6

AFTER READING THIS CHAPTER, YOU SHOULD BE ABLE TO:

1. **Define and explain the relationship between total utility, marginal utility, and the law of diminishing marginal utility.**
2. **Describe how rational consumers maximize utility by comparing the marginal utility-to-price ratios of all the products they could possibly purchase.**
3. **Explain how a demand curve can be derived by observing the outcomes of price changes in the utility-maximization model.**
4. **Discuss how the utility-maximization model helps highlight the income and substitution effects of a price change.**
5. **Relate how behavioral economics and prospect theory shed light on many consumer behaviors.**
6. **(Appendix) Relate how the indifference curve model of consumer behavior derives demand curves from budget lines, indifference curves, and utility maximization.**

Consumer Behavior

If you were to compare the shopping carts of almost any two consumers, you would observe striking differences. Why does Paula have potatoes, peaches, and Pepsi in her cart, while Sam has sugar, saltines, and 7-Up in his? Why didn't Paula also buy pasta and plums? Why didn't Sam have soup and spaghetti on his grocery list?

In this chapter, you will see how individual consumers allocate their incomes among the various goods and services available to them. Given a certain budget, how does a consumer decide which goods and services to buy? This chapter will develop a model to answer this question.

This chapter will also survey some of the recent insights about consumer behavior provided by the field of behavioral economics. These insights explain many of the less-rational and oftentimes quirky behaviors exhibited by consumers. Better yet, they also suggest concrete policies that individuals, companies, and governments can use to make consumers better off by working with—rather than against—people's behavioral quirks.

Law of Diminishing Marginal Utility

The simplest theory of consumer behavior rests squarely on the **law of diminishing marginal utility.** This principle, first discussed in Chapter 3, is that added satisfaction declines as a consumer acquires additional units of a given product. Although consumer wants in general may be insatiable, wants for particular items can be satisfied. In a specific span of time over which consumers' tastes remain unchanged, consumers can obtain as much of a particular good or service as they can afford. But the more of that product they obtain, the less they want still more of it.

Consider durable goods, for example. A consumer's desire for an automobile, when he or she has none, may be very strong. But the desire for a second car is less intense; and for a third or fourth, weaker and weaker. Unless they are collectors, even the wealthiest families rarely have more than a half-dozen cars, although their incomes would allow them to purchase a whole fleet of vehicles.

Terminology

Evidence indicates that consumers can fulfill specific wants with succeeding units of a product but that each added unit provides less utility than the last unit purchased. Recall that a consumer derives utility from a product if it can satisfy a want: **Utility** is want-satisfying power. The utility of a good or service is the satisfaction or pleasure one gets from consuming it. Keep in mind three characteristics of this concept:

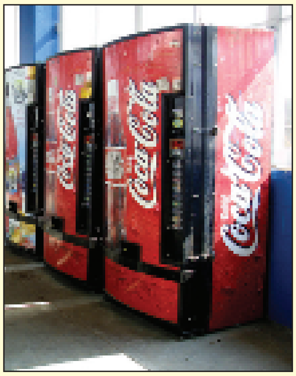
- "Utility" and "usefulness" are not synonymous. Paintings by Picasso may offer great utility to art connoisseurs but are useless functionally (other than for hiding a crack on a wall).
- Utility is subjective. The utility of a specific product may vary widely from person to person. A lifted pickup truck may have great utility to someone who drives off-road but little utility to someone unable or unwilling to climb into the rig. Eyeglasses have tremendous utility to someone who has poor eyesight but no utility to a person with 20-20 vision.
- Utility is difficult to quantify. But for purposes of illustration we assume that people can measure satisfaction with units called *utils* (units of utility). For example, a particular consumer may get 100 utils of satisfaction from a smoothie, 10 utils of satisfaction from a candy bar, and 1 util of satisfaction from a stick of gum. These imaginary units of satisfaction are convenient for quantifying consumer behavior for explanatory purposes.

Total Utility and Marginal Utility

Total utility and marginal utility are related, but different, ideas. **Total utility** is the total amount of satisfaction or pleasure a person derives from consuming some specific quantity—for example, 10 units—of a good or service. **Marginal utility** is the *extra* satisfaction a consumer realizes from an additional unit of that product—for example, from the eleventh unit. Alternatively, marginal utility is the change in total utility that results from the consumption of 1 more unit of a product.

Figure 6.1 (Key Graph) and the accompanying table demonstrate the relation between total utility and marginal

CONSIDER THIS . . .



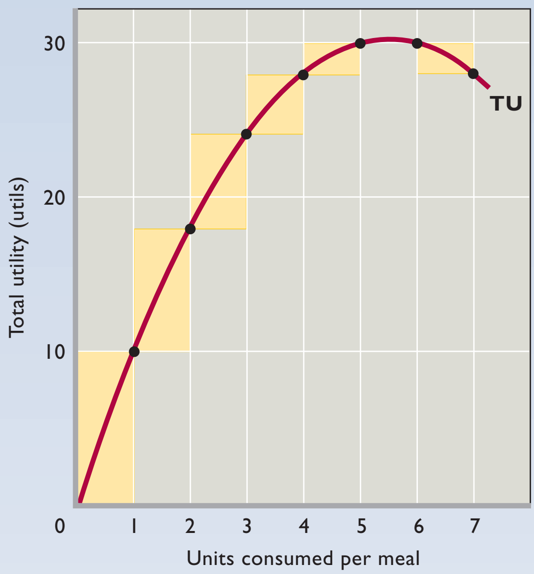
Vending Machines and Marginal Utility

Newspaper dispensing devices and soft-drink vending machines are similar in their basic operations. Both enable consumers to buy a product by inserting coins. But there is an important difference in the two devices. The newspaper dispenser opens to the full stack of papers and seemingly "trusts" the customer to take only a single copy, whereas the vending machine displays no such "trust," requiring the consumer to buy one can at a time. Why the difference?

The idea of diminishing marginal utility is key to solving this puzzle. Most consumers take only single copies from the newspaper box because the marginal utility of a second newspaper is nearly zero. They could grab a few extra papers and try to sell them on the street, but the revenue obtained would be small relative to their time and effort. So, in selling their product, newspaper publishers rely on "zero marginal utility of the second unit," not on "consumer honesty." Also, newspapers have little "shelf life"; they are obsolete the next day. In contrast, soft-drink sellers do not allow buyers to make a single payment and then take as many cans as they want. If they did, consumers would clean out the machine because the marginal utility of successive cans of soda diminishes slowly and buyers could take extra sodas and consume them later. Soft-drink firms thus vend their products on a pay-per-can basis.

In summary, newspaper publishers and soft-drink firms use alternative vending techniques because of the highly different rates of decline in marginal utility for their products. The newspaper seller uses inexpensive dispensers that open to the full stack of papers. The soft-drink seller uses expensive vending machines that limit the consumer to a single can at a time. Each vending technique is optimal under the particular economic circumstance.

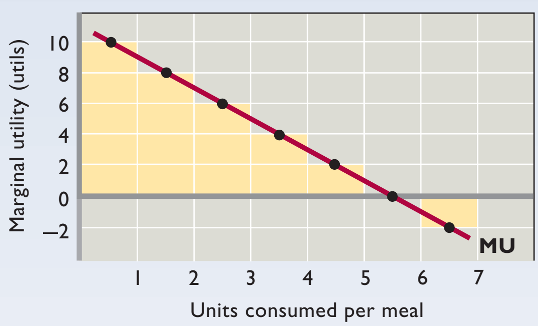
key graph



(a)
Total utility

FIGURE 6.1 Total and marginal utility. Curves TU and MU are graphed from the data in the table. (a) As more of a product is consumed, total utility increases at a diminishing rate, reaches a maximum, and then declines. (b) Marginal utility, by definition, reflects the changes in total utility. Thus marginal utility diminishes with increased consumption, becomes zero when total utility is at a maximum, and is negative when total utility declines. As shown by the shaded rectangles in (a) and (b), marginal utility is the change in total utility associated with each additional taco. Or, alternatively, each new level of total utility is found by adding marginal utility to the preceding level of total utility.

(1) Tacos Consumed per Meal	(2) Total Utility, Utils	(3) Marginal Utility, Utils
0	0	
1	10	10
2	18	8
3	24	6
4	28	4
5	30	2
6	30	0
7	28	–2



(b)
Marginal utility

QUICK QUIZ FOR FIGURE 6.1

1. Marginal utility:
   a. is the extra output a firm obtains when it adds another unit of labor.
   b. explains why product supply curves slope upward.
   c. typically rises as successive units of a good are consumed.
   d. is the extra satisfaction from the consumption of 1 more unit of some good or service.
2. Marginal utility in Figure 6.1b is positive, but declining, when total utility in Figure 6.1a is positive and:
   a. rising at an increasing rate.
   b. falling at an increasing rate.
   c. rising at a decreasing rate.
   d. falling at a decreasing rate.
3. When marginal utility is zero in graph (b), total utility in graph (a) is:
   a. also zero.
   b. neither rising nor falling.
   c. negative.
   d. rising, but at a declining rate.
4. Suppose the person represented by these graphs experienced a diminished taste for tacos. As a result the:
   a. TU curve would get steeper.
   b. MU curve would get flatter.
   c. TU and MU curves would shift downward.
   d. MU curve, but not the TU curve, would collapse to the horizontal axis.

Answers: 1. d; 2. c; 3. b; 4. c

utility. The curves reflect the data in the table. Column 2 shows the total utility associated with each level of consumption of tacos. Column 3 shows the marginal utility—the change in total utility—that results from the consumption of each successive taco. Starting at the origin in Figure 6.1a, observe that each of the first five units increases total utility (TU), but by a diminishing amount. Total utility reaches a maximum with the addition of the sixth unit and then declines.

ORIGIN OF THE IDEA

O 6.1

Diminishing marginal utility

So in Figure 6.1b marginal utility (MU) remains positive but diminishes through the first five units (because total utility increases at a declining rate). Marginal utility is zero for the sixth unit (because that unit doesn't change total utility). Marginal utility then becomes negative with the seventh unit and beyond (because total utility is falling). Figure 6.1b and table column 3 reveal that each successive taco yields less extra utility, meaning fewer utils, than the preceding taco.[1] That is, the table and graph illustrate the law of diminishing marginal utility.

INTERACTIVE GRAPHS

G 6.1

Total and marginal utility

Marginal Utility and Demand

The law of diminishing marginal utility explains why the demand curve for a given product slopes downward. If successive units of a good yield smaller and smaller amounts of marginal, or extra, utility, then the consumer will buy additional units of a product only if its price falls. The consumer for whom Figure 6.1 is relevant may buy two tacos at a price of $1 each. But because he or she obtains less marginal utility from additional tacos, the consumer will choose not to buy more at that price. The consumer would rather spend additional dollars on products that provide more utility, not less utility. Therefore, additional tacos with less utility are not worth buying unless the price declines. (When marginal utility becomes negative, Taco Bell would have to pay you to consume another taco!) Thus, diminishing marginal utility supports the idea that price must decrease in order for quantity demanded to increase. In other words, consumers behave in ways that make demand curves downsloping.

