CHAPTER 3

Consumer Behavior

In 1962, Pillsbury Co. acquired a company in Woodbridge, New Jersey, that produced a new premium ice cream. The ice cream was marketed under the name Haagen-Dazs. The inclusion of more cream and eggs made the ice cream richer and more flavorful than most other brands, and the Scandinavian-sounding name suggested that it was a quality product worth a higher price.. But before Haagen-Dazs could be extensively marketed, the company had to resolve an important problem-*how high a price should it charge*? No matter how good the ice cream was, its profitability would be affected considerably by the company's pricing decision. Knowing that consumers would pay more for a premium ice cream was not enough; at issue was *how much more.* Pillsbury therefore had to conduct a careful analysis of consumer preferences to determine the demand for ice cream and its dependence on both price and quality.

In the early 1960s, reports showing the extent to which the poor were underfed and malnourished aroused public concern. In response, Congress passed the Food Stamp Act of 1964, which directed the federal government to fund a program in which households with sufficiently low incomes would receive coupons that could be exchanged for food. But a problem arose in the design and evaluation of this program. To what extent would food stamps provide people with more food, as opposed .to simply subsidizing food that they would have bought anyway? In other words, would the program turn out to be little more than an income supplement that would be spent largely on non-food items, instead of a solution to the nutritional problems of the poor? Once again, an analysis of consumer behavior was needed. In this case, the federal government had to determine how spending on food, as opposed to other goods, is affected by changing income levels and prices.

These two problems-one involving corporate policy and the other public policy-exemplify the importance of the economic theory of consumer behavior and the kinds of issues it can help resolve. In this chapter and the next, we will see how consumers allocate their incomes and how this determines

the demands for various goods and services. This, in turn, will help us understand how changes in income and prices affect demands for goods and services and why the demands for some products are more sensitive than others to price and income changes.

Consumer behavior is best understood in three steps. The first step is to examine *consumer preferences.* Specifically, we need a practical way to describe how people might prefer one good to another. Second, we must account for the fact that consumers face *budget constraints*-they have limited incomes that restrict the quantities of goods that they can buy. The third step is to put consumer preferences and budget constraints together to determine *consumer choices.* In other words, given their preferences and limited incomes, what combinations of goods will consumers buy to maximize their satisfaction? We will go through each of these steps in turn.

3.1 *Consumer Preferences*

Given the vast number of goods and services that our industrial economy provides for purchase and given the wide diversity of personal tastes, how can we describe consumer preferences in a coherent way? A good way to begin is to think of preferences in terms of comparisons of market baskets. A *market basket* is just a collection of one or more commodities. For example, it might contain the various food items in a bag of groceries or the combination of food, clothing, and fuel that a consumer buys each month.

Because people purchase combinations of goods, we can ask whether one market basket is preferred to another. Table 3.1 shows several market baskets consisting of various amounts of food and clothing purchased monthly. For example, market basket A consists of 20 units of food and 30 units of clothing,

TABLE 3.1 Alternative Market Baskets

Market Basket	Units of Food	Units of Clothing
A	20	30
B	10	50
D	40	20
E	30	40
G	10	20
H	10	40

NOTE: We will avoid the use of theletters C and F to represent market baskets, whenever market baskets might be confused with the number of units of food and clothing.

basket *B* consists of 10 units of food and 50 units of clothing, and so on. By asking consumers to compare these different baskets, we can describe their preferences for food and clothing,

Some Basic Assumptions

The theory of consumer behavior begins with three basic assumptions regarding people's preferences for one market basket versus another. We believe that these assumptions hold for most people in most situations:

1. The first assumption is that preferences are *complete,* which means that consumers can compare and rank all market baskets. In other words, for any two market baskets A and B, a consumer will prefer A to B, will prefer B to A, or will be indifferent between the two. (By "indifferent" we mean that a person would be equally happy with either basket.) Note that these preferences ignore costs. A consumer might prefer steak to hamburger but would buy hamburger because it is cheaper.
2. The second important assumption.is that preferences are *transitive.* Transitivity means that if a consumer prefers market basket A to market basket B, and prefers B to C, then the consumer also prefers A to C. For example, if a Rolls Royce is preferred to a Cadillac and a Cadillac is preferred to a Chevrolet, then a Rolls Royce is also preferred to a Chevrolet. This transitivity assumption ensures that the consumer's preferences are consistent, and hence rational.
3. The third assumption is that all goods are "good" (i.e., desirable), so that leaving costs aside, *consumers always prefer more of any good to less.* This assumption is made for pedagogic reasons; it simplifies the graphical analysis. Of course, some goods, such as air pollution, may be undesirable, and consumers will avoid them whenever possible. We ignore these undesirable goods in the context of our current discussion of consumer choice because most consumers would not choose to purchase them. We will, however, discuss them later in the book.

These three assumptions form the basis of consumer theory. They don't explain consumers' preferences, but they do impose a degree of rationality and reasonableness on them. Building on these assumptions, we will now explore consumer behavior.

Indifference Curves

We can show a consumer's preferences graphically with the use of *indifference curves. An indifference curve represents all combinations of market baskets that provide the same level of satisfaction to a person.* That person is therefore indifferent among the market baskets represented by the points on the curve.

Given the three assumptions about preferences discussed above, we know that a consumer can always indicate a preference for one market basket over another or indifference between the two. This information can then be used to rank all possible consumption choices. To see this in graphic form, we assume there are only two goods, food F and clothing C, available for consumption. In this case, market baskets describe combinations of food and clothing that a person might wish to consume. Table 3.1 provides some examples of market baskets containing various amounts of food and clothing.

Figure 3.1 shows the same market baskets that are in Table 3.1. The horizontal axis measures the number of units of food purchased each week, and the vertical axis measures the number of units of clothing. Market basket A, with 20 units of food and 30 units of clothing, is preferred to market basket G because A contains more food *and* more clothing (recall our third assumption that more is better than less). Similarly, market basket E, which contains still more food and more clothing, is preferred to A. In fact, we can easily compare all market baskets in the shaded areas (such as E and G) to A because they

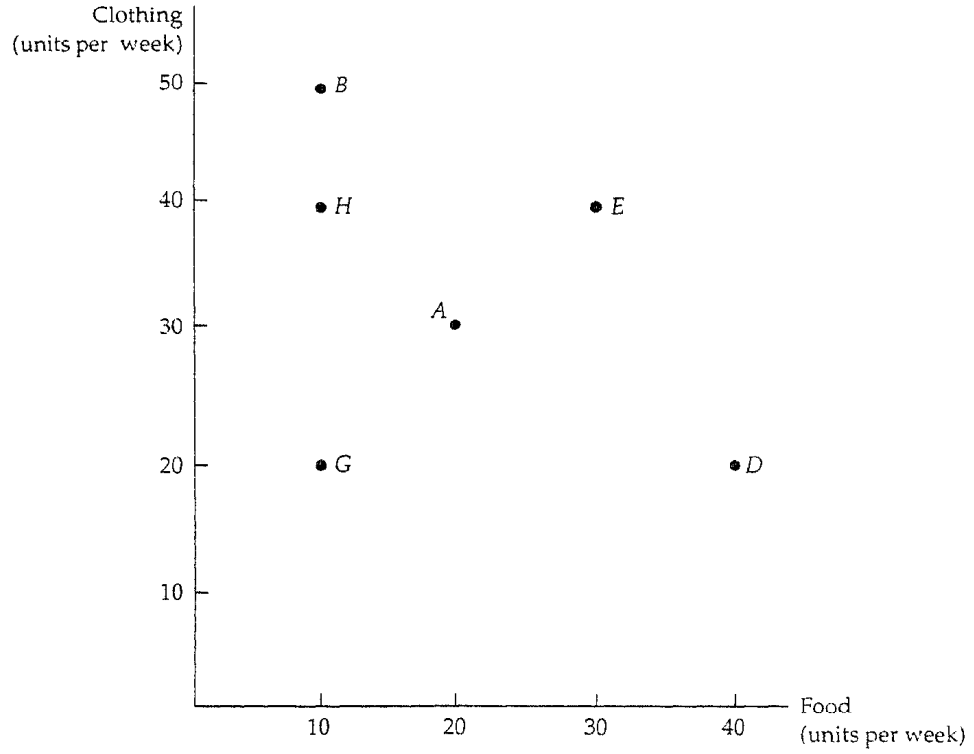

FIGURE 3.1 Describing Individual Preferences. Because more of each good is preferred to less, we can compare market baskets in the shaded areas. Market basket A is clearly preferred to market basket G, while E is clearly preferred to A. However, A cannot be compared with B, D, or H without additional information.

contain either more or less of both food and clothing. However, comparisons of market basket *A* with market baskets *B*, *D*, and *H* are not possible without more information about the consumer's ranking because *B* contains more clothing but less food, and *D* contains more food but less clothing than *A*.

This additional information is provided in Figure 3.2, which shows an indifference curve, labeled U_1, that passes through points *A*, *B*, and *D*. This curve indicates that the consumer is indifferent among these three market baskets. It tells us that the consumer feels neither better nor worse off in giving up 10 units of food to obtain 20 additional units of clothing in moving from market basket *A* to *B*. Likewise, the consumer is indifferent between points *A* and *D* (i.e., will give up 10 units of clothing to obtain 20 units of food). On the other hand, the consumer prefers *A* to *H*, which lies below U_1.

The indifference curve in Figure 3.2 slopes downward from left to right. To understand why this must be the case, suppose instead that the indifference curve sloped upward from *A* to *E*. This would violate the assumption that

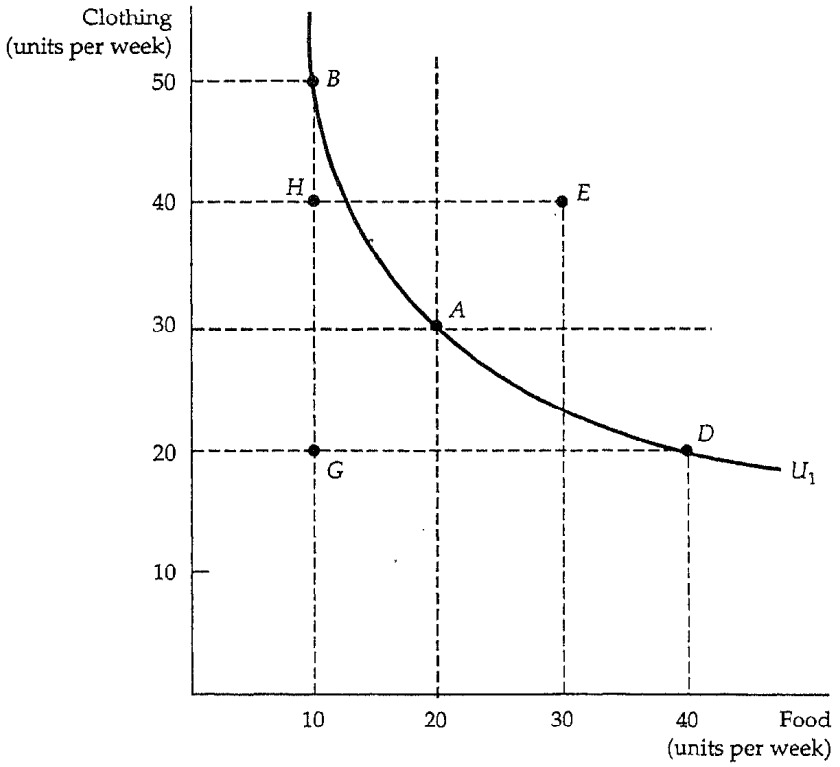

FIGURE 3.2 **An Indifference Curve.** A person's indifference curve U_1 shows all market baskets that generate the same level of satisfaction as does market basket *A*. The person prefers market basket *E*, which lies above U_1, to *A*, but prefers *A* to *H* or *G*, which lie below U_1.

more of any commodity is preferred to less. Since market basket *E* has more of both food and clothing than market basket *A*, it must be preferred to *A* and therefore cannot be on the same indifference curve as *A*. In fact, any market basket lying above and to the right of indifference curve U_1 in Figure 3.2 is preferred to any market basket on U_1.

