explained more fully in item 1. in Subunit 18.3.

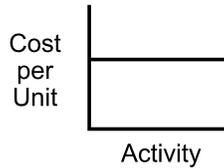
3. Direct vs. Indirect

- a. Costs can be classified by how they are assigned to cost objects.
- 1) **Direct costs** are ones that can be associated with a particular cost object in an economically feasible way, i.e., they can be **traced** to that object.
 - a) Examples are the direct materials and direct labor inputs to a manufacturing process discussed in item 1.a. on the previous page.
 - 2) **Indirect costs** are ones that cannot be associated with a particular cost object in an economically feasible way and thus must be **allocated** to that object.
 - a) Examples are the indirect materials and indirect labor inputs to a manufacturing process discussed in item 1.a.3) on the previous page.
 - b) To simplify the allocation process, indirect costs are often collected in cost pools.
 - i) A **cost pool** is an account into which a variety of similar cost elements with a common cause are accumulated.
 - ii) Manufacturing overhead is a commonly used cost pool into which various untraceable costs of the manufacturing process are accumulated prior to being allocated.

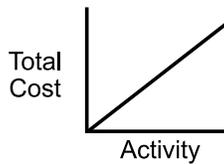
- 3) **Common costs** are another notable type of indirect cost. A common cost is one shared by two or more users.
 - a) The key to common costs is that, since they cannot be directly traced to the users that generate the costs, they must be **allocated** using some systematic and rational basis.
 - b) An example is depreciation on the headquarters building. This is a direct cost when treating the building as a whole, but it is a common cost of the departments located in the building and thus must be allocated when treating the individual departments.

4. **Fixed vs. Variable**

- a. The **relevant range** defines the limits within which per-unit variable costs remain constant and fixed costs are not changeable. It is synonymous with the **short run**.
 - 1) The relevant range is established by the efficiency of a company’s current manufacturing plant, its agreements with labor unions and suppliers, etc.
- b. **Variable cost per unit** remains constant in the short run regardless of the level of production.



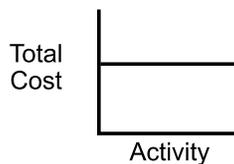
- c. **Variable costs in total**, on the other hand, vary directly and proportionally with changes in volume.



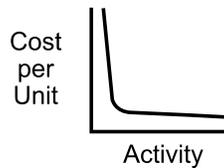
- d. **EXAMPLE:** A company requires one unit of direct material to be used in each finished good it produces.

Number of Units Produced	Cost per Unit	Total Cost of Units
0	\$10	\$0
100	\$10	\$1,000
1,000	\$10	\$10,000
5,000	\$10	\$50,000
10,000	\$10	\$100,000

- e. **Fixed costs in total** remain unchanged in the short run regardless of production level; e.g., the amount paid for an assembly line is the same even if production is halted entirely.



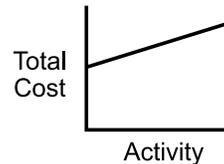
- f. **Fixed cost per unit**, on the other hand, varies indirectly with the activity level.



- g. **EXAMPLE:** The historical cost of the assembly line is settled, but its cost per unit decreases as production increases.

Number of Units Produced	Cost of Assembly Line	Per Unit Cost of Assembly Line
0	\$1,000,000	\$1,000,000
100	\$1,000,000	\$10,000
1,000	\$1,000,000	\$1,000
5,000	\$1,000,000	\$200
10,000	\$1,000,000	\$100

- h. **Mixed (semivariable) costs** combine fixed and variable elements, e.g., rental on a car that carries a flat fee per month plus an additional fee for each mile driven.



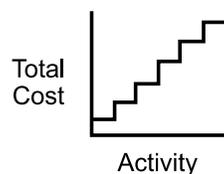
- i. **EXAMPLE:** The company rents a piece of machinery to make its production line more efficient. The rental is \$150,000 per year plus \$1 for every unit produced.

Number of Units Produced	Fixed Cost of Extra Machine	Variable Cost of Extra Machine	Total Cost of Extra Machine
0	\$150,000	\$0	\$150,000
100	\$150,000	\$100	\$150,100
1,000	\$150,000	\$1,000	\$151,000
5,000	\$150,000	\$5,000	\$155,000
10,000	\$150,000	\$10,000	\$160,000

- j. Four of the five costs described above are **linear-cost functions**; i.e., they change at a constant rate (or remain unchanged) over the short run.

- 1) Fixed cost per unit, however, is an example of a **nonlinear-cost function**.

- a) Note that fixed cost per unit has an asymptotic character with respect to the x axis, approaching it closely while never intersecting it. (It does intersect the y axis at the zero level of activity.) The function shows a high degree of variability over its range taken as a whole (see item 4.f. above).
- b) Another type of nonlinear-cost function is a **step-cost function**, one that is constant over small ranges of output but increases by steps (discrete amounts) as levels of activity increase.



