CHAPTER

5

# DEMAND: THE BENEFIT SIDE OF THE MARKET

On the northern border of a large university in the East, a creek widens to form a picturesque lake, fondly remembered by generations of alumni as a popular recreation spot. Over the years, the lake had gradually silted in, and by the late 1980s, even paddling a canoe across it had become impossible. A generous alumnus then sponsored an effort to restore the lake. Heavy dredging equipment hauled out load after load of mud, and months later the lake was finally silt-free.

To mark the occasion, the university held a ceremony. Bands played, the president spoke, a chorus sang, and distinguished visitors applauded the donor's generosity. Hundreds of faculty and students turned out for the festivities. Spotting a good opportunity to promote their product, the proprietors of a local ice cream store set up a temporary stand at the water's edge, with a large sign: "Free Ice Cream."

Word spread. Soon scores of people were lined up waiting to try Vanilla Almond Delight, Hazelnut Cream, and Fudge Faire. The ice cream was plentiful, and because it was free, everyone could obviously afford it—or so it seemed. In fact, many people who wanted ice cream that day never got any. The reason, of course, was that they found waiting in a long line too steep a price.

When a good or service is scarce, it must somehow be rationed among competing users. In most markets, monetary prices perform that task. But in the case of a stand offering free ice cream, waiting time becomes the effective rationing device. Having to stand in line is a cost, no less so than having to part with some money.

This example drives home the point that although the demand curve is usually described as a relationship between the quantity demanded of a good and its monetary price, the relationship is really a much more general one. At bottom, the demand curve is a relationship between the quantity demanded and *all* costs—monetary and nonmonetary—associated with acquiring a good.

Our task in this chapter will be to explore the demand side of the market in greater depth than was possible in Chapter 3. There we merely asked you to accept as an intuitively plausible claim that the quantity demanded of a good or service declines as its price rises. This relationship is known as the law of demand, and we will see how it emerges as a simple consequence of the assumption that people spend their limited incomes in rational ways. In the process, we will see more clearly the dual roles of income and substitution as factors that account for the law of demand. We will also see how to generate market demand curves by adding the demand curves for individual buyers horizontally. Finally, we will see how to use the demand curve to generate a measure of the total benefit that buyers reap from their participation in a market.

## THE LAW OF DEMAND

With our discussion of the free ice cream offer in mind, let us restate the law of demand as follows:

**Law of Demand: People do less of what they want to do as the cost of doing it rises.**

By stating the law of demand this way, we can see it as a direct consequence of the cost-benefit principle, which says that an activity should be pursued if (and only if) its benefits are at least as great as its costs. Recall that we measure the benefit of an activity by the highest price we'd be willing to pay to pursue it—namely, our reservation price for the activity. When the cost of an activity rises, it is more likely to exceed our reservation price, and we are therefore less likely to pursue that activity.

The law of demand applies to BMWs, cheap key rings, and "free" ice cream, not to mention compact discs, manicures, medical care, and acid-free rain. It stresses that a "cost" is the sum of *all* the sacrifices—monetary and nonmonetary, implicit and explicit—we must make to engage in an activity.

### THE ORIGINS OF DEMAND

How much are you willing to pay for the latest Alanis Morisette CD? The answer will clearly depend on how you feel about her music. To Morisette's diehard fans, buying the new release might seem absolutely essential; they'd pay a steep price indeed. But those who don't like Morisette's music may be unwilling to buy it at any price.

Wants (also called "preferences" or "tastes") are clearly an important determinant of a consumer's reservation price for a good. But that begs the question of where wants come from. Many tastes—such as the taste for water on a hot day or for a comfortable place to sleep at night—are largely biological in origin. But many others are heavily shaped by culture, and even basic cravings may be socially molded. For example, people raised in southern India develop a taste for hot curry dishes, while those raised in England generally prefer milder foods.

Tastes for some items may remain stable for many years, but tastes for others may be highly volatile. Although books about the *Titanic* disaster have been continuously available since the vessel sank in the spring of 1912, not until the appearance of James Cameron's blockbuster film did these books begin to sell in large quantities. In the spring of 1998, five of the 15 books on the *New York Times* paperback bestseller list were about the *Titanic* itself or one of the actors in the film. Yet none of these books, or any other book about the *Titanic,* made the bestseller list in 1999. Still, echoes of the film continued to reverberate in the marketplace. In the years since its release, for example, demand for ocean cruises has grown sharply, and several television networks have introduced shows set on cruise ships.

Peer influence provides another example of how social forces often influence demand. Indeed, it is often the most important single determinant of demand. For instance, if our goal is to predict whether a young man will purchase an illegal recreational drug, knowing how much income he has is not very helpful. Knowing the prices of whiskey and other legal substitutes for illicit drugs also tells us little. Although these factors do influence purchase decisions, by themselves they are weak predictors. But if we know that most of the young man's best friends are heavy drug users, there is a reasonably good chance that he will use drugs as well.

Another important way in which social forces shape demand is in the relatively common desire to consume goods and services that are recognized as the best of their kind. For instance, many people want to hear Luciano Pavorotti sing, not just because of the quality of his voice, but because he is widely regarded as the world's best—or at least the world's best known—tenor.

Consider, too, the decision of how much to spend on an interview suit. As the employment counselors never tire of reminding us, making a good first impression is extremely important when you go for a job interview. At the very least, that means showing up in a suit that looks good. But looking good is a relative concept. If everyone else shows up in a \$200 suit, you'll look good if you show up in a \$300 suit. But you won't look as good in that same \$300 suit if everyone else shows up in suits costing \$1,000. The amount you'll choose to spend on an interview suit, then, clearly depends on how much others in your circle are spending.

## NEEDS VERSUS WANTS

In everyday language, we distinguish between goods and services people need and those they merely want. For example, we might say that someone wants a ski vacation in Utah, but what he really needs is a few days off from his daily routine; or that someone wants a house with a view, but what she really needs is shelter from the elements. Likewise, since people need protein to survive, we might say that a severely malnourished person needs more protein. But it would strike us as odd to say that anyone—even a malnourished person—needs more prime filet of beef, since health can be restored by consuming far less expensive sources of protein.

Economists like to emphasize that once we have achieved bare subsistence levels of consumption—the amount of food, shelter, and clothing required to maintain our health—we can abandon all reference to needs and speak only in terms of wants. This linguistic distinction helps us to think more clearly about the true nature of our choices.

For instance, someone who says "Californians don't have nearly as much water as they need" will tend to think differently about water shortages than someone who says "Californians don't have nearly as much water as they want when the price of water is low." The first person is likely to focus on regulations to prevent people from watering their lawns, or on projects to capture additional runoff from the Sierra Nevada mountains. The second person is more likely to focus on the low price of water in California. Whereas remedies of the first sort are often costly and extremely difficult to implement, raising the price of water is both simple and effective.

**ECONOMIC NATURALIST 5.1**

**Why does California experience chronic water shortages?**

Some might respond that the state must serve the needs of a large population with a relatively low average annual rainfall. Yet other states, like New Mexico, have even less rainfall per person and do not experience water shortages nearly as often as California. California's problem exists because local governments sell water at extremely low prices, which encourages Californians to use water in ways that make no sense for a state with low rainfall. For instance, rice, which is well suited for conditions in high-rainfall states like South Carolina, requires extensive irrigation in California. But because California farmers can obtain water so cheaply, they plant and flood hundreds of thousands of acres of rice paddies each spring in the Central Valley. Two thousand tons of water are needed to produce one ton of rice, but many other grains can be produced with only half that amount. If the price of California water were higher, farmers would simply switch to other grains.

Likewise, cheap water encourages homeowners in Los Angeles and San Diego to plant water-intensive lawns and shrubs, like the ones common in the East and Midwest. By contrast, residents of cities like Santa Fe, New Mexico, where water prices are high, choose native plantings that require little or no watering.

## TRANSLATING WANTS INTO DEMAND

It's a simple fact of life that although our resources are finite, our appetites for good things are boundless. Even if we had unlimited bank accounts, we'd quickly run out of the time and energy needed to do all the things we wanted to do. Our challenge is to use our limited resources to fulfill our desires to the greatest possible degree. And that leaves us with this practical question: How should we allocate our incomes among the various goods and services that are available? To answer this question, it's helpful to begin by recognizing that the goods and services we buy are not ends in themselves, but rather means for satisfying our desires.

### MEASURING WANTS: THE CONCEPT OF UTILITY

Economists use the concept of *utility* to represent the satisfaction people derive from their consumption activities. The assumption is that people try to allocate their incomes so as to maximize their satisfaction, a goal that is referred to as *utility maximization*.

Early economists imagined that the utility associated with different activities might someday be subject to precise measurement. The nineteenth-century British economist Jeremy Bentham, for example, wrote of a "utilometer," a device that could be used to measure the amount of utility provided by different consumption activities. Although no such device existed in Bentham's day, contemporary neuropsychologists now have equipment that can generate at least crude measures of satisfaction.

