Effective managerial decision making is the process of arriving at the best solution to a problem. If only one solution is possible, then no decision problem exists. When alternative courses of action are available, the best decision is the one that produces a result most consistent with managerial objectives. The process of arriving at the best managerial decision is the goal of economic optimization and the focus of managerial economics.

Optimal Decisions

Should the quality of inputs be enhanced to better meet low-cost import competition? Is a necessary reduction in labor costs efficiently achieved through an across-the-board decrease in staffing, or is it better to make targeted cutbacks? Following an increase in product demand, is it preferable to increase managerial staff, line personnel, or both? These are the types of questions facing managers on a regular basis that require a careful consideration of basic economic relations. Answers to these questions depend on the objectives and preferences of management. Just as there is no single “best” purchase decision for all customers at all times, there is no single “best” investment decision for all managers at all times. When alternative courses of action are available, the decision that produces a result most consistent with managerial objectives is the **optimal decision**.

A challenge that must be met in the decision-making process is characterizing the desirability of decision alternatives in terms of the objectives of the organization. Decision makers must recognize all available choices and portray them in terms of appropriate costs and benefits. The description of decision alternatives is greatly enhanced through application of the principles of managerial economics. Managerial economics also provides tools for analyzing and evaluating decision alternatives. Economic concepts and methodology are used to select the optimal course of action in light of available options and objectives.

Principles of economic analysis form the basis for describing demand, cost, and profit relations. Once basic economic relations are understood, the tools and techniques of optimization can be applied to find the best course of action. Most important, the theory and process of optimization gives practical insight concerning the value maximization theory of the firm.

Optimization techniques are helpful because they offer a realistic means for dealing with the complexities of goal-oriented managerial activities.

Maximizing the Value of the Firm

In managerial economics, the primary objective of management is assumed to be maximization of the value of the firm. This *value maximization* objective in Equation

$$\text{Value} = \sum_{t=1}^{n} \frac{\text{Profit}_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{\text{Total Revenue}_t - \text{Total Cost}_t}{(1+i)^t}$$

Maximizing Equation is a complex task that involves consideration of future revenues, costs, and discount rates. Total revenues are directly determined by the quantity sold and the prices received. Factors that affect prices and the quantity sold include the choice of products made available for sale, marketing strategies, pricing and distribution policies, competition, and the general state of the economy. Cost analysis includes a detailed examination of the prices and availability of various input factors, alternative production schedules, production methods, and so on. Finally, the relation between an appropriate discount rate and the company's mix of products and both operating and financial leverage must be determined. All these factors affect the value of the firm as described in Equation.

To determine the optimal course of action, marketing, production, and financial decisions must be integrated within a decision analysis framework. Similarly, decisions related to personnel retention and development, organization structure, and long-term business strategy must be combined into a single integrated system that shows how managerial initiatives affect all parts of the firm. The value maximization model provides an attractive basis for such an integration. Using the principles of economic analysis, it is also possible to analyze and compare the higher costs or lower benefits of alternative, suboptimal courses of action.

The complexity of completely integrated decision analysis—or global optimization—confines its use to major planning decisions. For many day-to-day operating decisions, managers typically use less complicated, partial optimization techniques. For example, the marketing department is usually required to determine the price and advertising strategy that achieves some sales goal given the firm's current product line and marketing budget. Alternatively, a production department might minimize the cost of output at a stated quality level.

The decision process, whether it is applied to fully integrated or partial optimization problems, involves two steps. First, important economic relations must be expressed in analytical terms. Second, various optimization techniques must be applied to determine the best, or optimal, solution in the light of managerial objectives. The following material introduces a number of concepts that are useful for expressing decision problems in an economic framework.

Tables are the simplest and most direct form for presenting economic data. When these data are displayed electronically in the format of an accounting income statement or balance sheet, the tables are referred to as **spreadsheets**. When the underlying relation between economic data is simple, tables and spreadsheets may be sufficient for analytical purposes. In such instances, a simple **graph** or visual representation of the data can provide valuable insight.