- i) Both fixed and variable costs can display step-cost characteristics. If the steps are relatively narrow, these costs are usually treated as variable. If the steps are wide, they are more akin to fixed costs.

k. **Relevant Range and Marginal Cost**

- 1) **Marginal cost** is the cost incurred by a one-unit increase in the activity level of a particular cost driver.
 - a) Necessarily then, **marginal cost remains constant across the relevant range.**
- 2) Management accountants capture the concept of relevant range when they say that **“All costs are variable in the long run.”**
 - a) Investment in new, more productive equipment results in higher total fixed costs but may result in lower total and per-unit variable costs.

5. **Cost of Goods Sold and Cost of Goods Manufactured**

- a. **Cost of goods sold** is a straightforward computation for a **retailer** because retailers have only a **single class of inventory**.

Beginning inventory	\$XX,XXX
Add: purchases	X,XXX
Less: ending inventory	(X,XXX)
Cost of goods sold	<u>\$XX,XXX</u>

- b. The calculation is more complex for a **manufacturer**, because manufacturers have **three distinct classes of inventory**.

- 1) Cost of goods sold contains an additional component called **cost of goods manufactured**, analogous to the retailer’s purchases account.

Beginning work-in-process inventory	\$XX,XXX
Add: total manufacturing costs	X,XXX
Less: ending work-in-process inventory	(X,XXX)
Cost of goods manufactured	<u>\$XX,XXX</u>

- c. A comparison of these computations in full is as follows:

Cost of goods sold for a retailer:

Beginning inventory	\$ xxx,xxx
Add: Purchases	\$x,xxx,xxx
Less: Returns and discounts	(xx,xxx)
Net purchases	x,xxx,xxx
Add: Freight-in	xx,xxx
Goods available for sale	x,xxx,xxx
Less: Ending inventory	(xxx,xxx)
Costs of goods sold	<u>\$x,xxx,xxx</u>

Cost of goods sold for a manufacturer:

Beginning raw materials inventory	\$ xxx,xxx
Add: Purchases	\$x,xxx,xxx
Less: Returns and discounts	(xx,xxx)
Net purchases	x,xxx,xxx
Add: Freight-in	xx,xxx
Raw materials available for use	x,xxx,xxx
Less: Ending raw materials inventory	(xxx,xxx)
Direct materials used in production	\$ x,xxx,xxx
Direct labor costs	x,xxx,xxx
Total manufacturing costs for the period	<u>\$x,xxx,xxx</u>
Add: Beginning work-in-process inventory	xxx,xxx
Less: Ending work-in-process inventory	(xxx,xxx)
Costs of goods manufactured	x,xxx,xxx
Add: Beginning finished goods inventory	xxx,xxx
Goods available for sale	x,xxx,xxx
Less: Ending finished goods inventory	(xxx,xxx)
Costs of goods sold	<u>\$x,xxx,xxx</u>

6. Outlay vs. Opportunity

- a. **Outlay costs** require actual cash disbursements. They are also called **explicit, accounting, or out-of-pocket costs**.
 - 1) An example is the tuition, room, board, and books required to attend college.
- b. **Opportunity cost** is the maximum benefit forgone by using a scarce resource for a given purpose and not for the next-best alternative. It is also called **implicit cost**.
 - 1) An example is the wages foregone by attending college instead of working full-time.
- c. **Economic cost** is the sum of explicit and implicit costs.
- d. **Imputed costs** are those that should be involved in decision making even though no transaction has occurred that would be routinely recognized in the accounts. They may be outlay or opportunity costs.
 - 1) An example is the profit lost as a result of being unable to fill orders because the inventory level is too low.

7. Relevant vs. Sunk

- a. **Relevant costs** are those future costs that will vary depending on the action taken. All other costs are assumed to be constant and thus have no effect on (are irrelevant to) the decision.
 - 1) An example is tuition that must be spent to attend a fourth year of college.
- b. **Sunk costs** are costs either already paid or irrevocably committed to incur. Because they are unavoidable and will therefore not vary with the option chosen, they are not relevant to future decisions.
 - 1) An example is three years of tuition already spent. The previous three years of tuition make no difference in the decision to attend a fourth year.
- c. **Historical cost** is the actual (explicit) price paid for an asset. Financial accountants rely heavily on it for balance sheet reporting.
 - 1) Because historical cost is a sunk cost, however, management accountants often find other (implicit) costs to be more useful in decision making.

8. Additional Cost Concepts

- a. **Gross margin** is the intermediate figure between sales and operating income under absorption (full) costing. All manufacturing (and only manufacturing) costs, both variable and fixed, are deducted to arrive at gross margin.
 - 1) Only costs directly associated with manufacturing the product may be deducted.
 - 2) This is the only acceptable calculation under GAAP.
- b. **Contribution margin** is the intermediate figure when variable (direct) costing is used. All variable (and only variable) costs, both manufacturing and selling and administrative, are deducted to arrive at contribution margin.
 - 1) Contribution margin is the amount available to the firm to cover fixed costs.
 - 2) This calculation is often used for internal (managerial) reporting purposes.
- c. **Value-adding costs** are the costs of activities that cannot be eliminated without reducing the quality, responsiveness, or quantity of the output required by a customer or by an organization.
- d. **Incremental (differential) cost** is the difference in total cost between two decisions.