Figure 5.1, for example, shows a subject who is connected to an apparatus that measures the intensity of electrical waves emanating from his brain. University of Wisconsin psychologist Richard Davidson and his colleagues documented that subjects with relatively heavy brain wave measures emanating from the left prefrontal cortex tend to be happier (as assessed by a variety of other measures) than subjects with relatively heavy brain wave measures emanating from the right prefrontal cortex.

Jeremy Bentham would have been thrilled to learn that a device like the one pictured in Figure 5.1 might exist some day. His ideal utilometer would measure utility in utils, much as a thermometer measures temperature in degrees Fahrenheit or Celsius. It would assign a numerical utility value to every activity—watching a movie, eating a cheeseburger, and so on. Unfortunately, even sophisticated devices like the one shown in Figure 5.1 are far from capable of such fine-grained assessments.

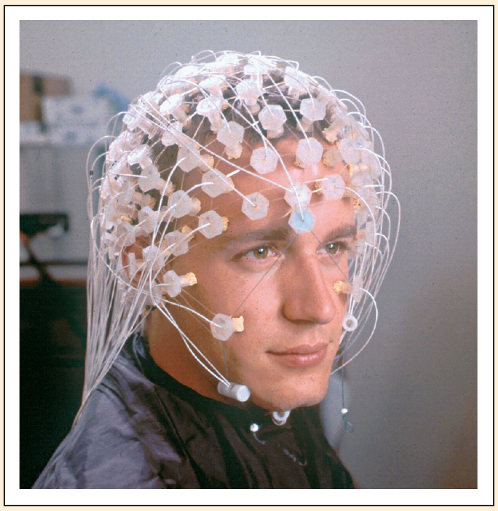


Photo courtesy of Richard J. Davidson

**FIGURE 5.1**
**Can Utility Be Measured Electronically?**
Scientists have shown that higher levels of electrical activity on the brain's left side are strongly associated with higher levels of satisfaction.

For Bentham's intellectual enterprise, however, the absence of a real utilometer was of no practical significance. Even without such a machine, he could continue to envision the consumer as someone whose goal was to maximize the total utility she obtained from the goods she consumed. Bentham's "utility maximization model," we will see, affords important insights about how a rational consumer ought to spend her income. To explore how the model works, we begin with an unusually simple problem, the one facing a consumer who reaches the front of the line at a free ice cream stand. How many cones of ice cream should this person, whom we'll call Sarah, ask for? Table 5.1 shows the relationship between the total number of ice cream cones Sarah eats per hour and the total utility, measured in utils per hour, she derives from them. Note that the measurements in the table are stated in terms of cones per hour and utils per hour. Why "per hour"? Because without an explicit time dimension, we would have no idea whether a given quantity was a lot or a little. Five ice cream cones in a lifetime isn't much, but five in an hour would be more than most of us would care to eat.

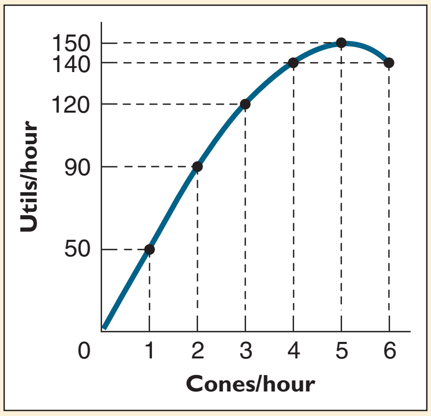
As the entries in Table 5.1 show, Sarah's total utility increases with each cone she eats, up to the fifth cone. Eating 5 cones per hour makes her happier than eating 4, which makes her happier than eating 3, and so on. But beyond 5 cones per hour, consuming more ice cream actually makes Sarah less happy. Thus the sixth cone reduces her total utility from 150 utils per hour to 140 utils per hour.

We can display the utility information in Table 5.1 graphically, as in Figure 5.2. Note in the graph that the more cones per hour Sarah eats, the more utils she

**TABLE 5.1**
**Sarah's Total Utility from Ice Cream Consumption**

| Cone quantity (cones/hour) | Total utility (utils/hour) |
|---|---|
| 0 | 0 |
| 1 | 50 |
| 2 | 90 |
| 3 | 120 |
| 4 | 140 |
| 5 | 150 |
| 6 | 140 |

**FIGURE 5.2**
**Sarah's Total Utility from Ice Cream Consumption.**
For most goods, utility rises at a diminishing rate with additional consumption.




gets—but again only up to the fifth cone. Once she moves beyond 5, her total utility begins to decline. Sarah's happiness reaches a maximum of 150 utils when she eats 5 cones per hour. At that point she has no incentive to eat the sixth cone, even though it's absolutely free. Eating it would actually make her worse off.

Table 5.1 and Figure 5.2 illustrate another important aspect of the relationship between utility and consumption—namely, that the additional utility from additional units of consumption declines as total consumption increases. Thus, whereas 1 cone per hour is a *lot* better—by 50 utils—than zero, 5 cones per hour is just a *little* better than 4 (just 10 utils' worth).

***marginal utility*** the additional utility gained from consuming an additional unit of a good

The term **marginal utility** denotes the amount by which total utility changes when consumption changes by one unit. In Table 5.2, the third column shows the marginal utility values that correspond to changes in Sarah's level of ice cream consumption. For example, the second entry in that column represents the increase in total utility (measured in utils per cone) when Sarah's consumption rises from 1 cone per hour to 2. Note that the marginal utility entries in the third column are placed midway between the rows of the preceding columns. We do this to indicate that marginal utility corresponds to the movement from one

**TABLE 5.2**
**Sarah's Total and Marginal Utility from Ice Cream Consumption**

| Cone quantity (cones/hour) | Total utility (utils/hour) | Marginal utility (utils/cone) |
|---|---|---|
| 0 | 0 | — |
| | | 50 |
| 1 | 50 | |
| | | 40 |
| 2 | 90 | |
| | | 30 |
| 3 | 120 | |
| | | 20 |
| 4 | 140 | |
| | | 10 |
| 5 | 150 | |
| | | −10 |
| 6 | 140 | |

Marginal utility

$$= \frac{\text{change in utility}}{\text{change in consumption}}$$

$$= \frac{90 \text{ utils} - 50 \text{ utils}}{2 \text{ cones} - 1 \text{ cone}}$$

= 40 utils/cone

consumption quantity to the next. Thus we would say that the marginal utility of moving from 1 to 2 cones per hour is 40 utils per cone.

Because marginal utility is the change in utility that occurs as we move from one quantity to another, when we graph marginal utility we normally adopt the convention of plotting each specific marginal utility value halfway between the two quantities to which it corresponds. Thus, in Figure 5.3, we plot the marginal utility value of 40 utils per cone midway between 1 cone per hour and 2 cones per hour, and so on. (In this example, the marginal utility graph is a downward-sloping straight line for the region shown, but this need not always be the case.)

The tendency for marginal utility to decline as consumption increases beyond some point is called the **law of diminishing marginal utility.** It holds not just for Sarah's consumption of ice cream in this illustration, but also for most other goods for most consumers. If we have one brownie or one Ferrari, we're happier than we are with none; if we have two, we'll be even happier—but not twice as happy—and so on. Though this pattern is called a law, there are exceptions. Indeed, some consumption activities even seem to exhibit *increasing* marginal utility. For example, an unfamiliar song may seem irritating the first time you hear it, then gradually become more tolerable the next few times you hear it. Before long, you may discover that you *like* the song, and you may even find yourself singing it in the shower. Notwithstanding such exceptions, the law of diminishing marginal utility is a plausible characterization of the relationship between utility and consumption for many goods. Unless otherwise stated, we'll assume that it holds for the various goods we discuss.

***law of diminishing marginal utility*** the tendency for the additional utility gained from consuming an additional unit of a good to diminish as consumption increases beyond some point

What will Sarah do when she gets to the front of the line? At that point, the opportunity cost of the time she spent waiting is a sunk cost, and is hence irrelevant to her decision about how many cones to order. And since there is no monetary charge for the cones, the cost of ordering an additional one is zero. According to the cost-benefit principle, Sarah should therefore continue to order cones as long as the marginal benefit (here, the marginal utility she gets from an additional cone) is greater than or equal to zero. As we can see from the entries in Table 5.2, marginal utility is positive up to and including the fifth cone but becomes negative after 5 cones. Thus, as noted earlier, Sarah should order 5 cones.

In this highly simplified example, Sarah's utility-maximization problem is just like the one she'd confront if she were deciding how much water to drink from a public fountain. (Solution: Keep drinking until the marginal utility of water declines to zero.)

