chapter:
10

>> The Rational Consumer

A CLAM TOO FAR

To entice customers, restaurants sometimes offer "all-you-can-eat" specials: all-you-can-eat salad bars, all-you-can-eat breakfast buffets, and all-you-can-eat fried-clam dinners.

But how can a restaurant owner who offers such a special be sure he won't be eaten out of business? If he charges $12.99 for an all-you-can-eat clam dinner, what prevents his average customer from wolfing down $30 worth of clams?

The answer is that even though every once in a while you see someone really take advantage of the offer—heaping a plate high with 30 or 40 fried clams—it's a rare occurrence. And even those of us who like fried clams shudder a bit at the sight. Five or even 10 fried clams can be a treat, but 30 clams is ridiculous. Anyone who pays for an all-you-can-eat meal wants to make the most of it, but a sensible person knows when one more clam would be one clam too many.

Notice that last sentence. We said that customers in a restaurant want to "make the most" of their meal; that sounds as if they are trying to maximize something. And we also said that they will stop when consuming one more clam would be a mistake; that sounds as if they are making a marginal decision.


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When is more of a good thing too much?

When, in later chapters, we analyze the behavior of *producers,* it makes sense to assume that they maximize profit. But what do consumers maximize? Isn't it all a matter of taste?

The answer is yes, it is a matter of taste—and economists can't say much about where tastes come from. But economists *can* say a lot about how a rational individual goes about satisfying his or her tastes. And that is in fact the way that economists think about consumer choice. They work with a model of a *rational consumer*—a consumer who knows what he or she wants and makes the most of the available opportunities.

In this chapter, we will show how to analyze the decisions of a rational consumer. We will begin by showing how the concept of *utility*—a measure of consumer satisfaction—allows us to begin thinking about rational consumer choice. We will then look at how *budget constraints* determine what a consumer can buy and how marginal analysis can be used to determine the consumption choice that maximizes utility. Finally, we will see how this analysis can be used to understand the law of demand and why the demand curve slopes downward.

WHAT YOU WILL LEARN IN THIS CHAPTER:

- How consumers choose to spend their income on goods and services
- Why consumers make choices by maximizing **utility,** a measure of satisfaction from consumption
- Why the **principle of diminishing marginal utility** applies to the consumption of most goods and services
- How to use marginal analysis to find the **optimal consumption bundle**
- What **income** and **substitution effects** are

Utility: Getting Satisfaction

When analyzing consumer behavior, we're talking about people trying to get what they want—that is, about subjective feelings. Yet there is no simple way to measure subjective feelings. How much satisfaction do I get from my third fried clam? Is it less or more than yours? Does it even make sense to ask the question?

Luckily, we don't need to make comparisons between your feelings and mine. All that is required to analyze consumer behavior is to suppose that each individual is trying to maximize some personal measure of the satisfaction gained from consumption of goods and services. That measure is known as the consumer's **utility,** a concept we use to understand behavior but don't expect to measure in practice. Nonetheless, we'll see that the assumption that consumers maximize utility helps us think clearly about consumer choice.

Utility and Consumption

An individual's utility depends on everything that individual consumes, from apples to Ziploc bags. The set of all the goods and services an individual consumes is known as the individual's **consumption bundle.** The relationship between an individual's consumption bundle and the total amount of utility it generates for that individual is known as the **utility function.** The utility function is a personal matter; two people with different tastes will have different utility functions. Someone who actually likes to consume 40 fried clams at a sitting must have a utility function that looks different from that of someone who would rather stop at 5 clams.

So we can think of consumers as using consumption to "produce" utility, much in the same way as in later chapters we will think of producers as using inputs to produce output. However, it's obvious that people do not have a little computer in their heads that calculates the utility generated by their consumption choices. Nonetheless, people must make choices, and they usually base them on at least a rough attempt to decide which choice will give them greater satisfaction. I can have either soup or salad with my dinner. Which will I enjoy more? I can go to Disney World this year or save the money toward buying a new car. Which will make me happier?