9. Accumulating Manufacturing Costs

- a. **Job-order costing** is appropriate when producing products with individual characteristics or when identifiable groupings are possible.
 - 1) Costs are attached to specific “jobs.” Each job will result in a single, identifiable end product.
 - 2) Examples are any industry that generates custom-built products, such as shipbuilding.
- b. **Process costing** is used when similar products are mass produced on a continuous basis.
 - 1) Costs are attached to specific departments or phases of production. Examples are automobile and candy manufacturing.
 - 2) Since costs are attached to streams of products rather than individuals, process costing involves calculating an average cost for all units. The two widely used methods are weighted-average and first-in, first-out (FIFO).
 - 3) Some units remain unfinished at the end of the period. For each department to adequately account for the costs attached to its unfinished units, the units must be restated in terms of equivalent units of production (EUP).
- c. **Activity-based costing (ABC)** attaches costs to activities rather than to physical goods.
 - 1) ABC is a response to the distortions of product cost information brought about by peanut-butter costing, which is the inaccurate averaging or spreading of costs like peanut butter over products or service units that use different amounts of resources.
 - a) A major cause of peanut-butter costing is the significant increase in indirect costs brought about by the increasing use of technology.
 - 2) The difference between traditional (that is, volume-based) costing systems and ABC can be summarized as follows:
 - a) Under volume-based systems, a single pool collects all indirect costs and is then allocated to production.
 - b) Under ABC, by contrast, every activity that bears on the production process has its own cost pool. The costs in each pool are assigned based on a cost driver specific to the activity.
- d. **Life-cycle costing** emphasizes the need to price products to cover all the costs incurred over the lifespan of a product, not just the costs of production.
 - 1) Costs incurred before production, such as R&D and product design, are referred to as upstream costs.
 - 2) Costs incurred after production, such as marketing and customer service, are called downstream costs.
- e. **Operation costing** is a hybrid of job-order and process costing and is used by companies whose manufacturing processes involve some similar and some dissimilar operations.
 - 1) Direct materials costs are charged to specific products (as in job-order systems).
 - 2) Conversion costs are accumulated and a unit conversion cost for each operation is derived (as in process costing).

- f. **Backflush costing** delays the assignment of costs until the goods are finished.
 - 1) After production is finished for the period, standard costs are flushed backward through the system to assign costs to products. The result is that detailed tracking of costs is eliminated.
 - 2) Backflush costing is best suited to companies that maintain low inventories because costs can flow directly to cost of goods sold. It is often used with just-in-time (JIT) inventory, one of the goals of which is the maintenance of low inventory levels.

18.2 COST-VOLUME-PROFIT (CVP) ANALYSIS

1. **Cost-volume-profit (CVP) analysis** (also called breakeven analysis) is a tool for understanding the interaction of revenues with fixed and variable costs. It illuminates how changes in assumptions about cost behavior and the relevant ranges in which those assumptions are valid may affect the relationships among revenues, variable costs, and fixed costs at various production levels. Thus, CVP analysis allows management to discern the probable effects of changes in sales volume, sales price, product mix, etc.
2. The inherent simplifying **assumptions** of CVP analysis are as follows:
 - a. Cost and revenue relationships are predictable and linear. These relationships are true over the **relevant range** of activity and specified time span. For example, reductions in prices are not necessary to increase revenues, and no learning curve effect operates to reduce unit variable labor costs at higher output levels.
 - b. Total **variable costs** change proportionally with volume, but unit variable costs are constant over the relevant range. Raw materials and direct labor are typically variable costs.
 - c. Changes in inventory are insignificant in amount.
 - d. **Fixed costs** remain constant over the relevant range of volume, but unit fixed costs vary indirectly with volume. The classification of fixed versus variable can be affected by the time frame being considered.
 - e. Unit selling prices and market conditions are constant.
 - f. Production equals sales.
 - g. The **revenue (sales) mix** is constant, or the firm makes and sells only one product.
 - h. All costs are either fixed or variable relative to a given cost object for a given time span. The longer the time span, the more likely the cost is variable.
 - i. Technology and productive efficiency are constant.
 - j. Revenues and costs vary only with changes in physical unit volume. Hence, volume is the sole revenue driver and cost driver.
 - k. The breakeven point is directly related to costs and inversely related to the budgeted margin of safety and the contribution margin.
 - l. The time value of money is ignored.
3. The assumptions under which CVP analysis operates primarily hinge on **certainty**. However, many decisions must be made even though uncertainty exists. Assigning probabilities to the various outcomes and sensitivity ("what-if") analysis are important approaches to dealing with uncertainty.