[1]Technical footnote: In Figure 6.1b we graphed marginal utility at half-units. For example, we graphed the marginal utility of 4 utils at $3\frac{1}{2}$ units because "4 utils" refers neither to the third nor the fourth unit per se but to the *addition* or *subtraction* of the fourth unit.

QUICK REVIEW 6.1

- Utility is the benefit or satisfaction a person receives from consuming a good or a service.
- The law of diminishing marginal utility indicates that gains in satisfaction become smaller as successive units of a specific product are consumed.
- Diminishing marginal utility provides a simple rationale for the law of demand.

Theory of Consumer Behavior

In addition to explaining the law of demand, the idea of diminishing marginal utility explains how consumers allocate their money incomes among the many goods and services available for purchase.

Consumer Choice and the Budget Constraint

For simplicity, we will assume that the situation for the typical consumer has the following dimensions.

- ***Rational behavior*** The consumer is a rational person, who tries to use his or her money income to derive the greatest amount of satisfaction, or utility, from it. Consumers want to get "the most for their money" or, technically, to maximize their total utility. They engage in **rational behavior.**
- ***Preferences*** Each consumer has clear-cut preferences for certain of the goods and services that are available in the market. Buyers also have a good idea of how much marginal utility they will get from successive units of the various products they might purchase.
- ***Budget constraint*** At any point in time the consumer has a fixed, limited amount of money income. Since each consumer supplies a finite amount of human and property resources to society, he or she earns only limited income. Thus, as noted in Chapter 1, every consumer faces a **budget constraint,** even consumers who earn millions of dollars a year. Of course, this budget limitation is more severe for a consumer with an average income than for a consumer with an extraordinarily high income.
- ***Prices*** Goods are scarce relative to the demand for them, so every good carries a price tag. We assume that the price of each good is unaffected by the amount of it that is bought by any particular person. After all, each person's purchase is a tiny part of total demand. Also, because the consumer has a limited number of dollars, he or she cannot buy everything wanted. This point drives home the reality of scarcity to each consumer.

So the consumer must compromise; he or she must choose the most personally satisfying mix of goods and services. Different individuals will choose different mixes.

Utility-Maximizing Rule

Of all the different combinations of goods and services a consumer can obtain within his or her budget, which specific combination will yield the maximum utility or satisfaction? *To maximize satisfaction, the consumer should allocate his or her money income so that the last dollar spent on each product yields the same amount of extra (marginal) utility.* We call this the **utility-maximizing rule.** When the consumer has "balanced his margins" using this rule, he has achieved **consumer equilibrium** and has no incentive to alter his expenditure pattern. In fact, any person who has achieved consumer equilibrium would be worse off—total utility would decline—if there were any alteration in the bundle of goods purchased, providing there is no change in taste, income, products, or prices.

TABLE 6.1 The Utility-Maximizing Combination of Apples and Oranges Obtainable with an Income of $10*

(1) Unit of Product	(2) Apple (Product A): Price = $1 — (a) Marginal Utility, Utils	(b) Marginal Utility per Dollar (MU/Price)	(3) Orange (Product B): Price = $2 — (a) Marginal Utility, Utils	(b) Marginal Utility per Dollar (MU/Price)
First	10	10	24	12
Second	8	8	20	10
Third	7	7	18	9
Fourth	6	6	16	8
Fifth	5	5	12	6
Sixth	4	4	6	3
Seventh	3	3	4	2

*It is assumed in this table that the amount of marginal utility received from additional units of each of the two products is independent of the quantity of the other product. For example, the marginal-utility schedule for apples is independent of the number of oranges obtained by the consumer.

Numerical Example

An illustration will help explain the utility-maximizing rule. For simplicity we limit our example to two products, but the analysis also applies if there are more. Suppose consumer Holly is analyzing which combination of two products she should purchase with her fixed daily income of $10. Let's suppose these products are apples and oranges.

Holly's preferences for apples and oranges and their prices are the basic data determining the combination that will maximize her satisfaction. Table 6.1 summarizes those data, with column 2a showing the amounts of marginal utility she will derive from each successive unit of A (apples) and with column 3a showing the same thing for product B (oranges). Both columns reflect the law of diminishing marginal utility, which, in this example, is assumed to begin with the second unit of each product purchased.

Marginal Utility per Dollar

To see how the utility-maximizing rule works, we must put the marginal-utility information in columns 2a and 3a on a per-dollar-spent basis. A consumer's choices are influenced not only by the extra utility that successive apples will yield but also by how many dollars (and therefore how many oranges) she must give up to obtain additional apples.

The rational consumer must compare the extra utility from each product with its added cost (that is, its price). Switching examples for a moment, suppose that you prefer a pizza whose marginal utility is, say, 36 utils to a movie whose marginal utility is 24 utils. But if the pizza's price is $12 and the movie costs only $6, you would choose the movie rather than the pizza! Why? Because the marginal utility per dollar spent would be 4 utils for the movie (= 24 utils/$6) compared to only 3 utils for the pizza (= 36 utils/$12). You could see two movies for $12 and, assuming that the marginal utility of the second movie is, say, 16 utils, your total utility would be 40 utils. Clearly, 40 units of satisfaction (= 24 utils + 16 utils) from two movies are superior to 36 utils from the same $12 expenditure on one pizza.

To make the amounts of extra utility derived from differently priced goods comparable, marginal utilities must be put on a per-dollar-spent basis. We do this in columns 2b and 3b by dividing the marginal-utility data of columns 2a and 3a by the prices of apples and oranges—$1 and $2, respectively.

Decision-Making Process

Table 6.1 shows Holly's preferences on a unit basis and a per-dollar basis as well as the price tags of apples and oranges. With $10 to spend, in what order should Holly allocate her dollars on units of apples and oranges to achieve the highest amount of utility within the $10 limit imposed by her income? And what specific combination of the two products will she have obtained at the time she uses up her $10?

Concentrating on columns 2b and 3b in Table 6.1, we find that Holly should first spend $2 on the first orange because its marginal utility per dollar of 12 utils is higher than the first apple's 10 utils. But now Holly finds herself indifferent about whether to buy a second orange or the first apple because the marginal utility per dollar of both is

10 utils per dollar. So she buys both of them. Holly now has 1 apple and 2 oranges. Also, the last dollar she spent on each good yielded the same marginal utility per dollar (10). But this combination of apples and oranges does not represent the maximum amount of utility that Holly can obtain. It cost her only \$5 [= (1 × \$1) + (2 × \$2)], so she has \$5 remaining, which she can spend to achieve a still higher level of total utility.

Examining columns 2b and 3b again, we find that Holly should spend the next \$2 on a third orange because marginal utility per dollar for the third orange is 9 compared with 8 for the second apple. But now, with 1 apple and 3 oranges, she is again indifferent between a second apple and a fourth orange because both provide 8 utils per dollar. So Holly purchases 1 more of each. Now the last dollar spent on each product provides the same marginal utility per dollar (8), and Holly's money income of \$10 is exhausted.

The utility-maximizing combination of goods attainable by Holly is 2 apples and 4 oranges. By summing marginal-utility information from columns 2a and 3a, we find that Holly is obtaining 18 (= 10 + 8) utils of satisfaction from the 2 apples and 78 (= 24 + 20 + 18 + 16) utils of satisfaction from the 4 oranges. Her \$10, optimally spent, yields 96 (= 18 + 78) utils of satisfaction.

Table 6.2 summarizes our step-by-step process for maximizing Holly's utility. Note that we have implicitly assumed that Holly spends her entire income. She neither borrows nor saves. However, saving can be regarded as a "commodity" that yields utility and can be incorporated into our analysis. In fact, we treat it that way in problem 4 at the end of this chapter.

Inferior Options Holly can obtain other combinations of apples and oranges with \$10, but none will yield as great a total utility as do 2 apples and 4 oranges. As an example, she can obtain 4 apples and 3 oranges for \$10. But this combination yields only 93 utils, clearly inferior to the 96 utils provided by 2 apples and 4 oranges. True, there are other combinations of apples and oranges (such as 4 apples and 5 oranges or 1 apple and 2 oranges) in which the marginal utility of the last dollar spent is the same for both goods. But all such combinations either are unobtainable with Holly's limited money income (as 4 apples and 5 oranges) or do not exhaust her money income (as 1 apple and 2 oranges) and therefore do not yield the maximum utility attainable.

WORKED PROBLEMS
W 6.1
Consumer choice

Algebraic Generalization

Economists generalize the utility-maximizing rule by saying that a consumer will maximize her satisfaction when she allocates her money income so that the last dollar spent on product A, the last on product B, and so forth, yield equal amounts of additional, or marginal, utility. The marginal utility per dollar spent on A is indicated by the MU of product A divided by the price of A (column 2b in Table 6.1), and the marginal utility per dollar spent on B by the MU of product B divided by the price of B (column 3b in Table 6.1). Our utility-maximizing rule merely requires that these ratios be equal for the last dollar spent on A and the last dollar spent on B. Algebraically,

$$\frac{\text{MU of product A}}{\text{Price of A}} = \frac{\text{MU of product B}}{\text{Price of B}}$$

And, of course, the consumer must exhaust her available income. Table 6.1 shows us that the combination of 2 units of A (apples) and 4 of B (oranges) fulfills these conditions in that

$$\frac{8 \text{ utils}}{\$1} = \frac{16 \text{ utils}}{\$2}$$

and the consumer's \$10 income is all spent.

TABLE 6.2 Sequence of Purchases to Achieve Consumer Equilibrium, Given the Data in Table 6.1

Choice Number	Potential Choices	Marginal Utility per Dollar	Purchase Decision	Income Remaining
1	First apple	10	First orange for \$2	\$8 = \$10 − \$2
	First orange	12		
2	First apple	10	First apple for \$1	\$5 = \$8 − \$3
	Second orange	10	and second orange for \$2	
3	Second apple	8	Third orange for \$2	\$3 = \$5 − \$2
	Third orange	9		
4	Second apple	8	Second apple for \$1	\$0 = \$3 − \$3
	Fourth orange	8	and fourth orange for \$2	

If the equation is not fulfilled, then some reallocation of the consumer's expenditures between A and B (from the low to the high marginal-utility-per-dollar product) will increase the consumer's total utility. For example, if the consumer spent $10 on 4 of A (apples) and 3 of B (oranges), we would find that

$$\frac{\text{MU of A of 6 utils}}{\text{Price of A of \$1}} < \frac{\text{MU of B of 18 utils}}{\text{Price of B of \$2}}$$

Here the last dollar spent on A provides only 6 utils of satisfaction, while the last dollar spent on B provides 9 (= 18/$2). So the consumer can increase total satisfaction by purchasing more of B and less of A. As dollars are reallocated from A to B, the marginal utility per dollar of A will increase while the marginal utility per dollar of B will decrease. At some new combination of A and B the two will be equal and consumer equilibrium will be achieved. Here that combination is 2 of A (apples) and 4 of B (oranges).

