**Exercise 2-1** (10 minutes)

1. The wages of employees who build the sailboats: direct labor cost.

2. The cost of advertising in the local newspapers: marketing and selling cost.

3. The cost of an aluminum mast installed in a sailboat: direct materials cost.

4. The wages of the assembly shop's supervisor: manufacturing overhead cost.

5. Rent on the boathouse: a combination of manufacturing overhead, administrative, and marketing and selling cost. The rent would most likely be prorated on the basis of the amount of space occupied by manufacturing, administrative, and marketing operations.

6. The wages of the company's bookkeeper: administrative cost.

7. Sales commissions paid to the company's salespeople: marketing and selling cost.

8. Depreciation on power tools: manufacturing overhead cost.

**Exercise 2-2** (15 minutes)

| | *Product Cost* | *Period Cost* |
|---|---|---|
| 1. The cost of the memory chips used in a radar set | X | |
| 2. Factory heating costs | X | |
| 3. Factory equipment maintenance costs | X | |
| 4. Training costs for new administrative employees | | X |
| 5. The cost of the solder that is used in assembling the radar sets | X | |
| 6. The travel costs of the company's salespersons | | X |
| 7. Wages and salaries of factory security personnel | X | |
| 8. The cost of air-conditioning executive offices | | X |
| 9. Wages and salaries in the department that handles billing customers | | X |
| 10. Depreciation on the equipment in the fitness room used by factory workers | X | |
| 11. Telephone expenses incurred by factory management | X | |
| 12. The costs of shipping completed radar sets to customers | | X |
| 13. The wages of the workers who assemble the radar sets | X | |
| 14. The president's salary | | X |
| 15. Health insurance premiums for factory personnel | X | |

**Exercise 2-3** (15 minutes)

1.

| | *Cups of Coffee Served in a Week* | | |
|---|---|---|---|
| | *1,800* | *1,900* | *2,000* |
| Fixed cost | $1,100 | $1,100 | $1,100 |
| Variable cost | 468 | 494 | 520 |
| Total cost | $1,568 | $1,594 | $1,620 |
| Average cost per cup served* | $0.871 | $0.839 | $0.810 |

* Total cost ÷ cups of coffee served in a week

2. The average cost of a cup of coffee declines as the number of cups of coffee served increases because the fixed cost is spread over more cups of coffee.

**Exercise 2-4** (20 minutes)

1.

| | *Occupancy-Days* | *Electrical Costs* |
|---|---|---|
| High activity level (August) .. | 3,608 | $8,111 |
| Low activity level (October).. | 186 | 1,712 |
| Change............................... | 3,422 | $6,399 |

Variable cost = Change in cost ÷ Change in activity
= $6,399 ÷ 3,422 occupancy-days
= $1.87 per occupancy-day

| | |
|---|---|
| Total cost (August).................................................. | $8,111 |
| Variable cost element ($1.87 per occupancy-day × 3,608 occupancy-days) | 6,747 |
| Fixed cost element .................................................. | $1,364 |

2. Electrical costs may reflect seasonal factors other than just the variation in occupancy days. For example, common areas such as the reception area must be lighted for longer periods during the winter. This will result in seasonal effects on the fixed electrical costs.

   Additionally, fixed costs will be affected by how many days are in a month. In other words, costs like the costs of lighting common areas are variable with respect to the number of days in the month, but are fixed with respect to how many rooms are occupied during the month.

   Other, less systematic, factors may also affect electrical costs such as the frugality of individual guests. Some guests will turn off lights when they leave a room. Others will not.

**Exercise 2-5** (15 minutes)

1. Traditional income statement

Redhawk, Inc.
Traditional Income Statement

| | | |
|---|---|---|
| Sales ($15 per unit × 10,000 units) | | $150,000 |
| Cost of goods sold | | |
| ($12,000 + $90,000 – $22,000) | | 80,000 |
| Gross margin | | 70,000 |
| Selling and administrative expenses: | | |
| Selling expenses | | |
| (($2 per unit × 10,000 units) + $20,000) | 40,000 | |
| Administrative expenses | | |
| (($1 per unit × 10,000 units) + $15,000) | 25,000 | 65,000 |
| Net operating income | | $ 5,000 |

2. Contribution format income statement

Redhawk, Inc.
Contribution Format Income Statement

| | | |
|---|---|---|
| Sales | | $150,000 |
| Variable expenses: | | |
| Cost of goods sold | | |
| ($12,000 + $90,000 – $22,000) | $80,000 | |
| Selling expenses ($2 per unit × 10,000 units) | 20,000 | |
| Administrative expenses | | |
| ($1 per unit × 10,000 units) | 10,000 | 110,000 |
| Contribution margin | | 40,000 |
| Fixed expenses: | | |
| Selling expenses | 20,000 | |
| Administrative expenses | 15,000 | 35,000 |
| Net operating income | | $ 5,000 |

**Exercise 2-6** (15 minutes)

| | *Cost* | *Cost Object* | *Direct Cost* | *Indirect Cost* |
|---|---|---|---|---|
| 1. | The salary of the head chef | The hotel's restaurant | X | |
| 2. | The salary of the head chef | A particular restaurant customer | | X |
| 3. | Room cleaning supplies | A particular hotel guest | | X |
| 4. | Flowers for the reception desk | A particular hotel guest | | X |
| 5. | The wages of the doorman | A particular hotel guest | | X |
| 6. | Room cleaning supplies | The housecleaning department | X | |
| 7. | Fire insurance on the hotel building | The hotel's gym | | X |
| 8. | Towels used in the gym | The hotel's gym | X | |

Note: The room cleaning supplies would most likely be considered an indirect cost of a particular hotel guest because it would not be practical to keep track of exactly how much of each cleaning supply was used in the guest's room.

**Exercise 2-7** (15 minutes)

| *Item* | *Differential Cost* | *Opportunity Cost* | *Sunk Cost* |
|---|---|---|---|
| 1. Cost of the new flat-panel displays | X | | |
| 2. Cost of the old computer terminals | | | X |
| 3. Rent on the space occupied by the registration desk | | | |
| 4. Wages of registration desk personnel | | | |
| 5. Benefits from a new freezer | | X | |
| 6. Costs of maintaining the old computer terminals | X | | |
| 7. Cost of removing the old computer terminals | X | | |
| 8. Cost of existing registration desk wiring | | | X |

Note: The costs of the rent on the space occupied by the registration desk and the wages of registration desk personnel are neither differential costs, opportunity costs, nor sunk costs. These are costs that do not differ between the alternatives and are therefore irrelevant in the decision, but they are not sunk costs since they occur in the future.

**Exercise 2-8** (20 minutes)

1. The company's variable cost per unit would be:

$$\frac{\$150,000}{60,000 \text{ units}} = \$2.50 \text{ per unit.}$$

In accordance with the behavior of variable and fixed costs, the completed schedule is:

| | *Units produced and sold* | | |
|---|---|---|---|
| | 60,000 | 80,000 | 100,000 |
| Total costs: | | | |
| Variable costs | $150,000 | $200,000 | $250,000 |
| Fixed costs | 360,000 | 360,000 | 360,000 |
| Total costs | $510,000 | $560,000 | $610,000 |
| Cost per unit: | | | |
| Variable cost | $2.50 | $2.50 | $2.50 |
| Fixed cost | 6.00 | 4.50 | 3.60 |
| Total cost per unit | $8.50 | $7.00 | $6.10 |

2. The company's income statement in the contribution format is:

| | |
|---|---|
| Sales (90,000 units × $7.50 per unit) | $675,000 |
| Variable expenses (90,000 units × $2.50 per unit) | 225,000 |
| Contribution margin | 450,000 |
| Fixed expenses | 360,000 |
| Net operating income | $ 90,000 |

**Problem 2-14** (45 minutes)

1.

House Of Organs, Inc.
Traditional Income Statement
For the Month Ended November 30

| | | |
|---|---|---|
| Sales (60 organs × $2,500 per organ) | | $150,000 |
| Cost of goods sold | | |
| (60 organs × $1,500 per organ) | | 90,000 |
| Gross margin | | 60,000 |
| Selling and administrative expenses: | | |
| Selling expenses: | | |
| Advertising | $ 950 | |
| Delivery of organs | | |
| (60 organs × $60 per organ) | 3,600 | |
| Sales salaries and commissions | | |
| [$4,800 + (4% × $150,000)] | 10,800 | |
| Utilities | 650 | |
| Depreciation of sales facilities | 5,000 | |
| Total selling expenses | 21,000 | |
| Administrative expenses: | | |
| Executive salaries | 13,500 | |
| Depreciation of office equipment | 900 | |
| Clerical | | |
| [$2,500 + (60 organs × $40 per organ)] | 4,900 | |
| Insurance | 700 | |
| Total administrative expenses | 20,000 | |
| Total selling and administrative expenses | | 41,000 |
| Net operating income | | $ 19,000 |

**Problem 2-14** (continued)

2.

House Of Organs, Inc.
Contribution Format Income Statement
For the Month Ended November 30

| | *Total* | *Per Unit* |
|---|---|---|
| Sales (60 organs × $2,500 per organ) | $150,000 | $2,500 |
| Variable expenses: | | |
| Cost of goods sold (60 organs × $1,500 per organ) | 90,000 | 1,500 |
| Delivery of organs (60 organs × $60 per organ) | 3,600 | 60 |
| Sales commissions (4% × $150,000) | 6,000 | 100 |
| Clerical (60 organs × $40 per organ) | 2,400 | 40 |
| Total variable expenses | 102,000 | 1,700 |
| Contribution margin | 48,000 | $ 800 |
| Fixed expenses: | | |
| Advertising | 950 | |
| Sales salaries | 4,800 | |
| Utilities | 650 | |
| Depreciation of sales facilities | 5,000 | |
| Executive salaries | 13,500 | |
| Depreciation of office equipment | 900 | |
| Clerical | 2,500 | |
| Insurance | 700 | |
| Total fixed expenses | 29,000 | |
| Net operating income | $ 19,000 | |

3. Fixed costs remain constant in total but vary on a per unit basis with changes in the activity level. For example, as the activity level increases, fixed costs decrease on a per unit basis. Showing fixed costs on a per unit basis on the income statement make them appear to be variable costs. That is, management might be misled into thinking that the per unit fixed costs would be the same regardless of how many organs were sold during the month. For this reason, fixed costs should be shown only in totals on a contribution-type income statement.

**Problem 2-17** (30 minutes)

1. Maintenance cost at the 80,000 machine-hour level of activity can be isolated as follows:

| | *Level of Activity* | |
|---|---|---|
| | *60,000 MH* | *80,000 MH* |
| Total factory overhead cost .. | 274,000 pesos | 312,000 pesos |
| Deduct: | | |
| Indirect materials @ 1.50 pesos per MH* ............... | 90,000 | 120,000 |
| Rent................................. | 130,000 | 130,000 |
| Maintenance cost ................ | 54,000 pesos | 62,000 pesos |

* 90,000 pesos ÷ 60,000 MHs = 1.50 pesos per MH

2. High-low analysis of maintenance cost:

| | *Machine-Hours* | *Maintenance Cost* |
|---|---|---|
| High activity level .............. | 80,000 | 62,000 pesos |
| Low activity level ............... | 60,000 | 54,000 |
| Change observed............... | 20,000 | 8,000 pesos |

$$\text{Variable cost} = \frac{\text{Change in cost}}{\text{Change in activity}}$$

$$= \frac{8{,}000 \text{ pesos}}{20{,}000 \text{ MHs}} = 0.40 \text{ peso per MH}$$

Fixed cost element:

| | |
|---|---|
| Total cost at the high level of activity .................. | 54,000 pesos |
| Less variable cost element (60,000 MHs × 0.40 pesos per MH) ................. | 24,000 |
| Fixed cost element ........................................... | 30,000 pesos |

Therefore, the cost formula is 30,000 pesos per year, plus 0.40 peso per machine-hour or

$$Y = 30{,}000 \text{ pesos} + 0.40 \text{ peso } X.$$

**Problem 2-17** (continued)

3. Total factory overhead cost at 65,000 machine-hours is:

| | | |
|---|---|---|
| Indirect materials (65,000 MHs × 1.50 pesos per MH) | | 97,500 pesos |
| Rent | | 130,000 |
| Maintenance: | | |
| Variable cost element (65,000 MHs × 0.40 peso per MH) | 26,000 pesos | |
| Fixed cost element | 30,000 | 56,000 |
| Total factory overhead cost | | 283,500 pesos |

**Problem 2-21** (45 minutes)

1. Maintenance cost at the 70,000 machine-hour level of activity can be isolated as follows:

| | *Level of Activity* | |
|---|---|---|
| | *40,000 MH* | *70,000 MH* |
| Total factory overhead cost | $170,200 | $241,600 |
| Deduct: | | |
| Utilities cost @ $1.30 per MH* | 52,000 | 91,000 |
| Supervisory salaries | 60,000 | 60,000 |
| Maintenance cost | $ 58,200 | $ 90,600 |

*$52,000 ÷ 40,000 MHs = $1.30 per MH

2. High-low analysis of maintenance cost:

| | *Machine-Hours* | *Maintenance Cost* |
|---|---|---|
| High activity level | 70,000 | $90,600 |
| Low activity level | 40,000 | 58,200 |
| Change | 30,000 | $32,400 |

Variable cost per unit of activity:

$$\frac{\text{Change in cost}}{\text{Change in activity}}=\frac{\$32{,}400}{30{,}000\text{ MHs}}=\$1.08\text{ per MH}$$

Total fixed cost:

| | |
|---|---|
| Total maintenance cost at the low activity level ............ | $58,200 |
| Less the variable cost element | |
| (40,000 MHs × $1.08 per MH).................................. | 43,200 |
| Fixed cost element ................................................... | $15,000 |

Therefore, the cost formula is $15,000 per month plus $1.08 per machine-hour or:

$$Y = \$15,000 + \$1.08X$$

**Problem 2-21** (continued)

3.

| | *Variable Rate per Machine-Hour* | *Fixed Cost* |
|---|---|---|
| Maintenance cost .............. | $1.08 | $15,000 |
| Utilities cost ...................... | 1.30 | |
| Supervisory salaries cost.... | | 60,000 |
| Totals ............................... | $2.38 | $75,000 |

Thus, the cost formula is: Y = $75,000 + $2.38X.

4. Total overhead cost at an activity level of 45,000 machine-hours:

| | |
|---|---|
| Fixed costs......................................................... | $ 75,000 |
| Variable costs: $2.38 per MH × 45,000 MHs.......... | 107,100 |
| Total overhead costs............................................ | $182,100 |

**Problem 2-23** (45 minutes)

1. High-low method:

| | *Units Sold* | *Shipping Expense* |
|---|---|---|
| High activity level .............. | 25,000 | $232,000 |
| Low activity level ............... | 16,000 | 160,000 |
| Change ............................. | 9,000 | $72,000 |

$$\text{Variable cost per unit} = \frac{\text{Change in cost}}{\text{Change in activity}}$$

$$= \frac{\$72,000}{9,000 \text{ units}} = \$8 \text{ per unit}$$

Fixed cost element:

| | |
|---|---|
| Total shipping expense at high activity level | $232,000 |
| Less variable element: | |
| 25,000 units × $8 per unit | 200,000 |
| Fixed cost element | $ 32,000 |

Therefore, the cost formula is: Y = $32,000 + $8X.

**Problem 2-23** (continued)

2.

Alden Company
Budgeted Income Statement
For the First Quarter of Year 3

| | | |
|---|---|---|
| Sales (21,000 units × $50 per unit) | | $1,050,000 |
| Variable expenses: | | |
| Cost of goods sold (21,000 units × $20 per unit) | $420,000 | |
| Shipping expense (21,000 units × $8.00 per unit) | 168,000 | |
| Sales commission ($1,050,000 × 0.05) | 52,500 | |
| Total variable expenses | | 640,500 |
| Contribution margin | | 409,500 |
| Fixed expenses: | | |
| Shipping expenses | 32,000 | |
| Advertising expense | 170,000 | |
| Administrative salaries | 80,000 | |
| Depreciation expense | 50,000 | |
| Total fixed expenses | | 332,000 |
| Net operating income | | $ 77,500 |

# Chapter 3
# Job-Order Costing

## Solutions to Questions

**3-1** By definition, manufacturing overhead consists of costs that cannot be practically traced to jobs. Therefore, if these costs are to be assigned to jobs, they must be allocated rather than traced.

**3-2** The first step is to estimate the total amount of the allocation base (the denominator) that will be required for next period's estimated level of production. The second step is to estimate the total fixed manufacturing overhead cost for the coming period and the variable manufacturing overhead cost per unit of the allocation base. The third step is to use the cost formula $Y = a + bX$ to estimate the total manufacturing overhead cost (the numerator) for the coming period. The fourth step is to compute the predetermined overhead rate.

**3-3** The job cost sheet is used to record all costs that are assigned to a particular job. These costs include direct materials costs traced to the job, direct labor costs traced to the job, and manufacturing overhead costs applied to the job. When a job is completed, the job cost sheet is used to compute the unit product cost.

**3-4** A sales order is issued after an agreement has been reached with a customer on quantities, prices, and shipment dates for goods. The sales order forms the basis for the production order. The production order specifies what is to be produced and forms the basis for the job cost sheet. The job cost sheet, in turn, is used to summarize the various production costs incurred to complete the job. These costs are entered on the job cost sheet from materials requisition forms, direct labor time tickets, and by applying overhead.

**3-5** Some production costs such as a factory manager's salary cannot be traced to a particular product or job, but rather are incurred as a result of overall production activities. In addition, some production costs such as indirect materials cannot be easily traced to jobs. If these costs are to be assigned to products, they must be allocated to the products.

**3-6** If actual manufacturing overhead cost is applied to jobs, the company must wait until the end of the accounting period to apply overhead and to cost jobs. If the company computes actual overhead rates more frequently to get around this problem, the rates may fluctuate widely due to seasonal factors or variations in output. For this reason, most companies use predetermined overhead rates to apply manufacturing overhead costs to jobs.

**3-7** The measure of activity used as the allocation base should drive the overhead cost; that is, the allocation base should cause the overhead cost. If the allocation base does not really cause the overhead, then costs will be incorrectly attributed to products and jobs and product costs will be distorted.

**3-8** Assigning manufacturing overhead costs to jobs does not ensure a profit. The units produced may not be sold and if they are sold, they may not be sold at prices sufficient to cover all costs. It is a myth that assigning costs to products or jobs ensures that those costs will be recovered. Costs are recovered only by selling to customers—not by allocating costs.

**3-9** The Manufacturing Overhead account is credited when overhead cost is applied to Work in Process. Generally, the amount of overhead applied will not be the same as the amount of actual cost incurred because the predetermined overhead rate is based on estimates.

**3-10** Underapplied overhead occurs when the actual overhead cost exceeds the amount of overhead cost applied to Work in Process inventory during the period. Overapplied overhead occurs when the actual overhead cost is less than the amount of overhead cost applied to Work in Process inventory during the period. Underapplied or overapplied overhead is disposed of by either closing out the amount to Cost of Goods Sold or by allocating the amount among Cost of Goods Sold and ending inventories in proportion to the applied overhead in each account. The adjustment for underapplied overhead increases Cost of Goods Sold (and inventories) whereas the adjustment for overapplied overhead decreases Cost of Goods Sold (and inventories).

**3-11** Manufacturing overhead may be underapplied for several reasons. Control over overhead spending may be poor. Or, some of the overhead may be fixed and the actual amount of the allocation base may be less than estimated at the beginning of the period. In this situation, the amount of overhead applied to inventory will be less than the actual overhead cost incurred.

**3-12** Underapplied overhead implies that not enough overhead was assigned to jobs during the period and therefore cost of goods sold was understated. Therefore, underapplied overhead is added to cost of goods sold. On the other hand, overapplied overhead is deducted from cost of goods sold.

**3-13** A plantwide overhead rate is a single overhead rate used throughout a plant. In a multiple overhead rate system, each production department may have its own predetermine overhead rate and its own allocation base. Some companies use multiple overhead rates rather than plantwide rates to more appropriately allocate overhead costs among products. Multiple overhead rates should be used, for example, in situations where one department is machine intensive and another department is labor intensive.

**3-14** When automated equipment replaces direct labor, overhead increases and direct labor decreases. This results in an increase in the predetermined overhead rate—particularly if it is based on direct labor.

**Exercise 3-1** (10 minutes)

The estimated total manufacturing overhead cost is computed as follows:

$$Y = \$466{,}000 + (\$3.00 \text{ per DLH})(40{,}000 \text{ DLHs})$$

| | |
|---|---|
| Estimated fixed manufacturing overhead | $466,000 |
| Estimated variable manufacturing overhead: | |
| $3.00 per DLH × 40,000 DLHs | 120,000 |
| Estimated total manufacturing overhead cost | $586,000 |

The predetermined overhead rate is computed as follows:

| | | |
|---|---|---|
| Estimated total manufacturing overhead | $586,000 | |
| ÷ Estimated total direct labor hours (DLHs) | 40,000 | DLHs |
| = Predetermined overhead rate | $14.65 | per DLH |

**Exercise 3-2** (10 minutes)

| | |
|---|---|
| Actual direct labor-hours | 12,600 |
| × Predetermined overhead rate | $23.10 |
| = Manufacturing overhead applied | $291,060 |

**Exercise 3-3** (10 minutes)

1. Total direct labor-hours required for Job A-200:

| | |
|---|---|
| Direct labor cost | $120 |
| ÷ Direct labor wage rate per hour | $12 |
| = Total direct labor hours | 10 |

Total manufacturing cost assigned to Job A-200:

| | |
|---|---|
| Direct materials | $200 |
| Direct labor | 120 |
| Manufacturing overhead applied ($18 per DLH × 10 DLHs) | 180 |
| Total manufacturing cost | $500 |

2. Unit product cost for Job A-200:

| | |
|---|---|
| Total manufacturing cost | $500 |
| ÷ Number of units in the job | 50 |
| = Unit product cost | $10 |

**Exercise 3-4** (15 minutes)

| | | | |
|---|---|---|---|
| a. | Raw Materials ........................ | 86,000 | |
| | Accounts Payable.......... | | 86,000 |
| b. | Work in Process .................... | 72,000 | |
| | Manufacturing Overhead........ | 12,000 | |
| | Raw Materials............... | | 84,000 |
| c. | Work in Process .................... | 105,000 | |
| | Manufacturing Overhead........ | 3,000 | |
| | Wages Payable ............. | | 108,000 |
| d. | Manufacturing Overhead........ | 197,000 | |
| | Various Accounts .......... | | 197,000 |

**Exercise 3-5** (20 minutes)

Parts 1 and 2.

**Cash**

| | | | |
|---|---|---|---|
| | | (a) | 75,000 |
| | | (c) | 152,000 |
| | | (d) | 126,000 |

**Raw Materials**

| | | | |
|---|---|---|---|
| (a) | 75,000 | (b) | 73,000 |
| Bal. | 2,000 | | |

**Work in Process**

| | | | |
|---|---|---|---|
| (b) | 67,000 | | |
| (c) | 134,000 | | |
| (e) | 178,000 | (f) | 379,000 |
| Bal. | 0 | | |

**Finished Goods**

| | | | |
|---|---|---|---|
| (f) | 379,000 | (f) | 379,000 |
| Bal. | 0 | | |

**Manufacturing Overhead**

| | | | |
|---|---|---|---|
| (b) | 6,000 | (e) | 178,000 |
| (c) | 18,000 | | |
| (d) | 126,000 | | |
| (g) | 28,000 | | |
| Bal. | 0 | | |

**Cost of Goods Sold**

| | | | |
|---|---|---|---|
| (f) | 379,000 | (g) | 28,000 |
| Bal. | 351,000 | | |

**Exercise 3-6** (20 minutes)

1. Cost of Goods Manufactured

| | | |
|---|---|---|
| Direct materials: | | |
| Raw materials inventory, beginning | $24,000 | |
| Add: Purchases of raw materials | 53,000 | |
| Total raw materials available | 77,000 | |
| Deduct: Raw materials inventory, ending | 6,000 | |
| Raw materials used in production | 71,000 | |
| Deduct: Indirect materials included in manufacturing overhead | 8,000 | $ 63,000 |
| Direct labor | | 62,000 |
| Manufacturing overhead applied to work in process inventory | | 41,000 |
| Total manufacturing costs | | 166,000 |
| Add: Beginning work in process inventory | | 41,000 |
| | | 207,000 |
| Deduct: Ending work in process inventory | | 38,000 |
| Cost of goods manufactured | | $169,000 |

2. Cost of Goods Sold

| | |
|---|---|
| Finished goods inventory, beginning | $ 86,000 |
| Add: Cost of goods manufactured | 169,000 |
| Cost of goods available for sale | 255,000 |
| Deduct: Finished goods inventory, ending | 93,000 |
| Unadjusted cost of goods sold | 162,000 |
| Add: Underapplied overhead | 8,000 |
| Adjusted cost of goods sold | $170,000 |

**Exercise 3-7** (10 minutes)

1.

| | |
|---|---|
| Actual direct labor-hours | 8,250 |
| × Predetermined overhead rate | $21.40 |
| = Manufacturing overhead applied | $176,550 |
| Less: Manufacturing overhead incurred | 172,500 |
| Manufacturing overhead overapplied | $ 4,050 |

2. Because manufacturing overhead is overapplied, the cost of goods sold would decrease by $4,050 and the gross margin would increase by $4,050.

**Exercise 3-8** (30 minutes)

1. Cost of Goods Manufactured

| | | |
|---|---|---|
| Direct materials: | | |
| Raw materials inventory, beginning | $ 8,000 | |
| Add: Purchases of raw materials | 132,000 | |
| Total raw materials available | 140,000 | |
| Deduct: Raw materials inventory, ending | 10,000 | |
| Raw materials used in production | | 130,000 |
| Direct labor | | 90,000 |
| Manufacturing overhead applied to work in process inventory | | 210,000 |
| Total manufacturing costs | | 430,000 |
| Add: Beginning work in process inventory | | 5,000 |
| | | 435,000 |
| Deduct: Ending work in process inventory | | 20,000 |
| Cost of goods manufactured | | $415,000 |

2. Cost of Goods Sold

| | |
|---|---|
| Finished goods inventory, beginning | $ 70,000 |
| Add: Cost of goods manufactured | 415,000 |
| Cost of goods available for sale | 485,000 |
| Deduct: Finished goods inventory, ending | 25,000 |
| Unadjusted cost of goods sold | 460,000 |
| Add: Underapplied overhead | 10,000 |
| Adjusted cost of goods sold | $470,000 |

3.

Eccles Company
Income Statement

| | | |
|---|---|---|
| Sales | | $643,000 |
| Cost of goods sold ($460,000 + $10,000) | | 470,000 |
| Gross margin | | 173,000 |
| Selling and administrative expenses: | | |
| Selling expenses | $100,000 | |
| Administrative expense | 43,000 | 143,000 |
| Net operating income | | $ 30,000 |

**Exercise 3-9** (10 minutes)

Yes, overhead should be applied to value the Work in Process inventory at year-end.

Because $15,000 of overhead was applied to Job X on the basis of $10,000 of direct labor cost, the company's predetermined overhead rate must be 150% of direct labor cost.

| | |
|---|---|
| Job Q direct labor cost | $8,000 |
| × Predetermined overhead rate | × 150% |
| = Manufacturing overhead applied to Job Q at year-end | $12,000 |

**Exercise 3-10** (10 minutes)

| | |
|---|---|
| Direct material | $12,000 |
| Direct labor | 8,000 |
| Manufacturing overhead applied: | |
| $8,000 × 120% | 9,600 |
| Total manufacturing cost | $29,600 |
| Unit product cost: | |
| $29,600 ÷ 200 units | $148 |

**Exercise 3-11** (30 minutes)

1\. a. Raw Materials Inventory ........................ 210,000
Accounts Payable ............................... 210,000

| | | | |
|---|---|---|---|
| 1. | a. Raw Materials Inventory | 210,000 | |
| | Accounts Payable | | 210,000 |
| | b. Work in Process | 152,000 | |
| | Manufacturing Overhead | 38,000 | |
| | Raw Materials Inventory | | 190,000 |
| | c. Work in Process | 49,000 | |
| | Manufacturing Overhead | 21,000 | |
| | Salaries and Wages Payable | | 70,000 |
| | d. Manufacturing Overhead | 105,000 | |
| | Accumulated Depreciation | | 105,000 |
| | e. Manufacturing Overhead | 130,000 | |
| | Accounts Payable | | 130,000 |
| | f. Work in Process | 300,000 | |
| | Manufacturing Overhead | | 300,000 |
| | 75,000 machine-hours × \$4 per machine-hour = \$300,000. | | |
| | g. Finished Goods | 510,000 | |
| | Work in Process | | 510,000 |
| | h. Cost of Goods Sold | 450,000 | |
| | Finished Goods | | 450,000 |
| | Accounts Receivable | 675,000 | |
| | Sales | | 675,000 |
| | \$450,000 × 1.5 = \$675,000. | | |

2\.

**Manufacturing Overhead**

| | | | |
|---|---|---|---|
| (b) | 38,000 | (f) | 300,000 |
| (c) | 21,000 | | |
| (d) | 105,000 | | |
| (e) | 130,000 | | |
| | | | 6,000 (Overapplied overhead) |

**Work in Process**

| | | | |
|---|---|---|---|
| Bal. | 35,000 | (g) | 510,000 |
| (b) | 152,000 | | |
| (c) | 49,000 | | |
| (f) | 300,000 | | |
| Bal. | 26,000 | | |

**Exercise 3-12** (20 minutes)

1. The estimated total manufacturing overhead cost is computed as follows:

$$Y = \$750,000 + \$4.00 \text{ per MH} \times 150,000 \text{ MHs}$$

| | |
|---|---|
| Estimated fixed manufacturing overhead | $ 750,000 |
| Estimated variable manufacturing overhead | |
| $4.00 per MH × 150,000 MHs | 600,000 |
| Estimated total manufacturing overhead cost | $1,350,000 |

The predetermined overhead rate is computed as follows:

| | | |
|---|---|---|
| Estimated total manufacturing overhead | $1,350,000 | |
| ÷ Estimated total machine-hours (MHs) | 150,000 | MHs |
| = Predetermined overhead rate | $9.00 | per MH |

2. Total manufacturing cost assigned to Job 500:

| | |
|---|---|
| Direct materials | $350 |
| Direct labor | 230 |
| Manufacturing overhead applied | |
| $9.00 per MH × 30 MHs | 270 |
| Total manufacturing cost | $850 |

3. Computing underapplied/overapplied overhead:

| | |
|---|---|
| Actual manufacturing overhead (a) | $1,325,000 |
| Actual machine-hours | 147,000 |
| × Predetermined overhead rate | $9.00 |
| = Manufacturing overhead applied (b) | $1,323,000 |
| Underapplied overhead (a) – (b) | $ 2,000 |
| Manufacturing overhead underapplied | $2,000 |

The closing entry would increase cost of goods sold by $2,000 and decrease net operating income by $2,000.

**Exercise 3-13** (15 minutes)

1. Actual manufacturing overhead costs and overhead applied:

| | | |
|---|---|---|
| Actual manufacturing overhead costs ............. | | $ 48,000 |
| Manufacturing overhead applied: | | |
| 10,000 MH × $5 per MH ............................. | | 50,000 |
| Overapplied overhead cost............................. | | $ 2,000 |

2. Cost of goods manufactured:

| | | |
|---|---|---|
| Direct materials: | | |
| Raw materials inventory, beginning .............. | $ 8,000 | |
| Add: Purchases of raw materials.................. | 32,000 | |
| Raw materials available for use .................... | 40,000 | |
| Deduct: Raw materials inventory, ending ...... | 7,000 | |
| Raw materials used in production ................. | | $ 33,000 |
| Direct labor................................................. | | 40,000 |
| Manufacturing overhead cost applied to work in process .................................................. | | 50,000 |
| Total manufacturing cost ............................... | | 123,000 |
| Add: Work in process, beginning .................... | | 6,000 |
| | | 129,000 |
| Deduct: Work in process, ending..................... | | 7,500 |
| Cost of goods manufactured .......................... | | $121,500 |

**Exercise 3-14** (30 minutes)

Note to the instructor: This exercise is a good vehicle for introducing the concept of predetermined overhead rates. This exercise can also be used as a launching pad for a discussion of the appendix to the chapter.

1.

| | *Units Produced* | *Manufacturing Overhead* |
|---|---|---|
| High activity level (First quarter) ... | 80,000 | $228,000 |
| Low activity level (Third quarter)... | 20,000 | 192,000 |
| Change...................................... | 60,000 | $36,000 |

Variable cost = Change in cost ÷ Change in activity
= $36,000 ÷ 60,000 units
= $0.60 per unit produced

| | |
|---|---|
| Total cost (First quarter)........................................... | $228,000 |
| Variable cost element ($0.60 per unit × 80,000 units) . | 48,000 |
| Fixed cost element ................................................. | $180,000 |

These fixed and variable cost estimates can be used to estimate the total manufacturing overhead cost for the fourth quarter as follows:

Y = $180,000 + ($0.60 per unit)(60,000 units)

| | |
|---|---|
| Estimated fixed manufacturing overhead ................. | $180,000 |
| Estimated variable manufacturing overhead | |
| $0.60 per unit × 60,000 units.............................. | 36,000 |
| Estimated total manufacturing overhead cost........... | $216,000 |

Total manufacturing cost and unit product cost:

| | |
|---|---|
| Direct materials.................................................. | $180,000 |
| Direct labor ........................................................ | 72,000 |
| Manufacturing overhead ...................................... | 216,000 |
| Total manufacturing costs..................................... | $468,000 |
| ÷ Number of units to be produced ........................ | 60,000 |
| = Unit product cost ............................................ | $7.80 |

**Exercise 3-14** (continued)

2. The fixed portion of the manufacturing overhead cost is causing the unit product costs to fluctuate. The unit product cost increases as the level of production decreases because fixed overhead is being spread over fewer units.

3. The unit product cost can be stabilized by using a predetermined overhead rate that is based on expected activity for the entire year. The cost formula created in requirement 1 can be adapted to compute the annual predetermined overhead rate. The annual fixed manufacturing overhead is $720,000 ($180,000 per quarter × 4 quarters). The variable manufacturing overhead per unit is $0.60. The cost formula is as follows:

   Y = $720,000 + $0.60 per unit × 200,000 units

| | |
|---|---|
| Estimated fixed manufacturing overhead .................. | $720,000 |
| Estimated variable manufacturing overhead | |
| $0.60 per unit × 200,000 units .............................. | 120,000 |
| Estimated total manufacturing overhead cost ............ | $840,000 |

The annual predetermined overhead rate is computed as follows:

| | | |
|---|---|---|
| Estimated total manufacturing overhead .... | $840,000 | |
| ÷ Estimated total units produced .............. | 200,000 | |
| = Predetermined overhead rate ................. | $4.20 | per unit |

The predetermined overhead rate of $4.20 would be used throughout the entire year, thereby eliminating the impact of seasonal variations in demand on unit product costs.

**Exercise 3-15** (15 minutes)

1. Milling Department:

   The estimated total manufacturing overhead cost in the Milling Department is computed as follows:

$$Y = \$390{,}000 + (\$2.00 \text{ per MH})(60{,}000 \text{ MH})$$

| | |
|---|---|
| Estimated fixed manufacturing overhead | $390,000 |
| Estimated variable manufacturing overhead | |
| $2.00 per MH × 60,000 MHs | 120,000 |
| Estimated total manufacturing overhead cost | $510,000 |

The predetermined overhead rate is computed as follows:

| | | |
|---|---|---|
| Estimated total manufacturing overhead | $510,000 | |
| ÷ Estimated total machine-hours | 60,000 | MHs |
| = Predetermined overhead rate | $8.50 | per MH |

Assembly Department:

The estimated total manufacturing overhead cost in the Assembly Department is computed as follows:

$$Y = \$500{,}000 + (\$3.75 \text{ per DLH})(80{,}000 \text{ DLH})$$

| | |
|---|---|
| Estimated fixed manufacturing overhead | $500,000 |
| Estimated variable manufacturing overhead | |
| $3.75 per DLH × 80,000 DLHs | 300,000 |
| Estimated total manufacturing overhead cost | $800,000 |

The predetermined overhead rate is computed as follows:

| | | |
|---|---|---|
| Estimated total manufacturing overhead | $800,000 | |
| ÷ Estimated total direct labor-hours | 80,000 | DLHs |
| = Predetermined overhead rate | $10.00 | per DLH |

**Exercise 3-15** (continued)

2. Total manufacturing cost assigned to Job 407:

| | | |
|---|---|---|
| Direct materials ($800 + $370) | | $1,170 |
| Direct labor ($45 + $160) | | 205 |
| Milling Department (90 MHs × $8.50 per MH) | $765 | |
| Assembly Department (20 DLH × $10 per DLH) | 200 | 965 |
| Total manufacturing cost | | $2,340 |

3. Yes; if some jobs require a large amount of machine time and a small amount of labor time, they would be charged substantially less overhead cost if a plantwide rate based on direct labor hours were used. It appears, for example, that this would be true of Job 407 which required considerable machine time to complete, but required a relatively small amount of labor hours.

**Exercise 3-16** (15 minutes)

1. Item (a): Actual manufacturing overhead costs for the year.
   Item (b): Overhead cost applied to work in process for the year.
   Item (c): Cost of goods manufactured for the year.
   Item (d): Cost of goods sold for the year.

2. Manufacturing Overhead ............................ 30,000
   Cost of Goods Sold ............................... 30,000

| | Debit | Credit |
|---|---|---|
| Manufacturing Overhead | 30,000 | |
| Cost of Goods Sold | | 30,000 |

3. The overapplied overhead will be allocated to the other accounts on the basis of the amount of overhead applied during the year in the ending balance of each account:

| | | |
|---|---|---|
| Work in process | $ 32,800 | 8 % |
| Finished goods | 41,000 | 10 |
| Cost of goods sold | 336,200 | 82 |
| Total cost | $410,000 | 100 % |

Using these percentages, the journal entry would be as follows:

| | Debit | Credit |
|---|---|---|
| Manufacturing Overhead | 30,000 | |
| Work in Process (8% × $30,000) | | 2,400 |
| Finished Goods (10% × $30,000) | | 3,000 |
| Cost of Goods Sold (82% × $30,000) | | 24,600 |

**Exercise 3-17** (30 minutes)

1. The predetermined overhead rate is computed as follows:

$$Y = \$106,250 + \$0.75 \text{ per MH} \times 85,000 \text{ MHs}$$

| | |
|---|---|
| Estimated fixed manufacturing overhead | $106,250 |
| Estimated variable manufacturing overhead | |
| $0.75 per MH × 85,000 MHs | 63,750 |
| Estimated total manufacturing overhead cost | $170,000 |

The predetermined overhead rate is computed as follows:

| | | |
|---|---|---|
| Estimated total manufacturing overhead | $170,000 | |
| ÷ Estimated total machine-hours | 85,000 | MHs |
| = Predetermined overhead rate | $2.00 | per MH |

2. The amount of overhead cost applied to Work in Process for the year would be: 80,000 machine-hours × $2.00 per machine-hour = $160,000. This amount is shown in entry (a) below:

Manufacturing Overhead

| | Debit | Credit |
|---|---|---|
| (Utilities) | 14,000 | (a) 160,000 |
| (Insurance) | 9,000 | |
| (Maintenance) | 33,000 | |
| (Indirect materials) | 7,000 | |
| (Indirect labor) | 65,000 | |
| (Depreciation) | 40,000 | |
| Balance | 8,000 | |

Work in Process

| | Debit | Credit |
|---|---|---|
| (Direct materials) | 530,000 | |
| (Direct labor) | 85,000 | |
| (Overhead) | (a) 160,000 | |

3. Overhead is underapplied by $8,000 for the year, as shown in the Manufacturing Overhead account above. The entry to close out this balance to Cost of Goods Sold would be:

| | Debit | Credit |
|---|---|---|
| Cost of Goods Sold | 8,000 | |
| Manufacturing Overhead | | 8,000 |

**Exercise 3-17** (continued)

4. When overhead is applied using a predetermined rate based on machine-hours, it is assumed that overhead cost is proportional to machine-hours. When the actual level of activity turns out to be 80,000 machine-hours, the costing system assumes that the overhead will be 80,000 machine-hours × $2.00 per machine-hour, or $160,000. This is a drop of $10,000 from the initial estimated total manufacturing overhead cost of $170,000. However, the actual total manufacturing overhead did not drop by this much. The actual total manufacturing overhead was $168,000—a drop of only $2,000 from the estimate. The manufacturing overhead did not decline by the full $10,000 because of the existence of fixed costs and/or because overhead spending was not under control. These issues will be covered in more detail in later chapters.

**Exercise 3-18** (45 minutes)

1 a. The estimated total manufacturing overhead cost is computed as follows:

$$Y = \$1,100,000 + \$5.00 \text{ per MH} \times 50,000 \text{ MHs}$$

| | |
|---|---|
| Estimated fixed manufacturing overhead | $1,100,000 |
| Estimated variable manufacturing overhead $5.00 per MH × 50,000 MHs | 250,000 |
| Estimated total manufacturing overhead cost | $1,350,000 |

The predetermined overhead rate is computed as follows:

| | | |
|---|---|---|
| Estimated total manufacturing overhead | $1,350,000 | |
| ÷ Estimated total machine-hours (MHs) | 50,000 | MHs |
| = Predetermined overhead rate | $27.00 | per MH |

1 b and 1 c. Total manufacturing cost assigned to Jobs D-75 and C-100:

| | *D-75* | *C-100* |
|---|---|---|
| Direct materials | $ 700,000 | $ 550,000 |
| Direct labor | 360,000 | 400,000 |
| Manufacturing overhead applied ($27.00 per MH × 20,000 MHs; $27.00 per MH × 30,000 MHs) | 540,000 | 810,000 |
| Total manufacturing cost | $1,600,000 | $1,760,000 |

Bid prices for Jobs D-75 and C-100:

| | *D-75* | *C-100* |
|---|---|---|
| Total manufacturing cost | $1,600,000 | $1,760,000 |
| × Markup percentage | 150% | 150% |
| = Bid price | $2,400,000 | $2,640,000 |

1 d. Because the company has no beginning or ending inventories and only Jobs D-75 and C-100 were started, completed, and sold during the year, the cost of goods sold is equal to the sum of the manufacturing costs assigned to both jobs of $3,360,000 (= $1,600,000 + $1,760,000).

**Exercise 3-18** (continued)

2 a. Molding Department:

The estimated total manufacturing overhead cost in the Molding Department is computed as follows:

$$Y = \$800,000 + \$5.00 \text{ per MH} \times 20,000 \text{ MH}$$

| | |
|---|---|
| Estimated fixed manufacturing overhead | $800,000 |
| Estimated variable manufacturing overhead | |
| $5.00 per MH × 20,000 MHs | 100,000 |
| Estimated total manufacturing overhead cost | $900,000 |

The predetermined overhead rate is computed as follows:

| | | |
|---|---|---|
| Estimated total manufacturing overhead | $900,000 | |
| ÷ Estimated total machine-hours | 20,000 | MHs |
| = Predetermined overhead rate | $45.00 | per MH |

Fabrication Department:

The estimated total manufacturing overhead cost in the Fabrication Department is computed as follows:

$$Y = \$300,000 + \$5.00 \text{ per MH} \times 30,000 \text{ MH}$$

| | |
|---|---|
| Estimated fixed manufacturing overhead | $300,000 |
| Estimated variable manufacturing overhead | |
| $5.00 per MH × 30,000 MHs | 150,000 |
| Estimated total manufacturing overhead cost | $450,000 |

The predetermined overhead rate is computed as follows:

| | | |
|---|---|---|
| Estimated total manufacturing overhead | $450,000 | |
| ÷ Estimated total direct labor-hours | 30,000 | MHs |
| = Predetermined overhead rate | $15.00 | per MH |

**Exercise 3-18** (continued)

2b and 2c. Total manufacturing costs assigned to Jobs D-75 and C-100:

| | *D-75* | *C-100* |
|---|---|---|
| Direct materials | $700,000 | $550,000 |
| Direct labor | 360,000 | 400,000 |
| Molding Department (15,000 MHs × $45 per MH; 5,000 MHs × $45 per MH) | 675,000 | 225,000 |
| Fabrication Department (5,000 MH × $15 per MH; 25,000 MH × $15 per MH) | 75,000 | 375,000 |
| Total manufacturing cost | $1,810,000 | $1,550,000 |

Bid prices for Jobs D-75 and C-100:

| | *D-75* | *C-100* |
|---|---|---|
| Total manufacturing cost | $1,810,000 | $1,550,000 |
| × Markup percentage | 150% | 150% |
| = Bid price | $2,715,000 | $2,325,000 |

2 d. Because the company has no beginning or ending inventories and only Jobs D-75 and C-100 were started, completed, and sold during the year, the cost of goods sold is equal to the sum of the manufacturing costs assigned to both jobs $3,360,000 (= $1,810,000 + $1,550,000).

3. The plantwide and departmental approaches produce identical cost of goods sold figures. However, these two approaches lead to different bid prices for Jobs D-75 and C-100. The bid price for Job D-75 using the departmental approach is $315,000 higher than the bid price using the plantwide approach. This is because the departmental cost pools reflect the fact that Job D-75 is an intensive user of Molding machine-hours. The overhead rate in Molding ($45) is three times higher than the overhead rate in Fabrication ($15). Conversely, Job C-100 is an intensive user of the less-expensive Fabrication machine-hours, so its departmental bid price is $315,000 lower than the plantwide bid price.

**Exercise 3-18** (continued)

Whether a job-order costing system has only one plantwide overhead cost pool or numerous departmental overhead cost pools does not usually have an important impact on the accuracy of the cost of goods sold reported for the company as a whole. However, it can have a huge impact on internal decisions with respect to individual jobs, such as establishing bid prices for those jobs. Job-order costing systems that rely on one plantwide overhead cost pool are commonly used to value ending inventories and cost of goods sold for external reporting purposes, but they can create costing inaccuracies for individual jobs that adversely influence internal decision making.

**Exercise 3-19** (30 minutes)

1\. a. Raw Materials ............................ 315,000
Accounts Payable .................. 315,000

| | | |
|---|---|---|
| 1. a. Raw Materials | 315,000 | |
| Accounts Payable | | 315,000 |
| b. Work in Process | 216,000 | |
| Manufacturing Overhead | 54,000 | |
| Raw Materials | | 270,000 |
| c. Work in Process | 80,000 | |
| Manufacturing Overhead | 110,000 | |
| Wages and Salaries Payable | | 190,000 |
| d. Manufacturing Overhead | 63,000 | |
| Accumulated Depreciation | | 63,000 |
| e. Manufacturing Overhead | 85,000 | |
| Accounts Payable | | 85,000 |
| f. Work in Process | 300,000 | |
| Manufacturing Overhead | | 300,000 |

$$\text{Predetermined overhead rate} = \frac{\text{Estimated total manufacturing overhead cost}}{\text{Estimated total amount of the allocation base}}$$

$$= \frac{\$4,320,000}{576,000 \text{ machine-hours}} = \$7.50 \text{ per machine-hour}$$

40,000 MHs × \$7.50 per MH = \$300,000.

2\.

**Manufacturing Overhead**

| | | | |
|---|---|---|---|
| (b) | 54,000 | (f) | 300,000 |
| (c) | 110,000 | | |
| (d) | 63,000 | | |
| (e) | 85,000 | | |

**Work in Process**

| | | |
|---|---|---|
| (b) | 216,000 | |
| (c) | 80,000 | |
| (f) | 300,000 | |

3. The cost of the completed job would be \$596,000 as shown in the Work in Process T-account above. The entry for item (g) would be:

| | | |
|---|---|---|
| Finished Goods | 596,000 | |
| Work in Process | | 596,000 |

4. The unit product cost on the job cost sheet would be:
   \$596,000 ÷ 8,000 units = \$74.50 per unit.

**Exercise 3-20** (30 minutes)

1. Since $320,000 of studio overhead cost was applied to Work in Process on the basis of $200,000 of direct staff costs, the apparent predetermined overhead rate was 160%:

$$\frac{\text{Studio overhead applied}}{\text{Total amount of the allocation base}} = \frac{\$320{,}000}{\$200{,}000 \text{ direct staff costs}}$$

$$= 160\% \text{ of direct staff costs}$$

2. The Krimmer Corporation Headquarters project is the only job remaining in Work in Process at the end of the month; therefore, the entire $40,000 balance in the Work in Process account at that point must apply to it. Recognizing that the predetermined overhead rate is 160% of direct staff costs, the following computation can be made:

| | | |
|---|---|---|
| Total cost added to the Krimmer Corporation Headquarters project ..... | | $40,000 |
| Less: Direct staff costs ...................... | $13,500 | |
| Studio overhead cost ($13,500 × 160%)................ | 21,600 | 35,100 |
| Costs of subcontracted work .............. | | $ 4,900 |

With this information, we can now complete the job cost sheet for the Krimmer Corporation Headquarters project:

| | |
|---|---|
| Costs of subcontracted work ........... | $ 4,900 |
| Direct staff costs ............................ | 13,500 |
| Studio overhead .............................. | 21,600 |
| Total cost to January 31 ................. | $40,000 |

**Problem 3-21** (30 minutes)

1. The predetermined overhead rate was:

$$Y = \$1,275,000 + \$3.00 \text{ per hour} \times 85,000 \text{ hours}$$

| | |
|---|---|
| Estimated fixed manufacturing overhead | $1,275,000 |
| Estimated variable manufacturing overhead | |
| $3.00 per computer hour × 85,000 hours | 255,000 |
| Estimated total manufacturing overhead cost | $1,530,000 |

The predetermined overhead rate is computed as follows:

| | | |
|---|---|---|
| Estimated total manufacturing overhead | $1,530,000 | |
| ÷ Estimated total computer hours | 85,000 | hours |
| = Predetermined overhead rate | $18.00 | per hour |

2.

| | |
|---|---|
| Actual manufacturing overhead cost | $1,350,000 |
| Manufacturing overhead cost applied to Work in Process during the year: 60,000 actual computer hours × $18 per computer hour | 1,080,000 |
| Underapplied overhead cost | $ 270,000 |

3.

| | | |
|---|---|---|
| Cost of Goods Sold | 270,000 | |
| Manufacturing Overhead | | 270,000 |

4. The underapplied overhead would be allocated using the following percentages:

| Overhead applied during the year in: | | |
|---|---|---|
| Work in process | $ 43,200 | 4 % |
| Finished goods | 280,800 | 26 |
| Cost of goods sold | 756,000 | 70 |
| Total | $1,080,000 | 100 % |

**Problem 3-21** (continued)

The entry to record the allocation of the underapplied overhead is:

| | | |
|---|---|---|
| Work In Process (4% × $270,000) ......... | 10,800 | |
| Finished Goods (26% × $270,000) ......... | 70,200 | |
| Cost of Goods Sold (70% × $270,000) ... | 189,000 | |
| Manufacturing Overhead.................. | | 270,000 |

5. Comparing the two methods of closing underapplied overhead:

| | |
|---|---|
| Cost of goods sold if the underapplied overhead is closed directly to cost of goods sold ($2,800,000 + $270,000)................................ | $3,070,000 |
| Cost of goods sold if the underapplied overhead is allocated among the accounts ($2,800,000 + $189,000) ...................................................... | 2,989,000 |
| Difference in cost of goods sold .......................... | $ 81,000 |

Thus, net operating income will be $81,000 greater if the underapplied overhead is allocated among Work In Process, Finished Goods, and Cost of Goods Sold rather than closed directly to Cost of Goods Sold.

**Problem 3-22** (30 minutes)

1. Cost of Goods Manufactured

| | | |
|---|---|---|
| Direct materials: | | |
| Raw materials inventory, beginning* | $ 50,000 | |
| Add: Purchases of raw materials* | 260,000 | |
| Total raw materials available | 310,000 | |
| Deduct: Raw materials inventory, ending* | 40,000 | |
| Raw materials used in production | | 270,000 |
| Direct labor | | 65,000 |
| Manufacturing overhead applied to work in process inventory* | | 340,000 |
| Total manufacturing costs* | | 675,000 |
| Add: Beginning work in process inventory | | 48,000 |
| | | 723,000 |
| Deduct: Ending work in process inventory* | | 33,000 |
| Cost of goods manufactured | | $690,000 |

2. Cost of Goods Sold

| | |
|---|---|
| Finished goods inventory, beginning* | $ 30,000 |
| Add: Cost of goods manufactured | 690,000 |
| Cost of goods available for sale* | 720,000 |
| Deduct: Finished goods inventory, ending | 55,000 |
| Unadjusted cost of goods sold* | 665,000 |
| Add: Underapplied overhead | 10,000 |
| Adjusted cost of goods sold | $675,000 |

3.

Valenko Company
Income Statement

| | | |
|---|---|---|
| Sales | | $1,085,000 |
| Cost of goods sold ($665,000 + $10,000) | | 675,000 |
| Gross margin | | 410,000 |
| Selling and administrative expenses: | | |
| Selling expenses* | $215,000 | |
| Administrative expense* | 160,000 | 375,000 |
| Net operating income* | | $ 35,000 |

* Given

**Problem 3-23** (45 minutes)

1. The cost of raw materials put into production was:

| | |
|---|---|
| Raw materials inventory, 1/1 | $ 30,000 |
| Debits (purchases of materials) | 420,000 |
| Materials available for use | 450,000 |
| Raw materials inventory, 12/31 | 60,000 |
| Materials requisitioned for production | $390,000 |

2. Of the $390,000 in materials requisitioned for production, $320,000 was debited to Work in Process as direct materials. Therefore, the difference of $70,000 ($390,000 – $320,000 = $70,000) would have been debited to Manufacturing Overhead as indirect materials.

3. 

| | |
|---|---|
| Total factory wages accrued during the year (credits to the Factory Wages Payable account) | $175,000 |
| Less direct labor cost (from Work in Process) | 110,000 |
| Indirect labor cost | $ 65,000 |

4. The cost of goods manufactured for the year was $810,000—the credits to Work in Process.

5. The Cost of Goods Sold for the year was:

| | |
|---|---|
| Finished goods inventory, 1/1 | $ 40,000 |
| Add: Cost of goods manufactured (from Work in Process) | 810,000 |
| Cost of goods available for sale | 850,000 |
| Deduct: Finished goods inventory, 12/31 | 130,000 |
| Cost of goods sold | $720,000 |

6. The predetermined overhead rate was:

$$\text{Predetermined overhead rate} = \frac{\text{Manufacturing overhead cost applied}}{\text{Direct materials cost}}$$

$$= \frac{\$400{,}000}{\$320{,}000} = 125\% \text{ of direct materials cost}$$

**Problem 3-23** (continued)

7. Manufacturing overhead was overapplied by $15,000, computed as follows:

| | |
|---|---|
| Actual manufacturing overhead cost for the year (debits) | $385,000 |
| Applied manufacturing overhead cost (from Work in Process—this would be the credits to the Manufacturing Overhead account) | 400,000 |
| Overapplied overhead | $(15,000) |

8. The ending balance in Work in Process is $90,000. Direct labor makes up $18,000 of this balance, and manufacturing overhead makes up $40,000. The computations are:

| | |
|---|---|
| Balance, Work in Process, 12/31 | $90,000 |
| Less: Direct materials cost (given) | (32,000) |
| Manufacturing overhead cost ($32,000 × 125%) | (40,000) |
| Direct labor cost (remainder) | $18,000 |

**Problem 3-24** (60 minutes)

1. a.

$$\text{Predetermined overhead rate} = \frac{\text{Estimated total manufacturing overhead cost}}{\text{Estimated total amount of the allocation base}}$$

$$= \frac{\$126{,}000}{\$84{,}000 \text{ direct labor cost}} = 150\% \text{ of direct labor cost}$$

b. Actual manufacturing overhead costs:

| | |
|---|---|
| Insurance, factory | $ 7,000 |
| Depreciation of equipment | 18,000 |
| Indirect labor | 42,000 |
| Property taxes | 9,000 |
| Maintenance | 11,000 |
| Rent, building | 36,000 |
| Total actual costs | 123,000 |
| Applied manufacturing overhead costs: | |
| $80,000 × 150% | 120,000 |
| Underapplied overhead | $ 3,000 |

2.

Pacific Manufacturing Company
Schedule of Cost of Goods Manufactured

| | | |
|---|---|---|
| Direct materials: | | |
| Raw materials inventory, beginning | $ 21,000 | |
| Add: Purchases of raw materials | 133,000 | |
| Total raw materials available | 154,000 | |
| Deduct: Raw materials inventory, ending | 16,000 | |
| Raw materials used in production | | $138,000 |
| Direct labor | | 80,000 |
| Manufacturing overhead applied to work in process | | 120,000 |
| Total manufacturing cost | | 338,000 |
| Add: Work in process, beginning | | 44,000 |
| | | 382,000 |
| Deduct: Work in process, ending | | 40,000 |
| Cost of goods manufactured | | $342,000 |

**Problem 3-24** (continued)

3. Unadjusted cost of goods sold:

| | |
|---|---|
| Finished goods inventory, beginning | $ 68,000 |
| Add: Cost of goods manufactured | 342,000 |
| Cost of goods available for sale | 410,000 |
| Deduct: Finished goods inventory, ending | 60,000 |
| Unadjusted cost of goods sold | $350,000 |

The underapplied overhead may be closed directly to Cost of Goods Sold or allocated among Work in Process, Finished Goods, and Cost of Goods Sold in proportion to the overhead applied during the year in the ending balance of each of these accounts.

4.

| | |
|---|---|
| Direct materials | $ 3,200 |
| Direct labor | 4,200 |
| Overhead applied (150% × $4,200) | 6,300 |
| Total manufacturing cost | $13,700 |

$13,700 × 140% = $19,180 price to customer.

5. The amount of overhead cost in Work in Process was:

$8,000 direct labor cost × 150% = $12,000

The amount of direct materials cost in Work in Process was:

| | | |
|---|---|---|
| Total ending work in process | | $40,000 |
| Deduct: | | |
| Direct labor | $ 8,000 | |
| Manufacturing overhead | 12,000 | 20,000 |
| Direct materials | | $20,000 |

The completed schedule of costs in Work in Process was:

| | |
|---|---|
| Direct materials | $20,000 |
| Direct labor | 8,000 |
| Manufacturing overhead | 12,000 |
| Work in process inventory | $40,000 |

**Problem 3-25** (120 minutes)

| | | | |
|---|---|---|---|
| 1. | a. Raw Materials | 142,000 | |
| | Accounts Payable | | 142,000 |
| | b. Work in Process | 150,000 | |
| | Raw Materials | | 150,000 |
| | c. Manufacturing Overhead | 21,000 | |
| | Accounts Payable | | 21,000 |
| | d. Work in Process | 216,000 | |
| | Manufacturing Overhead | 90,000 | |
| | Salaries Expense | 145,000 | |
| | Salaries and Wages Payable | | 451,000 |
| | e. Manufacturing Overhead | 15,000 | |
| | Accounts Payable | | 15,000 |
| | f. Advertising Expense | 130,000 | |
| | Accounts Payable | | 130,000 |
| | g. Manufacturing Overhead | 45,000 | |
| | Depreciation Expense | 5,000 | |
| | Accumulated Depreciation | | 50,000 |
| | h. Manufacturing Overhead | 72,000 | |
| | Rent Expense | 18,000 | |
| | Accounts Payable | | 90,000 |
| | i. Miscellaneous Expense | 17,000 | |
| | Accounts Payable | | 17,000 |
| | j. Work in Process | 240,000 | |
| | Manufacturing Overhead | | 240,000 |

$$\frac{\text{Estimated total manufacturing overhead cost}}{\text{Estimated direct materials cost}} = \frac{\$248,000}{\$155,000}$$

$= 160\%$ of direct materials cost.

\$150,000 direct materials cost × 160% = \$240,000 applied.

**Problem 3-25** (continued)

| | | | |
|---|---|---|---|
| k. | Finished Goods | 590,000 | |
| | Work in Process | | 590,000 |
| l. | Accounts Receivable | 1,000,000 | |
| | Sales | | 1,000,000 |
| | Cost of Goods Sold | 600,000 | |
| | Finished Goods | | 600,000 |

2.

**Accounts Receivable**

| | | | |
|---|---|---|---|
| (l) | 1,000,000 | | |

**Raw Materials**

| | | | |
|---|---|---|---|
| Bal. | 18,000 | (b) | 150,000 |
| (a) | 142,000 | | |
| Bal. | 10,000 | | |

**Work in Process**

| | | | |
|---|---|---|---|
| Bal. | 24,000 | (k) | 590,000 |
| (b) | 150,000 | | |
| (d) | 216,000 | | |
| (j) | 240,000 | | |
| Bal. | 40,000 | | |

**Finished Goods**

| | | | |
|---|---|---|---|
| Bal. | 35,000 | (l) | 600,000 |
| (k) | 590,000 | | |
| Bal. | 25,000 | | |

**Manufacturing Overhead**

| | | | |
|---|---|---|---|
| (c) | 21,000 | (j) | 240,000 |
| (d) | 90,000 | | |
| (e) | 15,000 | | |
| (g) | 45,000 | | |
| (h) | 72,000 | | |
| Bal. | 3,000 | | |

**Accounts Payable**

| | | | |
|---|---|---|---|
| | | (a) | 142,000 |
| | | (c) | 21,000 |
| | | (e) | 15,000 |
| | | (f) | 130,000 |
| | | (h) | 90,000 |
| | | (i) | 17,000 |

**Accumulated Depreciation**

| | | | |
|---|---|---|---|
| | | (g) | 50,000 |

**Depreciation Expense**

| | | | |
|---|---|---|---|
| (g) | 5,000 | | |

**Salaries & Wages Payable**

| | | | |
|---|---|---|---|
| | | (d) | 451,000 |

**Salaries Expense**

| | | | |
|---|---|---|---|
| (d) | 145,000 | | |

**Miscellaneous Expense**

| | | | |
|---|---|---|---|
| (i) | 17,000 | | |

**Advertising Expense**

| | | | |
|---|---|---|---|
| (f) | 130,000 | | |

**Problem 3-25** (continued)

| Rent Expense | |
|---|---|
| (h) 18,000 | |

| Cost of Goods Sold | |
|---|---|
| (l) 600,000 | |

| Sales | |
|---|---|
| | (l) 1,000,000 |

3.

Southworth Company
Schedule of Cost of Goods Manufactured

| | | |
|---|---|---|
| Direct materials: | | |
| Raw materials inventory, beginning | $ 18,000 | |
| Add: Purchases of raw materials | 142,000 | |
| Materials available for use | 160,000 | |
| Deduct: Raw materials inventory, ending | 10,000 | |
| Materials used in production | | $150,000 |
| Direct labor | | 216,000 |
| Manufacturing overhead applied to work in process | | 240,000 |
| Total manufacturing cost | | 606,000 |
| Add: Work in process, beginning | | 24,000 |
| | | 630,000 |
| Deduct: Work in process, ending | | 40,000 |
| Cost of goods manufactured | | $590,000 |

4.

| | | |
|---|---|---|
| Cost of Goods Sold | 3,000 | |
| Manufacturing Overhead | | 3,000 |

| | |
|---|---|
| Schedule of cost of goods sold: | |
| Finished goods inventory, beginning | $ 35,000 |
| Add: Cost of goods manufactured | 590,000 |
| Cost of goods available for sale | 625,000 |
| Deduct: Finished goods inventory, ending | 25,000 |
| Unadjusted cost of goods sold | 600,000 |
| Add: Underapplied overhead | 3,000 |
| Adjusted cost of goods sold | $603,000 |

**Problem 3-25** (continued)

5.

Southworth Company
Income Statement

| | | |
|---|---|---|
| Sales | | $1,000,000 |
| Cost of goods sold | | 603,000 |
| Gross margin | | 397,000 |
| Selling and administrative expenses: | | |
| Salaries expense | $145,000 | |
| Advertising expense | 130,000 | |
| Depreciation expense | 5,000 | |
| Rent expense | 18,000 | |
| Miscellaneous expense | 17,000 | 315,000 |
| Net operating income | | $ 82,000 |

6.

| | |
|---|---|
| Direct materials | $ 3,600 |
| Direct labor (400 hours × $11 per hour) | 4,400 |
| Manufacturing overhead cost applied (160% × $3,600) | 5,760 |
| Total manufacturing cost | 13,760 |
| Add markup (75% × $13,760) | 10,320 |
| Total billed price of Job 218 | $24,080 |

$24,080 ÷ 500 units = $48.16 per unit.

**Problem 3-26** (30 minutes)

1. Preparation Department:

   The estimated total manufacturing overhead cost in the Preparation Department is computed as follows:

$$Y = \$256,000 + \$2.00 \text{ per MH} \times 80,000 \text{ MH}$$

| | |
|---|---|
| Estimated fixed manufacturing overhead | $256,000 |
| Estimated variable manufacturing overhead: | |
| $2.00 per MH × 80,000 MHs | 160,000 |
| Estimated total manufacturing overhead cost | $416,000 |

The predetermined overhead rate is computed as follows:

| | | |
|---|---|---|
| Estimated total manufacturing overhead | $416,000 | |
| ÷ Estimated total machine-hours | 80,000 | MHs |
| = Predetermined overhead rate | $5.20 | per MH |

Fabrication Department:

The estimated total manufacturing overhead cost in the Fabrication Department is computed as follows:

$$Y = \$520,000 + \$4.00 \text{ per DLH} \times 50,000 \text{ DLH}$$

| | |
|---|---|
| Estimated fixed manufacturing overhead | $520,000 |
| Estimated variable manufacturing overhead: | |
| $4.00 per DLH × 50,000 DLHs | 200,000 |
| Estimated total manufacturing overhead cost | $720,000 |

The predetermined overhead rate is computed as follows:

| | | |
|---|---|---|
| Estimated total manufacturing overhead | $720,000 | |
| ÷ Estimated total machine-hours | 50,000 | DLHs |
| = Predetermined overhead rate | $14.40 | per DLH |

**Problem 3-26** (continued)

2. Preparation Department overhead applied:

| | |
|---|---|
| 350 machine-hours × \$5.20 per machine-hour | \$1,820 |
| Fabrication Department overhead applied: | |
| 130 direct labor-hours × \$14.40 per labor-hour | 1,872 |
| Total overhead cost | \$3,692 |

3. Total cost of Job 127:

| | *Preparation* | *Fabrication* | *Total* |
|---|---|---|---|
| Direct materials | \$ 940 | \$1,200 | \$2,140 |
| Direct labor | 710 | 980 | 1,690 |
| Manufacturing overhead | 1,820 | 1,872 | 3,692 |
| Total cost | \$3,470 | \$4,052 | \$7,522 |

Unit product cost for Job 127:

| | | |
|---|---|---|
| Total manufacturing cost | \$7,522 | |
| ÷ Number of units in the job | 25 | units |
| = Unit product cost | \$300.88 | per unit |

4.

| | *Preparation* | *Fabrication* |
|---|---|---|
| Manufacturing overhead cost incurred | \$390,000 | \$740,000 |
| Manufacturing overhead cost applied: | | |
| 73,000 machine-hours × \$5.20 per machine-hour | 379,600 | |
| 54,000 direct labor-hours × \$14.40 per direct labor-hour | | 777,600 |
| Underapplied (or overapplied) overhead | \$ 10,400 | \$(37,600) |

**Problem 3-27** (45 minutes)

| | | | |
|---|---|---|---|
| 1. | a. Raw Materials | 160,000 | |
| | Accounts Payable | | 160,000 |
| | b. Work in Process | 120,000 | |
| | Manufacturing Overhead | 20,000 | |
| | Raw Materials | | 140,000 |
| | c. Work in Process | 90,000 | |
| | Manufacturing Overhead | 60,000 | |
| | Sales Commissions Expense | 20,000 | |
| | Salaries Expense | 50,000 | |
| | Salaries and Wages Payable | | 220,000 |
| | d. Manufacturing Overhead | 13,000 | |
| | Insurance Expense | 5,000 | |
| | Prepaid Insurance | | 18,000 |
| | e. Manufacturing Overhead | 10,000 | |
| | Accounts Payable | | 10,000 |
| | f. Advertising Expense | 15,000 | |
| | Accounts Payable | | 15,000 |
| | g. Manufacturing Overhead | 20,000 | |
| | Depreciation Expense | 5,000 | |
| | Accumulated Depreciation | | 25,000 |
| | h. Work in Process | 110,000 | |
| | Manufacturing Overhead | | 110,000 |

$$\frac{\text{Estimated total manufacturing overhead cost}}{\text{Estimated total amount of the allocation base}} = \frac{£99{,}000}{45{,}000 \text{ MHs}} = £2.20 \text{ per MH}$$

50,000 actual MHs × £2.20 per MH = £110,000 overhead applied.