To describe a person's preferences for all combinations of food and clothing, we can graph a set of indifference curves. This is called an *indifference map.* Each indifference curve in the map shows the market baskets among which the person is indifferent. Figure 3.3 shows three indifference curves that form part of an indifference map. Indifference curve U_3 generates the highest level of satisfaction, followed by indifference curves U_2 and U_1.

Indifference curves cannot intersect. To see why, we will assume the contrary and see how it violates the assumptions about consumer behavior. Figure 3.4 shows two indifference curves, U_1 and U_2 that intersect at A. Since *A* and *B* are both on indifference curve U_1, the consumer must be indifferent between the two market baskets. Both *A* and *D* lie on indifference curve U_2 so the consumer must be indifferent between both these market baskets. As a result, the consumer must also be indifferent between *B* and *D*. But this can't be true because market basket *B* must be preferred to *D* since it contains more of both food and clothing than *D*. Hence indifference curves that intersect would contradict our assumption that more is preferred to less.

Of course, there are an infinite number of nonintersecting indifference curves, one for every possible level of satisfaction. In fact, every possible mar-

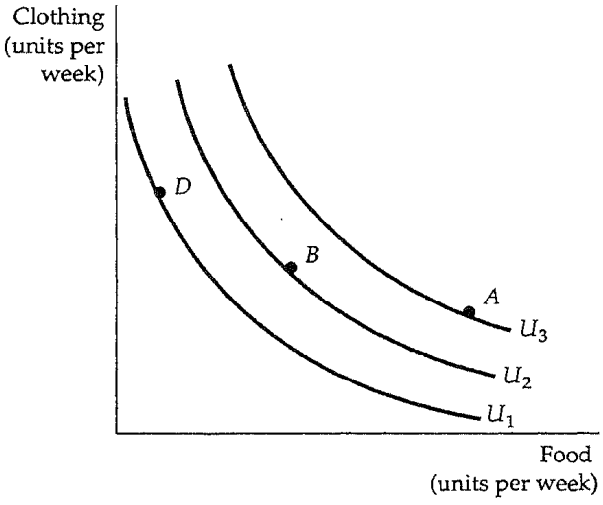

FIGURE 3.3 An Indifference Map. An indifference map is a set of indifference curves that describes a person's preferences. Any market basket on indifference curve U_3, such as market basket *A*, is preferred to any market basket on curve U_2 (e.g., basket *B*), which in turn is preferred to any market basket on U_1, such as *D*.

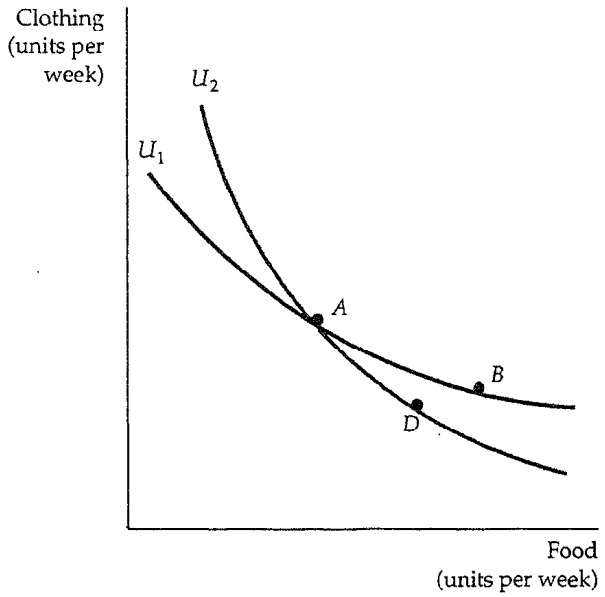

FIGURE 3.4 Indifference Curves Cannot Cross. If indifference curves U_1 and U_2 intersected, one of the assumptions of consumer theory would be violated. According to this diagram, the consumer should be indifferent among market baskets *A*, *B*, and *D*. Yet *B* is preferred to *D* because *B* has more of both goods.

ket basket (corresponding to a point on the graph) has an indifference curve passing through it.

Ordinal Versus Cardinal Rankings

For simplicity, we have shown only three indifference curves in Figure 3.3. The three curves provide an ordinal ranking of market baskets. An *ordinal ranking places market baskets in the order of most preferred to least preferred,* but it does not indicate by *how much* one market basket is preferred to another. For example, we know that consumption of any basket on U_3, such as *A*, is preferred to consumption of any basket on U_2 such as *B*. However, the amount by which *A* is preferred to *B* (and *B* to *D*) is not revealed by the indifference map.

By contrast, when economists first studied utility, they hoped that individuals' preferences could be easily quantified or measured in terms of basic units and could therefore provide *a cardinal ranking* of alternatives. Today, however, we know that the particular unit of measurement of utility is unimportant. For example, although we cannot say that consumers on U_2 are twice as happy as they might be on U_1, an ordinal ranking is sufficient to help us explain how

most individual decisions are made. In the few instances where it is not, we will discuss an alternative approach to describing preferences.

The Marginal Rate of Substitution

People face trade-offs when choosing among two or more goods, and indifference curves can help to clarify those trade-offs. The indifference curve in Figure 3.5 illustrates this. Starting at market basket *A* and moving to market basket *B*, we see that the consumer is willing to give up six units of clothing to obtain one extra unit of food. However, moving from *B* to *D*, he is willing to give up only four units of clothing to obtain an additional unit of food, and in moving from *D* to *E*, he will give up two units of clothing for one unit of food. The more clothing and the less food a person consumes, the more clothing he will give up to obtain more food. Similarly, the more food that a person possesses, the less clothing he will give up for more food.

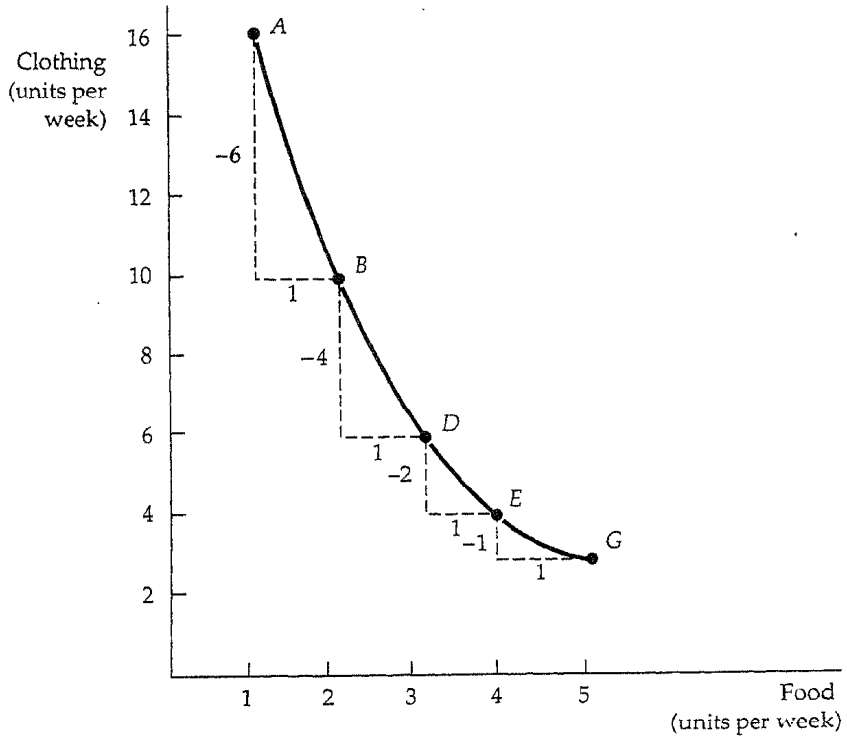

FIGURE 3.5 The Marginal Rate of Substitution. The slope of an indifference curve measures the consumer's marginal rate of substitution between two goods. In the figure, the marginal rate of substitution between clothing (*C*) and food (*F*), $-\Delta C/\Delta F$, falls from 6 to 4 to 2 to 1. When the marginal rate of substitution diminishes along an indifference curve, the indifference curve is convex.

To quantify the amount of one good a consumer will give up to obtain more of another good, we use a measure called the *marginal rate of substitution* (MRS). The MRS of food F for clothing C is the maximum amount of clothing that a person is willing to give up to obtain one additional unit of food. If the MRS is 3, the consumer will give up 3 units of clothing: to obtain an additional unit of food, while if the MRS is ½, only ½ a unit of clothing will be given up.

To be consistent throughout the book, we will describe the MRS in terms of the amount of the good drawn on the vertical axis that must be given up to obtain one extra unit of the good drawn on the horizontal axis. Thus, in Figure 3.5 we refer to the amount of clothing given up to obtain an additional unit of food. If we denote the change in clothing by ΔC and the change in food by ΔF, the MRS can be written as $-\Delta C/\Delta F$. The negative sign. is included to make the marginal rate of substitution a positive number (ΔC is always negative). As a result, the marginal rate of substitution at any point is equal in absolute value to the slope of the indifference curve at that point,

At this point it is useful to add an additional assumption regarding consumer preferences to the three we discussed earlier in the chapter:

4. The fourth assumption is that indifference curves are *convex*, that is, bowed inward. The term *convex* means that the slope of the indifference curve increases (i.e., becomes less negative) as we move down along the curve. In other words, an indifference curve is convex if the MRS diminishes along the curve. The indifference curve in Figure 3.5 is convex. Starting with market basket A in Figure 3.5 and moving to market basket B, we note that the MRS of food F for clothing C is $-\Delta C/\Delta F = -(-6)/1 = 6$. However, when starting at market basket B and moving from B to D, the MRS falls to 4. Starting at market basket D and moving to E, the MRS is 2, and starting at E and moving to G, the MRS is 1. As food consumption increases, the slope of the indifference curve falls in magnitude, so the MRS also falls.[1]

Is it reasonable to assume that indifference curves are convex? Yes. As more and more of one good is consumed, we would expect that a consumer would prefer to give up fewer and fewer units of a second good to get additional units of the first one. As we move down along the indifference curve in Figure 3.5 and consumption of food increases, the consumer's desire for still more food should diminish. Thus, he should be willing to give up less and less clothing to obtain additional food.

Another way of describing this is to say that consumers generally prefer a balanced market basket to market baskets that contain all of one good and none of the other. Note from Figure 3.5 that a relatively balanced market basket containing 3 units of food and 6 units of clothing (basket D) generates as

[1] With nonconvex preferences, the MRS increases as the amount of the good measured on the horizontal axis increases along any indifference curve. This unlikely possibility might arise if one or both goods are addictive. For example, the willingness to substitute an addictive drug for other goods might increase as the use of the addictive drug increased.

much satisfaction as another market basket that contains only 1 unit of food, but 16 units of clothing (basket A). It follows that a balanced market basket containing (for example) 6 units of food and 8 units of clothing would generate a higher level of satisfaction.

Perfect Substitutes and Perfect Complements

The shapes of indifference curves can imply different degrees of willingness to substitute one good for another. To see this, look at the two polar cases illustrated in Figure 3.6. Figure 3.6a shows Philip's preferences for apple juice and orange juice. These two goods are perfect substitutes for Philip, since he is entirely indifferent between having a glass of one or the other. In this case, the marginal rate of substitution of apple juice for orange juice is 1; Philip is always willing to trade a glass of one for a glass of the other. In general, we say that two goods are *perfect substitutes* when the marginal rate of substitution of one good for the other is a constant; that is, the indifference curves that describe the trade-off between the consumption of the goods are straight lines.