Utility Maximization and the Demand Curve

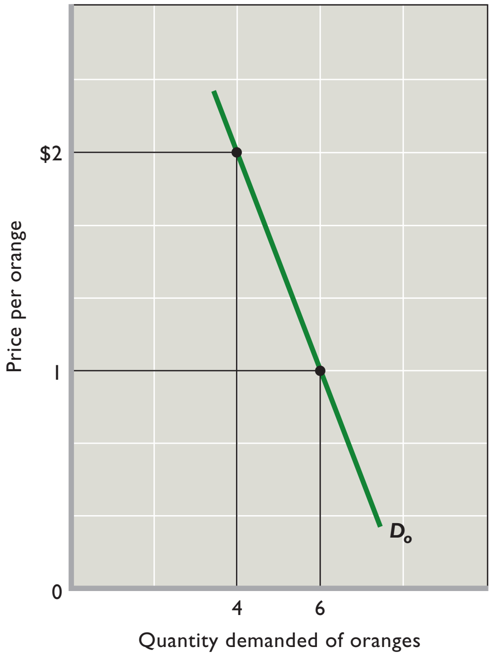
Once you understand the utility-maximizing rule, you can easily see why product price and quantity demanded are inversely related. Recall that the basic determinants of an individual's demand for a specific product are (1) preferences or tastes, (2) money income, and (3) the prices of other goods. The utility data in Table 6.1 reflect our consumer's preferences. We continue to suppose that her money income is $10. And, concentrating on the construction of an individual demand curve for oranges, we assume that the price of apples, now representing all "other goods," is still $1.

Deriving the Demand Schedule and Curve

We can derive a single consumer's demand schedule for oranges by considering alternative prices at which oranges might be sold and then determining the quantity the consumer will purchase. We already know one such price-quantity combination in the utility-maximizing example: Given tastes, income, and the prices of other goods, Holly will purchase 4 oranges at $2.

Now let's assume the price of oranges falls to $1. The marginal-utility-per-dollar data of column 3b in Table 6.1 will double because the price of oranges has been halved; the new data for column 3b are (by coincidence) identical to the data in column 3a. The doubling of the MU per dollar for each successive orange means that the purchase of 2 apples and 4 oranges is no longer an equilibrium combination. By applying the same reasoning we used previously, we now find that Holly's utility-maximizing combination is 4 apples and 6 oranges. As summarized in the table in Figure 6.2, Holly will purchase 6 oranges when the price of oranges is $1. Using the data in this table, we can sketch the downward-sloping demand curve for oranges, D_o, shown in Figure 6.2. This exercise, then, clearly links the utility-maximizing behavior of a consumer and that person's downsloping demand curve for a particular product.

FIGURE 6.2 Deriving an individual demand curve. The consumer represented by the data in the table maximizes utility by purchasing 4 oranges at a price of $2. The decline in the price of oranges to $1 disrupts the consumer's initial utility-maximizing equilibrium. The consumer restores equilibrium by purchasing 6 rather than 4 oranges. Thus, a simple price-quantity schedule emerges, which locates two points on a downsloping demand curve.



Price per Orange	Quantity Demanded
$2	4
1	6

Income and Substitution Effects

Recall from Chapter 3 that the **income effect** is the impact that a change in the price of a product has on a consumer's real income and consequently on the quantity demanded of that good. In contrast, the **substitution effect** is the impact that a change in a product's price has on its relative expensiveness and consequently on the quantity demanded. Both effects help explain why a demand curve such as that in Figure 6.2 is downsloping.

Let's first look at the substitution effect. Recall that before the price of oranges declined, Holly was in equilibrium when purchasing 2 apples and 4 oranges because

$$\frac{\text{MU of apples of 8}}{\text{Price of apples of \$1}} = \frac{\text{MU of oranges of 16}}{\text{Price of oranges of \$2}}$$

But after the price of oranges declines from $2 to $1,

$$\frac{\text{MU of apples of 8}}{\text{Price of apples of \$1}} < \frac{\text{MU of oranges of 16}}{\text{Price of oranges of \$1}}$$

Clearly, the last dollar spent on oranges now yields greater utility (16 utils) than does the last dollar spent on apples (8 utils). This will lead Holly to switch, or substitute, purchases away from apples and towards oranges so as to restore consumer equilibrium. This substitution effect contributes to the inverse relationship between price and quantity that is found along her demand curve for oranges: When the price of oranges declines, the substitution effect causes Holly to buy more oranges.

What about the income effect? The decline in the price of oranges from $2 to $1 increases Holly's real income. Before the price decline, she maximized her utility and achieved consumer equilibrium by selecting 2 apples and 4 oranges. But at the lower $1 price for oranges, Holly would have to spend only $6 rather than $10 to buy that particular combination of goods. That means that the lower price of oranges has freed up $4 that can be spent on buying more apples, more oranges, or more of both. How many more of each fruit she ends up buying will be determined by applying the utility-maximizing rule to the new situation. But it is quite likely that the increase in real income caused by the reduction in the price of oranges will cause Holly to end up buying more oranges than before the price reduction. Any such increase in orange purchases is referred to as the income effect of the reduction in the price of oranges and it, too, helps to explain why demand curves are downward sloping: When the price of oranges falls, the income effect causes Holly to buy more oranges.

ORIGIN OF THE IDEA

O 6.2

Income and substitution effects

QUICK REVIEW 6.2

- The theory of consumer behavior assumes that, with limited income and a set of product prices, consumers make rational choices on the basis of well-defined preferences.
- A consumer maximizes utility by allocating income so that the marginal utility per dollar spent is the same for every good purchased.
- A downsloping demand curve can be derived by changing the price of one product in the consumer-behavior model and noting the change in the utility-maximizing quantity of that product demanded.
- By providing insights on the income effect and substitution effects of a price decline, the utility-maximization model helps explain why demand curves are downsloping.

Applications and Extensions

Many real-world phenomena can be explained by applying the theory of consumer behavior.

iPods

Every so often a new product totally captures consumers' imaginations. One such product is Apple's iPod, which debuted in November 2001. Less than six years later, Apple sold its 100 millionth unit. Furthermore, those units enabled Apple to sell more than 2.5 billion songs through its online iTunes Store.

The swift ascendancy of the iPod resulted mainly from a leapfrog in technology. Not only is the iPod much more compact than the portable digital CD player that it replaced, it can store and play back several thousand songs—whereas a single CD only has a 74-minute recording capacity. The improved portability and storage—and enhanced consumer satisfaction—caused a major shift in consumer demand away from the portable CD player and toward the iPod.

In the language of our analysis, Apple's introduction of the iPod severely disrupted consumer equilibrium. Consumers en masse concluded that iPods had a higher marginal-utility-to-price ratio (= MU/P) than the ratios for alternative products. They therefore shifted spending away from those other products and toward iPods as a way to increase total utility. Of course, for most people the marginal utility of a second or third iPod relative to price is quite low, so most consumers purchased only a single iPod. But Apple continued to enhance the iPod, enticing some of the buyers of older models to buy new models.

This example demonstrates a simple but important point: New products succeed by enhancing consumers' total utility. This "delivery of value" generates a revenue stream. If revenues exceed production costs, substantial profits can result—as they have for Apple.

The Diamond-Water Paradox

Early economists such as Adam Smith were puzzled by the fact that some "essential" goods had much lower prices than some "unimportant" goods. Why would water, essential to life, be priced below diamonds, which have much less usefulness? The paradox is resolved when we acknowledge that water is in great supply relative to demand and thus has a very low price per gallon. Diamonds, in contrast, are rare. Their supply is small relative to demand and, as a result, they have a very high price per carat.

Moreover, the marginal utility of the last unit of water consumed is very low. The reason follows from our utility-maximizing rule. Consumers (and producers) respond to the very low price of water by using a great deal of it—for generating electricity, irrigating crops, heating buildings, watering lawns, quenching thirst, and so on. Consumption is expanded until marginal utility, which declines as more water is consumed, equals its low price. On the other hand, relatively few diamonds are purchased because of their prohibitively high price, meaning that their marginal utility remains high. In equilibrium:

$$\frac{\text{MU of water (low)}}{\text{Price of water (low)}} = \frac{\text{MU of diamonds (high)}}{\text{Price of diamonds (high)}}$$

Although the marginal utility of the last unit of water consumed is low and the marginal utility of the last diamond purchased is high, the total utility of water is very high and the total utility of diamonds quite low. The total utility derived from the consumption of water is large because of the enormous amounts of water consumed. Total utility is the sum of the marginal utilities of all the gallons of water consumed, including the trillions of gallons that have far higher marginal utilities than the last unit consumed. In contrast, the total utility derived from diamonds is low since their high price means that relatively few of them are bought. Thus the water-diamond "paradox" is solved: Water has much more total utility (roughly, usefulness) than diamonds even though the price of diamonds greatly exceeds the price of water. These relative prices relate to marginal utility, not total utility.

ORIGIN OF THE IDEA

O 6.3

Diamond-water paradox

Opportunity Cost and the Value of Time

The theory of consumer behavior has been generalized to account for the economic value of *time*. Both consumption and production take time. Time is a valuable economic commodity; by using an hour in productive work a person can earn \$6, \$10, \$50, or more, depending on her or his education and skills. By using that hour for leisure or in consumption activities, the individual incurs the opportunity cost of forgone income; she or he sacrifices the \$6, \$10, or \$50 that could have been earned by working.

Imagine a self-employed consumer named Linden who is considering buying a round of golf, on the one hand, and a concert, on the other. The market price of the golf game is \$30 and that of the concert is \$40. But the golf game takes more time than the concert. Suppose Linden spends 4 hours on the golf course but only 2 hours at the concert. If her time is worth \$10 per hour, as evidenced by the \$10 wage she can obtain by working, then the "full price" of the golf game is \$70 (the \$30 market price plus \$40 worth of time). Similarly, the full price of the concert is \$60 (the \$40 market price plus \$20 worth of time). We find that, contrary to what market prices alone indicate, the full price of the concert is really less than the full price of the golf game.

If we now assume that the marginal utilities derived from successive golf games and concerts are identical, traditional theory would indicate that Linden should consume more golf games than concerts because the market price of the former (\$30) is lower than that of the latter (\$40). But when time is taken into account, the situation is reversed and golf games (\$70) are more expensive than concerts (\$60). So it is rational for Linden to consume more concerts than golf games.

By accounting for the opportunity cost of a consumer's time, we can explain certain phenomena that are otherwise quite puzzling. It may be rational for the unskilled worker or retiree whose time has little market value to ride a bus from Chicago to Pittsburgh. But the corporate executive, whose time is very valuable, will find it cheaper to fly, even though bus fare is only a fraction of plane fare. It is sensible for the retiree, living on a modest company pension and a Social Security check, to spend many hours shopping for bargains at the mall or taking long trips in a motor home. It is equally intelligent for the highly paid physician, working 55 hours per week, to buy a new personal computer over the Internet and take short vacations at expensive resorts.