The concept of a utility function is just a way of representing the fact that people must make such choices and that they make those choices in a more or less rational way.

The **utility** of a consumer is a measure of the satisfaction the consumer derives from consumption of goods and services.

An individual's **consumption bundle** is the collection of all the goods and services consumed by that individual.

An individual's **utility function** gives the total utility generated by his or her consumption bundle.

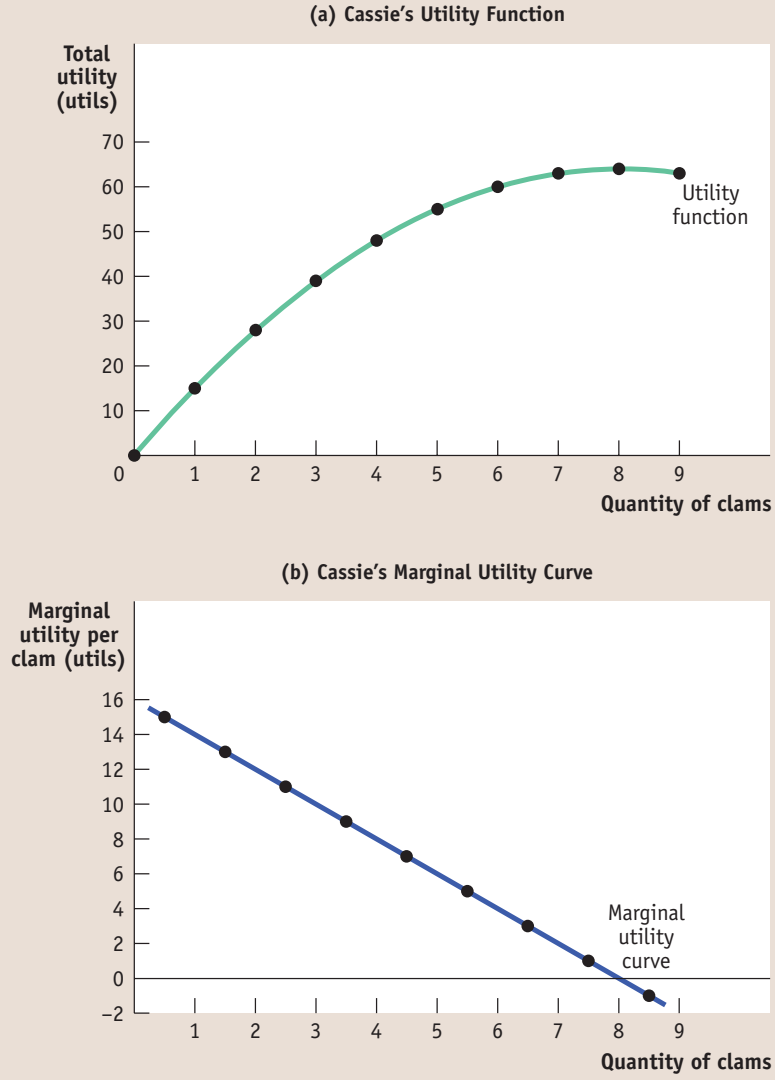
A **util** is a unit of utility.

How do we measure utility? For the sake of simplicity, it is useful to suppose that we can measure utility in hypothetical units called—what else?—**utils.**

Figure 10-1 illustrates a utility function. It shows the total utility that Cassie, who likes fried clams, gets from an all-you-can-eat clam dinner. We suppose that her consumption bundle consists of a side of coleslaw, which comes with the meal, plus a number of clams to be determined. The table that accompanies the figure shows how Cassie's total utility depends on the number of clams; the curve in panel (a) of the figure shows that same information graphically.