Figure 3.6b illustrates Jane's preferences for left shoes and right shoes. For Jane, the two goods are perfect complements, since a left shoe will not increase her satisfaction unless she can obtain the matching right shoe. In this case, the

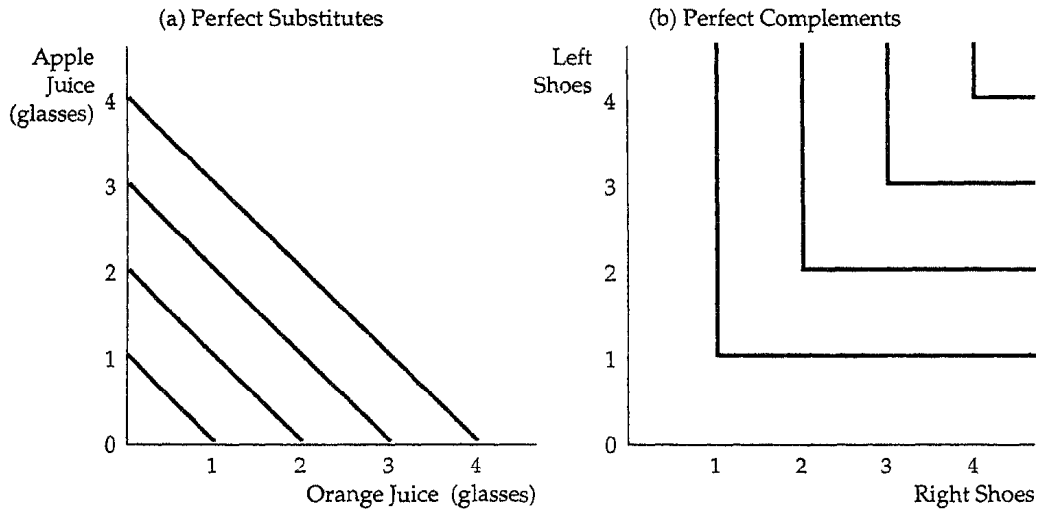

FIGURE 3.6a and b **Perfect Substitutes and Perfect Complements.** In (a), Philip views orange juice and apple juice as perfect substitutes; he is always indifferent between a glass of one and a glass of the other. In (b), Jane views left shoes and right shoes as perfect complements. An additional left shoe gives her no extra satisfaction unless she also obtains the matching right shoe.

marginal rate of substitution of left shoes for right shoes is zero whenever there are more right shoes than left shoes, since Jane would not give up any left shoes to get additional right shoes. Correspondingly, the marginal rate of substitution is infinite whenever there are more left shoes than right, since Jane will give up all but one of the excess left shoes she has in order to obtain an additional right shoe. Two goods are *perfect complements* when the indifference curves for the goods are shaped as right angles.

EXAMPLE 3.1 DESIGNING NEW AUTOMOBILES

If you were an automobile company executive, how would you decide when to introduce new models and how much money to invest in restyling? You would probably know that two of the most important attributes of a car are its styling (e.g., design and interior features) and its performance (e.g., gas mileage and handling). Both styling and performance are desirable attributes; the better the styling and the better the performance, the greater will be the demand for a car. However, it costs money to restyle a car and to improve its performance. How much of each attribute should you include in the car?

The answer depends in part on the costs of production, but it also depends on consumer preferences for automobile attributes. Two characterizations of consumer preferences are shown in Figure 3.7. People with preferences shown in Figure 3.7a prefer performance to styling-they are willing to give up quite a bit of styling to get better performance. Compare these preferences to those of a different segment of the population shown in Figure 3.7b. These people prefer styling to performance, and will put up with poor gas mileage or handling to get a more stylish car.

Knowing which preference group is most prevalent in the population can help automobile company executives make strategic production decisions. One way to determine this is by conducting surveys in which individuals are asked about their preferences for a number of automobiles with differing combinations of styling and performance. Another way is to statistically analyze past consumer purchases of cars that varied in styling and performance. By relating the prices paid for different cars to the levels of the cars' attributes, one can determine the relative value attached to each attribute by various groups of consumers.[2] Either approach can help determine whether the largest group of consumers values performance more highly (as in Figure 3.7a) or styling more highly (as in Figure 3.7b), and to what extent people in each group are willing to trade off one attribute for the other.

A recent study of automobile demand in the United States shows that over the past two decades most consumers have preferred styling over performance.[3] The study divided all cars sold in the United States from 1977 through 1991 into nine market classes, ranging from subcompact to luxury sport. Within

[2] For an example, see Vladimir Bajic, "Automobiles and Implicit Markets: An Estimate of a Structural Demand Model for Automobile Characteristics," *Applied Economics* 25 (1993): 541-551.

[3] See Edward L. Millner and George E. Hoffer, "A Reexamination of the Impact of Automotive Styling on Demand," *Applied Economics* 25 (1993): 101-110.

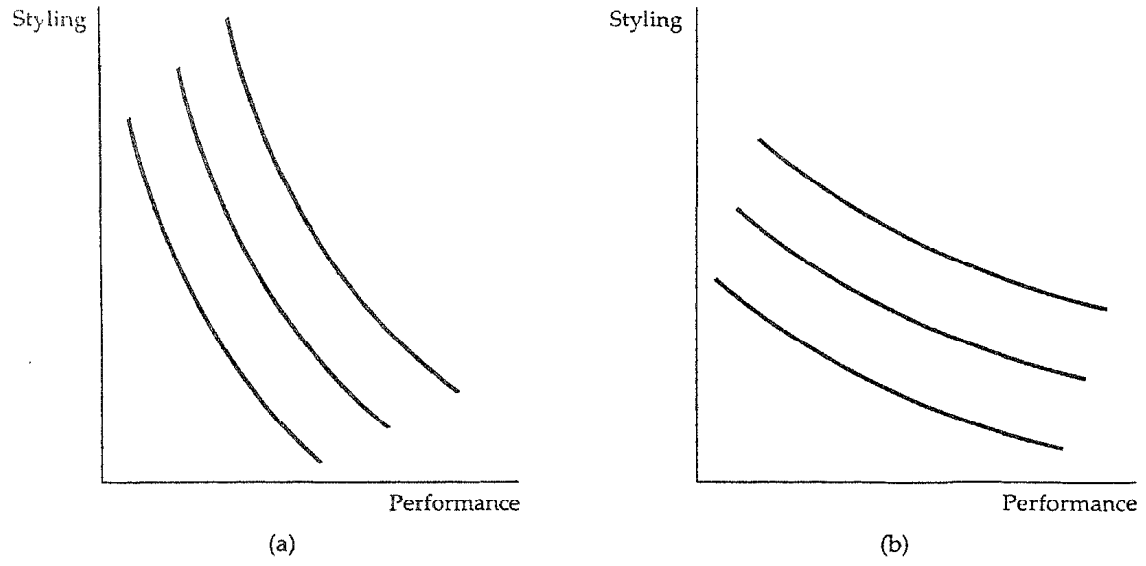

FIGURE 3.7a and b Preferences for Automobile Attributes. Preferences for automobile attributes can be described by indifference curves. Each curve shows the combinations of performance and styling that give the same satisfaction. Consumers in (a) are willing to give up a considerable amount of styling for additional performance. The opposite is true for consumers in (b).

each class, the degree of styling change was indexed from 1 (no visible exterior change, as in the 1991 Honda Accord) to 5 (a complete sheet metal change, as in the 1989 Buick Century) to 9 (a complete new body, a change in size, and a.. conversion of rear-wheel to front-wheel drive, as in the 1980 Chevrolet Citation). The study found that automobile companies that emphasized style changes grew more rapidly than companies that emphasized performance. In particular, those cars undergoing major style changes enjoyed a significantly-higher growth in sales than cars not undergoing such changes. (The major effect occurred immediately after the style change, but smaller effects were felt in subsequent years.)

The importance of styling helps explain the growing share of Japanese imports in the United States-U.S. domestic sales grew at 1.3, percent per year, while sales of imports grew at 6.4 percent per year. On average, 15 percent of all domestic U.S. cars underwent a major style change each year, as compared to 23.4 percent of all imports. Clearly, styling changes (along with improvements in performance and reliability) spurred the growth of imported, cars. This has implications for the European Common Market; if Europeans respond to style changes as Americans have, Japanese penetration into European markets should increase over the next decade.

3.2 *Budget Constraints*

An indifference map describes a person's preferences for various combinations of goods and services. But preferences do not explain all of consumer behavior. Individual choices are also affected by *budget constraints,* which limit people's ability to consume in light of the prices they must pay for various goods and services.

The Budget Line

To see how a budget constraint limits a consumer's choices, let's consider a situation in which a woman has a fixed amount of income, I, that can be spent on food and clothing. Let F be the amount of food purchased, and C the amount of clothing. We will denote the prices of the two goods P_F and P_C. Then $P_F F$ *(i.e.,* price of food times the quantity) is the amount of money spent on food, and $P_C C$ is the amount of money spent on clothing.

The *budget line* indicates all combinations of F and C for which total money spent is equal to income. Since there are only two goods, the woman will spend her entire income on food and clothing. As a result,the combinations of food and clothing that she can buy will all lie on this line:

$$P_F F + P_C C = I \qquad (3.1)$$

For example, suppose the consumer has a weekly income of $80, the price of food is $1 per unit, and the price of clothing is $2 per unit. Table 3.2 shows various combinations of food and clothing that she can purchase each week with her $80. If all her budget were allocated to clothing, the most that she could buy would be 40 units (at a price of $2 per unit), as represented by market basket A. If she spent all her budget on food, she could buy 80 units (at $1 per unit), as given by market basket G. Market baskets B, D, and E show three additional ways in which $80 could be spent on food and clothing.

Figure 3.8 shows the budget line associated with the market baskets given

TABLE 3.2 Market Baskets and the Budget Line

Market Basket	Food (F)	Clothing (C)	Total Spending
A	0	40	$80
B	20	30	$80
D	40	20	$80
E	60	10	$80
G	80	0	$80

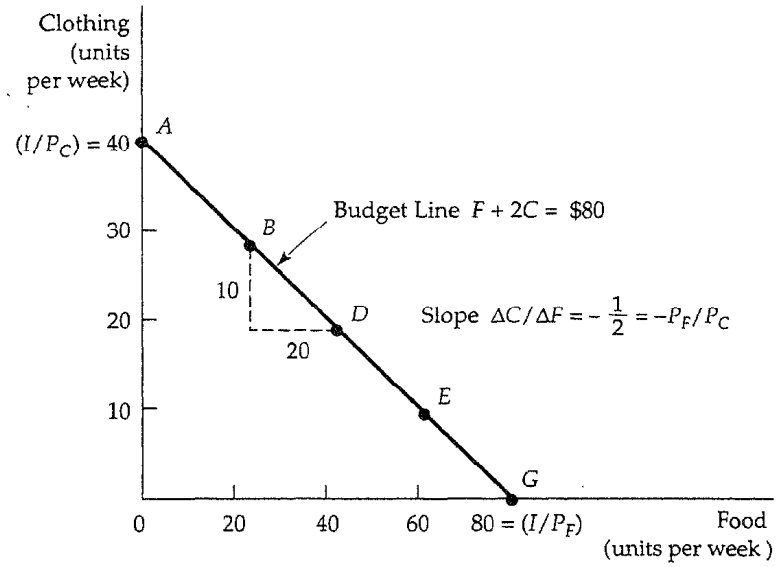

FIGURE 3.8 A Budget Line. The consumer's budget line describes the combinations of goods that can be purchased given the consumer's income and the prices of the goods. Line AG shows the budget associated with an income of \$80, a price of food of P_F = \$1 per unit, and a price of clothing of P_C = \$2 per unit. The slope of the budget line is $-P_F/P_C$.

in Table 3.2. Because giving up a unit of clothing saves \$2 and buying a unit of food costs \$1, the amount of clothing given up for food along the budget line must be the same everywhere. As a result, the budget line is a straight line from point A to point G. In this particular case, the budget line is given by the equation $F + 2C = \$80$.

The intercept of the budget line is represented by market basket A. As she moves along the line from market basket A to market basket G, the consumer spends less on clothing and more on food. It is easy to see that the extra clothing that must be given up to consume an additional unit of food is given by the ratio of the price of food to the price of clothing (\$1/\$2 = ½). Since clothing costs \$2 per unit, while food is only \$1 per unit, a unit of clothing must be given up to get 1 unit of food. In Figure 3.8 the slope of the line, measures the relative cost of food and clothing.

Using equation (3.1), we can see how much of C must be given up to consume more of F by dividing both sides of the equation by P_C and then solving for C:

$$C = (I/P_C) - (P_F/P_C)F \qquad (3.2)$$

Equation (3.2) is the equation for a straight line; it has a vertical intercept of I/P_C and a slope of $-(P_F/P_C)$.