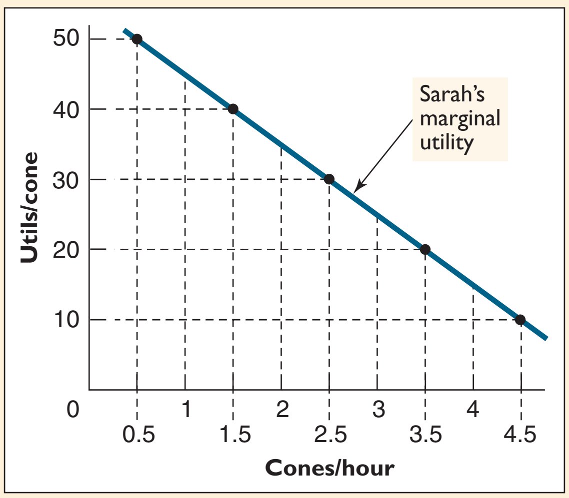



**FIGURE 5.3**
**Diminishing Marginal Utility.**
The more cones Sarah consumes each hour, the smaller her marginal utility will be. For Sarah, consumption of ice cream cones satisfies the law of diminishing marginal utility.

## ALLOCATING A FIXED INCOME BETWEEN TWO GOODS

Most of us confront considerably more complex purchase decisions than the one Sarah faced. For one thing, we generally must make decisions not just about a single good but about many. Another complication is that the cost of consuming additional units of each good will rarely be zero.

To see how to proceed in more complex cases, let's suppose Sarah must decide how to spend a fixed sum of money on two different goods, each with a positive price. Should she spend all of it on one of the goods, or part of it on each? The law of diminishing marginal utility suggests that spending it all on a single good isn't a good strategy. Rather than devote more and more money to the purchase of a good we already consume in large quantities (and whose marginal utility is therefore relatively low), we generally do better to spend that money on other goods we don't have much of, whose marginal utility will likely be higher.

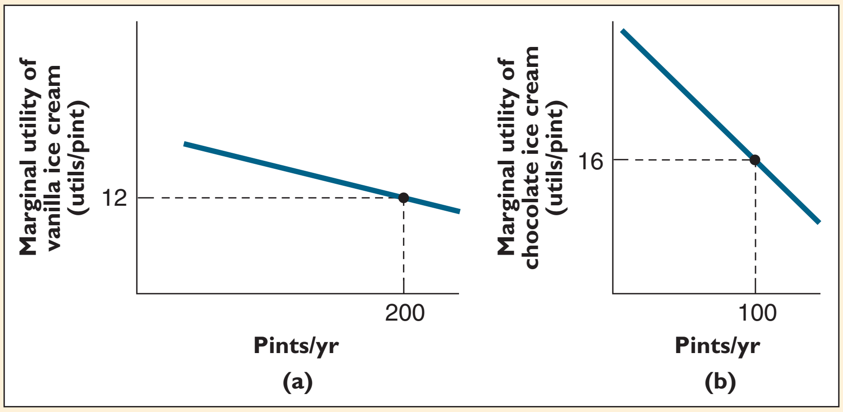
The simplest way to illustrate how economists think about the spending decisions of a utility-maximizing consumer is to work through an example like the following:

**EXAMPLE 5.1**

**Is Sarah maximizing her utility from consuming chocolate and vanilla ice cream (I)?**

Chocolate ice cream sells sell for $2 per pint and vanilla sells for $1. Sarah has a budget of $400 per year to spend on ice cream, and her marginal utility from consuming each type varies with the amount consumed as shown in Figure 5.4. If she is currently buying 200 pints of vanilla and 100 pints of chocolate each year, is she maximizing her utility?

**FIGURE 5.4**
**Marginal Utility Curves for Two Flavors of Ice Cream (I).**
At Sarah's current consumption levels, her marginal utility of chocolate ice cream is 25 percent higher than her marginal utility of vanilla. But chocolate is twice as expensive as vanilla.




Note first that with 200 pints per year of vanilla and 100 pints of chocolate, Sarah is spending $200 per year on each type of ice cream, for a total expenditure of $400 per year on ice cream, exactly the amount in her budget. By spending her money in this fashion, is she getting as much utility as possible? Note in Figure 5.4(b) that her marginal utility from chocolate ice cream is 16 utils per pint. Since chocolate costs $2 per pint, her current spending on chocolate is yielding additional utility at the rate of (16 utils/pint)/($2/pint) = 8 utils per dollar. Similarly, note in Figure 5.4(a) that Sarah's marginal utility for vanilla is 12 utils per pint. And since vanilla costs only $1 per pint, her current spending on vanilla is yielding (12 utils/pint)/($1/pint) = 12 utils per dollar. In other words, at her current rates of consumption of the two flavors, her spending yields higher marginal utility per dollar for vanilla than for chocolate. And this means that Sarah cannot possibly be maximizing her total utility.

To see why, note that if she spent $2 less on chocolate (that is, if she bought one pint less than before), she would lose about 16 utils;[1] but with the same $2, she could buy two additional pints of vanilla, which would boost her utility by about 24 utils,[2] for a net gain of about 8 utils. Under Sarah's current budget allocation, she is thus spending too little on vanilla and too much on chocolate.

In the next example, we'll see what happens if Sarah spends $100 per year less on chocolate and $100 per year more on vanilla.

**EXAMPLE 5.2**

**Is Sarah maximizing her utility from consuming chocolate and vanilla ice cream (II)?**

Sarah's total ice cream budget and the prices of the two flavors are the same as in Example 5.1. If her marginal utility from consuming each type varies with the amount consumed as shown in Figure 5.5 and if she is currently buying 300 pints of vanilla and 50 pints of chocolate each year, is she maximizing her utility?

Note first that the direction of Sarah's rearrangement of her spending makes sense in light of Example 5.1, in which we saw that she was spending too much on chocolate and too little on vanilla. Spending $100 less on chocolate ice cream causes

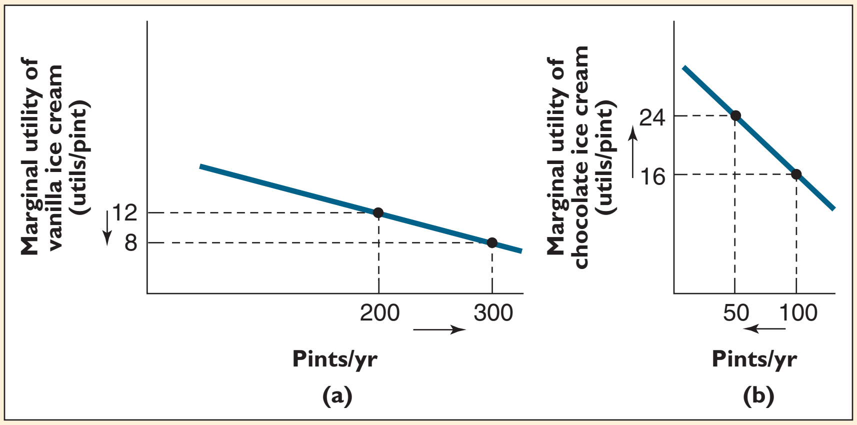



**FIGURE 5.5**
**Marginal Utility Curves for Two Flavors of Ice Cream (II).**
When Sarah increases her consumption of vanilla (a), her marginal utility of vanilla falls. Conversely, when she reduces her consumption of chocolate (b), her marginal utility of chocolate rises.

her marginal utility from that flavor to rise from 16 to 24 utils per pint [Figure 5.5(b)]. By the same token, spending $100 more on vanilla ice cream causes her marginal utility from that flavor to fall from 12 to 8 utils per pint [Figure 5.5(a)]. Both movements are a simple consequence of the law of diminishing marginal utility.

Since chocolate still costs $2 per pint, her spending on chocolate now yields additional utility at the rate of (24 utils/pint)/($2/pint) = 12 utils per dollar. Similarly, since vanilla still costs $1 per pint, her spending on vanilla now yields additional utility at the rate of only (8 utils/pint)/($1/pint) = 8 utils per dollar. So at her new rates of consumption of the two flavors, her spending yields higher marginal utility per dollar for chocolate than for vanilla—precisely the opposite of the ordering we saw in Example 5.1.

Sarah has thus made too big an adjustment in her effort to remedy her original consumption imbalance. Starting from the new combination of flavors (300 pints per year of vanilla and 50 pints per year of chocolate), for example, if she then bought two fewer pints of vanilla (which would reduce her utility by about 16 utils) and used the $2 she saved to buy an additional pint of chocolate (which would

[1]The actual reduction would be slightly larger than 16 utils, because her marginal utility of chocolate rises slightly as she consumes less of it.
[2]The actual increase will be slightly smaller than 24 utils, because her marginal utility of vanilla falls slightly as she buys more of it.

boost her utility by about 24 utils), she would experience a net gain of about 8 utils. So again, her current combination of the two flavors fails to maximize her total utility. This time, she is spending too little on chocolate and too much on vanilla.