People in other nations often feel affluent Americans are "wasteful" of food and other material goods but "overly economical" in their use of time. Americans who visit developing countries find that time is used casually or "squandered," while material goods are very highly prized and carefully used. These differences are not a paradox or a case of radically different temperaments. The differences are primarily a rational reflection of the fact that the high productivity of labor in an industrially advanced society gives time a high market value, whereas the opposite is true in a low-income, developing country.

Medical Care Purchases

The method of payment for certain goods and services affects their prices at the time we buy them and significantly changes the amount purchased. Let's go back to Table 6.1. Suppose the $1 price for apples is its "true" value or opportunity cost. But now, for some reason, its price is only, say, $.20. A rational consumer clearly would buy more apples at the $.20 price than at the $1 price.

That is what happens with medical care. People in the United States who have health insurance pay a fixed premium once a month that covers, say, 80 percent of all incurred health care costs. This means that when they actually need health care, its price to them will be only 20 percent of the actual market price. How would you act in such a situation? When you are ill, you would likely purchase a great deal more medical care than you would if you were confronted with the full price. As a result, financing health care through insurance is an important factor in explaining today's high expenditures on health care and the historical growth of such spending as a percentage of domestic output.

Similar reasoning applies to purchases of buffet meals. If you buy a meal at an all-you-can-eat buffet, you will tend to eat more than if you purchased it item by item. Why not eat that second dessert? Its marginal utility is positive and its "price" is zero!

Cash and Noncash Gifts

Marginal-utility analysis also helps us understand why people generally prefer cash gifts to noncash gifts costing the same amount. The reason is simply that the noncash gifts may not match the recipient's preferences and thus may not add as much as cash to total utility. Thought of differently, consumers know their own preferences better than the gift giver does, and the $100 cash gift provides more choices.

Look back at Table 6.1. Suppose Holly has zero earned income but is given the choice of a $2 cash gift or a noncash gift of 2 apples. Because 2 apples can be bought with $2, these two gifts are of equal monetary value. But by spending the $2 cash gift on the first orange, Holly could obtain 24 utils. The noncash gift of the first 2 apples would yield only 18 (= 10 + 8) units of utility. Conclusion: The noncash gift yields less utility to the beneficiary than does the cash gift.

Since giving noncash gifts is common, a considerable value of those gifts is potentially lost because they do not match their recipients' tastes. For example, Uncle Fred may have paid $15 for the Frank Sinatra CD he gave you for the holidays, but you would pay only $7.50 for it. Thus, a $7.50, or 50 percent, value loss is involved. Multiplied by billions of gifts a year, the total potential loss of value is huge.

But some of that loss is avoided by the creative ways individuals handle the problem. For example, newlyweds set up gift registries for their weddings to help match up their wants to the noncash gifts received. Also, people obtain cash refunds or exchanges for gifts so they can buy goods that provide more utility. And people have even been known to "recycle gifts" by giving them to someone else at a later time. All three actions support the proposition that individuals take actions to maximize their total utility.

Prospect Theory

Up to this point, we have restricted ourselves to dealing with consumer-choice situations in which people only have to deal with "goods" as opposed to "bads." When deciding on how to spend a budget, people only consider items that can bring them positive marginal utility—that is "good" things. They then use the utility-maximizing rule to select how much of each of those good things they should consume to get as much utility as possible from their limited budgets.

Unfortunately, life often forces us to deal with bad things, too. Our houses may burn down. A potential investment may go bad. The money we lend out may not be repaid.

How people deal with these negative possibilities is a central focus of **behavioral economics**—the branch of economics that combines insights from economics, psychology, and neuroscience to better understand those situations in which actual choice behavior deviates from the predictions made by earlier theories, which incorrectly concluded that people were *always* rational, deliberate, and unswayed by emotions. By studying how people actually deal with the prospect of bad things as well as good things, behavioral economists discovered three very interesting facts about how people react to goods and bads:

- People judge good things and bad things in relative terms, as gains and losses relative to their current situation, or **status quo.**
- People experience both diminishing marginal utility for gains (as you have already seen) as well as diminishing marginal disutility for losses (meaning that each successive unit of loss hurts, but less painfully than the previous unit).

- People are **loss averse,** meaning that for losses and gains near the status quo, losses are felt *much* more intensely than gains—in fact, about 2.5 times more intensely. Thus, for instance, the pain experienced by an investor who loses one dollar from his current status quo level of wealth will be about 2.5 times more intense than the pleasure he would have felt if he had gained one dollar relative to his current level of wealth.

These three facts about how people deal with goods and bads form the basis of **prospect theory,** which sheds important light on how consumers plan for and deal with life's ups and downs as well as why they often appear narrow-minded and fail to "see the big picture." To give you an idea of how powerful prospect theory is—and why its pioneer, Daniel Kahneman, was awarded the Nobel Prize in Economics—let's go through some examples of consumer behavior that would be hard to explain without the insights provided by prospect theory.

CONSIDER THIS . . .

Rising Consumption and the Hedonic Treadmill

For many sensations, people's brains are wired to notice changes rather than states. For example, your brain can sense acceleration—your change in speed—but not speed itself. As a result, standing still feels the same as moving at a constant 50 miles per hour. And if you accelerate from one constant speed to another—say, from 50 miles per hour to 70 miles per hour—you will feel the acceleration only while it's happening. Once you settle down at the new higher speed, it will feel like you are standing still again.

Consumption appears to work in much the same way. If you are used to a given level of consumption—say, $50,000 per year—then you will get a lot of enjoyment for a while if your consumption accelerates to $100,000 per year. But, as time passes, you will get used to that higher level of consumption, so that $100,000 per year seems ordinary and doesn't bring you any more pleasure than $50,000 per year used to bring you when it was your status quo.

Economist Richard Easterlin coined the term *hedonic treadmill* (pleasure treadmill) to describe this phenomenon. Just as a person walking on a real treadmill gets nowhere, people trying to make themselves permanently happier by consuming more also get nowhere, because they end up getting used to any higher level of consumption. Indeed, except for the extremely poor, people across the income spectrum report similar levels of happiness and satisfaction with their lives. This has led several economists, including Robert Frank, to argue that we should all stop trying to consume more, because doing so doesn't make us any happier in the long run. What do you think? Should we all step off of the hedonic treadmill?

ORIGIN OF THE IDEA

O 6.4

Prospect theory

Losses and Shrinking Packages

Because people see the world in terms of gains and losses relative to the status quo situations that they are used to, businesses have to be very careful about increasing the prices they charge for their products. This is because once consumers become used to a given price, they will view any increase in the price as a loss relative to the status quo price they were used to.

The fact that consumers may view a price increase as a loss explains the otherwise curious fact that many food producers react to rising input costs by shrinking the sizes of their products. The company most famous for doing this was Hershey's chocolates, which during its first decades of operation about 100 years ago would always charge exactly 5 cents for one of its Hershey's chocolate bars. But the size of the bars would increase or decrease depending on the cost of the company's inputs. When the cost of raw materials rose, the company would keep the price fixed at 5 cents but decrease the size of the bar. When the cost of raw materials fell, it would again keep the price fixed at 5 cents but increase the size of the bar.

This seems rather bizarre when you consider that consumers were not in any way *actually* being shielded from the changes in input prices. That is because what should rationally matter to consumers is the price per ounce that they are paying for Hershey's Bars. And that *does* go up and down when the price remains fixed but the size of the bars changes.

But people aren't being fully rational here. They mentally fixate on the product's price because that is the characteristic that they are used to focusing on when making their purchasing decisions. And because the 5-cent price had become the status quo that they were used to, Hershey's understood that any price increase would be mentally categorized as a loss. Thus, Hershey's wisely chose to keep the price of its product fixed at 5 cents even when input prices were rising.

Other companies employ the same strategy today. In 2008, the prices of many raw materials, including sugar, wheat, and corn, rose substantially. Many major manufacturers reacted by reducing product sizes while keeping prices fixed. Kellogg's reduced the size of its Frosted Flakes and Rice Krispies cereal boxes from 19 to 18 ounces. Frito-Lay reduced Doritos bags from 12 to 10 ounces. Dial Soap bars shrank from 4.5 to 4 ounces. And Procter and Gamble reduced the size of Bounty paper towel rolls from 60 to 52 sheets.

Framing Effects and Advertising

Because people evaluate situations in terms of gains and losses, their decision-making can be very sensitive to the *mental frame* that they use to evaluate whether a possible outcome should be viewed as a gain or a loss. Here are a couple of examples in which differences in the context or "frame" change the perception of whether a situation should be treated as a gain or loss. See how you react to them.

- Would you be happy with a salary of $100,000 per year? You might say yes. But what if your salary last year had been $140,000? Are you still going to say yes? Now that you know you are taking a $40,000 pay cut, does that $100,000 salary seem as good as it did before?
- Similarly, suppose you have a part-time job. One day, your boss Joe walks in and says that he is going to give you a 10 percent raise. Would that please you? Now, what if he also mentioned that *everyone else* at your firm would be getting a 15 percent raise. Are you still going to be just as pleased? Or does your raise now seem like a loss compared to what everyone else will be getting?

Changes in people's preferences that are caused by new information that alters the frame used to define whether situations are gains or losses are referred to as **framing effects.** These are important to recognize because they can be manipulated by advertisers, lawyers, and politicians to try to alter people's decisions. For instance, would an advertising company be better off marketing a particular brand of hamburger as "20% fat" or as "80% lean"? Both phrases describe the same meat, but one frames the situation as a loss (20 percent fat) while the other frames it as a gain (80 percent lean).

And would you be more willing to take a particular medicine if you were told that 99.9 percent of the people who take it live or if you were told that 0.1 percent of the people who take it die? Continuing to live is a gain, whereas dying is clearly a loss. Which frame sounds better to you?

Finally, note that framing effects have important consequences for the utility-maximizing rule that we studied earlier in this chapter. If a frame alters people's valuations of marginal utility, it *will* affect their consumption decisions!

Anchoring and Credit Card Bills

Before people can calculate their gains and losses, they must first define the status quo from which to measure those changes. But it turns out that irrelevant information can unconsciously influence people's feelings about the status quo. Here's a striking example. Find a group of people and ask each person to write down the last two digits of his or her Social Security number. Then ask each person to write down his or her best estimate of the value of some object that you display to them—say, a nice cordless keyboard. What you will find is that the people whose Social Security numbers end in higher numbers—say, 67 or 89—will give higher estimates for the value of the keyboard than people whose Social Security numbers end in smaller numbers like 18 or 37. The effect can be huge. Among students in one MBA class at MIT, those with Social Security numbers ending between 80 and 99 gave average estimates of $56 for a cordless keyboard, while their classmates whose Social Security numbers ended in numbers from 00 to 20 gave average estimates of just $16.