4. Definitions

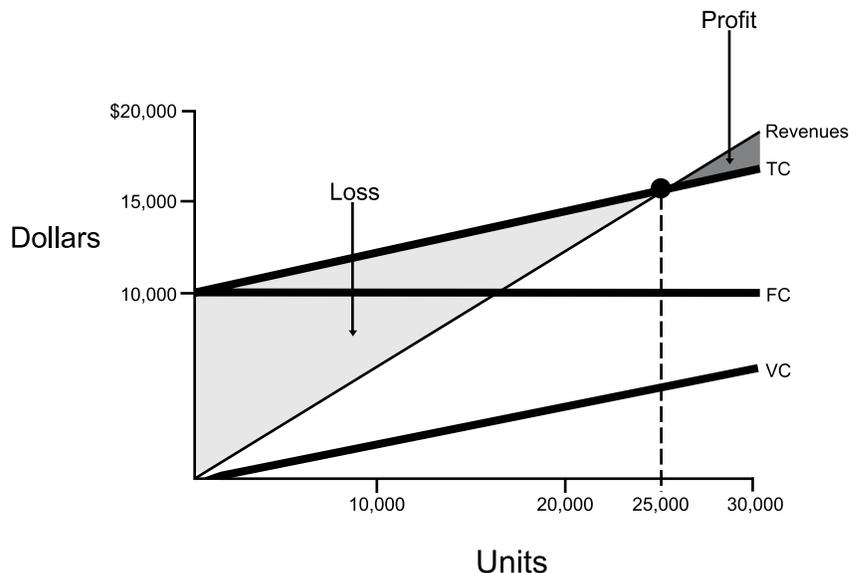
- a. The **breakeven point** is the level of output at which total revenues equal total expenses, that is, the point at which operating income is zero.
- b. The **margin of safety** is a measure of risk. It is the excess of budgeted revenues over breakeven revenues (or budgeted units over breakeven units).
- c. **Mixed costs (or semivariable costs)** are costs with both fixed and variable elements.
- d. The **revenue (sales) mix** is the composition of total revenues in terms of various products, i.e., the percentages of each product included in total revenues. It is maintained for all volume changes.
- e. **Sensitivity analysis** examines the effect on the outcome of not achieving the original forecast or of changing an assumption.
- f. **Unit contribution margin (UCM)** is the unit selling price minus the unit variable cost. It is the contribution from the sale of one unit to cover fixed costs (and possibly a targeted profit).
 - 1) It is expressed as either a percentage of the selling price (**contribution margin ratio**) or a dollar amount.
 - 2) The UCM is the slope of the total cost curve plotted so that volume is on the x-axis and dollar value is on the y-axis.

5. The general formula for operating income can be stated as follows:

$$\text{Operating income} = \text{Sales} - \text{Variable costs} - \text{Fixed costs}$$

- a. The **breakeven point** can be determined by setting **operating income equal to zero** and solving the equation.
- b. **EXAMPLE:** A product is sold for \$.60 per unit, with variable costs of \$.20 per unit and fixed costs of \$10,000. What is the breakeven point?

$$\begin{aligned} \text{Operating income} &= \text{Sales} - \text{Variable costs} - \text{Fixed costs} \\ \$0 &= (\$.60 \times Q) - (\$.20 \times Q) - \$10,000 \\ \$.40 \times Q &= \$10,000 \\ Q &= 25,000 \text{ units} \end{aligned}$$



- c. A simpler calculation is to divide fixed costs by the unit contribution margin (the unit contribution to coverage of fixed costs).

$$\text{Breakeven point in units} = \frac{\text{Fixed costs}}{\text{UCM}}$$

- 1) The UCM is \$.40 (\$.60 sales price – \$.20 variable cost). Thus, to cover \$10,000 of fixed costs, 25,000 units (\$10,000 ÷ \$.40 UCM) must be sold to break even.
 - d. The breakeven point in dollars can be calculated by dividing fixed costs by the contribution margin ratio {[\$10,000 ÷ (\$.40 ÷ \$.60)] = \$15,000}.
6. The **contribution income statement with per-unit amounts** is an integral part of breakeven analysis.