The slope of the budget line, $-(P_F/P_C)$, is the negative of the ratio of the prices of the two goods. The magnitude of the slope tells us the rate at which the two goods can be substituted for each other without changing the total amount of money spent. The vertical intercept (I/P_C) represents the maximum amount of C that can be purchased with income I. Finally,the horizontal intercept (I/P_F) tells us how many units of F could be purchased if all income were spent on F.

The Effects of Changes in Income and Prices

We have seen that the budget line depends on income and on the prices of the goods P_F and P_C. Prices and income often change, however. Let's see how such changes affect the budget line.

Income Changes What happens to the budget line when income changes? From the equation for the straight line, we can see that a change in income alters the vertical intercept of the budget line but does not change the slope (because the price of neither good changed). Figure 3.9 shows that if income is

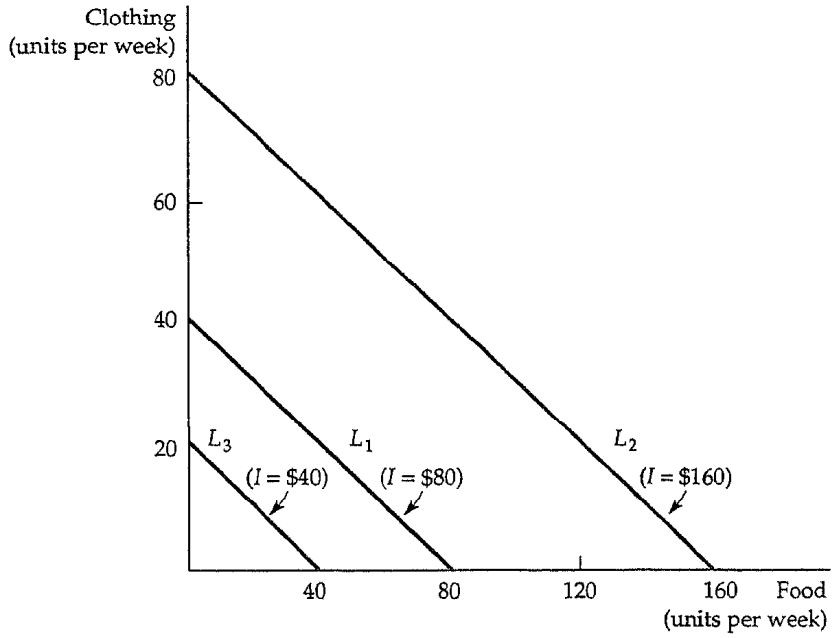

FIGURE 3.9 Effects of a Change in Income on the Budget Line. A change in income (with prices unchanged) causes the budget line to shift parallel to the original line (L_1). When the income of $80 (on L_1) is increased to $160, the budget line shifts outward to L_2. If the income falls to $40, the line shifts inward to L_3.

doubled (from \$80 to \$160), the budget line shifts outward (from budget line L_1 to budget line L_2). Note, however, that L_2 remains parallel to L_1. If she desires, the consumer could now double her purchases of both food and clothing. Likewise, if her income is cut in half (from \$80 to \$40), the budget line shifts inward, from L_1 to L_3.

Price Changes What happens to the budget line if the price of one good changes, but the price of the other good does not? We can use the equation $C = (I/P_C) - (P_F/P_C)F$ to describe the effects of a change in the price of food on the budget line. Suppose the price of food falls by half, from \$1 to \$0.50. Then the vertical intercept of the budget line remains unchanged, but the slope changes from $-P_F/P_C = -1/\$2 = -\frac{1}{2}$ to $-\$0.50/\$2 = -\frac{1}{4}$. In Figure 3.10 we obtain the new budget line L_2 by rotating the original budget line L_1 outward, pivoting from the C-intercept. This rotation makes sense because a person who consumes only clothing and no food is unaffected by the price change. However, someone who consumes a large amount of food will have an increase in his purchasing power. The maximum amount of food that can be purchased has doubled in response to the decline in the price of food.

On the other hand, when the price of food doubles from \$1 to \$2, the budget line rotates inward to line L_3 because the person's purchasing power has diminished. Again, a person who consumed only clothing would be unaffected by the food price increase.

What happens if the prices of both food and clothing change., but in a way that leaves the *ratio* of the two prices unchanged? Because the slope of the

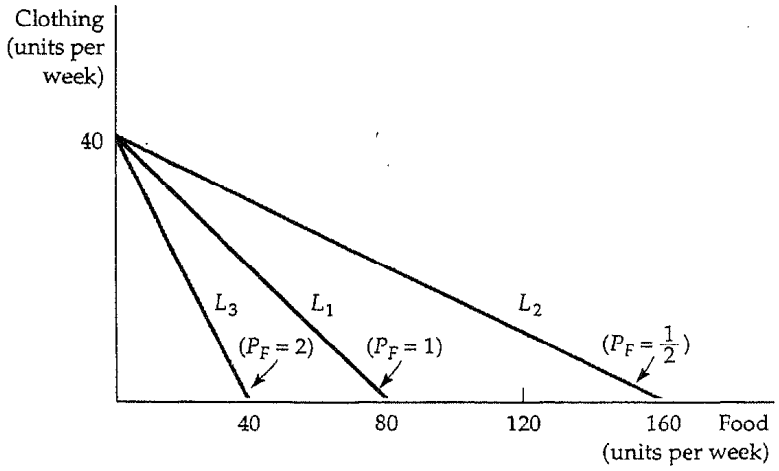

FIGURE 3.10 **Effects of a Change in Price on the Budget Line.** A change in the price of one good (with income unchanged) causes the budget line to rotate about one intercept. When the price of food falls from \$1.00 to \$0.50, the budget line rotates outward from L_1 to L_2. However, when the price increases from \$1.00 to \$2.00, the line rotates inward from L_1 to L_3.

budget line is equal to the ratio of the two prices, the slope will remain the same. The intercept of the budget line must shift so that the new line is parallel to the old one. For example, if the prices of both goods fall by half, then the slope of the budget line does not change, but both intercepts double, and the budget line is shifted outward.

This tells us something about the determinants of a consumer's *purchasing power*-her ability to buy goods. Purchasing power is determined not only by income, but also by prices. For example, a consumer's purchasing power can double either because her income doubles *or* because the prices of all goods that she buys fall by half.

Finally, consider what happens if everything doubles-the prices of both food and clothing *and* the consumer's income. (This can happen in an inflationary economy.) Because both prices have doubled, the ratio of the prices has not changed and, therefore, neither has the slope of the budget line. Because the price of clothing has doubled as has income, the maximum amount of clothing that can be purchased (represented by the vertical intercept of the budget line) is unchanged. The same is true for food. Therefore, an inflation in which all prices and income levels rise proportionately will not affect the consumer's budget line or purchasing power.

3.3 *Consumer Choice*

Given preferences and budget constraints, we can now determine how individual consumers choose how much of each good to buy. We assume that consumers make this choice in a rational way-that they choose goods to *maximize the satisfaction they can achieve, given the limited budget available to them.*

The maximizing market basket must satisfy two conditions. First, *it must be located on the budget line.* To see why, note that any market basket to the left of and below the. budget line leaves some income unallocated, which if spent could increase the consumer's satisfaction. Of course, consumers can-and sometimes do-save some of their incomes for future consumption. But this means that the choice is not just between food and clothing, but between consuming food or clothing now and consuming food or clothing in the future. At this point we will keep things simple by assuming that all income is spent now. Note also that any market basket to the right of and above the budget line cannot be purchased with available income. Thus, the only rational and feasible choice is a market basket on the budget line.

The second condition is that *the maximizing market basket must give the consumer the most preferred combination of goods and services.* These two conditions reduce the problem of maximizing consumer satisfaction to one of picking an appropriate point on the budget line.

In our food and clothing example, as with any two goods, we can graphically illustrate the solution to the consumer's choice problem. Figure 3.11

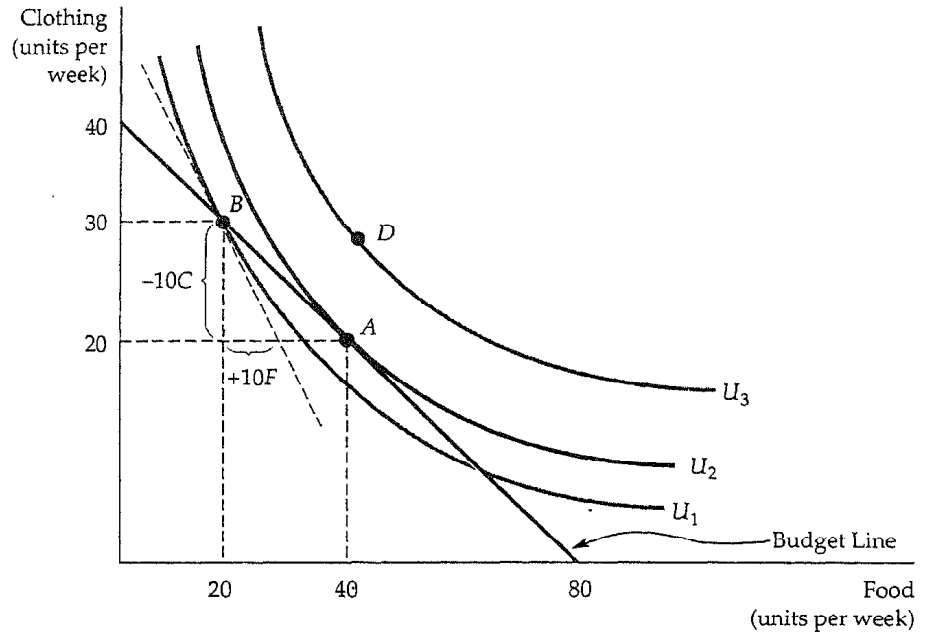

FIGURE 3.11 Maximizing Consumer Satisfaction. Consumers maximize their satisfaction by choosing market basket A. At this point the budget line and indifference curve U_2 are tangent, and no higher level of satisfaction can be attained. At A, the point of maximization, the marginal rate of substitution between the two goods equals the price ratio. At *B*, however, the marginal rate of substitution (1) is greater than the price ratio (½), and maximization does not occur.

shows how the problem is solved. Here, three indifference curves describe a consumer's preferences for food and clothing. Remember that of the three curves, the outermost curve U3 yields the greatest amount of satisfaction, the curve U_2 yields the next greatest amount, and the curve U_1 yields the least.

First, note that point *B* on indifference curve U_1 is not the most preferred choice, because a reallocation of income in which more is spent on food and less on clothing can increase the consumer's satisfaction. In particular, by moving to point *A*, the consumer spends the same amount of money and achieves the increased level of satisfaction associated with indifference curve U_2. Second, note that market baskets to the right and above indifference curve U_2, like the market basket associated with *D* on indifference curve U_3, achieve a higher level of satisfaction but cannot be purchased with the available income. Therefore, *A* maximizes the consumer's satisfaction.

We see from this that the market basket that maximizes satisfaction must lie on the highest indifference curve that touches the budget line. Point *A* is the point of tangency between indifference curve U_2 and the budget line. At *A* the slope of the budget line is exactly equal to the slope of the indifference curve. Because the MRS is the negative of the slope of the indifference curve, we can

say that satisfaction is maximized (given the budget constraint) at the point where

$$MRS = P_F/P_C \tag{3.3}$$

This is an important result: Satisfaction is maximized when *the marginal rate of substitution (of F for C) is equal to the ratio of the prices (of F to C).* Thus, the consumer can obtain maximum satisfaction by adjusting his consumption of goods F and C, so that the MRS equals the price ratio.

The condition given in equation (3.3) is an example of the kinds of optimization conditions that arise in economics. In this instance, maximization is achieved when the *marginal benefit,* that is, the benefit associated with the consumption of one additional unit of food, is equal to the *marginal cost.* The marginal benefit is measured by the MRS. At point *A* it equals ½ (the magnitude of the slope of the indifference curve), which implies that the consumer is willing to give up ½ unit of clothing to obtain 1 unit of food. At the same point, the marginal cost is measured by the value of the slope of the budget line; it also equals ½ because the cost of getting one unit of food is to give up ½ unit of clothing (P_F = 1 and P_C = 2 on the budget line).