Psychologists and behavioral economists refer to this phenomenon as **anchoring** because people's estimates about the value of the keyboard are influenced, or "anchored," by the recently considered information about the last two digits of their Social Security numbers. Why irrelevant information can anchor subsequent valuations is not fully understood. But the anchoring effect is real and can lead people to unconsciously alter how they evaluate different options.

Unfortunately, credit card companies have figured this out. They use anchoring to increase their profits by showing very small minimum-payment amounts on borrowers' monthly credit card statements. The companies could require larger minimum payments, but the minimum-payment numbers that they present are only typically about 2% of what a customer owes. Why such a small amount? Because it acts as an anchor that causes people to unconsciously make smaller payments each month. This can make a huge difference in how long it takes to pay off their bill and how much in total interest they will end up paying. For a customer who owes $1000 on a credit card that charges the typical interest rate of 19 percent per year, it will take 22 years and $3398.12 in total payments (including accumulated interest) to pay off the debt if he only makes 2 percent monthly payments. By showing such small minimum-payment amounts, credit card companies anchor many customers into the expensive habit of paying off their debts slowly rather than quickly.

LAST Word Nudging People Toward Better Decisions

Behavioral Economists Have Recently Found Success in Using People's Behavioral Quirks to "Nudge" Them Toward Making Better Decisions.*

Behavioral economics began as a descriptive science, meaning that its first goal was to develop theories that accurately described human economic behavior. In particular, it sought to explain a number of behaviors that at first glance seemed irrational. Now that behavioral economics has made significant headway in explaining many of those behaviors, some economists are suggesting that its insights be used to nudge people toward choices that are better for themselves and others.

A key feature of "nudges" is that they are subtle. This subtlety means that nudges can cause large changes in behavior without making people feel bullied or coerced—and also without imposing stringent new rules or having to offer people big monetary incentives or disincentives to get them to do what you want.

Take retirement savings. As you may know, people tend to consume too much in the present and therefore undersave for retirement. But as it turns out, this unfortunate behavioral tendency can be easily offset by another behavioral tendency: the tendency people have to stick with default options. In terms of retirement savings, this comes down to designing corporate retirement programs in which each worker is "defaulted into" her company's retirement savings program.

Under those savings programs, money is automatically deducted each month from a worker's paycheck and deposited in her retirement savings account. It used to be the case that the default for such programs was for workers to start out *not* enrolled in them. To get enrolled, they would have to request to join the program. That is, they would have to choose to go against the default option of not being enrolled.

And because people have the behavioral tendency of sticking with whatever option is presented to them as the default, relatively few workers would make the change and enroll in their company's savings program. That was disappointing. But instead of being deterred, behavioral economists saw an opportunity. Why not change the default? Why not make automatic enrollment the default option? By making that change, people's tendency to stick with default options would work in their own favor—they would stay enrolled and save money for retirement.

When this strategy of switching the default was actually implemented, the number of workers participating in retirement

*The term "nudge" was popularized by Richard Thaler and Cass Sunstein in their book *Nudge: Improving Decisions about Health, Wealth, and Happiness*, Yale University Press, 2008.

Mental Accounting and Overpriced Warranties

The utility-maximizing rule assumes that people will look at all of their potential consumption options simultaneously when trying to maximize the total utility that they can get from spending their limited incomes. But economist Richard Thaler famously noted that people sometimes look at consumption options in isolation, thereby irrationally failing to look at all their options simultaneously. Thaler coined the term **mental accounting** to describe this behavior, because it was as if people arbitrarily put certain options into totally separate "mental accounts" that they dealt with without any thought to options outside of those accounts.

An example of where this suboptimal tendency leads is the warranties that patrons of big electronic stores are offered when they purchase an expensive product, such as a plasma TV that costs $1000. These warranties are very much overpriced given that the products they insure hardly ever break down. Personal financial experts universally tell people not to buy them. Yet many people do buy them because they engage in mental accounting.

They do this by mentally labeling their purchase of the TV as an isolated, individual transaction, sticking it into a separate mental account in their brain that might have a title like, "Purchase of New TV." Viewing the purchase in isolation exaggerates the size of the potential loss that would come from a broken TV. Customers who view the transaction in isolation see the possibility of a $1000 loss on their $1000 purchase as a potential total loss—"Holy cow! I could lose $1000 on a $1000 TV!" By contrast, people who see the big picture compare the potential loss with their entire future income stream—thereby seeing it correctly as a relatively minor loss. Because of this difference, mental accounting inclines people to pay for overpriced warranties.

savings programs skyrocketed—jumping from 60 percent to 98 percent. Those workers can now look forward to much more pleasant retirements thanks to this simple change that works *with* people's preference to stick with default options.

People's tendency to look around them for social cues as to what constitutes good behavior can also be exploited to modify their consumption behavior. But you have to be careful about how you do it, as was discovered by a California power company that wanted to encourage its customers to conserve electricity. Its first attempt to use social cues involved sending each customer a bill that showed not only his or her own usage of electricity in kilowatt-hours, but also the average usage of nearby houses. The company hoped that by showing the average usage of neighbors, customers would receive a subtle hint about their own usage. In particular, it was hoped that customers who used more than their neighbors would feel that they were being wasteful and would thus cut back on their usage.

And that did indeed happen. *But*, their reduction in electricity usage ended up being completely swamped by an increase in electricity usage on the part of the customers who had previously been below-average users. Those customers interpreted the new information that they were below-average electricity users to mean that they should feel free to consume more. After all, why should they use so little when their neighbors were using so much more?

The power company finally hit upon a solution that worked. Smilies. Yes, symbols like ☺ and ☹. In addition to printing people's own usage and the average usage of their neighbors, the company also started printing a ☺ on a customer's bill if his usage was below average and a ☹ on his bill if his usage was above average. The unhappy smilies embarrassed the heavy users into reducing their consumption even more, while the happy smilies gave a pat on the back to the light users—a pat on the back that kept their usage low.

Bear in mind that both the electricity customers and the workers saving for retirement were being *manipulated* by the people who designed the nudges. This fact is perhaps even more disturbing when you consider that the changes in behavior that were caused by the nudges were most likely *unconscious* on the part of those being manipulated. Keep this in mind as you consider for yourself when and if it is morally or ethically acceptable to use nudges to guide people's behavior.

The Endowment Effect and Market Transactions

Prospect theory also offers an explanation for the **endowment effect,** which is the tendency that people have to put a higher valuation on anything that they currently possess (are endowed with) than on identical items that they do not own but might purchase. For instance, if we show a person a new coffee mug and ask him what the maximum amount is that he would pay to buy it, he might say $10. But if we then give the mug to him so that he now owns it, and we then ask how much we would have to pay him to buy it back, he will very likely report a much higher value—say, $15.

The interesting thing is that he is not just bluffing or driving a hard bargain. Human brains appear wired to do this, to put a higher value on things we own than on things we don't. Economist John List has shown that this tendency can moderate if people are used to buying things for resale—that is, buying them with the intention of getting rid of them—but without such experience the endowment effect can be quite strong. If it is, it can make market transactions between buyers and sellers harder because sellers will be demanding higher prices for the items they are selling ("Hey, *my* mug is worth $15 to me!") than the values put on those items by potential buyers ("Dude, *your* mug is only worth $10 to me").

Several researchers have pointed to the fact that human beings are loss averse as providing an explanation for the endowment effect. Once a person possesses something, the thought of parting with it seems like a potential loss. And because potential losses are felt so intensely (2.5 times more intensely than potential gains), the owners of items end up demanding a lot of money as compensation when asked to sell their property. The potential purchasers, on the other hand, do not own the property and thus do not feel any potential sense of loss. So they put lower valuations on the items in question than do the sellers.

Summary

1. The law of diminishing marginal utility states that beyond a certain quantity, additional units of a specific good will yield declining amounts of extra satisfaction to a consumer.
2. The utility-maximization model assumes that the typical consumer is rational and acts on the basis of well-defined preferences. Because income is limited and goods have prices, the consumer cannot purchase all the goods and services he or she might want. The consumer therefore selects the attainable combination of goods that maximizes his or her utility or satisfaction.
3. A consumer's utility is maximized when income is allocated so that the last dollar spent on each product purchased yields the same amount of extra satisfaction. Algebraically, the utility-maximizing rule is fulfilled when

$$\frac{\text{MU of product A}}{\text{Price of A}} = \frac{\text{MU of product B}}{\text{Price of B}}$$

and the consumer's total income is spent.
4. The utility-maximizing rule and the demand curve are logically consistent. Because marginal utility declines, a lower price is needed to induce the consumer to buy more of a particular product.
5. The utility-maximization model illuminates the income and substitution effects of a price change. The income effect implies that a decline in the price of a product increases the consumer's real income and enables the consumer to buy more of that product with a fixed money income. The substitution effect implies that a lower price makes a product relatively more attractive and therefore increases the consumer's willingness to substitute it for other products.
6. Behavioral economics explains many consumption behaviors, including why irrelevant information can anchor valuations, how people value possibilities in terms of gains and losses relative to a status quo, and how framing effects can change people's decisions by affecting whether particular consumption possibilities seem like gains or losses.

Terms and Concepts

law of diminishing marginal utility
utility
total utility
marginal utility
rational behavior
budget constraint
utility-maximizing rule
consumer equilibrium
income effect
substitution effect
behavioral economics
status quo
loss averse
prospect theory
framing effects
anchoring
mental accounting
endowment effect

