

## Marketing Math

To develop marketing strategies to meet the goals of an organization effectively and efficiently, it is essential that marketers understand and use a variety of financial analyses. This supplement provides some of these basic financial analyses, including a review of the income statement and balance sheet, as well as some basic performance ratios. In addition, this supplement includes an explanation of some of the specific calculations that marketers use routinely to set prices for their goods and services.

### Income Statement and Balance Sheet

The two most important documents used to analyze the financial situation of a company are the income statement and the balance sheet. The *income statement* (which is sometimes referred to as the *profit and loss statement* or the *P&L*) provides a summary of the revenues and expenses of a firm—that is, the amount of income a company received from sales or other sources, the amount of money it spent, and the resulting income or loss that the company experienced.

The major elements of the income statement are as follows:

- **Gross sales** are the total of all income the firm receives from the sales of goods and services.
- **Net sales revenue** is the gross sales minus the amount for returns and promotional or other allowances given to customers.
- **Cost of goods sold** (sometimes called the *cost of sales*) is the cost of inventory or goods that the firm has sold.
- **Gross margin** (also called *gross profit*) is the amount of sales revenue that is in excess of the cost of goods sold.
- **Operating expenses** are expenses other than the cost of goods sold that are necessary for conducting business. These may include salaries, rent, depreciation on buildings and equipment, insurance, utilities, supplies, and property taxes.
- **Operating income** (sometimes called *income from operations*) is the gross margin minus the operating expenses. Sometimes accountants prepare an *operating statement*, which is similar to the income statement except that the final calculation is the operating income—that is, other revenues or expenses and taxes are not included.
- **Other revenue and expenses** are income and/or expenses other than those required for conducting the business. These may include items such as interest income/expenses and any gain or loss experienced from the sale of property or plant assets.
- **Taxes** are the amount of income tax the firm owes calculated as a percentage of income.

- **Net income** (sometimes called *net earnings* or *net profit*) is the excess of total revenue over total expenses.

Table 10S.1 shows the income statement for an imaginary company, DLL Incorporated. DLL is a typical merchandising firm. Note that the income statement is for a specific year and includes income and expenses inclusively from January 1 through December 31. The following comments explain the meaning of some of the important entries included in this statement.

- DLL Inc. has total or gross sales during the year of \$253,950. This figure was adjusted, however, by deducting the \$3,000 worth of goods returned and special allowances given to customers and by \$2,100 in special discounts. Thus, the actual or net sales generated by sales is \$248,850.
- The cost of goods sold is calculated by adding the inventory of goods on January 1 to the amount purchased during the year and then subtracting the inventory of goods on December 31. In this case, DLL had \$60,750 worth of inventory on hand on January 1. During the year the firm made purchases in the amount of \$135,550. This amount, however, was reduced by purchase returns and allowances of \$1,500 and by purchase discounts of \$750, so the net purchases are only \$133,300.

**Table 10S.1** | DLL Income Statement for the Year Ended December 31, 2008

Gross Sales		\$253,950	
Less: Sales Returns and Allowances	\$ 3,000		
Sales Discounts	<u>2,100</u>	<u>5,100</u>	
Net Sales Revenue			\$248,850
Cost of Goods Sold			
Inventory, January 1, 2014		60,750	
Purchases	135,550		
Less: Purchase Returns and Allowances	1,500		
Purchase Discounts	750		
Net Purchases	<u>133,300</u>		
Plus: Freight-In	2,450	<u>135,750</u>	
Goods Available for Sale		196,500	
Less: Inventory, December 31, 2014		<u>60,300</u>	
Cost of Goods Sold			<u>136,200</u>
Gross Margin			112,650
Operating Expenses			
Salaries and Commissions		15,300	
Rent		12,600	
Insurance		1,500	

Depreciation	900	
Supplies	<u>825</u>	
Total Operating Expenses		<u>31,125</u>
Operating Income		81,525
Other Revenue and (Expenses)		
Interest Revenue	1,500	
Interest Expense	(2,250)	<u>(750)</u>
Income Before Tax		80,775
Taxes (40%)		<u>32,310</u>
Net Income		<u>\$ 48,465</u>