**Problem 3-27** (continued)

| | | | |
|---|---|---|---|
| i. | Finished Goods | 310,000 | |
| | Work in Process | | 310,000 |
| j. | Accounts Receivable | 498,000 | |
| | Sales | | 498,000 |
| | Cost of Goods Sold | 308,000 | |
| | Finished Goods | | 308,000 |

2.

**Raw Materials**

| | | | |
|---|---|---|---|
| Bal. | 10,000 | (b) | 140,000 |
| (a) | 160,000 | | |
| Bal. | 30,000 | | |

**Work in Process**

| | | | |
|---|---|---|---|
| Bal. | 4,000 | (i) | 310,000 |
| (b) | 120,000 | | |
| (c) | 90,000 | | |
| (h) | 110,000 | | |
| Bal. | 14,000 | | |

**Finished Goods**

| | | | |
|---|---|---|---|
| Bal. | 8,000 | (j) | 308,000 |
| (i) | 310,000 | | |
| Bal. | 10,000 | | |

**Manufacturing Overhead**

| | | | |
|---|---|---|---|
| (b) | 20,000 | (h) | 110,000 |
| (c) | 60,000 | | |
| (d) | 13,000 | | |
| (e) | 10,000 | | |
| (g) | 20,000 | | |
| Bal. | 13,000 | | |

**Cost of Goods Sold**

| | | | |
|---|---|---|---|
| (j) | 308,000 | | |

3. Manufacturing overhead is underapplied by £13,000 for the year. The entry to close this balance to Cost of Goods Sold would be:

| | | |
|---|---|---|
| Cost of Goods Sold | 13,000 | |
| Manufacturing Overhead | | 13,000 |

**Problem 3-27** (continued)

4.

Sovereign Millwork, Ltd.
Income Statement
For the Year Ended June 30

| | | |
|---|---|---|
| Sales | | £498,000 |
| Cost of goods sold (£308,000 + £13,000) | | 321,000 |
| Gross margin | | 177,000 |
| Selling and administrative expenses: | | |
| Sales commissions | £20,000 | |
| Administrative salaries | 50,000 | |
| Insurance expense | 5,000 | |
| Advertising expenses | 15,000 | |
| Depreciation expense | 5,000 | 95,000 |
| Net operating income | | £ 82,000 |

**Problem 3-28** (60 minutes)

1. and 2.

**Cash**

| | | | |
|---|---|---|---|
| Bal. | 15,000 | (c) | 225,000 |
| (l) | 445,000 | (m) | 150,000 |
| Bal. | 85,000 | | |

**Accounts Receivable**

| | | | |
|---|---|---|---|
| Bal. | 40,000 | (l) | 445,000 |
| (k) | 450,000 | | |
| Bal. | 45,000 | | |

**Raw Materials**

| | | | |
|---|---|---|---|
| Bal. | 25,000 | (b) | 90,000 |
| (a) | 80,000 | | |
| Bal. | 15,000 | | |

**Work in Process**

| | | | |
|---|---|---|---|
| Bal. | 30,000 | (j) | 310,000 |
| (b) | 85,000 | | |
| (c) | 120,000 | | |
| (i) | 96,000 | | |
| Bal. | 21,000 | | |

**Finished Goods**

| | | | |
|---|---|---|---|
| Bal. | 45,000 | (k) | 300,000 |
| (j) | 310,000 | | |
| Bal. | 55,000 | | |

**Prepaid Insurance**

| | | | |
|---|---|---|---|
| Bal. | 5,000 | (f) | 4,800 |
| Bal. | 200 | | |

**Buildings & Equipment**

| | | | |
|---|---|---|---|
| Bal. | 500,000 | | |

**Accumulated Depreciation**

| | | | |
|---|---|---|---|
| | | Bal. | 210,000 |
| | | (e) | 30,000 |
| | | Bal. | 240,000 |

**Manufacturing Overhead**

| | | | |
|---|---|---|---|
| (b) | 5,000 | (i)* | 96,000 |
| (c) | 30,000 | | |
| (d) | 12,000 | | |
| (e) | 25,000 | | |
| (f) | 4,000 | | |
| (h) | 17,000 | | |
| | | Bal. | 3,000 |

**Accounts Payable**

| | | | |
|---|---|---|---|
| (m) | 150,000 | Bal. | 75,000 |
| | | (a) | 80,000 |
| | | (d) | 12,000 |
| | | (g) | 40,000 |
| | | (h) | 17,000 |
| | | Bal. | 74,000 |

$* \frac{\$80,000}{\$100,000}$ = 80% of direct labor cost; \$120,000 × 0.80 = \$96,000.

**Retained Earnings**

| | | | |
|---|---|---|---|
| | | Bal. | 125,000 |

**Capital Stock**

| | | | |
|---|---|---|---|
| | | Bal. | 250,000 |

**Problem 3-28** (continued)

| Salaries Expense | |
|---|---|
| (c) 75,000 | |

| Depreciation Expense | |
|---|---|
| (e) 5,000 | |

| Insurance Expense | |
|---|---|
| (f) 800 | |

| Shipping Expense | |
|---|---|
| (g) 40,000 | |

| Cost of Goods Sold | |
|---|---|
| (k) 300,000 | |

| Sales | |
|---|---|
| | (k) 450,000 |

3. Manufacturing overhead was overapplied by $3,000 for the year. This balance would be allocated between Work in Process, Finished Goods, and Cost of Goods Sold in proportion to the ending balances in these accounts. The allocation would be:

| | | |
|---|---|---|
| Work in Process, 12/31 ................ | $ 21,000 | 5.6 % |
| Finished Goods, 12/31.................. | 55,000 | 14.6 |
| Cost of Goods Sold, 12/31 ............ | 300,000 | 79.8 |
| | $376,000 | 100.0 % |

| | | |
|---|---|---|
| Manufacturing Overhead ............................. | 3,000 | |
| Work in Process (5.6% × $3,000)........... | | 168 |
| Finished Goods (14.6% × $3,000) ........... | | 438 |
| Cost of Goods Sold (79.8% × $3,000)...... | | 2,394 |

4.

Fantastic Props, Inc.
Income Statement
For the Year Ended December 31

| | | |
|---|---|---|
| Sales .......................................................... | | $450,000 |
| Cost of goods sold ($300,000 – $2,394).......... | | 297,606 |
| Gross margin............................................... | | 152,394 |
| Selling and administrative expenses: | | |
| Salaries expense ........................................ | $75,000 | |
| Depreciation expense ................................. | 5,000 | |
| Insurance expense..................................... | 800 | |
| Shipping expense....................................... | 40,000 | 120,800 |
| Net operating income ................................... | | $ 31,594 |

**Case 3-29** (60 minutes)

1. a.

$$\text{Predetermined overhead rate} = \frac{\text{Estimated total manufacturing overhead cost}}{\text{Estimated total amount of the allocation base}}$$

$$= \frac{\$1{,}440{,}000}{\$900{,}000 \text{ direct labor cost}} = 160\% \text{ of direct labor cost}$$

b. $21,200 × 160% = $33,920.

2. a.

| | *Cutting Department* | *Machining Department* | *Assembly Department* |
|---|---|---|---|
| Estimated manufacturing overhead cost (a) .......... | $540,000 | $800,000 | $100,000 |
| Estimated direct labor cost (b) ......................... | $300,000 | $200,000 | $400,000 |
| Predetermined overhead rate (a) ÷ (b) ............... | 180% | 400% | 25% |

b.

| | |
|---|---|
| Cutting Department: | |
| $6,500 × 180% ................................ | $11,700 |
| Machining Department: | |
| $1,700 × 400% ................................ | 6,800 |
| Assembly Department: | |
| $13,000 × 25% ................................ | 3,250 |
| Total applied overhead ......................... | $21,750 |

3. The bulk of the labor cost on the Hastings job is in the Assembly Department, which incurs very little overhead cost. The department has an overhead rate of only 25% of direct labor cost as compared to much higher rates in the other two departments. Therefore, as shown above, use of departmental overhead rates results in a relatively small amount of overhead cost charged to the job.

**Case 3-29** (continued)

However, use of a plantwide overhead rate in effect redistributes overhead costs proportionately between the three departments (at 160% of direct labor cost) and results in a large amount of overhead cost being charged to the Hastings job, as shown in Part 1. This may explain why the company bid too high and lost the job. Too much overhead cost was assigned to the job for the kind of work being done on the job in the plant.

If a plantwide overhead rate is being used, the company will tend to charge too little overhead cost to jobs that require a large amount of labor in the Cutting or Machining Departments. The reason is that the plantwide overhead rate (160%) is much lower than the rates if these departments were considered separately.

4. The company's bid price was:

| | |
|---|---|
| Direct materials | $ 18,500 |
| Direct labor | 21,200 |
| Manufacturing overhead applied (above) | 33,920 |
| Total manufacturing cost | 73,620 |
| Bidding rate | × 1.5 |
| Total bid price | $110,430 |

If departmental overhead rates had been used, the bid price would have been:

| | |
|---|---|
| Direct materials | $ 18,500 |
| Direct labor | 21,200 |
| Manufacturing overhead applied (above) | 21,750 |
| Total manufacturing cost | 61,450 |
| Bidding rate | × 1.5 |
| Total bid price | $ 92,175 |

Note that if departmental overhead rates had been used, Lenko Products would have been the low bidder on the Hastings job since the competitor underbid Lenko by only $10,000.

**Case 3-29** (continued)

5. a.

| | |
|---|---|
| Actual overhead cost | $1,482,000 |
| Applied overhead cost ($870,000 × 160%) | 1,392,000 |
| Underapplied overhead cost | $ 90,000 |

b.

| | *Department* | | | |
|---|---|---|---|---|
| | *Cutting* | *Machining* | *Assembly* | *Total Plant* |
| Actual overhead cost | $560,000 | $830,000 | $92,000 | $1,482,000 |
| Applied overhead cost: | | | | |
| $320,000 × 180% | 576,000 | | | |
| $210,000 × 400% | | 840,000 | | |
| $340,000 × 25% | | | 85,000 | 1,501,000 |
| Underapplied (overapplied) overhead cost | $(16,000) | $(10,000) | $ 7,000 | $ (19,000) |

**Case 3-30** (45 minutes)

1. Shaving 5% off the estimated direct labor-hours in the predetermined overhead rate will result in an artificially high overhead rate, which is likely to result in overapplied overhead for the year. The cumulative effect of overapplying the overhead throughout the year is all recognized in December when the balance in the Manufacturing Overhead account is closed out to Cost of Goods Sold. If the balance were closed out every month or every quarter, this effect would be dissipated over the course of the year.

2. This question may generate lively debate. Where should Cristin Madsen's loyalties lie? Is she working for the general manager of the division or for the corporate controller? Is there anything wrong with the "Christmas bonus"? How far should Cristin go in bucking her boss on a new job?

   While individuals can certainly disagree about what Cristin should do, some of the facts are indisputable. First, the practice of understating direct labor-hours results in artificially inflating the overhead rate. This has the effect of inflating the cost of goods sold figures in all months prior to December and overstating the costs of inventories. In December, the adjustment for overapplied overhead provides a big boost to net operating income. Therefore, the practice results in distortions in the pattern of net operating income over the year. In addition, since all of the adjustment is taken to Cost of Goods Sold, inventories are still overstated at year-end. This means that retained earnings is also overstated.

   While Cristin is in an extremely difficult position, her responsibilities under the IMA's Statement of Ethical Professional Practice seem to be clear. The Credibility standard states that management accountants have a responsibility to "disclose all relevant information that could reasonably be expected to influence an intended user's understanding of the reports, analyses, or recommendations." Cristin should discuss this situation with her immediate supervisor in the controller's office at corporate headquarters. This step may bring her into direct conflict with the general manager of the division, so it would be a very difficult decision for her to make.

**Case 3-30** (continued)

In the actual situation that this case is based on, the corporate controller's staff were aware of the general manager's accounting tricks, but top management of the company supported the general manager because "he comes through with the results" and could be relied on to hit the annual profit targets for his division. Personally, we would be very uncomfortable supporting a manager who will resort to deliberate distortions to achieve "results." If the manager will pull tricks in this area, what else might he be doing that is questionable or even perhaps illegal?

# Appendix 3A
## The Predetermined Overhead Rate and Capacity

**Exercise 3A-1** (30 minutes)

1. The overhead applied to Ms. Miyami's account would be computed as follows:

| | *2010* | *2011* |
|---|---|---|
| Estimated overhead cost (a) | $144,000 | $144,000 |
| Estimated professional staff hours (b) | 2,400 | 2,250 |
| Predetermined overhead rate (a) ÷ (b) | $60 | $64 |
| Professional staff hours charged to Ms. Miyami's account | × 5 | × 5 |
| Overhead applied to Ms. Miyami's account | $300 | $320 |

2. If the actual overhead cost and the actual professional hours charged turn out to be exactly as estimated there would be no underapplied or overapplied overhead.

| | *2010* | *2011* |
|---|---|---|
| Predetermined overhead rate (see above) | $60 | $64 |
| Actual professional staff hours charged to clients' accounts (by assumption) | × 2,400 | × 2,250 |
| Overhead applied | $144,000 | $144,000 |
| Actual overhead cost incurred (by assumption) | 144,000 | 144,000 |
| Under- or overapplied overhead | $ 0 | $ 0 |

3. If the predetermined overhead rate is based on the professional staff hours available, the computations would be:

| | *2010* | *2011* |
|---|---|---|
| Estimated overhead cost (a) | $144,000 | $144,000 |
| Professional staff hours available (b) | 3,000 | 3,000 |
| Predetermined overhead rate (a) ÷ (b) | $48 | $48 |
| Professional staff hours charged to Ms. Miyami's account | × 5 | × 5 |
| Overhead applied to Ms. Miyami's account | $240 | $240 |

**Problem 3A-1** (continued)

4. If the actual overhead cost and the actual professional staff hours charged to clients' accounts turn out to be exactly as estimated overhead would be underapplied as shown below.

| | *2010* | *2011* |
|---|---|---|
| Predetermined overhead rate (see 3 above) (a)... | $48 | $48 |
| Actual professional staff hours charged to clients' accounts (by assumption) (b) ............... | × 2,250 | × 2,400 |
| Overhead applied (a) × (b) ................................ | $108,000 | $115,200 |
| Actual overhead cost incurred (by assumption).... | 144,000 | 144,000 |
| Underapplied overhead ..................................... | $ 36,000 | $ 28,800 |

The underapplied overhead is best interpreted in this situation as the cost of idle capacity. Proponents of this method of computing predetermined overhead rates suggest that the underapplied overhead be treated as a period expense that would be separately disclosed on the income statement as Cost of Unused Capacity.

**Exercise 3A-2** (30 minutes)

1. There were no beginning or ending inventories, so all of the jobs were started, finished, and sold during the month. Therefore cost of goods sold equals the total manufacturing cost. We can verify that by computing the cost of goods sold as shown below:

| | |
|---|---|
| Manufacturing costs charged to jobs: | |
| Direct materials | $ 5,350 |
| Direct labor (all variable) | 8,860 |
| Manufacturing overhead applied (150 hours × $82 hour) | 12,300 |
| Total manufacturing cost charged to jobs | 26,510 |
| Add: Beginning work in process inventory | 0 |
| | 26,510 |
| Deduct: Ending work in process inventory | 0 |
| Cost of goods manufactured | $26,510 |
| Beginning finished goods inventory | $ 0 |
| Add: Cost of goods manufactured | 26,510 |
| Goods available for sale | 26,510 |
| Deduct: Ending finished goods inventory | 0 |
| Cost of goods sold | $26,510 |

At the end of the month, overhead was underapplied by $1,920 as shown below:

| | |
|---|---|
| Manufacturing overhead incurred | $14,220 |
| Manufacturing overhead applied (150 hours × $82 hour) | 12,300 |
| Overhead underapplied | $ 1,920 |

**Exercise 3A-2** (continued)

Consequently, the income statement would appear as follows:

Wixis Cabinets
Income Statement

| | | |
|---|---|---|
| Sales | | $43,740 |
| Cost of goods sold (see above) | | 26,510 |
| Gross margin | | 17,230 |
| Underapplied manufacturing overhead | $1,920 | |
| Selling and administrative expenses | 8,180 | 10,100 |
| Net operating income | | $ 7,130 |

2. When the predetermined overhead rate is based on capacity, overhead is ordinarily underapplied because manufacturing overhead ordinarily contains significant amounts of fixed costs. Suppose, for example, that manufacturing overhead includes $10,000 of fixed costs and the capacity is 100 hours. Then the portion of the predetermined overhead rate that represents fixed costs is $10,000 divided by 100 hours or $100 per hour. Because the plant is seldom (if ever) operated beyond capacity, less than $10,000 will ordinarily be applied to jobs. In other words, $100 per hour multiplied by something less than 100 hours always yields less than $10,000. Therefore, overhead will ordinarily be underapplied.

**Problem 3A-3** (60 minutes)

1. The overhead applied to the Slug Fest job would be computed as follows:

| | 2010 | 2011 |
|---|---|---|
| Estimated studio overhead cost (a) | $90,000 | $90,000 |
| Estimated hours of studio service (b) | 1,000 | 750 |
| Predetermined overhead rate (a) ÷ (b) | $90 | $120 |
| Slug Fest job's studio hours | × 30 | × 30 |
| Overhead applied to the Slug Fest job | $2,700 | $3,600 |

Overhead is underapplied for both years as computed below:

| | 2010 | 2011 |
|---|---|---|
| Predetermined overhead rate (see above) (a) | $90 | $120 |
| Actual hours of studio service provided (b) | × 900 | × 600 |
| Overhead applied (a) × (b) | $81,000 | $72,000 |
| Actual studio cost incurred | 90,000 | 90,000 |
| Underapplied overhead | $ 9,000 | $18,000 |

2. If the predetermined overhead rate is based on the hours of studio service at capacity, the computations would be:

| | 2010 | 2011 |
|---|---|---|
| Estimated studio overhead cost (a) | $90,000 | $90,000 |
| Hours of studio service at capacity (b) | 1,800 | 1,800 |
| Predetermined overhead rate (a) ÷ (b) | $50 | $50 |
| Slug Fest job's studio hours | × 30 | × 30 |
| Overhead applied to the Slug Fest job | $1,500 | $1,500 |

Overhead is underapplied for both years under this method as well:

| | 2010 | 2011 |
|---|---|---|
| Predetermined overhead rate (see above) (a) | $50 | $50 |
| Actual hours of studio service provided (b) | × 900 | × 600 |
| Overhead applied (a) × (b) | $45,000 | $30,000 |
| Actual studio cost incurred | 90,000 | 90,000 |
| Underapplied overhead | $45,000 | $60,000 |

3. When the predetermined overhead rate is based on capacity, underapplied overhead is interpreted as the cost of idle capacity. Indeed, proponents of this method suggest that underapplied overhead be treated as a period expense that would be separately disclosed on the income statement as Cost of Unused Capacity.

4. Skid Road Recording's fundamental problem is the competition that is drawing customers away. The competition is able to offer the latest equipment, excellent service, and attractive prices. The company must do something to counter this threat or it will ultimately face failure.

   Under the conventional approach in which the predetermined overhead rate is based on the estimated studio hours, the apparent cost of the Slug Fest job has increased between 2010 and 2011. That happens because the company is losing business to competitors and therefore the company's fixed overhead costs are being spread over a smaller base. This results in costs that seem to increase as the volume declines. Skid Road Recording's managers may be misled into thinking that the problem is rising costs and they may be tempted to raise prices to recover their apparently increasing costs. This would almost surely accelerate the company's decline.

   Under the alternative approach, the overhead cost of the Slug Fest job is stable at $1,500 and lower than the costs reported under the conventional method. Under the conventional method, managers may be misled into thinking that they are actually losing money on the Slug Fest job and they might refuse such jobs in the future—another sure road to disaster. This is much less likely to happen if the lower cost of $1,500 is reported. It is true that the underapplied overhead under the alternative approach is much larger than under the conventional approach and is growing. However, if it is properly labeled as the cost of idle capacity, management is much more likely to draw the appropriate conclusion that the real problem is the loss of business (and therefore more idle capacity) rather than an increase in costs.

   While basing the predetermined rate on capacity rather than on estimated activity will not solve the company's basic problems, at least this method will be less likely to send managers misleading signals.

**Case 3A-4** (120 minutes)

1. **Traditional approach:**

| | |
|---|---|
| Actual total manufacturing overhead cost incurred (assumed to equal the original estimate) | $2,000,000 |
| Manufacturing overhead applied (80,000 units × $25 per unit) | 2,000,000 |
| Overhead underapplied or overapplied | $ 0 |

TurboDrives, Inc.
Income Statement: Traditional Approach

| | | |
|---|---|---|
| Sales (75,000 units × $70 per unit) | | $5,250,000 |
| Cost of goods sold: | | |
| Variable manufacturing (75,000 units × $18 per unit) | $1,350,000 | |
| Manufacturing overhead applied (75,000 units × $25 per unit) | 1,875,000 | 3,225,000 |
| Gross margin | | 2,025,000 |
| Selling and administrative expenses | | 1,950,000 |
| Net operating income | | $ 75,000 |

**New approach:**

TurboDrives, Inc.
Income Statement: New Approach

| | | |
|---|---|---|
| Sales (75,000 units × $70 per unit) | | $5,250,000 |
| Cost of goods sold: | | |
| Variable manufacturing (75,000 units × $18 per unit) | $1,350,000 | |
| Manufacturing overhead applied (75,000 units × $20 per unit) | 1,500,000 | 2,850,000 |
| Gross margin | | 2,400,000 |
| Cost of unused capacity [(100,000 units – 80,000 units) × $20 per unit] | | 400,000 |
| Selling and administrative expenses | | 1,950,000 |
| Net operating income | | $ 50,000 |

2. **Traditional approach:**
   Under the traditional approach, the reported net operating income can be increased by increasing the production level, which then results in overapplied overhead that is deducted from Cost of Goods Sold.

| | |
|---|---|
| Additional net operating income required to attain target net operating income ($210,000 − $75,000) (a) | $135,000 |
| Overhead applied per unit of output (b) | $25 per unit |
| Additional output required to attain target net operating income (a) ÷ (b) | 5,400 units |
| Actual total manufacturing overhead cost incurred | $2,000,000 |
| Manufacturing overhead applied [(80,000 units + 5,400 units) × $25 per unit] | 2,135,000 |
| Overhead overapplied | $ 135,000 |

TurboDrives, Inc.
Income Statement: Traditional Approach

| | | |
|---|---|---|
| Sales (75,000 units × $70 per unit) | | $5,250,000 |
| Cost of goods sold: | | |
| Variable manufacturing (75,000 units × $18 per unit) | $1,350,000 | |
| Manufacturing overhead applied (75,000 units × $25 per unit) | 1,875,000 | |
| Less: Manufacturing overhead overapplied | 135,000 | 3,090,000 |
| Gross margin | | 2,160,000 |
| Selling and administrative expenses | | 1,950,000 |
| Net operating income | | $ 210,000 |

Note: If the overapplied manufacturing overhead were prorated between ending inventories and Cost of Goods Sold, more units would have to be produced to attain the target net profit of $210,000.

**Case 3A-4** (continued)

**New approach:**
Under the new approach, the reported net operating income can be increased by increasing the production level which then results in less of a deduction on the income statement for the Cost of Unused Capacity.

| | |
|---|---|
| Additional net operating income required to attain target net operating income ($210,000 − $50,000) (a) | $160,000 |
| Overhead applied per unit of output (b) | $20 per unit |
| Additional output required to attain target net operating income (a) ÷ (b) | 8,000 units |
| Estimated number of units produced | 80,000 units |
| Actual number of units to be produced | 88,000 units |

TurboDrives, Inc.
Income Statement: New Approach

| | | |
|---|---|---|
| Sales (75,000 units × $70 per unit) | | $5,250,000 |
| Cost of goods sold: | | |
| Variable manufacturing (75,000 units × $18 per unit) | $1,350,000 | |
| Manufacturing overhead applied (75,000 units × $20 per unit) | 1,500,000 | 2,850,000 |
| Gross margin | | 2,400,000 |
| Cost of unused capacity [(100,000 units − 88,000 units) × $20 per unit] | | 240,000 |
| Selling and administrative expenses | | 1,950,000 |
| Net operating income | | $ 210,000 |

3. Net operating income is more volatile under the new method than under the old method. The reason for this is that the reported profit per unit sold is higher under the new method by $5, the difference in the predetermined overhead rates. As a consequence, swings in sales in either direction will have a more dramatic impact on reported profits under the new method.

**Case 3A-4** (continued)

4. As the computations in part (2) above show, the "hat trick" is a bit harder to perform under the new method. Under the old method, the target net operating income can be attained by producing an additional 5,400 units. Under the new method, the production would have to be increased by 8,000 units. This is a consequence of the difference in predetermined overhead rates. The drop in sales has had a more dramatic effect on net operating income under the new method as noted above in part (3). In addition, since the predetermined overhead rate is lower under the new method, producing excess inventories has less of an effect per unit on net operating income than under the traditional method and hence more excess production is required.

5. One can argue that whether the "hat trick" is unethical depends on the level of sophistication of the owners of the company and others who read the financial statements. If they understand the effects of excess production on net operating income and are not misled, it can be argued that the hat trick is ethical. However, if that were the case, there does not seem to be any reason to use the hat trick. Why would the owners want to tie up working capital in inventories just to artificially attain a target net operating income for the period? And increasing the rate of production toward the end of the year is likely to increase overhead costs due to overtime and other costs. Building up inventories all at once is very likely to be much more expensive than increasing the rate of production uniformly throughout the year. In the case, we assumed that there would not be an increase in overhead costs due to the additional production, but that is likely not to be true.

   In our opinion the hat trick is unethical unless there is a good reason for increasing production other than to artificially boost the current period's net operating income. It is certainly unethical if the purpose is to fool users of financial reports such as owners and creditors or if the purpose is to meet targets so that bonuses will be paid to top managers.

# Appendix 3B
## Further Classification of Labor Costs

**Exercise 3B-1** (10 minutes)

| | |
|---|---|
| Direct labor (36 hours × \$18 per hour) .......... | \$648 |
| Manufacturing overhead | |
| (idle time: 4 hours × \$18 per hour) ........... | 72 |
| Total wages earned ..................................... | \$720 |

**Exercise 3B-2** (10 minutes)

| | |
|---|---|
| Direct labor (46 hours × $16 per hour) .......... | $736 |
| Manufacturing overhead | |
| (overtime: 6 hours × $8 per hour) ............ | 48 |
| Total wages earned ...................................... | $784 |

**Exercise 3B-3** (15 minutes)

1. No. It appears that the overtime spent completing the job was simply a matter of how the job happened to be scheduled. Under these circumstances, an overtime premium probably should not be charged to a customer whose job happens to fall at the tail end of the day's schedule.

2.

| | |
|---|---|
| Direct labor: 9 hours × $20 per hour | $180 |
| General overhead: 1 hour × $10 per hour | 10 |
| Total labor cost | $190 |

3. A charge for an overtime premium might be justified if the customer requested that the work be done on a "rush" basis.

**Exercise 3B-4** (15 minutes)

1. 

| | |
|---|---|
| Direct labor: 34 hours × $12 per hour | $408 |
| Manufacturing overhead: 6 hours × $12 per hour | 72 |
| Total cost | $480 |

2. 

| | |
|---|---|
| Direct labor: 50 hours × $12 per hour | $600 |
| Manufacturing overhead: 10 hours × $6 per hour | 60 |
| Total cost | $660 |

3. The company could treat the cost of fringe benefits relating to direct labor workers as part of manufacturing overhead. This approach spreads the cost of such fringe benefits over all units of output. Alternatively, the company could treat the cost of fringe benefits relating to direct labor workers as additional direct labor cost. This latter approach charges the costs of fringe benefits to specific jobs rather than to all units of output.

**Problem 3B-5** (30 minutes)

1. Total wages for the week:

| | | |
|---|---|---|
| Regular time: 40 hours × $24 per hour | | $ 960 |
| Overtime: 5 hours × $36 per hour | | 180 |
| Total wages | | $1,140 |
| Allocation of total wages: | | |
| Direct labor: 45 hours × $24 per hour | | $1,080 |
| Manufacturing overhead: 5 hours × $12 per hour | | 60 |
| Total wages | | $1,140 |

2. Total wages for the week:

| | | |
|---|---|---|
| Regular time: 40 hours × $24 per hour | | $ 960 |
| Overtime: 10 hours × $36 per hour | | 360 |
| Total wages | | $1,320 |
| Allocation of total wages: | | |
| Direct labor: 46 hours × $24 per hour | | $1,104 |
| Manufacturing overhead: | | |
| Idle time: 4 hours × $24 per hour | $ 96 | |
| Overtime premium: 10 hours × $12 per hour | 120 | 216 |
| Total wages | | $1,320 |

3. Total wages and fringe benefits for the week:

| | | |
|---|---|---|
| Regular time: 40 hours × $24 per hour | | $ 960 |
| Overtime: 8 hours × $36 per hour | | 288 |
| Fringe benefits: 48 hours × $8 per hour | | 384 |
| Total wages and fringe benefits | | $1,632 |
| Allocation of wages and fringe benefits: | | |
| Direct labor: 45 hours × $24 per hour | | $1,080 |
| Manufacturing overhead: | | |
| Idle time: 3 hours × $24 per hour | $ 72 | |
| Overtime premium: 8 hours × $12 per hour | 96 | |
| Fringe benefits: 48 hours × $8 per hour | 384 | 552 |
| Total wages and fringe benefits | | $1,632 |

**Problem 3B-5** (continued)

4. Allocation of wages and fringe benefits:

| | | |
|---|---|---|
| Direct labor: | | |
| Wage cost: 45 hours × $24 per hour | $1,080 | |
| Fringe benefits: 45 hours × $8 per hour | 360 | $1,440 |
| Manufacturing overhead: | | |
| Idle time: 3 hours × $24 per hour | 72 | |
| Overtime premium: 8 hours × $12 per hour | 96 | |
| Fringe benefits: 3 hours × $8 per hour | 24 | 192 |
| Total wages and fringe benefits | | $1,632 |

# Chapter 4
# Process Costing

## Solutions to Questions

**4-1** A process costing system should be used in situations where a homogeneous product is produced on a continuous basis.

**4-2** Job-order and processing costing are similar in the following ways:

1. Job-order costing and process costing have the same basic purposes—to assign materials, labor, and overhead cost to products and to provide a mechanism for computing unit product costs.
2. Both systems use the same basic manufacturing accounts.
3. Costs flow through the accounts in basically the same way in both systems.

**4-3** Cost accumulation is simpler under process costing because costs only need to be assigned to departments—not individual jobs. A company usually has a small number of processing departments, whereas a job-order costing system often must keep track of the costs of hundreds or even thousands of jobs.

**4-4** In a process costing system, a Work in Process account is maintained for each processing department.

**4-5** The journal entry to record the transfer of work in process from the Mixing Department to the Firing Department is:

| | | |
|---|---|---|
| Work in Process, Firing........ | XXXX | |
| Work in Process, Mixing. | | XXXX |

**4-6** The costs that might be added in the Firing Department include: (1) costs transferred in from the Mixing Department; (2) materials costs added in the Firing Department; (3) labor costs added in the Firing Department; and (4) overhead costs added in the Firing Department.

**4-7** Under the weighted-average method, equivalent units of production consist of units transferred to the next department (or to finished goods) during the period plus the equivalent units in the department's ending work in process inventory.

**4-8** The company will want to distinguish between the costs of the metals used to make the medallions, but the medals are otherwise identical and go through the same production processes. Thus, operation costing is ideally suited for the company's needs.

**Exercise 4-1** (20 minutes)

a. To record issuing raw materials for use in production:

| | | |
|---|---|---|
| Work in Process—Molding Department | 28,000 | |
| Work in Process—Firing Department | 5,000 | |
| Raw Materials | | 33,000 |

b. To record direct labor costs incurred:

| | | |
|---|---|---|
| Work in Process—Molding Department | 18,000 | |
| Work in Process—Firing Department | 5,000 | |
| Wages Payable | | 23,000 |

c. To record applying manufacturing overhead:

| | | |
|---|---|---|
| Work in Process—Molding Department | 24,000 | |
| Work in Process—Firing Department | 37,000 | |
| Manufacturing Overhead | | 61,000 |

d. To record transfer of unfired, molded bricks from the Molding Department to the Firing Department:

| | | |
|---|---|---|
| Work in Process—Firing Department | 67,000 | |
| Work in Process—Molding Department | | 67,000 |

e. To record transfer of finished bricks from the Firing Department to the finished goods warehouse:

| | | |
|---|---|---|
| Finished Goods | 108,000 | |
| Work in Process—Firing Department | | 108,000 |

f. To record Cost of Goods Sold:

| | | |
|---|---|---|
| Cost of Goods Sold | 106,000 | |
| Finished Goods | | 106,000 |

**Exercise 4-2** (10 minutes)

Weighted-Average Method

| | Equivalent Units | |
|---|---|---|
| | *Materials* | *Conversion* |
| Units transferred out ................................... | 410,000 | 410,000 |
| Work in process, ending: | | |
| 30,000 units × 70%.................................. | 21,000 | |
| 30,000 units × 50%.................................. | | 15,000 |
| Equivalent units of production ....................... | 431,000 | 425,000 |

**Exercise 4-3** (10 minutes)

Weighted-Average Method

1.

| | *Materials* | *Labor* | *Overhead* |
|---|---|---|---|
| Cost of beginning work in process inventory | $ 14,550 | $ 23,620 | $118,100 |
| Cost added during the period | 88,350 | 14,330 | 71,650 |
| Total cost (a) | $102,900 | $37,950 | $189,750 |
| Equivalent units of production (b) | 1,200 | 1,100 | 1,100 |
| Cost per equivalent unit (a) ÷ (b) | $85.75 | $34.50 | $172.50 |

2.

| | |
|---|---|
| Cost per equivalent unit for materials | $ 85.75 |
| Cost per equivalent unit for labor | 34.50 |
| Cost per equivalent unit for overhead | 172.50 |
| Total cost per equivalent unit | $292.75 |

**Exercise 4-4** (10 minutes)

Weighted-Average Method

| | *Materials* | *Conversion* | *Total* |
|---|---|---|---|
| *Ending work in process inventory:* | | | |
| Equivalent units of production ................. | 300 | 100 | |
| Cost per equivalent unit .......................... | $31.56 | $9.32 | |
| Cost of ending work in process inventory . | $9,468 | $932 | $10,400 |
| | | | |
| *Units completed and transferred out:* | | | |
| Units transferred to the next department . | 1,300 | 1,300 | |
| Cost per equivalent unit .......................... | $31.56 | $9.32 | |
| Cost of units transferred out ................... | $41,028 | $12,116 | $53,144 |

**Exercise 4-5** (10 minutes)

Baking Department
Cost Reconciliation

| | |
|---|---|
| Costs to be accounted for: | |
| Cost of beginning work in process inventory . | $ 4,830 |
| Costs added to production during the period. | 25,650 |
| Total cost to be accounted for .................... | $30,480 |
| Costs accounted for as follows: | |
| Cost of ending work in process inventory...... | $ 1,120 |
| Cost of units completed and transferred out . | 29,360 * |
| Total cost accounted for ............................ | $30,480 |

*The cost of units completed and transferred out can be deduced as follows:

$$\text{Cost of beginning work in process inventory} + \text{Costs added to production during the period} = \text{Cost of ending work in process inventory} + \text{Cost of units completed and transferred out}$$

$$\$4{,}830 + \$25{,}650 = \$1{,}120 + \text{Cost of units completed and transferred out}$$

$$\text{Cost of units completed and transferred out} = \$4{,}830 + \$25{,}650 - \$1{,}120$$

$$\text{Cost of units completed and transferred out} = \$29{,}360$$

**Exercise 4-6** (15 minutes)

Weighted-Average Method

| 1. | *Materials* | *Labor* | *Overhead* |
|---|---|---|---|
| Units transferred to the next department | 790,000 | 790,000 | 790,000 |
| Work in process, ending: | | | |
| Materials: | | | |
| 50,000 units × 60% complete | 30,000 | | |
| Labor and overhead: | | | |
| 50,000 units × 20% complete | | 10,000 | 10,000 |
| Equivalent units of production | 820,000 | 800,000 | 800,000 |

| 2. | *Materials* | *Labor* | *Overhead* |
|---|---|---|---|
| Cost of beginning work in process | $ 68,600 | $ 30,000 | $ 48,000 |
| Cost added during the period | 907,200 | 370,000 | 592,000 |
| Total cost (a) | $975,800 | $400,000 | $640,000 |
| Equivalent units of production (b) | 820,000 | 800,000 | 800,000 |
| Cost per equivalent unit (a) ÷ (b) | $1.19 | $0.50 | $0.80 |

**Exercise 4-7** (30 minutes)

Weighted-Average Method

1. Equivalent units of production

| | Pulping | Conversion |
|---|---|---|
| Transferred to next department | 146,000 | 146,000 |
| Ending work in process: | | |
| Pulping: 6,000 units x 100% complete | 6,000 | |
| Conversion: 6,000 units x 75% complete | | 4,500 |
| Equivalent units of production | 152,000 | 150,500 |

2. Cost per equivalent unit

| | Pulping | Conversion |
|---|---|---|
| Cost of beginning work in process | $ 1,500 | $ 400 |
| Cost added during the period | 59,300 | 22,100 |
| Total cost (a) | $60,800 | $22,500 |
| Equivalent units of production (b) | 152,000 | 150,500 |
| Cost per equivalent unit, (a) ÷ (b) | $0.40 | $0.1495 |

3. Cost of ending work in process inventory and units transferred out

| | Pulping | Conversion | Total |
|---|---|---|---|
| Ending work in process inventory: | | | |
| Equivalent units of production | 6,000 | 4,500 | |
| Cost per equivalent unit | $0.40 | $0.1495 | |
| Cost of ending work in process inventory | $2,400 | $673 | $3,073 |
| Units completed and transferred out: | | | |
| Units transferred to the next department | 146,000 | 146,000 | |
| Cost per equivalent unit | $0.40 | $0.1495 | |
| Cost of units completed and transferred out | $58,400 | $21,827 | $80,227 |

**Exercise 4-7** (continued)

4. Cost reconciliation

| | |
|---|---|
| Costs to be accounted for: | |
| Cost of beginning work in process inventory ($1,500 + $400) | $ 1,900 |
| Costs added to production during the period ($59,300 + $22,100) | 81,400 |
| Total cost to be accounted for | $83,300 |
| Costs accounted for as follows: | |
| Cost of ending work in process inventory | $ 3,073 |
| Cost of units completed and transferred out | 80,227 |
| Total cost accounted for | $83,300 |

**Exercise 4-8** (10 minutes)

| | | |
|---|---|---|
| Work in Process—Mixing | 330,000 | |
| Raw Materials Inventory | | 330,000 |
| Work in Process—Mixing | 260,000 | |
| Work in Process—Baking | 120,000 | |
| Wages Payable | | 380,000 |
| Work in Process—Mixing | 190,000 | |
| Work in Process—Baking | 90,000 | |
| Manufacturing Overhead | | 280,000 |
| Work in Process—Baking | 760,000 | |
| Work in Process—Mixing | | 760,000 |
| Finished Goods | 980,000 | |
| Work in Process—Baking | | 980,000 |

**Exercise 4-9** (20 minutes)

Weighted-Average Method

1. Computation of equivalent units in ending inventory:

| | *Materials* | *Labor* | *Overhead* |
|---|---|---|---|
| Units in ending inventory.......... | 1,500 | 1,500 | 1,500 |
| Percent completed.................. | 90% | 40% | 40% |
| Equivalent units of production... | 1,350 | 600 | 600 |

2. Cost of ending work in process inventory and units transferred out:

| | *Materials* | *Labor* | *Overhead* | *Total* |
|---|---|---|---|---|
| Ending work in process inventory: | | | | |
| Equivalent units of production.................. | 1,350 | 600 | 600 | |
| Cost per equivalent unit. | $24.00 | $7.00 | $14.00 | |
| Cost of ending work in process inventory........ | $32,400 | $4,200 | $8,400 | $45,000 |
| Units completed and transferred out: | | | | |
| Units transferred to the next department......... | 18,000 | 18,000 | 18,000 | |
| Cost per equivalent unit. | $24.00 | $7.00 | $14.00 | |
| Cost of units completed and transferred out..... | $432,000 | $126,000 | $252,000 | $810,000 |

3. Cost reconciliation:

| | |
|---|---|
| Total cost to be accounted for .......................... | $855,000 |
| Costs accounted for as follows: | |
| Cost of ending work in process inventory ...... | $ 45,000 |
| Cost of units completed and transferred out .. | 810,000 |
| Total cost accounted for............................... | $855,000 |

**Exercise 4-10** (10 minutes)

Weighted-Average Method

1.

| | Kilograms of Cement |
|---|---|
| Work in process, May 1 | 80,000 |
| Started into production during the month | 300,000 |
| Total kilograms in process | 380,000 |
| Deduct work in process, May 31 | 50,000 |
| Completed and transferred out during the month | 330,000 |

2.

| | Equivalent Units (EU) | |
|---|---|---|
| | Materials | Conversion |
| Units transferred out | 330,000 | 330,000 |
| Work in process, ending: | | |
| Materials: 50,000 kilograms × 40% | 20,000 | |
| Conversion: 50,000 kilograms × 10% | | 5,000 |
| Equivalent units of production | 350,000 | 335,000 |

**Exercise 4-11** (30 minutes)

Weighted-Average Method

1.

| | *Materials* | *Conversion* |
|---|---|---|
| Units transferred to the next process | 300,000 | 300,000 |
| Ending work in process: | | |
| Materials: 40,000 units × 50% complete | 20,000 | |
| Conversion: 40,000 units × 25% complete | | 10,000 |
| Equivalent units of production | 320,000 | 310,000 |

2.

| | *Materials* | *Conversion* |
|---|---|---|
| Cost of beginning work in process | $ 56,600 | $ 14,900 |
| Cost added during the period | 385,000 | 214,500 |
| Total cost (a) | $441,600 | $229,400 |
| Equivalent units of production (b) | 320,000 | 310,000 |
| Cost per equivalent unit (a) ÷ (b) | $1.38 | $0.74 |

3.

| | *Materials* | *Conversion* | *Total* |
|---|---|---|---|
| *Ending work in process inventory:* | | | |
| Equivalent units of production (see above) | 20,000 | 10,000 | |
| Cost per equivalent unit (see above) | $1.38 | $0.74 | |
| Cost of ending work in process inventory | $27,600 | $7,400 | $35,000 |
| *Units completed and transferred out:* | | | |
| Units transferred to the next process | 300,000 | 300,000 | |
| Cost per equivalent unit (see previous exercise) | $1.38 | $0.74 | |
| Cost of units completed and transferred out | $414,000 | $222,000 | $636,000 |

**Exercise 4-12** (10 minutes)

Weighted-Average Method

| | *Material s* | *Labor & Overhead* |
|---|---|---|
| Pounds transferred to the Packing Department during May* | 490,000 | 490,000 |
| Work in process, May 31: | | |
| Materials: 20,000 pounds × 100% complete | 20,000 | |
| Labor and overhead: 20,000 pounds × 90% complete | | 18,000 |
| Equivalent units of production | 510,000 | 508,000 |

* 30,000 + 480,000 – 20,000 = 490,000

**Problem 4-13** (45 minutes)

Weighted-Average Method

1. Equivalent Units of Production

| | *Materials* | *Conversion* |
|---|---|---|
| Transferred to next department* | 380,000 | 380,000 |
| Ending work in process: | | |
| Materials: 40,000 units x 75% complete | 30,000 | |
| Conversion: 40,000 units x 25% complete | | 10,000 |
| Equivalent units of production | 410,000 | 390,000 |

*Units transferred to the next department = Units in beginning work in process + Units started into production − Units in ending work in process = 70,000 + 350,000 − 40,000 = 380,000

2. Cost per Equivalent Unit

| | *Materials* | *Conversion* |
|---|---|---|
| Cost of beginning work in process | $ 86,000 | $ 36,000 |
| Cost added during the period | 447,000 | 198,000 |
| Total cost (a) | $533,000 | $234,000 |
| Equivalent units of production (b) | 410,000 | 390,000 |
| Cost per equivalent unit, (a) ÷ (b) | $1.30 | $0.60 |

3. Cost of Ending Work in Process Inventory and Units Transferred Out

| | *Materials* | *Conversion* | *Total* |
|---|---|---|---|
| Ending work in process inventory: | | | |
| Equivalent units of production (materials: 40,000 units x 75% complete; conversion: 40,000 units x 25% complete) | 30,000 | 10,000 | |
| Cost per equivalent unit | $1.30 | $0.60 | |
| Cost of ending work in process inventory | $39,000 | $6,000 | $45,000 |
| Units completed and transferred out: | | | |
| Units transferred to the next department | 380,000 | 380,000 | |
| Cost per equivalent unit | $1.30 | $0.60 | |

| | | | |
|---|---|---|---|
| Cost of units completed and transferred out .................. | $494,000 | $228,000 | $722,000 |

**Problem 4-13** (continued)

4. Cost Reconciliation

| | |
|---|---|
| Costs to be accounted for: | |
| Cost of beginning work in process inventory ($86,000 + $36,000) | $122,000 |
| Costs added to production during the period ($447,000 + $198,000) | 645,000 |
| Total cost to be accounted for | $767,000 |
| Costs accounted for as follows: | |
| Cost of ending work in process inventory | $ 45,000 |
| Cost of units completed and transferred out | 722,000 |
| Total cost accounted for | $767,000 |

**Problem 4-14** (45 minutes)

Weighted-Average Method

1. Equivalent Units of Production

| | *Materials* | *Conversion* |
|---|---|---|
| Transferred to next department ...................... | 450,000 | 450,000 |
| Ending work in process: | | |
| Materials: 80,000 units x 75% complete ......... | 60,000 | |
| Conversion: 80,000 units x 25% complete ...... | | 20,000 |
| Equivalent units of production ........................ | 510,000 | 470,000 |

2. Cost per Equivalent Unit

| | *Materials* | *Conversion* |
|---|---|---|
| Cost of beginning work in process ................ | $ 36,550 | $ 13,500 |
| Cost added during the period ...................... | 391,850 | 287,300 |
| Total cost (a) ............................................ | $428,400 | $300,800 |
| Equivalent units of production (b) ................ | 510,000 | 470,000 |
| Cost per equivalent unit, (a) ÷ (b) .............. | $0.84 | $0.64 |

3. Applying Costs to Units

| | *Materials* | *Conversion* | *Total* |
|---|---|---|---|
| Ending work in process inventory: | | | |
| Equivalent units of production | 60,000 | 20,000 | |
| Cost per equivalent unit ....... | $0.84 | $0.64 | |
| Cost of ending work in process inventory .......................... | $50,400 | $12,800 | $63,200 |
| Units completed and transferred out: | | | |
| Units transferred to the next department ...................... | 450,000 | 450,000 | |
| Cost per equivalent unit ....... | $0.84 | $0.64 | |
| Cost of units completed and transferred out .................. | $378,000 | $288,000 | $666,000 |

**Problem 4-14** (continued)

4. Cost Reconciliation

| | |
|---|---|
| Costs to be accounted for: | |
| Cost of beginning work in process inventory ($36,550 + $13,500) | $ 50,050 |
| Costs added to production during the period ($391,850 + $287,300) | 679,150 |
| Total cost to be accounted for | $729,200 |
| Costs accounted for as follows: | |
| Cost of ending work in process inventory | $ 63,200 |
| Cost of units completed and transferred out | 666,000 |
| Total cost accounted for | $729,200 |

**Problem 4-15** (45 minutes)

Weighted-Average Method

1. Equivalent units of production

| | *Materials* | *Conversion* |
|---|---|---|
| Transferred to next department* | 270,000 | 270,000 |
| Ending work in process: | | |
| Materials: 45,000 units x 100% complete | 45,000 | |
| Conversion: 45,000 units x 60% complete | | 27,000 |
| Equivalent units of production | 315,000 | 297,000 |

*Units transferred to the next department = Units in beginning work in process + Units started into production − Units in ending work in process = 35,000 + 280,000 − 45,000 = 270,000

2. Cost per equivalent unit

| | *Materials* | *Conversion* |
|---|---|---|
| Cost of beginning work in process | $ 43,400 | $ 20,300 |
| Cost added during the period | 397,600 | 187,600 |
| Total cost (a) | $441,000 | $207,900 |
| Equivalent units of production (b) | 315,000 | 297,000 |
| Cost per equivalent unit, (a) ÷ (b) | $1.40 | $0.70 |

3. Cost of ending work in process inventory and units transferred out

| | *Materials* | *Conversion* | *Total* |
|---|---|---|---|
| Ending work in process inventory: | | | |
| Equivalent units of production | 45,000 | 27,000 | |
| Cost per equivalent unit | $1.40 | $0.70 | |
| Cost of ending work in process inventory | $63,000 | $18,900 | $81,900 |
| Units completed and transferred out: | | | |
| Units transferred to the next department | 270,000 | 270,000 | |
| Cost per equivalent unit | $1.40 | $0.70 | |
| Cost of units completed and transferred out | $378,000 | $189,000 | $567,000 |

**Problem 4-16** (45 minutes)

Weighted-Average Method

| | | | |
|---|---|---|---|
| 1. a. | Work in Process—Blending | 147,600 | |
| | Work in Process—Bottling | 45,000 | |
| | Raw Materials | | 192,600 |
| b. | Work in Process—Blending | 73,200 | |
| | Work in Process—Bottling | 17,000 | |
| | Salaries and Wages Payable | | 90,200 |
| c. | Manufacturing Overhead | 596,000 | |
| | Accounts Payable | | 596,000 |
| d. | Work in Process—Blending | 481,000 | |
| | Manufacturing Overhead | | 481,000 |
| | Work in Process—Bottling | 108,000 | |
| | Manufacturing Overhead | | 108,000 |
| e. | Work in Process—Bottling | 722,000 | |
| | Work in Process—Blending | | 722,000 |
| f. | Finished Goods | 920,000 | |
| | Work in Process—Bottling | | 920,000 |
| g. | Accounts Receivable | 1,400,000 | |
| | Sales | | 1,400,000 |
| | Cost of Goods Sold | 890,000 | |
| | Finished Goods | | 890,000 |

**Problem 4-16** (continued)

2.

**Accounts Receivable**

| | | | |
|---|---|---|---|
| (g) | 1,400,000 | | |

**Raw Materials**

| | | | |
|---|---|---|---|
| Bal. | 198,600 | (a) | 192,600 |
| Bal. | 6,000 | | |

**Work in Process Blending Department**

| | | | |
|---|---|---|---|
| Bal. | 32,800 | (e) | 722,000 |
| (a) | 147,600 | | |
| (b) | 73,200 | | |
| (d) | 481,000 | | |
| Bal. | 12,600 | | |

**Work in Process Bottling Department**

| | | | |
|---|---|---|---|
| Bal. | 49,000 | (f) | 920,000 |
| (a) | 45,000 | | |
| (b) | 17,000 | | |
| (d) | 108,000 | | |
| (e) | 722,000 | | |
| Bal. | 21,000 | | |

**Finished Goods**

| | | | |
|---|---|---|---|
| Bal. | 20,000 | (g) | 890,000 |
| (f) | 920,000 | | |
| Bal. | 50,000 | | |

**Manufacturing Overhead**

| | | | |
|---|---|---|---|
| (c) | 596,000 | (d) | 589,000 |
| Bal. | 7,000 | | |

**Accounts Payable**

| | | | |
|---|---|---|---|
| | | (c) | 596,000 |

**Salaries and Wages Payable**

| | | | |
|---|---|---|---|
| | | (b) | 90,200 |

**Sales**

| | | | |
|---|---|---|---|
| | | (g) | 1,400,000 |

**Cost of Goods Sold**

| | | | |
|---|---|---|---|
| (g) | 890,000 | | |

# Chapter 5
# Cost-Volume-Profit Relationships

## Solutions to Questions

**5-1** The contribution margin (CM) ratio is the ratio of the total contribution margin to total sales revenue. It is used in target profit and break-even analysis and can be used to quickly estimate the effect on profits of a change in sales revenue.

**5-2** Incremental analysis focuses on the changes in revenues and costs that will result from a particular action.

**5-3** All other things equal, Company B, with its higher fixed costs and lower variable costs, will have a higher contribution margin ratio than Company A. Therefore, it will tend to realize a larger increase in contribution margin and in profits when sales increase.

**5-4** Operating leverage measures the impact on net operating income of a given percentage change in sales. The degree of operating leverage at a given level of sales is computed by dividing the contribution margin at that level of sales by the net operating income at that level of sales.

**5-5** The break-even point is the level of sales at which profits are zero.

**5-6** (a) If the selling price decreased, then the total revenue line would rise less steeply, and the break-even point would occur at a higher unit volume. (b) If the fixed cost increased, then both the fixed cost line and the total cost line would shift upward and the break-even point would occur at a higher unit volume. (c) If the variable cost increased, then the total cost line would rise more steeply and the break-even point would occur at a higher unit volume.

**5-7** The margin of safety is the excess of budgeted (or actual) sales over the break-even volume of sales. It is the amount by which sales can drop before losses begin to be incurred.

**5-8** The sales mix is the relative proportions in which a company's products are sold. The usual assumption in cost-volume-profit analysis is that the sales mix will not change.

**5-9** A higher break-even point and a lower net operating income could result if the sales mix shifted from high contribution margin products to low contribution margin products. Such a shift would cause the average contribution margin ratio in the company to decline, resulting in less total contribution margin for a given amount of sales. Thus, net operating income would decline. With a lower contribution margin ratio, the break-even point would be higher because more sales would be required to cover the same amount of fixed costs.

**Exercise 5-1** (20 minutes)

1. The new income statement would be:

| | *Total* | *Per Unit* |
|---|---|---|
| Sales (8,050 units)..... | $209,300 | $26.00 |
| Variable expenses ...... | 144,900 | 18.00 |
| Contribution margin.... | 64,400 | $ 8.00 |
| Fixed expenses .......... | 56,000 | |
| Net operating income . | $ 8,400 | |

You can get the same net operating income using the following approach.

| | |
|---|---|
| Original net operating income .. | $8,000 |
| Change in contribution margin (50 units × $8.00 per unit).... | 400 |
| New net operating income ....... | $8,400 |

2. The new income statement would be:

| | *Total* | *Per Unit* |
|---|---|---|
| Sales (7,950 units) ........... | $206,700 | $26.00 |
| Variable expenses ............ | 143,100 | 18.00 |
| Contribution margin........... | 63,600 | $ 8.00 |
| Fixed expenses ................. | 56,000 | |
| Net operating income ........ | $ 7,600 | |

You can get the same net operating income using the following approach.

| | |
|---|---|
| Original net operating income ............ | $8,000 |
| Change in contribution margin (-50 units × $8.00 per unit) ............ | (400) |
| New net operating income ................. | $7,600 |

## Exercise 5-1 (continued)

3. The new income statement would be:

| | Total | Per Unit |
|---|---|---|
| Sales (7,000 units) ....... | $182,000 | $26.00 |
| Variable expenses ........ | 126,000 | 18.00 |
| Contribution margin...... | 56,000 | $ 8.00 |
| Fixed expenses ........... | 56,000 | |
| Net operating income ... | $ 0 | |

Note: This is the company's break-even point.

**Exercise 5-2** (30 minutes)

1. The CVP graph can be plotted using the three steps outlined in the text. The graph appears on the next page.

   Step 1. Draw a line parallel to the volume axis to represent the total fixed expense. For this company, the total fixed expense is $12,000.

   Step 2. Choose some volume of sales and plot the point representing total expenses (fixed and variable) at the activity level you have selected. We'll use the sales level of 2,000 units.

| | |
|---|---|
| Fixed expenses ................................................ | $12,000 |
| Variable expenses (2,000 units × $24 per unit)..... | 48,000 |
| Total expense .................................................. | $60,000 |

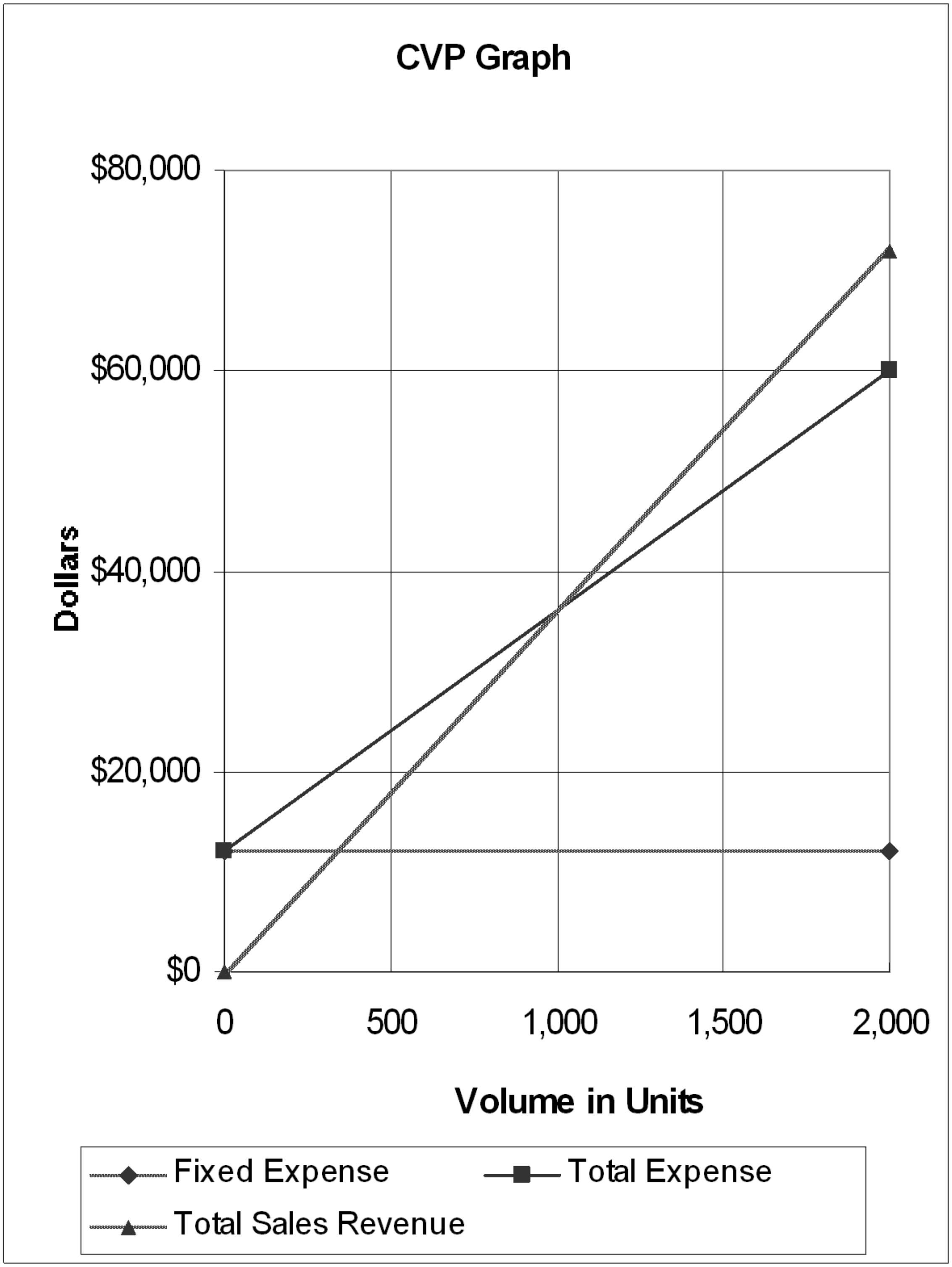
   Step 3. Choose some volume of sales and plot the point representing total sales dollars at the activity level you have selected. We'll use the sales level of 2,000 units again.

| | |
|---|---|
| Total sales revenue (2,000 units × $36 per unit)... | $72,000 |

2. The break-even point is the point where the total sales revenue and the total expense lines intersect. This occurs at sales of 1,000 units. This can be verified as follows:

$$
\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
&= (\$36 - \$24) \times 1{,}000 - \$12{,}000 \\
&= \$12 \times 1{,}000 - \$12{,}000 \\
&= \$12{,}000 - \$12{,}000 \\
&= \$0
\end{aligned}
$$

**Exercise 5-2** (continued)

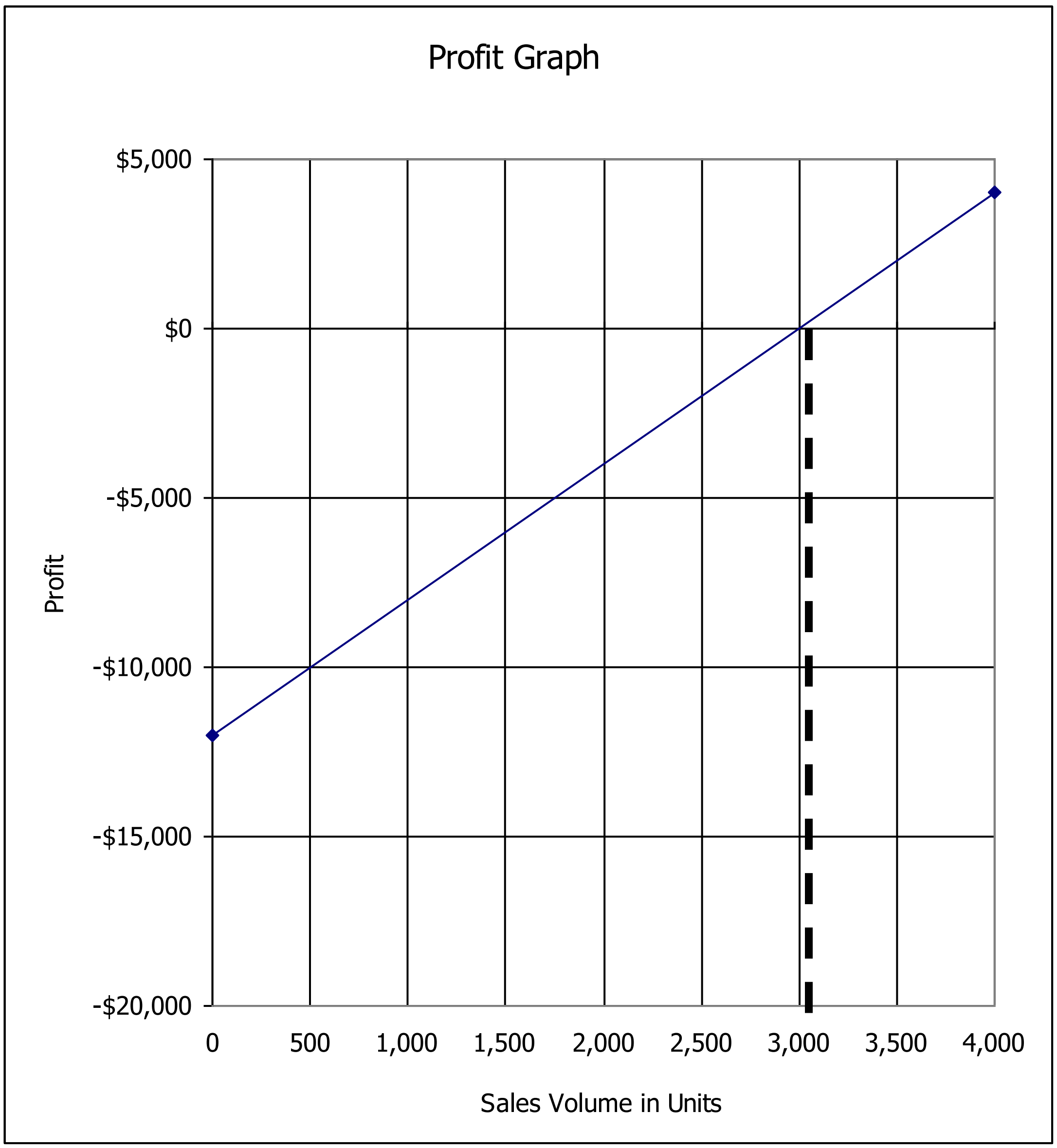


**Exercise 5-3** (15 minutes)

1. The profit graph is based on the following simple equation:

   Profit = Unit CM × Q − Fixed expenses
   Profit = ($19 − $15) × Q − $12,000
   Profit = $4 × Q − $12,000

   To plot the graph, select two different levels of sales such as Q=0 and Q=4,000. The profit at these two levels of sales are -$12,000 (= $4 × 0 − $12,000) and $4,000 (= $4 × 4,000 − $12,000).



**Exercise 5-3** (continued)

2. Looking at the graph, the break-even point appears to be 3,000 units. This can be verified as follows:

$$\begin{aligned} \text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\ &= \$4 \times Q - \$12{,}000 \\ &= \$4 \times 3{,}000 - \$12{,}000 \\ &= \$12{,}000 - \$12{,}000 = \$0 \end{aligned}$$

**Exercise 5-4** (10 minutes)

1. The company's contribution margin (CM) ratio is:

| | |
|---|---|
| Total sales | $300,000 |
| Total variable expenses | 240,000 |
| = Total contribution margin | $ 60,000 |
| ÷ Total sales | $300,000 |
| = CM ratio | 20% |

2. The change in net operating income from an increase in total sales of $1,500 can be estimated by using the CM ratio as follows:

| | |
|---|---|
| Change in total sales | $1,500 |
| × CM ratio | 20% |
| = Estimated change in net operating income | $ 300 |

This computation can be verified as follows:

| | | |
|---|---|---|
| Total sales | $300,000 | |
| ÷ Total units sold | 40,000 | units |
| = Selling price per unit | $7.50 | per unit |

| | | |
|---|---|---|
| Increase in total sales | $1,500 | |
| ÷ Selling price per unit | $7.50 | per unit |
| = Increase in unit sales | 200 | units |
| Original total unit sales | 40,000 | units |
| New total unit sales | 40,200 | units |

| | *Original* | *New* |
|---|---|---|
| Total unit sales | 40,000 | 40,200 |
| Sales | $300,000 | $301,500 |
| Variable expenses | 240,000 | 241,200 |
| Contribution margin | 60,000 | 60,300 |
| Fixed expenses | 45,000 | 45,000 |
| Net operating income | $ 15,000 | $ 15,300 |

**Exercise 5-5** (20 minutes)

1. The following table shows the effect of the proposed change in monthly advertising budget:

| | *Current Sales* | *Sales With Additional Advertising Budget* | *Difference* |
|---|---|---|---|
| Sales | $225,000 | $240,000 | $15,000 |
| Variable expenses | 135,000 | 144,000 | 9,000 |
| Contribution margin | 90,000 | 96,000 | 6,000 |
| Fixed expenses | 75,000 | 83,000 | 8,000 |
| Net operating income | $ 15,000 | $ 13,000 | $(2,000) |

Assuming that there are no other important factors to be considered, the increase in the advertising budget should not be approved because it would lead to a decrease in net operating income of $2,000.