Questions

Mc Graw Hill connect ECONOMICS

1. Complete the following table and answer the questions below: **LO1**

Units Consumed	Total Utility	Marginal Utility
0	0	
1	10	10
2	—	8
3	25	—
4	30	—
5	—	3
6	34	—

   a. At which rate is total utility increasing: a constant rate, a decreasing rate, or an increasing rate? How do you know?
   b. "A rational consumer will purchase only 1 unit of the product represented by these data, since that amount maximizes marginal utility." Do you agree? Explain why or why not.
   c. "It is possible that a rational consumer will not purchase any units of the product represented by these data." Do you agree? Explain why or why not.
2. Mrs. Simpson buys loaves of bread and quarts of milk each week at prices of $1 and 80 cents, respectively. At present she is buying these products in amounts such that the marginal utilities from the last units purchased of the two products are 80 and 70 utils, respectively. Is she buying the utility-maximizing combination of bread and milk? If not, how should she reallocate her expenditures between the two goods? **LO2**
3. How can time be incorporated into the theory of consumer behavior? Explain the following comment: "Want to make

millions of dollars? Devise a product that saves Americans lots of time." LO2

4. Explain: LO2
   a. Before economic growth, there were too few goods; after growth, there is too little time.
   b. It is irrational for an individual to take the time to be completely rational in economic decision making.
   c. Telling your spouse where you would like to go out to eat for your birthday makes sense in terms of utility maximization.
5. In the last decade or so, there has been a dramatic expansion of small retail convenience stores (such as 7-Eleven, Kwik Shop, and Circle K), although their prices are generally much higher than prices in large supermarkets. What explains the success of the convenience stores? LO2
6. Many apartment-complex owners are installing water meters for each apartment and billing the occupants according to the amount of water they use. This is in contrast to the former procedure of having a central meter for the entire complex and dividing up the collective water expense as part of the rent. Where individual meters have been installed, water usage has declined 10 to 40 percent. Explain that drop, referring to price and marginal utility. LO3
7. Using the utility-maximization rule as your point of reference, explain the income and substitution effects of an increase in the price of product B, with no change in the price of product A. LO4
8. **ADVANCED ANALYSIS** A "mathematically fair bet" is one in which the amount won will on average equal the amount bet, for example, when a gambler bets, say, \$100 for a 10 percent chance to win \$1000 (\$100 = .10 × \$1000). Assuming diminishing marginal utility of dollars, explain why this is *not* a fair bet in terms of utility. Why is it even a less fair bet when the "house" takes a cut of each dollar bet? So is gambling irrational? LO4
9. Suppose that Ike is loss averse. In the morning, Ike's stockbroker calls to tell him that he has gained \$1000 on his stock portfolio. In the evening, his accountant calls to tell him that he owes an extra \$1000 in taxes. At the end of the day, does Ike feel emotionally neutral since the dollar value of the gain in his stock portfolio exactly offsets the amount of extra taxes he has to pay? Explain. LO5
10. You just accepted a campus job helping to raise money for your school's athletic program. You are told to draft a fundraising letter. The bottom of the letter asks recipients to write down a donation amount. If you want to raise as much money as possible, would it be better if the text of that section mentioned that your school is #3 in the nation in sports or that you are better than 99% of other schools at sports? Explain. LO5
11. **LAST WORD** What do you think of the ethics of using unconscious nudges to alter people's behavior? Before you answer, consider the following argument made by economists Richard Thaler and Cass Sunstein, who favor the use of nudges. They argue that in most situations, we couldn't avoid nudging even if we wanted to, because whatever policy we choose will contain some set of unconscious nudges and incentives that will influence people. Thus, they say, we might as well choose the wisest set of nudges.

Problems

1. Mylie's total utility from singing the same song over and over is 50 utils after one repetition, 90 utils after two repetitions, 70 utils after three repetitions, 20 utils after four repetitions, −50 utils after five repetitions, and −200 utils after six repetitions. Write down her marginal utility for each repetition. Once Mylie's total utility begins to decrease, does each additional singing of the song hurt more than the previous one or less than the previous one? LO1
2. John likes Coca-Cola. After consuming one Coke, John has a total utility of 10 utils. After two Cokes, he has a total utility of 25 utils. After three Cokes, he has a total utility of 50 utils. Does John show diminishing marginal utility for Coke, or does he show increasing marginal utility for Coke? Suppose that John has \$3 in his pocket. If Cokes cost \$1 each and John is willing to spend one of his dollars on purchasing a first can of Coke, would he spend his second dollar on a Coke, too? What about the third dollar? If John's marginal utility for Coke keeps on increasing no matter how many Cokes he drinks, would it be fair to say that he is addicted to Coke? LO1
3. Suppose that Omar's marginal utility for cups of coffee is constant at 1.5 utils per cup no matter how many cups he drinks. On the other hand, his marginal utility per doughnut is 10 for the first doughnut he eats, 9 for the second he eats, 8 for the third he eats, and so on (that is, declining by 1 util per additional doughnut). In addition, suppose that coffee costs \$1 per cup, doughnuts cost \$1 each, and Omar has a budget that he can spend only on doughnuts, coffee, or both. How big would that budget have to be before he would spend a dollar buying a first cup of coffee? LO2
4. Columns 1 through 4 in the table at the top of the next page show the marginal utility, measured in utils, that Ricardo would get by purchasing various amounts of products A, B, C, and D. Column 5 shows the marginal utility Ricardo gets from saving. Assume that the prices of A, B, C, and D are, respectively, \$18, \$6, \$4, and \$24 and that Ricardo has an income of \$106. LO2

Column 1		Column 2		Column 3		Column 4		Column 5	
Units of A	MU	Units of B	MU	Units of C	MU	Units of D	MU	Number of Dollars Saved	MU
1	72	1	24	1	15	1	36	1	5
2	54	2	15	2	12	2	30	2	4
3	45	3	12	3	8	3	24	3	3
4	36	4	9	4	7	4	18	4	2
5	27	5	7	5	5	5	13	5	1
6	18	6	5	6	4	6	7	6	$\frac{1}{2}$
7	15	7	2	7	$3\frac{1}{2}$	7	4	7	$\frac{1}{4}$
8	12	8	1	8	3	8	2	8	$\frac{1}{8}$

a. What quantities of A, B, C, and D will Ricardo purchase in maximizing his utility?

b. How many dollars will Ricardo choose to save?

c. Check your answers by substituting them into the algebraic statement of the utility-maximizing rule.

5. You are choosing between two goods, X and Y, and your marginal utility from each is as shown in the table below. If your income is $9 and the prices of X and Y are $2 and $1, respectively, what quantities of each will you purchase to maximize utility? What total utility will you realize? Assume that, other things remaining unchanged, the price of X falls to $1. What quantities of X and Y will you now purchase? Using the two prices and quantities for X, derive a demand schedule (a table showing prices and quantities demanded) for X. **LO3**

Units of X	MU_x	Units of Y	MU_y
1	10	1	8
2	8	2	7
3	6	3	6
4	4	4	5
5	3	5	4
6	2	6	3

6. **ADVANCED ANALYSIS** Let $MU_A = z = 10 - x$ and $MU_B = z = 21 - 2y$, where z is marginal utility per dollar measured in utils, x is the amount spent on product A, and y is the amount spent on product B. Assume that the consumer has $10 to spend on A and B—that is, $x + y = 10$. How is the $10 best allocated between A and B? How much utility will the marginal dollar yield? **LO3**

7. Suppose that with a budget of $100, Deborah spends $60 on sushi and $40 on bagels when sushi costs $2 per piece and bagels cost $2 per bagel. But then, after the price of bagels falls to $1 per bagel, she spends $50 on sushi and $50 on bagels. How many pieces of sushi and how many bagels did Deborah consume before the price change? At the new prices, how much money would it have cost Deborah to buy those same quantities (the ones that she consumed before the price change)? Given that it used to take Deborah's entire $100 to buy those quantities, how big is the income effect caused by the reduction in the price of bagels? **LO4**

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Indifference Curve Analysis

The utility-maximization rule previously discussed requires individuals to measure and compare utility, much as a business would measure and compare costs or revenues. Such *cardinal utility* is measured in units such as 1, 2, 3, and 4 and can be added, subtracted, multiplied, and divided, just like the cardinal numbers in mathematics. More importantly, cardinal utility allows precise quantification of the marginal utilities upon which the utility-maximizing rule depends. In fact, the marginal-utility theory of consumer demand that we explained in the body of this chapter rests squarely on the assumption that economists be able to measure cardinal utility. The reality, however, is that measuring cardinal utility is highly difficult, at best. (Can you, for instance, state exactly how many utils you are getting from reading this book right now or how many utils you would get from watching a sunset?)

To avoid this measurement problem, economists have developed an alternative explanation of consumer behavior and equilibrium in which cardinal measurement is not required. In this more-advanced analysis, the consumer must simply *rank* various combinations of goods in terms of preference. For instance, Sally can simply report that she *prefers* 4 units of A to 6 units of B without having to put number values on how much she likes either option. The model of consumer behavior that is based upon such *ordinal utility* rankings is called indifference curve analysis. It has two main elements: budget lines and indifference curves.

The Budget Line: What Is Attainable

We know from Chapter 1 that a **budget line** (or, more technically, a *budget constraint*) is a schedule or curve showing various combinations of two products a consumer can purchase with a specific money income. If the price of product A is $1.50 and the price of product B is $1, a consumer could purchase all the combinations of A and B shown in the table in Figure 1 with $12 of money income. At one extreme, the consumer might spend all of his or her income on 8 units of A and have nothing left to spend on B. Or, by giving up 2 units of A and thereby "freeing" $3, the consumer could have 6 units of A and 3 of B. And so on to the other extreme, at which the consumer could buy 12 units of B at $1 each, spending his or her entire money income on B with nothing left to spend on A.

Figure 1 also shows the budget line graphically. Note that the graph is not restricted to whole units of A and B as is the table. Every point on the graph represents a possible combination of A and B, including fractional quantities. The slope of the graphed budget line measures the ratio of the price of B to the price of A; more precisely, the absolute value of the slope is $P_B/P_A = \$1.00/\$1.50 = \frac{2}{3}$. This is the mathematical way of saying that the consumer must forgo 2 units of A (measured on the vertical axis) to buy

FIGURE 1 A consumer's budget line. The budget line shows all the combinations of any two products that someone can purchase, given the prices of the products and the person's money income.

Units of A (Price = $1.50)	Units of B (Price = $1)	Total Expenditure
8	0	$12 (= $12 + $0)
6	3	$12 (= $9 + $3)
4	6	$12 (= $6 + $6)
2	9	$12 (= $3 + $9)
0	12	$12 (= $0 + $12)

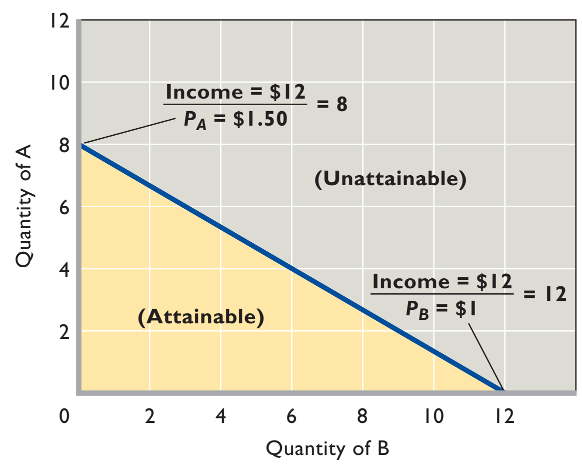
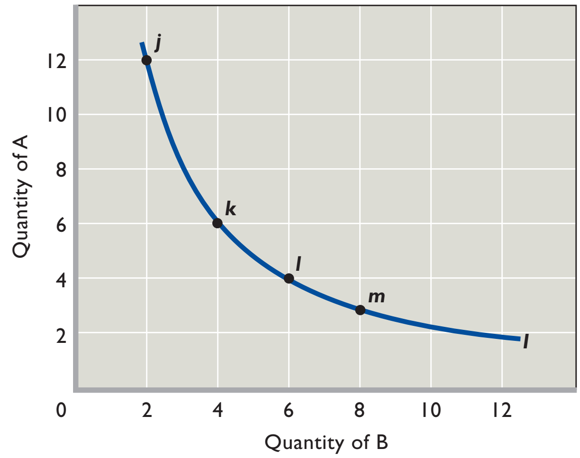


FIGURE 2 A consumer's indifference curve. Every point on indifference curve *I* represents some combination of products A and B, and all those combinations are equally satisfactory to the consumer. That is, each combination of A and B on the curve yields the same total utility.