There is also an amount on the statement labeled “Freight-In.” This is the amount spent by the firm in shipping charges to get goods to its facility from suppliers. Any expenses for freight from DLL to its customers (Freight-Out) would be an operating expense. In this case, the Freight-In expense of \$2,450 is added to net purchase costs. Then these costs of current purchases are added to the beginning inventory to show that during the year the firm had a total of \$196,500 in goods available for sale. Finally, the inventory of goods held on December 31 is subtracted from the goods available for sale, to reveal the total cost of goods sold of \$136,200.

We mentioned that DLL Inc. is a merchandising firm—a retailer of some type. If DLL were instead a manufacturer, calculation of the cost of goods sold would be a bit more complicated and would probably include separate figures for items such as inventory of finished goods, the “work-in-process” inventory, the raw materials inventory, and the cost of goods delivered to customers during the year. Continuing down the previous income statement we have the following:

- The cost of goods sold is subtracted from the net sales revenue to get a gross margin of \$112,650.
- Operating expenses for DLL include the salaries and commissions paid to its employees, rent on facilities and/or equipment, insurance, depreciation of capital items, and the cost of operating supplies. DLL has a total of \$31,125 in operating expenses, which is deducted from the gross margin. Thus, DLL has an operating income of \$81,525.
- DLL had both other income and expenses in the form of interest revenues of \$1,500 and interest expenses of \$2,250, making a total other expense of \$750, which was subtracted from the operating income, leaving an income before taxes of \$80,775.
- Finally, the income before taxes is reduced by 40 percent (\$32,310) for taxes, leaving a net income of \$48,465. The 40 percent is an average amount for federal and state corporate income taxes incurred by most firms.

The *balance sheet* lists the assets, liabilities, and stockholders’ equity of the firm. Whereas the income statement represents what happened during an entire year, the balance sheet is like a snapshot; it shows the firm’s financial situation at one point in time. For this reason, the balance sheet is sometimes called the *statement of financial position*.

Table 10S.2 shows DLL Inc.’s balance sheet for December 31. Assets include any economic resource that is expected to benefit the firm in the short or long term. *Current assets* are items that are normally expected to be turned into cash or used up during the next 12 months or during the firm’s normal operating cycle. Current assets for DLL include cash, securities, accounts

receivable (money owed to the firm and not yet paid), inventory on hand, prepaid insurance, and supplies: a total of \$84,525. *Long-term assets* include all assets that are not current assets. For DLL, these are furniture and fixtures (less an amount for depreciation) and land, or \$45,300. The *total assets* for DLL are \$129,825.

**Table 10S.2** | DLL Inc. Balance Sheet: December 31, 2008

<b>Assets</b>			
Current assets			
Cash		\$ 4,275	
Marketable securities		12,000	
Accounts receivable		6,900	
Inventory		60,300	
Prepaid insurance		300	
Supplies		<u>150</u>	
Total current assets			84,525
Long-term assets—property, plant and equipment			
Furniture and fixtures	\$42,300		
Less: accumulated depreciation	<u>4,500</u>	37,800	
Land		<u>7,500</u>	
Total long-term assets			<u>45,300</u>
Total assets			<u>\$129,825</u>
<b>Liabilities</b>			
Current liabilities			
Accounts payable	\$70,500		
Unearned sales revenue	1,050		
Wages payable	600		
Interest payable	<u>300</u>		
Total current liabilities		72,450	
Long-term liabilities			
Note payable		<u>18,900</u>	
Total liabilities			91,350
Stockholders' equity			
Common stock		15,000	
Retained earnings		<u>23,475</u>	
Total stockholders' equity			<u>38,475</u>
Total liabilities and stockholders' equity			<u>\$129,825</u>

A firm's *liabilities* are its economic obligations, or debts that are payable to individuals or organizations outside the firm. *Current liabilities* are debts due to be paid in the coming year or

during the firm's normal operating cycle. For DLL, the current liabilities—the accounts payable, unearned sales revenue, wages payable, and interest payable—total \$72,450. *Long-term liabilities* (in the case of DLL, a note in the amount of \$18,900) are all liabilities that are not due to be paid during the coming cycle. *Stockholders' equity* is the value of the stock and the corporation's capital or retained earnings. DLL has \$15,000 in common stock and \$23,475 in retained earnings for a total stockholders' equity of \$38,475. Total liabilities always equal total assets—in this case \$129,825.