## EXERCISE 5.1

**In Example 5.1, verify that the stated combination of flavors in Example 5.2 costs exactly the amount that Sarah has budgeted for ice cream.**

***optimal combination of goods*** the affordable combination that yields the highest total utility

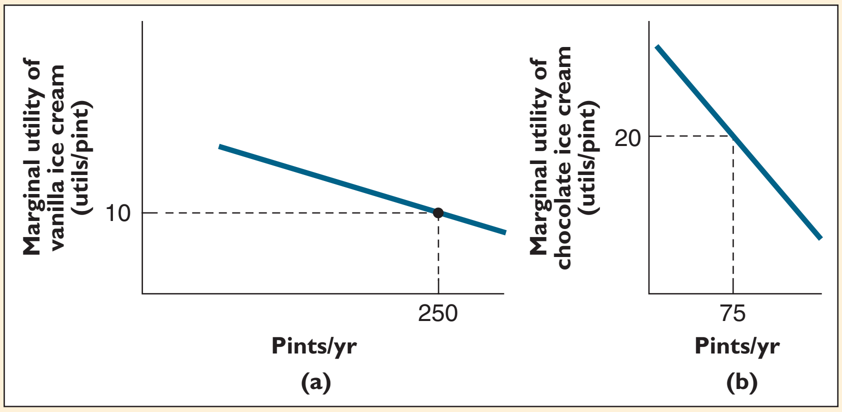
What is Sarah's **optimal combination** the two flavors? In other words, among all the combinations of vanilla and chocolate ice cream that Sarah can afford, which one provides the maximum possible total utility? The following example illustrates the condition that this optimal combination must satisfy.

## EXAMPLE 5.3

**Is Sarah maximizing her utility from consuming chocolate and vanilla ice cream (III)?**

Sarah's total ice cream budget and the prices of the two flavors are again as in Examples 5.1 and 5.2. If her marginal utility from consuming each type varies with the amounts consumed as shown in Figure 5.6 and if she is currently buying 250 pints of vanilla and 75 pints of chocolate each year, is she maximizing her utility?

**FIGURE 5.6**
**Marginal Utility Curves for Two Flavors of Ice Cream (III).**
At her current consumption levels, marginal utility per dollar is exactly the same for each flavor.




As you can easily verify, the combination of 250 pints per year of vanilla and 75 pints per year of chocolate again costs a total of $400, exactly the amount of Sarah's ice cream budget. Her marginal utility from chocolate is now 20 utils per pint [Figure 5.6(b)], and since chocolate still costs $2 per pint, her spending on chocolate now yields additional utility at the rate of (20 utils/pint)/($2/pint) = 10 utils per dollar. Sarah's marginal utility for vanilla is now 10 utils per pint [Figure 5.6(a)], and since vanilla still costs $1 per pint, her last dollar spent on vanilla now also yields (10 utils/pint)/($1/pint) = 10 utils per dollar. So at her new rates of consumption of the two flavors, her spending yields precisely the same marginal utility per dollar for each flavor. Thus, if she spent a little less on chocolate and a little more on vanilla (or vice versa), her total utility would not change at all. For example, if she bought two more pints of vanilla (which would increase her utility by 20 utils) and one fewer pint of chocolate (which would reduce her utility by 20 utils), both her total expenditure on ice cream and her total utility would remain the same as before. *When her marginal utility per dollar is the same for each flavor, it is impossible for Sarah to rearrange her spending to increase total utility.* So 250 pints of vanilla and 75 pints of chocolate per year is the optimal combination of the two flavors.

## THE RATIONAL SPENDING RULE

Example 5.3 illustrates the **rational spending rule** for solving the problem of how to allocate a fixed budget across different goods. The optimal, or utility-maximizing, combination must satisfy this rule.

**The Rational Spending Rule: Spending should be allocated across goods so that the marginal utility per dollar is the same for each good.**

The rational spending rule can be expressed in the form of a simple formula. If we use $MU_C$ to denote marginal utility from chocolate ice cream consumption (again measured in utils per pint), and $P_C$ to denote the price of chocolate (measured in dollars per pint), then the ratio $MU_C/P_C$ will represent the marginal utility per dollar spent on chocolate, measured in utils per dollar. Similarly, if we use $MU_V$ to denote the marginal utility from vanilla ice cream consumption and $P_V$ to denote the price of vanilla, then $MU_V/P_V$ will represent the marginal utility per dollar spent on vanilla. The marginal utility per dollar will be exactly the same for the two types—and hence total utility will be maximized—when the following simple equation for the rational spending rule for two goods is satisfied:

$$MU_C/P_C = MU_V/P_V.$$

The rational spending rule is easily generalized to apply to spending decisions regarding large numbers of goods. In its most general form, it says that the ratio of marginal utility to price must be the same for each good the consumer buys. If the ratio were higher for one good than for another, the consumer could always increase her total utility by buying more of the first good and less of the second.

Strictly speaking, the rational spending rule applies to goods that are perfectly divisible, such as milk or gasoline. Many other goods, such as bus rides and television sets, can be consumed only in whole-number amounts. In such cases, it may not be possible to satisfy the rational spending rule exactly. For example, when you buy one television set, your marginal utility per dollar spent on televisions may be somewhat higher than the corresponding ratio for other goods, yet if you bought a second set the reverse might well be true. Your best alternative in such cases is to allocate each additional dollar you spend to the good for which your marginal utility per dollar is highest.[1]

Notice that we have not chosen to classify the rational spending rule as one of the core principles of economics. We omit it from this list not because the rule is unimportant, but because it follows directly from the cost-benefit principle. And as we noted earlier, there is considerable advantage in keeping the list of core principles as small as possible. (If we included 200 principles on this list, there's a good chance you wouldn't remember any of them a few years from now.)

## INCOME AND SUBSTITUTION EFFECTS REVISITED

In Chapter 3, we saw that the quantity of a good that consumers wish to purchase depends on its own price, the prices of substitutes and complements, and on consumer incomes. We also saw that when the price of a good changes, the quantity of it demanded changes for two reasons—the substitution effect and the income effect. The substitution effect refers to the fact that when the price of a good goes up, substitutes for that good become relatively more attractive, causing some consumers to abandon the good for its substitutes.

The income effect refers to the fact a price change makes the consumer either poorer or richer in real terms. Consider, for instance, the effect of a change in the price of one of the ice cream flavors in Example 5.3. At the original prices ($2 per

[1] See Problems 6 and 10 at the end of the chapter for examples.

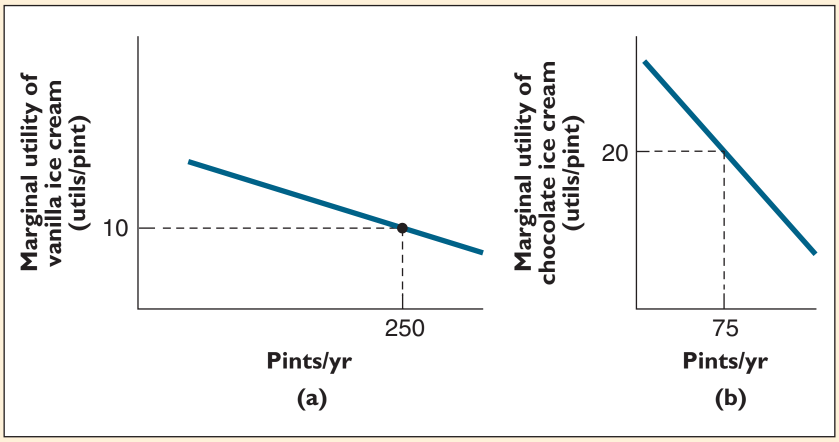
pint for chocolate, \$1 per pint for vanilla), Sarah's \$400 annual ice cream budget would have enabled her to buy at most 200 pints per year of chocolate or 400 pints per year of vanilla. If the price of vanilla rose to \$2 per pint, that would reduce not only the maximum amount of vanilla she could afford (from 400 to 200 pints per year) but also the maximum amount of chocolate she could afford in combination with any given amount of vanilla. For example, at the original price of \$1 per pint for vanilla, Sarah could afford to buy 150 pints of chocolate while buying 100 pints of vanilla; but when the price of vanilla rises to \$2, she can buy only 100 pints of chocolate while buying 100 pints of vanilla. As noted in Chapter 3, a reduction in real income shifts the demand curves for normal goods to the left.

The rational spending rule helps us see more clearly why a change in the price of one good affects demands for other goods. The rule requires that the ratio of marginal utility to price be the same for all goods. This means that if the price of one good goes up, the ratio of its current marginal utility to its new price will be lower than for other goods. Consumers can then increase their total utility by devoting smaller proportions of their incomes to that good and larger proportions to others.

**EXAMPLE 5.4** **How should Sarah respond to a reduction in the price of chocolate ice cream?**

Sarah's total ice cream budget is again \$400 per year and prices of the two flavors are again \$2 per pint for chocolate and \$1 per pint for vanilla. Her marginal utility from consuming each type varies with the amounts consumed as shown in Figure 5.7. She is currently buying 250 pints of vanilla and 75 pints of chocolate each year, which is the optimal combination for her at these prices (see Example 5.3). How should she reallocate her spending among the two flavors if the price of chocolate ice cream falls to \$1 per pint?