Alternative Solution 1

| | |
|---|---|
| Expected total contribution margin: | |
| $240,000 × 40% CM ratio | $96,000 |
| Present total contribution margin: | |
| $225,000 × 40% CM ratio | 90,000 |
| Incremental contribution margin | 6,000 |
| Change in fixed expenses: | |
| Less incremental advertising expense | 8,000 |
| Change in net operating income | $(2,000) |

Alternative Solution 2

| | |
|---|---|
| Incremental contribution margin: | |
| $15,000 × 40% CM ratio | $6,000 |
| Less incremental advertising expense | 8,000 |
| Change in net operating income | $(2,000) |

**Exercise 5-5** (continued)

2. The $3 increase in variable expenses will cause the unit contribution margin to decrease from $30 to $27 with the following impact on net operating income:

| | |
|---|---|
| Expected total contribution margin with the higher-quality components: | |
| 3,450 units × $27 per unit | $93,150 |
| Present total contribution margin: | |
| 3,000 units × $30 per unit | 90,000 |
| Change in total contribution margin | $ 3,150 |

Assuming no change in fixed expenses and all other factors remain the same, the higher-quality components should be used.

**Exercise 5-6** (10 minutes)

1. The equation method yields the required unit sales, Q, as follows:

$$
\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
\$6{,}000 &= (\$140 - \$60) \times Q - \$40{,}000 \\
\$6{,}000 &= (\$80) \times Q - \$40{,}000 \\
\$80 \times Q &= \$6{,}000 + \$40{,}000 \\
Q &= \$46{,}000 \div \$80 \\
Q &= 575 \text{ units}
\end{aligned}
$$

2. The formula approach yields the required unit sales as follows:

$$
\begin{aligned}
\text{Units sold to attain the target profit} &= \frac{\text{Target profit} + \text{Fixed expenses}}{\text{Unit contribution margin}} \\
&= \frac{\$8{,}000 + \$40{,}000}{\$80 \text{ per unit}} \\
&= \frac{\$48{,}000}{\$80 \text{ per unit}} \\
&= 600 \text{ units}
\end{aligned}
$$

**Exercise 5-7** (20 minutes)

1. The equation method yields the break-even point in unit sales, Q, as follows:

$$\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
\$0 &= (\$8 - \$6) \times Q - \$5{,}500 \\
\$0 &= (\$2) \times Q - \$5{,}500 \\
\$2Q &= \$5{,}500 \\
Q &= \$5{,}500 \div \$2 \\
Q &= 2{,}750 \text{ baskets}
\end{aligned}$$

2. The equation method can be used to compute the break-even point in sales dollars as follows:

$$\text{CM ratio} = \frac{\text{Unit contribution margin}}{\text{Unit selling price}}$$

$$= \frac{\$2}{\$8} = 0.25$$

$$\begin{aligned}
\text{Profit} &= \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\
\$0 &= 0.25 \times \text{Sales} - \$5{,}500 \\
0.25 \times \text{Sales} &= \$5{,}500 \\
\text{Sales} &= \$5{,}500 \div 0.25 \\
\text{Sales} &= \$22{,}000
\end{aligned}$$

3. The formula method gives an answer that is identical to the equation method for the break-even point in unit sales:

$$\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit CM}}$$

$$= \frac{\$5{,}500}{\$2 \text{ per basket}} = 2{,}750 \text{ baskets}$$

**Exercise 5-7** (continued)

4. The formula method also gives an answer that is identical to the equation method for the break-even point in dollar sales:

$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$

$$= \frac{\$5{,}500}{0.25} = \$22{,}000$$

**Exercise 5-8** (10 minutes)

1. To compute the margin of safety, we must first compute the break-even unit sales.

   Profit = Unit CM × Q − Fixed expenses
   $0 = ($25 − $15) × Q − $8,500
   $0 = ($10) × Q − $8,500
   $10Q = $8,500
   Q = $8,500 ÷ $10
   Q = 850 units

| | |
|---|---|
| Sales (at the budgeted volume of 1,000 units) | $25,000 |
| Break-even sales (at 850 units) | 21,250 |
| Margin of safety (in dollars) | $ 3,750 |

2. The margin of safety as a percentage of sales is as follows:

| | |
|---|---|
| Margin of safety (in dollars) | $3,750 |
| ÷ Sales | $25,000 |
| Margin of safety percentage | 15% |

**Exercise 5-9** (20 minutes)

1. The company's degree of operating leverage would be computed as follows:

| | |
|---|---|
| Contribution margin............... | $36,000 |
| ÷ Net operating income......... | $12,000 |
| Degree of operating leverage. | 3.0 |

2. A 10% increase in sales should result in a 30% increase in net operating income, computed as follows:

| | |
|---|---|
| Degree of operating leverage.................................. | 3.0 |
| × Percent increase in sales ..................................... | 10% |
| Estimated percent increase in net operating income .. | 30% |

3. The new income statement reflecting the change in sales is:

| | Amount | Percent of Sales |
|---|---|---|
| Sales ........................... | $132,000 | 100% |
| Variable expenses ........ | 92,400 | 70% |
| Contribution margin...... | 39,600 | 30% |
| Fixed expenses ............ | 24,000 | |
| Net operating income ... | $ 15,600 | |

| | |
|---|---|
| Net operating income reflecting change in sales...... | $15,600 |
| Original net operating income (a)........................... | 12,000 |
| Change in net operating income (b) ....................... | $ 3,600 |
| Percent change in net operating income (b ÷ a) ..... | 30% |

**Exercise 5-10** (20 minutes)

1. The overall contribution margin ratio can be computed as follows:

$$\text{Overall CM ratio} = \frac{\text{Total contribution margin}}{\text{Total sales}}$$

$$= \frac{\$120{,}000}{\$150{,}000} = 80\%$$

2. The overall break-even point in sales dollars can be computed as follows:

$$\text{Overall break-even} = \frac{\text{Total fixed expenses}}{\text{Overall CM ratio}}$$

$$= \frac{\$90{,}000}{80\%} = \$112{,}500$$

3. To construct the required income statement, we must first determine the relative sales mix for the two products:

| | *Predator* | *Runway* | *Total* |
|---|---|---|---|
| Original dollar sales ...... | $100,000 | $50,000 | $150,000 |
| Percent of total ........... | 67% | 33% | 100% |
| Sales at break-even...... | $75,000 | $37,500 | $112,500 |

| | *Predator* | *Runway* | *Total* |
|---|---|---|---|
| Sales ........................... | $75,000 | $37,500 | $112,500 |
| Variable expenses*....... | 18,750 | 3,750 | 22,500 |
| Contribution margin...... | $56,250 | $33,750 | 90,000 |
| Fixed expenses ............ | | | 90,000 |
| Net operating income ... | | | $ 0 |

*Predator variable expenses: ($75,000/$100,000) × $25,000 = $18,750
Runway variable expenses: ($37,500/$50,000) × $5,000 = $3,750

**Exercise 5-11** (30 minutes)

1. 
$$
\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
\$0 &= (\$40 - \$28) \times Q - \$150{,}000 \\
\$0 &= (\$12) \times Q - \$150{,}000 \\
\$12Q &= \$150{,}000 \\
Q &= \$150{,}000 \div \$12 \text{ per unit} \\
Q &= 12{,}500 \text{ units, or at \$40 per unit, \$500,000}
\end{aligned}
$$

Alternatively:

$$\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}}$$

$$= \frac{\$150{,}000}{\$12 \text{ per unit}} = 12{,}500 \text{ units}$$

or, at $40 per unit, $500,000.

2. The contribution margin at the break-even point is $150,000 because at that point it must equal the fixed expenses.

3. 
$$\text{Units sold to attain target profit} = \frac{\text{Target profit + Fixed expenses}}{\text{Unit contribution margin}}$$

$$= \frac{\$18{,}000 + \$150{,}000}{\$12 \text{ per unit}} = 14{,}000 \text{ units}$$

| | *Total* | *Unit* |
|---|---|---|
| Sales (14,000 units × $40 per unit) | $560,000 | $40 |
| Variable expenses (14,000 units × $28 per unit) | 392,000 | 28 |
| Contribution margin (14,000 units × $12 per unit) | 168,000 | $12 |
| Fixed expenses | 150,000 | |
| Net operating income | $ 18,000 | |

**Exercise 5-11** (continued)

4. Margin of safety in dollar terms:

$$\text{Margin of safety in dollars} = \text{Total sales - Break-even sales}$$

$$= \$600{,}000 - \$500{,}000 = \$100{,}000$$

Margin of safety in percentage terms:

$$\text{Margin of safety percentage} = \frac{\text{Margin of safety in dollars}}{\text{Total sales}}$$

$$= \frac{\$100{,}000}{\$600{,}000} = 16.7\% \text{ (rounded)}$$

5. The CM ratio is 30%.

| | |
|---|---|
| Expected total contribution margin: $680,000 × 30% .... | $204,000 |
| Present total contribution margin: $600,000 × 30% ...... | 180,000 |
| Increased contribution margin ..................................... | $ 24,000 |

Alternative solution:
$80,000 incremental sales × 30% CM ratio = $24,000

Given that the company's fixed expenses will not change, monthly net operating income will increase by the amount of the increased contribution margin, $24,000.

## **Exercise 5-12** (30 minutes)

1. Profit = Unit CM × Q − Fixed expenses

$$
\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
\$0 &= (\$90 - \$63) \times Q - \$135{,}000 \\
\$0 &= (\$27) \times Q - \$135{,}000 \\
\$27Q &= \$135{,}000 \\
Q &= \$135{,}000 \div \$27 \text{ per lantern} \\
Q &= 5{,}000 \text{ lanterns, or at \$90 per lantern, \$450,000 in sales}
\end{aligned}
$$

Alternative solution:

$$
\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}}
$$

$$
= \frac{\$135{,}000}{\$27 \text{ per lantern}} = 5{,}000 \text{ lanterns,}
$$

or at $90 per lantern, $450,000 in sales

2. An increase in variable expenses as a percentage of the selling price would result in a higher break-even point. If variable expenses increase as a percentage of sales, then the contribution margin will decrease as a percentage of sales. With a lower CM ratio, more lanterns would have to be sold to generate enough contribution margin to cover the fixed costs.

3.

| | *Present: 8,000 Lanterns* | | *Proposed: 10,000 Lanterns** | |
|---|---|---|---|---|
| | *Total* | *Per Unit* | *Total* | *Per Unit* |
| Sales | $720,000 | $90 | $810,000 | $81 ** |
| Variable expenses | 504,000 | 63 | 630,000 | 63 |
| Contribution margin | 216,000 | $27 | 180,000 | $18 |
| Fixed expenses | 135,000 | | 135,000 | |
| Net operating income | $ 81,000 | | $ 45,000 | |

* 8,000 lanterns × 1.25 = 10,000 lanterns
** $90 per lantern × 0.9 = $81 per lantern

As shown above, a 25% increase in volume is not enough to offset a 10% reduction in the selling price; thus, net operating income decreases.

**Exercise 5-12** (continued)

4.
$$\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
\$72{,}000 &= (\$81 - \$63) \times Q - \$135{,}000 \\
\$72{,}000 &= (\$18) \times Q - \$135{,}000 \\
\$18Q &= \$207{,}000 \\
Q &= \$207{,}000 \div \$18 \text{ per lantern} \\
Q &= 11{,}500 \text{ lanterns}
\end{aligned}$$

Alternative solution:

$$\begin{aligned}
\begin{array}{c}\text{Unit sales to attain}\\ \text{target profit}\end{array} &= \frac{\text{Target profit} + \text{Fixed expenses}}{\text{Unit contribution margin}} \\
&= \frac{\$72{,}000 + \$135{,}000}{\$18 \text{ per lantern}} = 11{,}500 \text{ lanterns}
\end{aligned}$$

**Exercise 5-13** (30 minutes)

1. The contribution margin per person would be:

| | | |
|---|---|---|
| Price per ticket | | $30 |
| Variable expenses: | | |
| Dinner | $7 | |
| Favors and program | 3 | 10 |
| Contribution margin per person | | $20 |

The fixed expenses of the Extravaganza total $8,000; therefore, the break-even point would be computed as follows:

Profit = Unit CM × Q − Fixed expenses
$0 = ($30 − $10) × Q − $8,000
$0 = ($20) × Q − $8,000
$20Q = $8,000
Q = $8,000 ÷ $20
Q = 400 persons; or, at $30 per person, $12,000

Alternative solution:

$$\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}}$$

$$= \frac{\$8,000}{\$20 \text{ per person}} = 400 \text{ persons}$$

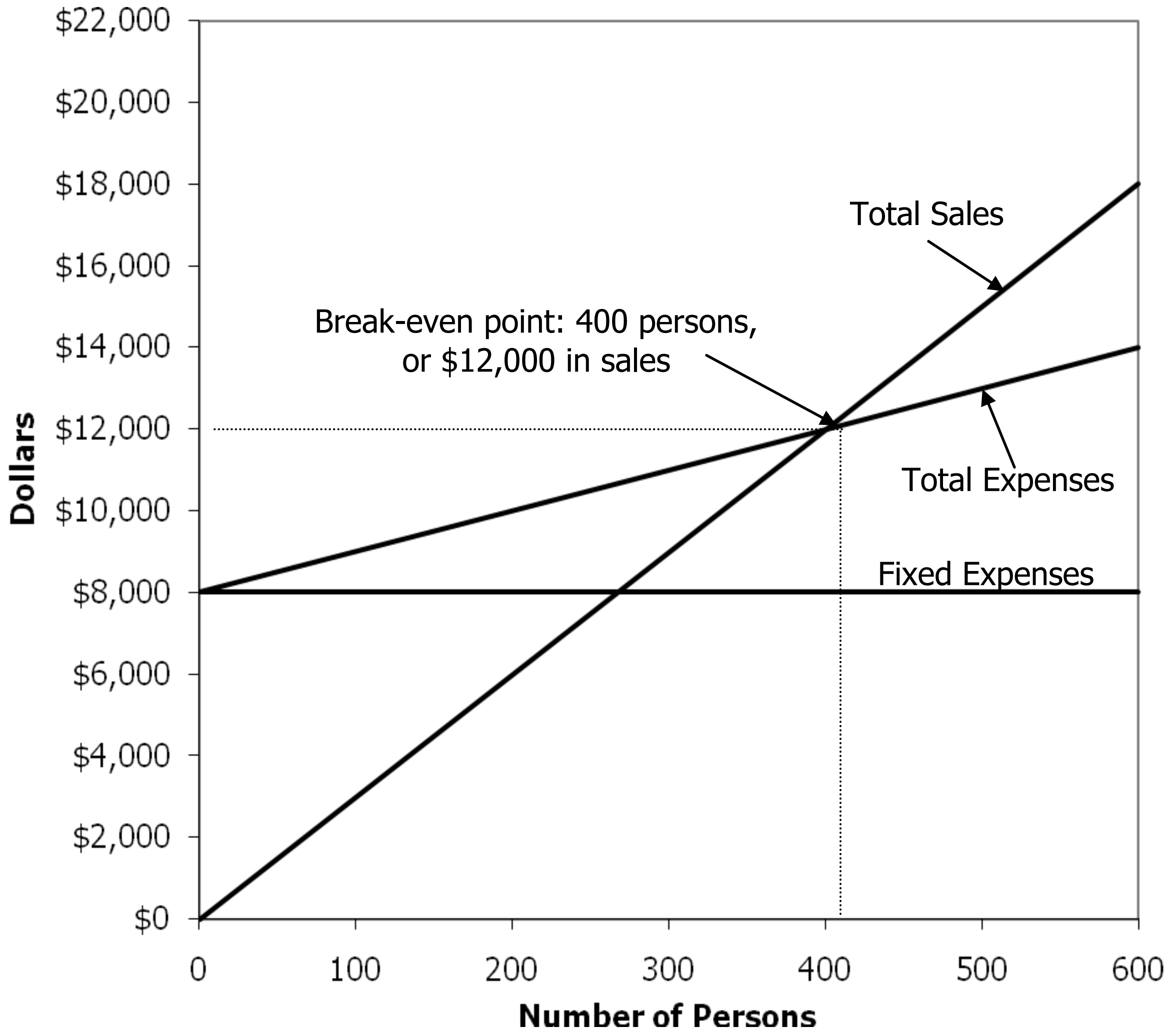
or, at $30 per person, $12,000.

2.

| | |
|---|---|
| Variable cost per person ($7 + $3) | $10 |
| Fixed cost per person ($8,000 ÷ 250 persons) | 32 |
| Ticket price per person to break even | $42 |

**Exercise 5-13** (continued)

3. Cost-volume-profit graph:



**Exercise 5-14** (30 minutes)

1.

| | *Model A100* | | *Model B900* | | *Total Company* | | |
|---|---|---|---|---|---|---|---|
| | *Amount* | *%* | *Amount* | *%* | *Amount* | *%* | |
| Sales | $700,000 | 100 | $300,000 | 100 | $1,000,000 | 100 | |
| Variable expenses | 280,000 | 40 | 90,000 | 30 | 370,000 | 37 | |
| Contribution margin | $420,000 | 60 | $210,000 | 70 | 630,000 | 63 | * |
| Fixed expenses | | | | | 598,500 | | |
| Net operating income | | | | | $ 31,500 | | |

*630,000 ÷ $1,000,000 = 63%.

2. The break-even point for the company as a whole is:

$$\text{Break-even point in total dollar sales} = \frac{\text{Fixed expenses}}{\text{Overall CM ratio}}$$

$$= \frac{\$598{,}500}{0.63} = \$950{,}000 \text{ in sales}$$

3. The additional contribution margin from the additional sales is computed as follows:

$50,000 × 63% CM ratio = $31,500

Assuming no change in fixed expenses, all of this additional contribution margin should drop to the bottom line as increased net operating income.

This answer assumes no change in selling prices, variable costs per unit, fixed expenses, or sales mix.

**Exercise 5-15** (15 minutes)

1.

| | | |
|---|---|---|
| Sales (30,000 doors) | $1,800,000 | $60 |
| Variable expenses | 1,260,000 | 42 |
| Contribution margin | 540,000 | $18 |
| Fixed expenses | 450,000 | |
| Net operating income | $ 90,000 | |

$$\text{Degree of operating leverage} = \frac{\text{Contribution margin}}{\text{Net operating income}}$$

$$= \frac{\$540,000}{\$90,000} = 6$$

2. a. Sales of 37,500 doors represent an increase of 7,500 doors, or 25%, over present sales of 30,000 doors. Because the degree of operating leverage is 6, net operating income should increase by 6 times as much, or by 150% (6 × 25%).

   b. Expected total dollar net operating income for the next year is:

| | |
|---|---|
| Present net operating income | $ 90,000 |
| Expected increase in net operating income next year (150% × $90,000) | 135,000 |
| Total expected net operating income | $225,000 |

**Exercise 5-16** (30 minutes)

1. Variable expenses: $\$60 \times (100\% - 40\%) = \$36$.

2. a.

| | | |
|---|---|---|
| Selling price | $60 | 100% |
| Variable expenses | 36 | 60% |
| Contribution margin | $24 | 40% |

Let Q = Break-even point in units.

$$\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
\$0 &= (\$60 - \$36) \times Q - \$360{,}000 \\
\$0 &= (\$24) \times Q - \$360{,}000 \\
\$24Q &= \$360{,}000 \\
Q &= \$360{,}000 \div \$24 \text{ per unit} \\
Q &= 15{,}000 \text{ units}
\end{aligned}$$

In sales dollars: 15,000 units × $60 per unit = $900,000

Alternative solution:

$$\begin{aligned}
\text{Profit} &= \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\
\$0 &= 0.40 \times \text{Sales} - \$360{,}000 \\
0.40 \times \text{Sales} &= \$360{,}000 \\
\text{Sales} &= \$360{,}000 \div 0.40 \\
\text{Sales} &= \$900{,}000
\end{aligned}$$

In units: $900,000 ÷ $60 per unit = 15,000 units

b.

$$\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
\$90{,}000 &= (\$60 - \$36) \times Q - \$360{,}000 \\
\$90{,}000 &= (\$24) \times Q - \$360{,}000 \\
\$24Q &= \$450{,}000 \\
Q &= \$450{,}000 \div \$24 \text{ per unit} \\
Q &= 18{,}750 \text{ units}
\end{aligned}$$

In sales dollars: 18,750 units × $60 per unit = $1,125,000

**Exercise 5-16** (continued)

Alternative solution:

$$
\begin{aligned}
\text{Profit} &= \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\
\$90{,}000 &= 0.40 \times \text{Sales} - \$360{,}000 \\
0.40 \times \text{Sales} &= \$450{,}000 \\
\text{Sales} &= \$450{,}000 \div 0.40 \\
\text{Sales} &= \$1{,}125{,}000
\end{aligned}
$$

In units: $1,125,000 ÷ $60 per unit = 18,750 units

c. The company's new cost/revenue relationships will be:

| | | |
|---|---|---|
| Selling price | $60 | 100% |
| Variable expenses ($36 – $3) | 33 | 55% |
| Contribution margin | $27 | 45% |

$$
\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
\$0 &= (\$60 - \$33) \times Q - \$360{,}000 \\
\$0 &= \$27Q - \$360{,}000 \\
\$27Q &= \$360{,}000 \\
Q &= \$360{,}000 \div \$27 \text{ per unit} \\
Q &= 13{,}333 \text{ units (rounded).}
\end{aligned}
$$

In sales dollars: 13,333 units × $60 per unit = $800,000 (rounded)

Alternative solution:

$$
\begin{aligned}
\text{Profit} &= \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\
\$0 &= 0.45 \times \text{Sales} - \$360{,}000 \\
0.45 \times \text{Sales} &= \$360{,}000 \\
\text{Sales} &= \$360{,}000 \div 0.45 \\
\text{Sales} &= \$800{,}000
\end{aligned}
$$

In units: $800,000 ÷ $60 per unit = 13,333 units (rounded)

**Exercise 5-16** (continued)

3 a. $$\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}}$$

$$= \$360{,}000 \div \$24 \text{ per unit} = 15{,}000 \text{ units}$$

In sales dollars: 15,000 units × $60 per unit = $900,000

Alternative solution:

$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$

$$= \$360{,}000 \div 0.40 = \$900{,}000$$

In units: $900,000 ÷ $60 per unit = 15,000 units

b. $$\text{Unit sales to attain target profit} = \frac{\text{Target profit} + \text{Fixed expenses}}{\text{Unit contribution margin}}$$

$$= (\$90{,}000 + \$360{,}000) \div \$24 \text{ per unit}$$

$$= 18{,}750 \text{ units}$$

In sales dollars: 18,750 units × $60 per unit = $1,125,000

Alternative solution:

$$\text{Dollar sales to attain target profit} = \frac{\text{Target profit} + \text{Fixed expenses}}{\text{CM ratio}}$$

$$= (\$90{,}000 + \$360{,}000) \div 0.40$$

$$= \$1{,}125{,}000$$

In units: $1,125,000 ÷ $60 per unit = 18,750 units

**Exercise 5-16** (continued)

c. $$\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}}$$

$$= \$360{,}000 \div \$27 \text{ per unit}$$

$$= 13{,}333 \text{ units (rounded)}$$

In sales dollars: 13,333 units × \$60 per unit = \$800,000 (rounded)

Alternative solution:

$$\text{Break-even point in sales dollars} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$

$$= \$360{,}000 \div 0.45 = \$800{,}000$$

In units: \$800,000 ÷ \$60 per unit = 13,333 (rounded)

**Exercise 5-17** (20 minutes)

| | | Total | Per Unit |
|---|---|---|---|
| 1. | Sales (30,000 units × 1.15 = 34,500 units).. | $172,500 | $5.00 |
| | Variable expenses .................................... | 103,500 | 3.00 |
| | Contribution margin.................................. | 69,000 | $2.00 |
| | Fixed expenses ........................................ | 50,000 | |
| | Net operating income ................................ | $ 19,000 | |
| 2. | Sales (30,000 units × 1.20 = 36,000 units).. | $162,000 | $4.50 |
| | Variable expenses .................................... | 108,000 | 3.00 |
| | Contribution margin.................................. | 54,000 | $1.50 |
| | Fixed expenses ........................................ | 50,000 | |
| | Net operating income ................................ | $ 4,000 | |
| 3. | Sales (30,000 units × 0.95 = 28,500 units).. | $156,750 | $5.50 |
| | Variable expenses .................................... | 85,500 | 3.00 |
| | Contribution margin.................................. | 71,250 | $2.50 |
| | Fixed expenses ($50,000 + $10,000) .......... | 60,000 | |
| | Net operating income ................................ | $ 11,250 | |
| 4. | Sales (30,000 units × 0.90 = 27,000 units).. | $151,200 | $5.60 |
| | Variable expenses .................................... | 86,400 | 3.20 |
| | Contribution margin.................................. | 64,800 | $2.40 |
| | Fixed expenses ........................................ | 50,000 | |
| | Net operating income ................................ | $ 14,800 | |

## **Exercise 5-18** (20 minutes)

a.

| | Case #1 | | Case #2 | |
|---|---|---|---|---|
| Number of units sold .... | 9,000 * | | 14,000 | |
| Sales .......................... | $270,000 * | $30 | $350,000 * | $25 |
| Variable expenses ........ | 162,000 * | 18 | 140,000 | 10 |
| Contribution margin...... | 108,000 | $12 | 210,000 | $15 * |
| Fixed expenses ........... | 90,000 * | | 170,000 * | |
| Net operating income ... | $ 18,000 | | $ 40,000 * | |

| | Case #3 | | Case #4 | |
|---|---|---|---|---|
| Number of units sold .... | 20,000 * | | 5,000 * | |
| Sales .......................... | $400,000 | $20 | $160,000 * | $32 |
| Variable expenses ........ | 280,000 * | 14 | 90,000 | 18 |
| Contribution margin...... | 120,000 | $ 6 * | 70,000 | $14 |
| Fixed expenses ........... | 85,000 | | 82,000 * | |
| Net operating income ... | $ 35,000 * | | $(12,000) * | |

b.

| | Case #1 | | Case #2 | |
|---|---|---|---|---|
| Sales .......................... | $450,000 * | 100% | $200,000 * | 100 % |
| Variable expenses ........ | 270,000 | 60 | 130,000 * | 65 |
| Contribution margin...... | 180,000 | 40%* | 70,000 | 35 % |
| Fixed expenses ........... | 115,000 | | 60,000 * | |
| Net operating income ... | $ 65,000 * | | $ 10,000 | |

| | Case #3 | | Case #4 | |
|---|---|---|---|---|
| Sales .......................... | $700,000 | 100% | $300,000 * | 100 % |
| Variable expenses ........ | 140,000 | 20 | 90,000 * | 30 |
| Contribution margin...... | 560,000 | 80%* | 210,000 | 70 % |
| Fixed expenses ........... | 470,000 * | | 225,000 | |
| Net operating income ... | $ 90,000 * | | $(15,000) * | |

*Given

**Problem 5-19** (60 minutes)

1. $$\begin{aligned} \text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\ \$0 &= (\$40 - \$25) \times Q - \$300{,}000 \\ \$0 &= (\$15) \times Q - \$300{,}000 \\ \$15Q &= \$300{,}000 \\ Q &= \$300{,}000 \div \$15 \text{ per shirt} \\ Q &= 20{,}000 \text{ shirts} \end{aligned}$$

   20,000 shirts × $40 per shirt = $800,000

   Alternative solution:

   $$\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}}$$

   $$= \frac{\$300{,}000}{\$15 \text{ per shirt}} = 20{,}000 \text{ shirts}$$

   $$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$

   $$= \frac{\$300{,}000}{0.375} = \$800{,}000 \text{ in sales}$$

2. See the graph on the following page.

3. The simplest approach is:

| | |
|---|---|
| Break-even sales ................. | 20,000 shirts |
| Actual sales......................... | 19,000 shirts |
| Sales short of break-even .... | 1,000 shirts |

   1,000 shirts × $15 contribution margin per shirt = $15,000 loss

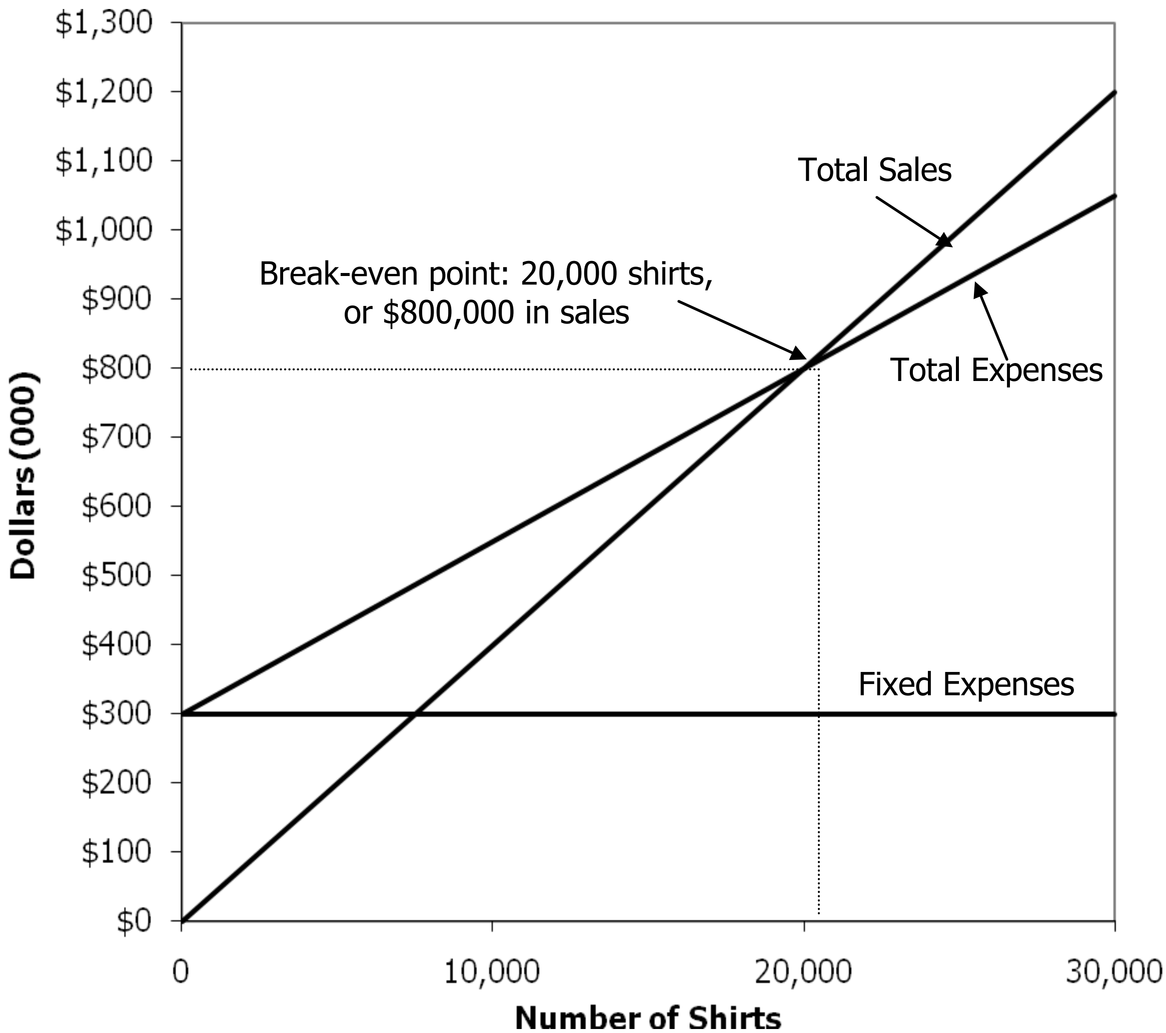
   Alternative solution:

| | |
|---|---|
| Sales (19,000 shirts × $40 per shirt) ......................... | $760,000 |
| Variable expenses (19,000 shirts × $25 per shirt)....... | 475,000 |
| Contribution margin.................................................. | 285,000 |
| Fixed expenses........................................................ | 300,000 |

| | |
|---|---|
| Net operating loss | $(15,000) |

**Problem 5-19** (continued)

2. Cost-volume-profit graph:



**Problem 5-19** (continued)

4. The variable expenses will now be $28 ($25 + $3) per shirt, and the contribution margin will be $12 ($40 – $28) per shirt.

$$\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
\$0 &= (\$40 - \$28) \times Q - \$300{,}000 \\
\$0 &= (\$12) \times Q - \$300{,}000 \\
\$12Q &= \$300{,}000 \\
Q &= \$300{,}000 \div \$12 \text{ per shirt} \\
Q &= 25{,}000 \text{ shirts}
\end{aligned}$$

25,000 shirts × $40 per shirt = $1,000,000 in sales

Alternative solution:

$$\begin{array}{c} \text{Unit sales} \\ \text{to break even} \end{array} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}}$$

$$= \frac{\$300{,}000}{\$12 \text{ per shirt}} = 25{,}000 \text{ shirts}$$

$$\begin{array}{c} \text{Dollar sales} \\ \text{to break even} \end{array} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$

$$= \frac{\$300{,}000}{0.30} = \$1{,}000{,}000 \text{ in sales}$$

5. The simplest approach is:

| | |
|---|---|
| Actual sales................................ | 23,500 shirts |
| Break-even sales .......................... | 20,000 shirts |
| Excess over break-even sales........ | 3,500 shirts |

3,500 shirts × $12 per shirt* = $42,000 profit

*$15 present contribution margin – $3 commission = $12 per shirt

**Problem 5-19** (continued)

Alternative solution:

| | |
|---|---|
| Sales (23,500 shirts × \$40 per shirt) | \$940,000 |
| Variable expenses [(20,000 shirts × \$25 per shirt) + (3,500 shirts × \$28 per shirt)] | 598,000 |
| Contribution margin | 342,000 |
| Fixed expenses | 300,000 |
| Net operating income | \$ 42,000 |

6. a. The new variable expense will be \$18 per shirt (the invoice price).

$$
\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
\$0 &= (\$40 - \$18) \times Q - \$407{,}000 \\
\$0 &= (\$22) \times Q - \$407{,}000 \\
\$22Q &= \$407{,}000 \\
Q &= \$407{,}000 \div \$22 \text{ per shirt} \\
Q &= 18{,}500 \text{ shirts}
\end{aligned}
$$

18,500 shirts × \$40 shirt = \$740,000 in sales

b. Although the change will lower the break-even point from 20,000 shirts to 18,500 shirts, the company must consider whether this reduction in the break-even point is more than offset by the possible loss in sales arising from having the sales staff on a salaried basis. Under a salary arrangement, the sales staff may have far less incentive to sell than under the present commission arrangement, resulting in a loss of sales and a reduction in profits. Although it generally is desirable to lower the break-even point, management must consider the other effects of a change in the cost structure. The break-even point could be reduced dramatically by doubling the selling price per shirt, but it does not necessarily follow that this would increase the company's profit.

**Problem 5-20** (60 minutes)

1. The CM ratio is 30%.

| | *Total* | *Per Unit* | *Percentage* |
|---|---|---|---|
| Sales (13,500 units)......... | $270,000 | $20 | 100% |
| Variable expenses........... | 189,000 | 14 | 70% |
| Contribution margin......... | $ 81,000 | $ 6 | 30% |

The break-even point is:

$$\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
\$0 &= (\$20 - \$14) \times Q - \$90{,}000 \\
\$0 &= (\$6) \times Q - \$90{,}000 \\
\$6Q &= \$90{,}000 \\
Q &= \$90{,}000 \div \$6 \text{ per unit} \\
Q &= 15{,}000 \text{ units}
\end{aligned}$$

15,000 units × $20 per unit = $300,000 in sales

Alternative solution:

$$\begin{array}{c}\text{Unit sales}\\ \text{to break even}\end{array} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}}$$

$$= \frac{\$90{,}000}{\$6 \text{ per unit}} = 15{,}000 \text{ units}$$

$$\begin{array}{c}\text{Dollar sales}\\ \text{to break even}\end{array} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$

$$= \frac{\$90{,}000}{0.30} = \$300{,}000 \text{ in sales}$$

2. Incremental contribution margin:

| | |
|---|---|
| $70,000 increased sales × 30% CM ratio ........... | $21,000 |
| Less increased fixed costs: | |
| Increased advertising cost................................ | 8,000 |
| Increase in monthly net operating income ............ | $13,000 |

Since the company presently has a loss of $9,000 per month, if the changes are adopted, the loss will turn into a profit of $4,000 per month.

**Problem 5-20** (continued)

3\.

| | |
|---|---|
| Sales (27,000 units × $18 per unit*) | $486,000 |
| Variable expenses (27,000 units × $14 per unit) | 378,000 |
| Contribution margin | 108,000 |
| Fixed expenses ($90,000 + $35,000) | 125,000 |
| Net operating loss | $(17,000) |

*$20 – ($20 × 0.10) = $18

4\.

$$\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
\$4{,}500 &= (\$20.00 - \$14.60^{*}) \times Q - \$90{,}000 \\
\$4{,}500 &= (\$5.40) \times Q - \$90{,}000 \\
\$5.40Q &= \$94{,}500 \\
Q &= \$94{,}500 \div \$5.40 \text{ per unit} \\
Q &= 17{,}500 \text{ units}
\end{aligned}$$

*$14.00 + $0.60 = $14.60.

Alternative solution:

$$\text{Unit sales to attain target profit} = \frac{\text{Target profit + Fixed expenses}}{\text{CM per unit}}$$

$$= \frac{\$4{,}500 + \$90{,}000}{\$5.40 \text{ per unit}^{**}}$$

$$= 17{,}500 \text{ units}$$

**$6.00 – $0.60 = $5.40.

5\. a. The new CM ratio would be:

| | *Per Unit* | *Percentage* |
|---|---|---|
| Sales | $20 | 100% |
| Variable expenses | 7 | 35% |
| Contribution margin | $13 | 65% |

**Problem 5-20** (continued)

The new break-even point would be:

$$\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}}$$

$$= \frac{\$208{,}000}{\$13 \text{ per unit}} = 16{,}000 \text{ units}$$

$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$

$$= \frac{\$208{,}000}{0.65} = \$320{,}000 \text{ in sales}$$

b. Comparative income statements follow:

| | *Not Automated* | | | *Automated* | | |
|---|---|---|---|---|---|---|
| | *Total* | *Per Unit* | *%* | *Total* | *Per Unit* | *%* |
| Sales (20,000 units).... | $400,000 | $20 | 100 | $400,000 | $20 | 100 |
| Variable expenses....... | 280,000 | 14 | 70 | 140,000 | 7 | 35 |
| Contribution margin.... | 120,000 | $ 6 | 30 | 260,000 | $13 | 65 |
| Fixed expenses........... | 90,000 | | | 208,000 | | |
| Net operating income.. | $ 30,000 | | | $ 52,000 | | |

**Problem 5-20** (continued)

c. Whether or not one would recommend that the company automate its operations depends on how much risk he or she is willing to take, and depends heavily on prospects for future sales. The proposed changes would increase the company's fixed costs and its break-even point. However, the changes would also increase the company's CM ratio (from 30% to 65%). The higher CM ratio means that once the break-even point is reached, profits will increase more rapidly than at present. If 20,000 units are sold next month, for example, the higher CM ratio will generate $22,000 more in profits than if no changes are made.

   The greatest risk of automating is that future sales may drop back down to present levels (only 13,500 units per month), and as a result, losses will be even larger than at present due to the company's greater fixed costs. (Note the problem states that sales are erratic from month to month.) In sum, the proposed changes will help the company if sales continue to trend upward in future months; the changes will hurt the company if sales drop back down to or near present levels.

   Note to the Instructor: Although it is not asked for in the problem, if time permits you may want to compute the point of indifference between the two alternatives in terms of units sold; i.e., the point where profits will be the same under either alternative. At this point, total revenue will be the same; hence, we include only costs in our equation:

$$\begin{aligned}
\text{Let } Q &= \text{Point of indifference in units sold} \\
\$14Q + \$90{,}000 &= \$7Q + \$208{,}000 \\
\$7Q &= \$118{,}000 \\
Q &= \$118{,}000 \div \$7 \text{ per unit} \\
Q &= 16{,}857 \text{ units (rounded)}
\end{aligned}$$

If more than 16,857 units are sold, the proposed plan will yield the greatest profit; if less than 16,857 units are sold, the present plan will yield the greatest profit (or the least loss).

**Problem 5-21** (60 minutes)

1. The CM ratio is 60%:

| | | |
|---|---|---|
| Selling price ...................... | $15 | 100% |
| Variable expenses............. | 6 | 40% |
| Contribution margin........... | $ 9 | 60% |

2.

$$\text{Break-even point in total sales dollars} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$

$$= \frac{\$180{,}000}{0.60} = \$300{,}000 \text{ sales}$$

3. $45,000 increased sales × 60% CM ratio = $27,000 increase in contribution margin. Since fixed costs will not change, net operating income should also increase by $27,000.

4. a.

$$\text{Degree of operating leverage} = \frac{\text{Contribution margin}}{\text{Net operating income}}$$

$$= \frac{\$216{,}000}{\$36{,}000} = 6$$

b. 6 × 15% = 90% increase in net operating income. In dollars, this increase would be 90% × $36,000 = $32,400.

**Problem 5-21** (continued)

5.

| | *Last Year: 28,000 units* | | *Proposed: 42,000 units** | |
|---|---|---|---|---|
| | *Total* | *Per Unit* | *Total* | *Per Unit* |
| Sales | $420,000 | $15.00 | $567,000 | $13.50** |
| Variable expenses | 168,000 | 6.00 | 252,000 | 6.00 |
| Contribution margin | 252,000 | $ 9.00 | 315,000 | $ 7.50 |
| Fixed expenses | 180,000 | | 250,000 | |
| Net operating income | $ 72,000 | | $ 65,000 | |

* 28,000 units × 1.5 = 42,000 units
** $15 per unit × 0.90 = $13.50 per unit

No, the changes should not be made.

6.

| | |
|---|---|
| Expected total contribution margin: | |
| 28,000 units × 200% × $7 per unit* | $392,000 |
| Present total contribution margin: | |
| 28,000 units × $9 per unit | 252,000 |
| Incremental contribution margin, and the amount by which advertising can be increased with net operating income remaining unchanged | $140,000 |

*$15 – ($6 + $2) = $7

**Problem 5-22** (30 minutes)

1.

| | Product | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Sinks | | Mirrors | | Vanities | | | |
| Percentage of total sales | 32% | | 40% | | 28% | | 100% | |
| Sales | $160,000 | 100% | $200,000 | 100% | $140,000 | 100% | $500,000 | 100% |
| Variable expenses | 48,000 | 30% | 160,000 | 80% | 77,000 | 55% | 285,000 | 57% |
| Contribution margin | $112,000 | 70% | $ 40,000 | 20% | $ 63,000 | 45% | 215,000 | 43%* |
| Fixed expenses | | | | | | | 223,600 | |
| Net operating income (loss) | | | | | | | $ (8,600) | |

*$215,000 ÷ $500,000 = 43%.

**Problem 5-22** (continued)

2. Break-even sales:

$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$

$$= \frac{\$223{,}600}{0.43} = \$520{,}000 \text{ in sales}$$

3. Memo to the president:

   Although the company met its sales budget of $500,000 for the month, the mix of products sold changed substantially from that budgeted. This is the reason the budgeted net operating income was not met, and the reason the break-even sales were greater than budgeted. The company's sales mix was planned at 48% Sinks, 20% Mirrors, and 32% Vanities. The actual sales mix was 32% Sinks, 40% Mirrors, and 28% Vanities.

   As shown by these data, sales shifted away from Sinks, which provides our greatest contribution per dollar of sales, and shifted strongly toward Mirrors, which provides our least contribution per dollar of sales. Consequently, although the company met its budgeted level of sales, these sales provided considerably less contribution margin than we had planned, with a resulting decrease in net operating income. Notice from the attached statements that the company's overall CM ratio was only 43%, as compared to a planned CM ratio of 52%. This also explains why the break-even point was higher than planned. With less average contribution margin per dollar of sales, a greater level of sales had to be achieved to provide sufficient contribution margin to cover fixed costs.

**Problem 5-23** (45 minutes)

1. a.

| | *Alvaro* | % | *Bazan* | % | *Total* | % |
|---|---|---|---|---|---|---|
| Sales | €800 | 100 | €480 | 100 | €1,280 | 100 |
| Variable expenses | 480 | 60 | 96 | 20 | 576 | 45 |
| Contribution margin | €320 | 40 | €384 | 80 | 704 | 55 |
| Fixed expenses | | | | | 660 | |
| Net operating income | | | | | € 44 | |

b.

$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{€660}{0.55} = €1,200$$

$$\text{Margin of safety} = \text{Actual sales - Break-even sales}$$

$$= €1,280 - €1,200 = €80$$

$$\text{Margin of safety percentage} = \frac{\text{Margin of safety in euros}}{\text{Actual sales}}$$

$$= \frac{€80}{€1,280} = 6.25\%$$

**Problem 5-23** (continued)

2. a.

| | *Alvaro* | % | *Bazan* | % | *Cano* | % | *Total* | % |
|---|---|---|---|---|---|---|---|---|
| Sales | €800 | 100 | €480 | 100 | €320 | 100 | €1,600 | 100 |
| Variable expenses | 480 | 60 | 96 | 20 | 240 | 75 | 816 | 51 |
| Contribution margin | €320 | 40 | €384 | 80 | € 80 | 25 | 784 | 49 |
| Fixed expenses | | | | | | | 660 | |
| Net operating income | | | | | | | € 124 | |

**Problem 5-23** (continued)

b. $$\frac{\text{Euro sales to break even}}{} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{€660}{0.49} = €1{,}347 \text{(rounded)}$$

Margin of safety = Actual sales - Break-even sales

= €1,600 - €1,347 = €253

$$\text{Margin of safety percentage} = \frac{\text{Margin of safety in euros}}{\text{Actual sales}}$$

$$= \frac{€253}{€1{,}600} = 15.81\%$$

3. The reason for the increase in the break-even point can be traced to the decrease in the company's average contribution margin ratio when the third product is added. Note from the income statements above that this ratio drops from 55% to 49% with the addition of the third product. This product, called Cano, has a CM ratio of only 25%, which causes the average contribution margin ratio to fall.

   This problem shows the somewhat tenuous nature of break-even analysis when more than one product is involved. The manager must be very careful of his or her assumptions regarding sales mix when making decisions such as adding or deleting products.

   It should be pointed out to the president that even though the break-even point is higher with the addition of the third product, the company's margin of safety is also greater. Notice that the margin of safety increases from €80 to €253 or from 6.25% to 15.81%. Thus, the addition of the new product shifts the company much further from its break-even point, even though the break-even point is higher.

**Problem 5-24** (60 minutes)

1. April's Income Statement:

| | *Standard* | | *Deluxe* | | *Pro* | | *Total* | |
|---|---|---|---|---|---|---|---|---|
| | *Amount* | *%* | *Amount* | *%* | *Amount* | *%* | *Amount* | *%* |
| Sales | $80,000 | 100 | $60,000 | 100 | $450,000 | 100 | $590,000 | 100 |
| Variable expenses: | | | | | | | | |
| Production | 44,000 | 55 | 27,000 | 45 | 157,500 | 35 | 228,500 | 38.7 |
| Selling | 4,000 | 5 | 3,000 | 5 | 22,500 | 5 | 29,500 | 5.0 |
| Total variable expenses | 48,000 | 60 | 30,000 | 50 | 180,000 | 40 | 258,000 | 43.7 |
| Contribution margin | $32,000 | 40 | $30,000 | 50 | $270,000 | 60 | 332,000 | 56.3 |
| Fixed expenses: | | | | | | | | |
| Production | | | | | | | 120,000 | |
| Advertising | | | | | | | 100,000 | |
| Administrative | | | | | | | 50,000 | |
| Total fixed expenses | | | | | | | 270,000 | |
| Net operating income | | | | | | | $ 62,000 | |

**Problem 5-24** (continued)

May's Income Statement:

| | *Standard* | | *Deluxe* | | *Pro* | | *Total* | |
|---|---|---|---|---|---|---|---|---|
| | *Amount* | *%* | *Amount* | *%* | *Amount* | *%* | *Amount* | *%* |
| Sales | $320,000 | 100 | $60,000 | 100 | $270,000 | 100 | $650,000 | 100.0 |
| Variable expenses: | | | | | | | | |
| Production | 176,000 | 55 | 27,000 | 45 | 94,500 | 35 | 297,500 | 45.8 |
| Selling | 16,000 | 5 | 3,000 | 5 | 13,500 | 5 | 32,500 | 5.0 |
| Total variable expenses | 192,000 | 60 | 30,000 | 50 | 108,000 | 40 | 330,000 | 50.8 |
| Contribution margin | $128,000 | 40 | $30,000 | 50 | $162,000 | 60 | 320,000 | 49.2 |
| Fixed expenses: | | | | | | | | |
| Production | | | | | | | 120,000 | |
| Advertising | | | | | | | 100,000 | |
| Administrative | | | | | | | 50,000 | |
| Total fixed expenses | | | | | | | 270,000 | |
| Net operating income | | | | | | | $ 50,000 | |

**Problem 5-24** (continued)

2. The sales mix has shifted over the last month from a greater concentration of Pro rackets to a greater concentration of Standard rackets. This shift has caused a decrease in the company's overall CM ratio from 56.3% in April to only 49.2% in May. For this reason, even though total sales (both in units and in dollars) is greater, net operating income is lower than last month in the division.

3. The break-even in dollar sales can be computed as follows:

$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$270{,}000}{0.563} = \$479{,}574 \text{ (rounded)}$$

4. May's break-even point has gone up. The reason is that the division's overall CM ratio has declined for May as stated in (2) above. Unchanged fixed expenses divided by a lower overall CM ratio would yield a higher break-even point in sales dollars.

5.

| | *Standard* | *Pro* |
|---|---|---|
| Increase in sales | $20,000 | $20,000 |
| Multiply by the CM ratio | × 40% | × 60% |
| Increase in net operating income* | $ 8,000 | $12,000 |

*Assuming that fixed costs do not change.

**Problem 5-25** (45 minutes)

1.

| | |
|---|---|
| Sales (25,000 units × SFr 90 per unit) | SFr 2,250,000 |
| Variable expenses | |
| (25,000 units × SFr 60 per unit) | 1,500,000 |
| Contribution margin | 750,000 |
| Fixed expenses | 840,000 |
| Net operating loss | SFr (90,000) |

2.

$$\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}}$$

$$= \frac{\text{SFr } 840{,}000}{\text{SFr } 30 \text{ per unit}} = 28{,}000 \text{ units}$$

28,000 units × SFr 90 per unit = SFr 2,520,000 to break even.

3. See the next page.

4. At a selling price of SFr 80 per unit, the contribution margin is SFr 20 per unit. Therefore:

$$\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}}$$

$$= \frac{\text{SFr } 840{,}000}{\text{SFr } 20 \text{ per unit}}$$

$$= 42{,}000 \text{ units}$$

42,000 units × SFr 80 per unit = SFr 3,360,000 to break even.

This break-even point is different from the break-even point in (2) because of the change in selling price. With the change in selling price, the unit contribution margin drops from SFr 30 to SFr 20, resulting in an increase in the break-even point.

**Problem 5-25** (continued)

3.

| *Unit Selling Price (SFrs)* | *Unit Variable Expense (SFrs)* | *Unit Contribution Margin (SFrs)* | *Volume (Units)* | *Total Contribution Margin (SFrs)* | *Fixed Expenses (SFrs)* | *Net Operating Income (SFrs)* |
|---|---|---|---|---|---|---|
| 90 | 60 | 30 | 25,000 | 750,000 | 840,000 | (90,000) |
| 88 | 60 | 28 | 30,000 | 840,000 | 840,000 | 0 |
| 86 | 60 | 26 | 35,000 | 910,000 | 840,000 | 70,000 |
| 84 | 60 | 24 | 40,000 | 960,000 | 840,000 | 120,000 |
| 82 | 60 | 22 | 45,000 | 990,000 | 840,000 | 150,000 |
| 80 | 60 | 20 | 50,000 | 1,000,000 | 840,000 | 160,000 |
| 78 | 60 | 18 | 55,000 | 990,000 | 840,000 | 150,000 |

The maximum profit is SFr 160,000. This level of profit can be earned by selling 50,000 units at a selling price of SFr 80 per unit.

**Problem 5-26** (60 minutes)

1. The income statements would be:

| | *Present* | | |
|---|---|---|---|
| | *Amount* | *Per Unit* | *%* |
| Sales | $800,000 | $20 | 100% |
| Variable expenses | 560,000 | 14 | 70% |
| Contribution margin | 240,000 | $6 | 30% |
| Fixed expenses | 192,000 | | |
| Net operating income | $ 48,000 | | |

| | *Proposed* | | |
|---|---|---|---|
| | *Amount* | *Per Unit* | *%* |
| Sales | $800,000 | $20 | 100% |
| Variable expenses* | 320,000 | 8 | 40% |
| Contribution margin | 480,000 | $12 | 60% |
| Fixed expenses | 432,000 | | |
| Net operating income | $ 48,000 | | |

*$14 – $6 = $8

2. a. Degree of operating leverage:

Present:

$$\text{Degree of operating leverage} = \frac{\text{Contribution margin}}{\text{Net operating income}}$$

$$= \frac{\$240,000}{\$48,000} = 5$$

Proposed:

$$\text{Degree of operating leverage} = \frac{\text{Contribution margin}}{\text{Net operating income}}$$

$$= \frac{\$480,000}{\$48,000} = 10$$

**Problem 5-26** (continued)

b. Dollar sales to break even:

Present:

$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$

$$= \frac{\$192{,}000}{0.30} = \$640{,}000$$

Proposed:

$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$

$$= \frac{\$432{,}000}{0.60} = \$720{,}000$$

c. Margin of safety:

Present:

Margin of safety = Actual sales - Break-even sales

= \$800,000 - \$640,000 = \$160,000

$$\text{Margin of safety percentage} = \frac{\text{Margin of safety in dollars}}{\text{Actual sales}}$$

$$= \frac{\$160{,}000}{\$800{,}000} = 20\%$$

Proposed:

$$\text{Margin of safety} = \text{Actual sales} - \text{Break-even sales}$$

$$= \$800{,}000 - \$720{,}000 = \$80{,}000$$

$$\text{Margin of safety percentage} = \frac{\text{Margin of safety in dollars}}{\text{Actual sales}}$$

$$= \frac{\$80{,}000}{\$800{,}000} = 10\%$$

**Problem 5-26** (continued)

3. The major factor would be the sensitivity of the company's operations to cyclical movements in the economy. Because the new equipment will increase the CM ratio, in years of strong economic activity, the company will be better off with the new equipment. However, the company will be worse off with the new equipment in years in which sales drop. The fixed costs of the new equipment will result in losses being incurred more quickly and they will be deeper. Thus, management must decide whether the potential for greater profits in good years is worth the risk of deeper losses in bad years.

4. No information is given in the problem concerning the new variable expenses or the new contribution margin ratio. Both of these items must be determined before the new break-even point can be computed. The computations are:

   New variable expenses:

$$\begin{aligned}\text{Profit} &= (\text{Sales} - \text{Variable expenses}) - \text{Fixed expenses}\\ \$60{,}000^{**} &= (\$1{,}200{,}000^{*} - \text{Variable expenses}) - \$240{,}000\\ \text{Variable expenses} &= \$1{,}200{,}000 - \$240{,}000 - \$60{,}000\\ &= \$900{,}000\end{aligned}$$

   * New level of sales: $800,000 × 1.5 = $1,200,000
   ** New level of net operating income: $48,000 × 1.25 = $60,000

   New CM ratio:

| | | |
|---|---|---|
| Sales | $1,200,000 | 100% |
| Variable expenses | 900,000 | 75% |
| Contribution margin | $ 300,000 | 25% |

   With the above data, the new break-even point can be computed:

$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$240{,}000}{0.25} = \$960{,}000$$

**Problem 5-26** (continued)

The greatest risk is that the increases in sales and net operating income predicted by the marketing manager will not happen and that sales will remain at their present level. Note that the present level of sales is $800,000, which is well below the break-even level of sales under the new marketing strategy.

It would be a good idea to compare the new marketing strategy to the current situation more directly. What level of sales would be needed under the new method to generate at least the $48,000 in profits the company is currently earning each month? The computations are:

$$\text{Dollar sales to attain target profit} = \frac{\text{Target profit + Fixed expenses}}{\text{CM ratio}}$$

$$= \frac{\$48{,}000 + \$240{,}000}{0.25}$$

$$= \$1{,}152{,}000 \text{ in sales each month}$$

Thus, sales would have to increase by at least 44% ($1,152,000 is 44% higher than $800,000) in order to make the company better off with the new marketing strategy than with the current approach. This appears to be extremely risky.

**Problem 5-27** (30 minutes)

1. The numbered components are as follows:

   (1) Dollars of revenue and costs.
   (2) Volume of output, expressed in units, % of capacity, sales, or some other measure of activity.
   (3) Total expense line.
   (4) Variable expense area.
   (5) Fixed expense area.
   (6) Break-even point.
   (7) Loss area.
   (8) Profit area.
   (9) Revenue line.

**Problem 5-27** (continued)

2. a. Line 3: Remain unchanged.
   Line 9: Have a flatter slope.
   Break-even point: Increase.

   b. Line 3: Have a steeper slope.
   Line 9: Remain unchanged.
   Break-even point: Increase.

   c. Line 3: Shift downward.
   Line 9: Remain unchanged.
   Break-even point: Decrease.

   d. Line 3: Remain unchanged.
   Line 9: Remain unchanged.
   Break-even point: Remain unchanged.

   e. Line 3: Shift upward and have a flatter slope.
   Line 9: Remain unchanged.
   Break-even point: Probably change, but the direction is uncertain.

   f. Line 3: Have a flatter slope.
   Line 9: Have a flatter slope.
   Break-even point: Remain unchanged in terms of units; decrease in terms of total dollars of sales.

   g. Line 3: Shift upward.
   Line 9: Remain unchanged.
   Break-even point: Increase.

   h. Line 3: Shift downward and have a steeper slope.
   Line 9: Remain unchanged.
   Break-even point: Probably change, but the direction is uncertain.

**Problem 5-28** (60 minutes)

1.
$$
\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses}\\
\$0 &= (\$2.00 - \$0.80) \times Q - \$60{,}000\\
\$0 &= (\$1.20) \times Q - \$60{,}000\\
\$1.20Q &= \$60{,}000\\
Q &= \$60{,}000 \div \$1.20 \text{ per pair}\\
Q &= 50{,}000 \text{ pairs}
\end{aligned}
$$

50,000 pairs × $2 per pair = $100,000 in sales.

Alternative solution:

$$\begin{array}{c}\text{Unit sales}\\ \text{to break even}\end{array} = \frac{\text{Fixed expenses}}{\text{CM per unit}} = \frac{\$60{,}000}{\$1.20 \text{ per pair}} = 50{,}000 \text{ pairs}$$

$$\begin{array}{c}\text{Dollar sales}\\ \text{to break even}\end{array} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$60{,}000}{0.60} = \$100{,}000 \text{ in sales}$$

2. See the graph on the following page.

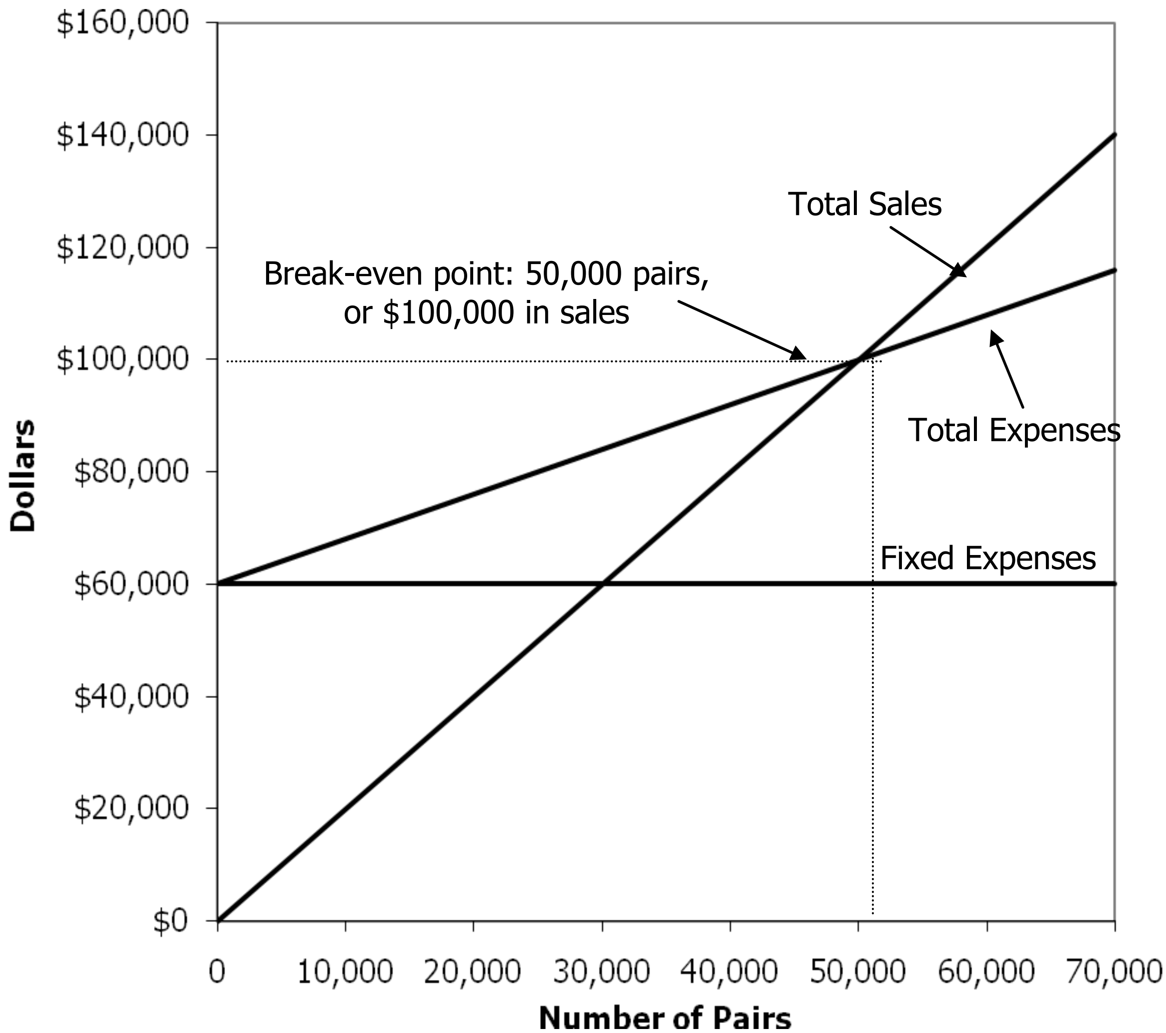
3.
$$
\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses}\\
\$9{,}000 &= \$1.20 \times Q - \$60{,}000\\
\$1.20Q &= \$9{,}000 + \$60{,}000\\
Q &= \$69{,}000 \div \$1.20 \text{ per pair}\\
Q &= 57{,}500 \text{ pairs}
\end{aligned}
$$

Alternative solution:

$$
\begin{aligned}
\begin{array}{c}\text{Unit sales to attain}\\ \text{target profit}\end{array} &= \frac{\text{Target profit} + \text{Fixed expenses}}{\text{CM per unit}}\\
&= \frac{\$9{,}000 + \$60{,}000}{\$1.20 \text{ per pair}}\\
&= 57{,}500 \text{ pairs}
\end{aligned}
$$

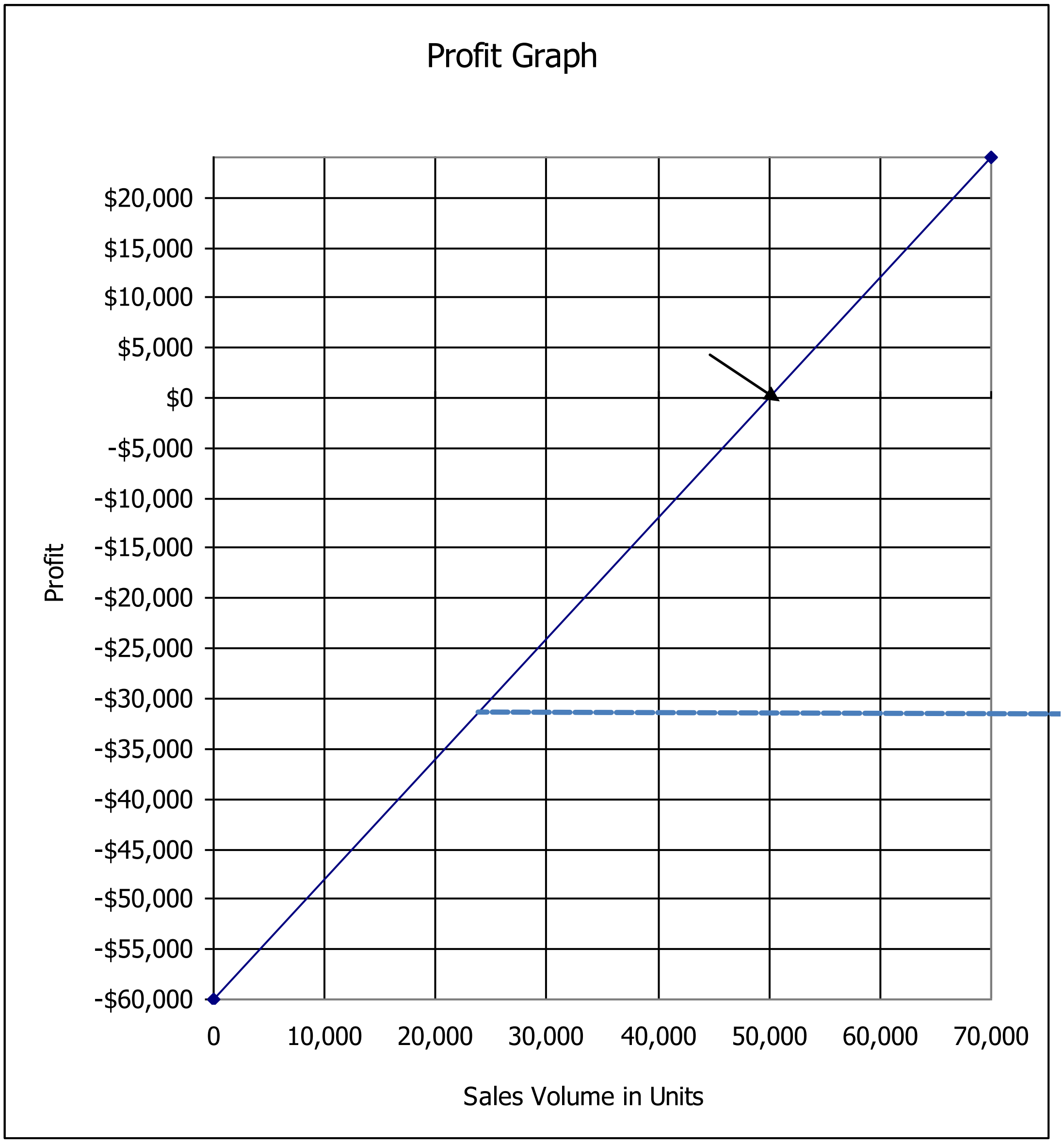
**Problem 5-28** (continued)

2. Cost-volume-profit graph:



**Problem 5-28** (continued)

Profit graph:



**Problem 5-28** (continued)

4. Incremental contribution margin:

| | |
|---|---|
| $20,000 increased sales × 60% CM ratio | $12,000 |
| Less incremental fixed salary cost | 8,000 |
| Increased net operating income | $ 4,000 |

Yes, the position should be converted to a full-time basis.