## Important Financial Performance Ratios

How do managers and financial analysts compare the performance of a firm from one year to the next? How do investors compare the performance of one firm with that of another? As the book notes, managers often rely upon various metrics to measure performance.

Often a number of different financial ratios provide important information for such comparisons. Such *ratios* are percentage figures comparing various income statement items to net sales. Ratios provide a better way to compare performance than simple dollar sales or cost figures for two reasons. They enable analysts to compare the performance of large and small firms, and they provide a fair way to compare performance over time without having to take inflation and other changes into account. In this section, we will explain the basic operating ratios. Other measures of performance that marketers frequently use and that are also explained here are the inventory turnover rate and return on investment (ROI).

### Operating Ratios

Measures of performance calculated directly from the information in a firm's income statement (sometimes called an operating statement) are called the *operating ratios*. Each ratio compares some income statement item to net sales. The most useful of these are the *gross margin ratio*, the *net income ratio*, the *operating expense ratio*, and the *returns and allowances ratio*. These ratios vary widely by industry but tend to be important indicators of how a firm is doing within its industry. The ratios for DLL Inc. are shown in Table 10S.3.

- **Gross margin ratio** shows what percentage of sales revenues is available for operating and other expenses and for profit. With DLL, this means that 45 percent, or nearly half, of every sales dollar is available for operating costs and for profits.
- **Net income ratio** (sometimes called the *net profit ratio*) shows what percentage of sales revenues is income or profit. For DLL, the net income ratio is 19.5 percent. This means that the firm's profit before taxes is about 20 cents of every dollar.
- **Operating expense ratio** is the percentage of sales needed for operating expenses. DLL has an operating expense ratio of 12.5 percent. Tracking operating expense ratios from one year to the next or comparing them with an industry average gives a firm important information about the efficiency of its operations.
- **Returns and allowances ratio** shows what percentage of all sales is being returned, probably by unhappy customers. DLL's returns and allowances ratio shows that only a little over 1 percent of sales is being returned.

**Table 10S.3** | Hypothetical Operating Ratios for DLL Inc.

Gross margin ratio	$= \frac{\text{gross margin}}{\text{net sales}}$	$= \frac{\$112,650}{248,850} = 45.3\%$
Net Income ratio	$= \frac{\text{net income}}{\text{net sales}}$	$= \frac{\$48,465}{248,850} = 19.5\%$
Operating expense ratio	$= \frac{\text{total operating expenses}}{\text{net sales}}$	$= \frac{\$31,125}{248,850} = 12.5\%$
Returns and allowances ratio	$= \frac{\text{return and allowances}}{\text{net sales}}$	$= \frac{\$3,000}{248,850} = 1.2\%$

## Inventory Turnover Rate

The *inventory turnover rate*, also referred to as the *stockturn rate*, is the number of times inventory or stock is turned over (sold and replaced) during a specified time period, usually a year. Inventory turnover rates are usually calculated on the basis of inventory costs, sometimes on the basis of inventory selling prices, and sometimes by number of units.

In our example, for DLL Inc. we know that for the year the cost of goods sold was \$136,200. Information on the balance sheet enables us to find the average inventory. By adding the value of the beginning inventory to the ending inventory and dividing by 2, we can compute an average inventory. In the case of DLL, this would be as follows:

$$\frac{\$60,750 + \$60,300}{2} = \$60,525$$

Thus,

$$\text{inventory turnover rate (in cost of goods sold)} = \frac{\text{costs of goods sold}}{\text{average inventory at cost}} = \frac{\$136,200}{\$60,525} = 2.25 \text{ times}$$

## Return on Investment

Firms often develop business objectives in terms of *return on investment (ROI)*, and ROI is often used to determine how effective (and efficient) the firm's management has been. First, however, we need to define exactly what a firm means by investment. In most cases, firms define investment as the total assets of the firm. To calculate the ROI, we need the net income found in the income statement and the total assets (or investment) found in the firm's balance sheet.