Complex economic relations require more sophisticated methods of expression.

An **equation** is an expression of the functional relationship or connection among economic variables. When the underlying relation among economic variables is uncomplicated, equations offer a compact means for data description; when underlying relations are complex, equations are helpful because they permit the powerful tools of mathematical and statistical analysis to be used.

Functional Relations: Equations

The easiest way to examine basic economic concepts is to consider the functional relations incorporated in the basic valuation model. Consider the relation between output, Q, and total revenue, TR. Using functional notation, total revenue is

$TR = f(Q)$

Equation is read, “Total revenue is a function of output.” The value of the dependent variable (total revenue) is determined by the independent variable (output). The variable to the left of the equal sign is called the **dependent variable**. Its value depends on the size of the variable or variables to the right of the equal sign. Variables on the right-hand side of the equal sign are called **independent variables**. Their values are determined independently of the functional relation expressed by the equation.

Equation does not indicate the specific relation between output and total revenue; it merely states that some relation exists. Equation provides a more precise expression of this functional relation:

$TR = P \times Q$

where P represents the price at which each unit of Q is sold. Total revenue is equal to price times the quantity sold. If price is constant at $1.50 regardless of the quantity sold, the relation between quantity sold and total revenue is

$TR = f(Q)$

Data in Table are specified by Equation and graphically illustrated in Figure.

Total, Average, and Marginal Relations

Total, average, and marginal relations are very useful in optimization analysis. Whereas the definitions of totals and averages are well known, the meaning of marginals needs further explanation. A**marginal** relation is the change in the dependent variable caused by a one-unit change in an independent variable. For example, **marginal revenue** is the change in total revenue associated with a one-unit change in output; **marginal cost** is the change in total cost following a one-unit change in output; and **marginal profit** is the change in total profit due to a one-unit change in output.

Relation Between Total Revenue and Output; Total Revenue = $1.50

Marginal analysis gives clear rules to follow for optimal resource allocation. As a result, geometric relations between totals and marginals offer a fruitful basis for examining the role of marginal analysis in managerial decision making.

Use of Marginals in Resource Allocation

The application of marginal analysis for resource allocation can be illustrated using the example of Payless Furniture, Inc., a San Francisco–based retailer. The company is faced with the important decision of how it should allocate its cable TV advertising budget of $5,000 per week between its Bay Area and Sacramento markets. In the allocation of the advertising budget between each market, the company seeks to maximize the total profit generated. For simplicity, assume that a prime-time advertisement on local cable TV in each market costs an identical $1,000. Moreover, assume that each advertisement addresses a different segment of Payless' customer base, so there is no synergy obtained from running a mix of advertisements. Because profits average a flat 8 percent of sales revenue, the profit-maximizing advertising allocation also results in maximum sales revenue. According to Payless' best estimate, the relation between weekly gross revenues before advertising costs and the number of advertisements per week is shown in Table.

Clearly, the first best use of advertising dollars is for promotion in the Bay Area market. A first advertisement in the Bay Area generates $50,000 in marginal revenues; a second advertisement generates $30,000; a third advertisement generates $25,000; a fourth advertisement generates $20,000. Rather than run a fifth advertisement in the Bay Area, it would be wise to run a first advertisement in the Sacramento market. This advertisement would generate $20,000 in marginal revenue, the same amount produced by a fourth advertisement in the Bay Area market. Because a fourth advertisement in the Bay Area market generates the same amount as a first advertisement in the Sacramento market, at the margin Payless is indifferent between these two advertising alternatives. With only $5,000 to spend, Payless should spend $4,000 for promotion in the Bay Area and $1,000 for advertising in the Sacramento market.

