where Q_d = quantity demanded for advertising on the show (minutes), P = the price per minute that you charge for advertising, and V is the number of viewers expected to watch the advertisements (in millions).

a. All your costs are fixed and your goal is to maximize the total revenue received from selling advertising. Suppose that the expected number of viewers is one million people. What price should you charge? How many minutes of advertising will you sell? What is total revenue?

b. Suppose price is held constant at the value from part (*a*). What will happen to the quantity demanded if due to PVRs the number of expected viewers falls to 0.5 million? Calculate the "viewer elasticity" based on the two points. Explain in words what this value means.

3. As more viewers begin using PVRs, what happens to the revenues of the major networks (CBS, NBC, ABC, and FOX)?
4. Discuss the long-run effects if a significant proportion of the viewers begin adopting these "advertising snipping" systems.
5. What advice would you give the major commercial networks and producers of programming for these networks as more consumers adopt PVRs?

SOURCE: J. Gudmundsen (2002), "Video Gizmos Change the Rules," *Democrat and Chronicle* (August), 5E and 8E; B. Fisher (2003), "TiVo and Replay TV Have Features to Satisfy Any TV Junkie," *Detroit News* (June 24); R. Reilly (2003), "Great Invention Period," *Sports Illustrated* (December 22).

Summary

Understanding product demand is critical for many managerial decisions such as pricing, setting production levels, undertaking capital investment, and establishing an advertising budget. This chapter provides a basic analysis of demand.

A *demand function* is a mathematical representation of the relations among the quantity demanded of a product over a specified time period and the various factors that influence this quantity. We focus on three independent variables in the demand function: the price of the product, the prices of related products, and customers' incomes.

A *demand curve* for a product displays how many units will be purchased over a given period at each price holding all other factors fixed. Movements along a demand curve reflect changes in price and are called *changes in the quantity demanded.* Movements of the entire demand curve are caused by other factors, such as changes in income, and are referred to as *changes in demand.*

Demand curves generally slope downward to the right: Quantity demanded varies inversely with price. This relation often is referred to as the *law of demand.* Demand curves vary in their sensitivities of the quantity demanded to price. *Price elasticity* is defined as the percentage change in quantity demanded from a percentage change in price (expressed as a positive number). The price elasticity tends to be high when there are close substitutes for the product and when the good represents a significant expenditure for the consumer. Demand tends to be more elastic over the long run than over the short run. How total revenue from a product changes with price depends on the price elasticity. A small price increase results in an increase in expenditures when demand is *inelastic* and a decrease in expenditures when demand is *elastic.* Total expenditures remain unchanged when the demand elasticity is *unitary.*

An important concept in economics is *marginal revenue,* which is defined as the *change in total revenue given a one-unit change in quantity.* Marginal revenue for a linear demand curve is given by the line with the same intercept as the demand curve but with twice the negative slope. Total revenue increases with quantity when marginal revenue is positive and decreases with quantity when marginal revenue is negative.

The price of related products can affect the demand for a product. Goods that compete with each other are referred to as *substitutes.* Products that tend to be consumed together are *complements.* One frequently used measure of substitution between two products is the *cross elasticity of demand.* The cross elasticity is positive for substitutes and negative for complements.

Another factor that can affect the demand for a product is the income of potential buyers. The sensitivity of demand to income is measured by the *income elasticity.* The income elasticity is positive for *normal goods,* and negative for *inferior goods.*

Demand curves can be defined for individual firms or entire industries. The price elasticities for individual firms within an industry are generally higher than for the industry as a whole. Cross elasticities can be helpful in defining the appropriate industry.

For some products, demand increases with the number of users. For example, fax machines and telephones are not very useful unless there is a *network* of users. Products where these network concerns are important often have relatively elastic demands. When price is lowered, there is both a *standard price effect* and a *network effect.*

The standard economic analysis of demand takes the *attributes* of the product as given. Information about consumer demand, however, is also important in the initial design of products. Parts 3 and 4 of this book provide important insights into how to design the firm's organizational architecture to help ensure that this type of information is incorporated in the decision-making process.

Managers use three basic approaches to estimate demand: *interviews, price experimentation,* and *statistical analysis.* All three approaches can suffer from potentially serious problems. Managers have to do the best they can given imperfect information and limited resources. Knowledge of the potential pitfalls can make managers more intelligent producers and users of demand estimates.

Appendix

Demand[19]

In the chapter, we presented formulas for arc elasticities that estimate elasticities between two points on the demand curve. This appendix shows how to calculate elasticities at single points on the demand curve. It also derives the equation for marginal revenue for a linear demand curve and discusses a special (log-linear) demand function.

Point Elasticities

Elasticities measure the percentage change in quantity demanded for a percentage change in some other variable. There are several ways to express the formula for an elasticity. One way, using price elasticity as an example, follows:

$$\eta = -(\Delta Q/Q)/(\Delta P/P) \qquad (4.12)$$
$$= -(\Delta Q/\Delta P) \times (P/Q)$$

By definition, as the change in P goes to zero, the limit of the first term $(\Delta Q/\Delta P)$ is the partial derivative of Q with respect to P. At a particular point on the demand curve, the elasticity of demand for small changes in P is given by

$$-(\partial Q/\partial P) \times (P/Q) \qquad (4.13)$$