Combination	Units of A	Units of B
j	12	2
k	6	4
l	4	6
m	3	8



3 units of B (measured on the horizontal axis). In moving down the budget or price line, 2 units of A (at \$1.50 each) must be given up to obtain 3 more units of B (at \$1 each). This yields a slope of $\frac{2}{3}$.

The budget line has two other significant characteristics:

- ***Income changes*** The location of the budget line varies with money income. An increase in money income shifts the budget line to the right; a decrease in money income shifts it to the left. To verify this, recalculate the table in Figure 1, assuming that money income is (a) \$24 and (b) \$6, and plot the new budget lines in Figure 1.
- ***Price changes*** A change in product prices also shifts the budget line. A decline in the prices of both products—the equivalent of an increase in real income—shifts the curve to the right. (You can verify this by recalculating the table in Figure 1 and replotting Figure 1 assuming that P_A = \$.75 and P_B = \$.50.) Conversely, an increase in the prices of A and B shifts the curve to the left. (Assume P_A = \$3 and P_B = \$2, and rework the table and Figure 1 to substantiate this statement.)

Note what happens if P_B changes while P_A and money income remain constant. In particular, if P_B drops, say, from \$1 to \$.50, the lower end of the budget line fans outward to the right. Conversely, if P_B increases, say, from \$1 to \$1.50, the lower end of the line fans inward to the left. In both instances the line remains "anchored" at 8 units on the vertical axis because P_A has not changed.

Indifference Curves: What Is Preferred

Budget lines reflect "objective" market data, specifically income and prices. They reveal combinations of products A and B that can be purchased, given current money income and prices.

Indifference curves, on the other hand, reflect "subjective" information about consumer preferences for A and B. An **indifference curve** shows all the combinations of two products A and B that will yield the same total satisfaction or total utility to a consumer. The table and graph in Figure 2 present a hypothetical indifference curve for products A and B. The consumer's subjective preferences are such that he or she will realize the same total utility from each combination of A and B shown in the table or on the curve. So the consumer will be indifferent (will not care) as to which combination is actually obtained.

ORIGIN OF THE IDEA
O 6.5
Indifference curves

Indifference curves have several important characteristics.

Indifference Curves Are Downsloping

An indifference curve slopes downward because more of one product means less of the other if total utility is to remain unchanged. Suppose the consumer moves from one combination of A and B to another, say, from *j* to *k* in Figure 2. In so doing, the consumer obtains more of product B, increasing his or her total utility. But because total utility is the same everywhere on the curve, the consumer must give up some of the other product, A, to reduce total utility by a precisely offsetting amount. Thus "more of B" necessitates "less of A," and the quantities of A and B are inversely related. A curve that reflects inversely related variables is downsloping.

Indifference Curves Are Convex to the Origin

Recall from the appendix to Chapter 1 that the slope of a curve at a particular point is measured by drawing a straight line that is tangent to that point and then measuring the "rise over run" of the straight line. If you drew such straight lines for several points on the curve in Figure 2, you would find that their slopes decline (in absolute terms) as you move down the curve. An indifference curve is therefore convex (bowed inward) to the origin of the graph. Its slope diminishes or becomes flatter as we move down the curve from *j* to *k* to *l*, and so on. Technically, the slope of an indifference curve at each point measures the **marginal rate of substitution (MRS)** of the combination of two goods represented by that point. The slope or MRS shows the rate at which the consumer who possesses the combination must substitute one good for the other (say, B for A) to remain equally satisfied. The diminishing slope of the indifference curve means that the willingness to substitute B for A diminishes as more of B is obtained.

The rationale for this convexity—that is, for a diminishing MRS—is that a consumer's subjective willingness to substitute B for A (or A for B) will depend on the amounts of B and A he or she has to begin with. Consider the table and graph in Figure 2 again, beginning at point *j*. Here, in relative terms, the consumer has a substantial amount of A and very little of B. Within this combination, a unit of B is very valuable (that is, its marginal utility is high), while a unit of A is less valuable (its marginal utility is low). The consumer will then be willing to give up a substantial amount of A to get, say, 2 more units of B. In this case, the consumer is willing to forgo 6 units of A to get 2 more units of B; the MRS is $\frac{6}{2}$, or 3, for the *jk* segment of the curve.

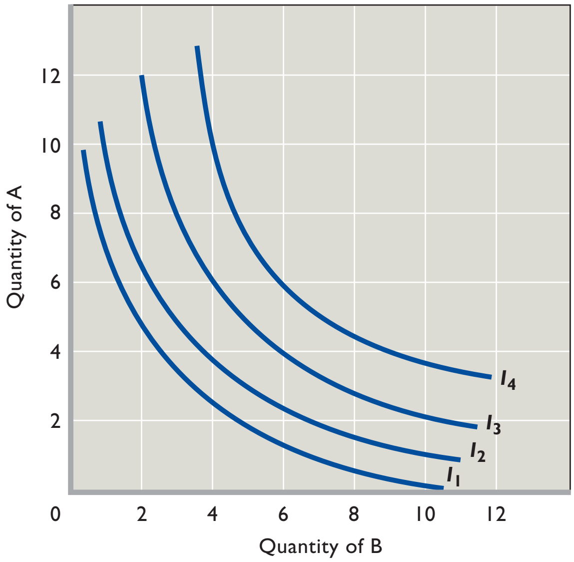
But at point *k* the consumer has less A and more B. Here A is somewhat more valuable, and B less valuable, "at the margin." In a move from point *k* to point *l*, the consumer is willing to give up only 2 units of A to get 2 more units of B, so the MRS is only $\frac{2}{2}$, or 1. Having still less of A and more of B at point *l*, the consumer is willing to give up only 1 unit of A in return for 2 more units of B and the MRS falls to $\frac{1}{2}$ between *l* and *m*.[1]

In general, as the amount of B *increases*, the marginal utility of additional units of B *decreases*. Similarly, as the quantity of A *decreases*, its marginal utility *increases*. In Figure 2 we see that in moving down the curve, the consumer will be willing to give up smaller and smaller amounts of A to offset acquiring each additional unit of B. The result is a curve with a diminishing slope, a curve that is convex to the origin. The MRS declines as one moves southeast along the indifference curve.

The Indifference Map

The single indifference curve of Figure 2 reflects some constant (but unspecified) level of total utility or satisfaction. It is possible and useful to sketch a whole series of indifference curves or an **indifference map,** as shown in Figure 3. Each curve reflects a different level of total utility and therefore never crosses another indifference curve. Specifically, each curve to the right of our original curve (labeled I_3 in Figure 3) reflects combinations of A and B that yield more utility than I_3. Each curve to the left of I_3 reflects less total utility than I_3. As we move out from the origin, each successive indifference curve represents a higher level of utility. To demonstrate this fact, draw a line in a northeasterly direction from the origin; note that its points of intersection with successive curves entail larger

FIGURE 3 An indifference map. An indifference map is a set of indifference curves. Curves farther from the origin indicate higher levels of total utility. Thus any combination of products A and B represented by a point on I_4 has greater total utility than any combination of A and B represented by a point on I_3, I_2, or I_1.



[1]MRS declines continuously between *j* and *k*, *k* and *l*, and *l* and *m*. Our numerical values for MRS relate to the curve segments between points and are not the actual values of the MRS at each point. For example, the MRS *at* point *l* is $\frac{2}{3}$.

amounts of both A and B and therefore higher levels of total utility.

Equilibrium at Tangency

Since the axes in Figures 1 and 3 are identical, we can superimpose a budget line on the consumer's indifference map, as shown in Figure 4. By definition, the budget line indicates all the combinations of A and B that the consumer can attain with his or her money income, given the prices of A and B. Of these attainable combinations, the consumer will prefer the combination that yields the greatest satisfaction or utility. Specifically, the utility-maximizing combination will be the combination lying on the highest attainable indifference curve. It is called the consumer's **equilibrium position.**

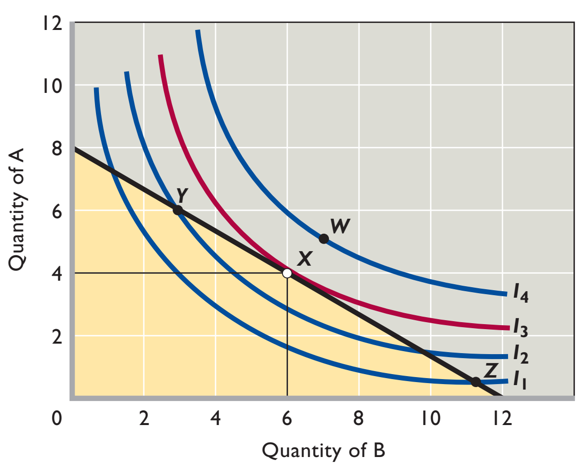
In Figure 4 the consumer's equilibrium position is at point *X*, where the budget line is *tangent* to I_3. Why not point *Y*? Because *Y* is on a lower indifference curve, I_2. By moving "down" the budget line—by shifting dollars from purchases of A to purchases of B—the consumer can attain an indifference curve farther from the origin and thereby increase the total utility derived from the same income. Why not point *Z*? For the same reason: Point *Z* is on a lower indifference curve, I_1. By moving "up" the budget line—by reallocating dollars from B to A—the consumer can get on higher indifference curve I_3 and increase total utility.

How about point *W* on indifference curve I_4? While it is true that *W* would yield a greater total utility than *X*, point *W* is beyond (outside) the budget line and hence is *not* attainable by the consumer. Point *X* represents the optimal *attainable* combination of products A and B. Note that at the equilibrium position, *X*, the definition of tangency implies that the slope of the highest attainable indifference curve equals the slope of the budget line. Because the slope of the indifference curve reflects the MRS (marginal rate of substitution) and the slope of the budget line is P_B/P_A, the consumer's optimal or equilibrium position is the point where

$$\text{MRS} = \frac{P_B}{P_A}$$

(You may benefit by trying Appendix Question 3 at this time.)

FIGURE 4 The consumer's equilibrium position. The consumer's equilibrium position is represented by point *X*, where the black budget line is tangent to indifference curve I_3. The consumer buys 4 units of A at $1.50 per unit and 6 of B at $1 per unit with a $12 money income. Points *Z* and *Y* represent attainable combinations of A and B but yield less total utility, as is evidenced by the fact that they are on lower indifference curves. Point *W* would entail more utility than *X*, but it requires a greater income than the $12 represented by the budget line.