5. a.

$$\text{Degree of operating leverage} = \frac{\text{Contribution margin}}{\text{Net operating income}} = \frac{\$75{,}000}{\$15{,}000} = 5$$

b. 5 × 20% sales increase = 100% increase in net operating income. Thus, net operating income would double next year, going from $15,000 to $30,000.

**Problem 5-29** (75 minutes)

1. a.

| | | |
|---|---|---|
| Selling price | $37.50 | 100% |
| Variable expenses | 22.50 | 60% |
| Contribution margin | $15.00 | 40% |

$$\text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses}$$
$$\$0 = \$15 \times Q - \$480{,}000$$
$$\$15Q = \$480{,}000$$
$$Q = \$480{,}000 \div \$15 \text{ per skateboard}$$
$$Q = 32{,}000 \text{ skateboards}$$

Alternative solution:

$$\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit CM}}$$
$$= \frac{\$480{,}000}{\$15 \text{ per skateboard}}$$
$$= 32{,}000 \text{ skateboards}$$

b. The degree of operating leverage would be:

$$\text{Degree of operating leverage} = \frac{\text{Contribution margin}}{\text{Net operating income}}$$
$$= \frac{\$600{,}000}{\$120{,}000} = 5.0$$

2. The new CM ratio will be:

| | | |
|---|---|---|
| Selling price | $37.50 | 100% |
| Variable expenses | 25.50 | 68% |
| Contribution margin | $12.00 | 32% |

**Problem 5-29** (continued)

The new break-even point will be:

$$
\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
\$0 &= \$12 \times Q - \$480{,}000 \\
\$12Q &= \$480{,}000 \\
Q &= \$480{,}000 \div \$12 \text{ per skateboard} \\
Q &= 40{,}000 \text{ skateboards}
\end{aligned}
$$

Alternative solution:

$$
\begin{aligned}
\text{Unit sales to break even} &= \frac{\text{Fixed expenses}}{\text{Unit CM}} \\
&= \frac{\$480{,}000}{\$12 \text{ per skateboard}} \\
&= 40{,}000 \text{ skateboards}
\end{aligned}
$$

3.

$$
\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
\$120{,}000 &= \$12 \times Q - \$480{,}000 \\
\$12Q &= \$120{,}000 + \$480{,}000 \\
Q &= \$600{,}000 \div \$12 \text{ per skateboard} \\
Q &= 50{,}000 \text{ skateboards}
\end{aligned}
$$

Alternative solution:

$$
\begin{aligned}
\text{Unit sales to attain target profit} &= \frac{\text{Target profit} + \text{Fixed expenses}}{\text{Unit CM}} \\
&= \frac{\$120{,}000 + \$480{,}000}{\$12 \text{ per skateboard}} \\
&= 50{,}000 \text{ skateboards}
\end{aligned}
$$

## **Problem 5-29** (continued)

Thus, sales will have to increase by 10,000 skateboards (50,000 skateboards, less 40,000 skateboards currently being sold) to earn the same amount of net operating income as earned last year. The computations above and in part (2) show the dramatic effect that increases in variable costs can have on an organization. These effects from a $3 per unit increase in labor costs for Tyrene Company are summarized below:

| | *Present* | *Expected* |
|---|---|---|
| Break-even point (in skateboards) .......... | 32,000 | 40,000 |
| Sales (in skateboards) needed to earn net operating income of $120,000 ............. | 40,000 | 50,000 |

Note that if variable costs do increase next year, then the company will just break even if it sells the same number of skateboards (40,000) as it did last year.

4. The contribution margin ratio last year was 40%. If we let P equal the new selling price, then:

$$P = \$25.50 + 0.40P$$
$$0.60P = \$25.50$$
$$P = \$25.50 \div 0.60$$
$$P = \$42.50$$

| | | | |
|---|---|---|---|
| To verify: | Selling price ........................... | $42.50 | 100% |
| | Variable expenses .................. | 25.50 | 60% |
| | Contribution margin ................ | $17.00 | 40% |

Therefore, to maintain a 40% CM ratio, a $3 increase in variable costs would require a $5 increase in the selling price.

**Problem 5-29** (continued)

5. The new CM ratio would be:

| | | |
|---|---|---|
| Selling price ....................... | $37.50 | 100% |
| Variable expenses................ | 13.50 * | 36% |
| Contribution margin............. | $24.00 | 64% |

*$22.50 – ($22.50 × 40%) = $13.50

The new break-even point would be:

Profit = Unit CM × Q − Fixed expenses
$0 = $24 × Q − $912,000*
$24Q = $912,000
Q = $912,000 ÷ $24 per skateboard
Q = 38,000 skateboards

*$480,000 × 1.9 = $912,000

Alternative solution:

$$\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit CM}}$$

$$= \frac{\$912{,}000}{\$24 \text{ per skateboard}}$$

$$= 38{,}000 \text{ skateboards}$$

Although this break-even figure is greater than the company's present break-even figure of 32,000 skateboards [see part (1) above], it is less than the break-even point will be if the company does not automate and variable labor costs rise next year [see part (2) above].

**Problem 5-29** (continued)

6. a.

$$\text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses}$$
$$\$120{,}000 = \$24 \times Q - \$912{,}000^*$$
$$\$24Q = \$120{,}000 + \$912{,}000$$
$$Q = \$1{,}032{,}000 \div \$24.00 \text{ per skateboard}$$
$$Q = 43{,}000 \text{ skateboards}$$

*480,000 × 1.9 = $912,000

Alternative solution:

$$\text{Unit sales to attain target profit} = \frac{\text{Target profit + Fixed expenses}}{\text{Unit CM}}$$

$$= \frac{\$120{,}000 + \$912{,}000}{\$24 \text{ per skateboard}}$$

$$= 43{,}000 \text{ skateboards}$$

Thus, the company will have to sell 3,000 more skateboards (43,000 – 40,000 = 3,000) than now being sold to earn a profit of $120,000 each year. However, this is still less than the 50,000 skateboards that would have to be sold to earn a $120,000 profit if the plant is not automated and variable labor costs rise next year [see part (3) above].

**Problem 5-29** (continued)

b. The contribution income statement would be:

| | |
|---|---|
| Sales | |
| (40,000 skateboards × $37.50 per skateboard).. | $1,500,000 |
| Variable expenses | |
| (40,000 skateboards × $13.50 per skateboard) . | 540,000 |
| Contribution margin .......................................... | 960,000 |
| Fixed expenses ................................................ | 912,000 |
| Net operating income......................................... | $ 48,000 |

$$\text{Degree of operating leverage} = \frac{\text{Contribution margin}}{\text{Net operating income}}$$

$$= \frac{\$960,000}{\$48,000} = 20$$

c. This problem shows the difficulty faced by some companies. When variable labor costs increase, it is often difficult to pass these cost increases along to customers in the form of higher prices. Thus, companies are forced to automate, resulting in higher operating leverage, often a higher break-even point, and greater risk for the company.

There is no clear answer as to whether one should have been in favor of constructing the new plant.

**Problem 5-30** (30 minutes)

1. The contribution margin per stein would be:

| | | |
|---|---|---|
| Selling price | | $30 |
| Variable expenses: | | |
| Purchase cost of the steins | $15 | |
| Commissions to the student salespersons | 6 | 21 |
| Contribution margin | | $ 9 |

Since there are no fixed costs, the number of unit sales needed to yield the desired $7,200 in profits can be obtained by dividing the target profit by the unit contribution margin:

$$\frac{\text{Target profit}}{\text{Unit CM}} = \frac{\$7{,}200}{\$9 \text{ per stein}} = 800 \text{ steins}$$

800 steins × $30 per stein = $24,000 in total sales

2. Since an order has been placed, there is now a "fixed" cost associated with the purchase price of the steins (i.e., the steins can't be returned). For example, an order of 200 steins requires a "fixed" cost (investment) of $3,000 (= 200 steins × $15 per stein). The variable costs drop to only $6 per stein, and the new contribution margin per stein becomes:

| | |
|---|---|
| Selling price | $30 |
| Variable expenses (commissions only) | 6 |
| Contribution margin | $24 |

Since the "fixed" cost of $3,000 must be recovered before Marbury shows any profit, the break-even computation would be:

$$\begin{array}{c}\text{Unit sales}\\ \text{to break even}\end{array} = \frac{\text{Fixed expenses}}{\text{Unit CM}} = \frac{\$3{,}000}{\$24 \text{ per stein}} = 125 \text{ steins}$$

125 steins × $30 per stein = $3,750 in total sales

If a quantity other than 200 steins were ordered, the answer would change accordingly.

**Problem 5-31** (45 minutes)

1. The contribution margin per unit on the first 30,000 units is:

| | Per Unit |
|---|---|
| Selling price | $2.50 |
| Variable expenses | 1.60 |
| Contribution margin | $0.90 |

The contribution margin per unit on anything over 30,000 units is:

| | Per Unit |
|---|---|
| Selling price | $2.50 |
| Variable expenses | 1.75 |
| Contribution margin | $0.75 |

Thus, for the first 30,000 units sold, the total amount of contribution margin generated would be:

30,000 units × $0.90 per unit = $27,000.

Since the fixed costs on the first 30,000 units total $40,000, the $27,000 contribution margin above is not enough to permit the company to break even. Therefore, in order to break even, more than 30,000 units will have to be sold. The fixed costs that will have to be covered by the additional sales are:

| | |
|---|---|
| Fixed costs on the first 30,000 units | $40,000 |
| Less contribution margin from the first 30,000 units | 27,000 |
| Remaining unrecovered fixed costs | 13,000 |
| Add monthly rental cost of the additional space needed to produce more than 30,000 units | 2,000 |
| Total fixed costs to be covered by remaining sales | $15,000 |

**Problem 5-31** (continued)

The additional sales of units required to cover these fixed costs would be:

$$\frac{\text{Total remaining fixed costs}}{\text{Unit contribution margin on added units}} = \frac{\$15{,}000}{\$0.75 \text{ per unit}}$$

$$= 20{,}000 \text{ units}$$

Therefore, a total of 50,000 units (30,000 + 20,000) must be sold for the company to break even. This number of units would equal total sales of:

50,000 units × \$2.50 per unit = \$125,000 in total sales.

2 $$\frac{\text{Target profit}}{\text{Unit contribution margin}} = \frac{\$9{,}000}{\$0.75 \text{ per unit}} = 12{,}000 \text{ units}$$

Thus, the company must sell 12,000 units above the break-even point to earn a profit of \$9,000 each month. These units, added to the 50,000 units required to break even, equal total sales of 62,000 units each month to reach the target profit.

3. If a bonus of \$0.15 per unit is paid for each unit sold in excess of the break-even point, then the contribution margin on these units would drop from \$0.75 to only \$0.60 per unit.

   The desired monthly profit would be:

   25% × (\$40,000 + \$2,000) = \$10,500

   Thus,

$$\frac{\text{Target profit}}{\text{Unit contribution margin}} = \frac{\$10{,}500}{\$0.60 \text{ per unit}} = 17{,}500 \text{ units}$$

   Therefore, the company must sell 17,500 units above the break-even point to earn a profit of \$10,500 each month. These units, added to the 50,000 units required to break even, would equal total sales of 67,500 units each month.

**Case 5-32** (75 minutes)

1. The contribution format income statements (in thousands of dollars) for the three alternatives are:

| | *18% Commission* | | *20% Commission* | | *Own Sales Force* | | |
|---|---|---|---|---|---|---|---|
| Sales | $30,000 | 100% | $30,000 | 100% | $30,000 | | 100% |
| Variable expenses: | | | | | | | |
| Variable cost of goods sold | 17,400 | | 17,400 | | 17,400 | | |
| Commissions | 5,400 | | 6,000 | | 3,000 | | |
| Total variable expense | 22,800 | 76% | 23,400 | 78% | 20,400 | | 68% |
| Contribution margin | 7,200 | 24% | 6,600 | 22% | 9,600 | | 32% |
| Fixed expenses: | | | | | | | |
| Fixed cost of goods sold | 2,800 | | 2,800 | | 2,800 | | |
| Fixed advertising expense | 800 | | 800 | | 1,300 | * | |
| Fixed marketing staff expense | | | | | 1,300 | ** | |
| Fixed administrative expense | 3,200 | | 3,200 | | 3,200 | | |
| Total fixed expenses | 6,800 | | 6,800 | | 8,600 | | |
| Net operating income | $ 400 | | $ (200) | | $ 1,000 | | |

* $800,000 + $500,000 = $1,300,000

** $700,000 + $400,000 + $200,000 = $1,300,000

**Case 5-32** (continued)

2. Given the data above, the break-even points can be determined using total fixed expenses and the CM ratios as follows:

   a. $$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$6{,}800{,}000}{0.24} = \$28{,}333{,}333$$

   b. $$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$6{,}800{,}000}{0.22} = \$30{,}909{,}091$$

   c. $$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$8{,}600{,}000}{0.32} = \$26{,}875{,}000$$

3. $$\text{Dollar sales to attain target profit} = \frac{\text{Target profit + Fixed expenses}}{\text{CM ratio}}$$

$$= \frac{-\$200{,}000 + \$8{,}600{,}000}{0.32}$$

$$= \$26{,}250{,}000$$

4. $$X = \text{Total sales revenue}$$

$$\text{Net operating income with company sales force} = 0.32X - \$8{,}600{,}000$$

$$\text{Net operating income with the 20\% commissions} = 0.22X - \$6{,}800{,}000$$

The two net operating incomes are equal when:

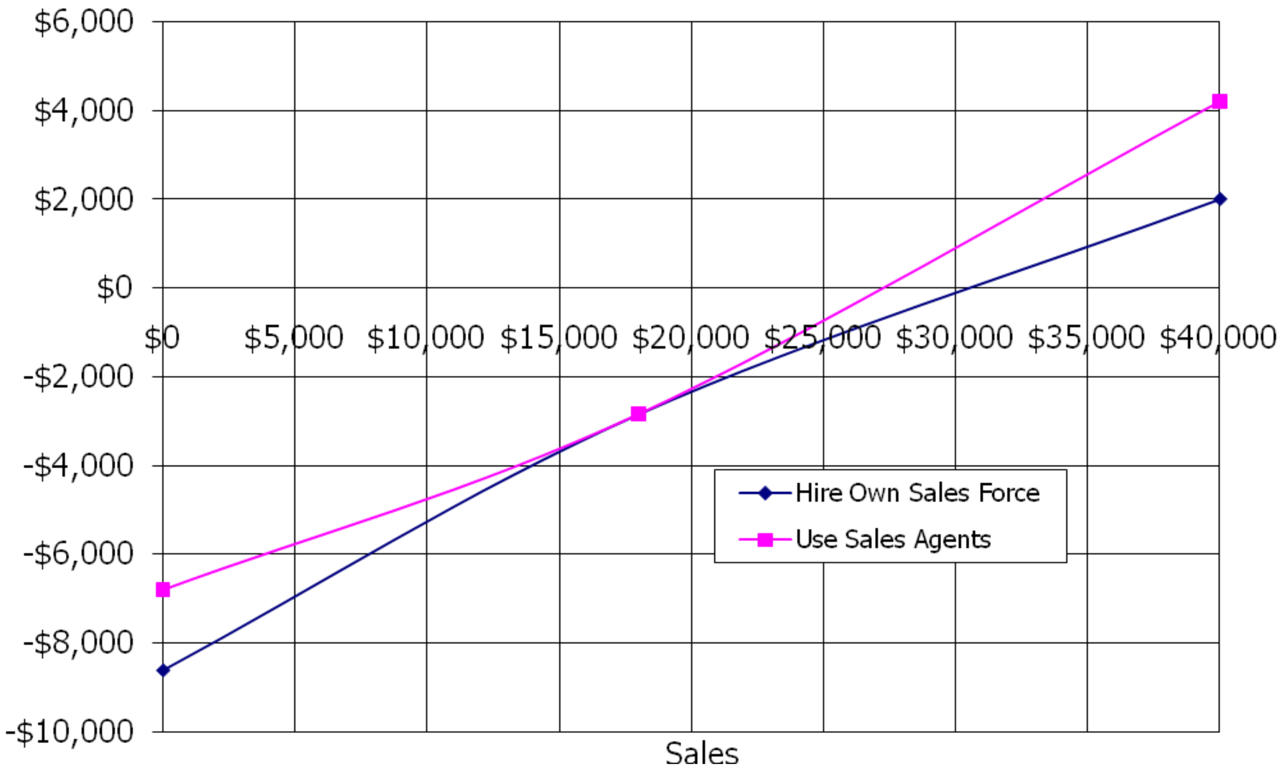
$$\begin{aligned}
0.32X - \$8{,}600{,}000 &= 0.22X - \$6{,}800{,}000 \\
0.10X &= \$1{,}800{,}000 \\
X &= \$1{,}800{,}000 \div 0.10 \\
X &= \$18{,}000{,}000
\end{aligned}$$

**Case 5-32** (continued)

Thus, at a sales level of $18,000,000 either plan will yield the same net operating income. This is verified below (in thousands of dollars):

| | *20% Commission* | | *Own Sales Force* | |
|---|---|---|---|---|
| Sales | $ 18,000 | 100% | $ 18,000 | 100% |
| Total variable expense | 14,040 | 78% | 12,240 | 68% |
| Contribution margin | 3,960 | 22% | 5,760 | 32% |
| Total fixed expenses | 6,800 | | 8,600 | |
| Net operating income | $ (2,840) | | $ (2,840) | |

5. A graph showing both alternatives appears below:



**Case 5-32** (continued)

6.

To: President of Marston Corporation
Fm: Student's name

Assuming that a competent sales force can be quickly hired and trained and the new sales force is as effective as the sales agents, this is the better alternative. Using the data provided by the controller, unless sales fall below $18,000,000 net operating income is higher when the company has its own sales force. At that level of sales and below, the company would be losing money, so it is unlikely that this would be the normal situation.

The major concern I have with this recommendation is the assumption that the new sales force will be as effective as the sales agents. The sales agents have been selling our product for a number of years, so they are likely to have more field experience than any sales force we hire. And, our own sales force would be selling just our product instead of a variety of products. On the one hand, that will result in a more focused selling effort. On the other hand, that may make it more difficult for a salesperson to get the attention of a hospital's purchasing agent.

The purchasing agents may prefer to deal through a small number of salespersons, each of whom sells many products, rather than a large number of salespersons each of whom sells only a single product. Even so, we can afford some decrease in sales because of the lower cost of maintaining our own sales force. For example, assuming that the sales agents make the budgeted sales of $30,000,000, we would have a net operating loss of $200,000 for the year. We would do better than this with our own sales force as long as sales are greater than $26,250,000. In other words, we could afford a fall-off in sales of $3,750,000, or 12.5%, and still be better off with our own sales force. If we are confident that our own sales force could do at least this well relative to the sales agents, then we should certainly switch to using our own sales force.

**CASE 5-33** (60 minutes)

Note: This is a problem that will challenge the very best students' conceptual and analytical skills. However, working through this case will yield substantial dividends in terms of a much deeper understanding of critical management accounting concepts.

1. The overall break-even sales can be determined using the CM ratio.

| | *Frog* | *Minnow* | *Worm* | *Total* |
|---|---|---|---|---|
| Sales ......................... | $200,000 | $280,000 | $240,000 | $720,000 |
| Variable expenses....... | 120,000 | 160,000 | 150,000 | 430,000 |
| Contribution margin.... | $ 80,000 | $120,000 | $ 90,000 | 290,000 |
| Fixed expenses .......... | | | | 282,000 |
| Net operating income . | | | | $ 8,000 |

$$\text{CM ratio} = \frac{\text{Contribution margin}}{\text{Sales}} = \frac{\$290,000}{\$720,000} = 0.4028$$

$$\begin{array}{c}\text{Dollar sales}\\ \text{to break even}\end{array} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$282,000}{0.4028} = \$700,100 \text{ (rounded)}$$

2. The issue is what to do with the common fixed costs when computing the break-evens for the individual products. The correct approach is to ignore the common fixed costs. If the common fixed costs are included in the computations, the break-even points will be overstated for individual products and managers may drop products that in fact are profitable.

   a. The break-even points for each product can be computed using the contribution margin approach as follows:

| | *Frog* | *Minnow* | *Worm* |
|---|---|---|---|
| Unit selling price ................ | $2.00 | $1.40 | $0.80 |
| Variable cost per unit ......... | 1.20 | 0.80 | 0.50 |
| Unit contribution margin (a) | $0.80 | $0.60 | $0.30 |
| Product fixed expenses (b) . | $18,000 | $96,000 | $60,000 |
| Unit sales to break even (b) ÷ (a)........................ | 22,500 | 160,000 | 200,000 |

**Case 5-33** (continued)

b. If the company were to sell exactly the break-even quantities computed above, the company would lose $108,000—the amount of the common fixed cost. This occurs because the common fixed costs have been ignored in the calculations of the break-evens.

The fact that the company loses $108,000 if it operates at the level of sales indicated by the break-evens for the individual products can be verified as follows:

| | *Frog* | *Minnow* | *Worm* | *Total* |
|---|---|---|---|---|
| Unit sales | 22,500 | 160,000 | 200,000 | |
| Sales | $45,000 | $224,000 | $160,000 | $ 429,000 |
| Variable expenses | 27,000 | 128,000 | 100,000 | 255,000 |
| Contribution margin | $18,000 | $ 96,000 | $ 60,000 | 174,000 |
| Fixed expenses | | | | 282,000 |
| Net operating loss | | | | $(108,000) |

At this point, many students conclude that something is wrong with their answer to part (a) because the company loses money operating at the break-evens for the individual products. They also worry that managers may be lulled into a false sense of security if they are given the break-evens computed in part (a). Total sales at the individual product break-evens is only $429,000 whereas the total sales at the overall break-even computed in part (1) is $700,100.

Many students (and managers, for that matter) attempt to resolve this apparent paradox by allocating the common fixed costs among the products prior to computing the break-evens for individual products. Any of a number of allocation bases could be used for this purpose—sales, variable expenses, product-specific fixed expenses, contribution margins, etc. (We usually take a tally of how many students allocated the common fixed costs using each possible allocation base before proceeding.) For example, the common fixed costs are allocated on the next page based on sales.

**Case 5-33** (continued)

Allocation of common fixed expenses on the basis of sales revenue:

| | *Frog* | *Minnow* | *Worm* | *Total* |
|---|---|---|---|---|
| Sales | $200,000 | $280,000 | $240,000 | $720,000 |
| Percentage of total sales | 27.8% | 38.9% | 33.3% | 100.0% |
| Allocated common fixed expense* | $30,000 | $ 42,000 | $36,000 | $108,000 |
| Product fixed expenses | 18,000 | 96,000 | 60,000 | 174,000 |
| Allocated common and product fixed expenses (a) | $48,000 | $138,000 | $96,000 | $282,000 |
| Unit contribution margin (b) | $0.80 | $0.60 | $0.30 | |
| "Break-even" point in units sold (a)÷(b) | 60,000 | 230,000 | 320,000 | |

*Total common fixed expense × Percentage of total sales

If the company sells 60,000 units of the Frog lure product, 230,000 units of the Minnow lure product, and 320,000 units of the Worm lure product, the company will indeed break even overall. However, the apparent break-evens for two of the products are above their normal annual sales.

| | *Frog* | *Minnow* | *Worm* |
|---|---|---|---|
| Normal annual unit sales volume | 100,000 | 200,000 | 300,000 |
| "Break-even" unit annual sales (see above) | 60,000 | 230,000 | 320,000 |
| "Strategic" decision | retain | drop | drop |

**Case 5-33** (continued)

It would be natural to interpret a break-even for a product as the level of sales below which the company would be financially better off dropping the product. Therefore, we should not be surprised if managers, based on the erroneous break-even calculation on the previous page, would decide to drop the Minnow and Worm lures and concentrate on the company's "core competency," which appears to be the Frog lure. However, if they were to do that, the company would face a loss of $46,000:

| | *Frog* | *Minnow* | *Worm* | *Total* |
|---|---|---|---|---|
| Sales | $200,000 | dropped | dropped | $200,000 |
| Variable expenses | 120,000 | | | 120,000 |
| Contribution margin | $ 80,000 | | | 80,000 |
| Fixed expenses* | | | | 126,000 |
| Net operating loss | | | | $(46,000) |

*By dropping the two products, the company reduces its fixed expenses by only $156,000 (= $96,000 + $60,000). Therefore, the total fixed expenses would be $126,000 (= $282,000 − $156,000).

By dropping the two products, the company would have a loss of $46,000 rather than a profit of $8,000. The reason is that the two products dropped were contributing $54,000 toward covering common fixed expenses and toward profits. This can be verified by looking at a segmented income statement like the one that will be introduced in a later chapter.

| | *Frog* | *Minnow* | *Worm* | *Total* |
|---|---|---|---|---|
| Sales | $200,000 | $280,000 | $240,000 | $720,000 |
| Variable expenses | 120,000 | 160,000 | 150,000 | 430,000 |
| Contribution margin | 80,000 | 120,000 | 90,000 | 290,000 |
| Product fixed expenses | 18,000 | 96,000 | 60,000 | 174,000 |
| Product segment margin | $ 62,000 | $ 24,000 | $ 30,000 | 116,000 |
| Common fixed expenses | | | | 108,000 |
| Net operating income | | | | $ 8,000 |

$\boxed{\$54,000}$

# Chapter 6
# Variable Costing and Segment Reporting: Tools for Management

## Solutions to Questions

**6-1** Absorption and variable costing differ in how they handle fixed manufacturing overhead. Under absorption costing, fixed manufacturing overhead is treated as a product cost and hence is an asset until products are sold. Under variable costing, fixed manufacturing overhead is treated as a period cost and is expensed on the current period's income statement.

**6-2** Selling and administrative expenses are treated as period costs under both variable costing and absorption costing.

**6-3** Under absorption costing, fixed manufacturing overhead costs are included in product costs, along with direct materials, direct labor, and variable manufacturing overhead. If some of the units are not sold by the end of the period, then they are carried into the next period as inventory. When the units are finally sold, the fixed manufacturing overhead cost that has been carried over with the units is included as part of that period's cost of goods sold.

**6-4** Absorption costing advocates argue that absorption costing does a better job of matching costs with revenues than variable costing. They argue that all manufacturing costs must be assigned to products to properly match the costs of producing units of product with the revenues from the units when they are sold. They believe that no distinction should be made between variable and fixed manufacturing costs for the purposes of matching costs and revenues.

**6-5** Advocates of variable costing argue that fixed manufacturing costs are not really the cost of any particular unit of product. If a unit is made or not, the total fixed manufacturing costs will be exactly the same. Therefore, how can one say that these costs are part of the costs of the products? These costs are incurred to have the capacity to make products during a particular period and should be charged against that period as period costs according to the matching principle.

**6-6** If production and sales are equal, net operating income should be the same under absorption and variable costing. When production equals sales, inventories do not increase or decrease and therefore under absorption costing fixed manufacturing overhead cost cannot be deferred in inventory or released from inventory.

**6-7** If production exceeds sales, absorption costing will usually show higher net operating income than variable costing. When production exceeds sales, inventories increase and under absorption costing part of the fixed manufacturing overhead cost of the current period is deferred in inventory to the next period. In contrast, all of the fixed manufacturing overhead cost of the current period is immediately expensed under variable costing.

**6-8** If fixed manufacturing overhead cost is released from inventory, then inventory levels must have decreased and therefore production must have been less than sales.

**6-9** Under absorption costing net operating income can be increased by simply increasing the level of production without any increase in sales. If production exceeds sales, units of product are added to inventory. These units carry a portion of the current period's fixed manufacturing overhead costs into the inventory account, reducing the current period's reported expenses and causing net operating income to increase.

**6-10** Differences in reported net operating income between absorption and variable costing arise because of changing levels of inventory. In lean production, goods are produced strictly to customers' orders. With production geared to sales, inventories are largely (or entirely) eliminated. If inventories are completely eliminated, they cannot change from one period to another and absorption costing and variable costing will report the same net operating income.

**6-11** A segment is any part or activity of an organization about which a manager seeks cost, revenue, or profit data. Examples of segments include departments, operations, sales territories, divisions, and product lines.

**6-12** Under the contribution approach, costs are assigned to a segment if and only if the costs are traceable to the segment (i.e., could be avoided if the segment were eliminated). Common costs are not allocated to segments under the contribution approach.

**6-13** A traceable cost of a segment is a cost that arises specifically because of the existence of that segment. If the segment were eliminated, the cost would disappear. A common cost, by contrast, is a cost that supports more than one segment, but is not traceable in whole or in part to any one of the segments. If the departments of a company are treated as segments, then examples of the traceable costs of a department would include the salary of the department's supervisor, depreciation of machines used exclusively by the department, and the costs of supplies used by the department. Examples of common costs would include the salary of the general counsel of the entire company, the lease cost of the headquarters building, corporate image advertising, and periodic depreciation of machines shared by several departments.

**6-14** The contribution margin is the difference between sales revenue and variable expenses. The segment margin is the amount remaining after deducting traceable fixed expenses from the contribution margin. The contribution margin is useful as a planning tool for many decisions, particularly those in which fixed costs don't change. The segment margin is useful in assessing the overall profitability of a segment.

**6-15** If common costs were allocated to segments, then the costs of segments would be overstated and their margins would be understated. As a consequence, some segments may appear to be unprofitable and managers may be tempted to eliminate them. If a segment were eliminated because of the existence of arbitrarily allocated common costs, the overall profit of the company would decline and the common cost that had been allocated to the segment would be reallocated to the remaining segments—making them appear less profitable.

**6-16** There are often limits to how far down an organization a cost can be traced. Therefore, costs that are traceable to a segment may become common as that segment is divided into smaller segment units. For example, the costs of national TV and print advertising might be traceable to a specific product line, but be a common cost of the geographic sales territories in which that product line is sold.

**Exercise 6-1** (15 minutes)

1. Under absorption costing, all manufacturing costs (variable and fixed) are included in product costs. (All currency values are in thousands of rupees, denoted by R.)

| | |
|---|---|
| Direct materials | R120 |
| Direct labor | 140 |
| Variable manufacturing overhead | 50 |
| Fixed manufacturing overhead (R600,000 ÷ 10,000 units) | 60 |
| Absorption costing unit product cost | R370 |

2. Under variable costing, only the variable manufacturing costs are included in product costs. (All currency values are in thousands of rupees, denoted by R.)

| | |
|---|---|
| Direct materials | R120 |
| Direct labor | 140 |
| Variable manufacturing overhead | 50 |
| Variable costing unit product cost | R310 |

Note that selling and administrative expenses are not treated as product costs under either absorption or variable costing. These expenses are always treated as period costs and are charged against the current period's revenue.

**Exercise 6-2** (20 minutes)

1. 2,000 units in ending inventory × R60 fixed manufacturing overhead per unit = R120,000.

2. The variable costing income statement appears below:

| | | |
|---|---|---|
| Sales ............................................ | | R4,000,000 |
| Variable expenses: | | |
| Variable cost of goods sold | | |
| (8,000 units × R310 per unit) ........ | R2,480,000 | |
| Variable selling and administrative | | |
| (8,000 units × R20 per unit) .......... | 160,000 | 2,640,000 |
| Contribution margin............................ | | 1,360,000 |
| Fixed expenses: | | |
| Fixed manufacturing overhead.......... | 600,000 | |
| Fixed selling and administrative ........ | 400,000 | 1,000,000 |
| Net operating income ......................... | | R 360,000 |

The difference in net operating income between variable and absorption costing can be explained by the deferral of fixed manufacturing overhead cost in inventory that has taken place under the absorption costing approach. Note from part (1) that R120,000 of fixed manufacturing overhead cost has been deferred in inventory to the next period. Thus, net operating income under the absorption costing approach is R120,000 higher than it is under variable costing.

**Exercise 6-3** (20 minutes)

1.

| | Year 1 | Year 2 | Year 3 |
|---|---|---|---|
| Beginning inventories .......... | 180 | 150 | 160 |
| Ending inventories .............. | 150 | 160 | 200 |
| Change in inventories .......... | (30) | 10 | 40 |
| Fixed manufacturing overhead in beginning inventories (@$450 per unit)................................ | $ 81,000 | $ 67,500 | $72,000 |
| Fixed manufacturing overhead in ending inventories (@$450 per unit)................................ | 67,500 | 72,000 | 90,000 |
| Fixed manufacturing overhead deferred in (released from) inventories (@$450 per unit)................................ | $(13,500) | $ 4,500 | $ 18,000 |
| Variable costing net operating income .............. | $292,400 | $269,200 | $251,800 |
| Add (deduct) fixed manufacturing overhead cost deferred in (released from) inventory under absorption costing ............ | (13,500) | 4,500 | 18,000 |
| Absorption costing net operating income .............. | $278,900 | $273,700 | $269,800 |

2. Because absorption costing net operating income was greater than variable costing net operating income in Year 4, inventories must have increased during the year and hence, fixed manufacturing overhead was deferred in inventories. The amount of the deferral is just the difference between the two net operating incomes or $27,000 = $267,200 – $240,200.

**Exercise 6-4** (10 minutes)

| | *Total* | *CD* | *DVD* |
|---|---|---|---|
| Sales* | $750,000 | $300,000 | $450,000 |
| Variable expenses** | 435,000 | 120,000 | 315,000 |
| Contribution margin | 315,000 | 180,000 | 135,000 |
| Traceable fixed expenses | 183,000 | 138,000 | 45,000 |
| Product line segment margin | 132,000 | $ 42,000 | $ 90,000 |
| Common fixed expenses not traceable to products | 105,000 | | |
| Net operating income | $ 27,000 | | |

* CD: 37,500 packs × $8.00 per pack = $300,000;
DVD: 18,000 packs × $25.00 per pack= $450,000.

** CD: 37,500 packs × $3.20 per pack = $120,000;
DVD: 18,000 packs × $17.50 per pack= $315,000.

**Exercise 6-5** (10 minutes)

Sales were above the company's break-even sales and yet the company sustained a loss. The apparent contradiction is explained by the fact that the CVP analysis is based on variable costing, whereas the income reported to shareholders is prepared using absorption costing. Because sales were above the breakeven, the variable costing net operating income would have been positive. However, the absorption costing net operating income was negative. Ordinarily, this would only happen if inventories decreased and fixed manufacturing overhead deferred in inventories was released to the income statement on the absorption costing income statement. This added fixed manufacturing overhead cost resulted in a loss on an absorption costing basis even though the company operated at its breakeven on a variable costing basis.

**Exercise 6-6** (20 minutes)

1. The company is using variable costing. The computations are:

| | *Variable Costing* | *Absorption Costing* |
|---|---|---|
| Direct materials | $10 | $10 |
| Direct labor | 5 | 5 |
| Variable manufacturing overhead | 2 | 2 |
| Fixed manufacturing overhead ($90,000 ÷ 30,000 units) | — | 3 |
| Unit product cost | $17 | $20 |
| Total cost, 5,000 units | $85,000 | $100,000 |

2. a. No, $85,000 is not the correct figure to use, because variable costing is not generally accepted for external reporting purposes or for tax purposes.

   b. The finished goods inventory account should be stated at $100,000, which represents the absorption cost of the 5,000 unsold units. Thus, the account should be increased by $15,000 for external reporting purposes. This $15,000 consists of the amount of fixed manufacturing overhead cost that is allocated to the 5,000 unsold units under absorption costing (5,000 units × $3 per unit fixed manufacturing overhead cost = $15,000).

**Exercise 6-7** (30 minutes)

1. a. The unit product cost under absorption costing would be:

| | |
|---|---|
| Direct materials | $18 |
| Direct labor | 7 |
| Variable manufacturing overhead | 2 |
| Total variable manufacturing costs | 27 |
| Fixed manufacturing overhead ($200,000 ÷ 20,000 units) | 10 |
| Absorption costing unit product cost | $37 |

b. The absorption costing income statement:

| | |
|---|---|
| Sales (16,000 units × $50 per unit) | $800,000 |
| Cost of goods sold (16,000 units × $37 per unit) | 592,000 |
| Gross margin | 208,000 |
| Selling and administrative expenses | |
| [(16,000 units × $2 per unit) + $110,000] | 142,000 |
| Net operating income | $ 66,000 |

2. a. The unit product cost under variable costing would be:

| | |
|---|---|
| Direct materials | $18 |
| Direct labor | 7 |
| Variable manufacturing overhead | 2 |
| Variable costing unit product cost | $27 |

b. The variable costing income statement:

| | | |
|---|---|---|
| Sales (16,000 units × $50 per unit) | | $800,000 |
| Less variable expenses: | | |
| Variable cost of goods sold | | |
| (16,000 units × $27 per unit) | $432,000 | |
| Variable selling expense | | |
| (16,000 units × $2 per unit) | 32,000 | 464,000 |
| Contribution margin | | 336,000 |
| Less fixed expenses: | | |
| Fixed manufacturing overhead | 200,000 | |
| Fixed selling and administrative | 110,000 | 310,000 |
| Net operating income | | $ 26,000 |

**Exercise 6-7** (continued)

3. The price increase appears to be a good idea from an absorption costing perspective because it increases net operating income by $4,000, but a variable costing income statement reveals that the price increase would actually decrease net operating income by $6,000. The income statements are shown below:

   The absorption costing income statement:

| | |
|---|---|
| Sales (15,000 units × $51 per unit) | $765,000 |
| Cost of goods sold (15,000 units × $37 per unit) | 555,000 |
| Gross margin | 210,000 |
| Selling and administrative expenses | |
| [(15,000 units × $2 per unit) + $110,000] | 140,000 |
| Net operating income | $ 70,000 |

   The variable costing income statement:

| | | |
|---|---|---|
| Sales (15,000 units × $51 per unit) | | $765,000 |
| Less variable expenses: | | |
| Variable cost of goods sold | | |
| (15,000 units × $27 per unit) | $405,000 | |
| Variable selling expense | | |
| (15,000 units × $2 per unit) | 30,000 | 435,000 |
| Contribution margin | | 330,000 |
| Less fixed expenses: | | |
| Fixed manufacturing overhead | 200,000 | |
| Fixed selling and administrative | 110,000 | 310,000 |
| Net operating income | | $ 20,000 |

**Exercise 6-8** (10 minutes)

The completed segmented income statement should appear as follows:

| | Total Company | | Divisions: East | | Divisions: West | |
|---|---|---|---|---|---|---|
| | *Amount* | *%* | *Amount* | *%* | *Amount* | *%* |
| Sales | $600,000 | 100.0 | $400,000 | 100.0 | $200,000 | 100.0 |
| Variable expenses | 300,000 | 50.0 | 250,000 | 62.5 | 50,000 | 25.0 |
| Contribution margin | 300,000 | 50.0 | 150,000 | 37.5 | 150,000 | 75.0 |
| Traceable fixed expenses | 190,000 | 31.7 | 80,000 | 20.0 | 110,000 | 55.0 |
| Territorial segment margin | 110,000 | 18.3 | $ 70,000 | 17.5 | $40,000 | 20.0 |
| Common fixed expenses | 60,000 | 10.0 | | | | |
| Net operating income | $ 50,000 | 8.3 | | | | |

**Exercise 6-9** (30 minutes)

1. Under variable costing, only the variable manufacturing costs are included in product costs.

| | |
|---|---|
| Direct materials | $ 60 |
| Direct labor | 30 |
| Variable manufacturing overhead | 10 |
| Variable costing unit product cost | $100 |

Note that selling and administrative expenses are not treated as product costs; that is, they are not included in the costs that are inventoried. These expenses are always treated as period costs.

2. The variable costing income statement appears below:

| | | |
|---|---|---|
| Sales | | $1,800,000 |
| Variable expenses: | | |
| Variable cost of goods sold (9,000 units × $100 per unit) | $900,000 | |
| Variable selling and administrative (9,000 units × $20 per unit) | 180,000 | 1,080,000 |
| Contribution margin | | 720,000 |
| Fixed expenses: | | |
| Fixed manufacturing overhead | 300,000 | |
| Fixed selling and administrative | 450,000 | 750,000 |
| Net operating loss | | $ (30,000) |

3. The break-even point in units sold can be computed using the contribution margin per unit as follows:

| | |
|---|---|
| Selling price per unit | $200 |
| Variable cost per unit | 120 |
| Contribution margin per unit | $ 80 |

Break-even unit sales = Fixed expenses ÷ Unit contribution margin
= $750,000 ÷ $80 per unit
= 9,375 units

**Exercise 6-10** (20 minutes)

1. Under absorption costing, all manufacturing costs (variable and fixed) are included in product costs.

| | |
|---|---|
| Direct materials | $ 60 |
| Direct labor | 30 |
| Variable manufacturing overhead | 10 |
| Fixed manufacturing overhead ($300,000 ÷ 10,000 units) | 30 |
| Unit product cost | $130 |

2. The absorption costing income statement appears below:

| | |
|---|---|
| Sales (9,000 units × $200 per unit) | $1,800,000 |
| Cost of goods sold (9,000 units × $130 per unit) | 1,170,000 |
| Gross margin | 630,000 |
| Selling and administrative expenses (9,000 units × $20 per unit) + $450,000 | 630,000 |
| Net operating income | $ 0 |

Note: The company apparently has exactly zero net operating income even though its sales are below the break-even point computed in Exercise 6-9. This occurs because $30,000 of fixed manufacturing overhead has been deferred in inventory and does not appear on the income statement prepared using absorption costing.

**Exercise 6-11** (20 minutes)

1.

| | Total Company | Geographic Market South | Central | North |
|---|---|---|---|---|
| Sales | $1,500,000 | $400,000 | $600,000 | $500,000 |
| Variable expenses | 588,000 | 208,000 | 180,000 | 200,000 |
| Contribution margin | 912,000 | 192,000 | 420,000 | 300,000 |
| Traceable fixed expenses | 770,000 | 240,000 | 330,000 | 200,000 |
| Geographic market segment margin | 142,000 | $(48,000) | $ 90,000 | $100,000 |
| Common fixed expenses not traceable to geographic markets* | 175,000 | | | |
| Net operating income (loss) | $ (33,000) | | | |

*$945,000 – $770,000 = $175,000.

2.

| | |
|---|---|
| Incremental sales ($600,000 × 15%) | $90,000 |
| Contribution margin ratio ($420,000 ÷ $600,000) | × 70% |
| Incremental contribution margin | 63,000 |
| Less incremental advertising expense | 25,000 |
| Incremental net operating income | $38,000 |

Yes, the advertising program should be initiated.

**Exercise 6-12** (30 minutes)

1 a. Under variable costing, only the variable manufacturing costs are included in product costs.

| | Year 1 | Year 2 |
|---|---|---|
| Direct materials | $20 | $20 |
| Direct labor | 12 | 12 |
| Variable manufacturing overhead | 4 | 4 |
| Variable costing unit product cost | $36 | $36 |

Note that selling and administrative expenses are not treated as product costs; that is, they are not included in the costs that are inventoried. These expenses are always treated as period costs.

1 b.

| | Year 1 | Year 2 |
|---|---|---|
| Sales | $2,000,000 | $2,500,000 |
| Variable expenses: | | |
| Variable cost of goods sold @ $36 per unit | 1,440,000 | 1,800,000 |
| Variable selling and administrative @ $3 per unit | 120,000 | 150,000 |
| Total variable expenses | 1,560,000 | 1,950,000 |
| Contribution margin | 440,000 | 550,000 |
| Fixed expenses: | | |
| Fixed manufacturing overhead | 200,000 | 200,000 |
| Fixed selling and administrative | 80,000 | 80,000 |
| Total fixed expenses | 280,000 | 280,000 |
| Net operating income (loss) | $ 160,000 | $ 270,000 |

2 a. The unit product costs under absorption costing:

| | Year 1 | Year 2 |
|---|---|---|
| Direct materials | $20 | $20 |
| Direct labor | 12 | 12 |
| Variable manufacturing overhead | 4 | 4 |
| Fixed manufacturing overhead | *4 | **5 |
| Absorption costing unit product cost | $40 | $41 |

* $200,000 ÷ 50,000 units = $4 per unit.
** $200,000 ÷ 40,000 units = $5 per unit.

**Exercise 6-12** (continued)

2 b. The absorption costing income statements appears below:

| | Year 1 | Year 2 |
|---|---|---|
| Sales | $2,000,000 | $2,500,000 |
| Cost of goods sold | *1,600,000 | **2,040,000 |
| Gross margin | 400,000 | 460,000 |
| Selling and administrative expenses | 200,000 | 230,000 |
| Net operating income | $ 200,000 | $ 230,000 |

* 40,000 units × $40 per unit = $1,600,000

** (40,000 units × $41 per unit) + (10,000 units × $40 per unit) = $2,040,000

3. The net operating incomes are reconciled as follows:

| | Year 1 | Year 2 |
|---|---|---|
| Variable costing net operating income (loss) | $ 160,000 | $ 270,000 |
| Add: Fixed manufacturing overhead cost deferred in inventory under absorption costing (10,000 units × $4 per unit) | 40,000 | |
| Deduct: Fixed manufacturing overhead cost released from inventory under absorption costing (10,000 units × $4 per unit) | | (40,000) |
| Absorption costing net operating income | $ 200,000 | $ 230,000 |

**Exercise 6-13** (20 minutes)

1.

| | | |
|---|---|---|
| Sales (40,000 units × $33.75 per unit) | | $1,350,000 |
| Variable expenses: | | |
| Variable cost of goods sold (40,000 units × $16 per unit*) | $640,000 | |
| Variable selling and administrative expenses (40,000 units × $3 per unit) | 120,000 | 760,000 |
| Contribution margin | | 590,000 |
| Fixed expenses: | | |
| Fixed manufacturing overhead | 250,000 | |
| Fixed selling and administrative expenses | 300,000 | 550,000 |
| Net operating income | | $ 40,000 |

| | |
|---|---|
| * Direct materials | $10 |
| Direct labor | 4 |
| Variable manufacturing overhead | 2 |
| Total variable manufacturing cost | $16 |

2. The difference in net operating income can be explained by the $50,000 in fixed manufacturing overhead deferred in inventory under the absorption costing method:

| | |
|---|---|
| Variable costing net operating income | $40,000 |
| Add fixed manufacturing overhead cost deferred in inventory under absorption costing (10,000 units × $5 per unit in fixed manufacturing overhead cost) | 50,000 |
| Absorption costing net operating income | $90,000 |

**Exercise 6-14** (20 minutes)

1. $75,000 × 40% CM ratio = $30,000 increased contribution margin in Dallas. Because the fixed costs in the office and in the company as a whole will not change, the entire $30,000 would result in increased net operating income for the company.

   It is incorrect to multiply the $75,000 increase in sales by Dallas' 25% segment margin ratio. This approach assumes that the segment's traceable fixed expenses increase in proportion to sales, but if they did, they would not be fixed.

2. a. The segmented income statement follows:

| | Total Company | | Segments: Houston | | Segments: Dallas | |
|---|---|---|---|---|---|---|
| | *Amount* | *%* | *Amount* | *%* | *Amount* | *%* |
| Sales | $800,000 | 100.0 | $200,000 | 100 | $600,000 | 100 |
| Variable expenses | 420,000 | 52.5 | 60,000 | 30 | 360,000 | 60 |
| Contribution margin | 380,000 | 47.5 | 140,000 | 70 | 240,000 | 40 |
| Traceable fixed expenses | 168,000 | 21.0 | 78,000 | 39 | 90,000 | 15 |
| Office segment margin | 212,000 | 26.5 | $ 62,000 | 31 | $150,000 | 25 |
| Common fixed expenses not traceable to segments | 120,000 | 15.0 | | | | |
| Net operating income | $ 92,000 | 11.5 | | | | |

   b. The segment margin ratio rises and falls as sales rise and fall due to the presence of fixed costs. The fixed expenses are spread over a larger base as sales increase.

   In contrast to the segment ratio, the contribution margin ratio is stable so long as there is no change in either variable expenses or the selling price of a unit of service.

**Exercise 6-15** (15 minutes)

1. The company should focus its campaign on Landscaping Clients. The computations are:

| | *Construction Clients* | *Landscaping Clients* |
|---|---|---|
| Increased sales | $70,000 | $60,000 |
| Market CM ratio | × 35% | × 50% |
| Incremental contribution margin | $24,500 | $30,000 |
| Less cost of the campaign | 8,000 | 8,000 |
| Increased segment margin and net operating income for the company as a whole | $16,500 | $22,000 |

2. The $90,000 in traceable fixed expenses in the previous exercise is now partly traceable and partly common. When we segment Dallas by market, only $72,000 remains a traceable fixed expense. This amount represents costs such as advertising and salaries that arise because of the existence of the construction and landscaping market segments. The remaining $18,000 ($90,000 – $72,000) is a common cost when Dallas is segmented by market. This amount would include such costs as the salary of the manager of the Dallas office that could not be avoided by eliminating either of the two market segments.

**Problem 6-16** (45 minutes)

1. a. The unit product cost under absorption costing is:

| | |
|---|---|
| Direct materials | $15 |
| Direct labor | 7 |
| Variable manufacturing overhead | 2 |
| Fixed manufacturing overhead (640,000 ÷ 40,000 units) | 16 |
| Absorption costing unit product cost | $40 |

b. The absorption costing income statement is:

| | |
|---|---|
| Sales (35,000 units × $60 per unit) | $2,100,000 |
| Cost of goods sold (35,000 units × $40 per unit) | 1,400,000 |
| Gross margin | 700,000 |
| Selling and administrative expenses (35,000 units × $2 per unit) + $560,000 | 630,000 |
| Net operating income | $ 70,000 |

2. a. The unit product cost under variable costing is:

| | |
|---|---|
| Direct materials | $15 |
| Direct labor | 7 |
| Variable manufacturing overhead | 2 |
| Variable costing unit product cost | $24 |

b. The variable costing income statement is:

| | | |
|---|---|---|
| Sales (35,000 units × $60 per unit) | | $2,100,000 |
| Variable expenses: | | |
| Variable cost of goods sold ($35,000 × $24 per unit) | $840,000 | |
| Variable selling expense (35,000 units × $2 per unit) | 70,000 | 910,000 |
| Contribution margin | | 1,190,000 |
| Fixed expenses: | | |
| Fixed manufacturing overhead | 640,000 | |
| Fixed selling and administrative expense | 560,000 | 1,200,000 |
| Net operating loss | | $ (10,000) |

**Problem 6-16** (continued)

3. The difference in the ending inventory relates to a difference in the handling of fixed manufacturing overhead costs. Under variable costing, these costs have been expensed in full as period costs. Under absorption costing, these costs have been added to units of product at the rate of $16 per unit ($640,000 ÷ 40,000 units produced = $16 per unit). Thus, under absorption costing a portion of the $640,000 fixed manufacturing overhead cost of the month has been added to the inventory account rather than expensed on the income statement:

| | |
|---|---|
| Added to the ending inventory (5,000 units × $16 per unit) | $ 80,000 |
| Expensed as part of cost of goods sold (35,000 units × $16 per unit) | 560,000 |
| Total fixed manufacturing overhead cost for the month | $640,000 |

Because $80,000 of fixed manufacturing overhead cost has been deferred in inventory under absorption costing, the net operating income reported under that costing method is $80,000 higher than the net operating income under variable costing, as shown in parts (1) and (2) above.

**Problem 6-17** (45 minutes)

1. The break-even point in units sold can be computed using the contribution margin per unit as follows:

| | |
|---|---|
| Selling price per unit | $56 |
| Variable cost per unit | 48 |
| Contribution margin per unit | $ 8 |

Break-even unit sales = Fixed expenses ÷ Unit contribution margin
= $480,000 ÷ $8 per unit
= 60,000 units

2 a. Under variable costing, only the variable manufacturing costs are included in product costs.

| | *Year 1* | *Year 2* | *Year 3* |
|---|---|---|---|
| Direct materials | $25 | $25 | $25 |
| Direct labor | 16 | 16 | 16 |
| Variable manufacturing overhead | 5 | 5 | 5 |
| Variable costing unit product cost | $46 | $46 | $46 |

Note that selling and administrative expenses are not treated as product costs; that is, they are not included in the costs that are inventoried. These expenses are always treated as period costs.

**Problem 6-17** (continued)

2 b. The variable costing income statements appear below:

| | *Year 1* | *Year 2* | *Year 3* |
|---|---|---|---|
| Sales | $3,360,000 | $2,800,000 | $3,640,000 |
| Variable expenses: | | | |
| Variable cost of goods sold @ $46 per unit | 2,760,000 | 2,300,000 | 2,990,000 |
| Variable selling and administrative @ $2 per unit | 120,000 | 100,000 | 130,000 |
| Total variable expenses | 2,880,000 | 2,400,000 | 3,120,000 |
| Contribution margin | 480,000 | 400,000 | 520,000 |
| Fixed expenses: | | | |
| Fixed manufacturing overhead | 300,000 | 300,000 | 300,000 |
| Fixed selling and administrative | 180,000 | 180,000 | 180,000 |
| Total fixed expenses | 480,000 | 480,000 | 480,000 |
| Net operating income (loss) | $ 0 | $ (80,000) | $ 40,000 |

3 a. The unit product costs under absorption costing:

| | *Year 1* | *Year 2* | *Year 3* |
|---|---|---|---|
| Direct materials | $25 | $25 | $25.00 |
| Direct labor | 16 | 16 | 16.00 |
| Variable manufacturing overhead | 5 | 5 | 5.00 |
| Fixed manufacturing overhead | *5 | **4 | ***7.50 |
| Absorption costing unit product cost | $51 | $50 | $53.50 |

* $300,000 ÷ 60,000 units = $5 per unit.

** $300,000 ÷ 75,000 units = $4 per unit.

*** $300,000 ÷ 40,000 units = $7.50 per unit.

**Problem 6-17** (continued)

3 b. The absorption costing income statements appears below:

| | Year 1 | Year 2 | Year 3 |
|---|---|---|---|
| Sales | $3,360,000 | $2,800,000 | $3,640,000 |
| Cost of goods sold | 3,060,000 | 2,500,000 | 3,390,000 |
| Gross margin | 300,000 | 300,000 | 250,000 |
| Selling and administrative expenses | 300,000 | 280,000 | 310,000 |
| Net operating income (loss) | $ 0 | $ 20,000 | $ (60,000) |

Cost of goods sold computations:
Year 1: 60,000 units × $51 per unit = $3,060,000
Year 2: 50,000 units × $50 per unit = $2,500,000
Year 3: (25,000 × $50 per unit) + (40,000 × $53.50 per unit) = $3,390,000

4.

| | Year 1 | Year 2 | Year 3 |
|---|---|---|---|
| Units sold | 60,000 | 50,000 | 65,000 |
| Break-even point in units | 60,000 | 60,000 | 60,000 |
| Units above (below) break-even point | 0 | (10,000) | 5,000 |
| Variable costing net operating income (loss) | $0 | $(80,000) | $ 40,000 |
| Absorption costing net operating income (loss) | $0 | $ 20,000 | $(60,000) |

The absorption costing net operating incomes in years 2 and 3 are counter-intuitive. In year 2, the number of units sold is below the break-even point; however, absorption costing reports a net operating income greater than zero. In year 3, the number of units sold is above the break-even point; however, absorption costing reports a net operating income less than zero.

**Problem 6-18** (30 minutes)

1. The unit product cost under the variable costing is computed as follows:

| | |
|---|---|
| Direct materials | $ 8 |
| Direct labor | 10 |
| Variable manufacturing overhead | 2 |
| Variable costing unit product cost | $20 |

With this figure, the variable costing income statements can be prepared:

| | *Year 1* | *Year 2* |
|---|---|---|
| Sales | $1,000,000 | $1,500,000 |
| Variable expenses: | | |
| Variable cost of goods sold @ $20 per unit | 400,000 | 600,000 |
| Variable selling and administrative @ $3 per unit | 60,000 | 90,000 |
| Total variable expenses | 460,000 | 690,000 |
| Contribution margin | 540,000 | 810,000 |
| Fixed expenses: | | |
| Fixed manufacturing overhead | 350,000 | 350,000 |
| Fixed selling and administrative | 250,000 | 250,000 |
| Total fixed expenses | 600,000 | 600,000 |
| Net operating income (loss) | $ (60,000) | $ 210,000 |

2. The reconciliation of absorption and variable costing follows:

| | *Year 1* | *Year 2* |
|---|---|---|
| Variable costing net operating income (loss) | $(60,000) | $210,000 |
| Add (deduct) fixed manufacturing overhead deferred in (released from) inventory under absorption costing (5,000 units × $14 per unit in Year 1; 5,000 units × $14 per unit in Year 2) | 70,000 | (70,000) |
| Absorption costing net operating income | $ 10,000 | $140,000 |

**Problem 6-19** (30 minutes)

1.

| | Total Company | | Sales Territory: Central | | Sales Territory: Eastern | |
|---|---|---|---|---|---|---|
| | *Amount* | *%* | *Amount* | *%* | *Amount* | *%* |
| Sales | $900,000 | 100.0 | $400,000 | 100 | $500,000 | 100 |
| Variable expenses | 408,000 | 45.3 | 208,000 | 52 | 200,000 | 40 |
| Contribution margin | 492,000 | 54.7 | 192,000 | 48 | 300,000 | 60 |
| Traceable fixed expenses | 290,000 | 32.2 | 160,000 | 40 | 130,000 | 26 |
| Territorial segment margin | 202,000 | 22.4 | $ 32,000 | 8 | $170,000 | 34 |
| Common fixed expenses* | 175,000 | 19.4 | | | | |
| Net operating income | $ 27,000 | 3.0 | | | | |

*465,000 – $290,000 = $175,000

| | Central Territory | | Product Line: Awls | | Product Line: Pows | |
|---|---|---|---|---|---|---|
| | *Amount* | *%* | *Amount* | *%* | *Amount* | *%* |
| Sales | $400,000 | 100.0 | $100,000 | 100 | $300,000 | 100 |
| Variable expenses | 208,000 | 52.0 | 25,000 | 25 | 183,000 | 61 |
| Contribution margin | 192,000 | 48.0 | 75,000 | 75 | 117,000 | 39 |
| Traceable fixed expenses | 114,000 | 28.5 | 60,000 | 60 | 54,000 | 18 |
| Product line segment margin | 78,000 | 19.5 | $ 15,000 | 15 | $ 63,000 | 21 |
| Common fixed expenses* | 46,000 | 11.5 | | | | |
| Sales territory segment margin | $ 32,000 | 8.0 | | | | |

*$160,000 – $114,000 = $46,000

**Problem 6-19** (continued)

2. Two points should be brought to the attention of management. First, compared to the Eastern territory, the Central territory has a low contribution margin ratio. Second, the Central territory has high traceable fixed expenses. Overall, compared to the Eastern territory, the Central territory is very weak.

3. Again, two points should be brought to the attention of management. First, the Central territory has a poor sales mix. Note that the territory sells very little of the Awls product, which has a high contribution margin ratio. It is this poor sales mix that accounts for the low overall contribution margin ratio in the Central territory mentioned in part (2) above. Second, the traceable fixed expenses of the Awls product seem very high in relation to sales. These high fixed expenses may simply mean that the Awls product is highly leveraged; if so, then an increase in sales of this product line would greatly enhance profits in the Central territory and in the company as a whole.

**Problem 6-20** (45 minutes)

1. a. and b.

| | *Absorption Costing* | *Variable Costing* |
|---|---|---|
| Direct materials | $ 86 | $86 |
| Variable manufacturing overhead | 4 | 4 |
| Fixed manufacturing overhead ($240,000 ÷ 4,000 units) | 60 | — |
| Unit product cost | $150 | $90 |

2. Absorption costing income statement:

| | |
|---|---|
| Sales (3,200 units × $250 per unit) | $800,000 |
| Cost of goods sold (3,200 units × $150 per unit) | 480,000 |
| Gross margin | 320,000 |
| Selling and administrative expenses (15% × $800,000 + $160,000) | 280,000 |
| Net operating income | $ 40,000 |

3. Variable costing income statement:

| | | |
|---|---|---|
| Sales (3,200 units × $250 per unit) | | $800,000 |
| Variable expenses: | | |
| Variable cost of goods sold (3,200 units × $90 per unit) | 288,000 | |
| Variable selling and administrative expense ($800,000 × 15%) | 120,000 | 408,000 |
| Contribution margin | | 392,000 |
| Fixed expenses: | | |
| Fixed manufacturing overhead | 240,000 | |
| Fixed selling and administrative | 160,000 | 400,000 |
| Net operating loss | | $ (8,000) |

**Problem 6-20** (continued)

4. A manager may prefer to take the statement prepared under the absorption approach in part (2), because it shows a profit for the month. As long as inventory levels are rising, absorption costing will report higher profits than variable costing. Notice in the situation above that the company is operating below its theoretical break-even point [$816,327 = $400,000 ÷ ($392,000/$800,000)], but yet reports a profit under the absorption approach. The ethics of this approach are debatable.

5.

| | |
|---|---|
| Variable costing net operating loss | $ (8,000) |
| Add fixed manufacturing overhead cost deferred in inventory under absorption costing (800 units × $60 per unit) | 48,000 |
| Absorption costing net operating income | $40,000 |

**Problem 6-21** (45 minutes)

1. a. and b.

| | *Absorption Costing* | *Variable Costing* |
|---|---|---|
| Direct materials | $ 6 | $ 6 |
| Direct labor | 12 | 12 |
| Variable manufacturing overhead | 4 | 4 |
| Fixed manufacturing overhead ($240,000 ÷ 30,000 units) | 8 | — |
| Unit product cost | $30 | $22 |

2.

| | *May* | *June* |
|---|---|---|
| Sales | $1,040,000 | $1,360,000 |
| Variable expenses: | | |
| Variable cost of goods sold @ $22 per unit | 572,000 | 748,000 |
| Variable selling and administrative expense @ $3 per unit | 78,000 | 102,000 |
| Total variable expenses | 650,000 | 850,000 |
| Contribution margin | 390,000 | 510,000 |
| Fixed expenses: | | |
| Fixed manufacturing overhead | 240,000 | 240,000 |
| Fixed selling and administrative expenses | 180,000 | 180,000 |
| Total fixed expenses | 420,000 | 420,000 |
| Net operating income (loss) | $ (30,000) | $ 90,000 |

3.

| | *May* | *June* |
|---|---|---|
| Variable costing net operating income (loss) | $ (30,000) | $ 90,000 |
| Add fixed manufacturing overhead cost deferred in inventory under absorption costing (4,000 units × $8 per unit) | 32,000 | |
| Deduct fixed manufacturing overhead cost released from inventory under absorption costing (4,000 units × $8 per unit) | | (32,000) |
| Absorption costing net operating income | $ 2,000 | $ 58,000 |

**Problem 6-21** (continued)

4. As shown in the reconciliation in part (3) above, $32,000 of fixed manufacturing overhead cost was deferred in inventory under absorption costing at the end of May, because $8 of fixed manufacturing overhead cost "attached" to each of the 4,000 unsold units that went into inventory at the end of that month. This $32,000 was part of the $420,000 total fixed cost that has to be covered each month in order for the company to break even. Because the $32,000 was added to the inventory account, and thus did not appear on the income statement for May as an expense, the company was able to report a small profit for the month even though it sold less than the break-even volume of sales. In short, only $388,000 of fixed cost ($420,000 – $32,000) was expensed for May, rather than the full $420,000, as contemplated in the break-even analysis. As stated in the text, this is a major problem with the use of absorption costing internally for management purposes. The method does not harmonize well with the principles of cost-volume-profit analysis, and can result in data that are unclear or confusing.

**Problem 6-22** (60 minutes)

1. a. Absorption costing unit product cost is:

| | |
|---|---|
| Direct materials | $1.00 |
| Direct labor | 0.80 |
| Variable manufacturing overhead | 0.20 |
| Fixed manufacturing overhead ($75,000 ÷ 50,000 units) | 1.50 |
| Absorption costing unit product cost | $3.50 |

b. The absorption costing income statement is:

| | |
|---|---|
| Sales (40,000 units) | $200,000 |
| Cost of goods sold (40,000 units × $3.50 per unit) | 140,000 |
| Gross margin | 60,000 |
| Selling and administrative expenses ($20,000 + 40,000 units × $0.75 per unit) | 50,000 |
| Net operating income | $ 10,000 |

c. The reconciliation is as follows:

| | |
|---|---|
| Variable costing net operating loss | $ (5,000) |
| Add fixed manufacturing overhead cost deferred in inventory under absorption costing (10,000 units × $1.50 per unit) | 15,000 |
| Absorption costing net operating income | $ 10,000 |

2. Under absorption costing, the company did earn a profit for the month. However, before the question can really be answered, one must first define what is meant by a "profit." The central issue here relates to *timing* of release of fixed manufacturing overhead costs to expense. Advocates of variable costing would argue that all such costs should be expensed immediately, and that no profit is earned unless the revenues of a period are sufficient to cover the fixed manufacturing overhead costs in full. From this point of view, then, no profit was earned during the month, because the fixed costs were not fully covered.

**Problem 6-22** (continued)

Advocates of absorption costing would argue, however, that fixed manufacturing overhead costs attach to units of product as they are produced, and that such costs do not become expense until the units are sold. Therefore, if the selling price of a unit is greater than the unit cost (including a proportionate amount of fixed manufacturing overhead), then a profit is earned even if some units produced are unsold and carry some fixed manufacturing overhead with them to the following period. A difficulty with this argument is that "profits" will vary under absorption costing depending on how many units are added to or taken out of inventory. That is, profits will depend not only on sales, but on what happens to inventories. In particular, profits can be consciously manipulated by increasing or decreasing a company's inventories.