Return on investment is calculated as follows:

$$\text{ROI} = \frac{\text{net income}}{\text{total investment}}$$

For DLL Inc., if the total assets are \$129,825 then the ROI is as follows:

$$\frac{\$48,465}{\$129,825} = 37.3\%$$

Sometimes return on investment is calculated by using an expanded formula:

$$\begin{aligned}\text{ROI} &= \frac{\text{net profit}}{\text{sales}} \times \frac{\text{sales}}{\text{investment}} \\ &= \frac{\$48,465}{\$248,850} \times \frac{\$248,850}{\$129,825} = 37.3\%\end{aligned}$$

This formula makes it easy to show how ROI can be increased and what might reduce ROI. For example, there are different ways to increase ROI. First, if the management focuses on cutting costs and increasing efficiency, profits may be increased while sales remain the same:

$$\begin{aligned}\text{ROI} &= \frac{\text{net profit}}{\text{sales}} \times \frac{\text{sales}}{\text{investment}} \\ &= \frac{\$53,277}{\$248,850} \times \frac{\$248,850}{\$129,825} = 41.0\%\end{aligned}$$

But ROI can be increased just as much without improving performance simply by reducing the investment—by maintaining less inventory:

$$\begin{aligned}\text{ROI} &= \frac{\text{net profit}}{\text{sales}} \times \frac{\text{sales}}{\text{investment}} \\ &= \frac{\$48,465}{\$248,850} \times \frac{\$248,850}{\$114,825} = 42.2\%\end{aligned}$$

Sometimes, however, differences among the total assets of firms may be related to the age of the firm or the type of industry, which makes ROI a poor indicator of performance. For this reason, some firms have replaced the traditional ROI measures with *return on assets managed* (ROAM), *return on net assets* (RONA), or *return on stockholders' equity* (ROE).

## Price Elasticity

Price elasticity, discussed in Chapter 10, is a measure of the sensitivity of customers to changes in price. Price elasticity is calculated by comparing the percentage change in quantity to the percentage change in price:

$$\text{Price elasticity of demand} = \frac{\text{percentage change in quantity}}{\text{percentage change in price}}$$

$$E = \frac{(Q_2 - Q_1)Q_1}{(P_2 - P_1)P_1}$$

where  $Q$  = quantity and  $P$  = price

For example, suppose a manufacturer of jeans increased its price for a pair of jeans from \$30.00 to \$35.00. But instead of 40,000 pairs being sold, sales declined to only 38,000 pairs. The price elasticity would be calculated as follows:

$$E = \frac{(38,000 - 40,000)/40,000}{(\$35.00 - 30.00)/\$30.00} = \frac{-0.05}{0.167} = 0.30$$

Note that elasticity is usually expressed as a positive number even though the calculations create a negative value.

In this case, a relatively small change in demand (5 percent) resulted from a fairly large change in price (16.7 percent), indicating that demand is inelastic. At 0.30, the elasticity is less than 1.

On the other hand, what if the same change in price resulted in a reduction in demand to 30,000 pairs of jeans? Then the elasticity would be as follows:

$$E = \frac{(30,000 - 40,000)/40,000}{(\$35.00 - 30.00)/\$30.00} = \frac{-0.25}{0.167} = 1.50$$

In this case, because the 16.7 percent change in price resulted in an even larger change in demand (25 percent), demand is elastic. The elasticity of 1.50 is greater than 1.

Note: Elasticity may also be calculated by dividing the change in quantity by the average of  $Q_1$  and  $Q_2$  and dividing the change in price by the average of the two prices. However, we have chosen to include the formula that uses the initial quantity and price rather than the average.