**FIGURE 5.7**
**Marginal Utility Curves for Two Flavors of Ice Cream (IV).**
At the current combination of flavors, marginal utility per dollar is the same for each flavor. When the price of chocolate falls, marginal utility per dollar becomes higher for chocolate than for vanilla. To redress this imbalance, Sarah should buy more chocolate and less vanilla.




Because the quantities shown in Figure 5.7 constitute the optimal combination of the two flavors for Sarah at the original prices, they must exactly satisfy the rational spending rule:

$$\begin{aligned} MU_C/P_C &= (20 \text{ utils/pint})/\$2/\text{pint}) = 10 \text{ utils/dollar} \\ &= MU_V/P_V = (10 \text{ utils/pint})/(\$1/\text{pint}). \end{aligned}$$

When the price of chocolate falls to \$1 per pint, the original quantities will no longer satisfy the rational spending rule, because the marginal utility per dollar for chocolate will suddenly be twice what it was before:

$$\begin{aligned} MU_C/P_C &= (20 \text{ utils/pint})/\$1/\text{pint}) = 20 \text{ utils/dollar} \\ &> MU_V/P_V = 10 \text{ utils/dollar}. \end{aligned}$$

To redress this imbalance, Sarah must rearrange her spending on the two flavors in such a way as to increase the marginal utility per dollar for vanilla relative to the marginal utility per dollar for chocolate. And as we see in Figure 5.7, that will happen if she buys a larger quantity than before of chocolate and a smaller quantity than before of vanilla.

### EXERCISE 5.2

**John spends all of his income on two goods, food and shelter. The price of food is $5 per pound and the price of shelter is $10 per square yard. At his current consumption levels, his marginal utilities for the two goods are 20 utils per pound and 30 utils per square yard, respectively. Is John maximizing his utility? If not, how should he reallocate his spending?**

In Chapter 1 we saw that people often make bad decisions because they fail to appreciate the distinction between average and marginal costs and benefits. As the following example illustrates, this pitfall also arises when people attempt to apply the economist's model of utility maximization.

**EXAMPLE 5.5**

**Should Eric consume more apples?**

Eric gets a total of 1,000 utils per week from his consumption of apples and a total of 400 utils per week from his consumption of oranges. The price of apples is $2 each, the price of oranges is $1 each, and he consumes 50 apples and 50 oranges each week. True or false: Eric should consume more apples and fewer oranges.

Eric spends $100 per week on apples and $50 on oranges. He thus averages (1,000 utils/week)/($100/week) = 10 utils per dollar from his consumption of apples and (400 utils/week)/($50/week) = 8 utils per dollar from his consumption of oranges. Many might be tempted to respond that because Eric's average utility per dollar for apples is higher than for oranges, he should consume more apples. But knowing only his *average* utility per dollar for each good simply does not enable us to say whether his current combination is optimal. To make that determination, we need to compare Eric's *marginal* utility per dollar for each good. The information given simply doesn't permit us to make that comparison.

**RECAP TRANSLATING WANTS INTO DEMAND**

The scarcity principle challenges us to allocate our incomes among the various goods that are available so as to fulfill our desires to the greatest possible degree. The optimal combination of goods is the affordable combination that yields the highest total utility. For goods that are perfectly divisible, the rational spending rule tells us that the optimal combination is one for which the marginal utility per dollar is the same for each good. If this condition were not satisfied, the consumer could increase her utility by spending less on goods for which the marginal utility per dollar was lower and more on goods for which her marginal utility was higher.

## APPLYING THE RATIONAL SPENDING RULE

The real payoff from learning the law of demand and the rational spending rule lies not in working through hypothetical examples, but in using these abstract concepts to make sense of the world around you. To encourage you in your efforts to become an economic naturalist, we turn now to a sequence of examples in this vein.

## SUBSTITUTION AT WORK

In the first of these examples, we focus on the role of substitution. When the price of a good or service goes up, rational consumers generally turn to less expensive substitutes. Can't meet the payments on a new car? Then buy a used one, or rent an apartment on a bus or subway line. French restaurants too pricey? Then go out for Chinese, or eat at home more often. National Football League tickets too high? Watch the game on television, or read a book. Can't afford a book? Check one out of the library, or download some reading matter from the Internet. Once you begin to see substitution at work, you will be amazed by the number and richness of the examples that confront you every day.

ECONOMIC NATURALIST 5.2

**Why do the wealthy in Manhattan live in smaller houses than the wealthy in Seattle?**

Microsoft cofounder Bill Gates lives in a 45,000-square-foot house in Seattle, Washington. His house is large even by the standards of Seattle, many of whose wealthy residents live in houses with more than 10,000 square feet of floor space. By contrast, persons of similar wealth in Manhattan rarely live in houses larger than 5,000 square feet. Why this difference?

For people trying to decide how large a house to buy, the most obvious difference between Manhattan and Seattle is the huge difference in housing prices. The cost of land alone is several times higher in Manhattan than in Seattle, and construction costs are also much higher. Although plenty of New Yorkers could *afford* to build a 45,000-square-foot mansion, Manhattan housing prices are so high that they simply choose to live in smaller houses and spend what they save in other ways—on lavish summer homes in eastern Long Island, for instance. New Yorkers also eat out and go to the theater more often than their wealthy counterparts in other U.S. cities.

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Would Bill Gates build a 45,000-square-foot house if he lived in Manhattan?

An especially vivid illustration of substitution occurred during the late 1970s, when fuel shortages brought on by interruptions in the supply of oil from the Middle East led to sharp increases in the price of gasoline and other fuels. In a variety of ways—some straightforward, others remarkably ingenious—consumers changed their behavior to economize on the use of energy. They formed car pools, switched to public transportation, bought four-cylinder cars, moved closer to work, took fewer trips, turned down their thermostats, installed insulation, storm windows, and solar heaters, and bought more efficient appliances. Many people even moved farther south to escape high winter heating bills.

As the next example points out, consumers not only abandon a good in favor of substitutes when it gets more expensive, but they also return to that good when prices return to their original levels.

ECONOMIC NATURALIST 5.3

**Why did people turn to four-cylinder cars in the 1970s, only to shift back to six- and eight-cylinder cars in the 1990s?**

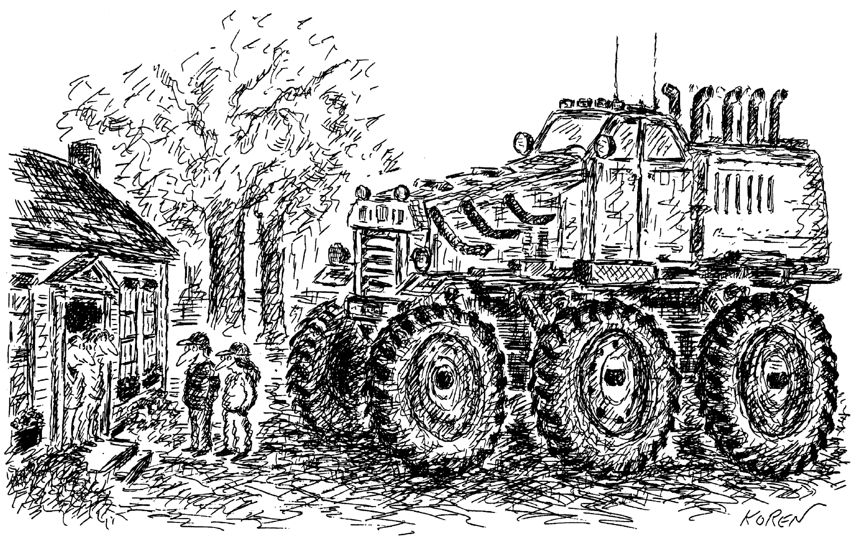
In 1973, the price of gasoline was 38 cents per gallon. The following year the price shot up to 52 cents per gallon in the wake of a major disruption of oil supplies. A second disruption in 1979 drove the 1980 price to $1.19 per gallon. These sharp increases in the price of gasoline led to big increases in the demand for cars with four-cylinder engines, which delivered much better fuel economy than the six- and eight-cylinder cars most people had owned. After 1980, however, fuel supplies stabilized, and prices rose only slowly, reaching $1.40 per gallon by 1999. Yet despite the continued rise in the price of gasoline, the switch to smaller engines did not continue. By the late 1980s, the proportion of cars sold with six- and eight-cylinder engines began rising again. Why this reversal?

The key to explaining these patterns is to focus on changes in the **real price** of gasoline. When someone decides how big an automobile engine to choose, what matters is not the **nominal price** of gasoline, but the price of gasoline *relative* to all other goods. After all, for a consumer faced with a decision of whether to spend $1.40 for a gallon of gasoline, the important question is how much utility she could get from other things she could purchase with the same money. Even though the price of gasoline has continued to rise slowly in nominal, or dollar, terms since 1981, it has declined sharply relative to the price of other goods. Indeed, in terms of real purchasing power, the 1999 price was actually slightly lower than the 1973 price. (That is, in 1999 $1.40 bought slightly more goods and services than 38 cents bought in 1973.) It is this decline in the real price of gasoline that accounts for the reversal of the trend toward smaller engines.