If the MRS is less or greater than the price ratio, the consumers satisfaction has not been maximized. For example, compare point *B* in Figure 3.11 to point *A*. At point *B*, the consumer is purchasing 20 units of food and 30 units of clothing. The price ratio (or marginal cost) is equal to ½ because food costs $1 and clothing costs $2. However, the MRS (or marginal benefit) is greater than ½. (It is approximately 1.) As a result, the consumer is willing to substitute one unit of food for one unit of clothing without loss of satisfaction. Because food is cheaper than clothing, it is in his interest to buy more food and less clothing. If the consumer purchases one less unit of clothing, for example, that $2 can be allocated to two units of food, when only one unit is needed to maintain his level of satisfaction.[4]

The reallocation of the budget continues in this manner (moving along the budget line), until we reach point *A*, because at *A* the price ratio of ½ just equals the MRS of ½, which implies that the consumer is willing to trade one unit of clothing for two units of food. Only when the condition MRS = ½ = P_F/P_C holds is he maximizing his satisfaction.

EXAMPLE 3.2 DESIGNING NEW AUTOMOBILES

Our analysis of consumer choice allows us to see how the differing preferences of consumer groups for automobiles can affect their purchasing deci-

[4] The result that the MRS equals the price ratio is deceptively powerful. Imagine two consumers who have just purchased various quantities of food and clothing. Without looking at their purchases, you can tell both persons (if they are maximizing) the value of their MRS (by looking at the prices of the two goods). What you cannot tell, however, is the quantity of each good purchased, because that is determined by their individual preferences. If the two consumers have different tastes, they will consume different quantities of food and clothing, even though each MRS is the same.

sions. Following up on Example 3.1, we consider two groups of consumers; each group wishes to spend $10,000 on the styling and performance of cars (additional money could be allocated to other attributes of automobiles not discussed here), but each group has different preferences for styling and performance.

Figure 3.12 shows the car-buying budget constraint that individuals in each group face. The first group, with preferences similar to those in Figure 3.7a, prefers performance to styling. By finding the point of tangency between a typical individual's indifference curve and the budget constraint, we see that consumers in this group would prefer to buy a car whose performance was worth $7,000 and whose styling was worth $3,000. Individuals in the second group, however, would prefer cars with $2,500 worth of performance and $7,500 worth of styling. (Recall from Example 3.1 that statistical studies have shown that the majority of consumers belong to the second group.)

With knowledge of group preferences, an automobile company can design a production and marketing plan. One potentially profitable option is to manufacture a model that emphasizes styling to a somewhat lesser degree than individuals in Figure 3.12b would prefer, but to a much greater degree than individuals in Figure 3.12a would like (so as to appeal to both groups). A second option is to produce a relatively large number of cars that emphasize

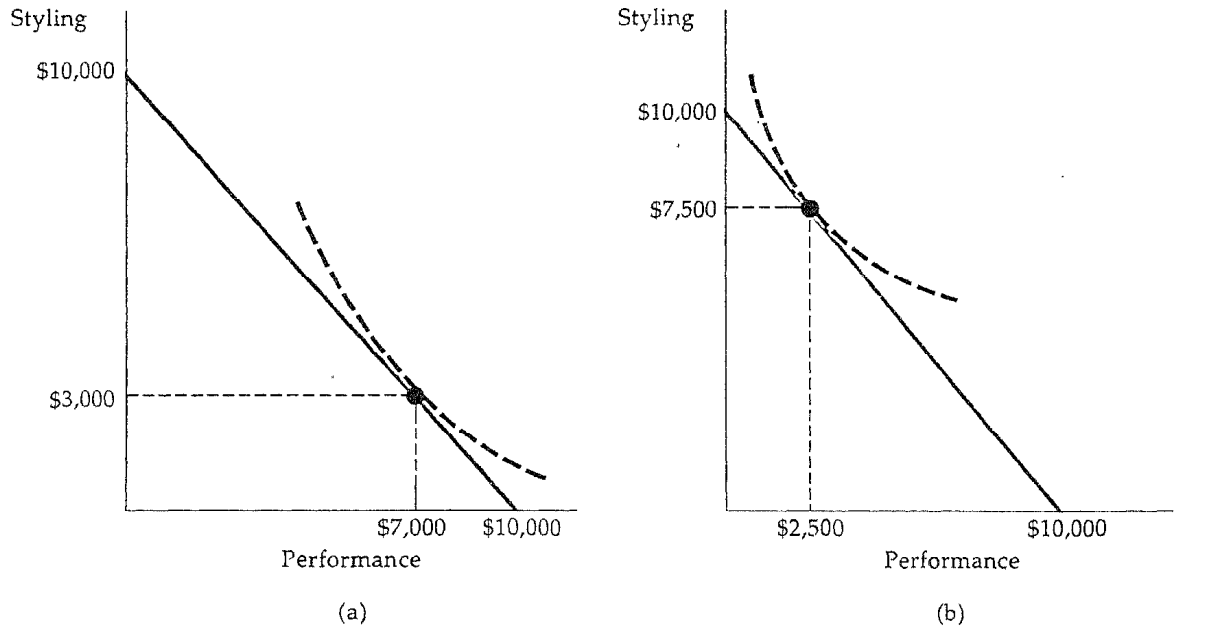

FIGURE 3.12a and b Consumer Choice of Automobile Attributes. The consumers in (a) are willing to trade off a considerable amount of styling for some additional performance. Given a budget constraint, they will choose a car that emphasizes performance. The opposite is true for consumers in (b).

styling, and a smaller number that emphasize performance. Either choice would follow from knowledge of the car-buying preferences discussed above.

EXAMPLE 3.3: THE DECISION MAKING OF A LOCAL PUBLIC OFFICIAL

Grant programs from the federal government to state and local governments serve many purposes. One program might seek to increase school spending, another to redistribute income from relatively wealthy states and localities to those that are relatively poor, and a third to ensure that individual governments provide minimum service levels to their constituents.

Which kinds of grant programs are best suited to achieve these different objectives? The answer depends on the incentive effects that each program generates; by changing the constraints that local public officials face, a grant program can alter the official's decision about how much the local government should spend. We can use consumer theory to see how two types of grant programs evoke different responses from public officials.

Suppose that a public official is in charge of the police budget, which is paid for by local taxes. Her preferences reflect what she believes should be allocated for police spending and what she feels citizens would prefer to have available for private consumption. Before the introduction of the grant program, the city's budget line is PQ in Figure 3.13a. This budget line represents the *total* amount of resources available for public police spending (shown on the horizontal axis) and private spending (shown on the vertical axis).[5] The preference-maximizing market basket A on indifference curve U_1 shows that OR is spent on private expenditures and OS on police expenditures. Since public expenditures are paid for by local taxes, these private expenditures represent spending after local taxes have been paid.

The first type of grant program, a *nonmatching grant, is* simply a check from the federal government that the local government can spend without restriction. An unconditional grant of this sort expands the community budget line outward from PQ to TV in Figure 3.13a, where $PT = QV$ is the dollar amount of the grant. The response to this influx of dollars is to move to a higher indifference curve by selecting market basket B, with more of both goods (OU of private expenditures and OZ of police expenditures). But more private expenditures means that some of the money for police that came previously from taxes now comes from government grants.

The second type of grant is the *matching grant.* Matching funds are offered as a form of subsidy to local spending. For example, the federal government

[5] This sum would approximately equal the per capita income of the jurisdiction (say $10/000) times the number of taxpayers (say, 50,000).

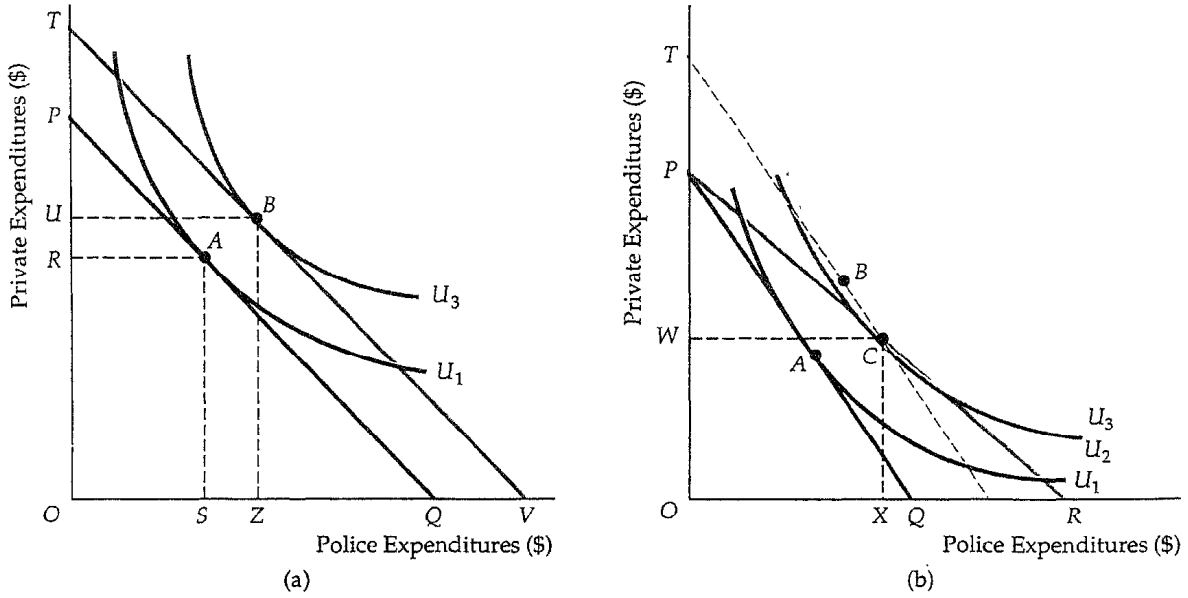

FIGURE 3.13a A Nonmatdiing Grant. A nonmatching grant from the federal government to a local government acts just like an increase in income in the traditional consumer analysis. The local government official moves from *A* to *B*, allocating a portion of the grant to public expenditures and a portion to lower taxes and therefore to an increase in private expenditures.

FIGURE 3.13b A Matching Grant. A matching grant acts just like a price decrease in the traditional consumer analysis. The local government official moves from *A* to *C*, allocating some of the grant to public expenditures and some to private expenditures. Relatively more money, however, is spent on public expenditures than would be with a nonmatching grant of the same total amount.

might offer to pay $1 for every $2 that the local government raises to pay for police. As a result, a matching grant lowers the relative cost of the publicly provided good. In terms of Figure 3.13b, the matching grant rotates the budget line outward from *PQ* to *PR*. If no local money is spent on police, the budget line is unchanged. However, if the local public official decides to spend money on the public sector, the budget increases.

In response to the matching grant, the official chooses market basket C rather than A. As with a nonmatching grant, there is an increase in both police and private expenditures. At *C*, *OX* dollars are allocated to police and *OW* to private expenditures. However, the spending effects of the two types of grant are different. The diagram shows that the matching grant leads to greater police spending than does the nonmatching grant, even when the two programs involve identical government expenditures.

A Corner Solution

Sometimes consumers buy in extremes, at least within categories of goods. For example,some people spend no money on travel and entertainment. The indifference curve analysis can be used to show conditions under which consumers choose not to consume a particular good.

In Figure 3.14, faced with budget line *AB*, a man chooses to purchase only food and no clothing. This is called a *corner solution* because when one of the goods is not consumed, the consumption bundle appears at the corner of the graph. At *B*, which is the point of maximum satisfaction, the marginal rate of substitution of food for clothing is greater than the slope of the budget line. This suggests that if the consumer had more clothing to give up, he would gladly trade it for additional food. However, at this point the consumer is already consuming all food and no clothing, and it is impossible to consume *regative* amounts of clothing!