EXAMPLE:

	<u>In Total</u>	<u>Per Unit</u>	<u>Percent</u>
Sales (40,000 units)	\$ 24,000	\$ 0.60	100%
Less: variable costs	(8,000)	(0.20)	(33%)
Contribution margin	<u>\$ 16,000</u>	<u>\$ 0.40</u>	<u>67%</u>
Less: fixed costs	(10,000)		
Operating income	<u><u>\$ 6,000</u></u>		

- a. Every unit sold **contributes** a certain percentage of its sales revenue, in this case 67%, to **covering fixed costs**. Management can conclude that every unit sold in the relevant range will contribute \$.40 to covering fixed costs.
 - b. Once fixed costs are fully covered, all additional revenue becomes **profit**.
7. **Target operating income.** An amount of operating income, either in dollars or as a percentage of sales, is frequently required.
- a. EXAMPLE: If units are sold at \$6.00 and variable costs are \$2.00, how many units must be sold to realize operating income of 15% (\$6.00 × .15 = \$.90 per unit) before taxes, given fixed costs of \$37,500?

$$\begin{aligned} \text{Operating income} &= \text{Sales} - \text{Variable costs} - \text{Fixed costs} \\ \$0.90 \times Q &= (\$6.00 \times Q) - (\$2.00 \times Q) - \$37,500 \\ \$3.10Q &= \$37,500 \\ Q &= 12,097 \text{ units} \end{aligned}$$

- 1) Selling 12,097 units results in \$72,582 of revenues. Variable costs are \$24,194, and operating income is \$10,888 (\$72,582 × 15%). The proof is that variable costs of \$24,194, plus fixed costs of \$37,500, plus operating income of \$10,888, equals \$72,582 of sales.
- 2) A variation of this problem asks for net income (an after-tax amount) instead of operating income (a pretax amount). In this case, the computation requires converting the **target net income** to **target operating income** by dividing the target net income by one minus the income tax rate. Income tax liability does not change the breakeven point because, at that output level, operating income and therefore income tax expense are zero. However, other taxes, such as sales tax, do change the breakeven point.
- 3) Thus, to incorporate taxes into the calculation, the basic CVP formula is adjusted as follows:

$$\text{Sales} = [\text{Target net income} \div (1 - \text{tax rate})] + \text{Variable costs} + \text{Fixed costs}$$

- 4) EXAMPLE: If variable costs are \$1.20, fixed costs are \$10,000, and selling price is \$2, and the company targets a \$5,000 after-tax profit when the tax rate is 30%, the calculation is as follows:

$$\begin{aligned} \$2Q &= [\$5,000 \div (1 - .3)] + \$1.20Q + \$10,000 \\ \$.8Q &= \$7,142.86 + \$10,000 \\ \$.8Q &= \$17,142.86 \\ Q &= \$17,142.86 \div .8 \\ Q &= 21,428.575 \text{ units} \end{aligned}$$

- a) If the company plans to sell 21,428.575 units at \$2 each, revenue will be \$42,857.15. The following is the pro forma income statement for the target net income:

Sales (21,428.575 × \$2)	\$ 42,857.15
Less: variable costs (21,428.575 × \$1.20)	<u>(25,714.29)</u>
Contribution margin	\$ 17,142.86
Less: fixed costs	<u>(10,000.00)</u>
Operating income	\$ 7,142.86
Income taxes (30%)	<u>(2,142.86)</u>
Net income	<u>\$ 5,000.00</u>

8. **Multiple products (or services)** may be involved in calculating a breakeven point.

- a. EXAMPLE: A and B account for 60% and 40% of total sales, respectively. The variable costs of A and B are 60% and 85% of individual product sales, respectively. What is the breakeven point, given fixed costs of \$150,000?

$$\begin{aligned} S &= FC + VC \\ S &= \$150,000 + .6(.6S) + .85(.4S) \\ S &= \$150,000 + .36S + .34S \\ .30S &= \$150,000 \\ S &= \$500,000 \end{aligned}$$

- 1) In effect, the result is obtained by calculating a weighted-average contribution margin ratio (100% – 36% – 34% = 30%) and dividing it into the fixed costs to arrive at the breakeven point in sales dollars.
- 2) Another approach to multiproduct breakeven problems is to divide fixed costs by the UCM for a composite unit (when unit prices are known) to determine the number of composite units. The number of individual units can then be calculated based on the stated mix.
 - a) EXAMPLE: If 150,000 units of X and 300,000 units of Y are expected to be sold, the composite unit consists of 1 unit of X and 2 units of Y. If X and Y have UCMs of \$5 and \$7, respectively, the composite UCM is \$19 (\$5 + \$7 + \$7). Dividing \$19 into fixed costs gives the breakeven point in composite units. The units of X and Y equal the number of composite units and twice the number of composite units, respectively.
 - b) In a multiple product (or service) problem, the breakeven point in total units varies with the sales mix. The BEP in units will be lower (higher) when the proportion of high (low) CM items is greater. Thus, there is no unique breakeven point in multiple-product situations. The breakeven point depends upon the specific mix of products.

9. **Choice of product.** When resources are limited, a company may produce only a single product. A breakeven analysis of the point where the same operating income or loss will result, regardless of the product selected, is calculated by setting the breakeven formulas of the individual products equal to each other.

a. **EXAMPLE:** Assume a lessor can rent property to either of two lessees. One lessee offers a rental fee of \$100,000 per year plus 2% of revenues. The other lessee offers \$20,000 per year plus 5% of revenues. The optimal solution depends on the level of revenues. A CPA may question at what level the lessor will be indifferent. The solution is to equate the two formulas as follows:

$$\begin{aligned}
 \$100,000 + .02R &= \$20,000 + .05R \\
 .03R &= \$80,000 \\
 R &= \$80,000 \div .03 \\
 R &= \$2,666,667 \\
 \text{If: } R &= \text{revenues}
 \end{aligned}$$

Thus, if revenues are expected to be less than \$2,666,667, the lessor would prefer the larger fixed rental of \$100,000 and the smaller variable rental.