***real price*** the dollar price of a good relative to the average dollar price of all other goods

***nominal price*** the absolute price of a good in dollar terms

A sharp decline in the real price of gasoline also helps account for the explosive growth in sport utility vehicles in the 1990s. Almost 4 million SUVs were sold in the United States in 2001, up from only 750,000 in 1990. Some of them—like the Ford Excursion—weigh more than 7,500 pounds (three times as much as a Honda Civic) and get less than 10 miles per gallon on city streets. Vehicles like these would have been dismal failures during the 1970s, but they're by far the hottest sellers in the current cheap-energy environment.






*"We motored over to say hi!"*

Here's another closely related example of the influence of price on spending decisions.

**Why are automobile engines smaller in England than in the United States?**

ECONOMIC NATURALIST 5.4

In England, the most popular model of BMW's 5-series car is the 516i, whereas in the United States it is the 525i. The engine in the 516i is 40 percent smaller than the engine in the 525i. Why this difference?

In both countries, BMWs appeal to professionals with roughly similar incomes, so the difference cannot be explained by differences in purchasing power. Rather, it is the direct result of the heavy tax the British levy on gasoline. With tax, a gallon of gasoline sells for almost $6 in England—more than four times the price in the United States. This difference encourages the British to choose smaller, more fuel-efficient engines.

### THE IMPORTANCE OF INCOME DIFFERENCES

The most obvious difference between the rich and the poor is that the rich have higher incomes. To explain why the wealthy generally buy larger houses than the poor, we need not assume that the wealthy feel more strongly about housing than the poor. A much simpler explanation is that the total utility from housing, as with most other goods, increases with the amount that one consumes.

As the next example illustrates, income influences the demand not only for housing and other goods, but also for quality of service.

ECONOMIC NATURALIST 5.5

**Why are waiting lines longer in poorer neighborhoods?**

As part of a recent promotional campaign, a Baskin-Robbins retailer offered free ice cream at two of its franchise stores. The first was located in a high-income neighborhood, the second in a low-income neighborhood. Why was the queue for free ice cream longer in the low-income neighborhood?

Residents of both neighborhoods must decide whether to stand in line for free ice cream or go to some other store and avoid the line by paying the usual price. If we make the plausible assumption that people with higher incomes are more willing than others to pay to avoid standing in line, we should expect to see shorter lines in the high-income neighborhood.

Similar reasoning helps explain why lines are shorter in grocery stores that cater to high-income consumers. Keeping lines short at *any* grocery store means hiring more clerks, which means charging higher prices. High-income consumers are more likely than others to be willing to pay for shorter lines.

**RECAP** **APPLYING THE RATIONAL SPENDING RULE**

Application of the rational spending rule highlights the important roles of income and substitution in explaining differences in consumption patterns—among individuals, among communities, and across time. The rule also highlights the fact that real, as opposed to nominal, prices and income are what matter. The demand for a good falls when the real price of a substitute falls or the real price of a complement rises.

## INDIVIDUAL AND MARKET DEMAND CURVES

If we know what each individual's demand curve for a good looks like, how can we use that information to construct the market demand curve for the good? We must add the individual demand curves together, a process that is straightforward but requires care.

### HORIZONTAL ADDITION

Suppose that there only two buyers—Smith and Jones—in the market for canned tuna, and that their demand curves are as shown in Figure 5.8(a) and (b). To construct the market demand curve for canned tuna, we simply announce a sequence of prices and then add the quantity demanded by each buyer at each price. For example, at a price of $4 per can, Smith demands 6 cans per week (a) and Jones demands 2 cans per week (b), for a market demand of 8 cans per week (c).

The process of adding individual demand curves to get the market demand curve is known as *horizontal addition,* a term used to emphasize that we are adding quantities, which are measured on the horizontal axes of individual demand curves.

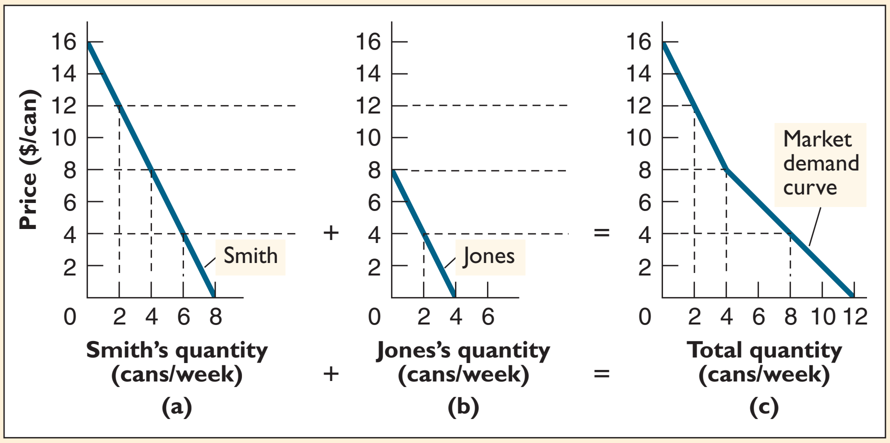



**FIGURE 5.8**
**Individual and Market Demand Curves for Canned Tuna.**
The quantity demanded at any price on the market demand curve (c) is the sum of the individual quantities demanded at that price, (a) and (b).

## EXERCISE 5.3

**The buyers' side of the market for movie tickets consists of two consumers whose demands are as shown in the diagram below. Graph the market demand curve for this market.**

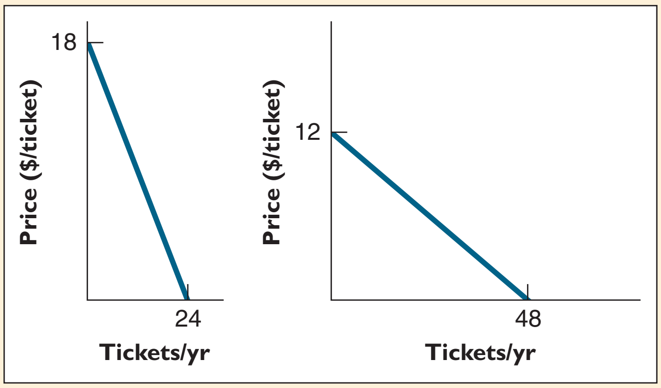



Figure 5.9 illustrates the special case in which each of 1,000 consumers in the market has the same demand curve (a). To get the market demand curve (b) in this case, we simply multiply each quantity on the representative individual demand curve by 1,000.

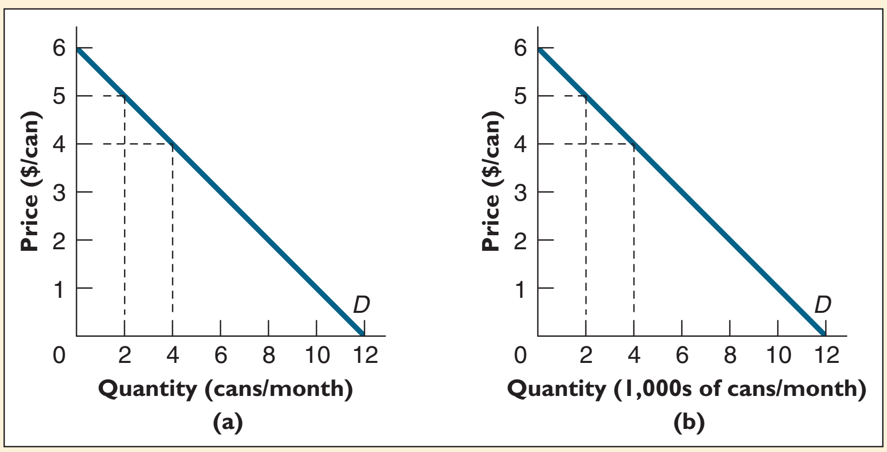



**FIGURE 5.9**
**The Individual and Market Demand Curves When All Buyers Have Identical Demand Curves.**
When individual demand curves are identical, we get the market demand curve (b) by multiplying each quantity on the individual demand curve (a) by the number of consumers in the market.