With this advertising allocation—$200,000 in Bay Area revenue plus $25,000 in Sacramento market revenue—a total of $225,000 per week would be generated. Because gross profits before advertising expenses average a flat 8 percent of sales, a total of $18,000 (= 0.08 _ $225,000) per week in gross profits and $13,000 (= $18,000 – $5,000) per week in net profits after advertising costs would be generated. No other allocation of a $5,000 advertising budget would be as profitable. Subject to a $5,000 advertising budget constraint, this is the profit-maximizing allocation of advertising between Payless' two markets.

Before concluding that this advertising budget allocation represents the best that Payless can do in terms of producing profits, it is necessary to ask if profits would be increased or decreased following an expansion in the advertising budget. When gross profit before advertising expenditures averages a flat 8 percent, expansion is called for so long as an additional advertisement generates *more than* $12,500 in revenues. This stems from the fact that the marginal cost of a single advertisement is $1,000, and *more than* $1,000 (= 0.08 _ $12,500) in marginal gross profit before advertising expenses will be generated with more than $12,500 in additional revenues. Notice that a second advertisement in the Sacramento market results in an additional $15,000 per week in revenues. Given an 8 percent of revenues gross profit before advertising expenditures, such an advertisement would produce an additional $1,200 (= 0.08 _ $15,000) in gross profits and $200 (= $1,200 – $1,000) in net profits per week. Expansion in Payless' advertising budget from $5,000 to $6,000 per week is clearly appropriate. With a $6,000 advertising budget, $4,000 should be spent in the Bay Area market and $2,000 should be spent in the Sacramento market. A total of $240,000 in revenues, $19,200 (= 0.08 _ $240,000) in gross profits before advertising expenses, and $13,200 (= $19,200 – $6,000) in net profits per week would thus be generated. Because a third advertisement in the Sacramento market would produce only breakeven additional revenues of $12,500, running such an advertisement would neither increase nor decrease Payless profits. As a result, Payless would be indifferent as to running or not running a third advertisement in the Sacramento market.

Total and Marginal Functional Relationships

Geometric relations between totals and marginals offer a fruitful basis for examining the role of marginal analysis in economic decision making. Managerial decisions frequently require finding the maximum value of a function. For a function to be at a maximum, its marginal value (slope) must be zero. Evaluating the slope, or marginal value, of a function, therefore, enables one to determine the point at which the function is maximized. To illustrate, consider the following profit function:

$$\pi = -\$10{,}000 + \$400Q - \$2Q^2$$

Here π = total profit and *Q* is output in units. As shown in Figure, if output is zero, the firm incurs a $10,000 loss because fixed costs equal $10,000. As output rises, profits increase. A breakeven point is reached at 28 units of output; total revenues equal total costs and profit is zero at that activity level. Profit is maximized at 100 units and declines thereafter. The marginal profit function graphed in Figure begins at a level of $400 and declines continuously. For output quantities from 0 to 100 units, marginal profit is positive and total profit increases with each additional unit of output. At *Q* = 100, marginal profit is zero and total profit is at its maximum. Beyond *Q* = 100, marginal profit is negative and total profit is decreasing. Another example of the importance of the marginal concept in economic decision analysis is provided by the important fact that marginal revenue equals marginal cost at the point of **profit maximization**. Figure illustrates this relation using hypothetical revenue and cost functions. Total profit is equal to total revenue minus total cost and is, therefore, equal to the vertical distance between the total revenue and total cost curves at any output level. This distance is maximized at output *QB*. At that point, marginal revenue, *MR*, and marginal cost, *MC*, are equal; *MR* = *MC* at the profit-maximizing output level.

The reason why *QB* is the profit-maximizing output can be intuitively explained by considering the shapes of the revenue and cost curves to the right of point *QA*.