Equivalency at Equilibrium

As indicated at the beginning of this appendix, an important difference exists between the marginal-utility theory of consumer demand and the indifference curve theory. The marginal-utility theory assumes that utility is *numerically* measurable, that is, that the consumer can say how much extra utility he or she derives from each extra unit of A or B. The consumer needs that information to determine the utility-maximizing (equilibrium) position, which is defined by

$$\frac{\text{Marginal utility of A}}{\text{Price of A}} = \frac{\text{Marginal utility of B}}{\text{Price of B}}$$

The indifference curve approach imposes a less stringent requirement on the consumer. He or she need only specify whether a particular combination of A and B will yield more than, less than, or the same amount of utility as some other combination of A and B will yield. The consumer need only say, for example, that 6 of A and 7 of B will yield more (or less) satisfaction than will 4 of A and 9 of B. Indifference curve theory does not require that the consumer specify *how much* more (or less) satisfaction will be realized.

That being said, it is a remarkable mathematical fact that both models of consumer behavior will, in any given situation, point to exactly the same consumer equilibrium and, consequently, exactly the same demand behavior. This fact allows us to combine the separate pieces of information that each theory gives us about equilibrium in order to deduce an interesting property about marginal utilities that must also hold true in equilibrium. To see this, note that when we compare the equilibrium situations in the two theories, we find that in the indifference curve analysis the MRS equals P_B/P_A at equilibrium; however, in the marginal-utility approach the ratio of marginal

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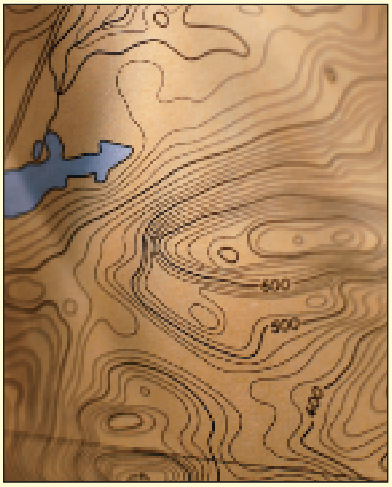


Indifference Maps and Topographical Maps

The familiar topographical map may help you understand the idea of indifference curves and indifference maps. Each line on a topographical map represents a particular elevation above sea level, say, 500 feet. Similarly, an indifference curve represents a particular level of total utility. When you move from one point on a specific elevation line to another, the elevation remains the same. So it is with an indifference curve. A move from one position to another on the curve leaves total utility unchanged. Neither elevation lines nor indifference curves can intersect. If they did, the meaning of each line or curve would be violated. An elevation line is "an equal-elevation line"; an indifference curve is "an equal-total-utility curve."

Like the topographical map, an indifference map contains not just one line but a series of lines. That is, the topographical map may have elevation lines representing successively higher elevations of 100, 200, 300, 400, and 500 feet. Similarly, the indifference curves on the indifference map represent successively higher levels of total utility. The climber whose goal is to maximize elevation wants to get to the highest attainable elevation line; the consumer desiring to maximize total utility wants to get to the highest attainable indifference curve.

Finally, both topographical maps and indifference maps show only a few of the many such lines that could be drawn. The topographical map, for example, leaves out the elevation lines for 501 feet, 502, 503, and so on. The indifference map leaves out all the indifference curves that could be drawn between those that are displayed.

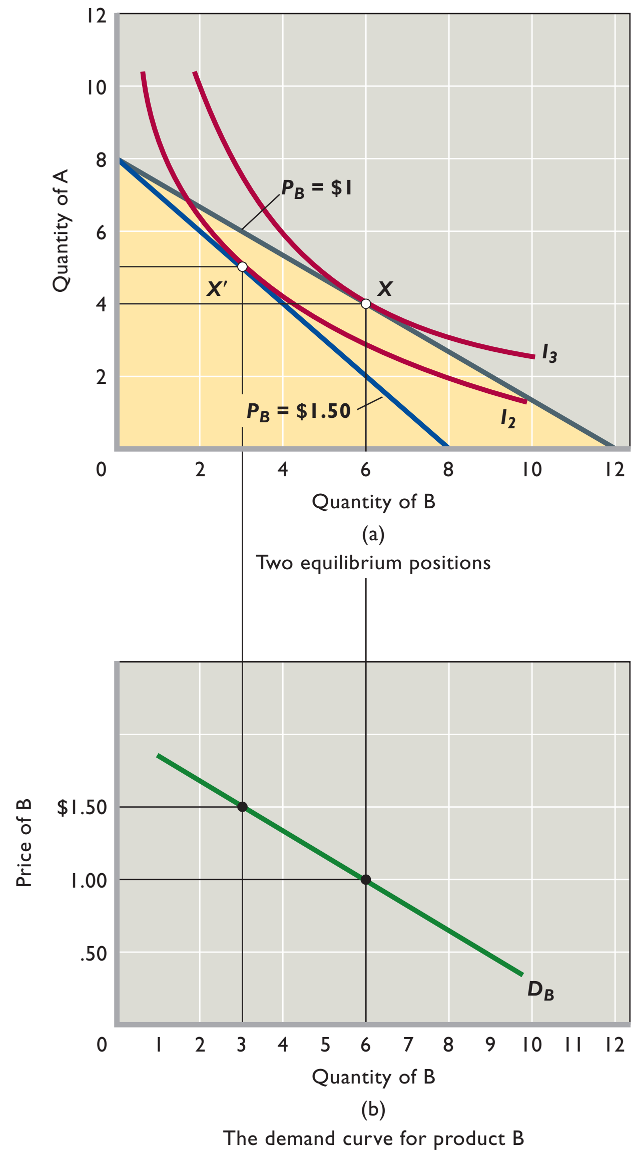
utilities equals P_B/P_A. We therefore deduce that at equilibrium the MRS is equivalent in the marginal-utility approach to the ratio of the marginal utilities of the last purchased units of the two products.[2]

[2]Technical footnote: If we begin with the utility-maximizing rule, $MU_A/P_A = MU_B/P_B$, and then multiply through by P_B and divide through by MU_A, we obtain $P_B/P_A = MU_B/MU_A$. In indifference curve analysis we know that at the equilibrium position $MRS = P_B/P_A$. Hence, at equilibrium, MRS also equals MU_B/MU_A.

The Derivation of the Demand Curve

We noted earlier that with a fixed price for A, an increase in the price of B will cause the bottom of the budget line to fan inward to the left. We can use that fact to derive a demand curve for product B. In Figure 5a we reproduce the part of Figure 4 that shows our initial consumer equilibrium at point *X*. The budget line determining this

FIGURE 5 Deriving the demand curve. (a) When the price of product B is increased from $1 to $1.50, the equilibrium position moves from *X* to *X*′, decreasing the quantity demanded of product B from 6 to 3 units. (b) The demand curve for product B is determined by plotting the $1–6-unit and the $1.50–3-unit price-quantity combinations for product B.



equilibrium position assumes that money income is $12 and that P_A = $1.50 and P_B = $1. Let's see what happens to the equilibrium position when we increase P_B to $1.50 and hold both money income and the price of A constant. The result is shown in Figure 5a. The budget line fans to the left, yielding a new equilibrium point X' where it is tangent to lower indifference curve I_2. At X' the consumer buys 3 units of B and 5 of A, compared with 4 of A and 6 of B at *X*. Our interest is in B, and we now have sufficient information to locate two points on the demand curve for product B. We know that at equilibrium point *X* the price of B is $1 and 6 units are purchased; at equilibrium point X' the price of B is $1.50 and 3 units are purchased.

These data are shown graphically in Figure 5b as points on the consumer's demand curve for B. Note that the horizontal axes of Figures 5a and 5b are identical; both measure the quantity demanded of B. We can therefore drop vertical reference lines from Figure 5a down to the horizontal axis of Figure 5b. On the vertical axis of Figure 5b we locate the two chosen prices of B. Knowing that these prices yield the relevant quantities demanded, we locate two points on the demand curve for B. By simple manipulation of the price of B in an indifference curve–budget line context, we have obtained a downward-sloping demand curve for B. We have thus again derived the law of demand assuming "other things equal," since only the price of B was changed (the price of A and the consumer's money income and tastes remained constant). But, in this case, we have derived the demand curve without resorting to the questionable assumption that consumers can measure utility in units called "utils." In this indifference curve approach, consumers simply compare combinations of products A and B and determine which combination they prefer, given their incomes and the prices of the two products.

Appendix Summary

1. The indifference curve approach to consumer behavior is based on the consumer's budget line and indifference curves.
2. The budget line shows all combinations of two products that the consumer can purchase, given product prices and his or her money income.
3. A change in either product prices or money income moves the budget line.
4. An indifference curve shows all combinations of two products that will yield the same total utility to a consumer. Indifference curves are downsloping and convex to the origin.
5. An indifference map consists of a number of indifference curves; the farther from the origin, the higher the total utility associated with a curve.
6. The consumer is in equilibrium (utility is maximized) at the point on the budget line that lies on the highest attainable indifference curve. At that point the budget line and indifference curve are tangent.
7. Changing the price of one product shifts the budget line and determines a new equilibrium point. A downsloping demand curve can be determined by plotting the price-quantity combinations associated with two or more equilibrium points.

Appendix Terms and Concepts

budget line
indifference curve
marginal rate of substitution (MRS)
indifference map
equilibrium position

Appendix Questions

1. What information is embodied in a budget line? What shifts occur in the budget line when money income (*a*) increases and (*b*) decreases? What shifts occur in the budget line when the price of the product shown on the vertical axis (*c*) increases and (*d*) decreases? LO6
2. What information is contained in an indifference curve? Why are such curves (*a*) downsloping and (*b*) convex to the origin? Why does total utility increase as the consumer moves to indifference curves farther from the origin? Why can't indifference curves intersect? LO6
3. Using Figure 4, explain why the point of tangency of the budget line with an indifference curve is the consumer's equilibrium position. Explain why any point where the budget line intersects an indifference curve is not equilibrium. Explain: "The consumer is in equilibrium where MRS = P_B/P_A." LO6

Appendix Problems

1. Assume that the data in the accompanying table give an indifference curve for Mr. Chen. Graph this curve, putting A on the vertical axis and B on the horizontal axis. Assuming that the prices of A and B are $1.50 and $1, respectively, and that Mr. Chen has $24 to spend, add his budget line to your graph. What combination of A and B will Mr. Chen purchase? Does your answer meet the MRS = P_B/P_A rule for equilibrium? **LO6**

Units of A	Units of B
16	6
12	8
8	12
4	24

2. Explain graphically how indifference analysis can be used to derive a demand curve. **LO6**
3. **ADVANCED ANALYSIS** First, graphically illustrate a doubling of income without price changes in the indifference curve model. Next, on the same graph, show a situation in which the person whose indifference curves you are drawing buys considerably more of good B than good A after the income increase. What can you conclude about the relative coefficients of the income elasticity of demand for goods A and B (Chapter 4)? **LO6**