10. Sometimes CVP analysis is applied to **special orders**. This application is essentially contribution margin analysis.

a. **EXAMPLE:** What is the effect of accepting a special order for 10,000 units at \$8.00, given the following operating data?

	Gross Approach	Per Unit
Sales		\$12.50
Less: manufacturing costs		
Variable	\$6.25	
Fixed	1.75	(8.00)
Gross profit		\$ 4.50
Less: selling expenses		
Variable	\$1.80	
Fixed	1.45	(3.25)
Operating income		\$ 1.25

- 1) Because the variable cost of manufacturing is \$6.25, the UCM is \$1.75 (\$8.00 – \$6.25), and the increase in operating income resulting from accepting the special order is \$17,500 (10,000 units × \$1.75).
- 2) The assumptions are that idle capacity is sufficient to manufacture 10,000 extra units, that sale at \$8.00 per unit will not affect the price or quantity of other units sold, and that no additional selling expenses are incurred.

11. The **degree of operating leverage (DOL)** is the change in operating income (earnings before interest and taxes) resulting from a percentage change in sales. It measures the extent to which a firm incurs fixed rather than variable costs in operations.

$$\text{Operating leverage} = \frac{\text{Percentage change in operating income}}{\text{Percentage change in sales}}$$

- a. The assumption is that companies with larger investments (and greater fixed costs) will have higher contribution margins and more operating leverage.
- 1) Thus, as companies invest in better and more expensive equipment, their variable production costs should decrease.
 - 2) **EXAMPLE:** If sales increase by 40% and operating income increases by 50%, the operating leverage is 1.25 (50% ÷ 40%).

- b. Given that Q equals the number of units sold, P is unit price, VC is unit variable cost, and FC is fixed cost, the DOL can also be calculated from the formula below, which equals total contribution margin divided by operating income (total contribution margin minus fixed cost). This formula is derived from the operating leverage formula on the previous page, but the derivation procedure is not given.

$$\frac{Q(P - VC)}{Q(P - VC) - FC}$$

- c. The DOL is calculated with respect to a given base level of sales. The significance of the DOL is that a given percentage increase in sales yields a percentage increase in operating income equal to the DOL for the base sales level times the percentage increase in sales.

18.3 ABSORPTION (FULL) VS. VARIABLE (DIRECT) COSTING

1. Under **absorption costing** (sometimes called full or full absorption costing), the fixed portion of manufacturing overhead is “absorbed” into the cost of each product.
 - a. **Product cost** thus includes **all manufacturing costs, both fixed and variable**.
 - b. Absorption-basis cost of goods sold is subtracted from sales to arrive at gross margin.
 - c. Total selling and administrative expenses (i.e., fixed and variable) are then subtracted from gross margin to arrive at operating income.
 - d. This method is **required under GAAP** for external reporting purposes **and under the Internal Revenue Code** for tax purposes. The justification is that, for external reporting, product cost should include all manufacturing costs.
2. **Variable costing** (sometimes called direct costing) is more appropriate for internal reporting.
 - a. The term “direct costing” is somewhat misleading because it suggests traceability, which is not what is meant in this context. “Variable costing” is more suitable.
 - b. **Product cost** includes **only variable manufacturing costs**.
 - c. Variable cost of goods sold and the variable portion of selling and administrative expenses are subtracted from gross margin to arrive at **contribution margin**.
 - 1) This figure (sales – total variable costs) is an important element of the variable costing income statement because it is the amount available for **covering fixed costs** (fixed manufacturing and fixed selling and administrative).
 - 2) For this reason, some accountants call the method **contribution margin reporting**.
 - 3) This is an important metric internally, but it is generally irrelevant to outside financial statement users.

3. EXAMPLE: A firm, during its first month in business, produced 100 units and sold 80 while incurring the following costs:

Direct materials	\$1,000
Direct labor	2,000
Variable overhead	1,500
Manufacturing costs used in variable costing	<u>\$4,500</u>
Fixed overhead	3,000
Manufacturing costs used in absorption costing	<u>\$7,500</u>

- a. The impact on the financial statements from using one method over the other can be seen in these calculations:

	<u>Manufacturing costs</u>	<u>Units produced</u>	<u>Divided by:</u> Per-unit cost	<u>Equals:</u> Units in ending inventory	<u>Times:</u> Value of ending inventory
Absorption basis	\$7,500	100	\$75	20	\$1,500
Variable basis	\$4,500	100	\$45	20	\$900