3. a. The variable costing income statement is:

| | | |
|---|---|---|
| Sales (60,000 units × $5 per unit) | | $300,000 |
| Variable expenses: | | |
| Variable cost of goods sold (60,000 units × $2 per unit) | $120,000 | |
| Variable selling and administrative expenses (60,000 units × $0.75 per unit) | 45,000 | 165,000 |
| Contribution margin | | 135,000 |
| Fixed expense: | | |
| Fixed manufacturing overhead | 75,000 | |
| Fixed selling and administrative expense | 20,000 | 95,000 |
| Net operating income | | $ 40,000 |

**Problem 6-22** (continued)

b. The absorption costing income statement would be constructed as follows:

The absorption costing unit product cost will remain at $3.50, the same as in part (1).

| | |
|---|---|
| Sales (60,000 units × $5 per unit) | $300,000 |
| Cost of goods sold (60,000 units × $3.50 per unit) | 210,000 |
| Gross margin | 90,000 |
| Selling and administrative expenses (60,000 units × $0.75 per unit + $20,000) | 65,000 |
| Net operating income | $ 25,000 |

c. The reconciliation is as follows:

| | |
|---|---|
| Variable costing net operating income | $ 40,000 |
| Deduct fixed manufacturing overhead cost released from inventory under absorption costing (10,000 units × $1.50 per unit) | 15,000 |
| Absorption costing net operating income | $ 25,000 |

**Problem 6-23** (60 minutes)

1. The disadvantages or weaknesses of the company's version of a segmented income statement are as follows:
   a. The company should include a column showing the combined results of the three territories taken together.
   b. The territorial expenses should be segregated into variable and fixed categories to permit the computation of both a contribution margin and a territorial segment margin.
   c. The corporate expenses are probably common to the territories and should not be allocated.

2. Corporate advertising expenses have apparently been allocated on the basis of sales dollars; the general administrative expenses have apparently been allocated evenly among the three territories. Such allocations can be misleading to management because they seem to imply that these expenses are caused by the segments to which they have been allocated. The segment margin—which only includes costs that are actually caused by the segments—should be used to measure the performance of a segment. The "net operating income" or "net loss" after allocating common expenses should *not* be used to judge the performance of a segment.

**Problem 6-23** (continued)

3.

| | Total | | Southern Europe | | Middle Europe | | Northern Europe | |
|---|---|---|---|---|---|---|---|---|
| | *Amount in €s* | *%* | *Amount in €s* | *%* | *Amount in €s* | *%* | *Amount in €s* | *%* |
| Sales | 1,800,000 | 100.0 | 300,000 | 100 | 800,000 | 100 | 700,000 | 100 |
| Variable expenses: | | | | | | | | |
| Cost of goods sold | 648,000 | 36.0 | 93,000 | 31 | 240,000 | 30 | 315,000 | 45 |
| Shipping expense | 89,000 | 4.9 | 15,000 | 5 | 32,000 | 4 | 42,000 | 6 |
| Total variable expenses | 737,000 | 40.9 | 108,000 | 36 | 272,000 | 34 | 357,000 | 51 |
| Contribution margin | 1,063,000 | 59.1 | 192,000 | 64 | 528,000 | 66 | 343,000 | 49 |
| Traceable fixed expenses: | | | | | | | | |
| Salaries | 222,000 | 12.3 | 54,000 | 18 | 56,000 | 7 | 112,000 | 16 |
| Insurance | 39,000 | 2.2 | 9,000 | 3 | 16,000 | 2 | 14,000 | 2 |
| Advertising | 590,000 | 32.8 | 105,000 | 35 | 240,000 | 30 | 245,000 | 35 |
| Depreciation | 81,000 | 4.5 | 21,000 | 7 | 32,000 | 4 | 28,000 | 4 |
| Total traceable fixed expenses | 932,000 | 51.8 | 189,000 | 63 | 344,000 | 43 | 399,000 | 57 |
| Territorial segment margin | 131,000 | 7.3 | 3,000 | 1 | 184,000 | 23 | (56,000) | (8) |
| Common fixed expenses: | | | | | | | | |
| Advertising (general) | 90,000 | 5.0 | | | | | | |
| General administration | 60,000 | 3.3 | | | | | | |
| Total common fixed expense | 150,000 | 8.3 | | | | | | |
| Net operating loss | (19,000) | ( 1.1) | | | | | | |

Note: Columns may not total due to rounding.

**Problem 6-23** (continued)

4. The following points should be brought to the attention of management:
   a. Sales in Southern Europe are much lower than in the other two territories. This is not due to lack of salespeople—salaries in Southern Europe are about the same as in Middle Europe, which has the highest sales of the three territories.
   b. Southern Europe is spending less than half as much for advertising as Middle Europe. Perhaps this is the reason for Southern Europe's lower sales.
   c. Northern Europe has a poor sales mix; apparently it is selling a large amount of low-margin items. Note that its contribution margin ratio is only 49%, as compared to 64% or more for the other two territories.
   d. Northern Europe may be overstaffed. Its total salaries are much higher than in either of the other two territories.
   e. Northern Europe is not covering its own traceable costs. Attention should be given to changing the sales mix and reducing expenses in this territory.
   f. Apparently, the salespeople in all three territories are on a salary basis. Perhaps a change to a commission basis would encourage the sales staff to be more aggressive and improve sales throughout the company.

**Problem 6-24** (30 minutes)

1. Because of soft demand for the Australian Division's product, the inventory should be drawn down to the minimum level of 1,500 units. Drawing inventory down to the minimum level would require production as follows during the last quarter:

| | |
|---|---|
| Desired inventory, December 31 ............ | 1,500 units |
| Expected sales, last quarter .................. | 18,000 units |
| Total needs ......................................... | 19,500 units |
| Less inventory, September 30................ | 12,000 units |
| Required production ............................. | 7,500 units |

This plan would save inventory carrying costs such as storage (rent, insurance), interest, and obsolescence.

The number of units scheduled for production will not affect the reported net operating income or loss for the year if variable costing is in use. All fixed manufacturing overhead cost will be treated as an expense of the period regardless of the number of units produced. Thus, no fixed manufacturing overhead cost will be shifted between periods through the inventory account and income will be a function of the number of units sold, rather than a function of the number of units produced.

2. To maximize the Australian Division's operating income, Mr. Constantinos could produce as many units as storage facilities will allow. By building inventory to the maximum level, Mr. Constantinos will be able to defer a portion of the year's fixed manufacturing overhead costs to future years through the inventory account, rather than having all of these costs appear as charges on the current year's income statement. Building inventory to the maximum level of 30,000 units would require production as follows during the last quarter:

| | |
|---|---|
| Desired inventory, December 31 ............ | 30,000 units |
| Expected sales, last quarter .................. | 18,000 units |
| Total needs ......................................... | 48,000 units |
| Less inventory, September 30................ | 12,000 units |
| Required production ............................. | 36,000 units |

**Problem 6-24** (continued)

Thus, by producing enough units to build inventory to the maximum level that storage facilities will allow, Mr. Constantinos could relieve the current year of fixed manufacturing overhead cost and thereby maximize the current year's net operating income.

3. By setting a production schedule that will maximize his division's net operating income—and maximize his own bonus—Mr. Constantinos will be acting against the best interests of the company as a whole. The extra units aren't needed and will be expensive to carry in inventory. Moreover, there is no indication that demand will be any better next year than it has been in the current year, so the company may be required to carry the extra units in inventory a long time before they are ultimately sold.

   The company's bonus plan undoubtedly is intended to increase the company's profits by increasing sales and controlling expenses. If Mr. Constantinos sets a production schedule as shown in part (2) above, he will obtain his bonus as a result of *producing* rather than as a result of selling. Moreover, he will obtain it by creating *greater* expenses—rather than fewer expenses—for the company as a whole.

   In sum, producing as much as possible so as to maximize the division's net operating income and the manager's bonus would be unethical because it subverts the goals of the overall organization.

**Problem 6-25** (75 minutes)

1.

| | *Year 1* | *Year 2* | *Year 3* |
|---|---|---|---|
| Unit sales | 50,000 | 40,000 | 50,000 |
| Sales | $1,000,000 | $ 800,000 | $1,000,000 |
| Variable expenses: | | | |
| Variable cost of goods sold @ $4 per unit | 200,000 | 160,000 | 200,000 |
| Variable selling and administrative @ $2 per unit | 100,000 | 80,000 | 100,000 |
| Total variable expenses | 300,000 | 240,000 | 300,000 |
| Contribution margin | 700,000 | 560,000 | 700,000 |
| Fixed expenses: | | | |
| Fixed manufacturing overhead | 600,000 | 600,000 | 600,000 |
| Fixed selling and administrative | 70,000 | 70,000 | 70,000 |
| Total fixed expenses | 670,000 | 670,000 | 670,000 |
| Net operating income (loss) | $ 30,000 | $(110,000) | $ 30,000 |

**Problem 6-25** (continued)

2. a.

| | *Year 1* | *Year 2* | *Year 3* |
|---|---|---|---|
| Variable manufacturing cost | $ 4 | $ 4 | $ 4 |
| Fixed manufacturing cost: | | | |
| $600,000 ÷ 50,000 units | 12 | | |
| $600,000 ÷ 60,000 units | | 10 | |
| $600,000 ÷ 40,000 units | | | 15 |
| Absorption costing unit product cost | $16 | $14 | $19 |

b.

| | Year 1 | Year 2 | Year 3 |
|---|---|---|---|
| Variable costing net operating income (loss) | $30,000 | $(110,000) | $ 30,000 |
| Add (deduct) fixed manufacturing overhead cost deferred in (released from) inventory from Year 2 to Year 3 under absorption costing (20,000 units × $10 per unit) | | 200,000 | (200,000) |
| Add fixed manufacturing overhead cost deferred in inventory from Year 3 to the future under absorption costing (10,000 units × $15 per unit) | | | 150,000 |
| Absorption costing net operating income (loss) | $30,000 | $ 90,000 | $(20,000) |

3. Production went up sharply in Year 2 thereby reducing the unit product cost, as shown in (2a). This reduction in cost, combined with the large amount of fixed manufacturing overhead cost deferred in inventory for the year, more than offset the loss of revenue. The net result is that the company's net operating income increased.

4. The fixed manufacturing overhead cost deferred in inventory from Year 2 was charged against Year 3 operations, as shown in the reconciliation in (2b). This added charge against Year 3 operations was offset somewhat by the fact that part of Year 3's fixed manufacturing overhead costs was deferred in inventory to future years [again see (2b)]. Overall, the added costs charged against Year 3 were greater than the costs deferred to future years, so the company reported less income for the year even though the same number of units were sold as in Year 1.

**Problem 6-25** (continued)

5. a. With lean production, production would have been geared to sales in each year so that little or no inventory of finished goods would have been built up in either Year 2 or Year 3.

   b. If lean production had been in use, the net operating income under absorption costing would have been the same as under variable costing in all three years. With production geared to sales, there would have been no ending inventory on hand, and therefore there would have been no fixed manufacturing overhead costs deferred in inventory to other years. If the predetermined overhead rate is based on 50,000 units in each year, the income statements under absorption costing would have appeared as follows:

| | *Year 1* | *Year 2* | *Year 3* |
|---|---|---|---|
| Unit sales | 50,000 | 40,000 | 50,000 |
| Sales | $1,000,000 | $ 800,000 | $1,000,000 |
| Cost of goods sold: | | | |
| Cost of goods manufactured @ $16 per unit | 800,000 | 640,000 * | 800,000 |
| Add underapplied overhead | | 120,000 ** | |
| Cost of goods sold | 800,000 | 760,000 | 800,000 |
| Gross margin | 200,000 | 40,000 | 200,000 |
| Selling and administrative expenses | 170,000 | 150,000 | 170,000 |
| Net operating income (loss) | $ 30,000 | $(110,000) | $ 30,000 |

* 40,000 units × $16 per unit = $640,000.

** 10,000 units *not* produced × $12 per unit fixed manufacturing overhead cost = $120,000 fixed manufacturing overhead cost not applied to products.

**Problem 6-26** (45 minutes)

1. The segmented income statement follows:

| | *Total Company* | *Wheat Cereal* | *Pancake Mix* | *Flour* |
|---|---|---|---|---|
| Sales | $600,000 | $200,000 | $300,000 | $100,000 |
| Variable expenses: | | | | |
| Materials, labor & other | 204,000 | 60,000 | 126,000 | 18,000 |
| Sales commissions | 60,000 | 20,000 | 30,000 | 10,000 |
| Total variable expenses | 264,000 | 80,000 | 156,000 | 28,000 |
| Contribution margin | 336,000 | 120,000 | 144,000 | 72,000 |
| Traceable fixed expenses: | | | | |
| Advertising | 123,000 | 48,000 | 60,000 | 15,000 |
| Salaries | 66,000 | 34,000 | 21,000 | 11,000 |
| Equipment depreciation* | 30,000 | 12,000 | 15,000 | 3,000 |
| Warehouse rent** | 12,000 | 4,000 | 7,000 | 1,000 |
| Total traceable fixed expenses | 231,000 | 98,000 | 103,000 | 30,000 |
| Product line segment margin | 105,000 | $ 22,000 | $ 41,000 | $ 42,000 |
| Common fixed expenses: | | | | |
| General administration | 90,000 | | | |
| Net operating income | $ 15,000 | | | |

* $30,000 × 40%, 50%, and 10% respectively

** $0.50 per square foot × 8,000 square feet, 14,000 square feet, and 2,000 square feet respectively

**Problem 6-26** (continued)

2. a. No, the wheat cereal should not be eliminated. The wheat cereal product is covering all of its own costs and is generating a $22,000 segment margin toward covering the company's common costs and toward profits. (Note: Problems relating to the elimination of a product line are covered in more depth in a later chapter.)

   b.

| | *Wheat Cereal* | *Pancake Mix* | *Flour* |
|---|---|---|---|
| Contribution margin (a) ................ | $120,000 | $144,000 | $72,000 |
| Sales (b)...................................... | $200,000 | $300,000 | $100,000 |
| Contribution margin ratio (a) ÷ (b). | 60% | 48% | 72% |

It is probably unwise to focus all available resources on promoting the pancake mix. The company is already spending nearly as much on the promotion of this product as on the other two products together. Furthermore, the pancake mix has the lowest contribution margin ratio of the three products. Therefore, a dollar of sales of the pancake mix generates less profit than a dollar of sales of either of the two other products. Nevertheless, we cannot say for sure which product should be emphasized in this situation without more information. The problem states that there is ample demand for all three products, which suggests that there is no idle capacity. If the equipment is being fully utilized, increasing the production of any one product would probably require cutting back production of the other products. In a later chapter we will discuss how to choose the most profitable product when a production constraint forces such a trade-off among products.

**Case 6-27** (45 minutes)

1 a. Under variable costing, only the variable manufacturing costs are included in product costs.

| | *Year 1* | *Year 2* | *Year 3* |
|---|---|---|---|
| Direct materials | $30 | $30 | $30 |
| Direct labor | 18 | 18 | 18 |
| Variable manufacturing overhead | 6 | 6 | 6 |
| Variable costing unit product cost | $54 | $54 | $54 |

1 b. The variable costing income statements appear below:

| | Year 1 | Year 2 | Year 3 |
|---|---|---|---|
| Sales | $5,600,000 | $6,300,000 | $5,250,000 |
| Variable expenses: | | | |
| Variable cost of goods sold @ $54 per unit | 4,320,000 | 4,860,000 | 4,050,000 |
| Variable selling and administrative @ $4 per unit | 320,000 | 360,000 | 300,000 |
| Total variable expenses | 4,640,000 | 5,220,000 | 4,350,000 |
| Contribution margin | 960,000 | 1,080,000 | 900,000 |
| Fixed expenses: | | | |
| Fixed manufacturing overhead | 600,000 | 600,000 | 600,000 |
| Fixed selling and administrative | 180,000 | 180,000 | 180,000 |
| Total fixed expenses | 780,000 | 780,000 | 780,000 |
| Net operating income (loss) | $ 180,000 | $ 300,000 | $ 120,000 |

2a and 2b.

The answers to 2a and 2b are the same as 1a and 1b because the unit product costs are the same for all three years. The inventory flow assumption is irrelevant when the unit product cost stays constant.

**Case 6-27** (continued)

3 a. The unit product costs under absorption costing:

| | *Year 1* | *Year 2* | *Year 3* |
|---|---|---|---|
| Direct materials | $30 | $30 | $30.00 |
| Direct labor | 18 | 18 | 18.00 |
| Variable manufacturing overhead | 6 | 6 | 6.00 |
| Fixed manufacturing overhead | *6 | **8 | ***7.50 |
| Absorption costing unit product cost | $60 | $62 | $61.50 |

* $600,000 ÷ 100,000 units = $6 per unit.
** $600,000 ÷ 75,000 units = $8 per unit.
*** $600,000 ÷ 80,000 units = $7.50 per unit.

3 b. The absorption costing income statements appear below (FIFO):

| | *Year 1* | *Year 2* | *Year 3* |
|---|---|---|---|
| Sales | $5,600,000 | $6,300,000 | $5,250,000 |
| Cost of goods sold | 4,800,000 | 5,540,000 | 4,615,000 |
| Gross margin | 800,000 | 760,000 | 635,000 |
| Selling and administrative expenses | 500,000 | 540,000 | 480,000 |
| Net operating income | $ 300,000 | $ 220,000 | $ 155,000 |

Cost of goods sold computations:
Year 1: 80,000 units × $60 per unit = $4,800,000
Year 2: (20,000 units × $60 per unit) + (70,000 units × $62 per unit) = $5,540,000
Year 3: (5,000 × $62 per unit) + (70,000 × $61.50 per unit) = $4,615,000

4 a. The unit product costs under absorption costing:

| | *Year 1* | *Year 2* | *Year 3* |
|---|---|---|---|
| Direct materials | $30 | $30 | $30.00 |
| Direct labor | 18 | 18 | 18.00 |
| Variable manufacturing overhead | 6 | 6 | 6.00 |
| Fixed manufacturing overhead | *6 | **8 | ***7.50 |
| Absorption costing unit product cost | $60 | $62 | $61.50 |

* $600,000 ÷ 100,000 units = $6 per unit.
** $600,000 ÷ 75,000 units = $8 per unit.
*** $600,000 ÷ 80,000 units = $7.50 per unit.

4 b. The absorption costing income statements appears below (LIFO):

| | *Year 1* | *Year 2* | *Year 3* |
|---|---|---|---|
| Sales | $5,600,000 | $6,300,000 | $5,250,000 |
| Cost of goods sold | 4,800,000 | 5,550,000 | 4,612,500 |
| Gross margin | 800,000 | 750,000 | 637,500 |
| Selling and administrative expenses | 500,000 | 540,000 | 480,000 |
| Net operating income | $ 300,000 | $ 210,000 | $ 157,500 |

Cost of goods sold computations:
Year 1: 80,000 units × $60 per unit = $4,800,000
Year 2: (75,000 units × $62 per unit) + (15,000 units × $60 per unit) = $5,550,000
Year 3: 75,000 × $61.50 per unit = $4,612,500

**Case 6-28** (75 minutes)

1. See the segmented statement that follows. Supporting computations for the statement are given below:

| | |
|---|---|
| Revenues: | |
| Membership dues (10,000 × $60) | $600,000 |
| Assigned to the Journal (10,000 × $15) | 150,000 |
| Assigned to Membership Service | $450,000 |
| Nonmember journal subscriptions (1,000 × $20) | $ 20,000 |
| Advertising (given) | $ 50,000 |
| Books and reports (given) | $ 70,000 |
| Continuing education courses (given) | $230,000 |
| Occupancy costs: | |
| Membership Services ($100,000 × 0.3 + $20,000) | $ 50,000 |
| Journal ($100,000 × 0.1) | 10,000 |
| Books and Reports ($100,000 × 0.1) | 10,000 |
| Continuing Education ($100,000 × 0.2) | 20,000 |
| Central staff ($100,000 × 0.3) | 30,000 |
| Total occupancy costs | $120,000 |
| Printing costs: | |
| Journal (11,000 × $4) | $ 44,000 |
| Books and Reports (given) | 25,000 |
| Continuing Education (plug) | 13,000 |
| Total printing costs | $ 82,000 |
| Mailing costs: | |
| Journal (11,000 × $1) | $ 11,000 |
| Books and Reports (given) | 8,000 |
| Central staff (plug) | 5,000 |
| Total mailing costs | $ 24,000 |

**Case 6-28** (continued)

A statement detailing revenues by program appears directly below. The segmented income statement follows on the next page.

| | *Total* | *Membership Services* | *Journal* | *Books and Reports* | *Continuing Education* |
|---|---|---|---|---|---|
| Revenues: | | | | | |
| Membership dues | $600,000 | $450,000 | $150,000 | | |
| Nonmember journal subscriptions | 20,000 | | 20,000 | | |
| Advertising | 50,000 | | 50,000 | | |
| Books and reports | 70,000 | | | $ 70,000 | |
| Continuing education courses | 230,000 | | | | $230,000 |
| Total revenues | 970,000 | 450,000 | 220,000 | 70,000 | 230,000 |

**Case 6-28** (continued)

| | *Total* | *Membership Services* | *Journal* | *Books and Reports* | *Continuing Education* |
|---|---|---|---|---|---|
| Total revenues | $970,000 | $450,000 | $220,000 | $70,000 | $230,000 |
| Expenses traceable to segments: | | | | | |
| Salaries | 320,000 | 170,000 | 60,000 | 40,000 | 50,000 |
| Occupancy costs | 90,000 | 50,000 | 10,000 | 10,000 | 20,000 |
| Distributions to local chapters | 210,000 | 210,000 | | | |
| Printing | 82,000 | | 44,000 | 25,000 | 13,000 |
| Mailing | 19,000 | | 11,000 | 8,000 | |
| Continuing education instructors' fees | 60,000 | | | | 60,000 |
| Total traceable expenses | 781,000 | 430,000 | 125,000 | 83,000 | 143,000 |
| Program segment margin | 189,000 | $ 20,000 | $ 95,000 | $(13,000) | $ 87,000 |
| Common expenses: | | | | | |
| Salaries—central staff | 120,000 | | | | |
| Occupancy costs | 30,000 | | | | |
| Mailing | 5,000 | | | | |
| General administrative | 27,000 | | | | |
| Total common expenses | 182,000 | | | | |
| Excess of revenues over expenses | $ 7,000 | | | | |

Note: Some may argue that apart from the $20,000 in rental cost directly attributed to Membership Services, occupancy costs are common costs that should not be allocated to programs. The correct treatment of the occupancy costs depends on whether they could be avoided in part by eliminating a program. We have assumed that they could be avoided.

**Case 6-28** (continued)

2. While we do not favor the allocation of common costs to segments, the reason most often given for this practice is that segment managers need to be aware of the fact that common costs exist and that they must be covered.

   Arguments against allocation of common costs include:

   - Allocation bases must be chosen arbitrarily since no cause-and-effect relationship exists between common costs and the segments to which they are allocated.
   - Management may be misled into eliminating a profitable segment that appears to be unprofitable because of allocated common costs.
   - Segment managers usually have little control over common costs. They should not be held accountable for costs over which they have little or no control.
   - Allocations of common costs tend to undermine the credibility of performance reports.

# Chapter 7
# Activity-Based Costing: A Tool to Aid Decision Making

## Solutions to Questions

**7-1** Activity-based costing differs from traditional costing systems in a number of ways. In activity-based costing, nonmanufacturing as well as manufacturing costs may be assigned to products. And, some manufacturing costs—including the costs of idle capacity—may be excluded from product costs. An activity-based costing system typically includes a number of activity cost pools, each of which has its unique measure of activity. These measures of activity often differ from the allocation bases used in traditional costing systems.

**7-2** When direct labor is used as an allocation base for overhead, it is implicitly assumed that overhead cost is directly proportional to direct labor. When cost systems were originally developed in the 1800s, this assumption may have been reasonably accurate. However, direct labor has declined in importance over the years while overhead has been increasing. This suggests that there is no longer a direct link between the level of direct labor and overhead. Indeed, when a company automates, direct labor is replaced by machines; a decrease in direct labor is accompanied by an increase in overhead. This violates the assumption that overhead cost is directly proportional to direct labor. Overhead cost appears to be driven by factors such as product diversity and complexity as well as by volume, for which direct labor has served as a convenient measure.

**7-3** Top managers provide leadership that is needed to properly motivate all employees to embrace the need to implement ABC. Top managers also have the authority to link ABC data to the employee evaluation and reward system. Cross-functional employees are also important because they possess intimate knowledge of operations that is needed to design an effective ABC system. Tapping the knowledge of cross-functional employees also lessens their resistance to ABC because they feel included in the implementation process.

**7-4** Unit-level activities are performed for each unit that is produced. Batch-level activities are performed for each batch regardless of how many units are in the batch. Product-level activities must be carried out to support a product regardless of how many batches are run or units produced. Customer-level activities must be carried out to support customers regardless of what products or services they buy. Organization-sustaining activities are carried out regardless of the company's precise product mix or mix of customers.

**7-5** Organization-sustaining costs, customer-level costs, and the costs of idle capacity should not be assigned to products. These costs represent resources that are not consumed by the products.

**7-6** In activity-based costing, costs must first be allocated to activity cost pools and then they are allocated from the activity cost pools to products, customers, and other cost objects.

**7-7** Because people are often involved in more than one activity, some way must be found to estimate how much time they spend in each activity. The most practical approach is often to ask employees how they spend their time. It is also possible to ask people to keep records of how they spend their time or observe them as they perform their tasks, but both of these alternatives are costly and it is not obvious that the data would be any better. People who know they are being observed may change how they behave.

**7-8** In traditional cost systems, product-level costs are indiscriminately spread across all products using direct labor-hours or some other allocation base related to volume. As a consequence, high-volume products are assigned the bulk of such costs. If a product is responsible for 40% of the direct labor in a factory, it will be assigned 40% of the manufacturing overhead cost in the factory—including 40% of the product-level costs of low-volume products. In an activity-based costing system, batch-level and product-level costs are assigned more appropriately. This results in shifting product-level costs back to the products that cause them and away from the high-volume products. (A similar effect will be observed with batch-level costs if high-volume products are produced in larger batches than low-volume products.)

**7-9** Activity rates tell managers the average cost of resources consumed to carry out a particular activity such as processing purchase orders. An activity whose average cost is high may be a good candidate for process improvements. Benchmarking can be used to identify which activities have unusually large costs. If some other organization is able to carry out the activity at a significantly lower cost, it is reasonable to suppose that improvement may be possible.

**7-10** The activity-based costing approach described in the chapter is probably unacceptable for external financial reports for two reasons. First, activity-based product costs, as described in this chapter, exclude some manufacturing costs and include some nonmanufacturing costs. Second, the first-stage allocations are based on interviews rather than verifiable, objective data.

**Exercise 7-1** (10 minutes)

| | | |
|---|---|---|
| a. | Various individuals manage the parts inventories. | Product-level |
| b. | A clerk in the factory issues purchase orders for a job. | Batch-level |
| c. | The personnel department trains new production workers. | Organization-sustaining |
| d. | The factory's general manager meets with other department heads, such as marketing, to coordinate plans. | Organization-sustaining |
| e. | Direct labor workers assemble products. | Unit-level |
| f. | Engineers design new products. | Product-level |
| g. | The materials storekeeper issues raw materials to be used in jobs. | Batch-level |
| h. | The maintenance department performs periodic preventative maintenance on general-use equipment. | Organization-sustaining |

Some of these classifications are debatable and may depend on the specific circumstances found in particular companies.

**Exercise 7-2** (15 minutes)

| | *Travel* | *Pickup and Delivery* | *Customer Service* | *Other* | *Totals* |
|---|---|---|---|---|---|
| Driver and guard wages | $336,000 | $378,000 | $ 84,000 | $ 42,000 | $ 840,000 |
| Vehicle operating expense | 202,500 | 13,500 | 0 | 54,000 | 270,000 |
| Vehicle depreciation | 105,000 | 15,000 | 0 | 30,000 | 150,000 |
| Customer representative salaries and expenses | 0 | 0 | 153,000 | 27,000 | 180,000 |
| Office expenses | 0 | 10,000 | 14,000 | 16,000 | 40,000 |
| Administrative expenses | 0 | 17,000 | 187,000 | 136,000 | 340,000 |
| Total cost | $643,500 | $433,500 | $438,000 | $305,000 | $1,820,000 |

Each entry in the table is derived by multiplying the total cost for the cost category by the percentage taken from the table below that shows the distribution of resource consumption:

| | *Travel* | *Pickup and Delivery* | *Customer Service* | *Other* | *Totals* |
|---|---|---|---|---|---|
| Driver and guard wages | 40% | 45% | 10% | 5% | 100% |
| Vehicle operating expense | 75% | 5% | 0% | 20% | 100% |
| Vehicle depreciation | 70% | 10% | 0% | 20% | 100% |
| Customer representative salaries and expenses | 0% | 0% | 85% | 15% | 100% |
| Office expenses | 0% | 25% | 35% | 40% | 100% |
| Administrative expenses | 0% | 5% | 55% | 40% | 100% |

**Exercise 7-3** (10 minutes)

| *Activity Cost Pool* | *Estimated Overhead Cost* | *Expected Activity* | | *Activity Rate* | |
|---|---|---|---|---|---|
| Caring for lawn | $77,400 | 180,000 | square feet of lawn | $0.43 | per square foot of lawn |
| Caring for garden beds– low maintenance | $30,000 | 24,000 | square feet of low maintenance beds | $1.25 | per square foot of low maintenance beds |
| Caring for garden beds– high maintenance | $57,600 | 18,000 | square feet of high maintenance beds | $3.20 | per square foot of high maintenance beds |
| Travel to jobs | $4,200 | 15,000 | miles | $0.28 | per mile |
| Customer billing and service | $8,700 | 30 | customers | $290 | per customer |

The activity rate for each activity cost pool is computed by dividing its estimated overhead cost by its expected activity.

**Exercise 7-4** (10 minutes)

*J78*

| *Activity Cost Pool* | | *Activity Rate* | *Activity* | | *ABC Cost* |
|---|---|---|---|---|---|
| Supporting direct labor ......... | $7 | per direct labor-hour | 1,000 | direct labor-hours | $ 7,000 |
| Machine processing ............. | $3 | per machine-hour | 3,200 | machine-hours | 9,600 |
| Machine setups .................... | $40 | per setup | 5 | setups | 200 |
| Production orders ................ | $160 | per order | 5 | order | 800 |
| Shipments.......................... | $120 | per shipment | 10 | shipment | 1,200 |
| Product sustaining ............... | $800 | per product | 1 | product | 800 |
| Total overhead cost ............. | | | | | $19,600 |

*W52*

| *Activity Cost Pool* | | *Activity Rate* | *Activity* | | *ABC Cost* |
|---|---|---|---|---|---|
| Supporting direct labor ......... | $7 | per direct labor-hour | 40 | direct labor-hours | $ 280 |
| Machine processing ............. | $3 | per machine-hour | 30 | machine-hours | 90 |
| Machine setups .................... | $40 | per setup | 1 | setups | 40 |
| Production orders ................ | $160 | per order | 1 | orders | 160 |
| Shipments.......................... | $120 | per shipment | 1 | shipments | 120 |
| Product sustaining ............... | $800 | per product | 1 | product | 800 |
| Total overhead cost ............. | | | | | $1,490 |

## **Exercise 7-5** (15 minutes)

| | | |
|---|---|---|
| Sales ($1,650 per standard model glider × 10 standard model gliders + $2,300 per custom designed glider × 2 custom designed gliders) | | $21,100 |
| Costs: | | |
| Direct materials ($462 per standard model glider × 10 standard model gliders + $576 per custom designed glider × 2 custom designed gliders) | $5,772 | |
| Direct labor ($19 per direct labor-hour × 28.5 direct labor-hours per standard model glider × 10 standard model gliders + $19 per direct labor-hour × 32 direct labor-hours per custom designed glider × 2 custom designed gliders) | 6,631 | |
| Supporting direct labor ($18 per direct labor-hour × 28.5 direct labor-hours per standard model glider × 10 standard model gliders + $18 per direct labor-hour × 32 direct labor-hours per custom designed glider × 2 custom designed gliders) | 6,282 | |
| Order processing ($192 per order × 3 orders) | 576 | |
| Custom designing ($261 per custom design × 2 custom designs) | 522 | |
| Customer service ($426 per customer × 1 customer) | 426 | 20,209 |
| Customer margin | | $ 891 |

**Exercise 7-6** (10 minutes)

| *Activity Cost Pool* | *(a) Activity Rate* | *(b) Activity* | *(a) × (b) ABC Cost* |
|---|---|---|---|
| Order size ........... | R 17.60 per direct labor-hour | 150 direct labor-hours | R 2,640 |
| Customer orders .. | R 360.00 per customer order | 1 customer order | 360 |
| Product testing .... | R 79.00 per product testing hour | 18 product testing hours | 1,422 |
| Selling ................. | R 1,494.00 per sales call | 3 sales calls | 4,482 |
| Total .................. | | | R 8,904 |

According to these calculations, the total overhead cost of the order is R 8,904.

## **Exercise 7-7** (10 minutes)

| | |
|---|---|
| Teller wages ............................ | $150,000 |
| Assistant branch manager salary .. | $70,000 |
| Branch manager salary ............... | $85,000 |

| | *Distribution of Resource Consumption Across Activities* | | | | |
|---|---|---|---|---|---|
| | *Opening Accounts* | *Processing Deposits and Withdrawals* | *Processing Other Customer Transactions* | *Other Activities* | *Totals* |
| Teller wages ............................ | 0% | 75% | 15% | 10% | 100% |
| Assistant branch manager salary .. | 10% | 15% | 25% | 50% | 100% |
| Branch manager salary ............... | 0% | 0% | 20% | 80% | 100% |

| | *Opening Accounts* | *Processing Deposits and Withdrawals* | *Processing Other Customer Transactions* | *Other Activities* | *Totals* |
|---|---|---|---|---|---|
| Teller wages............................ | $ 0 | $112,500 | $22,500 | $ 15,000 | $150,000 |
| Assistant branch manager salary... | 7,000 | 10,500 | 17,500 | 35,000 | 70,000 |
| Branch manager salary................ | 0 | 0 | 17,000 | 68,000 | 85,000 |
| Total cost................................ | $7,000 | $123,000 | $57,000 | $118,000 | $305,000 |

Teller wages are $150,000 and 75% of the tellers' time is spent processing deposits and withdrawals:

$150,000 × 75% = $112,500

Other entries in the table are similarly determined.

**Exercise 7-8** (20 minutes)

1. Computation of activity rates:

| Activity Cost Pools | (a) Total Cost | (b) Total Activity | (a) ÷ (b) Activity Rate |
|---|---|---|---|
| Opening accounts................ | $7,000 | 200 accounts opened | $35.00 per account opened |
| Processing deposits and withdrawals..................... | $123,000 | 50,000 deposits and withdrawals | $2.46 per deposit or withdrawal |
| Processing other customer transactions..................... | $57,000 | 1,000 other customer transactions | $57.00 per other customer transaction |

2. The cost of opening an account at the Avon branch is much higher than at the lowest cost branch ($35.00 versus $24.35). On the other hand, the cost of processing deposits and withdrawals is lower than at the lowest cost branch ($2.46 versus $2.72). And the cost of processing other customer transactions is somewhat higher at the Avon branch ($57.00 versus $48.90). The other branches may have something to learn from Avon concerning processing deposits and withdrawals and Avon may benefit from learning about how some of the other branches open accounts and process other transactions. It may be particularly instructive to compare the details of the activity rates. For example, is the cost of opening accounts at Avon apparently high because of the involvement of the assistant branch manager in this activity? Perhaps tellers open new accounts at other branches.

   The apparent differences in the costs of the activities at the various branches could be due to inaccuracies in employees' reports of the amount of time they devote to the activities. The differences in costs may also reflect different strategies. For example, the Avon branch may purposely spend more time with new customers to win their loyalty. The higher cost of opening new accounts at the Avon branch may be justified by future benefits of having more satisfied customers. Nevertheless, comparative studies of the costs of activities may provide a useful starting point for identifying best practices within a company and where improvements can be made.

**Exercise 7-9** (30 minutes)

1. Total revenue received:

| | *City General* | *County General* |
|---|---|---|
| Cost of goods sold to the hospital (a) .......... | $30,000 | $30,000 |
| Markup percentage .................................. | × 5% | × 5% |
| Markup in dollars (b) ................................ | $1,500 | $1,500 |
| Revenue received from hospitals (a) + (b).... | $31,500 | $31,500 |

2. Activity Rates:

| *Activity Cost Pool* | *(a) Estimated Overhead Cost* | *(b) Expected Activity* | | *(a) ÷ (b) Activity rate* | |
|---|---|---|---|---|---|
| Customer deliveries ........... | $400,000 | 5,000 | deliveries | $80.00 | per delivery |
| Manual order processing..... | $300,000 | 4,000 | orders | $75.00 | per manual order |
| Electronic order processing . | $200,000 | 12,500 | orders | $16.00 | per electronic order |
| Line item picking ............... | $500,000 | 400,000 | line items | $1.25 | per line item picked |

**Exercise 7-9** (continued)

3. Activity costs are assigned to the two hospitals as follows:

*City General:*

| *Activity Cost Pool* | *(a)* *Activity Rate* | *(b)* *Activity* | *(a) × (b)* *ABC Cost* |
|---|---|---|---|
| Customer deliveries ............ | \$80.00 per delivery | 10 deliveries | \$ 800 |
| Manual order processing ..... | \$75.00 per order | 0 orders | 0 |
| Electronic order processing . | \$16.00 per order | 10 orders | 160 |
| Line item picking ................ | \$1.25 per line item | 100 line items | 125 |
| Total activity costs.............. | | | \$1,085 |

*County General:*

| *Activity Cost Pool* | *(a)* *Activity Rate* | *(b)* *Activity* | *(a) × (b)* *ABC Cost* |
|---|---|---|---|
| Customer deliveries ............ | \$80.00 per delivery | 20 deliveries | \$1,600 |
| Manual order processing ..... | \$75.00 per order | 40 orders | 3,000 |
| Electronic order processing . | \$16.00 per order | 0 orders | 0 |
| Line item picking ................ | \$1.25 per line item | 260 line items | 325 |
| Total activity costs.............. | | | \$4,925 |

**Exercise 7-9** (continued)

4. Customer margins for the two hospitals:

| | *City General* | *County General* |
|---|---|---|
| Sales | $31,500 | $31,500 |
| Cost of goods sold | 30,000 | 30,000 |
| Gross margin | 1,500 | 1,500 |
| Customer deliveries | 800 | 1,600 |
| Manual order processing | 0 | 3,000 |
| Electronic order processing | 160 | 0 |
| Line item picking | 125 | 325 |
| Total activity costs | 1,085 | 4,925 |
| Customer margin | $ 415 | $(3,425) |

5. Hospitals that require frequent deliveries, place a high volume of manual orders, and order many line items are likely to be unprofitable.

**Exercise 7-10** (10 minutes)

| | *Activity* | *Activity Classification* | *Examples of Activity Measures* |
|---|---|---|---|
| a. | Materials are moved from the receiving dock to the assembly area by a material-handling crew | Batch-level | Number of materials moves; time spent moving materials |
| b. | Direct labor workers assemble various products | Unit-level | Time spent assembling products |
| c. | Diversity training is provided to all employees in the company | Organization-sustaining | Number of employees taking diversity training; Time spent in training |
| d. | A product is designed by a cross-functional team | Product-level | Number of new products designed; time spent developing new products |
| e. | Equipment is set up to process a batch | Batch-level | Number of batches run; time spent setting up |
| f. | A customer is billed for all products delivered during the month | Customer-level | Number of customer bills prepared; time spent preparing bills |

Notes:

1. In all cases except for direct labor in part (b), two activity measures are listed. The first is a "transaction driver" and the second is a "duration driver." Transaction drivers are simple counts of the number of times an activity occurs, such as the number of times materials are moved. Duration drivers are measures of the amount of time required to perform an activity, such as the time spent moving materials. In general, duration drivers are more accurate measures of the consumption of resources than transaction drivers, but they take more effort to record.
2. Activity measures should be assigned to organization-sustaining activities and costs only when they will be allocated. In this case, the costs of diversity training may be allocated to departments and for that purpose the number of employees taking the training or the amount of time they spend in the training may be recorded. However, these costs should not be allocated beyond departments to products or customers.

**Exercise 7-11** (30 minutes)

1. First-stage allocations of overhead costs to the activity cost pools:

| | *Distribution of Resource Consumption Across Activity Cost Pools* | | | | |
|---|---|---|---|---|---|
| | *Direct Labor Support* | *Order Processing* | *Customer Support* | *Other* | *Totals* |
| Wages and salaries.......... | 30% | 35% | 25% | 10% | 100% |
| Other overhead costs ...... | 25% | 15% | 20% | 40% | 100% |

| | *Direct Labor Support* | *Order Processing* | *Customer Support* | *Other* | *Totals* |
|---|---|---|---|---|---|
| Wages and salaries.......... | $105,000 | $122,500 | $ 87,500 | $ 35,000 | $350,000 |
| Other overhead costs ...... | 50,000 | 30,000 | 40,000 | 80,000 | 200,000 |
| Total cost........................ | $155,000 | $152,500 | $127,500 | $115,000 | $550,000 |

Example: 30% of $350,000 is $105,000.

2. Computation of activity rates:

| *Activity Cost Pools* | *(a) Total Cost* | *(b) Total Activity* | *(a) ÷ (b) Activity Rate* |
|---|---|---|---|
| Direct labor support........ | $155,000 | 10,000 DLHs | $15.50 per DLH |
| Order processing............ | $152,500 | 500 orders | $305 per order |
| Customer support........... | $127,500 | 100 customers | $1,275 per customer |

**Exercise 7-11** (continued)

3. Computation of the overhead costs for the Indus Telecom order:

| *Activity Cost Pool* | *(a)* *Activity Rate* | *(b)* *Activity* | *(a) × (b)* *ABC Cost* |
|---|---|---|---|
| Direct labor support | $15.50 per DLH | 50 DLHs* | $ 775 |
| Order processing | $305 per order | 1 orders | 305 |
| Customer support | $1,275 per customer | 1 customer | 1,275 |
| Total | | | $2,355 |

*0.5 DLH per unit × 100 units = 50 DLHs

4. The customer margin for Indus Telecom is computed as follows:

| *Customer Margin—ABC Analysis* | | |
|---|---|---|
| Sales (100 units × $295 per unit) | | $29,500 |
| Costs: | | |
| Direct materials ($264 per unit × 100 units) | $26,400 | |
| Direct labor ($25 per DLH × 0.5 DLH per unit × 100 units) | 1,250 | |
| Direct labor support overhead (see part 3 above) | 775 | |
| Order processing overhead (see part 3 above) | 305 | |
| Customer support overhead (see part 3 above) | 1,275 | 30,005 |
| Customer margin | | $( 505) |

**Exercise 7-12** (30 minutes)

1. Activity rates are computed as follows:

| *Activity Cost Pool* | *(a) Estimated Overhead Cost* | *(b) Expected Activity* | *(a) ÷ (b) Activity Rate* |
|---|---|---|---|
| Machine setups ....... | $21,600 | 180 setups | $120 per setup |
| Special processing... | $180,000 | 4,000 MHs | $45 per MH |
| General factory ....... | $288,000 | 24,000 DLHs | $12 per DLH |

2. Overhead is assigned to the two products as follows:

*Rims:*

| *Activity Cost Pool* | *(a) Activity Rate* | *(b) Activity* | *(a) × (b) ABC Cost* |
|---|---|---|---|
| Machine setups ..................... | $120 per setup | 100 setups | $ 12,000 |
| Special processing ................ | $45 per MH | 4,000 MHs | 180,000 |
| General factory ..................... | $12 per DLH | 8,000 DLHs | 96,000 |
| Total.................................... | | | $288,000 |

*Posts:*

| *Activity Cost Pool* | *(a) Activity Rate* | *(b) Activity* | *(a) × (b) ABC Cost* |
|---|---|---|---|
| Machine setups ..................... | $120 per setup | 80 setups | $ 9,600 |
| Special processing ................ | $45 per MH | 0 MHs | 0 |
| General factory ..................... | $12 per DLH | 16,000 DLHs | 192,000 |
| Total.................................... | | | $201,600 |

## **Exercise 7-12** (continued)

| | *Rims* | *Posts* |
|---|---|---|
| Direct materials | $17.00 | $10.00 |
| Direct labor: | | |
| $16 per DLH × 0.40 DLHs per unit | 6.40 | |
| $16 per DLH × 0.20 DLHs per unit | | 3.20 |
| Overhead: | | |
| $288,000 ÷ 20,000 units | 14.40 | |
| $201,600 ÷ 80,000 units | | 2.52 |
| Unit cost | $37.80 | $15.72 |

**Exercise 7-13** (15 minutes)

| | | |
|---|---|---|
| *Customer Margin—ABC Analysis* | | |
| Sales (2,400 seats × $137.95 per seat) | | $331,080 |
| Costs: | | |
| Direct materials ($112 per seat × 2,400 seats) | $268,800 | |
| Direct labor ($14.40 per seat × 2,400 seats) | 34,560 | |
| Supporting direct labor ($12 per DLH × 0.8 DLH per seat × 2,400 seats) | 23,040 | |
| Batch processing ($96 per batch × 4 batches) | 384 | |
| Order processing ($284 per order × 1 order) | 284 | |
| Customer service overhead ($2,620 per customer × 1 customer) | 2,620 | 329,688 |
| Customer margin | | $ 1,392 |

**Exercise 7-14** (10 minutes)

| | *Activity* | *Level* |
|---|---|---|
| a. | The purchasing department orders the specific color of paint specified by the customer from the company's supplier. | Batch-level |
| b. | A steering wheel is installed in a golf cart. | Unit-level |
| c. | An outside attorney draws up a new generic sales contract for the company limiting Green Glider's liability in the case of accidents that involve its golf carts. | Organization-sustaining |
| d. | The company's paint shop makes a stencil for a customer's logo. | Batch-level |
| e. | A sales representative visits an old customer to check on how the company's golf carts are working out and to try to make a new sale. | Customer-level |
| f. | The accounts receivable department prepares the bill for a completed order. | Batch-level |
| g. | Electricity is used to heat and light the factory and the administrative offices. | Organization-sustaining |
| h. | A golf cart is painted. | Unit-level |
| i. | The company's engineer modifies the design of a model to eliminate a potential safety problem. | Product-level |
| j. | The marketing department has a catalogue printed and then mails them to golf course managers. | Customer-level |
| k. | Completed golf carts are each tested on the company's test track. | Unit-level |
| l. | A new model golf cart is shipped to the leading golfing trade magazine to be evaluated for the magazine's annual rating of golf carts. | Product-level |

**Exercise 7-15** (30 minutes)

1. The first step is to determine the activity rates:

| Activity Cost Pools | (a) Total Cost | (b) Total Activity | (a) ÷ (b) Activity Rate |
|---|---|---|---|
| Serving parties ....... | $12,000 | 5,000 parties | $2.40 per party |
| Serving diners ........ | $90,000 | 12,000 diners | $7.50 per diner |
| Serving drinks ........ | $26,000 | 10,000 drinks | $2.60 per drink |

According to the activity-based costing system, the cost of serving each of the parties can be computed as follows:

a. Party of 4 persons who order a total of 3 drinks:

| Activity Cost Pool | (a) Activity Rate | (b) Activity | (a) × (b) ABC Cost |
|---|---|---|---|
| Serving parties ....... | $2.40 per party | 1 party | $ 2.40 |
| Serving diners ........ | $7.50 per diner | 4 diners | 30.00 |
| Serving drinks ........ | $2.60 per drink | 3 drinks | 7.80 |
| Total .................... | | | $40.20 |

b. Party of 2 persons who order no drinks:

| Activity Cost Pool | (a) Activity Rate | (b) Activity | (a) × (b) ABC Cost |
|---|---|---|---|
| Serving parties ....... | $2.40 per party | 1 party | $ 2.40 |
| Serving diners ........ | $7.50 per diner | 2 diners | 15.00 |
| Serving drinks ........ | $2.60 per drink | 0 drinks | 0 |
| Total .................... | | | $17.40 |

c. Party of 1 person who orders 2 drinks:

| Activity Cost Pool | (a) Activity Rate | (b) Activity | (a) × (b) ABC Cost |
|---|---|---|---|
| Serving parties ....... | $2.40 per party | 1 party | $ 2.40 |
| Serving diners ........ | $7.50 per diner | 1 diner | 7.50 |
| Serving drinks ........ | $2.60 per drink | 2 drinks | 5.20 |
| Total .................... | | | $15.10 |

**Exercise 7-15** (continued)

2. The average cost per diner for each party can be computed by dividing the total cost of the party by the number of diners in the party as follows:
   a. \$40.20 ÷ 4 diners = \$10.05 per diner
   b. \$17.40 ÷ 2 diners = \$8.70 per diner
   c. \$15.10 ÷ 1 diner = \$15.10 per diner

3. The average cost per diner differs from party to party under the activity-based costing system for two reasons. First, the \$2.40 cost of serving a party does not depend on the number of diners in the party. Therefore, the average cost per diner of this activity decreases as the number of diners in the party increases. With only one diner, the cost is \$2.40. With two diners, the average cost per diner is cut in half to \$1.20. With six diners, the average cost per diner would be only \$0.40. And so on. Second, the average cost per diner differs also because of the differences in the number of drinks ordered by the diners. If a party does not order any drinks, as was the case with the party of two, no costs of serving drinks are assigned to the party.

   The average cost per diner under the ABC system differs from the overall average cost of \$15 per diner for several reasons. First, the average cost of \$15 per diner includes organization-sustaining costs that are excluded from the computations in the activity-based costing system. Second, the \$15 per diner figure does not recognize differences in the diners' demands on resources. It does not recognize that some diners order more drinks than others, nor does it recognize that there are some economies of scale in serving larger parties. (The batch-level costs of serving a party can be spread over more diners if the party is larger.)

   We should note that the activity-based costing system itself does not recognize all of the differences in diners' demands on resources. For example, the costs of preparing the various meals on the menu surely differ. It may or may not be worth the effort to build a more detailed activity-based costing system that would take into account such nuances.

**Problem 7-16** (20 minutes)

1. The cost of serving the local commercial market according to the ABC model can be determined as follows:

| *Activity Cost Pool* | (a) *Activity Rate* | (b) *Activity* | (a) × (b) *ABC Cost* |
|---|---|---|---|
| Animation concept........ | $6,000 per proposal | 20 proposals | $120,000 |
| Animation production.... | $7,700 per minute of animation | 12 minutes | 92,400 |
| Contract administration. | $6,600 per contract | 8 contracts | 52,800 |
| | | | $265,200 |

2. The margin earned serving the local commercial market is negative, as shown below:

*Profitability Analysis*

| | | |
|---|---|---|
| Sales .................................................. | | $240,000 |
| Costs: | | |
| Animation concept............................. | $120,000 | |
| Animation production......................... | 92,400 | |
| Contract administration...................... | 52,800 | 265,200 |
| Margin ............................................... | | $(25,200) |

3. It appears that the local commercial market is losing money and the company would be better off dropping this market segment. However, not all of the costs included above may be avoidable. If more than $25,200 of the total costs of $265,200 is not avoidable, then the company really isn't losing money on the local commercial market and the segment should not be dropped. These issues will be discussed in more depth in later chapters.

**Problem 7-17** (45 minutes)

1. Under the traditional direct labor-dollar based costing system, manufacturing overhead is applied to products using the predetermined overhead rate computed as follows:

$$\text{Predetermined overhead rate} = \frac{\text{Estimated total manufacturing overhead cost}}{\text{Estimated total direct labor dollars}}$$

$$= \frac{\$508{,}625}{\$162{,}500} = \$3.13 \text{ per DL\$}$$

The product margins using the traditional approach would be computed as follows:

| | *EX300* | *TX500* | *Total* |
|---|---|---|---|
| Sales | $1,200,000 | $500,000 | $1,700,000 |
| Direct materials | 366,325 | 162,550 | 528,875 |
| Direct labor | 120,000 | 42,500 | 162,500 |
| Manufacturing overhead applied @ $3.13 per direct labor-dollar | 375,600 | 133,025 | 508,625 |
| Total manufacturing cost | 861,925 | 338,075 | 1,200,000 |
| Product margin | $ 338,075 | $161,925 | $ 500,000 |

Note that all of the manufacturing overhead cost is applied to the products under the company's traditional costing system.

**Problem 7-17** (continued)

2. The first step is to determine the activity rates:

| Activity Cost Pools | (a) Total Cost | (b) Total Activity | (a) ÷ (b) Activity Rate |
|---|---|---|---|
| Machining ............ | $198,250 | 152,500 MHRs | $1.30 per MHR |
| Setups .................. | $150,000 | 375 setup hrs. | $400 per setup hr. |
| Product sustaining. | $100,000 | 2 products | $50,000 per product |

*The Other activity cost pool is not shown above because it includes organization-sustaining and idle capacity costs that should not be assigned to products.

Under the activity-based costing system, the product margins would be computed as follows:

| | *EX300* | *TX500* | *Total* |
|---|---|---|---|
| Sales ......................... | $1,200,000 | $500,000 | $1,700,000 |
| Direct materials.......... | 366,325 | 162,550 | 528,875 |
| Direct labor................ | 120,000 | 42,500 | 162,500 |
| Advertising expense ... | 50,000 | 100,000 | 150,000 |
| Machining ................. | 117,000 | 81,250 | 198,250 |
| Setups ...................... | 30,000 | 120,000 | 150,000 |
| Product sustaining...... | 50,000 | 50,000 | 100,000 |
| Total cost .................. | 733,325 | 556,300 | 1,289,625 |
| Product margin .......... | $ 466,675 | $(56,300) | $ 410,375 |

**Problem 7-17** (continued)

3. The quantitative comparison is as follows:

| | EX300 | | TX500 | | Total |
|---|---|---|---|---|---|
| | (a) | (a) ÷ (c) | (b) | (b) ÷ (c) | (c) |
| *Traditional Cost System* | *Amount* | *%* | *Amount* | *%* | *Amount* |
| Direct materials | $366,325 | 69.3% | $162,550 | 30.7% | $ 528,875 |
| Direct labor | 120,000 | 73.8% | 42,500 | 26.2% | 162,500 |
| Manufacturing overhead | 375,600 | 73.8% | 133,025 | 26.2% | 508,625 |
| Total cost assigned to products | $861,925 | | $338,075 | | 1,200,000 |
| Selling and administrative | | | | | 550,000 |
| Total cost | | | | | $1,750,000 |
| | | | | | |
| *Activity-Based Costing System* | | | | | |
| Direct costs: | | | | | |
| Direct materials | $366,325 | 69.3% | $162,550 | 30.7% | $ 528,875 |
| Direct labor | 120,000 | 73.8% | 42,500 | 26.2% | 162,500 |
| Advertising expense | 50,000 | 33.3% | 100,000 | 66.7% | 150,000 |
| Indirect costs: | | | | | |
| Machining | 117,000 | 59.0% | 81,250 | 41.0% | 198,250 |
| Setups | 30,000 | 20.0% | 120,000 | 80.0% | 150,000 |
| Product sustaining | 50,000 | 50.0% | 50,000 | 50.0% | 100,000 |
| Total cost assigned to products | $733,325 | | $556,300 | | 1,289,625 |
| Costs not assigned to products: | | | | | |
| Selling and administrative | | | | | 400,000 |
| Other | | | | | 60,375 |
| Total cost | | | | | $1,750,000 |

**Problem 7-17** (continued)

The traditional and activity-based cost assignments differ for three reasons. First, the traditional system assigns all $508,625 of manufacturing overhead to products. The ABC system assigns only $448,250 of manufacturing overhead to products. The ABC system does not assign the $60,375 of Other activity costs to products because they represent organization-sustaining costs. Second, the traditional system uses one unit-level activity measure, direct labor dollars, to assign 73.9% of all overhead to the EX300 product line and 26.1% of all overhead to the TX500 product line. The ABC system assigns 59.0% of Machining costs to the EX300 product line and 41.0% to the TX500 product line. The ABC system assigns 20.0% of Setup costs (a batch-level activity) to the EX300 product line and 80.0% to the TX500 product line. The ABC system assigns 50% of Product sustaining costs (a product-level activity) to each product line. Third, the traditional system does not trace any advertising expenses to the two products. The ABC system traces $50,000 of advertising to the EX300 and $100,000 of advertising to the TX500 product line.

**Problem 7-18** (45 minutes)

1. Under the traditional direct labor-hour based costing system, manufacturing overhead is applied to products using the predetermined overhead rate computed as follows:

$$\text{Predetermined overhead rate} = \frac{\text{Estimated total manufacturing overhead cost}}{\text{Estimated total direct labor-hours}}$$

$$= \frac{\$2{,}200{,}000}{110{,}000 \text{ DLHs}^*} = \$20.00 \text{ per DLH}$$

*25,000 units of Xactive @ 1.4 DLH per unit + 75,000 units of the Pathbreaker @ 1.0 DLH per unit = 35,000 DLHs + 75,000 DLHs = 110,000 DLHs

Consequently, the product margins using the traditional approach would be computed as follows:

| | *Xactive* | *Pathbreaker* | *Total* |
|---|---|---|---|
| Sales | $3,175,000 | $6,675,000 | $9,850,000 |
| Direct materials | 1,620,000 | 3,825,000 | 5,445,000 |
| Direct labor | 455,000 | 975,000 | 1,430,000 |
| Manufacturing overhead applied @ $20.00 per direct labor-hour | 700,000 | 1,500,000 | 2,200,000 |
| Total manufacturing cost | 2,775,000 | 6,300,000 | 9,075,000 |
| Product margin | $ 400,000 | $ 375,000 | $ 775,000 |

Note that all of the manufacturing overhead cost is applied to the products under the company's traditional costing system.

**Problem 7-18** (continued)

2. The first step is to determine the activity rates:

| *Activity Cost Pools* | *(a) Total Cost* | *(b) Total Activity* | *(a) ÷ (b) Activity Rate* |
|---|---|---|---|
| Supporting direct labor | $797,500 | 110,000 DLHs | $7.25 per DLH |
| Batch setups | $680,000 | 400 setups | $1,700 per setup |
| Product sustaining | $650,000 | 2 products | $325,000 per product |

*The Other activity cost pool is not shown above because it includes organization-sustaining and idle capacity costs that should not be assigned to products.

Under the activity-based costing system, the product margins would be computed as follows:

| | *Xactive* | *Pathbreaker* | *Total* |
|---|---|---|---|
| Sales | $3,175,000 | $6,675,000 | $9,850,000 |
| Direct materials | 1,620,000 | 3,825,000 | 5,445,000 |
| Direct labor | 455,000 | 975,000 | 1,430,000 |
| Supporting direct labor | 253,750 | 543,750 | 797,500 |
| Batch setups | 425,000 | 255,000 | 680,000 |
| Product sustaining | 325,000 | 325,000 | 650,000 |
| Total cost | 3,078,750 | 5,923,750 | 9,002,500 |
| Product margin | $ 96,250 | $ 751,250 | $ 847,500 |

**Problem 7-18** (continued)

3. The quantitative comparison is as follows:

| | Xactive | | Pathbreaker | | Total |
|---|---|---|---|---|---|
| | (a) | (a) ÷ (c) | (b) | (b) ÷ (c) | (c) |
| *Traditional Cost System* | *Amount* | *%* | *Amount* | *%* | *Amount* |
| Direct materials | $1,620,000 | 29.8% | $3,825,000 | 70.2% | $5,445,000 |
| Direct labor | 455,000 | 31.8% | 975,000 | 68.2% | 1,430,000 |
| Manufacturing overhead | 700,000 | 31.8% | 1,500,000 | 68.2% | 2,200,000 |
| Total cost assigned to products | $2,775,000 | | $6,300,000 | | $9,075,000 |
| | | | | | |
| *Activity-Based Costing System* | | | | | |
| Direct costs: | | | | | |
| Direct materials | $1,620,000 | 29.8% | $3,825,000 | 70.2% | $5,445,000 |
| Direct labor | 455,000 | 31.8% | 975,000 | 68.2% | 1,430,000 |
| Indirect costs: | | | | | |
| Supporting direct labor | 253,750 | 31.8% | 543,750 | 68.2% | 797,500 |
| Batch setups | 425,000 | 62.5% | 255,000 | 37.5% | 680,000 |
| Product sustaining | 325,000 | 50.0% | 325,000 | 50.0% | 650,000 |
| Total cost assigned to products | $3,078,750 | | $5,923,750 | | 9,002,500 |
| Costs not assigned to products: | | | | | |
| Other | | | | | 72,500 |
| Total cost | | | | | $9,075,000 |

**Problem 7-18** (continued)

The traditional and activity-based cost assignments differ for two reasons. First, the traditional system assigns all $2,200,000 of manufacturing overhead to products. The ABC system assigns only $2,127,500 of manufacturing overhead to products. The ABC system does not assign the $72,500 of Other activity costs to products because they represent organization-sustaining and idle capacity costs. Second, the traditional system uses one unit-level activity measure, direct labor hours, to assign 31.8% of all overhead to the Xactive product line and 68.2% of all overhead to the Pathbreaker product line. The ABC system assigns 62.5% of Batch setup costs (a batch-level activity) to the Xactive product line and 37.5% to the Pathbreaker product line. The ABC system assigns 50% of Product sustaining costs (a product-level activity) to each product line.

**Problem 7-19** (45 minutes)

1. The results of the first-stage allocation appear below:

| | *Removing Asbestos* | *Estimating and Job Setup* | *Working on Nonroutine Jobs* | *Other* | *Totals* |
|---|---|---|---|---|---|
| Wages and salaries ......... | $ 80,000 | $ 20,000 | $ 70,000 | $ 30,000 | $ 200,000 |
| Disposal fees.................. | 420,000 | 0 | 180,000 | 0 | 600,000 |
| Equipment depreciation ... | 40,000 | 0 | 32,000 | 8,000 | 80,000 |
| On-site supplies ............. | 33,000 | 9,000 | 12,000 | 6,000 | 60,000 |
| Office expenses.............. | 19,000 | 76,000 | 57,000 | 38,000 | 190,000 |
| Licensing and insurance... | 185,000 | 0 | 148,000 | 37,000 | 370,000 |
| Total cost ....................... | $777,000 | $105,000 | $499,000 | $119,000 | $1,500,000 |

According to the data in the problem, 40% of the wages and salaries cost of $200,000 is attributable to activities related to job size.

$200,000 × 40% = $80,000
Other entries in the table are determined in a similar manner.

2.

| *Activity Cost Pool* | *(a) Total Cost* | *(b) Total Activity* | *(a) ÷ (b) Activity Rate* |
|---|---|---|---|
| Removing asbestos ........... | $777,000 | 500 thousand square feet | $1,554 per thousand square feet |
| Estimating and job setup ................ | $105,000 | 200 jobs | $525 per job |
| Working on nonroutine jobs. | $499,000 | 25 nonroutine jobs | $19,960 per nonroutine job |

**Problem 7-19** (continued)

3. The costs of each of the jobs can be computed as follows using the activity rates computed above:

a. *Routine two-thousand-square-foot job:*

| | |
|---|---|
| Removing asbestos | |
| ($1,554 per thousand square feet × 2 thousand square feet) | $3,108 |
| Estimating and job setup ($525 per job × 1 job) | 525 |
| Nonroutine job (not applicable) | 0 |
| Total cost of the job | $3,633 |
| Average cost per thousand square feet ($3,633 ÷ 2 thousand square feet) | $1,816.50 |

b. *Routine four-thousand-square-foot job:*

| | |
|---|---|
| Removing asbestos | |
| ($1,554 per thousand square feet × 4 thousand square feet) | $6,216 |
| Estimating and job setup ($525 per job × 1 job) | 525 |
| Nonroutine job (not applicable) | 0 |
| Total cost of the job | $6,741 |
| Cost per thousand square feet ($6,741 ÷ 4 thousand square feet) | $1,685.25 |

c. *Nonroutine two-thousand-square-foot job:*

| | |
|---|---|
| Removing asbestos | |
| ($1,554 per thousand square feet × 2 thousand square feet) | $ 3,108 |
| Estimating and job setup ($525 per job × 1 job) | 525 |
| Nonroutine job ($19,960 per nonroutine job × 1 nonroutine job) | 19,960 |
| Total cost of the job | $23,593 |
| Cost per thousand square feet ($23,593 ÷ 2 thousand square feet) | $11,796.50 |

**Problem 7-19** (continued)

4. The objectivity of the interview data can be questioned since the on-site work supervisors were undoubtedly trying to prove their case about the cost of nonroutine jobs. Nevertheless, the activity-based costing data certainly suggest that dramatic differences exist in the costs of jobs. While some of the costs may be difficult to adjust in response to changes in activity, it does appear that the standard bid of $4,000 per thousand square feet may be substantially under the company's cost for nonroutine jobs. Even though it may be difficult to detect nonroutine situations before work begins, the average additional cost of $19,960 for nonroutine work suggests that the estimator should try. And if a nonroutine situation is spotted, this should be reflected in the bid price.

   Savvy competitors are likely to bid less than $4,000 per thousand square feet on routine work and substantially more than $4,000 per thousand square feet on nonroutine work. Consequently, Denny Asbestos Removal may find that its product mix shifts toward nonroutine work and away from routine work as customers accept bids on nonroutine work from the company and go to competitors for routine work. This may have a disastrous effect on the company's profits.

**Problem 7-20** (45 minutes)

1. The first-stage allocation of costs to activity cost pools appears below:

| | *Cleaning Carpets* | *Travel to Jobs* | *Job Support* | *Other* | *Total* |
|---|---|---|---|---|---|
| | *Distribution of Resource Consumption Across Activity Cost Pools* | | | | |
| Wages | 75% | 15% | 0% | 10% | 100% |
| Cleaning supplies | 100% | 0% | 0% | 0% | 100% |
| Cleaning equipment depreciation | 70% | 0% | 0% | 30% | 100% |
| Vehicle expenses | 0% | 80% | 0% | 20% | 100% |
| Office expenses | 0% | 0% | 60% | 40% | 100% |
| President's compensation | 0% | 0% | 30% | 70% | 100% |

| | *Cleaning Carpets* | *Travel to Jobs* | *Job Support* | *Other* | *Total* |
|---|---|---|---|---|---|
| Wages | $105,000 | $21,000 | $ 0 | $14,000 | $140,000 |
| Cleaning supplies | 25,000 | 0 | 0 | 0 | 25,000 |
| Cleaning equipment depreciation | 7,000 | 0 | 0 | 3,000 | 10,000 |
| Vehicle expenses | 0 | 24,000 | 0 | 6,000 | 30,000 |
| Office expenses | 0 | 0 | 36,000 | 24,000 | 60,000 |
| President's compensation | 0 | 0 | 22,500 | 52,500 | 75,000 |
| Total cost | $137,000 | $45,000 | $58,500 | $99,500 | $340,000 |

75% of $140,000 = $105,000
Other entries in the table are determined in a similar manner.