## DEMAND AND CONSUMER SURPLUS

In Chapter 1 we first encountered the concept of economic surplus, which in a buyer's case is the difference between the most she would have been willing to pay for a product and the amount she actually pays for it. The economic surplus received by buyers is often referred to a **consumer surplus.**

***consumer surplus*** the difference between a buyer's reservation price for a product and the price actually paid

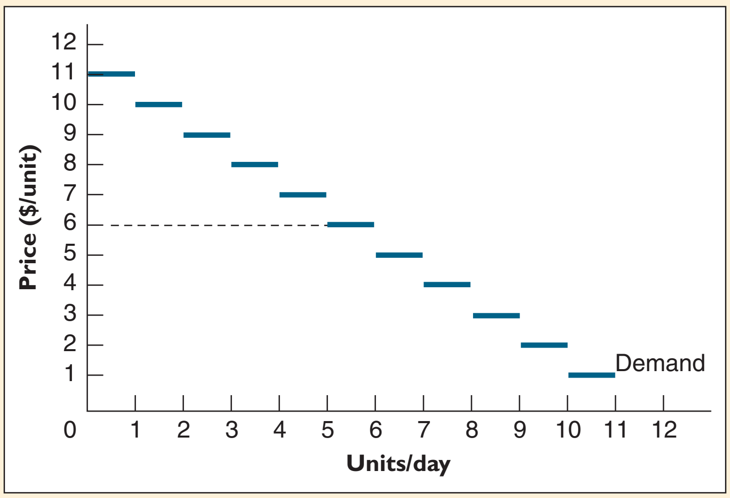
The term consumer surplus sometimes refers to the surplus received by a single buyer in a transaction. On other occasions it is used to denote the total surplus received by all buyers in a market or collection of markets.

### CALCULATING ECONOMIC SURPLUS

For performing cost-benefit analysis it is often important to be able to measure the total consumer surplus received by all buyers who participate in a given market. For example, a road linking a mountain village and a port city would create a new market for fresh fish in the mountain village; in deciding whether the road should be built, analysts would want to count as one of its benefits the gains that would be reaped by buyers in this new market.

To illustrate how economists actually measure consumer surplus, we'll consider a hypothetical market for a good with 11 potential buyers, each of whom can buy a maximum of one unit of the good each day. The first potential buyer's reservation price for the product is $11; the second buyer's reservation price is $10; the third buyer's reservation price is $9; and so on. The demand curve for this market will have the staircase shape shown in Figure 5.10. We can think of this curve as the digital counterpart of traditional analog demand curves. (If the units shown on the horizontal axis were fine enough, this digital curve would be visually indistinguishable from its analog counterparts.)

**FIGURE 5.10**
**A Market with a "Digital" Demand Curve.**
When a product can be sold only in whole-number amounts, its demand curve has the stair-step shape shown.




Suppose the good whose demand curve is shown in Figure 5.10 were available at a price of $6 per unit. How much total consumer surplus would buyers in this market reap? At a price of $6, six units per day would be sold in this market. The buyer of the sixth unit would receive no economic surplus, since his reservation price for that unit was exactly $6, the same as its selling price. But the first five buyers would reap a surplus for their purchases. The buyer of the first unit, for example, would have been willing to pay as much as $11 for it, but since she would pay only $6, she would receive a surplus of exactly $5. The buyer of the second unit, who would have been willing to pay as much as $10, would receive a surplus of $4. The surplus would be $3 for the buyer of the third unit, $2 for the buyer of the fourth unit, and $1 for the buyer of the fifth unit.

If we add all the buyers' surpluses together, we get a total of $15 of consumer surplus each day. That surplus corresponds to the shaded area shown in Figure 5.11.

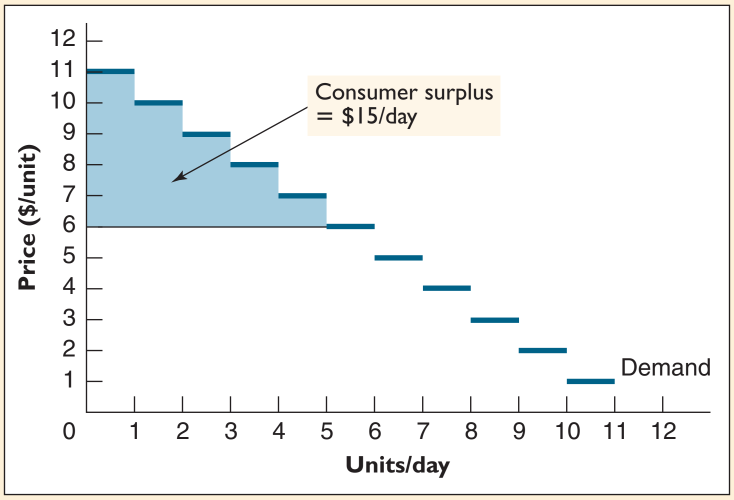
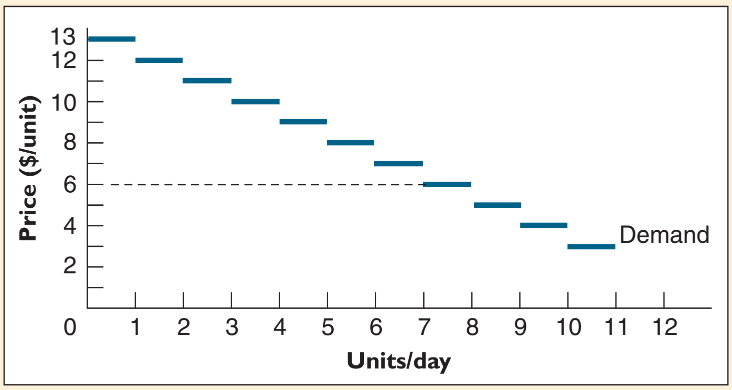



**FIGURE 5.11**
**Consumer Surplus.** Consumer surplus (shaded region) is the cumulative difference between the most that buyers are willing to pay for each unit and the price they actually pay.

### EXERCISE 5.4

**Calculate consumer surplus for a demand curve like the one just described except that the buyers' reservation prices for each unit are $2 higher than before.**




Now suppose we want to calculate consumer surplus in a market with a conventional straight-line demand curve. As the following example illustrates, this task is a simple extension of the method used for digital demand curves.

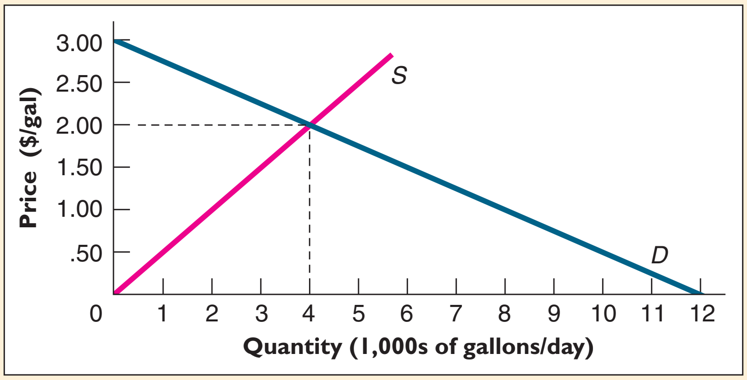
### EXAMPLE 5.6

**How much do buyers benefit from their participation in the market for milk?**

Consider the market for milk whose demand and supply curves are shown in Figure 5.12, which has an equilibrium price of $2 per gallon and an equilibrium quantity of 4,000 gallons per day. How much consumer surplus do the buyers in this market reap?

In Figure 5.12, note first that, as in Figure 5.11, the last unit exchanged each day generates no consumer surplus at all. Note also that for all milk sold up to 4,000 gallons per day, buyers receive consumer surplus, just as in Figure 5.11.

**FIGURE 5.12**
**Supply and Demand in the Market for Milk.**
For the supply and demand curves shown, the equilibrium price of milk is $2 per gallon and the equilibrium quantity is 4,000 gallons per day.

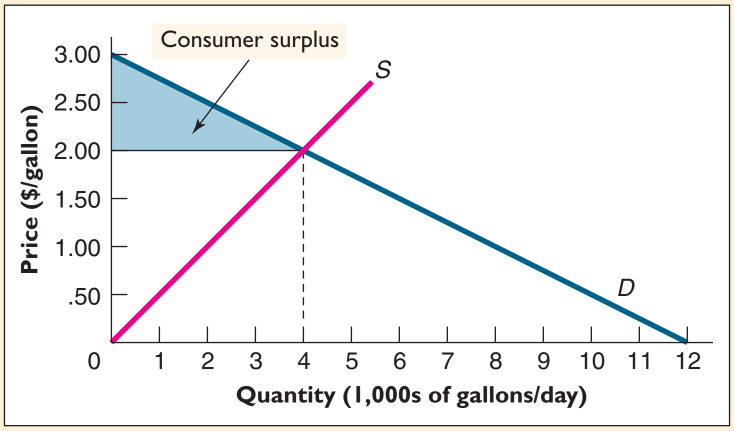



For these buyers, consumer surplus is the cumulative difference between the most they would be willing to pay for milk (as measured on the demand curve) and the price they actually pay.

Total consumer surplus received by buyers in the milk market is thus the shaded triangle between the demand curve and the market price in Figure 5.13. Note that this area is a right triangle whose vertical arm is $h$ = \$1/gallon and whose horizontal arm is $b$ = 4,000 gallons/day. And since the area of any triangle is equal to (1/2)$bh$, consumer surplus in this market is equal to

$$(1/2)(4{,}000 \text{ gallons/day})(\$1/\text{gallon}) = \$2{,}000/\text{day}.$$

**FIGURE 5.13**
**Consumer Surplus in the Market for Milk.**
Consumer surplus it the area of the shaded triangle (\$2,000/day).