- b. The per-unit selling price of the finished goods was \$100, and the company incurred \$200 of variable selling and administrative expenses and \$600 of fixed selling and administrative expenses.
- c. The following are partial income statements prepared using the two methods:

	<u>Absorption Costing</u> <u>(Required under GAAP)</u>	<u>Variable Costing</u> <u>(For Internal Reporting Only)</u>
Sales	\$ 8,000	\$ 8,000
Beginning inventory	\$ 0	\$ 0
Product Costs		
Plus: variable production costs	4,500 (a)	4,500 (a)
Plus: fixed production costs	3,000 (b)	
Goods available for sale	\$7,500	\$4,500
Less: ending inventory	<u>(1,500)</u>	<u>(900)</u>
Cost of goods sold	<u>\$(6,000)</u>	<u>\$(3,600)</u>
Less: variable S&A expenses		(200) (c)
Gross margin (abs.) / Contribution margin (var.)	<u>\$2,000</u>	<u>\$4,200</u>
Period Costs		
Less: fixed production costs		(3,000) (b)
Less: variable S&A expenses	(200) (c)	
Less: fixed S&A expenses	(600) (d)	(600) (d)
Operating income	<u>\$1,200</u>	<u>\$ 600</u>

- d. The \$600 difference in operating income (\$1,200 – \$600) is the difference between the two ending inventory values (\$1,500 – \$900).
- In essence, the absorption method treats 20% of the fixed overhead costs (\$3,000 × 20% = \$600) as an asset because 20% of the month’s production (100 available – 80 sold = 20 on hand) is still in inventory.
4. As production and sales levels change, the two methods have varying impacts on **operating income**.
- When **production and sales are equal** for a period, the two methods report the **same** operating income.
 - Total fixed costs budgeted for the period are charged to sales revenue in the period under both methods.

- b. When **production and sales are not equal** for a period, the two methods report **different** operating income.

1) ILLUSTRATION:

When production

△ △ △ △ △ △ △ △

exceeds sales,

△ △ △

ending inventory expands.

↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑

Under absorption costing,

some fixed costs are still embedded in ending inventory.

Under variable costing,

all fixed costs have been expensed.

Therefore,

operating income is higher under absorption costing.

When production

△ △ △

is less than sales,

△ △ △ △ △ △ △ △ △

ending inventory contracts.

↓↓↓↓↓↓

Under absorption costing,

fixed costs embedded in beginning inventory have been expensed.

Under variable costing,

only the current period's fixed costs are expensed.

Therefore,

operating income is higher under variable costing.

- c. Under **absorption** costing, operating income **behaves erratically** and sometimes moves in the opposite direction from sales.

- 1) Under **variable** costing, operating income always moves in the **same direction as sales volume**.
- 2) Operating income differences tend to be larger when calculations are made for short periods. In the long run, the two methods will report the same total operating income if sales equal production.
 - a) The inequalities between production and sales are usually minor over an extended period.
 - b) Production cannot continually exceed sales because an enterprise cannot produce more than it can sell in the long run.

3) EXTENDED EXAMPLE: A company has the following sales and cost data:

	Year 1	Year 2	Year 3
Production in units	40,000	50,000	0
Sales in units	30,000	30,000	30,000
Ending inventory in units (FIFO)	10,000	30,000	0
Unit sales price	\$1.00		
Unit variable cost	\$0.50		
Fixed manufacturing costs	\$4,000	per year	
Variable S&A expenses	\$0.03333	per unit	
Fixed S&A expenses	\$1,000	per year	

Compare the three-year income statements prepared under the two methods:

Absorption Costing (Required under GAAP)				Variable Costing (For Internal Reporting Only)			
	Year 1	Year 2	Year 3		Year 1	Year 2	Year 3
Sales	\$30,000	\$30,000	\$30,000	Sales	\$30,000	\$30,000	\$30,000
Beginning inventory	\$ 0	\$ 6,000	\$17,400	Beginning inventory	\$ 0	\$ 5,000	\$15,000
Variable mfg. costs	20,000	25,000	0	Variable mfg. costs	20,000	25,000	0
Fixed mfg. costs	4,000	4,000	4,000				
Goods available for sale	\$24,000	\$35,000	\$21,400	Goods avail. for sale	\$20,000	\$30,000	\$15,000
Less: ending inventory	(6,000)	(17,400)	0	Less: ending inventory	(5,000)	(15,000)	0
Absorption CGS	\$18,000	\$17,600	\$21,400	Variable CGS	\$15,000	\$15,000	\$15,000
				Variable S&A exps.	(1,000)	(1,000)	(1,000)
Gross margin	\$12,000	\$12,400	\$ 8,600	Contribution margin	\$14,000	\$14,000	\$14,000
				Fixed mfg. costs	(4,000)	(4,000)	(4,000)
Variable S&A expenses	(1,000)	(1,000)	(1,000)				
Fixed S&A expenses	(1,000)	(1,000)	(1,000)	Fixed S&A expenses	(1,000)	(1,000)	(1,000)
Operating income	\$10,000	\$10,400	\$ 6,600	Operating income	\$ 9,000	\$ 9,000	\$ 9,000

a) Note that, assuming zero inventory at the beginning of Year 1 and at the end of Year 3, the **total operating income for the 3-year period is the same** under either costing method.