When a corner solution arises, the. consumer's MRS *does not equal the price ratio*[6] The marginal benefit-marginal cost condition that we described in the

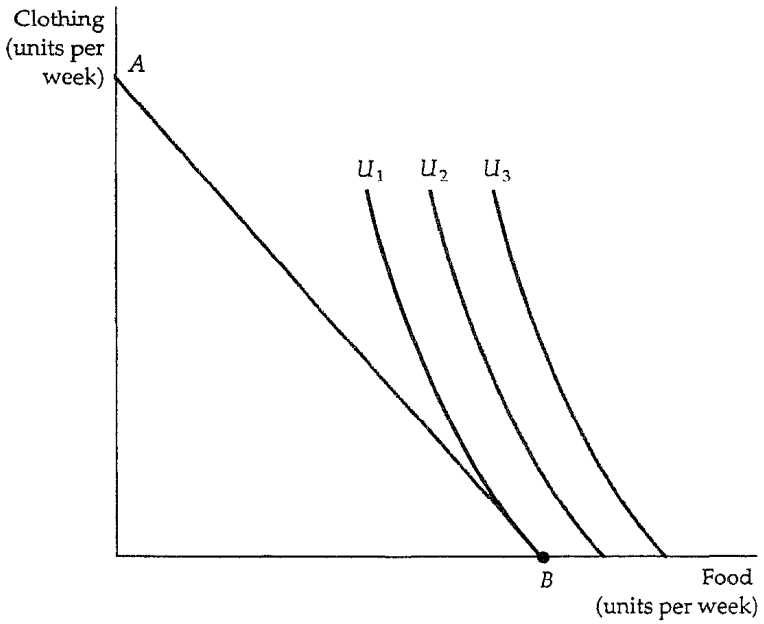

FIGURE 3.14 A Corner Solution. When the consumer's marginal rate of substitution is greater than the price ratio for all levels of consumption, then a corner solution arises. The consumer maximizes satisfaction by consuming only one of the two goods. Given budget line *AB*, the highest level of satisfaction is achieved at *B* on indifference curve U_1, and only food is consumed.

[6] It is possible, but unlikely, that a corner solution will be reached at which the MRS is equal to the price ratio. We have omitted this from the text to simplify the discussion.

previous section holds only when positive quantities of all goods are consumed.

An important lesson here is that predictions about how much of a product consumers will purchase when faced with changing economic conditions depend on the nature of consumer preferences for that product and related products and on the slope of the consumer's budget line. If the MRS of food for clothing is substantially greater than the price ratio, as in Figure 3.14, then a small decrease in the price of clothing will not alter the consumer's choice—he will still choose to consume only food. But if the price of clothing falls far enough, the consumer could quickly choose to consume a lot of clothing.

EXAMPLE 3.4 A COLLEGE TRUST FUND

Jane Doe's parents have provided a trust fund for her college education. Jane, who is 18, can receive the entire trust fund on the condition that she spend it only on education. The trust fund is a welcome gift to Jane but perhaps not as welcome as an unrestricted trust would be. To see this, consider Figure 3.15, in which dollars per year spent on education are shown on the horizontal axis, and dollars spent on other forms of consumption are on the vertical axis.

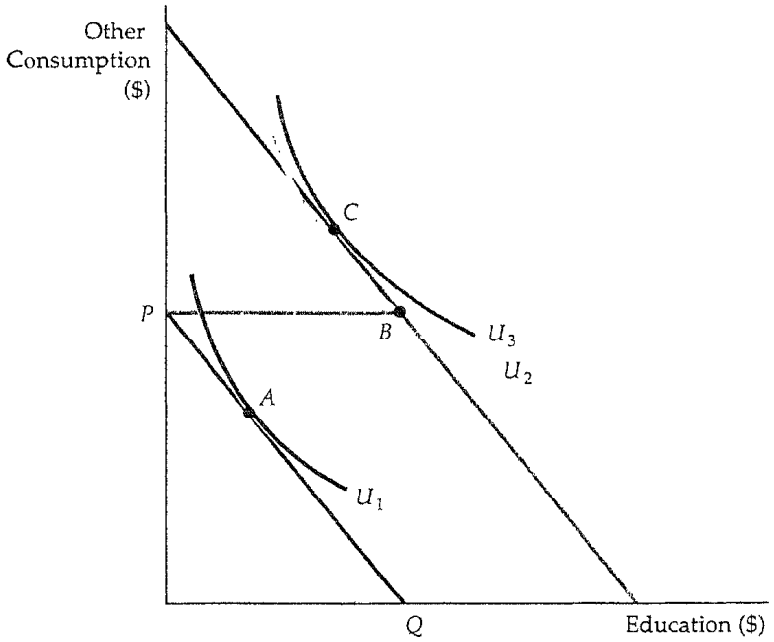

FIGURE 3.15 A College Trust Fund. A student is given a college trust fund that must be spent on education. The student moves from *A* to *B*, a corner solution. If, however, the trust fund could be spent on other consumption as well as education, the student would be better off at *C*

The budget line that Jane faces before being awarded the trust is given by line PQ. The trust fund expands the budget line outward so long as the full amount of the fund, shown by distance PB, is spent on education. By accepting the trust fund and going to college, Jane increases her satisfaction, moving from A on indifference curve U_1 to B on indifference curve U_2.

Note that B represents a corner solution because Jane's marginal rate of substitution of other consumption for education is lower than the relative price of other consumption. Jane would prefer to spend a portion of the trust fund on other goods as well as education. Without the restriction on the trust fund, she would move to C on indifference curve U_3, decreasing her spending on education (perhaps going to a junior college rather than a four-year college) but increasing her spending on items that she enjoys more than education.

Recipients usually prefer an unrestricted trust to a restricted one. Restricted trusts are popular, however, because they allow parents to control their children's expenditures in ways that they believe are in the children's long-run best interests.

3.4 *Revealed Preference*

In Section 3.1 we saw how an individual's preferences could be represented by a series of indifference curves. Then in Section 3.3, we saw how preferences determine choices, given a budget constraint. Can this process be reversed? If we know the choices a consumer has made, can we determine her preferences?

We can, if we have information about a sufficient number of choices that are made when prices and income levels vary. The basic idea is simple. If a consumer chooses one market basket over another, and the chosen market basket is more expensive than the alternative one, then the consumer must prefer the chosen market basket.

Suppose that an individual, facing the budget constraint given by line l_1 in Figure 3.16, chooses market basket A. Let's compare this to baskets B and D. Since the individual could have purchased market basket B (and all market baskets below line l_1) and did not, we say that A is *preferred* to B.

It might seem at first glance that we cannot make a direct comparison between market baskets A and D because D is not on l_1. But suppose the relative prices of food and clothing change, so that the new budget line is l_2 and the individual then chooses market basket B. Since D lies on budget line l_2 and was not chosen, B is preferred to D (and B is preferred to all market baskets below line l_2). Since A is preferred to B and B is preferred to D, we conclude that A is preferred to D. Furthermore, note in Figure 3.16 that market basket A is preferred to all of the market baskets that appear in the blue-shaded ar-

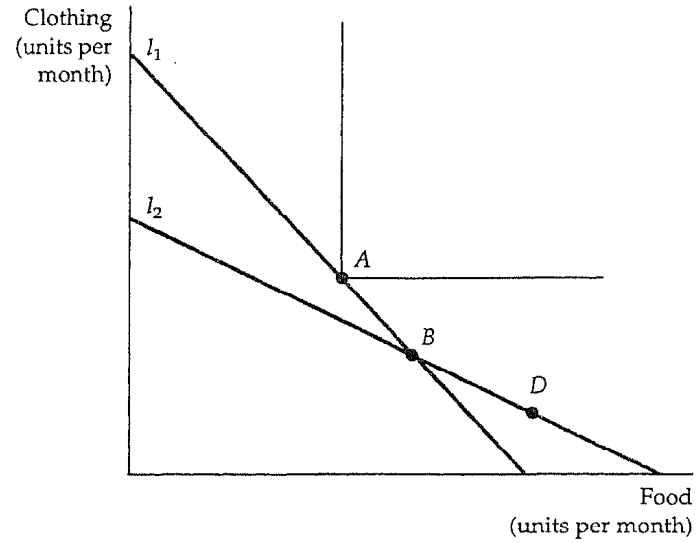

FIGURE 3.16 Revealed Preference-Two Budget Lines. If an individual facing budget line l_1 has chosen market basket A rather than market basket B, A is revealed preferred to B. Likewise, facing budget line l_2, the individual chooses market basket B, which is then revealed preferred to market basket D. A *is* preferred to all market baskets in the blue-shaded area, while all market baskets in the tan-shaded area are preferred to A.

eas. However, since food and clothing are "goods" rather than "bads," all market baskets that lie in the tan-shaded area in the rectangle above and to the right of A are preferred to A. Hence, the indifference curve passing through A must lie in the unshaded area.

Given more information about choices when prices and income levels vary, we can get a better fix on the shape of the indifference curve. Consider Figure 3.17. Suppose that facing line l_3 (which was chosen to pass through A), the individual chooses market basket E. Since E was chosen, even though A was equally expensive (it lies on the same budget line), E is preferred to A, as are all points in the rectangle above and to the right of E. Now suppose that facing line l_4 (which passes through A) the individual chooses market basket G. Since G was chosen and A was not, G is preferred to A, as are all market baskets above and to the right of G.

We can go further by making use of the assumption that preferences are convex. Then, since E is preferred to A, all market baskets above and to the right of line AE in Figure 3.17 must be preferred to A. (Otherwise the indifference curve passing through A would have to pass through a point above and to the right of AE and then fall below the line at E, and the indifference curve would not be convex.) By a similar argument, all points on AG or above are also preferred to A. Therefore, the indifference curve must lie within the unshaded area.

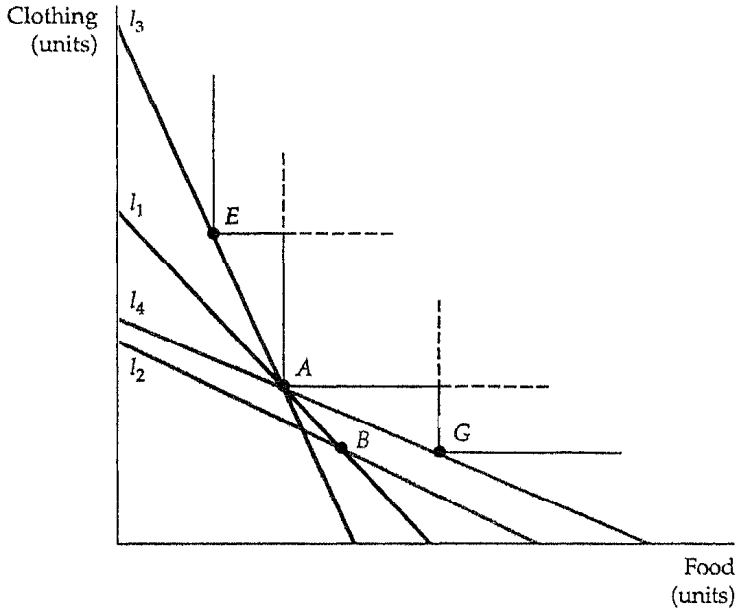

FIGURE 3.17 Revealed Preference-Four Budget Lines. Facing budget line l_3 the individual chooses E, which is revealed preferred to A (since A could have been chosen). Likewise, facing line l_4, G is chosen, which is also revealed preferred to A. A is preferred to all market baskets in the blue-shaded area, while all market baskets in the tan-shaded area are preferred to A.

Usually there is not enough information to use this revealed preference approach to determine indifference curves. Fortunately, the analysis is also valuable as a means of checking whether individual choices are consistent with the assumptions of consumer theory.

Revealed preference analysis has even been applied to the study of animal behavior. By changing an animal's environmeirt, one can test whether the animal's consumption choices are consistent with consumer theory. One study of rats varied the "price" of different foods according to the number of times the rats had to push a lever to obtain the foods. The rats' behavior was consistent with consumer theory-they were shown to have relatively low "price" elasticities for essential foods and higher elasticities for nonessentials.[7]

Finally, revealed preference analysis can help us understand the implications of choices that consumers must make in particular circumstances, as Example 3.5 shows.