**Problem 7-20** (continued)

2. The activity rates are computed as follows:

| *Activity Cost Pool* | *(a)* *Total Cost* | *(b)* *Total Activity* | *(a) ÷ (b)* *Activity Rate* |
|---|---|---|---|
| Cleaning carpets... | $137,000 | 10,000 hundred square feet | $13.70 per hundred square feet |
| Travel to jobs....... | $45,000 | 50,000 miles | $0.90 per mile |
| Job support.......... | $58,500 | 1,800 jobs | $32.50 per job |

3. The cost for the Lazy Bee Ranch job is computed as follows:

| *Activity Cost Pool* | *(a)* *Activity Rate* | *(b)* *Activity* | *(a) × (b)* *ABC Cost* |
|---|---|---|---|
| Cleaning carpets... | $13.70 per hundred square feet | 6 hundred square feet | $ 82.20 |
| Travel to jobs....... | $0.90 per mile | 52 miles | 46.80 |
| Job support.......... | $32.50 per job | 1 job | 32.50 |
| Total.................... | | | $161.50 |

4. The product margin can be easily computed below by using the costs calculated in part (3) above.

| | | |
|---|---|---|
| Sales...................... | | $137.70 |
| Costs: | | |
| Cleaning carpets... | $82.20 | |
| Travel to jobs....... | 46.80 | |
| Job support.......... | 32.50 | 161.50 |
| Product margin....... | | $(23.80) |

**Problem 7-20** (continued)

5. Gore Range Carpet Cleaning appears to be losing money on the Lazy Bee Ranch job. However, caution is advised. Some of the costs may not be avoidable and hence would have been incurred even if the Lazy Bee Ranch job had not been accepted. An action analysis (discussed in Appendix 7A) is a more appropriate starting point for analysis than the simple report in part (4) above.

   Nevertheless, there is a point at which travel costs eat up all of the profit from a job. With the company's current policy of charging a flat fee for carpet cleaning irrespective of how far away the client is from the office, there clearly is some point at which jobs should be turned down. (What if a potential customer is located in Florida?)

6. The company should consider charging a fee for travel to outlying customers based on the distance traveled and a flat fee per job. At present, close-in customers are in essence subsidizing service to outlying customers and large-volume customers are subsidizing service to low-volume customers. With fees for travel and for job support, the fee per hundred square feet can be dropped substantially. This may result in losing some low-volume jobs in outlying areas, but the lower fee per hundred square feet may result in substantially more business close to Eagle-Vail. (If the fee is low enough, the added business may not even have to come at the expense of competitors. Some customers may choose to clean their carpets more frequently if the price were more attractive.)

# Appendix 7A
## ABC Action Analysis

**Exercise 7A-1** (20 minutes)

| | | |
|---|---|---|
| Sales (80 clubs × $48 per club) | | $3,840.00 |
| Green costs: | | |
| Direct materials (80 clubs × $25.40 per club) | $2,032.00 | 2,032.00 |
| Green margin | | 1,808.00 |
| Yellow costs: | | |
| Direct labor (80 clubs × 0.3 hour per club × $21.50 per hour) | 516.00 | |
| Indirect labor | 90.00 | |
| Marketing expenses | 540.20 | 1,146.20 |
| Yellow margin | | 661.80 |
| Red costs: | | |
| Factory equipment depreciation | 106.40 | |
| Factory administration | 262.40 | |
| Selling and administrative wages and salaries | 436.00 | |
| Selling and administrative depreciation | 30.00 | 834.80 |
| Red margin | | $ (173.00) |

While not required in the problem, the conventional ABC analysis would be:

| | | |
|---|---|---|
| Sales (80 clubs × $48 per club) | | $3,840.00 |
| Costs: | | |
| Direct materials | $2,032.00 | |
| Direct labor | 516.00 | |
| Volume related overhead | 283.20 | |
| Batch processing overhead | 53.00 | |
| Order processing overhead | 118.80 | |
| Customer service overhead | 1,010.00 | 4,013.00 |
| Customer margin | | $ (173.00) |

Exercise 7A-2 (30 minutes)

1.

| | Order Size | Customer Orders | Product Testing | Selling | Total |
|---|---|---|---|---|---|
| Total activity for the order ........ | 150 direct labor-hours | 1 customer order | 18 product testing hours | 3 sales calls | |
| Manufacturing overhead: | | | | | |
| Indirect labor ........................ | R 1,440 | R 231 | R 648 | R 0 | R 2,319 |
| Factory depreciation ............. | 1,050 | 0 | 324 | 0 | 1,374 |
| Factory utilities..................... | 30 | 0 | 18 | 0 | 48 |
| Factory administration ........... | 0 | 46 | 432 | 36 | 514 |
| Selling and administrative: | | | | | |
| Wages and salaries ............... | 120 | 72 | 0 | 2,895 | 3,087 |
| Depreciation ......................... | 0 | 11 | 0 | 108 | 119 |
| Taxes and insurance............. | 0 | 0 | 0 | 147 | 147 |
| Selling expenses................... | 0 | 0 | 0 | 1,296 | 1,296 |
| Total overhead cost ................ | R 2,640 | R 360 | R 1,422 | R 4,482 | R 8,904 |

Example: R 9.60 per direct labor-hour × 150 direct labor-hours = R 1,440

According to these calculations, the overhead cost of the order was R 8,904. This agrees with the computations in Exercise 7-6.

**Exercise 7A-2** (continued)

2. The table prepared in part (1) above allows two different perspectives on the overhead cost of the order. The column totals that appear in the last row of the table tell us the cost of the order in terms of the activities it required. The row totals that appear in the last column of the table tell us how much the order cost in terms of the overhead accounts in the underlying accounting system. Another way of saying this is that the column totals tell us what the costs were incurred *for*. The row totals tell us what the costs were incurred *on*. For example, you may spend money *on* a chocolate bar to satisfy your craving *for* chocolate. Both perspectives are important. To control costs, it is necessary both to know what the costs were incurred for and what actual costs would have to be adjusted (i.e., what the costs were incurred on).

   The two different perspectives can be explicitly shown as follows:

   What the overhead costs were spent *on*:

| | |
|---|---|
| Manufacturing overhead: | |
| Indirect labor | R 2,319 |
| Factory depreciation | 1,374 |
| Factory utilities | 48 |
| Factory administration | 514 |
| Selling and administrative: | |
| Wages and salaries | 3,087 |
| Depreciation | 119 |
| Taxes and insurance | 147 |
| Selling expenses | 1,296 |
| Total overhead cost | R 8,904 |

   What the overhead costs were incurred *for*:

| | |
|---|---|
| Order size | R 2,640 |
| Customer orders | 360 |
| Product testing | 1,422 |
| Selling | 4,482 |
| Total overhead cost | R 8,904 |

**Exercise 7A-3** (30 minutes)

| | *Supporting Direct Labor* | *Batch Processing* | *Order Processing* | *Customer Service* | *Total* |
|---|---|---|---|---|---|
| Total activity for the order | 1,920 direct labor-hours* | 4 batches | 1 order | 1 customer | |
| Manufacturing overhead: | | | | | |
| Indirect labor | $ 3,456 | $288 | $ 18 | $ 0 | $ 3,762 |
| Factory equipment depreciation | 14,112 | 13 | 0 | 0 | 14,125 |
| Factory administration | 4,032 | 28 | 28 | 268 | 4,356 |
| Selling and administrative: | | | | | |
| Wages and salaries | 960 | 52 | 153 | 1,864 | 3,029 |
| Depreciation | 0 | 3 | 6 | 26 | 35 |
| Marketing expenses | 480 | 0 | 79 | 462 | 1,021 |
| Total overhead cost | $23,040 | $384 | $284 | $2,620 | $26,328 |

Example: $1.80 per direct labor-hour × 1,920 direct labor-hours = $3,456

*1,920 direct labor-hours = 0.8 direct labor-hour per seat × 2,400 seats

**Exercise 7A-3** (continued)

The action analysis report for the customer can be constructed using the row totals from the activity rate table, organized according to the ease of adjustment codes.

| | | |
|---|---|---|
| Sales ($137.95 per seat × 2,400 seats) | | $331,080 |
| Green costs: | | |
| Direct materials ($112 per seat × 2,400 seats) | $268,800 | 268,800 |
| Green margin | | 62,280 |
| Yellow costs: | | |
| Direct labor ($14.40 per seat × 2,400 seats) | 34,560 | |
| Indirect labor | 3,762 | |
| Marketing expenses | 1,021 | 39,343 |
| Yellow margin | | 22,937 |
| Red costs: | | |
| Factory equipment depreciation | 14,125 | |
| Factory administration | 4,356 | |
| Selling and administrative wages and salaries | 3,029 | |
| Selling and administrative depreciation | 35 | 21,545 |
| Red margin | | $ 1,392 |

**Exercise 7A-4** (60 minutes)

1. First-stage allocations of overhead costs to the activity cost pools:

| | *Distribution of Resource Consumption Across Activity Cost Pools* | | | | |
|---|---|---|---|---|---|
| | *Direct Labor Support* | *Order Processing* | *Customer Support* | *Other* | *Totals* |
| Wages and salaries....... | 30% | 35% | 25% | 10% | 100% |
| Other overhead costs ... | 25% | 15% | 20% | 40% | 100% |

| | *Direct Labor Support* | *Order Processing* | *Customer Support* | *Other* | *Totals* |
|---|---|---|---|---|---|
| Wages and salaries....... | $105,000 | $122,500 | $ 87,500 | $ 35,000 | $350,000 |
| Other overhead costs ... | 50,000 | 30,000 | 40,000 | 80,000 | 200,000 |
| Total cost.................... | $155,000 | $152,500 | $127,500 | $115,000 | $550,000 |

Example: 30% of $350,000 is $105,000.

Other entries in the table are determined in a similar manner.

**Exercise 7A-4** (continued)

2. The activity rates are computed by dividing the costs in the cells of the first-stage allocation above by the total activity from the top of the column.

| | *Direct Labor Support* | *Order Processing* | *Customer Support* |
|---|---|---|---|
| Total activity ............. | 10,000 DLHs | 500 orders | 100 customers |
| Wages and salaries .... | $10.50 | $245.00 | $ 875.00 |
| Other overhead costs . | 5.00 | 60.00 | 400.00 |
| Total cost ................. | $15.50 | $305.00 | $1,275.00 |

Example: $105,000 ÷ 10,000 DLHs = $10.50 per DLH

Direct labor support wages and salaries from the first-stage allocation above.

3. The overhead cost for the order is computed as follows:

| | *Direct Labor Support* | *Order Processing* | *Customer Support* | *Total* |
|---|---|---|---|---|
| Activity ............................ | 50 DLHs | 1 order | 1 customer | |
| Wages and salaries ........... | $525 | $245 | $ 875 | $1,645 |
| Other overhead costs ........ | 250 | 60 | 400 | 710 |
| Total cost ........................ | $775 | $305 | $1,275 | $2,355 |

Example: 50 DLHs × $10.50 per DLH = $525

Activity rate for direct labor support wages and salaries from part (2) above.

**Exercise 7A-4** (continued)

4. The report can be constructed using the column totals at the bottom of the overhead cost analysis in part (3) above.

*Customer Margin—ABC Analysis*

| | | |
|---|---|---|
| Sales (100 units × $295 per unit) | | $29,500 |
| Costs: | | |
| Direct materials ($264 per unit × 100 units) | $26,400 | |
| Direct labor ($25 per DLH × 0.5 DLH per unit × 100 units) | 1,250 | |
| Direct labor support overhead (see part 3 above) | 775 | |
| Order processing overhead (see part 3 above) | 305 | |
| Customer support overhead (see part 3 above) | 1,275 | 30,005 |
| Customer margin | | $( 505) |

5. The action analysis report can be constructed using the row totals from the activity rate table, organized according to the ease of adjustment codes:

| | | |
|---|---|---|
| Sales ($295 per unit × 100 units) | | $29,500 |
| Green costs: | | |
| Direct materials ($264 per unit × 100 units) | $26,400 | 26,400 |
| Green margin | | 3,100 |
| Yellow costs: | | |
| Direct labor ($25 per DLH × 0.5 DLH per unit × 100 units) | 1,250 | |
| Wages and salaries (see part 3 above) | 1,645 | 2,895 |
| Yellow margin | | 205 |
| Red costs: | | |
| Other overhead costs (see part 3 above) | 710 | 710 |
| Red margin | | $( 505) |

**Exercise 7A-4** (continued)

6. While the company appears to have incurred a loss on its business with Indus Telecom, caution must be exercised. The green margin on the business was $3,100. Silicon Optics really incurred a loss on this business only if at least $3,100 of the yellow and red costs would have been avoided if the Indus Telecom order had been rejected. For example, we don't know what specific costs are included in the "Other overhead" category. If these costs are committed fixed costs that cannot be avoided in the short run, then the company would been worse off if the Indus Telecom order had not been accepted.

   Suppose that Indus Telecom will be submitting a similar order every year. As a general policy, the company might consider turning down this business in the future. Costs that cannot be avoided in the short run, may be avoided in the long run through the budgeting process or in some other manner. However, if the Indus Telecom business is turned down, management must make sure that at least $3,100 of the yellow and red costs are really eliminated or the resources represented by those costs are really redeployed to the constraint. If these costs remain unchanged, then the company would be better off accepting than rejecting business from the Indus Telecom in the future.

**Problem 7A-5** (30 minutes)

1. The detailed cost analysis of local commercials appears below:

| | *Activity Rates* | | |
|---|---|---|---|
| | *Animation Concept* | *Animation Production* | *Contract Administration* |
| Technical staff salaries.................. | $3,500 | $5,000 | $1,800 |
| Animation equipment depreciation . | 600 | 1,500 | 0 |
| Administrative wages and salaries .. | 1,400 | 200 | 4,600 |
| Supplies costs .............................. | 300 | 600 | 100 |
| Facility costs ................................ | 200 | 400 | 100 |
| Total .......................................... | $6,000 | $7,700 | $6,600 |

| | *Animation Concept* | *Animation Production* | *Contract Administration* | *Total* |
|---|---|---|---|---|
| Activity level ................................ | 20 proposals | 12 minutes | 8 contracts | |
| Technical staff salaries.................. | $ 70,000 | $60,000 | $14,400 | $144,400 |
| Animation equipment depreciation .. | 12,000 | 18,000 | 0 | 30,000 |
| Administrative wages and salaries ... | 28,000 | 2,400 | 36,800 | 67,200 |
| Supplies costs .............................. | 6,000 | 7,200 | 800 | 14,000 |
| Facility costs ................................ | 4,000 | 4,800 | 800 | 9,600 |
| Total cost .................................... | $120,000 | $92,400 | $52,800 | $265,200 |

Example: $3,500 per proposal × 20 proposals = $70,000

**Problem 7A-5** (continued)

2. The action analysis report is constructed by using the row totals from the cost report in part (1) above:

| | | |
|---|---|---|
| Sales | | $240,000 |
| Green costs: | | |
| Supplies costs | $ 14,000 | 14,000 |
| Green margin | | 226,000 |
| Yellow costs: | | |
| Administrative wages and salaries | 67,200 | 67,200 |
| Yellow margin | | 158,800 |
| Red costs: | | |
| Technical staff salaries | 144,400 | |
| Animation equipment depreciation | 30,000 | |
| Facility costs | 9,600 | 184,000 |
| Red margin | | $( 25,200) |

3. At first glance, it appears that the company is losing money on local commercials. However, the action analysis report indicates that if this market segment were dropped, most of the costs would probably continue to be incurred. The nature of the technical staff salaries is clearly critical because it makes up the bulk of the costs. Management has suggested that the company's most valuable asset is the technical staff and that they would be the last to go in case of financial difficulties. Nevertheless, there are at least two situations in which these costs would be relevant. First, dropping the local commercial market segment may reduce future hiring of new technical staff. This would have the effect of reducing future spending and therefore would reduce the company's costs. Second, if technical staff time is a constraint, dropping the local commercial market segment would allow managers to shift technical staff time to other, presumably more profitable, work. However, if this is the case, there are better ways to determine which projects should get technical staff attention. This subject will be covered in Chapter 13 in the section on utilization of scarce resources.

**Problem 7A-5** (continued)

Finally, the cost of the animation concept at the proposal stage is a major drag on the profitability of the local commercial market. The activity-based costing system, as currently designed, assumes that all project proposals require the same effort. This may not be the case. Proposals for local commercials may be far less elaborate than proposals for major special effects animation sequences for motion pictures. If management *has* been putting about the same amount of effort into every proposal, the above activity-based costing analysis suggests that this may be a mistake. Management may want to consider cutting back on the effort going into animation concepts for local commercials at the project proposal stage. Of course, this may lead to an even lower success rate on bids for local commercials.

# Appendix 7B
## Using a Modified Form of Activity-Based Costing to Determine Product Costs for External Reports

**Exercise 7B-1** (45 minutes)

1. The predetermined overhead rate is computed as follows:

$$\text{Predetermined overhead rate} = \frac{\$290{,}000}{50{,}000 \text{ DLHs}} = \$5.80 \text{ per DLH}$$

The unit product costs under the company's traditional costing system are computed as follows:

| | *Deluxe* | *Standard* |
|---|---|---|
| Direct materials | $60.00 | $45.00 |
| Direct labor | 9.60 | 7.20 |
| Manufacturing overhead (0.8 DLH × $5.80 per DLH; 0.6 DLH × $5.80 per DLH) | 4.64 | 3.48 |
| Unit product cost | $74.24 | $55.68 |

**Exercise 7B-1** (continued)

2. The activity rates are computed as follows:

| *Activities* | *(a) Estimated Overhead Cost* | *(b) Total Expected Activity* | | *(a) ÷ (b) Activity Rate* | |
|---|---|---|---|---|---|
| Supporting direct labor... | $150,000 | 50,000 | DLHs | $3 | per DLH |
| Batch setups.................. | $60,000 | 250 | setups | $240 | per setup |
| Safety testing ................ | $80,000 | 100 | tests | $800 | per test |

Manufacturing overhead is assigned to the two products as follows:

*Deluxe Product:*

| *Activity Cost Pool* | *(a) Activity Rate* | *(b) Activity* | *(a) × (b) ABC Cost* |
|---|---|---|---|
| Supporting direct labor .......... | $3 per DLH | 8,000 DLHs | $ 24,000 |
| Batch setups ......................... | $240 per setup | 200 setups | 48,000 |
| Safety testing........................ | $800 per test | 80 tests | 64,000 |
| Total.................................... | | | $136,000 |

*Standard Product:*

| *Activity Cost Pool* | *(a) Activity Rate* | *(b) Activity* | *(a) × (b) ABC Cost* |
|---|---|---|---|
| Supporting direct labor .......... | $3 per DLH | 42,000 DLHs | $126,000 |
| Batch setups ......................... | $240 per setup | 50 setups | 12,000 |
| Safety testing........................ | $800 per test | 20 tests | 16,000 |
| Total.................................... | | | $154,000 |

**Exercise 7B-1** (continued)

Activity-based costing unit product costs are computed as follows:

| | *Deluxe* | *Standard* |
|---|---|---|
| Direct materials | $60.00 | $45.00 |
| Direct labor | 9.60 | 7.20 |
| Manufacturing overhead ($136,000 ÷ 10,000 units; $154,000 ÷ 70,000 units) | 13.60 | 2.20 |
| Unit product cost | $83.20 | $54.40 |

**Exercise 7-B2** (45 minutes)

1. The unit product costs under the company's conventional costing system would be computed as follows:

| | *Mercon* | *Wurcon* | *Total* |
|---|---|---|---|
| Number of units produced (a) | 10,000 | 40,000 | |
| Direct labor-hours per unit (b) | 0.20 | 0.25 | |
| Total direct labor-hours (a) × (b) | 2,000 | 10,000 | 12,000 |

| | |
|---|---|
| Total manufacturing overhead (a) | $336,000 |
| Total direct labor-hours (b) | 12,000 DLHs |
| Predetermined overhead rate (a) ÷ (b) | $28.00 per DLH |

| | *Mercon* | *Wurcon* |
|---|---|---|
| Direct materials | $10.00 | $ 8.00 |
| Direct labor | 3.00 | 3.75 |
| Manufacturing overhead applied: | | |
| 0.20 DLH per unit × $28.00 per DLH | 5.60 | |
| 0.25 DLH per unit × $28.00 per DLH | | 7.00 |
| Unit product cost | $18.60 | $18.75 |

**Exercise 7B-2** (continued)

2. The unit product costs with the proposed ABC system can be computed as follows:

| *Activity Cost Pool* | *Estimated Overhead Cost** | *(b) Expected Activity* | *(a) ÷ (b) Activity Rate* |
|---|---|---|---|
| Labor related ........... | $168,000 | 12,000 direct labor-hours | $14 per direct labor-hour |
| Engineering design... | 168,000 | 8,000 engineering-hours | $21 per engineering-hour |
| | $336,000 | | |

*The total manufacturing overhead cost is split evenly between the two activity cost pools.

Manufacturing overhead is assigned to the two products as follows:

Mercon:

| *Activity Cost Pool* | *(a) Activity Rate* | *(b) Activity* | *(a) × (b) ABC Cost* |
|---|---|---|---|
| Labor related ......... | $14 per DLH | 2,000 DLHs | $ 28,000 |
| Engineering design. | $21 per engineering-hour | 4,000 engineering-hours | 84,000 |
| Total..................... | | | $112,000 |

Wurcon:

| *Activity Cost Pool* | *(a) Activity Rate* | *(b) Activity* | *(a) × (b) ABC Cost* |
|---|---|---|---|
| Labor related ......... | $14 per DLH | 10,000 DLHs | $140,000 |
| Engineering design. | $21 per engineering-hour | 4,000 engineering-hours | 84,000 |
| Total..................... | | | $224,000 |

**Exercise 7B-2** (continued)

The unit product costs combine direct materials, direct labor, and manufacturing overhead costs:

| | *Mercon* | *Wurcon* |
|---|---|---|
| Direct materials | $10.00 | $ 8.00 |
| Direct labor | 3.00 | 3.75 |
| Manufacturing overhead ($112,000 ÷ 10,000 units; $224,000 ÷ 40,000 units) | 11.20 | 5.60 |
| Unit product cost | $24.20 | $17.35 |

3. The unit product cost of the high-volume product, Wurcon, declines under the activity-based costing system, whereas the unit product cost of the low-volume product, Mercon, increases. This occurs because half of the overhead is applied on the basis of engineering design hours instead of direct labor-hours. When the overhead was applied on the basis of direct labor-hours, most of the overhead was applied to the high-volume product. However, when the overhead is applied on the basis of engineering-hours, more of the overhead cost is shifted over to the low-volume product. Engineering design is a product-level activity, so the higher the volume, the lower the unit cost and the lower the volume, the higher the unit cost.

**Problem 7B-3** (60 minutes)

1. The company's estimated direct labor-hours (DLHs) can be computed as follows:

| | |
|---|---|
| Deluxe model: 15,000 units × 1.6 DLH per unit.... | 24,000 |
| Regular model: 120,000 units × 0.8 DLH per unit. | 96,000 |
| Total direct labor-hours.................................... | 120,000 |

Using direct labor-hours as the base, the predetermined overhead rate would be:

$$\frac{\text{Estimated overhead cost}}{\text{Estimated direct labor-hours}} = \frac{\$6{,}000{,}000}{120{,}000 \text{ DLHs}} = \$50 \text{ per DLH}$$

The unit product cost of each model using the company's traditional costing system would be:

| | *Deluxe* | *Regular* |
|---|---|---|
| Direct materials................ | $154 | $112 |
| Direct labor...................... | 16 | 8 |
| Manufacturing overhead: | | |
| $50 per DLH × 1.6 DLHs. | 80 | |
| $50 per DLH × 0.8 DLHs. | | 40 |
| Total unit product cost....... | $250 | $160 |

2. Predetermined overhead rates are computed below:

| *Activity Cost Pool* | *(a) Estimated Overhead Cost* | *(b) Expected Activity* | *(a) ÷ (b) Predetermined Overhead Rate* |
|---|---|---|---|
| Purchase orders........ | $252,000 | 1,200 purchase orders | $210 per purchase order |
| Scrap/rework orders.. | $648,000 | 900 scrap/rework orders | $720 per scrap/rework order |
| Product testing.......... | $1,350,000 | 15,000 tests | $90 per test |
| Machine related ........ | $3,750,000 | 50,000 MHs | $75 per MH |

**Problem 7B-3** (continued)

3. a. The overhead applied to each product can be determined as follows:

*The Deluxe Model*

| *Activity Cost Pool* | *(a) Predetermined Overhead Rate* | *(b) Activity* | *(a) × (b) Overhead Applied* |
|---|---|---|---|
| Purchase orders | $210 per PO | 400 POs | $ 84,000 |
| Scrap/rework orders | $720 per order | 500 orders | 360,000 |
| Product testing | $90 per test | 6,000 tests | 540,000 |
| Machine related | $75 per MH | 20,000 MHs | 1,500,000 |
| Total overhead cost (a) | | | $2,484,000 |
| Number of units produced (b) | | | 15,000 |
| Overhead cost per unit (a) ÷ (b) | | | $165.60 |

*The Regular Model*

| *Activity Cost Pool* | *(a) Predetermined Overhead Rate* | *(b) Activity* | *(a) × (b) Overhead Applied* |
|---|---|---|---|
| Purchase orders | $210 per PO | 800 POs | $ 168,000 |
| Scrap/rework orders | $720 per order | 400 orders | 288,000 |
| Product testing | $90 per test | 9,000 tests | 810,000 |
| Machine related | $75 per MH | 30,000 MHs | 2,250,000 |
| Total overhead cost (a) | | | $3,516,000 |
| Number of units produced (b) | | | 120,000 |
| Overhead cost per unit (a) ÷ (b) | | | $29.30 |

**Problem 7B-3** (continued)

b. Using activity-based costing, the unit product cost of each model would be:

| | *Deluxe* | *Regular* |
|---|---|---|
| Direct materials | $154.00 | $112.00 |
| Direct labor | 16.00 | 8.00 |
| Manufacturing overhead (above) | 165.60 | 29.30 |
| Total unit product cost | $335.60 | $149.30 |

4. It is risky to draw any definite conclusions based on the above analysis. The activity-based costing system used in this company is not completely suitable for making decisions. Product costs probably include the costs of idle capacity and organization-sustaining costs. They also exclude nonmanufacturing costs that may be caused by the products. Nevertheless, the above analysis is suggestive. Unit costs appear to be distorted as a result of using direct labor-hours as the base for assigning overhead cost to products. Although the deluxe model requires twice as much labor time as the regular model, it still is not being assigned enough overhead cost, as shown in the analysis in part 3(a).

   When the company's overhead costs are analyzed on an activities basis, it appears that the deluxe model is more expensive to manufacture than the company realizes. Note that the deluxe model accounts for 40% of the machine-hours, although it represents a small part of the company's total production. Also, it consumes a disproportionately large amount of the activities.

   When activity-based costing is used in place of direct labor as the basis for assigning overhead cost to products, the unit product cost of the deluxe model jumps from $250 to $335.60. If the $250 cost figure is being used as the basis for pricing, then the selling price for the deluxe model may be too low. This may be one reason why profits have been declining over the last several years. It may also be the reason why sales of the deluxe model have been increasing rapidly.

**Problem 7B-4** (60 minutes)

1. a. When direct labor-hours are used to apply overhead cost to products, the company's predetermined overhead rate would be:

$$\text{Predetermined overhead rate} = \frac{\text{Manufacturing overhead cost}}{\text{Direct labor hours}}$$

$$= \frac{\$1{,}480{,}000}{20{,}000\text{ DLHs}} = \$74 \text{ per DLH}$$

b.

| | *Model* | |
|---|---|---|
| | *XR7* | *ZD5* |
| Direct materials ...................................... | $35.00 | $25.00 |
| Direct labor: | | |
| $20 per hour × 0.2 DLH, 0.4 DLH ........... | 4.00 | 8.00 |
| Manufacturing overhead: | | |
| $74 per hour × 0.2 DLH, 0.4 DLH ........... | 14.80 | 29.60 |
| Total unit product cost............................. | $53.80 | $62.60 |

2. a. Predetermined overhead rates for the activity cost pools:

| *Activity Cost Pool* | *(a) Estimated Total Cost* | *(b) Estimated Total Activity* | *(a) ÷ (b) Activity Rate* |
|---|---|---|---|
| Machine setups.... | $180,000 | 250 setups | $720 per setup |
| Special milling...... | $300,000 | 1,000 MHs | $300 per MH |
| General factory .... | $1,000,000 | 20,000 DLHs | $50 per DLH |

**Problem 7B-4** (continued)

The overhead applied to each product can be determined as follows:

*Model XR7*

| *Activity Cost Pool* | *(a) Predetermined Overhead Rate* | *(b) Activity* | *(a) × (b) Overhead Applied* |
|---|---|---|---|
| Machine setups | $720 per setup | 150 setups | $108,000 |
| Special milling | $300 per MH | 1,000 MHs | 300,000 |
| General factory | $50 per DLH | 4,000 DLHs | 200,000 |
| Total manufacturing overhead cost (a) | | | $608,000 |
| Number of units produced (b) | | | 20,000 |
| Overhead cost per unit (a) ÷ (b) | | | $30.40 |

*Model ZD5*

| *Activity Cost Pool* | *(a) Predetermined Overhead Rate* | *(b) Activity* | *(a) × (b) Overhead Applied* |
|---|---|---|---|
| Machine setups | $720 per setup | 100 setups | $ 72,000 |
| Special milling | $300 per MH | 0 MHs | 0 |
| General factory | $50 per DLH | 16,000 DLHs | 800,000 |
| Total manufacturing overhead cost (a) | | | $872,000 |
| Number of units produced (b) | | | 40,000 |
| Overhead cost per unit (a) ÷ (b) | | | $21.80 |

**Problem 7B-4** (continued)

b. The unit product cost of each model under activity-based costing would be computed as follows:

| | Model | |
|---|---|---|
| | *XR7* | *ZD5* |
| Direct materials | $35.00 | $25.00 |
| Direct labor ($20 per DLH × 0.2 DLH; $20 per DLH × 04.DLH) | 4.00 | 8.00 |
| Manufacturing overhead (above) | 30.40 | 21.80 |
| Total unit product cost | $69.40 | $54.80 |

Comparing these unit cost figures with the unit costs in Part 1(b), we find that the unit product cost for Model XR7 has increased from $53.80 to $69.40, and the unit product cost for Model ZD5 has decreased from $62.60 to $54.80.

3. It is especially important to note that, even under activity-based costing, 68% of the company's overhead costs continue to be applied to products on the basis of direct labor-hours:

| | | |
|---|---|---|
| Machine setups (number of setups) | $ 180,000 | 12% |
| Special milling (machine-hours) | 300,000 | 20 |
| General factory (direct labor-hours) | 1,000,000 | 68 |
| Total overhead cost | $1,480,000 | 100% |

Thus, the shift in overhead cost from the high-volume product (Model ZD5) to the low-volume product (Model XR7) occurred as a result of reassigning only 32% of the company's overhead costs.

The increase in unit product cost for Model XR7 can be explained as follows: First, where possible, overhead costs have been traced to the products rather than being lumped together and spread uniformly over production. Therefore, the special milling costs, which are traceable to Model XR7, have all been assigned to Model XR7 and none assigned to Model ZD5 under the activity-based costing approach. It is common in industry to have some products that require special handling or special milling of some type. This is especially true in modern factories that produce a variety of products. Activity-based costing provides a vehicle for assigning these costs to the appropriate products.

**Problem 7B-4** (continued)

Second, the costs associated with the batch-level activity (machine setups) have also been assigned to the specific products to which they relate. These costs have been assigned according to the number of setups completed for each product. However, because a batch-level activity is involved, another factor affecting unit costs comes into play. That factor is batch size. Some products are produced in large batches and some are produced in small batches. *The smaller the batch, the higher the cost per unit of the batch activity.* In the case at hand, the data can be analyzed as shown below.

| | | |
|---|---|---|
| Model XR7: | | |
| Cost to complete one setup [see 2(a)] ......... | $720 | (a) |
| Number of units processed per setup (20,000 units ÷ 150 setups) ..................... | 133.33 | (b) |
| Setup cost per unit (a) ÷ (b) ....................... | $5.40 | |
| Model ZD5: | | |
| Cost to complete one setup (above) ........... | $720 | (a) |
| Number of units processed per setup (40,000 units ÷ 100 setups) ..................... | 400 | (b) |
| Setup cost per unit (a) ÷ (b) ....................... | $1.80 | |

Thus, the cost per unit for setups is three times as great for Model XR7, the low-volume product, as it is for Model ZD5, the high-volume product. Such differences in cost are obscured when direct labor-hours (or any other volume measure) is used as the basis for applying overhead cost to products.

In sum, overhead cost has shifted from the high-volume product to the low-volume product as a result of more appropriately assigning some costs to the products on the basis of the activities involved, rather than on the basis of direct labor-hours.

**Case 7B-5** (90 minutes)

1. a. The predetermined overhead rate would be computed as follows:

$$\frac{\text{Expected manufacturing overhead cost}}{\text{Estimated direct labor-hours}} = \frac{\$3,000,000}{50,000 \text{ DLHs}}$$

$$= \$60 \text{ per DLH}$$

b. The unit product cost per pound, using the company's present costing system, would be:

| | *Mona Loa* | *Malaysian* |
|---|---|---|
| Direct materials (given) ........... | $4.20 | $3.20 |
| Direct labor (given) ................. | 0.30 | 0.30 |
| Manufacturing overhead: | | |
| 0.025 DLH × $60 per DLH ..... | 1.50 | 1.50 |
| Total unit product cost............. | $6.00 | $5.00 |

2. a. Overhead rates by activity center:

| *Activity Center* | *(a) Estimated Overhead Costs* | *(b) Expected Activity* | *(a) ÷ (b) Predetermined Overhead Rate* |
|---|---|---|---|
| Purchasing ........... | $513,000 | 1,710 orders | $300 per order |
| Material handling .. | $720,000 | 1,800 setups | $400 per setup |
| Quality control ...... | $144,000 | 600 batches | $240 per batch |
| Roasting............... | $961,000 | 96,100 hours | $10 per hour |
| Blending............... | $402,000 | 33,500 hours | $12 per hour |
| Packaging............. | $260,000 | 26,000 hours | $10 per hour |

**Case 7B-5** (continued)

Before we can determine the amount of overhead cost to assign to the products we must first determine the activity for each of the products in the six activity centers. The necessary computations follow:

Number of purchase orders:
Mona Loa: 100,000 pounds ÷ 20,000 pounds per order = 5 orders
Malaysian: 2,000 pounds ÷ 500 pounds per order = 4 orders
Number of batches:
Mona Loa: 100,000 pounds ÷ 10,000 pounds per batch = 10 batches
Malaysian: 2,000 pounds ÷ 500 pounds per batch = 4 batches
Number of setups:
Mona Loa: 10 batches × 3 setups per batch = 30 setups
Malaysian: 4 batches × 3 setups per batch = 12 setups
Roasting hours:
Mona Loa: 1 hour × (100,000 pounds ÷ 100 pounds) = 1,000 hours
Malaysian: 1 hour × (2,000 pounds ÷ 100 pounds) = 20 hours
Blending hours:
Mona Loa: 0.5 hour × (100,000 pounds ÷ 100 pounds) = 500 hours
Malaysian: 0.5 hour × (2,000 pounds ÷ 100 pounds) = 10 hours
Packaging hours:
Mona Loa: 0.1 hour × (100,000 pounds ÷ 100 pounds) = 100 hours
Malaysian: 0.1 hour × (2,000 pounds ÷ 100 pounds) = 2 hours

**Case 7B-5** (continued)

The overhead applied to each product can be determined as follows:

*Mona Loa*

| *Activity Cost Pool* | *(a) Predetermined Overhead Rate* | *(b) Activity* | *(a) × (b) Overhead Applied* |
|---|---|---|---|
| Purchasing............ | \$300 per order | 5 orders | \$ 1,500 |
| Material handling ... | \$400 per setup | 30 setups | 12,000 |
| Quality control ....... | \$240 per batch | 10 batches | 2,400 |
| Roasting ............... | \$10 per roasting hour | 1,000 roasting hours | 10,000 |
| Blending ............... | \$12 per blending hour | 500 blending hours | 6,000 |
| Packaging ............. | \$10 per packaging hour | 100 packaging hours | 1,000 |
| Total .................... | | | \$32,900 |

*Malaysian*

| *Activity Cost Pool* | *(a) Predetermined Overhead Rate* | *(b) Activity* | *(a) × (b) Overhead Applied* |
|---|---|---|---|
| Purchasing............ | \$300 per order | 4 orders | \$1,200 |
| Material handling ... | \$400 per setup | 12 setups | 4,800 |
| Quality control ....... | \$240 per batch | 4 batches | 960 |
| Roasting ............... | \$10 per roasting hour | 20 roasting hours | 200 |
| Blending ............... | \$12 per blending hour | 10 blending hours | 120 |
| Packaging ............. | \$10 per packaging hour | 2 packaging hours | 20 |
| Total .................... | | | \$7,300 |

**Case 7B-5** (continued)

b. According to the activity-based costing system, the manufacturing overhead cost per pound is:

| | *Mona Loa* | *Malaysian* |
|---|---|---|
| Total overhead cost assigned (above) (a) ... | $32,900 | $7,300 |
| Number of pounds manufactured (b).......... | 100,000 | 2,000 |
| Cost per pound (a) ÷ (b) .......................... | $0.33 | $3.65 |

c. The unit product costs according to the activity-based costing system are:

| | *Mona Loa* | *Malaysian* |
|---|---|---|
| Direct materials (given) ......... | $4.20 | $3.20 |
| Direct labor (given) ............... | 0.30 | 0.30 |
| Manufacturing overhead ........ | 0.33 | 3.65 |
| Total unit product cost........... | $4.83 | $7.15 |

3. MEMO TO THE PRESIDENT: Analysis of CBI's data shows that several activities other than direct labor drive the company's manufacturing overhead costs. These activities include purchase orders issued, number of setups for material processing, and number of batches processed. The company's present costing system, which relies on direct labor time as the sole basis for assigning overhead cost to products, significantly undercosts low-volume products, such as the Malaysian coffee, and significantly overcosts high-volume products, such as our Mona Loa coffee.

   An implication of the activity-based costing analysis is that our low-volume products may not be covering the costs of the manufacturing resources they use. For example, Malaysian coffee is currently priced at $6.50 per pound, but this price is significantly below its activity-based cost of $7.15 per pound. Under our present costing and pricing system, our high-volume products, such as our Mona Loa coffee, may be subsidizing our low-volume products. Some adjustments in prices may be required. However, before taking such an action, an action analysis report (discussed in Appendix 7A) should be prepared.

**Case 7B-5** (continued)

ALTERNATIVE SOLUTION:

Many students will compute the manufacturing overhead cost per pound of the two coffees as shown above. However, the cost per pound can also be computed as shown below. *This alternative approach provides additional insight into the data and facilitates emphasis of some points made in the chapter.*

| | *Mona Loa* | | *Malaysian* | |
|---|---|---|---|---|
| | *Total* | *Per Pound (÷ 100,000)* | *Total* | *Per Pound (÷ 2,000)* |
| Purchasing | $ 1,500 | $0.015 | $1,200 | $0.600 |
| Material handling | 12,000 | 0.120 | 4,800 | 2.400 |
| Quality control | 2,400 | 0.024 | 960 | 0.480 |
| Roasting | 10,000 | 0.100 | 200 | 0.100 |
| Blending | 6,000 | 0.060 | 120 | 0.060 |
| Packaging | 1,000 | 0.010 | 20 | 0.010 |
| Total | $32,900 | $0.329 | $7,300 | $3.650 |

Note particularly how batch size impacts unit cost data. For example, the cost to the company to process a purchase order is $300, regardless of how many pounds of coffee are contained in the order. Twenty thousand pounds of the Mona Loa coffee are purchased per order (with five orders per year), and just 500 pounds of the Malaysian coffee are purchased per order (with four orders per year). Thus, the purchase order cost *per pound* for the Mona Loa coffee is just 1.5 cents, whereas the purchase order cost *per pound* for the Malaysian coffee is 40 times as much, or 60 cents. As stated in the text, this is one reason why unit costs of low-volume products, such as the Malaysian coffee, increase so dramatically when activity-based costing is used.

# Chapter 10
# Standard Costs and Variances

## Solutions to Questions

**10-1** A quantity standard indicates how much of an input should be used to make a unit of output. A price standard indicates how much the input should cost.

**10-2** Ideal standards assume perfection and do not allow for any inefficiency. Ideal standards are rarely, if ever, attained. Practical standards can be attained by employees working at a reasonable, though efficient pace and allow for normal breaks and work interruptions.

**10-3** Under management by exception, managers focus their attention on results that deviate from expectations. It is assumed that results that meet expectations do not require investigation.

**10-4** Separating an overall variance into a price variance and a quantity variance provides more information. Moreover, price and quantity variances are usually the responsibilities of different managers.

**10-5** The materials price variance is usually the responsibility of the purchasing manager. The materials quantity and labor efficiency variances are usually the responsibility of production managers and supervisors.

**10-6** The materials price variance can be computed either when materials are purchased or when they are placed into production. It is usually better to compute the variance when materials are purchased because that is when the purchasing manager, who has responsibility for this variance, has completed his or her work. In addition, recognizing the price variance when materials are purchased allows the company to carry its raw materials in the inventory accounts at standard cost, which greatly simplifies bookkeeping.

**10-7** This combination of variances may indicate that inferior quality materials were purchased at a discounted price, but the low-quality materials created production problems.

**10-8** If standards are used to find who to blame for problems, they can breed resentment and undermine morale. Standards should not be used to find someone to blame for problems.

**10-9** Several factors other than the contractual rate paid to workers can cause a labor rate variance. For example, skilled workers with high hourly rates of pay can be given duties that require little skill and that call for low hourly rates of pay, resulting in an unfavorable rate variance. Or unskilled or untrained workers can be assigned to tasks that should be filled by more skilled workers with higher rates of pay, resulting in a favorable rate variance. Unfavorable rate variances can also arise from overtime work at premium rates.

**10-10** If poor quality materials create production problems, a result could be excessive labor time and therefore an unfavorable labor efficiency variance. Poor quality materials would not ordinarily affect the labor rate variance.

**10-11** If overhead is applied on the basis of direct labor-hours, then the variable overhead efficiency variance and the direct labor efficiency variance will always be favorable or unfavorable together. Both variances are computed by comparing the number of direct labor-hours actually worked to the standard hours allowed. That is, in each case the formula is:

$$\text{Efficiency variance} = SR(AH - SH)$$

Only the “SR” part of the formula, the standard rate, differs between the two variances.

**10-12** A statistical control chart is a graphical aid that helps identify variances that should be investigated. Upper and lower limits are set on the control chart. Any variances falling between those limits are considered to be normal. Any variances falling outside of those limits are considered abnormal and are investigated.

**10-13** If labor is a fixed cost and standards are tight, then the only way to generate favorable labor efficiency variances is for every workstation to produce at capacity. However, the output of the entire system is limited by the capacity of the bottleneck. If workstations before the bottleneck in the production process produce at capacity, the bottleneck will be unable to process all of the work in process. In general, if every workstation is attempting to produce at capacity, then work in process inventory will build up in front of the workstations with the least capacity.

**Exercise 10-1** (20 minutes)

1.

| | |
|---|---|
| Number of chopping blocks | 4,000 |
| Number of board feet per chopping block | × 2.5 |
| Standard board feet allowed | 10,000 |
| Standard cost per board foot | × $1.80 |
| Total standard cost | $18,000 |
| Actual cost incurred | $18,700 |
| Standard cost above | 18,000 |
| Spending variance—unfavorable | $ 700 |

2.

| Standard Quantity Allowed for Actual Output, at Standard Price (SQ × SP) | Actual Quantity of Input, at Standard Price (AQ × SP) | Actual Quantity of Input, at Actual Price (AQ × AP) |
|---|---|---|
| 10,000 board feet × $1.80 per board foot = $18,000 | 11,000 board feet × $1.80 per board foot = $19,800 | $18,700 |

Materials quantity variance = $1,800 U

Materials price variance = $1,100 F

Spending variance = $700 U

Alternatively, the variances can be computed using the formulas:

Materials quantity variance = SP (AQ – SQ)
= $1.80 per board foot (11,000 board feet – 10,000 board feet)
= $1,800 U

Materials price variance = AQ (AP – SP)
= 11,000 board feet ($1.70 per board foot* – $1.80 per board foot)
= $1,100 F
*$18,700 ÷ 11,000 board feet = $1.70 per board foot.

**Exercise 10-2** (20 minutes)

1.

| | |
|---|---|
| Number of meals prepared | 6,000 |
| Standard direct labor-hours per meal | × 0.20 |
| Total direct labor-hours allowed | 1,200 |
| Standard direct labor cost per hour | × $9.50 |
| Total standard direct labor cost | $11,400 |
| Actual cost incurred | $11,500 |
| Total standard direct labor cost (above) | 11,400 |
| Spending variance | $ 100 Unfavorable |

2.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 1,200 hours × $9.50 per hour = $11,400 | 1,150 hours × $9.50 per hour = $10,925 | 1,150 hours × $10.00 per hour = $11,500 |

Labor efficiency variance = $475 F

Labor rate variance = $575 U

Spending variance = $100 U

Alternatively, the variances can be computed using the formulas:

Labor efficiency variance = SR(AH – SH)
= $9.50 per hour (1,150 hours – 1,200 hours)
= $475 F

Labor rate variance = AH(AR – SR)
= 1,150 hours ($10.00 per hour – $9.50 per hour)
= $575 U

**Exercise 10-3** (20 minutes)

1.

| | | |
|---|---|---|
| Number of items shipped | 140,000 | |
| Standard direct labor-hours per item | × 0.04 | |
| Total direct labor-hours allowed | 5,600 | |
| Standard variable overhead cost per hour | × $2.80 | |
| Total standard variable overhead cost | $15,680 | |
| Actual variable overhead cost incurred | $15,950 | |
| Total standard variable overhead cost (above) | 15,680 | |
| Spending variance | $ 270 | Unfavorable |

2.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 5,600 hours × $2.80 per hour = $15,680 | 5,800 hours × $2.80 per hour = $16,240 | 5,800 hours × $2.75 per hour* = $15,950 |

| Variable overhead efficiency variance = $560 U | Variable overhead rate variance = $290 F |
|---|---|
| Spending variance = $270 U | |

*$15,950 ÷ 5,800 hours = $2.75 per hour

Alternatively, the variances can be computed using the formulas:

Variable overhead efficiency variance = SR(AH – SH)
= $2.80 per hour (5,800 hours – 5,600 hours)
= $560 U

Variable overhead rate variance = AH(AR – SR)
= 5,800 hours ($2.75 per hour – $2.80 per hour)
= $290 F

**Exercise 10-4** (30 minutes)

1.

| | |
|---|---|
| Number of units manufactured ............................ | 20,000 |
| Standard labor time per unit | |
| (6 minutes ÷ 60 minutes per hour) ................... | × 0.10 |
| Total standard hours of labor time allowed ........... | 2,000 |
| Standard direct labor rate per hour ...................... | × $24.00 |
| Total standard direct labor cost .......................... | $48,000 |
| Actual direct labor cost ........................................ | $49,300 |
| Standard direct labor cost .................................... | 48,000 |
| Spending variance—unfavorable .......................... | $ 1,300 |

2.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 2,000 hours* × $24.00 per hour = $48,000 | 2,125 hours × $24.00 per hour = $51,000 | $49,300 |

| Labor efficiency variance = $3,000 U | Labor rate variance = $1,700 F |
|---|---|
| Spending variance = $1,300 U | |

*20,000 units × 0.10 hour per unit = 2,000 hours

Alternatively, the variances can be computed using the formulas:

Labor efficiency variance = SR (AH – SH)
= $24.00 per hour (2,125 hours – 2,000 hours)
= $3,000 U

Labor rate variance = AH (AR – SR)
= 2,125 hours ($23.20 per hour* – $24.00 per hour)
= $1,700 F
*$49,300 ÷ 2,125 hours = $23.20 per hour

**Exercise 10-4** (continued)

3.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 2,000 hours × $16.00 per hour = $32,000 | 2,125 hours × $16.00 per hour = $34,000 | $39,100 |

| | |
|---|---|
| Variable overhead efficiency variance = $2,000 U | Variable overhead rate variance = $5,100 U |
| Spending variance = $7,100 U | |

Alternatively, the variances can be computed using the formulas:

Variable overhead efficiency variance = SR (AH – SH)
=$16.00 per hour (2,125 hours – 2,000 hours)
= $2,000 U

Variable overhead rate variance = AH (AR – SR)
= 2,125 hours ($18.40 per hour* – $16.00 per hour)
= $5,100 U
*$39,100 ÷ 2,125 hours = $18.40 per hour

**Exercise 10-5** (20 minutes)

1. If the total labor spending variance is $330 unfavorable, and if the labor rate variance is $150 favorable, then the labor efficiency variance must be $480 unfavorable, because the labor rate and labor efficiency variances taken together equal the total labor spending variance.

   Knowing that the labor efficiency variance is $480 unfavorable, one approach to the solution would be:

   Labor efficiency variance = SR (AH – SH)
   $12 per hour (AH – 210 hours*) = $480 U
   $12 per hour × AH – $2,520 = $480**
   $12 per hour × AH = $3,000
   AH = 250 hours

   * 168 batches × 1.25 hours per batch = 210 hours
   ** When used with the formula, unfavorable variances are positive and favorable variances are negative.

2. Knowing that 250 hours of labor time were used during the week, the actual rate of pay per hour can be computed as follows:

   Labor rate variance = AH (AR – SR)
   250 hours (AR – $12 per hour) = $150 F
   250 hours × AR – $3,000 = -$150*
   250 hours × AR = $2,850
   AR = $11.40 per hour

   * When used with the formula, unfavorable variances are positive and favorable variances are negative.

## **Exercise 10-5** (continued)

An alternative approach would be to work from known to unknown data in the columnar model for variance analysis:

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 210 hours[§] × $12.00 per hour* = $2,520 | 250 hours × $12.00 per hour* = $3,000 | 250 hours × $11.40 per hour = $2,850 |

| Labor efficiency variance = $480 U | Labor rate variance = $150 F* |
|---|---|
| Spending variance = $330 U* | |

[§]168 batches × 1.25 hours per batch = 210 hours
*Given

**Exercise 10-6** (20 minutes)

1.

| Standard Quantity Allowed for Actual Output, at Standard Price (SQ × SP) | Actual Quantity of Input, at Standard Price (AQ × SP) | Actual Quantity of Input, at Actual Price (AQ × AP) |
|---|---|---|
| 18,000 ounces* × $2.50 per ounce = $45,000 | 20,000 ounces × $2.50 per ounce = $50,000 | 20,000 ounces × $2.40 per ounce = $48,000 |
| Materials quantity variance = $5,000 U | | Materials price variance = $2,000 F |
| Spending variance = $3,000 U | | |

*2,500 units × 7.2 ounces per unit = 18,000 ounces

Alternatively, the variances can be computed using the formulas:

Materials quantity variance = SP (AQ – SQ)
= $2.50 per ounce (20,000 ounces – 18,000 ounces)
= $5,000 U

Materials price variance = AQ (AP – SP)
= 20,000 ounces ($2.40 per ounce – $2.50 per ounce)
= $2,000 F

**Exercise 10-6** (continued)

2.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 1,000 hours* × $10.00 per hour = $10,000 | 900 hours × $10.00 per hour = $9,000 | $10,800 |

| Labor efficiency variance = $1,000 F | Labor rate variance = $1,800 U |
|---|---|
| Spending variance = $800 U | |

*2,500 units × 0.4 hour per unit = 1,000 hours

Alternatively, the variances can be computed using the formulas:

Labor efficiency variance = SR (AH – SH)
= $10 per hour (900 hours – 1,000 hours)
= 1,000 F

Labor rate variance = AH (AR – SR)
= 900 hours ($12 per hour* – $10 per hour)
= $1,800 U
*10,800 ÷ 900 hours = $12 per hour

**Exercise 10-7** (15 minutes)

Notice in the solution below that the materials price variance is computed on the entire amount of materials purchased, whereas the materials quantity variance is computed only on the amount of materials used in production.

| Standard Quantity Allowed for Actual Output, at Standard Price (SQ × SP) | Actual Quantity of Input, at Standard Price (AQ × SP) | Actual Quantity of Input, at Actual Price (AQ × AP) |
|---|---|---|
| 14,400 ounces* × $2.50 per ounce = $36,000 | 16,000 ounces × $2.50 per ounce = $40,000 | 20,000 ounces × $2.40 per ounce = $48,000 |

Materials quantity variance = $4,000 U

20,000 ounces × $2.50 per ounce = $50,000

Materials price variance = $2,000 F

*2,000 bottles × 7.2 ounces per bottle = 14,400 ounces

Alternatively, the variances can be computed using the formulas:

Materials quantity variance = SP (AQ – SQ)
= $2.50 per ounce (16,000 ounces – 14,400 ounces)
= $4,000 U

Materials price variance = AQ (AP – SP)
= 20,000 ounces ($2.40 per ounce – $2.50 per ounce)
= $2,000 F

**Exercise 10-8** (30 minutes)

1. a. Notice in the solution below that the materials price variance is computed on the entire amount of materials purchased, whereas the materials quantity variance is computed only on the amount of materials used in production.

| Standard Quantity Allowed for Actual Output, at Standard Price (SQ × SP) | Actual Quantity of Input, at Standard Price (AQ × SP) | Actual Quantity of Input, at Actual Price (AQ × AP) |
|---|---|---|
| 40,000 diodes* × $0.30 per diode = $12,000 | 50,000 diodes × $0.30 per diode = $15,000 | 70,000 diodes × $0.28 per diode = $19,600 |

Materials quantity variance = $3,000 U

70,000 diodes × $0.30 per diode = $21,000

Materials price variance = $1,400 F

*5,000 toys × 8 diodes per toy = 40,000 diodes

Alternatively, the variances can be computed using the formulas:

Materials quantity variance = SP (AQ – SQ)
= $0.30 per diode (50,000 diodes – 40,000 diodes)
= $3,000 U

Materials price variance = AQ (AP – SP)
= 70,000 diodes ($0.28 per diode – $0.30 per diode)
= $1,400 F

## Exercise 10-8 (continued)

b. Direct labor variances:

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 3,000 hours* × $14.00 per hour = $42,000 | 3,200 hours × $14.00 per hour = $44,800 | $48,000 |
| Labor efficiency variance = $2,800 U | Labor rate variance = $3,200 U | |
| Spending variance = $6,000 U | | |

*5,000 toys × 0.6 hours per toy = 3,000 hours

Alternatively, the variances can be computed using the formulas:

Labor efficiency variance = SR (AH – SH)
= $14.00 per hour (3,200 hours –3,000 hours)
= $2,800 U

Labor rate variance = AH (AR – SR)
= 3,200 hours ($15.00* per hour – $14.00 per hour)
= $3,200 U
*$48,000 ÷ 3,200 hours = $15.00 per hour

**Exercise 10-8** (continued)

2. A variance usually has many possible explanations. In particular, we should always keep in mind that the standards themselves may be incorrect. Some of the other possible explanations for the variances observed at Topper Toys appear below:

   *Materials Price Variance* Since this variance is favorable, the actual price paid per unit for the material was less than the standard price. This could occur for a variety of reasons including the purchase of a lower grade material at a discount, buying in an unusually large quantity to take advantage of quantity discounts, a change in the market price of the material, and particularly sharp bargaining by the purchasing department.

   *Materials Quantity Variance* Since this variance is unfavorable, more materials were used to produce the actual output than were called for by the standard. This could also occur for a variety of reasons. Some of the possibilities include poorly trained or supervised workers, improperly adjusted machines, and defective materials.

   *Labor Rate Variance* Since this variance is unfavorable, the actual average wage rate was higher than the standard wage rate. Some of the possible explanations include an increase in wages that has not been reflected in the standards, unanticipated overtime, and a shift toward more highly paid workers.

   *Labor Efficiency Variance* Since this variance is unfavorable, the actual number of labor hours was greater than the standard labor hours allowed for the actual output. As with the other variances, this variance could have been caused by any of a number of factors. Some of the possible explanations include poor supervision, poorly trained workers, low-quality materials requiring more labor time to process, and machine breakdowns. In addition, if the direct labor force is essentially fixed, an unfavorable labor efficiency variance could be caused by a reduction in output due to decreased demand for the company's products.

**Problem 10-9** (45 minutes)

1. a.

| Standard Quantity Allowed for Actual Output, at Standard Price (SQ × SP) | Actual Quantity of Input, at Standard Price (AQ × SP) | Actual Quantity of Input, at Actual Price (AQ × AP) |
|---|---|---|
| 20,000 pounds* × $2.50 per pound = $50,000 | 19,800 pounds × $2.50 per pound = $49,500 | 25,000 pounds × $2.95 per pound = $73,750 |
| Materials quantity variance = $500 F | | |
| | 25,000 pounds × $2.50 per pound = $62,500 | |
| | Materials price variance = $11,250 U | |

*5,000 ingots × 4.0 pounds per ingot = 20,000 pounds

Alternatively, the variances can be computed using the formulas:

Materials quantity variance = SP (AQ – SQ)
= $2.50 per pound (19,800 pounds – 20,000 pounds)
= $500 F

Materials price variance = AQ (AP – SP)
= 25,000 pounds ($2.95 per pound – $2.50 per pound)
= $11,250 U

**Problem 10-9** (continued)

1. b.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 3,000 hours* × $9.00 per hour = $27,000 | 3,600 hours × $9.00 per hour = $32,400 | 3,600 hours × $8.70 per hour = $31,320 |

| Labor efficiency variance = $5,400 U | Labor rate variance = $1,080 F |
|---|---|
| Spending variance = $4,320 U | |

*5,000 ingots × 0.6 hour per ingot = 3,000 hours

Alternatively, the variances can be computed using the formulas:

Labor efficiency variance = SR (AH – SH)
= $9.00 per hour (3,600 hours – 3,000 hours)
= $5,400 U

Labor rate variance = AH (AR – SR)
= 3,600 hours ($8.70 per hour – $9.00 per hour)
= $1,080 F

**Problem 10-9** (continued)

1. c.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 1,500 hours* × $2.00 per hour = $3,000 | 1,800 hours × $2.00 per hour = $3,600 | $4,320 |

| Variable overhead efficiency variance = $600 U | Variable overhead rate variance = $720 U |
|---|---|
| Spending variance = $1,320 U | |

*5,000 ingots × 0.3 hours per ingot = 1,500 hours

Alternatively, the variances can be computed using the formulas:

Variable overhead efficiency variance = SR (AH – SH)
= $2.00 per hour (1,800 hours – 1,500 hours)
= $600 U

Variable overhead rate variance = AH (AR – SR)
= 1,800 hours ($2.40 per hour* – $2.00 per hour)
= $720 U
*$4,320 ÷ 1,800 hours = $2.40 per hour

**Problem 10-9** (continued)

2. Summary of variances:

| | | |
|---|---|---|
| Material quantity variance | $ 500 | F |
| Material price variance | 11,250 | U |
| Labor efficiency variance | 5,400 | U |
| Labor rate variance | 1,080 | F |
| Variable overhead efficiency variance | 600 | U |
| Variable overhead rate variance | 720 | U |
| Net variance | $16,390 | U |

The net unfavorable variance of $16,390 for the month caused the plant's variable cost of goods sold to increase from the budgeted level of $80,000 to $96,390:

| | |
|---|---|
| Budgeted cost of goods sold at $16 per ingot | $80,000 |
| Add the net unfavorable variance (as above) | 16,390 |
| Actual cost of goods sold | $96,390 |

This $16,390 net unfavorable variance also accounts for the difference between the budgeted net operating income and the actual net loss for the month.

| | |
|---|---|
| Budgeted net operating income | $15,000 |
| Deduct the net unfavorable variance added to cost of goods sold for the month | 16,390 |
| Net operating loss | $(1,390) |

3. The two most significant variances are the materials price variance and the labor efficiency variance. Possible causes of the variances include:

| | |
|---|---|
| Materials price variance: | Outdated standards, uneconomical quantity purchased, higher quality materials, high-cost method of transport. |
| Labor efficiency variance: | Poorly trained workers, poor quality materials, faulty equipment, work interruptions, inaccurate standards, insufficient demand. |

**Problem 10-10** (45 minutes)

1. The standard quantity of plates allowed for tests performed during the month would be:

| | |
|---|---|
| Smears | 2,700 |
| Blood tests | 900 |
| Total | 3,600 |
| Plates per test | × 3 |
| Standard quantity allowed | 10,800 |

The variance analysis for plates would be:

| Standard Quantity Allowed for Actual Output, at Standard Price (SQ × SP) | Actual Quantity of Input, at Standard Price (AQ × SP) | Actual Quantity of Input, at Actual Price (AQ × AP) |
|---|---|---|
| 10,800 plates × $2.50 per plate = $27,000 | 14,000 plates × $2.50 per plate = $35,000 | $38,400 |
| Materials quantity variance = $8,000 U | | |
| | 16,000 plates × $2.50 per plate = $40,000 | |
| | Materials price variance = $1,600 F | |

Alternatively, the variances can be computed using the formulas:

Materials quantity variance = SP (AQ – SQ)
= $2.50 per plate (14,000 plates – 10,800 plates)
= $8,000 U

s Materials price variance = AQ (AP – SP)
= 16,000 plates ($2.40 per plate* – $2.50 per plate)
= $1,600 F
*$38,400 ÷ 16,000 plates = $2.40 per plate.

**Problem 10-10** (continued)

Note that all of the price variance is due to the hospital's 4% quantity discount. Also note that the $8,000 quantity variance for the month is equal to nearly 30% of the standard cost allowed for plates. This variance may be the result of using too many assistants in the lab.

2. a. The standard hours allowed for tests performed during the month would be:

| | |
|---|---|
| Smears: 0.3 hour per test × 2,700 tests ..... | 810 |
| Blood tests: 0.6 hour per test × 900 tests... | 540 |
| Total standard hours allowed...................... | 1,350 |

The variance analysis of labor would be:

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 1,350 hours × $12 per hour = $16,200 | 1,800 hours × $12 per hour = $21,600 | $18,450 |
| Labor efficiency variance = $5,400 U | Labor rate variance = $3,150 F | |
| Spending variance = $2,250 U | | |

Alternatively, the variances can be computed using the formulas:

Labor efficiency variance = SR (AH – SH)
= $12 per hour (1,800 hours – 1,350 hours)
= $5,400 U

Labor rate variance = AH (AR – SR)
= 1,800 hours ($10.25 per hour* – $12.00 per hour)
= $3,150 F
*$18,450 ÷ 1,800 hours = $10.25 per hour

**Problem 10-10** (continued)

2. b. The policy probably should not be continued. Although the hospital is saving $1.75 per hour by employing more assistants relative to the number of senior technicians than other hospitals, this savings is more than offset by other factors. Too much time is being taken in performing lab tests, as indicated by the large unfavorable labor efficiency variance. And, it seems likely that most (or all) of the hospital's unfavorable quantity variance for plates is traceable to inadequate supervision of assistants in the lab.

3. The variable overhead variances follow:

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 1,350 hours × $6.00 per hour = $8,100 | 1,800 hours × $6.00 per hour = $10,800 | $11,700 |

| Variable overhead efficiency variance = $2,700 U | Variable overhead rate variance = $900 U |
|---|---|
| Spending variance = $3,600 U | |

Alternatively, the variances can be computed using the formulas:

Variable overhead efficiency variance = SR (AH – SH)
= $6 per hour (1,800 hours – 1,350 hours)
= $2,700 U

Variable overhead rate variance = AH (AR – SR)
= 1,800 hours ($6.50 per hour* – $6.00 per hour)
= $900 U
*$11,700 ÷ 1,800 hours = $6.50 per hour

Yes, the two variances are related. Both are computed by comparing actual labor time to the standard hours allowed for the output of the period. Thus, if there is an unfavorable labor efficiency variance, there will also be an unfavorable variable overhead efficiency variance.

**Problem 10-11** (45 minutes)

1. a. In the solution below, the materials price variance is computed on the entire amount of materials purchased, whereas the materials quantity variance is computed only on the amount of materials used in production:

| Standard Quantity Allowed for Actual Output, at Standard Price (SQ × SP) | Actual Quantity of Input, at Standard Price (AQ × SP) | Actual Quantity of Input, at Actual Price (AQ × AP) |
|---|---|---|
| 4,500 pounds* × $6.00 per pound = $27,000 | 6,000 pounds × $6.00 per pound = $36,000 | $46,000 |

Materials quantity variance = $9,000 U

8,000 pounds × $6.00 per pound = $48,000

Materials price variance = $2,000 F

*3,000 units × 1.5 pounds per unit = 4,500 pounds

Alternatively, the variances can be computed using the formulas:

Materials quantity variance = SP (AQ – SQ)
= $6 per pound (6,000 pounds – 4,500 pounds) = $9,000 U

Materials price variance = AQ (AP – SP)
= 8,000 pounds ($5.75 per pound* – $6.00 per pound) = $2,000 F
*$46,000 ÷ 8,000 pounds = $5.75 per pound

b. No, the contract should probably not be signed. Although the new supplier is offering the material at only $5.75 per pound, the large materials quantity variance indicates a problem using these materials is production. The company still has 2,000 pounds of unused material in the warehouse; if these materials do as poorly in production as the 6,000 pounds already used, the total quantity variance on the 8,000 pounds of materials purchased will be very large.

**Problem 10-11** (continued)

2. a.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 1,800 hours* × $12.00 per hour = $21,600 | 1,600 hours** × $12.00 per hour = $19,200 | 1,600 hours** × $12.50 per hour = $20,000 |
| Labor efficiency variance = $2,400 F | Labor rate variance = $800 U | |
| Spending variance = $1,600 F | | |

* 3,000 units × 0.6 hours per unit = 1,800 hours
** 10 workers × 160 hours per worker = 1,600 hours

Alternatively, the variances can be computed using the formulas:

Labor efficiency variance = SR (AH – SH)
= $12.00 per hour (1,600 hours – 1,800 hours)
= $2,400 F

Labor rate variance = AH (AR – SR)
= 1,600 hours ($12.50 per hour – $12.00 per hour)
= $800 U

b. Yes, the new labor mix should probably be continued. Although it increases the average hourly labor cost from $12.00 to $12.50, resulting in an $800 unfavorable labor rate variance, this is more than offset by greater efficiency of labor time. Notice that the labor efficiency variance is $2,400 favorable. Thus, the new labor mix reduces overall labor costs.

**Problem 10-11** (continued)

3.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 1,800 hours × $2.50 per hour = $4,500 | 1,600 hours × $2.50 per hour = $4,000 | $3,600 |

| Variable overhead efficiency variance = $500 F | Variable overhead rate variance = $400 F |
|---|---|
| Spending variance = $900 F | |

Alternatively, the variances can be computed using the formulas:

Variable overhead efficiency variance = SR (AH – SH)
= $2.50 per hour (1,600 hours – 1,800 hours)
= $500 F

Variable overhead rate variance = AH (AR – SR)
= 1,600 hours ($2.25 per hour* – $2.50 per hour)
= $400 F
*$3,600 ÷ 1,600 hours = $2.25 per hour

Both the labor efficiency variance and the variable overhead efficiency variance are computed by comparing actual labor-hours to standard labor-hours. Thus, if the labor efficiency variance is favorable, then the variable overhead efficiency variance will be favorable as well.