	Absorption Costing	Variable Costing
Year 1	\$10,000	\$ 9,000
Year 2	10,400	9,000
Year 3	6,600	9,000
3-Year Total	\$27,000	\$27,000

- b) Absorption costing shows a higher operating income than variable costing in Years 1 and 2 because fixed overhead has been capitalized and does not get expensed until Year 3.
- i) Variable costing, on the other hand, treats fixed overhead as an expense of the period in which the cost is incurred.
 - ii) In Year 2, despite the same cash flow, there is a \$1,400 difference between the final operating income figures and an even greater difference in Year 3.
- c) If fixed costs increase relative to variable costs, the differences become more dramatic (here, 50% of the selling price is variable manufacturing cost, and fixed overhead is no more than 20% of the variable manufacturing cost).

5. Benefits of Variable Costing for Internal Purposes

- a. Although the use of variable costing for financial statements is controversial, most agree about its superiority for internal reporting. It is far better suited than absorption costing to the needs of management. Management requires a knowledge of cost behavior under various operating conditions. For planning and control, management is more concerned with treating fixed and variable costs separately than with calculating full costs. Full costs are usually of dubious value because they contain arbitrary allocations of fixed cost.
 - 1) Under variable costing, the cost data for **profit planning and decision making** are readily available from accounting records and statements. Reference to auxiliary records and supplementary analyses is not necessary.
 - 2) For example, **cost-volume-profit relationships** and the effects of changes in sales volume on operating income can easily be computed from the income statement prepared under the variable costing concept, but not from the conventional absorption cost income statement based on the same data.
 - 3) **Operating income or loss** reported under variable costing has a direct relationship to sales revenue and is not affected by inventory or production variations.
 - 4) Absorption cost income statements may show decreases in operating income when **sales** are rising and increases in operating income when sales are decreasing, which may be confusing to management. Attempts at explanation by means of volume variances often compound rather than clarify the confusion.
 - 5) If variable costing is used, the favorable **margin between selling prices and variable cost** should provide a constant reminder of the contribution margin forgone because of lack of sales volume. A favorable margin justifies a higher production level.
 - 6) The **hidden impact** of fixed costs on operating income, when they are partially included in inventory measurements under absorption costing, is emphasized by the presentation of costs on an income statement prepared under variable costing.
 - 7) Proponents of variable costing maintain that **fixed manufacturing overhead** is more closely correlated to **capacity to produce** than to the production of individual units.
 - 8) Production **managers cannot manipulate operating income** by producing more or fewer products than needed during a period. Under absorption costing, a production manager could increase income simply by producing more units than are currently needed for sales.

- b. Variable costing is also preferred over absorption costing for **studies of relative profitability** of products, territories, and other segments of a business. It concentrates on the contribution that each segment makes to the recovery of fixed costs that will not be altered by decisions to make and sell.
- 1) **Marginal analysis** leads to **better pricing**, the principal advantage of variable costing.
 - 2) **Out-of-pocket expenditures** required to manufacture products conform closely with the measurements of inventory.
 - 3) The relationship between operating income and the major factors of selling price, sales mix, sales volume, and variable manufacturing and nonmanufacturing costs is measured in terms of a **single index of profitability**.
 - a) This profitability index, expressed as a positive amount or as a ratio, facilitates the analysis of CVP relationships, compares the effects of two or more contemplated courses of action, and aids in answering many questions that arise in profit planning.
 - 4) **Inventory changes** have no effect on the **breakeven computations**.
 - 5) Marginal analysis facilitates appraisal of **products, territories, and other business segments** without having the results hidden or obscured by allocated joint fixed costs.
 - 6) Questions regarding whether a particular component should be **made or bought** can be more effectively answered if only variable costs are used.
 - a) Management must consider whether to charge the product being made only with variable costs or to charge a percentage of fixed costs as well.
 - b) Management must also consider whether making the component will require additional fixed costs and a decrease in normal production.
 - 7) **Disinvestment** decisions are facilitated because whether a product or department is recouping its variable costs can be determined.
 - a) If the variable costs are being covered, operating a department at an apparent loss may be profitable.
 - 8) Management is better able to **measure performance** by organizational subunits if certain fixed costs are omitted from the statements instead of being allocated arbitrarily.
 - 9) Costs are guided by **sales**.
 - a) Under variable costing, **cost of goods sold** varies directly with unit sales. The influence of production on operating income is avoided.
 - b) Variable costing also eliminates having to explain **over- or under-applied fixed manufacturing overhead** to higher management.