[7] See John H. Kagel, Raymond C. Battalio, Howard Rachlin, and Leonard Green, "Demand Curves for Animal Consumers," *Quarterly Journal of Economics* 96 (Feb. 1981): 1-15.

EXAMPLE 3.5 REVEALED PREFERENCE FOR RECREATION

A health club has been offering the use of its facilities to anyone who is willing to pay an hourly fee. Now the club decides to alter its pricing policy by charging an annual membership fee along with a lower hourly fee. Does this new financial arrangement make individuals better off or worse off than the old arrangement? The answer depends on people's preferences.

Suppose that Roberta has $100 of income available each week for recreational activities, including exercise, movies, restaurant meals, and so on. When the health club charged a fee of $4 per hour, Roberta used the facility 10 hours per week. Under the new arrangement, she is required to pay $30 per week for access to the facilities, but can use the club for only $1 per hour.

Is this change beneficial for Roberta? Revealed preference analysis provides the answer. In Figure 3.18 line l_1 represents the budget constraint that Roberta faced under the original pricing arrangement. In this case she maximized her satisfaction by choosing market basket A, with 10 hours of exercise and $60 of other recreational activities. Under the new arrangement, which shifts the budget line to l_2, she could still choose market basket A. But since U_1 is clearly not tangent to l_2, Roberta will be better off choosing another market basket, such as B, with 25 hours of exercise and $45 of other recreational activities. Since

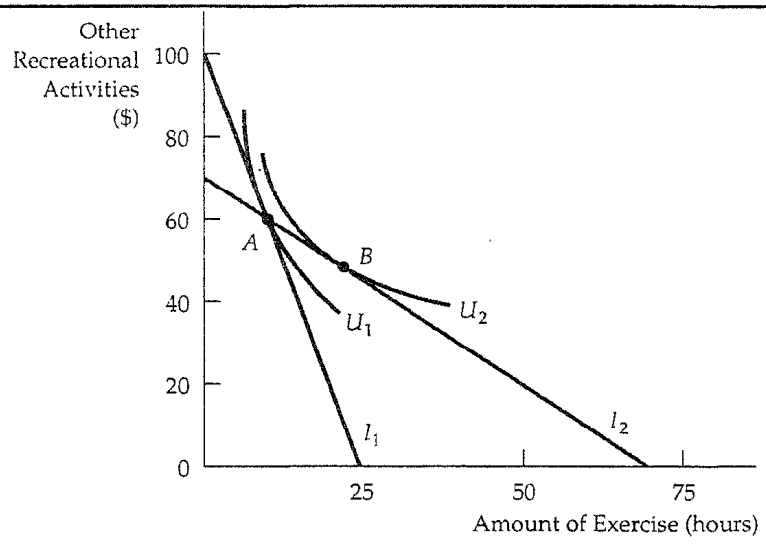

FIGURE 3.18 Revealed Preference for Recreation. An individual chooses to use a health club for 10 hours per week at point A, when facing budget line l_1. When the fees are altered, the individual faces budget line l_2. She is then made better off, since market basket A can still be purchased, as can market basket B, which lies on a higher indifference curve.

she would choose *B* when she could still choose *A*, she prefers *B* to *A*. The new pricing arrangement therefore makes Roberta better off.

We could also ask whether this new pricing system-called a *two-part tariff*-will increase the profits of the health club. If all members are like Roberta and more use generates more profit, then the answer is yes. In general, however,the answer depends on the preferences of all members, and on the costs of operating the facility. We discuss the two-part tariff in detail in Chapter 11 when we study how firms with market power set prices.

3.5 *The Concept of Utility*

Indifference curves allow us to describe consumer preferences graphically, and build on the assumption that consumers can rank alternatives. But consumer preferences can also be described using the concepts of utility and marginal utility. We will explain what each of these concepts means and then relate them to indifference curve analysis.

Utility and Satisfaction

Utility is the level of satisfaction that a person gets from consuming a good or undertaking an activity. Utility has an important psychological component because people obtain utility by getting things that give them pleasure and by avoiding things that give them pain. In economic analysis, however, utility is most often used to summarize the preference ranking of market baskets. If buying three books makes a person happier than the purchase of one shirt, then we say that the books give that person more utility than the shirt.

A *utility function* is obtained by attaching a number to each market basket, so that if market basket *A* is preferred to market basket *B*, the number will be higher for *A* than for *B*. For example, market basket *A* on the highest of three indifference curves U_3 might have a utility level of 3, while market basket *B* on the second-highest indifference curve U_2 might have a utility level of 2, and market basket *C*, on the lowest indifference curve U_1 a utility level of 1, Thus, the utility function provides the same information about preferences that an indifference map does. Both utility functions and indifference maps order consumer choices in terms of levels of satisfaction.

The utility function is more easily applied to the analysis of choices involving three or more goods simply because it is difficult to graph indifference curves in this case. But it is important to distinguish between the cardinal and ordinal properties of utility functions. For example, the levels of utility associated with the three market baskets *A*, *B*, and C might be 4, 2, and 1, or they

might be 3, 2, and 1. Because most choices can be explained simply by the ordinal ranking of utility levels, the indicators 4, 2, and 1 provide the same information as the indicators 3, 2, and 1. What is important is the *relative* rankings that are given when a particular set of numbers is chosen.

Bearing in mind that we are using the ordinal properties of utility functions, let's examine one in particular. The function $u(F,C) = FC$ tells us that the level of satisfaction obtained from consuming F units of food and C units of clothing is the product of F and C. Figure 3.19 shows indifference curves associated with this function. The graph was drawn by initially choosing one particular market basket, say, $F = 5$ and $C = 5$, which generates a utility level of 25. Then the indifference curve (also called an *isoutility curve)* was drawn by finding all market baskets for which $FC = 25$ (e.g., $F = 10$, $C = 2.5$; $F = 2.5$, $C = 10$). The second indifference curve contains all market baskets for which FC = 50, and the third all baskets such that $FC = 100$.

The important point is that the numbers attached to the indifference curves are for convenience only. Suppose the utility function were changed to $u(F,C) = 4FC$. Consider any market basket that previously generated a utility level of 25, say, $F = 5$ and $C = 5$. Now the level of utility has increased, by a factor of 4, to 100. Thus, the indifference curve labeled 25 looks the same, but it should now be labeled 100 rather than 25. In fact, the.only difference between the indifference curves associated with the utility function 4FC and the utility function FC is that the curves are numbered 100, 200, and 400, rather than 25,50, and 100. Most often when we use utility functions, we care about

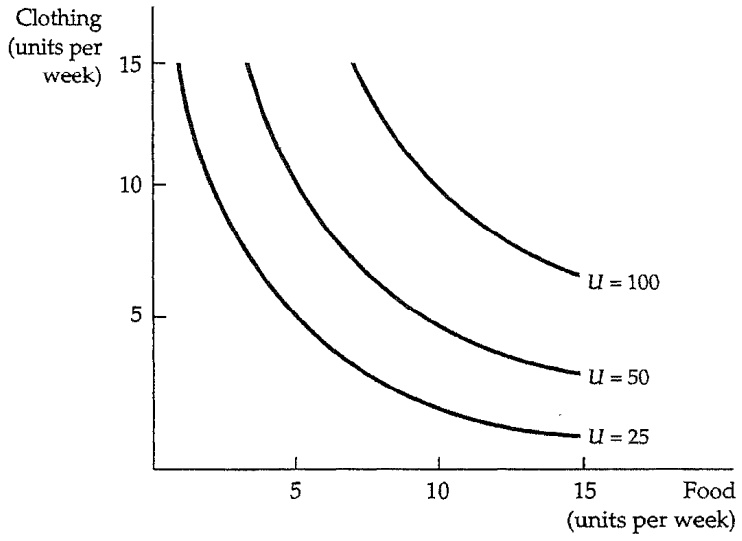

FIGURE 3.19 **Utility Functions and Indifference Curves.** A utility function can be represented by a set of indifference curves, each with a numerical indicator. The figure shows three indifference curves, with utility levels of 25, 50, and 100.

their ordinal rather than cardinal properties. On the few occasions when we do plan to use the stronger assumption that utility has cardinal meaning, we will let you know.

Marginal Utility

By introducing the concept of marginal utility, our previous analysis of consumer choice can be recast in a way that provides additional insight. To begin, let's distinguish between the total utility obtained by consumption and the satisfaction obtained from the last item consumed. *Marginal utility* (MU) measures the additional satisfaction obtained from consuming an additional amount of a good. For example, the marginal utility associated with a consumption increase from 0 to 10 units of food might be 9; from 10 to 20, it might be 7; and from 20 to 30, it might be 5.

These numbers are consistent with the principle of *diminishing marginal utility:* As more and more of a good is consumed, consuming additional amounts will yield smaller and smaller additions to utility. Imagine, for example, the consumption of television-marginal utility might fall after the second or third hour (and could become negative after the fourth or fifth).

We can relate the concept of marginal utility to the consumer's utility maximization problem in the following way. Consider a small movement down an indifference curve in Figure 3.19. The additional consumption of F, ΔF, will generate marginal utility MU_F. This results in a total increase in utility of $MU_F\Delta F$. At the same time, the loss of consumption of C, ΔC, will lower utility per unit by MU_C, resulting in a total loss of $MU_C\Delta C$.

Since all points on an indifference curve generate the same level of utility, the total gain in utility associated with the increase in F must balance the loss due to the lower consumption of C. Formally,

$$0 = MU_F(\Delta F) + MU_C(\Delta C)$$

Now we can rearrange this equation so that

$$-(\Delta C/\Delta F) = MU_F/MU_C$$

But since $-(\Delta C/\Delta F)$ is the marginal rate of substitution of F for C, it follows that

$$MRS = MU_F/MU_C \tag{3.4}$$

Equation (3.4) tells us that the marginal rate of substitution is the ratio of the marginal utility of F to the marginal utility of C. As the consumer gives up more and more of C to obtain more of F, the marginal utility of F falls and the marginal utility of C increases.

We saw earlier in this chapter that when consumers maximize their satisfaction, the marginal rate of substitution of F for C is equal to the ratio of the prices of the two goods:

$$MRS=P_F/P_C \tag{3.5}$$

Since the MRS is also equal to the ratio of the marginal utilities of consuming F and C (from equation 3.4), it follows that

$$MU_F/MU_C = P_F/P_C$$

or

$$MU_F/P_F = MU_C/P_C \tag{3.6}$$

According to equation (3.6), utility maximization is achieved when the budget is allocated so that *the marginal utility per dollar of expenditure is the same for each good.* To see why this must hold,note that if a person gets more utility from spending an additional dollar on food than on clothing, her utility will be increased by spending more on food. So long as the marginal utility of spending an extra dollar on food exceeds the marginal utility of spending an extra dollar on clothing, she should shift her budget toward food and away from clothing. Eventually, the marginal utility of food will decrease (because there is diminishing marginal utility in consumption) and the marginal utility of clothing will increase (for the same reason). Only when the consumer has equalized the marginal utility per dollar of expenditure across all goods will she have maximized utility. This *equal marginal principle* is an important concept in microeconomics. It will reappear in different forms throughout our analysis of consumer and producer behavior.

EXAMPLE 3.6 GASOLINE RATIONING

In 1974 and again in 1979, the government imposed price controls on gasoline, and many gas stations had to reduce their prices (world oil prices rose but controls kept domestic prices low). As a result, motorists wanted to buy more gasoline than was available at the controlled prices, and gasoline was rationed. Nonprice rationing is an alternative to the market that some people consider fair. Under one form of rationing everyone has an equal chance to purchase a rationed good, whereas under a market system those with higher incomes can outbid those with lower incomes to obtain goods that are in scarce supply.