A useful way of thinking about consumer surplus is to ask what is the highest price consumers would pay, in the aggregate, for the right to continue participating in this milk market. The answer is \$2,000 per day, since that is the amount by which their combined benefits exceed their combined costs.

As discussed in Chapter 3, the demand curve for a good can be interpreted either horizontally or vertically. The horizontal interpretation tells us, for each price, the total quantity that consumers wish to buy at that price. The vertical interpretation tells us, for each quantity, the most a buyer would be willing to pay for the good at that quantity. For the purpose of computing consumer surplus, we rely on the vertical interpretation of the demand curve. The value on the vertical axis that corresponds to each point along the demand curve corresponds to the marginal buyer's reservation price for the good. Consumer surplus is the cumulative sum of the differences between these reservation prices and the market price. It is the area bounded above by the demand curve and bounded below by the market price.

## SUMMARY

- The rational consumer allocates income among different goods so that the marginal utility gained from the last dollar spent on each good is the same. This rational spending rule gives rise to the law of demand, which states that people do less of what they want to do as the cost of doing it rises. Here, "cost" refers to the sum of all monetary and nonmonetary sacrifices—explicit and implicit—that must be made in order to engage in the activity.

- The ability to substitute one good for another is an important factor behind the law of demand. Because virtually every good or service has at least some substitutes, economists prefer to speak in terms of wants rather than needs. We face choices, and describing our demands as needs is misleading because it suggests we have no options.

- For normal goods, the income effect is a second important reason that demand curves slope downward. When the price of such a good falls, not only does it become more attractive relative to its substitutes, but the consumer also acquires more real purchasing power, and this, too, augments the quantity demanded.

- The demand curve is a schedule that shows the amounts of a good people want to buy at various prices. Demand curves can be used to summarize the price-quantity relationship for a single individual, but more commonly we employ them to summarize that relationship for an entire market. At any quantity along a demand curve, the corresponding price represents the amount by which the consumer (or consumers) would benefit from having an additional unit of the product. For this reason, the demand curve is sometimes described as a summary of the benefit side of the market.

- Consumer surplus is a quantitative measure of the amount by which buyers benefit as a result of their ability to purchase goods at the market price. It is the area between the demand curve and the market price.

## KEY TERMS

consumer surplus (134)
law of demand (118)
law of diminishing marginal utility (123)
marginal utility (122)
nominal price (131)
optimal combination of goods (126)
rational spending rule (127)
real price (131)

## REVIEW QUESTIONS

1. Why do economists prefer to speak of demands arising out of "wants" rather than "needs"?
2. Explain why economists consider the concept of utility useful, even if psychologists cannot measure it precisely.
3. Why does the law of diminishing marginal utility encourage people to spread their spending across many different types of goods?
4. Explain why a good or service that is offered at a monetary price of zero is unlikely to be a truly "free" good from an economic perspective.
5. Give an example of a good that you have consumed for which your marginal utility increased with the amount of it you consumed.

## PROBLEMS

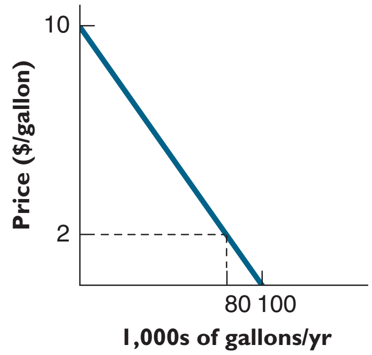
1. In which type of restaurant do you expect the service to be more prompt and courteous: an expensive gourmet restaurant or an inexpensive diner? Explain.
2. You are having lunch at an all-you-can-eat buffet. If you are rational, what should be your marginal utility from the last morsel of food you swallow?
3. Martha's current marginal utility from consuming orange juice is 75 utils per ounce and her marginal utility from consuming coffee is 50 utils per ounce. If orange juice costs 25 cents per ounce and coffee costs 20 cents per ounce, is Martha maximizing her total utility from the two beverages? If so, explain how you know. If not, how should she rearrange her spending?

4. Toby's current marginal utility from consuming peanuts is 100 utils per ounce and his marginal utility from consuming cashews is 200 utils per ounce. If peanuts cost 10 cents per ounce and cashews cost 25 cents per ounce, is Toby maximizing his total utility from the kinds of nuts? If so, explain how you know. If not, how should he rearrange his spending?

5. Sue gets a total of 20 utils per week from her consumption of pizza and a total of 40 utils per week from her consumption of yogurt. The price of pizza is $1 per slice, the price of yogurt is $1 per cup, and she consumes 10 slices of pizza and 20 cups of yogurt each week. True or false: Sue is consuming the optimal combination of pizza and yogurt.

6. Ann lives in Princeton and commutes by train each day to her job in New York City (20 round trips per month). When the price of a round trip goes up from $10 to $20, she responds by consuming exactly the same number of trips as before, while spending $200 per month less on restaurant meals.
   a. Does the fact that her quantity of train travel is completely unresponsive to the price increase imply that Ann is not a rational consumer?
   b. Explain why an increase in train travel might affect the amount she spends on restaurant meals.

7. For the demand curve shown, find the total amount of consumer surplus that results in the gasoline market if gasoline sells for $2 per gallon.




8. Tom has a weekly allowance of $24, all of which he spends on pizza and movie rentals, whose prices are $6 per slice and $3 per rental, respectively. If slices of pizza and movie rentals are available only in whole-number amounts, list all possible combinations of the two goods that Tom can purchase each week with his allowance.

9.* Refer to problem 8. Tom's total utility is the sum of the utility he derives from pizza and movie rentals. If these utilities vary with the amounts consumed as shown in the table, and pizzas and movie rentals are again consumable only in whole-number amounts, how many pizzas and how many movie rentals should Tom consume each week?

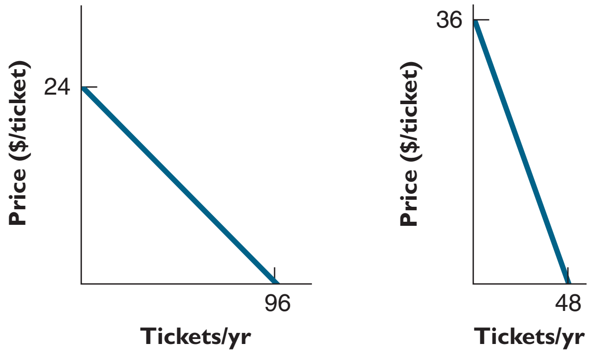
| Pizzas/week | Utils/week from pizza | Movie rentals/ week | Utils/week from rentals |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 1 | 20 | 1 | 40 |
| 2 | 38 | 2 | 46 |
| 3 | 54 | 3 | 50 |
| 4 | 68 | 4 | 54 |
| 5 | 80 | 5 | 56 |
| 6 | 90 | 6 | 57 |
| 7 | 98 | 7 | 57 |
| 8 | 104 | 8 | 57 |

*Problems marked with an asterisk (*) are more difficult.

10.* The buyers' side of the market for amusement park tickets consists of two consumers whose demands are as shown in the diagram below.

a. Graph the market demand curve for this market.

b. Calculate the total consumer surplus in the amusement park market if tickets sell for $12 each.

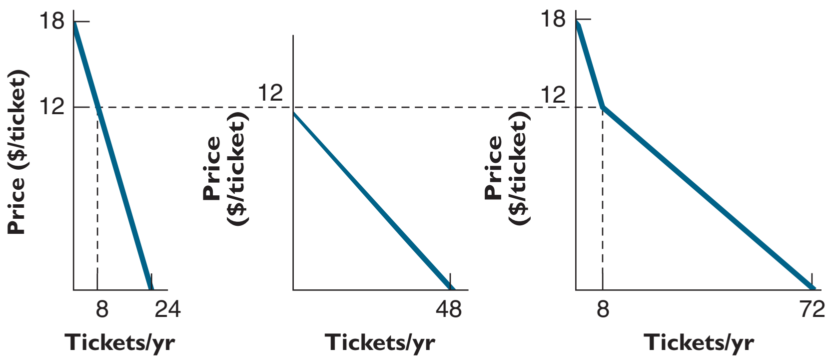



## ANSWERS TO IN-CHAPTER EXERCISES

5.1 The combination of 300 pints per year of vanilla ($300) and 50 pints of chocolate ($100) costs a total of $400, which is exactly equal to Sarah's ice cream budget.

5.2 The rational spending rule requires $MU_F/P_F = MU_C/P_C$ where $MU_F$ and $MU_C$ are John's marginal utilities from food and clothing and $P_F$ and $P_C$ are the prices of food and clothing, respectively. At John's original combination, $MU_F/P_F = 4$ utils per dollar and $MU_C/P_C = 3$ utils per dollar. John should thus spend more of his income on food and less on clothing.

5.3 Adding the two individual demand curves, (a) and (b), horizontally yields the market demand curve (c):




5.4 Consumer surplus is now the new shaded area, $28 per day.