## Cost-Plus Pricing

As noted in Chapter 10, the most common cost-based approach to pricing a product is *cost-plus pricing*, in which a marketer figures all costs for the product and then adds an amount to cover profit and, in some cases, any costs of doing business that are not assigned to specific products. The most frequently used type of cost-plus pricing is *straight markup pricing*. The price is calculated by adding a predetermined percentage to the cost. Most retailers and wholesalers use markup pricing exclusively because of its simplicity—users need only estimate the unit cost and add the markup.

The first step requires that the unit cost be easy to estimate accurately and that production rates are fairly consistent. As Table 10S.4 shows, we will assume that a jeans manufacturer has fixed costs (the cost of the factory, advertising, managers' salaries, etc.) of \$2,000,000. The variable cost, per pair of jeans (the cost of fabric, zipper, thread, and labor) is \$20.00. With the current plant, the firm can produce a total of 400,000 pairs of jeans, so the fixed cost per pair is \$5.00. Combining the fixed and variable costs per pair means that the jeans are produced at a total cost of \$25.00 per pair and the total cost of producing 400,000 pairs of jeans is \$10,000,000.

The second step is to calculate the markup. There are two methods for calculating the markup percentage: markup on cost and markup on selling price. For *markup on cost pricing*, just as the name implies, a percentage of the cost is added to the cost to determine the firm's selling price. As you can see, we have included both methods in our example shown in Table 10S.4.



## Table 10S.4 | Markup Pricing Using Jeans as an Example

### Step 1: Determine Costs

#### 1.a: Determine total fixed costs

Management and other nonproduction-related salaries	\$
	750,000
Rental of factory	600,000
Insurance	50,000
Depreciation on equipment	100,000
Advertising	500,000
<b>Total fixed costs</b>	<b>\$2,000,00</b>

#### 1.b: Determine fixed costs per unit

Number of units produced = 400,000

**Fixed cost per unit (\$2,000,000/400,000) \$5.00**

#### 1.c: Determine variable costs per unit

Cost of materials (fabric, zipper, thread, etc.)	\$ 7.00
Cost of production labor	10.00
Cost of utilities and supplies used in production process	3.00

**Variable cost per unit \$20.00**

#### 1.d: Determine total cost per unit

\$20.00 1 \$5.00 5 \$25.00

**Total cost per unit \$25.00**

**Total cost for producing 400,000 units = \$10,000,000**

### Step 2: Determine markup and price

#### *Manufacturer's markup on cost (assuming 20% markup)*

Formula: Price =  $\frac{\text{total cost}}{(1.00 - \text{markup percentage})}$

Manufacturer's Price to the Retailer =  $\frac{\$25.00}{(1.00 - .20)} = \frac{\$25.00}{.80} = \$31.25$  **\$30.00**

#### *Retailer's markup on selling price (assuming 40% markup)*

Formula: Price =  $\frac{\text{total cost}}{(1.00 - \text{markup percentage})}$

Retailer's Price to the Consumer =  $\frac{\$30.00}{(1.00 - .40)} = \frac{\$30.00}{.60} = \$50.00$  **\$50.00**

#### *Retailer's alternative markup on cost (assuming 40% markup)*

Formula: Price =  $\frac{\text{total cost}}{(1.00 - \text{markup percentage})}$

**Retailer's Price to the Consumer**  
 5 \$30.00 1 (\$30.00 3 .40) 5 \$30.00 1 \$12.00 5 **\$42.00**

## Markup on Cost

For markup on cost, the calculation is as follows:

$$\text{Price} = \text{total cost} + (\text{total cost} \times \text{markup percentage})$$

But how does the manufacturer or reseller know which markup percentage to use? One way is to base the markup on the total income needed for profits, for shareholder dividends, and for investment in the business. In our jeans example, the total cost of producing the 400,000 pairs of jeans is \$10,000,000. If the manufacturer wants a profit of \$2,000,000, what markup percentage would it use? The \$2,000,000 is 20 percent of the \$10 million total cost, so 20 percent. To find the price, the calculations would be as follows:

$$\text{Price} = \$25.00 + (\$25.00 \times 0.20) = \$25.00 + \$5.00 = \$30.00$$

Note that in the calculations, the markup percentage is expressed as a decimal; that is, 20% = 0.20, 25% = 0.25, 30% = 0.30, and so on.