In this case gasoline was allocated by long lines at the gas pumps: Those who were willing to give up their time waiting got the gas they wanted, while others did not. By guaranteeing every person a minimum amount of gasoline, rationing can provide some people with access to a product that they could not otherwise afford. But rationing hurts others by limiting the amount of gasoline that they can buy.[8]

[8] For a more extensive discussion of gasoline rationing, see H. E. Frech III and William C. Lee,"The Welfare Cost of Rationing-By-Queuing Across Markets: Theory and Estimates from the U.S. Gasoline Crises," *Quarterly Journal of Economics* (1987): 97-108. Other, more general examples of rationing appear in Martin L. Weitzman, "Is the Price System or Rationing More Effective in Getting a Commodity to Those Who Need it Most?" *Bell Journal of Economics* 8 (Autumn 1977): 517-525.

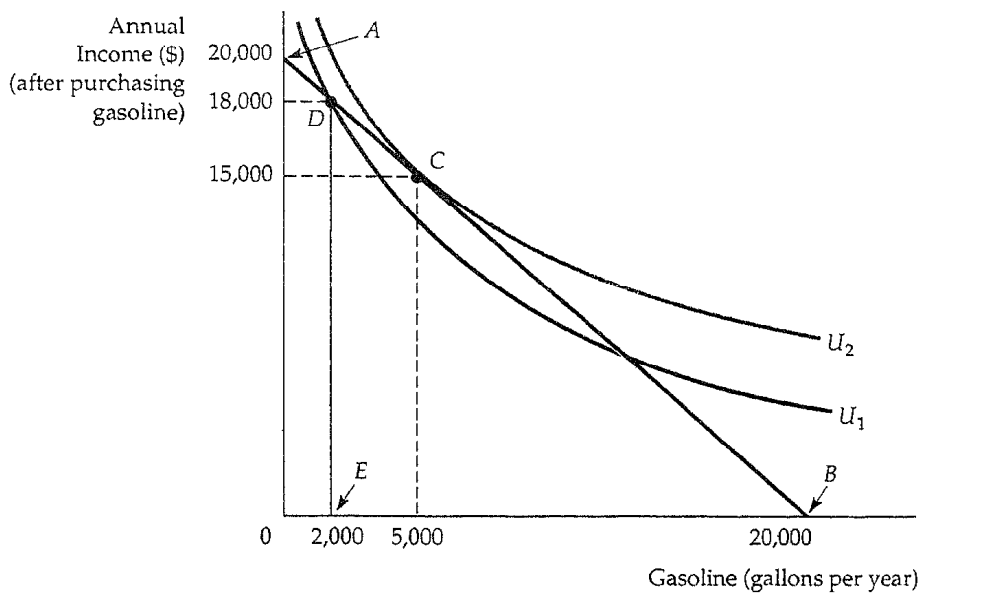

FIGURE 3.20 Inefficiency of Gasoline Rationing. When a good is rationed, less is available than consumers would like to buy, and consumers may be worse off. Without gasoline rationing, the consumer is at *C* on indifference curve U_2, consuming 5000 gallons of gasoline. However, with a limit of 2000 gallons of gasoline under rationing, the consumer moves to *D* on the lower indifference curve U_1.

We can see this clearly in Figure 3.20, which applies to a woman with an annual income of $20,000. The horizontal axis shows her annual consumption of gasoline, and the vertical axis shows her remaining income after purchasing gasoline. Suppose the controlled gasoline price is $1 per gallon. Because her income is $20,000, she is limited to the. points on budget line *AB*, which has a slope of -1. At $1 per gallon, the woman might wish to buy 5000gallons of gasoline per year and spend $15,000 on other goods, represented by C. At this point, she has maximized her utility (by being on the highest possible indifference curve U_2), given her budget constraint of $20,000.

Because of rationing, the woman can purchase only 2000 gallons of gasoline. As a result, she now faces budget line *ADE*. The budget line is no longer a straight line because purchases above 2000 gallons are not possible. The figure shows that her choice to consume at *D* involves a lower level of utility, U_1, than would be achieved without rationing, U_2, because she is consuming less gasoline and more of other goods than she would otherwise prefer.

Summary

1. The theory of consumer choice is built on the assumption that people behave rationally in an attempt to maximize the satisfaction that they can obtain by purchasing a particular combination of goods and services.
2. Consumer choice has two related parts: the study of the consumer's preferences, and the analysis of the budget line, which constrains the choices a person can make.
3. Consumers make choices by comparing market baskets or bundles of commodities. Their preferences are assumed to be complete (they can compare all possible market baskets) and transitive (if they prefer market basket *A* to *B*, and *B* to *C*, then they prefer *A* to *C*). In addition, we have assumed that more of each good is always preferred to less.
4. Indifference curves, which represent all combinations of goods and services that give the same level of satisfaction, are downward-sloping and cannot intersect one another.
5. Consumer preferences can be completely described by a set of indifference curves, or an indifference map. This indifference map provides an ordinal ranking of all choices that the consumer might make.
6. The marginal rate of substitution of *F* for *C* is the maximum amount of *C* that a person is willing to give up to obtain one additional unit of *F*. The marginal rate of substitution diminishes as we move down along an indifference curve. When there is a diminishing marginal rate of substitution, preferences are convex.
7. Budget lines represent all combinations of goods for which consumers expend all their income. Budget lines shift outward in response to an increase in consumer income, but they pivot and rotate about a fixed point (on the vertical axis) when the price of one good (on the horizontal axis) changes but income and the price of the other good do not.
8. Consumers maximize satisfaction subject to budget constraints. When a consumer maximizes satisfaction by consuming some of each of two goods, the marginal rate of substitution is equal to the ratio of the prices of the two goods being purchased.
9. This maximization is sometimes achieved at a corner solution in which one good is not consumed. In that case the marginal rate of substitution need not equal the ratio of the prices.
10. The theory of revealed preference shows how the choices that individuals make when prices and income vary can be used to determine their preferences. When an individual chooses basket *A* when she could afford *B*, we know that *A* is preferred to *B*.
11. The theory of the consumer can be presented using either an indifference curve approach, which uses the ordinal properties of utility (that is, which allows for the ranking of alternatives), or a utility function approach. *A* utility function is obtained by attaching a number to each market basket; if market basket *A* is preferred to market basket *B, A* generates more utility than *B*.
12. When risky choices are analyzed or when comparisons must be made among individuals, the cardinal properties of the utility function can be important. Usually the utility function will show diminishing marginal utility: As more and more of a good is consumed, the consumer obtains smaller and smaller increments to utility.

13. When the utility function approach is used and both goods are consumed, utility maximization occurs when the ratio of the marginal utilities of the two goods (which is the marginal rate of substitution) is equal to the ratio of the prices.

Questions for Review

1. What does *transitivity of preferences* mean?

2. Suppose that a set of indifference curves was not negatively sloped. What could you say about the desirability of the two goods?

3. Explain why two indifference curves cannot intersect.

4. Draw a set of indifference curves for which the marginal rate of substitution is constant. Draw two budget lines with different slopes; show what the satisfaction-maximizing choice will be in each case. What conclusions can you draw?

5. Explain why a person's marginal rate of substitution between two goods must equal the ratio of the price of the goods for the person to achieve maximum satisfaction.

6. Explain why consumers are likely to be worse off when a product that they consume is rationed.

7. Upon merging with West Germany's economy, East German consumers indicated a preference for Mercedes-Benz automobiles over Volkswagen automobiles. However, when they converted their savings into deutsche marks, they flocked to Volkswagen dealerships. How can you explain this apparent paradox?

8. Describe the equal marginal principle. Explain why this principle may not hold if increasing marginal utility is associated with the consumption of one or both goods.

9. What is the difference between ordinal utility and cardinal utility? Explain why the assumption of cardinal utility is not needed in order to rank consumer choices.

Exercises

1. In this chapter, consumer preferences for various commodities did not change during the analysis. Yet in some situations, preferences do change as consumption occurs. Discuss why and how preferences might change over time with consumption of these two commodities:
   a. cigarettes
   b. dinner for the first time at a restaurant with a special cuisine.

2. Draw the indifference curves for the following individuals' preferences for two goods: hamburgers and beer.
   a. Al likes beer but hates hamburgers. He always prefers more beer no matter how many hamburgers he has.
   b. Betty is indifferent between bundles of either three beers or two hamburgers. Her preferences do not change as she consumes any more of either food.
   c. Chris eats one hamburger and washes it down with one beer. He will not consume an additional unit of one item without an additional unit of the other.
   d. Doreen loves beer but is allergic to beef. Every time she eats a hamburger she breaks out in hives.

3. The price of records is $8, and the price of tapes is $10. Philip has a budget of $80 and has already purchased 4 records. He thus has $48 more to spend on additional records and tapes. Draw his budget line. If his remaining expenditure is made on 1

record and 4 tapes, show Philip's consumption choice on the budget line.

4. Suppose Bill views butter and margarine as perfectly substitutable for each other.

a. Draw a set of indifference curves that describes Bill's preferences for butter and margarine.

b. Are these indifference curves convex? Why?

c. If butter costs $2 per package, while margarine costs only $1, and Bill has a $20 budget to spend for the month, which butter-margarine market basket will he choose? Can you show this graphically?

5. Suppose Jones and Smith have decided to allocate $1000 per year on liquid refreshment in the form of alcoholic or nonalcoholic drinks. Jones and Smith differ substantially in their preferences for these two forms of refreshment. Jones prefers alcoholic to nonalcoholic drinks, while Smith prefers the nonalcoholic option.

a. Draw a set of indifference curves for Jones and a second set for Smith.

b. Discuss why the two sets of curves are different from each other using the concept of marginal rate of substitution.

c. If both Smith and Jones pay the same prices for their refreshments, will their marginal rates of substitution of alcoholic for nonalcoholic drinks be the same or different? Explain.

6. Anne is a frequent flyer whose fares are reduced (through coupon giveaways) by 25 percent after she flies 25,000 miles a year, and then by 50 percent after she flies 50/000 miles. Can you graph the budget line that Anne faces in making her flight plans for the year?

7. Antonio buys 8 new college textbooks during his first year at school at a cost of $50 each. Used books cost only $30 each. When the bookstore announces that there will be a 20 percent price increase in new texts and a 10 percent increase in used texts for the next year, Antonio's father offers him $80 extra. Is Antonio better off or worse off after the price change?

8. Suppose that Samantha and Jason both spend $24 per week on video and movie entertainment. When the prices of videos and movies are both $4, they each rent 3 videos and buy 3 movie tickets. Following a video price war and an increased cost of movie tickets, the video price falls to $2 and the movie ticket increases to $6. Samantha now rents 6 videos and buys 2 movie tickets; Jason, however, buys 1 movie ticket and rents 9 videos.

a. Is Samantha better off or worse off after the price change?

b. Is Jason better off or worse off?

9. Connie Consumer has a monthly income of $200, which she allocates between two goods: meat and potatoes.

a. Suppose meat costs $4 per pound and potatoes cost $2 per pound. Draw her budget constraint.

b. Suppose also that her utility function is given by the equation $u(M,P) = 2M + P$. What combination of meat and potatoes should she buy to maximize her utility? (Hint: Meat and potatoes are perfect substitutes.)

c. Connie's supermarket has a special promotion. If she buys 20 pounds of potatoes (at $2 per pound), she gets the next 10 pounds for free. This offer applies only to the first 20 pounds she buys. All potatoes in excess of the first 20 pounds (excluding bonus potatoes) are still $2 per pound. Draw her budget constraint.

d. An outbreak of potato rot raises the price of potatoes to $4 per pound. The supermarket ends its promotion. What does her budget constraint look like now? What combination of meat and potatoes maximizes her utility?

10. The utility that Jane receives by consuming food F and clothing C is given by $u(F,C) = FC$.

a. Draw the indifference curve associated with a utility level of 12, and the indifference curve associated with a utility level of 24. Are the indifference curves convex?

b. Suppose that food costs $1 a unit, clothing costs $3 a unit, and Jane has $12 to spend on food and clothing. Graph the budget line that she faces.

c. What is the utility-maximizing choice of food and clothing? (Suggestion: Solve the problem graphically.)

d. What is the marginal rate of substitution of food for clothing when utility is maximized?

e. Suppose that Jane buys 3 units of food and 3 units of clothing with her $12 budget. Would her marginal rate of substitution of food for clothing be greater or less than $\frac{1}{3}$? Explain.