**Problem 10-12** (45 minutes)

1. a.

| Standard Quantity Allowed for Actual Output, at Standard Price (SQ × SP) | Actual Quantity of Input, at Standard Price (AQ × SP) | Actual Quantity of Input, at Actual Price (AQ × AP) |
|---|---|---|
| 21,600 feet* × $3.00 per foot = $64,800 | 21,000 feet** × $3.00 per foot = $63,000 | 21,000 feet** × $3.20 per foot = $67,200 |

| Materials quantity variance = $1,800 F | Materials price variance = $4,200 U |
|---|---|
| Spending variance = $2,400 U | |

* 12,000 units × 1.80 feet per unit = 21,600 feet
** 12,000 units × 1.75 feet per unit = 21,000 feet

Alternatively, the variances can be computed using the formulas:

Materials quantity variance = SP (AQ – SQ)
= $3.00 per foot (21,000 feet – 21,600 feet)
= $1,800 F

Materials price variance = AQ (AP – SP)
= 21,000 feet ($3.20 per foot – $3.00 per foot)
= $4,200 U

**Problem 10-12** (continued)

1. b.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 10,800 hours* × $18.00 per hour = $194,400 | 11,400 hours** × $18.00 per hour = $205,200 | 11,400 hours** × $17.40 per hour = $198,360 |

| Labor efficiency variance | Labor rate variance |
|---|---|
| = $10,800 U | = $6,840 F |
| Spending variance = $3,960 U | |

* 12,000 units × 0.90 hours per unit = 10,800 hours
** 12,000 units × 0.95 hours per unit = 11,400 hours

Alternatively, the variances can be computed using the formulas:

Labor efficiency variance = SR (AH – SH)
= $18.00 per hour (11,400 hours – 10,800 hours)
= $10,800 U

Labor rate variance = AH (AR – SR)
= 11,400 hours ($17.40 per hour – $18.00 per hour)
= $6,840 F

**Problem 10-12** (continued)

1. c.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 10,800 hours* × $5.00 per hour = $54,000 | 11,400 hours** × $5.00 per hour = $57,000 | 11,400 hours** × $4.60 per hour = $52,440 |

| Variable overhead efficiency variance = $3,000 U | Variable overhead rate variance = $4,560 F |
|---|---|
| Spending variance = $1,560 F | |

* 12,000 units × 0.90 hours per unit = 10,800 hours
** 12,000 units × 0.95 hours per unit = 11,400 hours

Alternatively, the variances can be computed using the formulas:

Variable overhead efficiency variance = SR (AH – SH)
= $5.00 per hour (11,400 hours – 10,800 hours)
= $3,000 U

Variable overhead rate variance = AH (AR – SR)
= 11,400 hours ($4.60 per hour – $5.00 per hour)
= $4,560 F

2.

| | | |
|---|---|---|
| Materials: | | |
| Quantity variance ($1,800 ÷ 12,000 units)...... | $0.15 F | |
| Price variance ($4,200 ÷ 12,000 units).......... | 0.35 U | $0.20 U |
| Labor: | | |
| Efficiency variance ($10,800 ÷ 12,000 units) .. | 0.90 U | |
| Rate variance ($6,840 ÷ 12,000 units) .......... | 0.57 F | 0.33 U |
| Variable overhead: | | |
| Efficiency variance ($3,000 ÷ 12,000 units).... | 0.25 U | |
| Rate variance ($4,560 ÷ 12,000 units) .......... | 0.38 F | 0.13 F |
| Excess of actual over standard cost per unit........ | | $0.40 U |

**Problem 10-12** (continued)

3. Both the labor efficiency and variable overhead efficiency variances are affected by inefficient use of labor time.

| | | |
|---|---|---|
| Excess of actual over standard cost per unit ....... | | $0.40 U |
| Less portion attributable to labor inefficiency: | | |
| Labor efficiency variance .................................. | 0.90 U | |
| Variable overhead efficiency variance ................ | 0.25 U | 1.15 U |
| Portion due to other variances .......................... | | $0.75 F |

   In sum, had it not been for the apparent inefficient use of labor time, the total variance in unit cost for the month would have been favorable by $0.75 rather than unfavorable by $0.40.

4. Although the excess of actual cost over standard cost is only $0.40 per unit, the total amount of $4,800 (= $0.40 per unit × 12,000 units) is substantial. Moreover, the details of the variances are significant. The materials price variance is $4,200 U, the labor efficiency variance is $10,800 U, the labor rate variance is $6,840 F, the variable overhead efficiency variance is $3,000 U, and the variable rate variance is $4,560 F. Taken together, the two variances that reflect apparent inefficient use of the labor time total $13,800 U. Each of these variances may warrant further investigation.

**Problem 10-13** (45 minutes)

1. a. Materials price variance = AQ (AP – SP)
   6,000 pounds ($2.75 per pound* – SP) = $1,500 F**
   $16,500 – 6,000 pounds × SP = $1,500***
   6,000 pounds × SP = $18,000
   SP = $3.00 per pound

   *$16,500 ÷ 6,000 pounds = $2.75 per pound
   **$1,200 U + ? = $300 F; $1,200 U – $1,500 F = $300 F
   ***When used with the formula, unfavorable variances are positive and favorable variances are negative.

   b. Materials quantity variance = SP (AQ – SQ)
   $3.00 per pound (6,000 pounds – SQ) = $1,200 U
   $18,000 – $3.00 per pound × SQ = $1,200*
   $3.00 per pound × SQ = $16,800
   SQ = 5,600 pounds

   *When used with the formula, unfavorable variances are positive and favorable variances are negative.

   Alternative approach to parts (a) and (b):

| Standard Quantity Allowed for Actual Output, at Standard Price (SQ × SP) | Actual Quantity of Input, at Standard Price (AQ × SP) | Actual Quantity of Input, at Actual Price (AQ × AP) |
|---|---|---|
| 5,600 pounds × $3.00 per pound = $16,800 | 6,000 pounds* × $3.00 per pound = $18,000 | $16,500* |
| Materials quantity variance = $1,200 U* | Materials price variance = $1,500 F | |
| Spending variance = $300 F* | | |

   *Given.

   c. 5,600 pounds ÷ 1,400 units = 4 pounds per unit.

**Problem 10-13** (continued)

2. a. Labor efficiency variance = SR (AH – SH)
$9.00 per hour (AH – 3,500 hours*) = $4,500 F
$9.00 per hour × AH – $31,500 = –$4,500**
$9.00 per hour × AH = $27,000
AH = 3,000 hours

*1,400 units × 2.5 hours per unit = 3,500 hours
**When used with the formula, unfavorable variances are positive and favorable variances are negative.

b. Labor rate variance = AH (AR – SR)
3,000 hours ($9.50 per hour* – $9.00 per hour) = $1,500 U

Alternative approach to parts (a) and (b):

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 3,500 hours*** × $9.00 per hour** = $31,500 | 3,000 hours × $9.00 per hour** = $27,000 | 3,000 hours × $9.50 per hour* = $28,500* |

Labor efficiency variance = $4,500 F*
Labor rate variance = $1,500 U
Spending variance = $3,000 F

* $28,500 total labor cost ÷ 3,000 hours = $9.50 per hour
** Given
*** 1,400 units × 2.5 hours per unit = 3,500 hours

**Problem 10-14** (60 minutes)

1. Total standard cost for units produced during August:

| | |
|---|---|
| 500 kits × $42 per kit | $21,000 |
| Less standard cost of labor and overhead: | |
| Direct labor | (8,000) |
| Variable manufacturing overhead | (1,600) |
| Standard cost of materials used during August | $11,400 |

2.

| | |
|---|---|
| Standard cost of materials used during August (a) | $11,400 |
| Number of units produced (b) | 500 |
| Standard materials cost per kit (a) ÷ (b) | $22.80 |

$$\frac{\text{Standard materials cost per kit}}{\text{Standard materials cost per yard}} = \frac{\$22.80 \text{ per kit}}{\$6 \text{ per yard}} = 3.8 \text{ yards per kit}$$

3. Since there were no beginning or ending inventories of materials, all of the materials that were purchased during the period were used in production. Therefore, the sum of the price and quantity variances equals the spending variance, which is the difference between the actual cost and standard cost of materials used in production.

| | |
|---|---|
| Actual cost of material used | $10,000 |
| Standard cost of material used | 11,400 |
| Spending variance | $ 1,400 F |

As discussed above, in this case the price and quantity variances together equal the spending variance. If the quantity variance is $600 U, then the price variance must be $2,000F:

| | |
|---|---|
| Materials price variance | $ 2,000 F |
| Materials quantity variance | 600 U |
| Spending variance | $ 1,400 F |

**Problem 10-14** (continued)

Alternatively, the variances can be computed using the formulas:

| Standard Quantity Allowed for Actual Output, at Standard Price (SQ × SP) | Actual Quantity of Input, at Standard Price (AQ × SP) | Actual Quantity of Input, at Actual Price (AQ × AP) |
|---|---|---|
| 1,900 yards** × $6 per yard* = $11,400 | 2,000 yards × $6 per yard* = $12,000 | 2,000 yards × $5 per yard = $10,000* |

| Materials quantity variance = $600 U* | Materials price variance = $2,000 F |
|---|---|
| Spending variance = $1,400 F | |

*Given.

**500 kits × 3.8 yards per kit = 1,900 yards

4. The first step in computing the standard direct labor rate is to determine the standard direct labor-hours allowed for the month's production. The standard direct labor-hours can be computed by working with the variable manufacturing overhead cost figures because they are based on direct labor-hours worked:

| | |
|---|---|
| Standard manufacturing variable overhead cost for August (a) | $1,600 |
| Standard manufacturing variable overhead rate per direct labor-hour (b) | $2 |
| Standard direct labor-hours for the month (a) ÷ (b) | 800 |

$$\frac{\text{Total standard labor cost for the month}}{\text{Total standard direct labor-hours for the month}} = \frac{\$8{,}000}{800\text{ DLHs}}$$

$$= \$10 \text{ per DLH}$$

**Problem 10-14** (continued)

5. Before the labor variances can be computed, the actual direct labor cost for the month must be computed:

| | | |
|---|---|---|
| Actual cost per kit produced ($42.00 + $0.14) ...... | | $ 42.14 |
| Number of kits produced ................................... | | × 500 |
| Total actual cost of production ............................ | | $21,070 |
| Less: Actual cost of materials.............................. | $10,000 | |
| Actual cost of manufacturing variable overhead ................................................ | 1,620 | 11,620 |
| Actual cost of direct labor .................................. | | $ 9,450 |

With this information, the variances can be computed:

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| $8,000* | 900 hours* × $10 per hour = $9,000 | $9,450 |

Labor efficiency variance = $1,000 U

Labor rate variance = $450 U

Spending variance = $1,450 U

*Given.

**Problem 10-14** (continued)

6.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| | 900 hours* × $2 per hour* | |
| $1,600* | = $1,800 | $1,620* |

| | |
|---|---|
| Variable overhead efficiency variance = $200 U | Variable overhead rate variance = $180 F |
| Spending variance = $20 U | |

*Given.

7.

| | Standard Quantity or Hours per Kit | Standard Price or Rate | Standard Cost per Kit |
|---|---|---|---|
| Direct materials................. | 3.8 yards[1] | $ 6 per yard | $22.80 |
| Direct labor....................... | 1.6 hours[2] | $10 per hour[3] | 16.00 |
| Variable manufacturing overhead....................... | 1.6 hours | $ 2 per hour | 3.20 |
| Total standard cost per kit.. | | | $42.00 |

[1]From part 2.
[2]800 hours (from part 4) ÷ 500 kits = 1.6 hours per kit.
[3]From part 4.

**Problem 10-15** (45 minutes)

This is a very difficult problem that is harder than it looks. Be sure your students have been thoroughly "checked out" in the variance formulas before assigning it.

1.

| Standard Quantity Allowed for Actual Output, at Standard Price (SQ × SP) | Actual Quantity of Input, at Standard Price (AQ × SP) | Actual Quantity of Input, at Actual Price (AQ × AP) |
|---|---|---|
| 5,600 yards** × $6.50 per yard* = $36,400 | 6,000 yards × $6.50 per yard* = $39,000 | $36,000 |

| Materials quantity variance = $2,600 U | Materials price variance = $3,000 F |
|---|---|
| Spending variance = $400 F | |

*$18.20 ÷ 2.8 yards = $6.50 per yard.
**2,000 units × 2.8 yards per unit = 5,600 yards

Alternatively, the variances can be computed using the formulas:

Materials quantity variance = SP (AQ – SQ)
= $6.50 per yard (6,000 yards – 5,600 yards)
= $2,600 U

Materials price variance = AQ (AP – SP)
= 6,000 yards ($6.00 per yard* – $6.50 per yard)
= $3,000 F
*$36,000 ÷ 6,000 yards = $6.00 per yard

**Problem 10-15** (continued)

2. Many students will miss parts 2 and 3 because they will try to use *product* costs as if they were *hourly* costs. Pay particular attention to the computation of the standard direct labor time per unit and the standard direct labor rate per hour.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 800 hours** × $9 per hour* = $7,200 | 760 hours × $9 per hour* = $6,840 | $7,600 |
| Labor efficiency variance = $360 F | Labor rate variance $760 U | |
| Spending variance = $400 U | | |

* 780 standard hours ÷ 1,950 robes = 0.4 standard hour per robe
$3.60 standard cost per robe ÷ 0.4 standard hours = $9 standard rate per hour

** 2,000 robes × 0.4 standard hour per robe = 800 standard hours

Alternatively, the variances can be computed using the formulas:

Labor efficiency variance = SR (AH – SH)
= $9 per hour (760 hours – 800 hours)
= $360 F

Labor rate variance = AH (AR – SR)
= 760 hours ($10 per hour* – $9 per hour)
= $760 U
*$7,600 ÷ 760 hours = $10 per hour

**Problem 10-15** (continued)

3.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 800 hours × $3.00 per hour* = $2,400 | 760 hours × $3.00 per hour* = $2,280 | $3,800 |
| Variable overhead efficiency variance = $120 F | Variable overhead rate variance = $1,520 U | |
| Spending variance = $1,400 U | | |

*$1.20 standard cost per robe ÷ 0.4 standard hours = $3.00 standard rate per hour

Alternatively, the variances can be computed using the formulas:

Variable overhead efficiency variance = SR (AH – SH)
= $3.00 per hour (760 hours – 800 hours)
= $120 F

Variable overhead rate variance = AH (AR – SR)
= 760 hours ($5.00 per hour* – $3.00 per hour)
= $1,520 U
*$3,800 ÷ 760 hours = $5.00 per hour

**Problem 10-16** (45 minutes)

1.

| | *Standard Quantity or Hours* | *Standard Price or Rate* | *Standard Cost* |
|---|---|---|---|
| Alpha8: | | | |
| Direct materials—X342 ...... | 1.8 kilos | $3.50 per kilo | $ 6.30 |
| Direct materials—Y561 ...... | 2.0 liters | $1.40 per liter | 2.80 |
| Direct labor—Sintering....... | 0.20 hours | $20.00 per hour | 4.00 |
| Direct labor—Finishing....... | 0.80 hours | $19.00 per hour | 15.20 |
| Total ................................ | | | $28.30 |
| Zeta9: | | | |
| Direct materials—X342 ...... | 3.0 kilos | $3.50 per kilo | $10.50 |
| Direct materials—Y561 ...... | 4.5 liters | $1.40 per liter | 6.30 |
| Direct labor—Sintering....... | 0.35 hours | $20.00 per hour | 7.00 |
| Direct labor—Finishing....... | 0.90 hours | $19.00 per hour | 17.10 |
| Total ................................ | | | $40.90 |

**Problem 10-16** (continued)

2. The computations to follow will require the standard quantities allowed for the actual output for each material.

| | *Standard Quantity Allowed* |
|---|---|
| Material X342: | |
| Production of Alpha8 (1.8 kilos per unit × 1,500 units)...... | 2,700 kilos |
| Production of Zeta9 (3.0 kilos per unit × 2,000 units)........ | 6,000 kilos |
| Total ........................................................................ | 8,700 kilos |
| Material Y561: | |
| Production of Alpha8 (2.0 liters per unit × 1,500 units)..... | 3,000 liters |
| Production of Zeta9 (4.5 liters per unit × 2,000 units)....... | 9,000 liters |
| Total ........................................................................ | 12,000 liters |

Direct Materials Variances—Material X342:

Materials quantity variance = SP (AQ – SQ)
= $3.50 per kilo (8,500 kilos – 8,700 kilos)
= $700 F

Materials price variance = AQ (AP – SP)
= 14,000 kilos ($3.70 per kilo* – $3.50 per kilo)
= $2,800 U
*$51,800 ÷ 14,000 kilos = $3.70 per kilo

Direct Materials Variances—Material Y561:

Materials quantity variance = SP (AQ – SQ)
= $1.40 per liter (13,000 liters – 12,000 liters)
= $1,400 U

Materials price variance = AQ (AP – SP)
= 15,000 liters ($1.30 per liter* – $1.40 per liter)
= $1,500 F
*$19,500 ÷ 15,000 liters = $1.30 per liter

**Problem 10-16** (continued)

3. The computations to follow will require the standard quantities allowed for the actual output for direct labor in each department.

*Standard Hours Allowed*

| | |
|---|---|
| Sintering: | |
| Production of Alpha8 (0.20 hours per unit × 1,500 units) .. | 300 hours |
| Production of Zeta9 (0.35 hours per unit × 2,000 units).... | 700 hours |
| Total ................................................................ | 1,000 hours |
| Finishing: | |
| Production of Alpha8 (0.80 hours per unit × 1,500 units) .. | 1,200 hours |
| Production of Zeta9 (0.90 hours per unit × 2,000 units).... | 1,800 hours |
| Total ................................................................ | 3,000 hours |

Direct Labor Variances—Sintering:

Labor efficiency variance = SR (AH – SH)
= $20.00 per hour (1,200 hours – 1,000 hours)
= $4,000 U

Labor rate variance = AH (AR – SR)
= 1,200 hours ($22.50 per hour* – $20.00 per hour)
= $3,000 U
*$27,000 ÷ 1,200 hours = $22.50 per hour

Direct Labor Variances—Finishing:

Labor efficiency variance = SR (AH – SH)
= $19.00 per hour (2,850 hours – 3,000 hours)
= $2,850 F

Labor rate variance = AH (AR – SR)
= 2,850 hours ($21.00 per hour* – $19.00 per hour)
= $5,700 U
*$59,850 ÷ 2,850 hours = $21.00 per hour

**Case 10-17** (60 minutes)

1. The number of units produced can be computed by using the total standard cost applied for the period for *any* input—materials, labor, or variable overhead. Using the standard cost applied for materials, we have:

   $$\frac{\text{Total standard cost applied}}{\text{Standard cost per unit}} = \frac{\$608{,}000}{\$32.00 \text{ per unit}} = 19{,}000 \text{ units}$$

   The same answer can be obtained by using any other cost input.

2. 40,000 meters; see the following pages for a detailed analysis.

3. $15.71 per meter; see the following pages for a detailed analysis.

4. 20,000 hours; see the following pages for a detailed analysis.

5. $15.20 per hour; see the following pages for a detailed analysis.

6. $176,000; see the following pages for a detailed analysis.

**Case 10-17** (continued)

Direct materials analysis:

| Standard Quantity Allowed for Actual Output, at Standard Price (SQ × SP) | Actual Quantity of Input, at Standard Price (AQ × SP) | Actual Quantity of Input, at Actual Price (AQ × AP) |
|---|---|---|
| 38,000 meters* × $16.00 per meter = $608,000 | 40,000 meters** × $16.00 per meter = $640,000 | 40,000 meters × $15.71 per meter*** = $628,400 |

Materials quantity variance = $32,000 U

Materials price variance = $11,600 F

* 19,000 units × 2.0 meters per unit = 38,000 meters

** $640,000 ÷ $16.00 per meter = 40,000 meters

*** $628,400 ÷ 40,000 meters = $15.71 per meter

Direct labor analysis:

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 19,000 hours* × $15.00 per hour = $285,000 | 20,000 hours × $15.00 per hour = $300,000 | 20,000 hours × $15.20 per hour = $304,000 |

Labor efficiency variance = $15,000 U

Labor rate variance = $4,000 U

* 19,000 units × 1.0 hours per unit = 19,000 hours

** $300,000 ÷ $15.00 per hour = 20,000 hours

*** $304,000 ÷ 20,000 hours = $15.20 per hour

**Case 10-17** (continued)

Variable overhead analysis:

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 19,000 hours × $9.00 per hour = $171,000 | 20,000 hours × $9.00 per hour = $180,000 | $176,000* |
| Variable overhead efficiency variance = $9,000 U | Variable overhead rate variance = $4,000 F | |

* $180,000 – $4,000 = $176,000

# Appendix 10A
## Predetermined Overhead Rates and Overhead Analysis in a Standard Costing System

**Exercise 10A-1** (15 minutes)

1. The total overhead cost at the denominator level of activity must be determined before the predetermined overhead rate can be computed.

| | |
|---|---|
| Total fixed overhead cost per year | $600,000 |
| Total variable overhead cost ($3.50 per DLH × 80,000 DLHs) | 280,000 |
| Total overhead cost at the denominator level of activity | $880,000 |

$$\text{Predetermined overhead rate} = \frac{\text{Overhead at the denominator level of activity}}{\text{Denominator level of activity}}$$

$$= \frac{\$880,000}{80,000\text{ DLHs}} = \$11.00\text{ per DLH}$$

2.

| | |
|---|---|
| Standard direct labor-hours allowed for the actual output (a) | 82,000 DLHs |
| Predetermined overhead rate (b) | $11.00 per DLH |
| Overhead applied (a) × (b) | $902,000 |

**Exercise 10A-2** (15 minutes)

1.

$$\text{Fixed portion of the predetermined overhead rate} = \frac{\text{Fixed overhead}}{\text{Denominator level of activity}}$$

$$= \frac{\$400{,}000}{50{,}000 \text{ DLHs}}$$

$$= \$8.00 \text{ per DLH}$$

2.

$$\text{Budget variance} = \text{Actual fixed overhead cost} - \text{Budgeted fixed overhead cost}$$

$$= \$394{,}000 - \$400{,}000$$

$$= \$6{,}000 \text{ F}$$

$$\text{Volume variance} = \text{Fixed portion of the predetermined overhead rate} \times \left(\text{Denominator hours} - \text{Standard hours allowed}\right)$$

$$= \$8.00 \text{ per DLH } (50{,}000 \text{ DLHs} - 48{,}000 \text{ DLHs})$$

$$= \$16{,}000 \text{ U}$$

**Exercise 10A-3** (10 minutes)

| | |
|---|---|
| Company X: | This company has an unfavorable volume variance because the standard direct labor-hours allowed for the actual output are less than the denominator activity. |
| Company Y: | This company has an unfavorable volume variance because the standard direct labor-hours allowed for the actual output are less than the denominator activity. |
| Company Z: | This company has a favorable volume variance because the standard direct labor-hours allowed for the actual output are greater than the denominator activity. |

**Exercise 10A-4** (15 minutes)

1.

| | |
|---|---|
| Actual fixed overhead incurred ............................ | $79,000 |
| Add favorable budget variance ............................ | 1,000 |
| Budgeted fixed overhead cost ............................ | $80,000 |

$$\frac{\text{Budgeted fixed overhead cost}}{\text{Denominator hours}} = \frac{\$80,000}{20,000\text{ MHs}} = \$4 \text{ per MH}$$

2. 9,500 units × 2 MHs per unit = 19,000 MHs

3.

$$\begin{array}{c}\text{Volume}\\\text{Variance}\end{array} = \begin{array}{c}\text{Fixed Portion of}\\\text{the Predetermined}\\\text{Overhead Rate}\end{array}\left(\begin{array}{c}\text{Denominator}\\\text{Hours}\end{array} - \begin{array}{c}\text{Standard Hours}\\\text{Allowed}\end{array}\right)$$

= $4 per MH (20,000 MHs - 19,000 MHs) = 4,000 U

Alternative solutions to parts 1-3:

| Fixed Overhead Applied to Work in Process | Budgeted Fixed Overhead | Actual Fixed Overhead |
|---|---|---|
| 19,000 MHs[b] × $4 per MH[c] = $76,000 | $80,000[a] | $79,000* |

Volume variance = $4,000 U

Budget variance = $1,000 F*

*Given

[a]$79,000 + $1,000 = $80,000

[b]9,500 units × 2 MHs per unit = 19,000 MHs

[c]$80,000 ÷ 20,000 denominator MHs = $4 per MH

**Exercise 10A-5** (15 minutes)

1.

$$\text{Predetermined overhead rate} = \frac{\text{Total overhead at the denominator activity}}{\text{Denominator activity}}$$

$$= \frac{\$1.60 \text{ per DLH} \times 24{,}000 \text{ per DLH} + \$84{,}000}{24{,}000 \text{ DLHs}}$$

$$= \frac{\$122{,}400}{24{,}000 \text{ DLHs}}$$

$$= \$5.10 \text{ per DLH}$$

Variable element: ($1.60 per DLH × 24,000 DLH) ÷ 24,000 DLHs = $38,400 ÷ 24,000 DLHs = $1.60 per DLH

Fixed element: $84,000 ÷ 24,000 DLHs = $3.50 per DLH

2.

| | |
|---|---|
| Direct materials, 2 pounds × $4.20 per pound .................... | $ 8.40 |
| Direct labor, 3 DLHs* × $12.60 per DLH ............................. | 37.80 |
| Variable manufacturing overhead, 3 DLHs × $1.60 per DLH. | 4.80 |
| Fixed manufacturing overhead, 3 DLHs × $3.50 per DLH..... | 10.50 |
| Total standard cost per unit ............................................... | $61.50 |

*24,000 DLHs ÷ 8,000 units = 3 DLHs per unit

**Exercise 10A-6** (20 minutes)

1.
$$\text{Predetermined overhead rate} = \frac{\$1.05 \text{ per MH} \times 8{,}000 \text{ MHs} + \$24{,}800}{8{,}000 \text{ MHs}}$$

$$= \frac{\$33{,}200}{8{,}000 \text{ MHs}}$$

$$= \$4.15 \text{ per MH}$$

$$\text{Variable portion of the predetermined overhead rate} = \frac{\$1.05 \text{ per MH} \times 8{,}000 \text{ MHs}}{8{,}000 \text{ MHs}}$$

$$= \frac{\$8{,}400}{8{,}000 \text{ MHs}}$$

$$= \$1.05 \text{ per MH}$$

$$\text{Fixed portion of the predetermined overhead rate} = \frac{\$24{,}800}{8{,}000 \text{ MHs}}$$

$$= \$3.10 \text{ per MH}$$

2. The standard hours per unit of product are:
   8,000 MHs ÷ 3,200 units = 2.5 MHs per unit

   The standard hours allowed for the actual production would be:
   3,500 units × 2.5 MHs per unit = 8,750 MHs

3. Variable overhead variances:
   Variable overhead rate variance = (AH × AR) – (AH × SR)
   = ($9,860) – (8,500 MHs × $1.05 per MH)
   = ($9,860) – ($8,925)
   = $935 U

   Variable overhead efficiency variance = SR (AH – SH)
   = $1.05 per MH (8,500 MHs – 8,750 MHs)
   = $262.50 F

**Exercise 10A-6** (continued)

Fixed overhead budget and volume variances:

| Fixed Overhead Applied to Work in Process 8,750 standard MHs × $3.10 per MH = $27,125 | Budgeted Fixed Overhead $24,800* | Actual Fixed Overhead $25,100 |
|---|---|---|
| Volume variance = $2,325 F | Budget variance = $300 U | |
| Total Variance = $2,025 F | | |

*8,000 denominator MHs × $3.10 per MH = $24,800.

Alternative approach to the budget variance:

$$\text{Budget Variance} = \text{Actual Fixed Overhead Cost} - \text{Budgeted Fixed Overhead Cost}$$

$$= \$25{,}100 - \$24{,}800$$

$$= \$300\text{ U}$$

Alternative approach to the volume variance:

$$\text{Volume Variance} = \text{Fixed Portion of the Predetermined Overhead Rate}\left(\text{Denominator Hours} - \text{Standard Hours Allowed}\right)$$

$$= \$3.10\text{ per MH }(8{,}000\text{ MHs} - 8{,}750\text{ MHs})$$

$$= \$2{,}325\text{ F}$$

**Exercise 10A-7** (15 minutes)

1. 10,000 units × 0.8 DLH per unit = 8,000 DLHs.

2. and 3.

| Fixed Overhead Applied to Work in Process | Budgeted Fixed Overhead | Actual Fixed Overhead |
|---|---|---|
| 8,000 standard DLHs × $6.00 per DLH* = $48,000 | $45,000 | $45,600* |

| Volume variance | Budget variance |
|---|---|
| = $3,000 F* | = $600 U |

*Given.

4.
$$\text{Fixed cost element of the predetermined overhead rate} = \frac{\text{Budgeted fixed overhead cost}}{\text{Denominator activity}}$$

$$= \frac{\$45{,}000}{\text{Denominator activity}}$$

$$= \$6.00 \text{ per DLH}$$

Therefore, the denominator activity was $45,000 ÷ $6.00 per DLH = 7,500 DLHs.

**Problem 10A-8** (45 minutes)

1. Direct materials price and quantity variances:

   Materials quantity variance = SP (AQ – SQ)
   = \$3.50 per yard (78,000 yards – 80,000 yards*)
   = \$7,000 F

   Materials price variance = AQ (AP – SP)
   = 78,000 yards (\$3.75 per yard – \$3.50 per yard)
   = \$19,500 U

   *20,000 units × 4 yards per unit = 80,000 yards

2. Direct labor rate and efficiency variances:

   Labor efficiency variance = SR (AH – SH)
   = \$12.00 per DLH (32,500 DLHs – 30,000 DLHs*)
   = \$30,000 U

   Labor rate variance = AH (AR – SR)
   = 32,500 DLHs (\$11.80 per DLH – \$12.00 per DLH)
   = \$6,500 F

   *20,000 units × 1.5 DLHs per unit = 30,000 DLHs

3. a. Variable manufacturing overhead spending and efficiency variances:

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 30,000 DLHs × \$2 per DLH = \$60,000 | 32,500 DLHs × \$2 per DLH = \$65,000 | \$68,250 |

| Variable overhead efficiency variance | Variable overhead rate variance |
|---|---|
| = \$5,000 U | = \$3,250 U |

**Problem 10A-8** (continued)

Alternative solution:

Variable overhead efficiency variance = SR (AH – SH)
= \$2.00 per DLH (32,500 DLHs – 30,000 DLHs)
= \$5,000 U

Variable overhead rate variance = (AH × AR) – (AH × SR)
= (\$68,250) – (32,500 DLHs × \$2.00 per DLH)
= \$3,250 U

3. b. Fixed overhead variances:

| Fixed Overhead Applied to Work in Process | Budgeted Fixed Overhead | Actual Fixed Overhead |
|---|---|---|
| 30,000 DLHs × \$6 per DLH = \$180,000 | \$150,000 | \$148,000 |

| Volume variance | Budget variance |
|---|---|
| = \$30,000 F | = \$2,000 F |

Alternative solution:

$$\text{Volume Variance} = \begin{array}{c}\text{Fixed Portion of}\\ \text{the Predetermined}\\ \text{Overhead Rate}\end{array} \left(\begin{array}{c}\text{Denominator}\\ \text{Hours}\end{array} - \begin{array}{c}\text{Standard Hours}\\ \text{Allowed}\end{array}\right)$$

$$= \$6.00 \text{ per DLH } (25{,}000 \text{ DLHs} - 30{,}000 \text{ DLHs})$$

$$= \$30{,}000 \text{ F}$$

$$\text{Budget Variance} = \begin{array}{c}\text{Actual Fixed}\\ \text{Overhead Cost}\end{array} - \begin{array}{c}\text{Flexible Budget Fixed}\\ \text{Overhead Cost}\end{array}$$

$$= \$148{,}000 - \$150{,}000$$

$$= \$2{,}000 \text{ F}$$

**Problem 10A-8** (continued)

4. The total of the variances would be:

| | | |
|---|---|---|
| Direct materials variances: | | |
| Quantity variance | $ 7,000 | F |
| Price variance | 19,500 | U |
| Direct labor variances: | | |
| Efficiency variance | 30,000 | U |
| Rate variance | 6,500 | F |
| Variable manufacturing overhead variances: | | |
| Efficiency variance | 5,000 | U |
| Rate variance | 3,250 | U |
| Fixed manufacturing overhead variances: | | |
| Volume variance | 30,000 | F |
| Budget variance | 2,000 | F |
| Total of variances | $12,250 | U |

Notice that the total of the variances agrees with the $12,250 unfavorable variance mentioned by the vice president.

It appears that not everyone should be given a bonus for good cost control. The materials price variance and the labor efficiency variance are 7.1% and 8.3%, respectively, of the standard cost allowed and thus would warrant investigation. In addition, the variable overhead spending variance is 5.0% of the standard cost allowed.

The reason the company's large unfavorable variances (for materials price and labor efficiency) do not show up more clearly is that they are offset by the company's favorable volume variance for the year. This favorable volume variance is the result of the company operating at an activity level that is well above the denominator activity level used to set predetermined overhead rates. (The company operated at an activity level of 30,000 standard DLHs; the denominator activity level set at the beginning of the year was 25,000 DLHs.) As a result of the large favorable volume variance, the unfavorable price and efficiency variances have been concealed in a small "net" figure. Finally, the large favorable volume variance may have been achieved by building up inventories.

**Problem 10A-9** (60 minutes)

1. and 2.

| | Per Direct Labor-Hour | | |
|---|---|---|---|
| | *Variable* | *Fixed* | *Total* |
| Denominator of 40,000 DLHs: | | | |
| | $2.50 | | $ 2.50 |
| | | $8.00 | 8.00 |
| Total predetermined rate .................... | | | $10.50 |
| Denominator of 50,000 DLHs: | | | |
| | $2.50 | | $ 2.50 |
| | | $6.40 | 6.40 |
| Total predetermined rate .................... | | | $ 8.90 |

3.

| *Denominator Activity: 40,000 DLHs* | | *Denominator Activity: 50,000 DLHs* | |
|---|---|---|---|
| Direct materials, 3 yards × $5.00 per yard .......... | $15.00 | Same .............................. | $15.00 |
| Direct labor, 2.5 DLHs × $20.00 per DLH ............ | 50.00 | Same .............................. | 50.00 |
| Variable overhead, 2.5 DLHs × $2.50 per DLH.. | 6.25 | Same .............................. | 6.25 |
| Fixed overhead, 2.5 DLHs × $8.00 per DLH .......... | 20.00 | Fixed overhead, 2.5 DLHs × $6.40 per DLH ........... | 16.00 |
| Total standard cost per unit.............................. | $91.25 | Total standard cost per unit .............................. | $87.25 |

4. a. 18,500 units × 2.5 DLHs per unit = 46,250 standard DLHs

b.

| Manufacturing Overhead | | | |
|---|---|---|---|
| Actual costs | 446,500 | Applied costs (46,250 standard DLHs* × $10.50 per DLH) | 485,625 |
| | | Overapplied overhead | 39,125 |

*Determined in (a).

**Problem 10A-9** (continued)

4. c.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 46,250 DLHs × $2.50 per DLH = $115,625 | 48,000 DLHs × $2.50 per DLH = $120,000 | $124,800 |
| Variable overhead efficiency variance = $4,375 U | Variable overhead rate variance = $4,800 U | |

Alternative solution:

Variable overhead efficiency variance = SR (AH – SH)
= $2.50 per DLH (48,000 DLHs – 46,250 DLHs)
= $4,375 U

Variable overhead rate variance = (AH × AR) – (AH × SR)
= ($124,800) – (48,000 DLHs × $2.50 per DLH)
= $4,800 U

Fixed overhead variances:

| Fixed Overhead Applied to Work in Process | Budgeted Fixed Overhead | Actual Fixed Overhead |
|---|---|---|
| 46,250 standard DLHs × $8.00 per DLH = $370,000 | $320,000* | $321,700 |
| Volume variance = $50,000 F | Budget variance = $1,700 U | |

*40,000 denominator DLHs × $8 per DLH = $320,000.

**Problem 10A-9** (continued)

Alternative solution:

$$\text{Budget Variance} = \text{Actual Fixed Overhead Cost} - \text{Flexible Budget Fixed Overhead Cost}$$

$$= \$321{,}700 - \$320{,}000$$

$$= \$1{,}700\ \text{U}$$

$$\text{Volume Variance} = \text{Fixed Portion of the Predetermined Overhead Rate} \times \left(\text{Denominator Hours} - \text{Standard Hours Allowed}\right)$$

$$= \$8.00 \text{ per DLH } (40{,}000 \text{ DLHs} - 46{,}250 \text{ DLHs})$$

$$= \$50{,}000\ \text{F}$$

Summary of variances:

| | |
|---|---|
| Variable overhead efficiency ...... | $ 4,375 U |
| Variable overhead rate variance . | 4,800 U |
| Fixed overhead volume ............ | 50,000 F |
| Fixed overhead budget............. | 1,700 U |
| Overapplied overhead .............. | $39,125 F |

**Problem 10A-9** (continued)

5. The major disadvantage of using normal activity as the denominator in the predetermined rate is the large volume variance that ordinarily results. This occurs because the denominator activity used to compute the predetermined overhead rate is different from the activity level that is anticipated for the period. In the case at hand, the company has used the normal activity of 40,000 direct labor-hours to compute the predetermined overhead rate, whereas activity for the period was expected to be 50,000 DLHs. This has resulted in a large favorable volume variance that may be difficult for management to interpret. In addition, the large favorable volume variance in this case has masked the fact that the company did not achieve the budgeted level of activity for the period. The company had planned to work 50,000 DLHs, but managed to work only 46,250 DLHs (at standard). This unfavorable result is concealed due to using a denominator figure that is out of step with current activity.

   On the other hand, by using normal activity as the denominator unit costs are stable from year to year. Thus, management's decisions are not clouded by unit costs that jump up and down as the activity level rises and falls.

**Problem 10A-10** (45 minutes)

1.

Total rate: $\dfrac{£31{,}500 + £72{,}000}{18{,}000 \text{ MHs}} = £5.75$ per MH

Variable element: $\dfrac{£31{,}500}{18{,}000 \text{ MHs}} = £1.75$ per MH

Fixed element: $\dfrac{£72{,}000}{18{,}000 \text{ MHs}} = £4.00$ per MH

2. 16,000 standard MHs × £5.75 per MH = £92,000

3. Variable manufacturing overhead variances:

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 16,000 MHs × £1.75 per MH = £28,000 | 15,000 MHs × £1.75 per MH = £26,250 | £26,500 |

| Variable overhead efficiency variance | Variable overhead rate variance |
|---|---|
| = £1,750 F | = £250 U |

Alternative solution:

Variable overhead efficiency variance = SR (AH – SH)
= £1.75 per MH (15,000 MHs – 16,000 MHs)
= £1,750 F

Variable overhead rate variance = (AH × AR) – (AH × SR)
= (£26,500) – (15,000 MHs × £1.75 per MH)
= £250 U

**Problem 10A-10** (continued)

Fixed overhead variances:

| Fixed Overhead Applied to Work in Process | Budgeted Fixed Overhead | Actual Fixed Overhead |
|---|---|---|
| 16,000 MHs × £4 per MH = £64,000 | £72,000 | £70,000 |

Volume variance = £8,000 U; Budget variance = £2,000 F

Alternative solution:

$$\text{Volume Variance} = \text{Fixed Portion of the Predetermined Overhead Rate}\left(\text{Denominator Hours} - \text{Standard Hours Allowed}\right)$$

$$= £4 \text{ per MH } (18{,}000 \text{ MHs} – 16{,}000 \text{ MHs})$$

$$= £8{,}000 \text{ U}$$

$$\text{Budget Variance} = \text{Actual Fixed Overhead Cost} - \text{Flexible Budget Fixed Overhead Cost}$$

$$= £70{,}000 – £72{,}000$$

$$= £2{,}000 \text{ F}$$

Verification of variances:

| | | |
|---|---|---|
| Variable overhead efficiency variance | £1,750 | F |
| Variable overhead rate variance | 250 | U |
| Fixed overhead volume variance | 8,000 | U |
| Fixed overhead budget variance | 2,000 | F |
| Underapplied overhead | £4,500 | U |

**Problem 10A-10** (continued)

4. Variable overhead

   *Variable overhead rate variance:* This variance includes both price and quantity elements. The overhead spending variance reflects differences between actual and standard prices for variable overhead items. It also reflects differences between the amounts of variable overhead inputs that were actually used and the amounts that should have been used for the actual output of the period. Because the variable overhead spending variance is unfavorable, either too much was paid for variable overhead items or too many of them were used.

   *Variable overhead efficiency variance:* The term "variable overhead efficiency variance" is a misnomer, because the variance does not measure efficiency in the use of overhead items. It measures the indirect effect on variable overhead of the efficiency or inefficiency with which the activity base is utilized. In this company, machine-hours is the activity base. If variable overhead is really proportional to machine-hours, then more effective use of machine-hours has the indirect effect of reducing variable overhead. Because 1,000 fewer machine-hours were required than indicated by the standards, the indirect effect was presumably to reduce variable overhead spending by about £1,750 (£1.75 per machine-hour × 1,000 machine-hours).

   Fixed overhead

   *Fixed overhead budget variance:* This variance is simply the difference between the budgeted fixed cost and the actual fixed cost. In this case, the variance is favorable, which indicates that actual fixed costs were lower than anticipated in the budget.

   *Fixed overhead volume variance:* This variance occurs as a result of actual activity being different from the denominator activity that was used in the predetermined overhead rate. In this case, the variance is unfavorable, so actual activity was less than the denominator activity. It is difficult to place much of a meaningful economic interpretation on this variance. It tends to be large, so it often swamps the other, more meaningful variances if they are simply netted against each other.

**Problem 10A-11** (45 minutes)

1. Total: $\frac{\$240{,}000}{30{,}000 \text{ DLHs}} = \$8.00$ per DLH

Variable: $\frac{\$60{,}000}{30{,}000 \text{ DLHs}} = \$2.00$ per DLH

Fixed: $\frac{\$180{,}000}{30{,}000 \text{ DLHs}} = \$6.00$ per DLH

2.

| | |
|---|---|
| Direct materials: 4 feet × \$3.00 per foot.............. | \$12.00 |
| Direct labor: 1.5 DLHs × \$12.00 per DLH............. | 18.00 |
| Variable overhead: 1.5 DLHs × \$2.00 per DLH ...... | 3.00 |
| Fixed overhead: 1.5 DLHs × \$6.00 per DLH ......... | 9.00 |
| Standard cost per unit ....................................... | \$42.00 |

3. a. 22,000 units × 1.5 DLHs per unit = 33,000 standard DLHs.

b. Manufacturing Overhead

| | | | |
|---|---|---|---|
| Actual costs | 244,000 | Applied costs (33,000 standard DLHs × \$8.00 per DLH) | 264,000 |
| | | Overapplied overhead | 20,000 |

4. Variable overhead variances:

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 33,000 DLHs × \$2 per DLH = \$66,000 | 35,000 DLHs × \$2 per DLH = \$70,000 | \$63,000 |

Variable overhead efficiency variance = \$4,000 U

Variable overhead rate variance = \$7,000 F

**Problem 10A-11** (continued)

Alternative solution:

Variable overhead efficiency variance = SR (AH – SH)
= $2.00 per DLH (35,000 DLHs – 33,000 DLHs)
= $4,000 U

Variable overhead rate variance = (AH × AR) – (AH × SR)
= ($63,000) – (35,000 DLHs × $2.00 per DLH)
= $7,000 F

Fixed overhead variances:

| Fixed Overhead Applied to Work in Process | Budgeted Fixed Overhead | Actual Fixed Overhead |
|---|---|---|
| 33,000 DLHs × $6 per DLH = $198,000 | $180,000 | $181,000 |

Volume variance = $18,000 F

Budget variance = $1,000 U

Alternative solution:

$$\text{Volume Variance} = \text{Fixed Portion of the Predetermined Overhead Rate}\left(\text{Denominator Hours} - \text{Standard Hours Allowed}\right)$$

= $6 per DLH (30,000 DLHs – 33,000 DLHs)

= $18,000 F

$$\text{Budget Variance} = \text{Actual Fixed Overhead Cost} - \text{Flexible Budget Fixed Overhead Cost}$$

= $181,000 – $180,000

= $1,000 U

**Problem 10A-11** (continued)

Summary of variances:

| | |
|---|---|
| Variable overhead efficiency variance ................ | $ 4,000 U |
| Variable overhead rate variance ........................ | 7,000 F |
| Fixed overhead volume variance ........................ | 18,000 F |
| Fixed overhead budget variance......................... | 1,000 U |
| Overapplied overhead—see part 3..................... | $20,000 F |

5. Only the volume variance would have changed. It would have been unfavorable, because the standard DLHs allowed for the year's production (33,000 DLHs) would have been less than the denominator DLHs (36,000 DLHs).

**Problem 10A-12** (30 minutes)

| | |
|---|---|
| 1. Direct materials, 4 pounds × \$2.60 per pound ....................... | \$10.40 |
| Direct labor, 2 DLHs × \$9.00 per DLH.................................... | 18.00 |
| Variable manufacturing overhead, 2 DLHs × \$3.80 per DLH* .. | 7.60 |
| Fixed manufacturing overhead, 2 DLHs × \$7.00 per DLH** .... | 14.00 |
| Standard cost per unit ........................................................ | \$50.00 |

* \$34,200 ÷ 9,000 DLHs = \$3.80 per DLH
** \$63,000 ÷ 9,000 DLHs = \$7.00 per DLH

2. Materials variances:

Materials quantity variance = SP (AQ – SQ)
= \$2.60 per pound (20,000 pounds – 19,200 pounds*)
= \$2,080 U
*4,800 units × 4 pounds per unit = 19,200 pounds

Materials price variance = AQ (AP – SP)
= 30,000 pounds (\$2.50 per pound – \$2.60 per pound)
= \$3,000 F

Labor variances:

Labor efficiency variance = SR (AH – SH)
= \$9.00 per DLH (10,000 DLHs – 9,600 DLHs*)
= \$3,600 U
*4,800 units × 2 DLHs per unit = 9,600 DLHs

Labor rate variance = AH (AR – SR)
= 10,000 DLHs (\$8.60 per DLH – \$9.00 per DLH)
= \$4,000 F

**Problem 10A-12** (continued)

3. Variable manufacturing overhead variances:

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 9,600 DLHs × $3.80 per DLH = $36,480 | 10,000 DLHs × $3.80 per DLH = $38,000 | $35,900 |
| Variable overhead efficiency variance = $1,520 U | Variable overhead rate variance = $2,100 F | |
| Spending variance = $580 F | | |

Alternative solution:

Variable overhead efficiency variance = SR (AH – SH)
= $3.80 per DLH (10,000 DLHs – 9,600 DLHs)
= $1,520 U

Variable overhead rate variance = (AH × AR) – (AH × SR)
= ($35,900) – (10,000 DLHs × $3.80 per DLH)
= $2,100 F

Fixed manufacturing overhead variances:

| Fixed Overhead Applied to Work in Process | Budgeted Fixed Overhead | Actual Fixed Overhead |
|---|---|---|
| 9,600 DLHs × $7 per DLH = $67,200 | $63,000 | $64,800 |
| Volume variance = $4,200 F | Budget variance = $1,800 U | |

**Problem 10A-12** (continued)

Alternative solution:

$$\text{Volume Variance} = \text{Fixed Portion of the Predetermined Overhead Rate}\left(\text{Denominator Hours} - \text{Standard Hours Allowed}\right)$$

$$= \$7 \text{ per DLH } (9{,}000 \text{ DLHs} - 9{,}600 \text{ DLHs})$$

$$= \$4{,}200 \text{ F}$$

$$\text{Budget Variance} = \text{Actual Fixed Overhead Cost} - \text{Budgeted Fixed Overhead Cost}$$

$$= \$64{,}800 - \$63{,}000$$

$$= \$1{,}800 \text{ U}$$

4. The choice of a denominator activity level affects standard unit costs in that the higher the denominator activity level chosen, the lower standard unit costs will be. The reason is that the fixed portion of overhead costs is spread over more units as the denominator activity increases.

   The volume variance cannot be controlled by controlling spending. The volume variance simply reflects whether actual activity was greater or less than the denominator activity. Thus, the volume variance is controllable only through activity.

# Appendix 10B
## Journal Entries to Record Variances

**Exercise 10B-1** (20 minutes)

1. The general ledger entry to record the purchase of materials for the month is:

| | | |
|---|---|---|
| Raw Materials (15,000 meters at $5.40 per meter) ................. | 81,000 | |
| Materials Price Variance (15,000 meters at $0.20 per meter U) .............. | 3,000 | |
| Accounts Payable (15,000 meters at $5.60 per meter) ............ | | 84,000 |

2. The general ledger entry to record the use of materials for the month is:

| | | |
|---|---|---|
| Work in Process (12,000 meters at $5.40 per meter) ................. | 64,800 | |
| Materials Quantity Variance (100 meters at $5.40 per meter F) .............. | | 540 |
| Raw Materials (11,900 meters at $5.40 per meter) ............ | | 64,260 |

3. The general ledger entry to record the incurrence of direct labor cost for the month is:

| | | |
|---|---|---|
| Work in Process (2,000 hours at $14.00 per hour) | 28,000 | |
| Labor Rate Variance (1,950 hours at $0.20 per hour U).................... | 390 | |
| Labor Efficiency Variance (50 hours at $14.00 per hour F).................. | | 700 |
| Wages Payable (1,950 hours at $14.20 per hour)................. | | 27,690 |

**Exercise 10B-2** (45 minutes)

1. a.

| Standard Quantity Allowed for Actual Output, at Standard Price | Actual Quantity of Input, at Standard Price | Actual Quantity of Input, at Actual Price |
|---|---|---|
| (SQ × SP) | (AQ × SP) | (AQ × AP) |
| 5,250 feet* × | 6,000 feet × | 7,000 feet × |
| $6.00 per foot | $6.00 per foot | $5.75 per foot |
| = $31,500 | = $36,000 | = $40,250 |

Materials quantity variance = $4,500 U

7,000 feet ×
$6.00 per foot
= $42,000

Materials price variance = $1,750 F

*1,500 units × 3.5 feet per unit = 5,250 feet

Alternatively, the variances can be computed using the formulas:

Materials quantity variance = SP (AQ – SQ)
= $6.00 per foot (6,000 feet – 5,250 feet)
= $4,500 U

Materials price variance = AQ (AP – SP)
= 7,000 feet ($5.75 per foot – $6.00 per foot)
= $1,750 F

**Exercise 10B-2** (continued)

b. The journal entries would be:

| | | |
|---|---|---|
| Raw Materials (7,000 feet × \$6.00 per foot) ........ | 42,000 | |
| Materials Price Variance<br>(7,000 feet × \$0.25 F per foot) .................. | | 1,750 |
| Accounts Payable<br>(7,000 feet × \$5.75 per foot) ..................... | | 40,250 |
| Work in Process (5,250 feet × \$6.00 per foot) ..... | 31,500 | |
| Materials Quantity Variance<br>(750 feet U × \$6.00 per foot).......................... | 4,500 | |
| Raw Materials (6,000 feet × \$6.00 per foot)... | | 36,000 |

2. a.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 600 hours* × \$10 per hour = \$6,000 | 725 hours × \$10 per hour = \$7,250 | \$8,120 |

Labor efficiency variance = \$1,250 U

Labor rate variance = \$870 U

Spending variance = \$2,120 U

*1,500 units × 0.4 hour per unit = 600 hours

Alternatively, the variances can be computed using the formulas:

Labor efficiency variance = SR (AH – SH)
= \$10.00 per hour (725 hours – 600 hours)
= \$1,250 U

Labor rate variance = AH (AR – SR)
= 725 hours (\$11.20 per hour* – \$10.00 per hour)
= \$870 U
*\$8,120 ÷ 725 hours = \$11.20 per hour

**Exercise 10B-2** (continued)

b. The journal entry would be:

| | | |
|---|---|---|
| Work in Process (600 hours × \$10.00 per hour) | 6,000 | |
| Labor Rate Variance (725 hours × \$1.20 U per hour) | 870 | |
| Labor Efficiency Variance (125 U hours × \$10.00 per hour) | 1,250 | |
| Wages Payable (725 hours × \$11.20 per hour) | | 8,120 |

3. The entries are: (a) purchase of materials; (b) issue of materials to production; and (c) incurrence of direct labor cost.

**Raw Materials**

| Debit | | Credit | |
|---|---|---|---|
| (a) | 42,000 | (b) | 36,000 |
| Bal. | 6,000[1] | | |

**Accounts Payable**

| Debit | | Credit | |
|---|---|---|---|
| | | (a) | 40,250 |

**Materials Price Variance**

| Debit | | Credit | |
|---|---|---|---|
| | | (a) | 1,750 |

**Wages Payable**

| Debit | | Credit | |
|---|---|---|---|
| | | (c) | 8,120 |

**Materials Quantity Variance**

| Debit | | Credit | |
|---|---|---|---|
| (b) | 4,500 | | |

**Labor Rate Variance**

| Debit | | Credit | |
|---|---|---|---|
| (c) | 870 | | |

**Work in Process**

| Debit | | Credit | |
|---|---|---|---|
| (b) | 31,500[2] | | |
| (c) | 6,000[3] | | |

**Labor Efficiency Variance**

| Debit | | Credit | |
|---|---|---|---|
| (c) | 1,250 | | |

[1] 1,000 feet of material at a standard cost of \$6.00 per foot
[2] Materials used
[3] Labor cost

**Problem 10B-3** (75 minutes)

1. a.

| Standard Quantity Allowed for Actual Output, at Standard Price (SQ × SP) | Actual Quantity of Input, at Standard Price (AQ × SP) | Actual Quantity of Input, at Actual Price (AQ × AP) |
|---|---|---|
| 36,000 feet* × $1.00 per foot = $36,000 | 38,000 feet × $1.00 per foot = $38,000 | 60,000 feet × $0.95 per foot = $57,000 |
| Materials quantity variance = $2,000 U | | |
| | 60,000 feet × $1.00 per foot = $60,000 | |
| | Materials price variance = $3,000 F | |

*6,000 units × 6.0 feet per unit = 36,000 feet

Alternatively, the variances can be computed using the formulas:

Materials quantity variance = SP (AQ – SQ)
= $1.00 per foot (38,000 feet – 36,000 feet)
= $2,000 U

Materials price variance = AQ (AP – SP)
= 60,000 feet ($0.95 per foot – $1.00 per foot)
= $3,000 F

b.

| | | |
|---|---|---|
| Raw Materials (60,000 feet @ $1.00 per foot) | 60,000 | |
| Materials Price Variance (60,000 feet @ $0.05 per foot F) | | 3,000 |
| Accounts Payable (60,000 feet @ $0.95 per foot) | | 57,000 |
| Work in Process (36,000 feet @ $1.00 per foot) | 36,000 | |
| Materials Quantity Variance (2,000 feet U @ $1.00 per foot) | 2,000 | |
| Raw Materials (38,000 feet @ $1.00 per foot) | | 38,000 |

**Problem 10B-3** (continued)

2. a.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 6,000 hours** × $4.50 per hour = $27,000 | 6,500 hours* × $4.50 per hour = $29,250 | $27,950 |
| Labor efficiency variance = $2,250 U | Labor rate variance = $1,300 F | |
| Spending variance = $950 U | | |

*The actual hours worked during the period can be computed through the variable overhead efficiency variance, as follows:

SR (AH – SH) = Efficiency variance
$3 per hour (AH – 6,000 hours**) = $1,500 U
$3 per hour × AH – $18,000 = $1,500***
$3 per hour × AH = $19,500
AH = 6,500 hours

**6,000 units × 1.0 hour per unit = 6,000 hours
***When used with the formula, unfavorable variances are positive and favorable variances are negative.

Alternatively, the variances can be computed using the formulas:

Labor efficiency variance = SR (AH – SH)
= $4.50 per hour (6,500 hours – 6,000 hours)
= $2,250 U

Labor rate variance = AH × (AR – SR)
= 6,500 hours ($4.30 per hour* – $4.50 per hour)
= $1,300 F

*$27,950 ÷ 6,500 hours = $4.30 per hour

**Problem 10B-3** (continued)

b. Work in Process

| | | |
|---|---|---|
| Work in Process (6,000 hours @ $4.50 per hour) .................... | 27,000 | |
| Labor Efficiency Variance (500 hours U @ $4.50 per hour) .................... | 2,250 | |
| Labor Rate Variance (6,500 hours @ $0.20 per hour F) ............ | | 1,300 |
| Wages Payable (6,500 hours @ $4.30 per hour) .............. | | 27,950 |

3. a.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 6,000 hours × $3.00 per hour = $18,000 | 6,500 hours × $3.00 per hour = $19,500 | $20,475 |

Variable overhead efficiency variance = $1,500 U

Variable overhead rate variance = $975 U

Spending variance = $2,475 U

Alternatively, the variances can be computed using the formulas:

Variable overhead efficiency variance = SR (AH – SH)
= $3.00 per hour (6,500 hours – 6,000 hours)
= $1,500 U

Variable overhead rate variance = AH × (AR – SR)
= 6,500 hours ($3.15 per hour* – $3.00 per hour)
= $975 U

*$20,475 ÷ 6,500 hours = $3.15 per hour

**Problem 10B-3** (continued)

b. No. When variable manufacturing overhead is applied on the basis of direct labor-hours, it is impossible to have an unfavorable variable manufacturing overhead efficiency variance when the direct labor efficiency variance is favorable. The variable manufacturing overhead efficiency variance is the same as the direct labor efficiency variance except that the difference between actual hours and the standard hours allowed for the output is multiplied by a different rate. If the direct labor efficiency variance is favorable, the variable manufacturing overhead efficiency variance must also be favorable.

4. *For materials:*

Favorable price variance: Decrease in outside purchase prices, fortunate buy, inferior quality materials, unusual discounts due to quantity purchased, inaccurate standards.

Unfavorable quantity variance: Inferior quality materials, carelessness, poorly adjusted machines, unskilled workers, inaccurate standards.

*For labor:*

Favorable rate variance: Unskilled workers (paid lower rates), piecework, inaccurate standards.

Unfavorable efficiency variance: Poorly trained workers, poor quality materials, faulty equipment, work interruptions, fixed labor with insufficient demand to keep them all busy, inaccurate standards.

*For variable overhead:*

Unfavorable rate variance: Increase in supplier prices, inaccurate standards, waste, theft of supplies.

Unfavorable efficiency variance: See comments under direct labor efficiency variance.

**Problem 10B-4** (60 minutes)

1. a.

| Standard Quantity Allowed for Actual Output, at Standard Price (SQ × SP) | Actual Quantity of Input, at Standard Price (AQ × SP) | Actual Quantity of Input, at Actual Price (AQ × AP) |
|---|---|---|
| 19,200 yards* × $3.60 per yard = $69,120 | 21,120 yards × $3.60 per yard = $76,032 | 21,120 yards × $3.35 per yard = $70,752 |
| Materials quantity variance = $6,912 U | | Materials price variance = $5,280 F |
| Spending variance = $1,632 U | | |

*4,800 units × 4.0 yards per unit = 19,200 yards

Alternatively, the variances can be computed using the formulas:

Materials quantity variance = SP (AQ – SQ)
= $3.60 per yard (21,120 yards – 19,200 yards)
= $6,912 U

Materials price variance = AQ (AP – SP)
= 21,120 yards ($3.35 per yard – $3.60 per yard)
= $5,280 F

b.

| | | |
|---|---|---|
| Raw Materials (21,120 yards @ $3.60 per yard) ...... | 76,032 | |
| Materials Price Variance (21,120 yards @ $0.25 per yard F) ................ | | 5,280 |
| Accounts Payable (21,120 yards @ $3.35 per yard) .................... | | 70,752 |
| | | |
| Work in Process (19,200 yards @ $3.60 per yard) ... | 69,120 | |
| Materials Quantity Variance (1,920 yards U @ $3.60 per yard)........................ | 6,912 | |
| Raw Materials (21,120 yards @ $3.60 per yard) . | | 76,032 |

**Problem 10B-4** (continued)

2. a.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 7,680 hours** × $4.50 per hour = $34,560 | 6,720 hours × $4.50 per hour = $30,240 | 6,720 hours* × $4.85 per hour = $32,592 |

| | |
|---|---|
| Labor efficiency variance = $4,320 F | Labor rate variance = $2,352 U |
| Spending variance = $1,968 F | |

*4,800 units × 1.4 hours per unit = 6,720 hours
**4,800 units × 1.6 hours per unit = 7,680 hours

Alternatively, the variances can be computed using the formulas:

Labor efficiency variance = SR (AH – SH)
= $4.50 per hour (6,720 hours – 7,680 hours)
= $4,320 F

Labor rate variance = AH (AR – SR)
= 6,720 hours ($4.85 per hour – $4.50 per hour)
= $2,352 U

b.

| | | |
|---|---|---|
| Work in Process (7,680 hours @ $4.50 per hour)..... | 34,560 | |
| Labor Rate Variance (6,720 hours @ $0.35 per hour U)....................... | 2,352 | |
| Labor Efficiency Variance (960 hours F @ $4.50 per hour)..................... | | 4,320 |
| Wages Payable (6,720 hours @ $4.85 per hour). | | 32,592 |

**Problem 10B-4** (continued)

3.

| Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR) | Actual Hours of Input, at Standard Rate (AH × SR) | Actual Hours of Input, at Actual Rate (AH × AR) |
|---|---|---|
| 7,680 hours × $1.80 per hour = $13,824 | 6,720 hours × $1.80 per hour = $12,096 | 6,720 hours × $2.15 per hour = $14,448 |
| Variable overhead efficiency variance = $1,728 F | Variable overhead rate variance = $2,352 U | |
| Spending variance = $624 U | | |

Alternatively, the variances can be computed using the formulas:

Variable overhead efficiency variance = SR (AH – SH)
= $1.80 per hour (6,720 hours – 7,680 hours)
= $1,728 F

Variable overhead rate variance = AH (AR – SR)
= 6,720 hours ($2.15 per hour – $1.80 per hour)
= $2,352 U

4. No. This total variance is made up of several quite large individual variances, some of which may warrant investigation. A summary of variances is given below:

| | | |
|---|---|---|
| Materials: | | |
| Quantity variance | $6,912 U | |
| Price variance | 5,280 F | $1,632 U |
| Labor: | | |
| Efficiency variance | 4,320 F | |
| Rate variance | 2,352 U | 1,968 F |
| Variable overhead: | | |
| Efficiency variance | 1,728 F | |
| Spending variance | 2,352 U | 624 U |
| Net unfavorable variance | | $ 288 U |

**Problem 10B-4** (continued)

5. The variances have many possible causes. Some of the more likely causes include:

   *Materials variances:*

   Favorable price variance: Good price, inaccurate standards, inferior quality materials, unusual discount due to quantity purchased, drop in market price.

   Unfavorable quantity variance: Carelessness, poorly adjusted machines, unskilled workers, inferior quality materials, inaccurate standards.

   *Labor variances:*

   Unfavorable rate variance: Use of highly skilled workers, change in wage rates, inaccurate standards, overtime.

   Favorable efficiency variance: Use of highly skilled workers, high-quality materials, new equipment, inaccurate standards.

   *Variable overhead variances:*

   Unfavorable rate variance: Increase in costs, inaccurate standards, waste, theft, spillage, purchases in uneconomical lots.

   Favorable efficiency variance: Same as for labor efficiency variance.

**Case 10B-5** (30 minutes)

This case may be difficult for some students to grasp because it requires looking at standard costs from an entirely different perspective. In this case, standard costs have been inappropriately used as a means to manipulate reported earnings rather than as a way to control costs.

1. Lansing has evidently set very loose standards in which the standard prices and standard quantities are far too high. This guarantees that favorable variances will ordinarily result from operations. If the standard costs are set artificially high, the standard cost of goods sold will be artificially high and thus the division's net operating income will be depressed until the favorable variances are recognized. If Lansing saves the favorable variances, he can release just enough in the second and third quarters to show some improvement and then he can release all of the rest in the last quarter, creating the annual "Christmas present."

2. Lansing should not be permitted to continue this practice for several reasons. First, it distorts the quarterly earnings for both the division and the company. The distortions of the division's quarterly earnings are troubling because the manipulations may mask real signs of trouble. The distortions of the company's quarterly earnings are troubling because they may mislead external users of the financial statements. Second, Lansing should not be rewarded for manipulating earnings. This sets a moral tone in the company that is likely to lead to even deeper trouble. Indeed, the permissive attitude of top management toward the manipulation of earnings may indicate the existence of other, even more serious, ethical problems in the company. Third, a clear message should be sent to division managers like Lansing that their job is to manage their operations, not their earnings. If they keep on top of operations and manage well, the earnings should take care of themselves.

**Case 10B-5** (continued)

3. Stacy Cummins does not have any easy alternatives available. She has already taken the problem to the President, who was not interested. If she goes around the President to the Board of Directors, she will be putting herself in a politically difficult position with little likelihood that it will do much good if, in fact, the Board of Directors already knows what is going on.

   On the other hand, if she simply goes along, she will be violating the Credibility standard of ethical conduct for management accountants. The Home Security Division's manipulation of quarterly earnings does distort the entire company's quarterly reports. And the Credibility standard clearly stipulates that management accountants have a responsibility to "disclose all relevant information that could reasonably be expected to influence an intended user's understanding of the reports, analyses, or recommendations." Apart from the ethical issue, there is also a very practical consideration. If Merced Home Products becomes embroiled in controversy concerning questionable accounting practices, Stacy Cummins will be viewed as a responsible party by outsiders and her career is likely to suffer dramatically and she may even face legal problems.

   We would suggest that Ms. Cummins quietly bring the manipulation of earnings to the attention of the audit committee of the Board of Directors, carefully laying out in a non-confrontational manner the problems created by Lansing's practice of manipulating earnings. If the President and the Board of Directors are still not interested in dealing with the problem, she may reasonably conclude that the best alternative is to start looking for another job.

# Chapter 13
# Capital Budgeting Decisions

## Solutions to Questions

**13-1** A capital budgeting screening decision is concerned with whether a proposed investment project passes a preset hurdle, such as a 15% rate of return. A capital budgeting preference decision is concerned with choosing from among two or more alternative investment projects, each of which has passed the hurdle.

**13-2** The "time value of money" refers to the fact that a dollar received today is more valuable than a dollar received in the future simply because a dollar received today can be invested to yield more than a dollar in the future.

**13-3** Discounting is the process of computing the present value of a future cash flow. Discounting gives recognition to the time value of money and makes it possible to meaningfully add together cash flows that occur at different times.

**13-4** Accounting net income is based on accruals rather than on cash flows. Both the net present value and internal rate of return methods focus on cash flows.

**13-5** Unlike other common capital budgeting methods, discounted cash flow methods recognize the time value of money and take into account all future cash flows.

**13-6** Net present value is the present value of cash inflows less the present value of the cash outflows. The net present value can be negative if the present value of the outflows is greater than the present value of the inflows.

**13-7** One assumption is that all cash flows occur at the end of a period. Another is that all cash inflows are immediately reinvested at a rate of return equal to the discount rate.

**13-8** No. The cost of capital is not simply the interest paid on long-term debt. The cost of capital is a weighted average of the costs of all sources of financing, both debt and equity.

**13-9** The internal rate of return is the rate of return on an investment project over its life. It is computed by finding the discount rate that results in a zero net present value for the project.

**13-10** The cost of capital is a hurdle that must be cleared before an investment project will be accepted. In the case of the net present value method, the cost of capital is used as the discount rate. If the net present value of the project is positive, then the project is acceptable because its rate of return is greater than the cost of capital. In the case of the internal rate of return method, the cost of capital is compared to a project's internal rate of return. If the project's internal rate of return is greater than the cost of capital, then the project is acceptable.