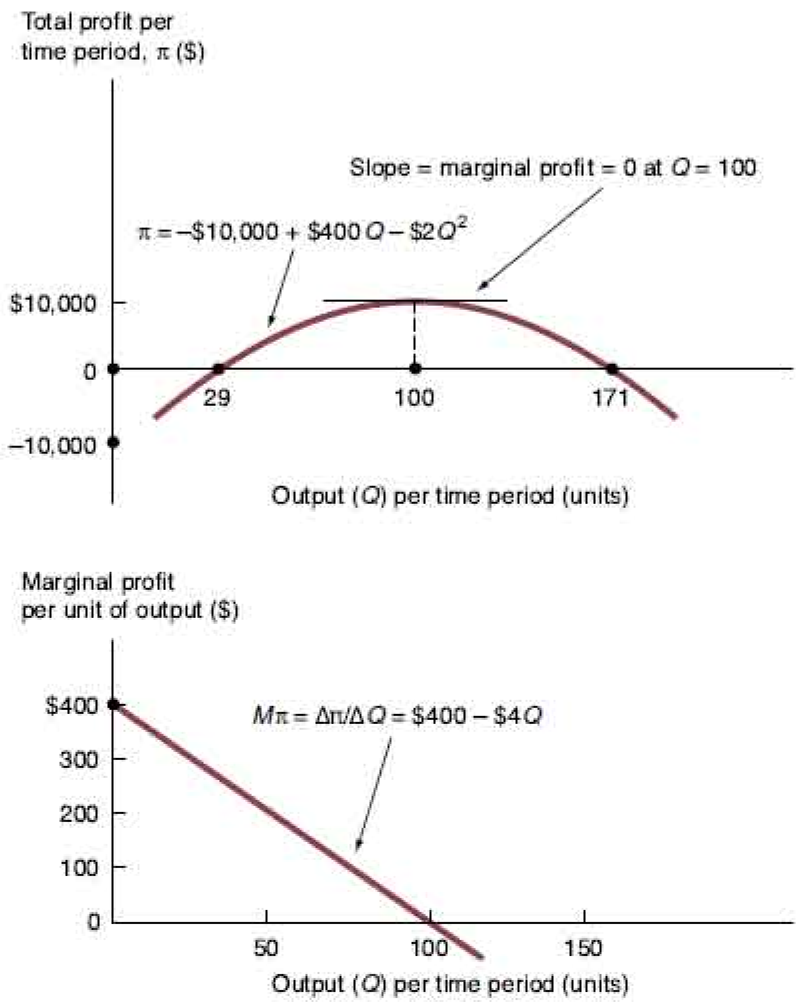
At *QA* and *QC*, total revenue equals total cost and two breakeven points are illustrated. As seen in Figure, a **breakeven point** identifies output quantities where total profits are zero. At output quantities just beyond *QA*, marginal revenue is greater than marginal cost, meaning that total revenue is rising faster than total cost. Thus, the total revenue and total cost curves are spreading farther apart and profits are increasing. The divergence between total revenue and total cost curves continues so long as total revenue is rising faster than total cost—in other words, so long as $MR > MC$. Notice that marginal revenue is continuously declining while marginal cost first declines but then begins to increase. Once the slope of the total revenue curve is exactly equal to the slope of the total cost curve and marginal revenue equals marginal cost, the two curves will be parallel and stop diverging. This occurs at output *QB*. Beyond *QB*, the slope of the total cost curve is greater than that of the total revenue curve. Marginal cost is then greater than marginal revenue, so the distance between the total revenue and total cost curves is decreasing and total profits are declining. The relations among marginal revenue, marginal cost, and profit maximization can also be demonstrated by considering the general profit expression, $\pi = TR - TC$. Because total profit is total revenue minus total cost, marginal profit ($M\pi$) is marginal revenue (MR) minus marginal cost (MC):

$$\mathbf{M\pi = MR - MC}$$

Because maximization of any function requires that the marginal of the function be set equal to zero, profit maximization occurs when

$$\mathbf{M\pi = MR - MC = 0}$$

Profit as a Function of Output



or where

MR = MC

Therefore, in determining the optimal activity level for a firm, the marginal relation tells us that so long as the increase in revenues associated with expanding output exceeds the increase in costs, continued expansion will be profitable. The optimal output level is determined when marginal revenue is equal to marginal cost, marginal profit is zero, and total profit is maximized.