## Markup on Selling Price

Some resellers, that is, retailers and wholesalers, set their prices using a markup on selling price. The markup percentage here is the seller's gross margin, the difference between the cost to the wholesaler or retailer and the price needed to cover overhead items such as salaries, rent, utility bills, advertising, and profit. For example, if the wholesaler or retailer knows that it needs a margin of 40 percent to cover its overhead and reach its target profits, that margin becomes the markup on the manufacturer's selling price. Markup on selling price is particularly useful when firms negotiate prices with different buyers because it allows them to set prices with their required margins in mind.

Now let's say a retailer buys the jeans from the supplier (wholesaler or manufacturer) for \$30.00 per pair. If the retailer requires a margin of 40 percent, it would calculate the price as a 40 percent markup on selling price. The calculation would be as follows:

$$\text{Price} = \frac{\text{total cost}}{1.00 - \text{markup percentage}}$$

$$\text{Price} = \frac{\$30.00}{(1.00 - 0.40)} = \frac{\$30.00}{.60} = \$50.00$$

Therefore, the price of the jeans with the markup on selling price is \$50.00.

Just to compare the difference in the final prices of the two markup methods, Table 10S.4 also shows what would happen if the retailer uses a markup on cost method. Using the same product cost and price with a 40 percent markup on cost would yield \$42.00, a much lower price. The markup on selling price gives you the percentage of the selling price that the markup is. The markup on cost gives you the percentage of the cost that the markup is. In the markup on selling price the markup amount is \$20.00, which is 40 percent of the selling price of \$50.00. In the markup on cost, the markup is \$12.00, which is 40 percent of the cost of \$30.00.

## SUPPLEMENT PROBLEMS: TEST YOUR MARKETING MATH

1. Assume that you are in charge of pricing for a firm that produces pickles. You have fixed costs of \$2,000,000. Variable costs are \$ .75 per jar of pickles. You are selling your product to retailers for \$.89. You sell the pickles in cases of 24 jars per case.
  - A. How many jars of pickles must you sell to break even?
  - B. How much must you sell in dollars to break even?
  - C. How many jars of pickles must you sell to break even plus make a profit of \$300,000?
  - D. Assume a retailer buys your product for \$ .89. His business requires that he prices products with a 35 percent markup on cost. Calculate his selling price.
  - E. Assume you have an MSRP of \$1.39 for the pickles. If a retailer has a required 35 percent retailer margin on all products he sells, what is the most he is willing to pay the producer for the pickles?
  - F. A clothing retailer knows that to break even and make a profit he needs to have a minimum retailer margin (also referred to as a contribution margin or gross margin) of at least 60 percent. If he is to sell a pair of shorts for the manufacturer's suggested retail price of \$49.99, what is the most he can pay the manufacturer for the shorts and maintain his margin?
  - G. A salesperson is developing a quote for a quantity of disposable hospital gowns. His cost for each case of gowns is \$85.00. His firm requires that he have a 20 percent margin so he is using a mark-up on selling price calculation to price the gowns. What will his quote be per case of gowns if he uses a 20 percent mark-up on selling price?
2. Executives of Studio Recordings, Inc. produced the latest compact disc by the Starshine Sisters Band, titled *Sunshine/Moonshine*. The following cost information pertains to the CD.
  - a. CD package \$1.25/CD
  - b. Songwriters' royalties \$0.35/CD
  - c. Recording artists' royalties \$1.00/CD
  - d. Advertising and promotion \$275,000
  - e. Studio Recording Inc.'s overhead \$250,000
  - f. Selling price to the CD distributor \$9.00

Calculate the following:

- 1) Contribution per CD unit
- 2) Break-even volume in CD units and dollars
- 3) Net profit if 1 million CDs are sold

4) Necessary CD unit volume to achieve a \$200,000 profit