**13-11** No. As the discount rate increases, the present value of a given future cash flow decreases. For example, the present value factor for a discount rate of 12% for cash to be received ten years from now is 0.322, whereas the present value factor for a discount rate of 14% over the same period is 0.270. If the cash to be received in ten years is $10,000, the present value in the first case is $3,220, but only $2,700 in the second case. Thus, as the discount rate increases, the present value of a given future cash flow decreases.

**13-12** The internal rate of return is more than 14% because the net present value is positive. The internal rate of return would be 14% only if the net present value (evaluated using a 14%

discount rate) is zero. The internal rate of return would be less than 14% if the net present value (evaluated using a 14% discount rate) is negative.

**13-13** The project profitability index is computed by dividing the net present value of the cash flows from an investment project by the required investment. The index measures the profit (in terms of net present value) provided by each dollar of investment in a project. The higher the project profitability index, the more desirable is the investment project.

**13-14** The payback period is the length of time for an investment to fully recover its initial cost out of the cash receipts that it generates. The payback method is used as a screening tool for investment proposals. The payback method is useful when a company has cash flow problems. The payback method is also used in industries where obsolescence is very rapid.

**13-15** Neither the payback method nor the simple rate of return method considers the time value of money. Under both methods, a dollar received in the future is weighed the same as a dollar received today. Furthermore, the payback method ignores all cash flows that occur after the initial investment has been recovered.

**Exercise 13-1** (10 minutes)

1.

| *Item* | *Year(s)* | *Cash Flow* | *12% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Annual cost savings.. | 1-10 | $4,000 | 5.650 | $ 22,600 |
| Initial investment ..... | Now | $(25,000) | 1.000 | (25,000) |
| Net present value..... | | | | $ (2,400) |

2.

| *Item* | *Cash Flow* | *Years* | *Total Cash Flows* |
|---|---|---|---|
| Annual cost savings.. | $4,000 | 10 | $ 40,000 |
| Initial investment ..... | $(25,000) | 1 | (25,000) |
| Net cash flow........... | | | $ 15,000 |

**Exercise 13-2** (30 minutes)

| | |
|---|---|
| 1. Annual savings over present method of delivery........ | $5,400 |
| Added contribution margin from expanded deliveries (1,800 pizzas × $2 per pizza) ............................... | 3,600 |
| Annual cash inflows............................................... | $9,000 |

2.

$$\text{Factor of the internal rate of return} = \frac{\text{Investment required}}{\text{Annual cash inflow}}$$

$$= \frac{\$45{,}000}{\$9{,}000} = 5.000$$

Looking in Exhibit 13B-2, and scanning along the six-year line, we can see that the factor computed above, 5.000, is closest to 5.076, the factor for the 5% rate of return. Therefore, to the nearest whole percent, the internal rate of return is 5%.

3. The cash flows are not even over the six-year life of the truck because of the extra $13,000 cash inflow that occurs in the sixth year. Therefore, the approach used above cannot be used to compute the internal rate of return. Using trial-and-error or some other method, the internal rate of return turns out to be about 11%:

| | *Year(s)* | *Amount of Cash Flows* | *11% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Initial investment ..... | Now | $(45,000) | 1.000 | $(45,000) |
| Annual cash inflows.. | 1-6 | $9,000 | 4.231 | 38,079 |
| Salvage value........... | 6 | $13,000 | 0.535 | 6,955 |
| Net present value..... | | | | $ 34 |

As expected, the extra cash inflow in the sixth year increases the internal rate of return.

**Exercise 13-3** (15 minutes)

The equipment's net present value without considering the intangible benefits would be:

| *Item* | *Year(s)* | *Amount of Cash Flows* | *15% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Cost of the equipment .. | Now | $(750,000) | 1.000 | $(750,000) |
| Annual cash savings ..... | 1-10 | $100,000 | 5.019 | 501,900 |
| Net present value ......... | | | | $(248,100) |

The annual value of the intangible benefits would have to be large enough to offset the $248,100 negative present value for the equipment. This annual value can be computed as follows:

$$\frac{\text{Required increase in present value}}{\text{Factor for 10 years}} = \frac{\$248,100}{5.019} = \$49,432$$

**Exercise 13-4** (10 minutes)

1. The project profitability index for each proposal is:

| *Proposal* | *Net Present Value (a)* | *Investment Required (b)* | *Project Profitability Index (a) ÷ (b)* |
|---|---|---|---|
| A | $34,000 | $85,000 | 0.40 |
| B | $50,000 | $200,000 | 0.25 |
| C | $45,000 | $90,000 | 0.50 |
| D | $51,000 | $170,000 | 0.30 |

2. The ranking is:

| *Proposal* | *Project Profitability Index* |
|---|---|
| C | 0.50 |
| A | 0.40 |
| D | 0.30 |
| B | 0.25 |

Note that proposals D and B have the highest net present values of the four proposals, but they rank at the bottom of the list in terms of the project profitability index.

**Exercise 13-5** (10 minutes)

1. The payback period is determined as follows:

| *Year* | *Investment* | *Cash Inflow* | *Unrecovered Investment* |
|---|---|---|---|
| 1 | $38,000 | $2,000 | $36,000 |
| 2 | $6,000 | $4,000 | $38,000 |
| 3 | | $8,000 | $30,000 |
| 4 | | $9,000 | $21,000 |
| 5 | | $12,000 | $9,000 |
| 6 | | $10,000 | $0 |
| 7 | | $8,000 | $0 |
| 8 | | $6,000 | $0 |
| 9 | | $5,000 | $0 |
| 10 | | $5,000 | $0 |

   The investment in the project is fully recovered in the 6th year. To be more exact, the payback period is approximately 6.9 years.

2. Because the investment is recovered prior to the last year, the amount of the cash inflow in the last year has no effect on the payback period.

**Exercise 13-6** (10 minutes)

The annual incremental net operating income is determined by comparing the operating cost of the old machine to the operating cost of the new machine and the depreciation that would be taken on the new machine:

| | |
|---|---|
| Operating cost of old machine | $33,000 |
| Less operating cost of new machine | 10,000 |
| Less annual depreciation on the new machine ($80,000 ÷ 10 years) | 8,000 |
| Annual incremental net operating income | $15,000 |
| Cost of the new machine | $80,000 |
| Less scrap value of old machine | 5,000 |
| Initial investment | $75,000 |

$$\text{Simple rate of return} = \frac{\text{Annual incremental net operating income}}{\text{Initial investment}}$$

$$= \frac{\$15,000}{\$75,000} = 20\%$$

**Exercise 13-7** (15 minutes)

1. Computation of the annual cash inflow associated with the new ride:

| | |
|---|---|
| Net operating income | $63,000 |
| Add: Noncash deduction for depreciation | 27,000 |
| Annual net cash inflow | $90,000 |

The payback computation would be:

$$\text{Payback period} = \frac{\text{Investment required}}{\text{Net annual cash inflow}}$$

$$= \frac{\$450{,}000}{\$90{,}000 \text{ per year}} = 5 \text{ years}$$

Yes, the new ride meets the requirement. The payback period is less than the maximum 6 years required by the Park.

2. The simple rate of return would be:

$$\text{Simple rate of return} = \frac{\text{Annual incremental net operating income}}{\text{Initial investment}}$$

$$= \frac{\$63{,}000}{\$450{,}000} = 14\%$$

Yes, the new ride satisfies the criterion. Its 14% return exceeds the Park's requirement of a 12% return.

**Exercise 13-8** (10 minutes)

1. Note: All present value factors have been taken from Exhibit 13B-1 in Appendix 13B, using a 16% discount rate.

| | | |
|---|---|---|
| Investment in the equipment .................. | | $134,650 |
| Less present value of Year 1 and | | |
| Year 2 cash inflows: | | |
| Year 1: $45,000 × 0.862 ................... | $38,790 | |
| Year 2: $60,000 × 0.743.................... | 44,580 | 83,370 |
| Present value of Year 3 cash inflow ......... | | $ 51,280 |

Therefore, the expected cash inflow for Year 3 is:

$51,280 ÷ 0.641 = $80,000.

**Exercise 13-9** (30 minutes)

1.

| *Item* | *Year(s)* | *Amount of Cash Flows* | *15% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Initial investment ..... | Now | $(40,350) | 1.000 | $(40,350) |
| Annual cash inflows.. | 1-4 | $15,000 | 2.855 | 42,825 |
| Net present value..... | | | | $ 2,475 |

Yes, this is an acceptable investment. Its net present value is positive, which indicates that its rate of return exceeds the minimum 15% rate of return required by the company.

2.

$$\text{Factor of the internal rate of return} = \frac{\text{Investment required}}{\text{Net annual cash inflow}}$$

$$= \frac{\$111{,}500}{\$20{,}000} = 5.575$$

Looking in Exhibit 13B-2, and reading along the 15-year line, we find that a factor of 5.575 represents an internal rate of return of 16%.

3.

$$\text{Factor of the internal rate of return} = \frac{\text{Investment required}}{\text{Net annual cash inflow}}$$

$$= \frac{\$14{,}125}{\$2{,}500} = 5.650$$

Looking in Exhibit 13B-2, and reading along the 10-year line, a factor of 5.650 represents an internal rate of return of 12%. The company did not make a wise investment because the return promised by the machine is less than the required rate of return.

**Exercise 13-10** (30 minutes)

1.

$$\text{Factor of the internal rate of return} = \frac{\text{Required investment}}{\text{Annual cash inflow}}$$

$$= \frac{\$136{,}700}{\$25{,}000} = 5.468$$

Looking in Exhibit 13B-2 and scanning along the 14-period line, a factor of 5.468 represents an internal rate of return of 16%.

2.

| *Item* | *Year(s)* | *Amount of Cash Flows* | *16% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Initial investment ......... | Now | $(136,700) | 1.000 | $(136,700) |
| Annual net cash inflows | 1-14 | $25,000 | 5.468 | 136,700 |
| Net present value ......... | | | | $ 0 |

The reason for the zero net present value is that 16% (the discount rate) represents the machine's internal rate of return. The internal rate of return is the rate that causes the present value of a project's cash inflows to just equal the present value of the investment required.

3.

$$\text{Factor of the internal rate of return} = \frac{\text{Required investment}}{\text{Annual cash inflow}}$$

$$= \frac{\$136{,}700}{\$20{,}000} = 6.835$$

Looking in Exhibit 13B-2 and scanning along the 14-period line, the 6.835 factor is closest to 6.982, the factor for the 11% rate of return. Thus, to the nearest whole percent, the internal rate of return is 11%.

## **Exercise 13-11** (10 minutes)

| *Item* | *Year(s)* | *Amount of Cash Flows* | *16% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Project A: | | | | |
| Investment required. | Now | $(15,000) | 1.000 | $(15,000) |
| Annual cash inflows.. | 1-10 | $4,000 | 4.833 | 19,332 |
| Net present value..... | | | | $ 4,332 |
| | | | | |
| Project B: | | | | |
| Investment ............. | Now | $(15,000) | 1.000 | $(15,000) |
| Cash inflow ............. | 10 | $60,000 | 0.227 | 13,620 |
| Net present value..... | | | | $ (1,380) |

Project A should be selected. Project B does not provide the required 16% return, as shown by its negative net present value.

**Exercise 13-12** (15 minutes)

1. The payback period is:

$$\text{Payback Period} = \frac{\text{Investment required}}{\text{Net annual cash inflow}}$$

$$= \frac{\$180{,}000}{\$37{,}500 \text{ per year}} = 4.8 \text{ years}$$

No, the equipment would not be purchased, because the 4.8-year payback period exceeds the company's maximum 4-year payback period.

2. The simple rate of return would be computed as follows:

| | |
|---|---|
| Annual cost savings | $37,500 |
| Less annual depreciation ($180,000 ÷ 12 years) | 15,000 |
| Annual incremental net operating income | $22,500 |

$$\text{Simple rate of return} = \frac{\text{Annual incremental net operating income}}{\text{Initial investment}}$$

$$= \frac{\$22{,}500}{\$180{,}000} = 12.5\%$$

The equipment would not be purchased because its 12.5% rate of return is less than the company's 14% required rate of return.

**Exercise 13-13** (10 minutes)

$$\text{Factor of the internal rate of return} = \frac{\text{Required investment}}{\text{Annual cash inflow}}$$

$$= \frac{\$307{,}100}{\$50{,}000} = 6.142$$

Looking in Exhibit 13B-2, and scanning *down* the 14% column, we find that a factor of 6.142 equals 15 years. Thus, the equipment will have to be used for 15 years to yield a return of 14%.

**Exercise 13-14** (15 minutes)

| *Item* | *Year(s)* | *Amount of Cash Flows* | *20% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Project A: | | | | |
| Cost of the equipment | Now | $(300,000) | 1.000 | $(300,000) |
| Annual cash inflows | 1-7 | $80,000 | 3.605 | 288,400 |
| Salvage value of the equipment | 7 | $20,000 | 0.279 | 5,580 |
| Net present value | | | | $ (6,020) |
| | | | | |
| Project B: | | | | |
| Working capital investment | Now | $(300,000) | 1.000 | $(300,000) |
| Annual cash inflows | 1-7 | $60,000 | 3.605 | 216,300 |
| Working capital released | 7 | $300,000 | 0.279 | 83,700 |
| Net present value | | | | $ 0 |

The $300,000 should be invested in Project B rather than in Project A. Project B has a zero net present value, which means that it promises exactly a 20% rate of return. Project A is not acceptable at all, since it has a negative net present value.

**Exercise 13-15** (10 minutes)

| | *Year(s)* | *Amount of Cash Flows* | *12% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Purchase of the stock.... | Now | $(18,000) | 1.000 | $(18,000) |
| Annual dividends*......... | 1-4 | $720 | 3.037 | 2,187 |
| Sale of the stock........... | 4 | $22,500 | 0.636 | 14,310 |
| Net present value ......... | | | | $( 1,503) |

*900 shares × $0.80 per share per year = $720 per year.

No, Mr. Critchfield did not earn a 12% return on the stock. The negative net present value indicates that the rate of return on the investment is less than the discount rate of 12%.

**Problem 13-16** (15 minutes)

| *Item* | *Year(s)* | *Amount of Cash Flows* | *14% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Cost of equipment required ...... | Now | $(850,000) | 1.000 | $(850,000) |
| Working capital required .......... | Now | $(100,000) | 1.000 | (100,000) |
| Annual net cash receipts .......... | 1-5 | $230,000 | 3.433 | 789,590 |
| Cost of road repairs ................. | 3 | $(60,000) | 0.675 | (40,500) |
| Salvage value of equipment...... | 5 | $200,000 | 0.519 | 103,800 |
| Working capital released .......... | 5 | $100,000 | 0.519 | 51,900 |
| Net present value .................... | | | | $ (45,210) |

No, the project should not be accepted; it has a negative net present value. This means that the rate of return on the investment is less than the company's required rate of return of 14%.

**Problem 13-17** (30 minutes)

1. The formula for the project profitability index is:

$$\text{Project profitability index} = \frac{\text{Net present value}}{\text{Investment required}}$$

The index for the projects under consideration would be:

Project 1: $87,270 ÷ $480,000 = 0.182
Project 2: $73,400 ÷ $360,000 = 0.204
Project 3: $66,140 ÷ $270,000 = 0.245
Project 4: $72,970 ÷ $450,000 = 0.162

2. a., b., and c.

| | *Net Present Value* | *Project Profitability Index* | *Internal Rate of Return* |
|---|---|---|---|
| First preference ........ | 1 | 3 | 4 |
| Second preference.... | 2 | 2 | 3 |
| Third preference....... | 4 | 1 | 1 |
| Fourth preference..... | 3 | 4 | 2 |

3. Which ranking is best will depend on the company's opportunities for reinvesting funds as they are released from a project. The internal rate of return method assumes that any released funds are reinvested at the internal rate of return. This means that funds released from project #4 would have to be reinvested at a rate of return of 19%, but another project yielding such a high rate of return might be difficult to find.

The project profitability index approach assumes that funds released from a project are reinvested at a rate of return equal to the discount rate, which in this case is only 10%. On balance, the project profitability index is generally regarded as the most dependable method of ranking competing projects.

The net present value is inferior to the project profitability index as a ranking device because it does not properly consider the amount of investment. For example, it ranks project #3 as fourth because of its low net present value; yet this project is the best in terms of the amount of cash inflow generated for each dollar of investment (as shown by the project profitability index).

**Problem 13-18** (30 minutes)

1. The formula for the project profitability index is:

$$\text{Project profitability index} = \frac{\text{Net present value}}{\text{Investment required}}$$

The project profitability index for each project is:

Project A: $221,615 ÷ $800,000 = 0.28
Project B: $210,000 ÷ $675,000 = 0.31
Project C: $175,175 ÷ $500,000 = 0.35
Project D: $152,544 ÷ $700,000 = 0.22

2. a., b., and c.

| | *Net Present Value* | *Project Profitability Index* | *Internal Rate of Return* |
|---|---|---|---|
| First preference .......... | A | C | D |
| Second preference...... | B | B | C |
| Third preference......... | C | A | A |
| Fourth preference....... | D | D | B |

3. Which ranking is best depends on Yancey Company's opportunities for reinvesting funds as they are released from a project. The internal rate of return method assumes that released funds are reinvested at the internal rate of return. For example, funds released from project D would have to be reinvested in another project yielding a rate of return of 22%. It might be difficult to find another project yielding such a high rate of return.

   The project profitability index assumes that funds released from a project are reinvested at a rate of return that is equal to the discount rate, which in this case is only 10%. On balance, the project profitability index is generally regarded as being the most dependable method of ranking competing projects.

   The net present value is inferior to the project profitability index as a ranking device because it does not consider the amount of investment required.

**Problem 13-19** (30 minutes)

1. The annual net cost savings is computed as follows:

| | |
|---|---|
| Reduction in labor costs | $240,000 |
| Reduction in material costs | 96,000 |
| Total cost reductions | 336,000 |
| Less increased maintenance costs ($4,250 × 12) | 51,000 |
| Annual net cost savings | $285,000 |

2. Using this cost savings figure, and other data provided in the text, the net present value analysis is:

| | *Year(s)* | *Amount of Cash Flows* | *18% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Cost of the machine | Now | $(900,000) | 1.000 | $ (900,000) |
| Installation and software | Now | $(650,000) | 1.000 | (650,000) |
| Salvage of the old machine | Now | $70,000 | 1.000 | 70,000 |
| Annual cost savings | 1-10 | $285,000 | 4.494 | 1,280,790 |
| Overhaul required | 6 | $(90,000) | 0.370 | (33,300) |
| Salvage of the new machine | 10 | $210,000 | 0.191 | 40,110 |
| Net present value | | | | $ (192,400) |

No, the etching machine should not be purchased. Its net present value is negative.

3. The intangible benefits would have to be worth at least $42,813 per year as shown below:

$$\frac{\text{Required increase in net present value}}{\text{Factor for 10 years}} = \frac{\$192,400}{4.494} = \$42,813$$

Thus, the new etching machine should be purchased if management believes that the intangible benefits are worth at least $42,813 per year to the company.

**Problem 13-20** (30 minutes)

1. The income statement would be:

| | | |
|---|---|---|
| Sales revenue (72,000 loaves × $1.25 per loaf) ... | | $90,000 |
| Less cost of ingredients ($90,000 × 40%) .......... | | 36,000 |
| Contribution margin........................................ | | 54,000 |
| Selling and administrative expenses: | | |
| Utilities ........................................................ | $ 9,000 | |
| Salaries ........................................................ | 18,000 | |
| Insurance ...................................................... | 3,000 | |
| Depreciation* ................................................ | 7,200 | |
| Total selling and administrative expenses............ | | 37,200 |
| Net operating income ....................................... | | $16,800 |

* $120,000 × 90% = $108,000
$108,000 ÷ 15 years = $7,200 per year.

2. The formula for the simple rate of return is:

$$\text{Simple rate of return} = \frac{\text{Annual incremental net operating income}}{\text{Initial investment}}$$

$$= \frac{\$16,800}{\$120,000} = 14\%$$

Yes, the oven and equipment would be purchased because their return exceeds Mr. Lugano's 12% requirement.

3. The formula for the payback period is:

$$\text{Payback period} = \frac{\text{Initial investment}}{\text{Net annual cash inflow}}$$

$$= \frac{\$120,000}{\$24,000 \text{ per year*}} = 5 \text{ years}$$

*Net operating income + Depreciation = Annual net cash inflow
$16,800 + $7,200 = $24,000.

Yes, the oven and equipment would be purchased. The payback period is less than the 6-year period Mr. Lugano requires.

**Problem 13-21** (20 minutes)

1. The annual net cash inflows would be:

| | |
|---|---|
| Reduction in annual operating costs: | |
| Operating costs, present hand method..... | $35,000 |
| Operating costs, new machine ................ | 14,000 |
| Annual savings in operating costs ........... | 21,000 |
| Increased annual contribution margin: | |
| 5,000 packages × $0.60 per package....... | 3,000 |
| Total annual net cash inflows .................... | $24,000 |

2.

| *Item* | *Year(s)* | *Amount of Cash Flows* | *16% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Cost of the machine ... | Now | $(90,000) | 1.000 | $(90,000) |
| Overhaul required ...... | 5 | $(7,500) | 0.476 | (3,570) |
| Annual net cash inflows.................... | 1-8 | $24,000 | 4.344 | 104,256 |
| Salvage value............. | 8 | $6,000 | 0.305 | 1,830 |
| Net present value....... | | | | $ 12,516 |

**Problem 13-22** (30 minutes)

1. The present value of cash flows would be:

| *Item* | *Year(s)* | *Amount of Cash Flows* | *18% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Purchase alternative: | | | | |
| Purchase cost of the plane .... | Now | $(850,000) | 1.000 | $(850,000) |
| Annual cost of servicing, etc. . | 1-5 | $(9,000) | 3.127 | (28,143) |
| Repairs: | | | | |
| First three years ................ | 1-3 | $(3,000) | 2.174 | (6,522) |
| Fourth year ........................ | 4 | $(5,000) | 0.516 | (2,580) |
| Fifth year .......................... | 5 | $(10,000) | 0.437 | (4,370) |
| Resale value of the plane ...... | 5 | $425,000 | 0.437 | 185,725 |
| Present value of cash flows ... | | | | $(705,890) |
| Lease alternative: | | | | |
| Damage deposit ................... | Now | $ (50,000) | 1.000 | $ (50,000) |
| Annual lease payments ......... | 1-5 | $(200,000) | 3.127 | (625,400) |
| Refund of deposit ................ | 5 | $50,000 | 0.437 | 21,850 |
| Present value of cash flows ... | | | | $(653,550) |
| Net present value in favor of leasing the plane ................. | | | | $ 52,340 |

2. The company should accept the leasing alternative. Even though the total cash flows for leasing exceed the total cash flows for purchasing, the leasing alternative is attractive because of the company's high required rate of return. One of the principal reasons for the attractiveness of the leasing alternative is the low present value of the resale value of the plane at the end of its useful life. If the required rate of return were lower, this present value would be higher and the purchasing alternative would become more attractive relative to the leasing alternative. Leasing is often attractive because those who offer leasing financing, such as pension funds and insurance companies, have a lower required rate of return than those who lease.

**Problem 13-23** (60 minutes)

1. a.

| | | |
|---|---|---|
| Sales revenue | | $350,000 |
| Variable production expenses (@ 20%) | | 70,000 |
| Contribution margin | | 280,000 |
| Fixed expenses: | | |
| Advertising | $42,000 | |
| Salaries | 86,000 | |
| Utilities | 9,000 | |
| Insurance | 13,000 | |
| Depreciation* | 58,500 | |
| Total fixed expenses | | 208,500 |
| Net operating income | | $ 71,500 |

* [$780,000 – (25% × $780,000)] ÷ 10 years = $58,500 per year

b. The formula for the simple rate of return is:

$$\text{Simple rate of return} = \frac{\text{Annual incremental net operating income}}{\text{Initial investment}}$$

$$= \frac{\$71,500}{\$780,000} = 9.2\%$$

c. The formula for the payback period is:

$$\text{Payback period} = \frac{\text{Investment required}}{\text{Net annual cash inflow}}$$

$$= \frac{\$780,000}{\$130,000\text{ per year*}} = 6.0\text{ years}$$

*Net annual cash inflow = Net operating income + Depreciation
= $71,500 + $58,500 = $130,000

**Problem 13-23** (continued)

2. a. A cost reduction project is involved here, so the formula for the simple rate of return would be:

$$\text{Simple rate of return} = \frac{\text{Cost savings - Depreciation}}{\text{Initial investment} - \text{Salvage from old equipment}}$$

The reduction in costs with the new equipment would be:

| | | |
|---|---|---|
| Annual costs, old equipment ................ | | $85,000 |
| Annual costs, new equipment: | | |
| Salary of operator ............................. | $26,000 | |
| Maintenance .................................... | 3,000 | 29,000 |
| Annual savings in costs ........................ | | $56,000 |

Thus, the simple rate of return would be:

$$\frac{\$56,000 - \$22,000^*}{\$220,000 - \$7,200} = \frac{\$34,000}{\$212,800} = 16.0\%$$

*$220,000 ÷ 10 years = $22,000 per year

b. The formula for the payback period remains the same as in Part (1), except we must reduce the investment required by the salvage from sale of the old equipment:

$$\text{Payback period} = \frac{\text{Investment required} - \text{Salvage from old equipment}}{\text{Net annual cash inflow}}$$

$$= \frac{\$220,000 - \$7,200}{\$56,000 \text{ per year}^*} = 3.8 \text{ years}$$

*See Part (2a) above.

3. According to the company's criteria, machine A should not be purchased and machine B should be purchased.

**Problem 13-24** (30 minutes)

1. The income statement is:

| | | |
|---|---|---|
| Sales revenue | | ¥200,000 |
| Commissions (40% × ¥200,000) | | 80,000 |
| Contribution margin | | 120,000 |
| Fixed expenses: | | |
| Maintenance | ¥50,000 | |
| Insurance | 10,000 | |
| Depreciation* | 36,000 | |
| Total fixed expenses | | 96,000 |
| Net operating income | | ¥ 24,000 |

*¥180,000 ÷ 5 years = ¥36,000 per year

2. The initial investment in the simple rate of return calculations is net of the salvage value of the old equipment as shown below:

$$\text{Simple rate of return} = \frac{\text{Annual incremental net operating income}}{\text{Initial investment}}$$

$$= \frac{¥24{,}000}{¥180{,}000\text{-}¥30{,}000} = \frac{¥24{,}000}{¥150{,}000} = 16\%$$

Yes, the games would be purchased. The return exceeds the 14% threshold set by the company.

3. The payback period is:

$$\text{Payback period} = \frac{\text{Invesment required}}{\text{Net annual cash inflow}}$$

$$= \frac{¥180{,}000\text{-}¥30{,}000}{¥60{,}000^{*}} = \frac{¥150{,}000}{¥60{,}000} = 2.5 \text{ years}$$

*Annual net cash inflow = Net operating income + Depreciation
= ¥24,000 + ¥36,000 = ¥60,000.

Yes, the games would be purchased. The payback period is less than the 3 years.

**Problem 13-25** (30 minutes)

1. The total-cost approach:

| | *Year(s)* | *Amount of Cash Flows* | *16% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Purchase the new generator: | | | | |
| Cost of the new generator | Now | $(20,000) | 1.000 | $(20,000) |
| Salvage of the old generator | Now | $4,000 | 1.000 | 4,000 |
| Annual cash operating costs | 1-8 | $(7,500) | 4.344 | (32,580) |
| Salvage of the new generator | 8 | $6,000 | 0.305 | 1,830 |
| Present value of the net cash outflows | | | | $(46,750) |
| Keep the old generator: | | | | |
| Overhaul needed now | Now | $(8,000) | 1.000 | $ (8,000) |
| Annual cash operating costs | 1-8 | $(12,500) | 4.344 | (54,300) |
| Salvage of the old generator | 8 | $3,000 | 0.305 | 915 |
| Present value of the net cash outflows | | | | $(61,385) |
| Net present value in favor of purchasing the new generator | | | | $ 14,635 |

The hospital should purchase the new generator because it has the lowest present value of total cost.

**Problem 13-25** (continued)

2. The incremental-cost approach:

| | *Year(s)* | *Amount of Cash Flows* | *16% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Incremental investment—new generator* | Now | $(12,000) | 1.000 | $(12,000) |
| Salvage of the old generator | Now | $4,000 | 1.000 | 4,000 |
| Savings in annual cash operating costs | 1-8 | $5,000 | 4.344 | 21,720 |
| Difference in salvage value in 8 years | 8 | $3,000 | 0.305 | 915 |
| Net present value in favor of purchasing the new generator | | | | $ 14,635 |

*$20,000 – $8,000 = $12,000.

**Problem 13-26** (45 minutes)

1.

| | | |
|---|---|---|
| Labor savings | €190,000 | |
| Ground mulch savings | 10,000 | €200,000 |
| Less out-of-pocket costs: | | |
| Operator | 70,000 | |
| Insurance | 1,000 | |
| Fuel | 9,000 | |
| Maintenance contract | 12,000 | 92,000 |
| Annual savings in cash operating costs | | €108,000 |

2. The first step is to determine the annual incremental net operating income:

| | |
|---|---|
| Annual savings in cash operating costs | €108,000 |
| Less annual depreciation (€480,000 ÷ 12 years) | 40,000 |
| Annual incremental net operating income | € 68,000 |

$$\text{Simple rate of return} = \frac{\text{Annual incremental net operating income}}{\text{Initial investment}}$$

$$= \frac{€68,000}{€480,000} = 14.2\% \text{ (rounded)}$$

3. The formula for the payback period is:

$$\text{Payback period} = \frac{\text{Investment required}}{\text{Net annual cash inflow}}$$

$$= \frac{€480,000}{€108,000^{*}} = 4.4 \text{ years (rounded)}$$

* In this case, the cash inflow is measured by the annual savings in cash operating costs.

The harvester meets Mr. Despinoy's payback criterion because its payback period is less than 5 years.

**Problem 13-26** (continued)

4. The formula for the internal rate of return is:

$$\text{Factor of the internal rate of return} = \frac{\text{Investment required}}{\text{Net annual cash inflow}}$$

$$= \frac{€480{,}000}{€108{,}000} = 4.4 \text{ (rounded)}$$

Looking at Exhibit 13B-2 in Appendix 13B, and reading along the 12-period line, a factor of 4.4 would represent an internal rate of return of approximately 20%.

Note that the payback and internal rate of return methods would indicate that the investment should be made. The simple rate of return method indicates the opposite since the simple rate of return is less than 16%. The simple rate of return method generally is not an accurate guide in investment decisions.

**Problem 13-27** (60 minutes)

1. The net cash inflow from sales of the detectors for each year would be:

| | Year 1 | Year 2 | Year 3 | Year 4-12 |
|---|---|---|---|---|
| Sales in units | 4,000 | 7,000 | 10,000 | 12,000 |
| Sales in dollars (@ $45 each) | $ 180,000 | $ 315,000 | $450,000 | $540,000 |
| Less variable expenses (@ $25 each) | 100,000 | 175,000 | 250,000 | 300,000 |
| Contribution margin | 80,000 | 140,000 | 200,000 | 240,000 |
| Less fixed expenses: | | | | |
| Advertising | 70,000 | 70,000 | 50,000 | 40,000 |
| Other fixed expenses* | 120,000 | 120,000 | 120,000 | 120,000 |
| Total fixed expenses | 190,000 | 190,000 | 170,000 | 160,000 |
| Net cash inflow (outflow) | $(110,000) | $ (50,000) | $ 30,000 | $ 80,000 |

* Depreciation is not a cash outflow and therefore must be eliminated when determining the net cash flow. The analysis is:

| | |
|---|---|
| Cost of the equipment | $100,000 |
| Less salvage value (10%) | 10,000 |
| Net depreciable cost | $ 90,000 |

$ 90,000 ÷ 12 years = $7,500 per year depreciation
$127,500 – $7,500 depreciation = $120,000 cash fixed expenses

**Problem 13-27** (continued)

2. The net present value of the proposed investment would be:

| *Item* | *Year(s)* | *Amount of Cash Flows* | *20% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Investment in equipment ... | Now | $(100,000) | 1.000 | $(100,000) |
| Working capital investment | Now | $(40,000) | 1.000 | (40,000) |
| Yearly cash flows .............. | 1 | $(110,000) | 0.833 | (91,630) |
| " " " ............... | 2 | $(50,000) | 0.694 | (34,700) |
| " " " ............... | 3 | $30,000 | 0.579 | 17,370 |
| " " " ............... | 4-12 | $80,000 | 2.333 * | 186,640 |
| Salvage value of equipment..................... | 12 | $10,000 | 0.112 | 1,120 |
| Release of working capital . | 12 | $40,000 | 0.112 | 4,480 |
| Net present value ............. | | | | $ (56,720) |

* Present value factor for 12 periods ..................... 4.439
Present value factor for 3 periods ....................... 2.106
Present value factor for 9 periods, starting 4 periods in the future ....................................... 2.333

Since the net present value is negative, the company should not accept the smoke detector as a new product.

**Problem 13-28** (90 minutes)

1.

$$\text{Factor of the internal rate of return} = \frac{\text{Required investment}}{\text{Annual cash inflow}}$$

$$= \frac{\$142,950}{\$37,500} = 3.812$$

From Exhibit 13B-2 in Appendix 13B, reading along the 7-period line, a factor of 3.812 equals an 18% rate of return.

Verification of the 18% rate of return:

| *Item* | *Year(s)* | *Amount of Cash Flows* | *18% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Investment in equipment..... | Now | $(142,950) | 1.000 | $(142,950) |
| Annual cash inflows............ | 1-7 | $37,500 | 3.812 | 142,950 |
| Net present value................ | | | | $ 0 |

2.

$$\text{Factor of the internal rate of return} = \frac{\text{Required investment}}{\text{Annual cash inflow}}$$

We know that the investment is $142,950, and we can determine the factor for an internal rate of return of 14% by looking in Exhibit 13B-2 along the 7-period line. This factor is 4.288. Using these figures in the formula, we get:

$$\frac{\$142,950}{\text{Annual cash inflow}} = 4.288$$

Therefore, the annual cash inflow would have to be:

$142,950 ÷ 4.288 = $33,337.

**Problem 13-28** (continued)

3. a. 5-year life for the equipment:
   The factor for the internal rate of return would still be 3.812 [as computed in (1) above]. From Exhibit 13B-2, reading this time along the 5-period line, a factor of 3.812 is closest to 3.791, the factor for 10%. Thus, to the nearest whole percent, the internal rate of return is 10%.

   b. 9-year life for the equipment:
   The factor of the internal rate of return would again be 3.812. From Exhibit 13B-2, reading along the 9-period line, a factor of 3.812 is closest to 3.786, the factor for 22%. Thus, to the nearest whole percent, the internal rate of return is 22%.

   The 10% return in part (a) is less than the 14% minimum return that Dr. Black wants to earn on the project. Of equal or even greater importance, the following diagram should be pointed out to Dr. Black:

| 5 years 10% | ← 2 years shorter | 7 years 18% | 2 years longer → | 9 years 22% |
|---|---|---|---|---|
| | A reduction of 8% | | An increase of only 4% | |

   As this illustration shows, a *decrease* in years has a much greater impact on the rate of return than an *increase* in years. This is because of the time value of money; added cash inflows far into the future do little to enhance the rate of return, but loss of cash inflows in the near term can do much to reduce it. Therefore, Dr. Black should be *very* concerned about any potential decrease in the life of the equipment, while at the same time realizing that any increase in the life of the equipment will do little to enhance her rate of return.

**Problem 13-28** (continued)

4. a. The expected annual cash inflow would be:

$\$37,500 \times 120\% = \$45,000$

$$\frac{\$142,950}{\$45,000} = 3.177$$

From Exhibit 13B-2 in Appendix 13B, reading along the 7-period line, a factor of 3.177 is closest to 3.161, the factor for 25%, and is between that factor and the factor for 24%. Thus, to the nearest whole percent, the internal rate of return is 25%.

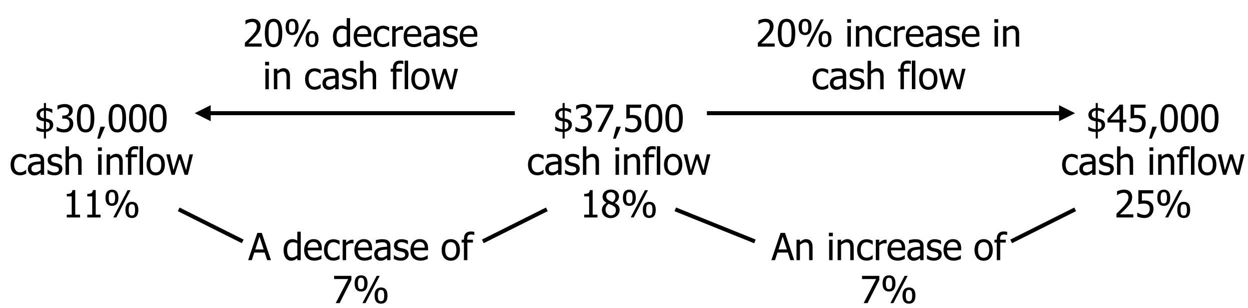
b. The expected annual cash inflow would be:

$\$37,500 \times 80\% = \$30,000$

$$\frac{\$142,950}{\$30,000} = 4.765$$

From Exhibit 13B-2 in Appendix 13B, reading along the 7-period line, a factor of 4.765 is closest to 4.712, the factor for 11%. Thus, to the nearest whole percent, the internal rate of return is 11%.

Unlike changes in time, increases and decreases in cash flows at a given point in time have basically the same impact on the rate of return, as shown below:



**Problem 13-28** (continued)

5. The cash flows are not even over the five-year period (there is an extra $61,375 cash inflow from sale of the equipment at the end of the fifth year), so the formula method cannot be used to compute the internal rate of return. Using trial-and-error or more sophisticated methods, it turns out that the actual internal rate of return will be 12%:

| *Item* | *Year(s)* | *Amount of Cash Flows* | *12% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Investment in the equipment . | Now | $(142,950) | 1.000 | $(142,950) |
| Annual cash inflow ................ | 1-5 | $30,000 | 3.605 | 108,150 |
| Sale of the equipment ........... | 5 | $61,375 | 0.567 | 34,800 |
| Net present value .................. | | | | $ 0 |

**Problem 13-29** (60 minutes)

1. Computation of the annual net cost savings:

| | |
|---|---|
| Savings in labor costs ($16 per hour × 20,000 hours).. | $320,000 |
| Savings in inventory carrying costs ............................ | 190,000 |
| Total ................................................................ | 510,000 |
| Less increased power and maintenance cost ($2,500 per month × 12 months) ........................... | 30,000 |
| Annual net cost savings ........................................... | $480,000 |

2.

| | Year(s) | Amount of Cash Flows | 20% Factor | Present Value of Cash Flows |
|---|---|---|---|---|
| Cost of the robot .............. | Now | $(1,600,000) | 1.000 | $(1,600,000) |
| Software and installation.... | Now | $(700,000) | 1.000 | (700,000) |
| Cash released from inventory....................... | 1 | $300,000 | 0.833 | 249,900 |
| Annual net cost savings ..... | 1-12 | $480,000 | 4.439 | 2,130,720 |
| Salvage value................... | 12 | $90,000 | 0.112 | 10,080 |
| Net present value ............. | | | | $ 90,700 |

Yes, the robot should be purchased. It has a positive net present value at a 20% discount rate.

3. Recomputation of the annual net cost savings:

| | |
|---|---|
| Savings in labor costs ($16 per hour × 17,500 hours).. | $280,000 |
| Savings in inventory carrying costs ............................ | 190,000 |
| Total ................................................................ | 470,000 |
| Less increased power and maintenance cost ($2,500 per month × 12 months) ........................... | 30,000 |
| Annual net cost savings ........................................... | $440,000 |

**Problem 13-29** (continued)

Recomputation of the net present value of the project:

| | *Year(s)* | *Amount of Cash Flows* | *20% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Cost of the robot | Now | $(1,600,000) | 1.000 | $(1,600,000) |
| Software and installation | Now | $(825,000) | 1.000 | (825,000) |
| Cash released from inventory | 1 | $300,000 | 0.833 | 249,900 |
| Annual net cost savings | 1-12 | $440,000 | 4.439 | 1,953,160 |
| Salvage value | 12 | $90,000 | 0.112 | 10,080 |
| Net present value | | | | $ (211,860) |

It appears that the company did not make a wise investment because the rate of return that will be earned by the robot is less than 20%. However, see part 4 below. This illustrates the difficulty in estimating data, and also shows what a heavy impact even seemingly small changes in the data can have on net present value. To mitigate these problems, some companies analyze several scenarios showing the "most likely" results, the "best case" results, and the "worst case" results. Probability analysis can also be used when probabilities can be attached to the various possible outcomes.

4. a. Several intangible benefits are usually associated with investments in automated equipment. These intangible benefits include:
   - Greater throughput.
   - Greater variety of products.
   - Higher quality.
   - Reduction in inventories.

   The president should understand that the value of these benefits can equal or exceed any savings that may come from reduced labor cost. However, these benefits are hard to quantify.

   b. $$\frac{\text{Additional present value required}}{\text{Factor for 12 years}} = \frac{\$211,860}{4.439} = \$47,727$$

   Thus, the intangible benefits in part (a) will have to be worth at least $47,727 per year in order for the robot to yield a 20% rate of return.

**Problem 13-30** (30 minutes)

1. Average weekly use of the washers and dryers would be:

$$\text{Washers: } \frac{\$1{,}800}{\$1.50 \text{ per use}} = 1{,}200 \text{ uses}$$

$$\text{Dryers: } \frac{\$1{,}125}{\$0.75 \text{ per use}} = 1{,}500 \text{ uses}$$

The expected annual net cash receipts would be:

| | | |
|---|---|---|
| Washer cash receipts ($1,800 × 52) ........ | | $ 93,600 |
| Dryer cash receipts ($1,125 × 52) ........... | | 58,500 |
| Total cash receipts .................................. | | 152,100 |
| Less cash disbursements: | | |
| Washer: Water and electricity | | |
| ($0.075 × 1,200 × 52) ...................... | $ 4,680 | |
| Dryer: Gas and electricity | | |
| ($0.09 × 1,500 × 52) ........................ | 7,020 | |
| Rent ($3,000 × 12) .............................. | 36,000 | |
| Cleaning ($1,500 × 12) ........................ | 18,000 | |
| Maintenance and other ($1,875 × 12)... | 22,500 | 88,200 |
| Annual net cash receipts ......................... | | $ 63,900 |

2.

| Item | Year(s) | Amount of Cash Flows | 12% Factor | Present Value of Cash Flows |
|---|---|---|---|---|
| Cost of equipment ........... | Now | $(194,000) | 1.000 | $(194,000) |
| Working capital invested .. | Now | $(6,000) | 1.000 | (6,000) |
| Annual net cash receipts .. | 1-6 | $63,900 | 4.111 | 262,693 |
| Salvage of equipment ...... | 6 | $19,400 | 0.507 | 9,836 |
| Working capital released .. | 6 | $6,000 | 0.507 | 3,042 |
| Net present value ........... | | | | $ 75,571 |

Yes, Mr. White should invest in the laundromat. The positive net present value indicates that the rate of return on this investment would exceed the 12% required rate of return.

**Problem 13-31** (45 minutes)

1. A net present value computation for each investment follows:

| *Item* | *Year(s)* | *Amount of Cash Flows* | *20% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Common stock: | | | | |
| Purchase of the stock ........ | Now | $(80,000) | 1.000 | $(80,000) |
| Sale of the stock .............. | 4 | $180,000 | 0.482 | 86,760 |
| Net present value ............. | | | | $ 6,760 |
| Preferred stock: | | | | |
| Purchase of the stock ........ | Now | $(30,000) | 1.000 | $(30,000) |
| Annual cash dividend (6%)............................ | 1-4 | $1,800 | 2.589 | 4,660 |
| Sale of the stock .............. | 4 | $24,000 | 0.482 | 11,568 |
| Net present value ............. | | | | $(13,772) |
| Bonds: | | | | |
| Purchase of the bonds ....... | Now | $(50,000) | 1.000 | $(50,000) |
| Semiannual interest received ......................... | 1-8* | $3,000 | 5.335** | 16,005 |
| Sale of the bonds ............. | 8* | $58,500 | 0.467** | 27,320 |
| Net present value ............. | | | | $ (6,675) |

* 8 semiannual interest periods.
** Factor for 8 periods at 10%.

Anita earned a 20% rate of return on the common stock, but not on the preferred stock or the bonds.

**Problem 13-31** (continued)

2. Considering all three investments together, Anita did not earn a 20% rate of return. The computation is:

| | *Net Present Value* |
|---|---|
| Common stock | $ 6,760 |
| Preferred stock | (13,772) |
| Bonds | (6,675) |
| Overall net present value | $(13,687) |

   The defect in the broker's computation is that it does not consider the time value of money and therefore has overstated the rate of return earned.

3. Because the assumption is that the project will yield the same annual cash inflow every year, the formula for the net present value of the project is:

$$\text{Net present value of the project} = \text{Present value factor for an annuity} \times \text{Annual cash inflow} - \text{Investment required}$$

   Substituting the $262,500 investment and the factor for 16% for 10 periods into this formula and requiring that the net present value be positive, we get:

$$4.833 \times \text{Annual cash inflow} - \$262,500 > 0$$

   Therefore, the required annual net cash inflow is at least:

$$\text{Annual cash inflow} > \$262,500 \div 4.833 = \$54,314$$

**Problem 13-32** (45 minutes)

The annual net cash inflow from rental of the property would be:

| | |
|---|---|
| Net operating income .......... | $30,100 |
| Add back depreciation ......... | 17,800 |
| Annual net cash inflow ........ | $47,900 |

Given this figure, the present value analysis would be as follows:

| *Item* | *Year(s)* | *Amount of Cash Flows* | *14% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Keep the property: | | | | |
| Annual loan payment ...... | 1-10 | $(12,600) | 5.216 | $ (65,722) |
| Annual net cash inflow .... | 1-16 | $47,900 | 6.265 | 300,094 |
| Resale value of the property ..................... | 16 | $139,600 * | 0.123 | 17,171 |
| Present value of cash flows .......................... | | | | $251,543 |
| Sell the property: | | | | |
| Payoff of mortgage ......... | Now | $(71,000) | 1.000 | $ (71,000) |
| Down payment received.. | Now | $150,000 | 1.000 | 150,000 |
| Annual payments received ..................... | 1-16 | $23,000 | 6.265 | 144,095 |
| Present value of cash flows .......................... | | | | $223,095 |
| Net present value in favor of keeping the property... | | | | $ 28,448 |

*Land: $52,000 × 2.5 = $130,000; Building: $9,600; Total: $139,600.

Thus, Professor Ryatt should be advised to keep the property. Note that even if the property were worth nothing at the end of 16 years, it would still be more desirable to keep the property rather than sell it under the terms offered by the realty company.

**Case 13-33** (90 minutes)

1. This is a least-cost problem; it can be worked either by the total-cost approach or by the incremental-cost approach. Regardless of which approach is used, we must first compute the annual production costs that would result from each of the machines. The computations are:

| | *Year* | | | |
|---|---|---|---|---|
| | *1* | *2* | *3* | *4-10* |
| Units produced | 20,000 | 30,000 | 40,000 | 45,000 |
| Model 2600: Total cost at $0.90 per unit | $18,000 | $27,000 | $36,000 | $40,500 |
| Model 5200: Total cost at $0.70 per unit | $14,000 | $21,000 | $28,000 | $31,500 |

Using these data, the solution by the total-cost approach would be:

| *Item* | *Year(s)* | *Amount of Cash Flows* | *18% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Alternative 1: Purchase the model 2600 machine: | | | | |
| Cost of new machine | Now | $(180,000) | 1.000 | $(180,000) |
| Cost of new machine | 6 | $(200,000) | 0.370 | (74,000) |
| Market value of replacement machine | 10 | $100,000 | 0.191 | 19,100 |
| Production costs (above) | 1 | $(18,000) | 0.847 | (15,246) |
| " " | 2 | $(27,000) | 0.718 | (19,386) |
| " " | 3 | $(36,000) | 0.609 | (21,924) |
| " " | 4-10 | $(40,500) | 2.320 * | (93,960) |
| Repairs and maintenance | 1-10 | $(6,000) | 4.494 | (26,964) |
| Present value of cash outflows | | | | $(412,380) |

**Case 13-33** (continued)

| *Item* | *Year(s)* | *Amount of Cash Flows* | *18% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Alternative 2: Purchase the model 5200 machine: | | | | |
| Cost of new machine | Now | $(250,000) | 1.000 | $(250,000) |
| Production costs (above) | 1 | $(14,000) | 0.847 | (11,858) |
| " " | 2 | $(21,000) | 0.718 | (15,078) |
| " " | 3 | $(28,000) | 0.609 | (17,052) |
| " " | 4-10 | $(31,500) | 2.320 * | (73,080) |
| Repairs and maintenance | 1-10 | $(4,600) | 4.494 | (20,672) |
| Present value of cash outflows | | | | $(387,740) |
| Net present value in favor of Alternative 2 | | | | $ 24,640 |

* Present value factor for 10 periods .......... 4.494
Present value factor for 3 periods .......... 2.174
Present value factor for 7 periods starting 4 periods in the future .......... 2.320

**Case 13-33** (continued)

The solution by the incremental-cost approach would be:

| *Item* | *Year(s)* | *Amount of Cash Flows* | *18% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Incremental cost of the model 5200 machine........... | Now | $(70,000) | 1.000 | $(70,000) |
| Cost avoided on a replacement model 2600 machine............................ | 6 | $200,000 | 0.370 | 74,000 |
| Salvage value forgone on the replacement machine.......... | 10 | $(100,000) | 0.191 | (19,100) |
| Savings in production costs.... | 1 | $4,000 | 0.847 | 3,388 |
| " " " ................... | 2 | $6,000 | 0.718 | 4,308 |
| " " " ................... | 3 | $8,000 | 0.609 | 4,872 |
| " " " ................... | 4-10 | $9,000 | 2.320 | 20,880 |
| Savings on repairs, etc. ......... | 1-10 | $1,400 | 4.494 | 6,292 |
| Net present value................. | | | | $ 24,640 |

Thus, the company should purchase the model 5200 machine and keep the presently owned model 2600 machine on standby.

2. An increase in materials cost would make the model 5200 machine less desirable because it uses more material per unit than the model 2600 machine, as evidenced by the greater material cost per unit.

3. An increase in labor cost would make the model 5200 machine more desirable because it uses less labor time per unit than the model 2600 machine, as evidenced by the lower labor cost per unit.

**Case 13-34** (45 minutes)

1. As a member of the division budget committee that is conducting the postaudit review, Amy Kimbell will be implicitly lending her credibility to any report that is forwarded to the board of directors. If she were to implicitly accept the review by failing to call attention to its shortcomings, she would be violating the credibility standard of the Code of Conduct adopted by the Institute of Management Accountants, which states "Communicate information fairly and objectively. Disclose fully all relevant information that could reasonably be expected to influence an intended user's understanding of the reports, comments, and recommendations presented." The intent of the current postaudit review is clearly to justify the earlier decision to invest in the high-tech operation, rather than to present a fair and balanced view. Unfavorable information has been suppressed.

   Amy is in a delicate situation if the other members of the budget committee are unwilling to heed her concerns. On the one hand, she cannot let the flawed postaudit review go to the board of directors. On the other hand, she needs to maintain good working relations with the other members of the budget committee. And her actions on this committee will likely become known throughout the company and influence her relations with just about everyone she comes into contact with. We suggest that, as diplomatically as she can, she should firmly state that she feels the postaudit review is an important document, but the current version is deeply flawed, and that she respects the opinions of the other members of the committee, but will feel obligated to file a minority report if the current version is sent to the board of directors. Quite often, the threat of such a report is enough to bring the other members of the committee to their senses. If it does not have this effect, then she should file the minority report.

**Case 13-34** (continued)

2. Unfortunately, the situation that Amy faces is all too common. Rather than acknowledge mistakes and cut losses, managers (and people in general) too often remain committed to their failing courses of action. This commitment leads people into self-delusion, self-justification, and cover-ups—all of which sap time and energy as well as perpetuating the results of bad decisions. Postaudits, if conducted properly, provide an escape route from this self-defeating behavior.

   The review process is flawed from the very beginning if the postaudit review is prepared by the same people who approved the original proposal. The people who approved the original proposal are probably going to be interested in justifying their original decision rather than in conducting an objective review. Therefore, the postaudit review should be conducted by an independent group—perhaps the company's internal audit office—rather than by the division budget committees.

**Case 13-35** (45 minutes)

1. Perhaps the clearest approach to a solution is as follows:

| *Item* | *Year(s)* | *Amount of Cash Flows* | *12% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Purchase of facilities: | | | | |
| Initial payment .......... | Now | $(6,000,000) | 1.000 | $ (6,000,000) |
| Annual payments ....... | 1-4 | $(2,000,000) | 3.037 | (6,074,000) |
| Annual cash operating costs ...................... | 1-20 | $(200,000) | 7.469 | (1,493,800) |
| Resale value of facilities .................. | 20 | $5,000,000 | 0.104 | 520,000 |
| Present value of cash flows ...................... | | | | $(13,047,800) |
| Lease of facilities: | | | | |
| Initial deposit ............ | Now | $(400,000) | 1.000 | $ (400,000) |
| First lease payment.... | Now | $(1,000,000) | 1.000 | (1,000,000) |
| Remaining lease payments ............... | 1-19 | $(1,000,000) | 7.366 | (7,366,000) |
| Annual repair and maintenance........... | 1-20 | $(50,000) | 7.469 | (373,450) |
| Return of deposit ....... | 20 | $400,000 | 0.104 | 41,600 |
| Present value of cash flows ...................... | | | | $ (9,097,850) |
| Net present value in favor of leasing the facilities.................... | | | | $ 3,949,950 |

This is a least-cost decision. In this particular case, the simplest way to handle the data is the total-cost approach as shown above. The problem with Harry Wilson's approach, in which he simply added up the payments, is that it ignores the time value of money. The purchase option ties up large amounts of funds that could be earning a return elsewhere.

**Case 13-35** (continued)

The incremental-cost approach is another way to organize the data, although it is harder to follow and would not be as clear in a presentation to the executive committee. The data could be arranged as follows:

***Lease rather than buy:***

| *Item* | *Year(s)* | *Amount of Cash Flows* | *12% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|
| Initial payment avoided[1] .. | Now | $5,000,000 | 1.000 | $5,000,000 |
| Deposit.......................... | Now | $(400,000) | 1.000 | (400,000) |
| Annual purchase payments avoided......... | 1-4 | $2,000,000 | 3.037 | 6,074,000 |
| Annual lease payments.... | 1-19 | $(1,000,000) | 7.366 | (7,366,000) |
| Cash operating cost savings[2] ...................... | 1-20 | $150,000 | 7.469 | 1,120,350 |
| Forgone resale value of facilities, net of the return of deposit[3].......... | 20 | $(4,600,000) | 0.104 | (478,400) |
| Net present value in favor of leasing the facilities... | | | | $3,949,950 |

[1] $6,000,000 – $1,000,000 = $5,000,000
[2] $200,000 – $50,000 = $150,000
[3] $5,000,000 – $400,000 = $4,600,000

2. The present value of $5 million in 20 years is only $520,000 if the company can invest its funds at 12%. Money to be received far into the future is worth very little in terms of present value when the discount rate is high. The facility's future value would have to be more than $37,980,000 (= $3,949,950 ÷ 0.104) higher than Harry Wilson has assumed to overturn the conclusion that leasing is the more attractive alternative.

# Appendix 13A
## The Concept of Present Value

**Exercise 13A-1** (10 minutes)

a. From Exhibit 13B-1, the present value factor for 8% for three periods is 0.794. Therefore, the present value of the investment in the garage is \$317,600 (=\$400,000 × 0.794). If \$317,600 is invested now at 8%, in three years it will have grown to \$400,000.

b. From Exhibit 13B-1, the present value factor for 12% for three periods is 0.712. Therefore, the present value of the investment in the garage is \$284,800 (=\$400,000 × 0.712). If \$284,800 is invested now at 12%, in three years it will have grown to \$400,000.

**Exercise 13A-2** (10 minutes)

You should prefer option (a) because its present value is the largest:

Option a: \$50,000 × 1.000 = \$50,000.
Option b: \$75,000 × 0.507 = \$38,025. (From Exhibit 13B-1)
Option c: \$12,000 × 4.111 = \$49,332. (From Exhibit 13B-2)

**Exercise 13A-3** (10 minutes)

a. From Exhibit 13B-1, the factor for 6% for 3 periods is 0.840. Therefore, the present value of the required investment is:

\$12,000 × 0.840 = \$10,080.

b. From Exhibit 13B-1, the factor for 10% for 3 periods is 0.751. Therefore, the present value of the required investment is:

\$12,000 × 0.751 = \$9,012.

**Exercise 13A-4** (10 minutes)

Looking in Exhibit 13B-2, the factor for 10% for 20 years is 8.514. Thus, the present value of Sally's winnings would be:

$50,000 × 8.514 = $425,700.

Whether or not Sally really won a million dollars depends on your point of view. She will receive a million dollars over the next 20 years; however, in terms of its value *right now* she won much less than a million dollars as shown by the present value computation above.

**Exercise 13A-5** (10 minutes)

| | *Amount of Cash Flows* | | | *Present Value of Cash Flows* | |
|---|---|---|---|---|---|
| *Year* | *Investment X* | *Investment Y* | *20% Factor* | *Investment X* | *Investment Y* |
| 1 | $1,000 | $4,000 | 0.833 | $ 833 | $3,332 |
| 2 | $2,000 | $3,000 | 0.694 | 1,388 | 2,082 |
| 3 | $3,000 | $2,000 | 0.579 | 1,737 | 1,158 |
| 4 | $4,000 | $1,000 | 0.482 | 1,928 | 482 |
| | | | | $5,886 | $7,054 |

**Exercise 13A-6** (10 minutes)

a. From Exhibit 13B-2, the present value factor for a six year annuity at an interest rate of 10% is 4.355. Therefore, the present value of the $5,000 annual savings is $21,775 (= $5,000 × 4.355). Consequently, the company should be willing to pay up to that amount, or $21,775 for the copier.

b. From Exhibit 13B-2, the present value factor for a six year annuity at an interest rate of 16% is 3.685. Therefore, the present value of the $5,000 annual savings is $18,425 (= $5,000 × 3.685). Consequently, the company should be willing to pay up to that amount, or $18,425 for the copier.

# Appendix 13C
## Income Taxes in Capital Budgeting Decisions

**Exercise 13C-1** (20 minutes)

| *Items and Computations* | *Year(s)* | *(1) Amount* | *(2) Tax Effect* | *(1) × (2) After-Tax Cash Flows* | *10% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|---|---|
| Project A: | | | | | | |
| Investment in photocopier ............. | Now | $(50,000) | — | $(50,000) | 1.000 | $(50,000) |
| Annual net cash inflows ................. | 1-8 | $9,000 | 1 – 0.30 | $6,300 | 5.335 | 33,611 |
| Depreciation deductions* ............... | 1-8 | $6,250 | 0.30 | $1,875 | 5.335 | 10,003 |
| Salvage value of the photocopier ...... | 8 | $5,000 | 1 – 0.30 | $3,500 | 0.467 | 1,635 |
| Net present value .......................... | | | | | | $( 4,751) |
| Project B: | | | | | | |
| Investment in working capital ........ | Now | $(50,000) | — | $(50,000) | 1.000 | $(50,000) |
| Annual net cash inflows ................. | 1-8 | $9,000 | 1 – 0.30 | $6,300 | 5.335 | 33,611 |
| Release of working capital ............. | 8 | $50,000 | — | $50,000 | 0.467 | 23,350 |
| Net present value .......................... | | | | | | $ 6,961 |

* $50,000 ÷ 8 years = $6,250 per year

**Exercise 13C-2** (20 minutes)

1. Annual cost of student help in collating

| | | |
|---|---|---|
| Annual cost of student help in collating | | $60,000 |
| Annual cost of the new collating machine: | | |
| Operator | $18,000 | |
| Maintenance | 7,000 | 25,000 |
| Annual net cost savings (cash inflow) | | $35,000 |

2. The net present value analysis follows:

| Items and Computations | Year(s) | (1) Amount | (2) Tax Effect | (1) × (2) After-Tax Cash Flows | 14% Factor | Present Value of Cash Flows |
|---|---|---|---|---|---|---|
| Cost of the new collating machine | Now | $(140,000) | | $(140,000) | 1.000 | $(140,000) |
| Annual net cost savings (above) | 1-10 | $35,000 | 1 – 0.30 | $24,500 | 5.216 | 127,792 |
| Depreciation deductions* | 1-10 | $14,000 | 0.30 | $4,200 | 5.216 | 21,907 |
| Cost of the new roller pads | 5 | $(20,000) | 1 – 0.30 | $(14,000) | 0.519 | (7,266) |
| Salvage value of the new machine | 10 | $40,000 | 1 – 0.30 | $28,000 | 0.270 | 7,560 |
| Net present value | | | | | | $ 9,993 |

* $140,000 ÷ 10 years = $14,000 per year

Yes, the new collating machine should be purchased.

**Exercise 13C-3** (10 minutes)

1.

| | |
|---|---|
| Management consulting fee....... | $100,000 |
| Multiply by 1 – 0.30 ................. | × 0.70 |
| After-tax cost.......................... | $ 70,000 |

2.

| | |
|---|---|
| Increased revenues.................. | $40,000 |
| Multiply by 1 – 0.30 ................. | × 0.70 |
| After-tax cash flow (benefit)...... | $28,000 |

3. The depreciation deduction is $210,000 ÷ 7 years = $30,000 per year, which has the effect of reducing taxes by 30% of that amount, or $9,000 per year.

**Problem 13C-4** (20 minutes)

| *Items and Computations* | *Year(s)* | *(1) Amount* | *(2) Tax Effect* | *(1) × (2) After-Tax Cash Flows* | *12% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|---|---|
| Investment in new trucks | Now | $(450,000) | | $(450,000) | 1.000 | $(450,000) |
| Salvage from sale of the old trucks | Now | $30,000 | 1 – 0.30 | $21,000 | 1.000 | 21,000 |
| Annual net cash receipts | 1-8 | $108,000 | 1 – 0.30 | $75,600 | 4.968 | 375,581 |
| Depreciation deductions* | 1-8 | $56,250 | 0.30 | $16,875 | 4.968 | 83,835 |
| Overhaul of motors | 5 | $(45,000) | 1 – 0.30 | $(31,500) | 0.567 | (17,861) |
| Salvage from the new trucks | 8 | $20,000 | 1 – 0.30 | $14,000 | 0.404 | 5,656 |
| Net present value | | | | | | $ 18,211 |

* $450,000 ÷ 8 years = $56,250 per year

Because the project has a positive net present value, the contract should be accepted.

**Problem 13C-5** (45 minutes)

| *Items and Computations* | *Year(s)* | *(1) Amount* | *(2) Tax Effect* | *(1) × (2) After-Tax Cash Flows* | *8% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|---|---|
| Alternative 1: | | | | | | |
| Investment in the bonds .......... | Now | $(200,000) | | $(200,000) | 1.000 | $(200,000) |
| Interest on the bonds (8% × $200,000) ................ | 1-12 | $16,000 | | $16,000 | 7.536 | 120,576 |
| Maturity of the bonds ............. | 12 | $200,000 | | $200,000 | 0.397 | 79,400 |
| Net present value ................... | | | | | | $( 24)* |

* This amount should be zero; the difference is due to rounding of the discount factors. (Because the bonds yield 8% after taxes, they would have a zero net present value at an 8% discount rate.)

**Problem 13C-5** (continued)

| *Items and Computations* | *Year(s)* | *(1) Amount* | *(2) Tax Effect* | *(1) × (2) After-Tax Cash Flows* | *8% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|---|---|
| Alternative 2: | | | | | | |
| Investment in the business ............... | Now | $(200,000) | — | $(200,000) | 1.000 | $(200,000) |
| Annual net cash receipts | | | | | | |
| ($400,000 – $370,000 = $30,000).. | 1-12 | $30,000 | 1 – 0.40 | $18,000 | 7.536 | 135,648 |
| Depreciation deductions: | | | | | | |
| Year 1: 14.3% of $80,000 ............. | 1 | $11,440 | 0.40 | $4,576 | 0.926 | 4,237 |
| Year 2: 24.5% of $80,000 ............. | 2 | $19,600 | 0.40 | $7,840 | 0.857 | 6,719 |
| Year 3: 17.5% of $80,000 ............. | 3 | $14,000 | 0.40 | $5,600 | 0.794 | 4,446 |
| Year 4: 12.5% of $80,000 ............. | 4 | $10,000 | 0.40 | $4,000 | 0.735 | 2,940 |
| Year 5: 8.9% of $80,000 ............. | 5 | $7,120 | 0.40 | $2,848 | 0.681 | 1,939 |
| Year 6: 8.9% of $80,000 ............. | 6 | $7,120 | 0.40 | $2,848 | 0.630 | 1,794 |
| Year 7: 8.9% of $80,000 ............. | 7 | $7,120 | 0.40 | $2,848 | 0.583 | 1,660 |
| Year 8: 4.5% of $80,000 ............. | 8 | $3,600 | 0.40 | $1,440 | 0.540 | 778 |
| Recovery of working capital | | | | | | |
| ($200,000 – $80,000 = $120,000).. | 12 | $120,000 | — | $120,000 | 0.397 | 47,640 |
| Net present value ............................ | | | | | | $ 7,801 |

The net present value of Alternative 2 is higher than the net present value of Alternative 1. That certainly gives the edge to Alternative 2. However, the additional net present value is so small that it may be outweighed by the higher risk of Alternative 2 and the potential hassles of owning a store.

**Problem 13C-6** (30 minutes)

1. The net present value analysis would be:

| *Items and Computations* | *Year(s)* | *(1) Amount* | *(2) Tax Effect* | *(1) × (2) After-Tax Cash Flows* | *10% Factor* | *Present Value of Cash Flows* |
|---|---|---|---|---|---|---|
| Investment in equipment ............. | Now | $(600,000) | | $(600,000) | 1.000 | $(600,000) |
| Working capital needed ................ | Now | $(85,000) | | $(85,000) | 1.000 | (85,000) |
| Annual net cash receipts .............. | 1-10 | $110,000 | 1 – 0.30 | $77,000 | 6.145 | 473,165 |
| Depreciation deductions ............... | 1-10 | $60,000 | 0.30 | $18,000 | 6.145 | 110,610 |
| Cost of restoring land .................... | 10 | $(70,000) | 1 – 0.30 | $(49,000) | 0.386 | (18,914) |
| Salvage value of the equipment* ... | 10 | $90,000 | 1 – 0.30 | $63,000 | 0.386 | 24,318 |
| Working capital released ............. | 10 | $85,000 | | $85,000 | 0.386 | 32,810 |
| Net present value ........................ | | | | | | $( 63,011) |

*$600,000 × 15% = $90,000.

2. No, the investment project should not be undertaken. It has a negative net present value.