Cassie's utility function slopes upward over most of the range shown, but it gets flatter as the number of clams consumed increases. And in this example it eventually turns downward. According to the information in the table in Figure 10-1, nine

FIGURE 10-1 **Cassie's Total Utility and Marginal Utility**



Quantity of clams	Total utility (utils)	Marginal utility per clam (utils)
0	0	
		15
1	15	
		13
2	28	
		11
3	39	
		9
4	48	
		7
5	55	
		5
6	60	
		3
7	63	
		1
8	64	
		−1
9	63	

Panel (a) shows how Cassie's total utility depends on her consumption of fried clams. It increases until it reaches its maximum utility level of 64 utils at 8 clams consumed and decreases after that. Marginal utility is calculated in the table. Panel (b) shows the marginal utility curve, which slopes downward due to diminishing marginal utility. That is, each additional clam gives Cassie less utility than the previous clam.

clams is a clam too far. Adding that additional clam actually makes Cassie worse off: it would lower her total utility. If she's rational, of course, Cassie will realize that and not consume the ninth clam.

So when Cassie chooses how many clams to consume, she will make this decision by considering the *change* in her total utility from consuming one more clam. This illustrates the general point: to maximize *total* utility, consumers must focus on *marginal* utility.

The Principle of Diminishing Marginal Utility

In addition to showing how Cassie's total utility depends on the number of clams she consumes, the table in Figure 10-1 also shows the **marginal utility** generated by consuming each additional clam—that is, the *change* in total utility from consuming one additional clam. Panel (b) shows the implied **marginal utility curve.** Following our practice in Chapter 9 with the marginal benefit curve, the marginal utility curve is constructed by plotting points at the midpoint of the unit intervals.

The **marginal utility** of a good or service is the change in total utility generated by consuming one additional unit of that good or service. The **marginal utility curve** shows how marginal utility depends on the quantity of a good or service consumed.

FOR INQUIRING MINDS

Is Marginal Utility Really Diminishing?

Are all goods really subject to diminishing marginal utility? Of course not; there are a number of goods for which, at least over some range, marginal utility is surely *increasing*.

For example, there are goods that require some experience to enjoy. The first time you do it, downhill skiing involves a lot more fear than enjoyment—or so they say: the authors have never tried it! It only becomes a pleasurable activity if you do it enough to become reasonably competent. And even some less strenuous forms of consumption take practice; people who are not accustomed to drinking coffee say it has a bitter taste and can't understand its appeal. (The authors, on the other hand, regard coffee as one of the basic food groups.)

Another example would be goods that only deliver positive utility if you buy enough. The great Victorian economist Alfred Marshall, who more or less invented the supply and demand model, gave the example of wallpaper: buying only enough to do half a room is worse than useless. If you need two rolls of wallpaper to finish a room, the marginal utility of the second roll is larger than the marginal utility of the first roll.

So why does it make sense to assume diminishing marginal utility? For one thing, most goods don't suffer from these qualifications: nobody needs to learn to like ice cream. Also, although most people don't ski and some people don't drink coffee, those who do ski or drink coffee do enough of it that the marginal utility of one more ski run or one more cup is less than that of the last. So *in the relevant range* of consumption, marginal utility is still diminishing.

The marginal utility curve slopes downward: each successive clam adds less to total utility than the previous clam. This is reflected in the table: marginal utility falls from a high of 15 utils for the first clam consumed to –1 for the ninth clam consumed. The fact that the ninth clam has negative marginal utility means that consuming it actually reduces total utility. (Restaurants that offer all-you-can-eat meals depend on the proposition that you can have too much of a good thing.) Not all marginal utility curves eventually become negative. But it is generally accepted that marginal utility curves do slope downward—that consumption of most goods and services is subject to *diminishing marginal utility*.

The basic idea behind the **principle of diminishing marginal utility** is that the additional satisfaction a consumer gets from one more unit of a good or service declines as the amount of that good or service consumed rises. Or, to put it slightly differently, the more of a good or service you consume, the closer you are to being satiated—reaching a point at which an additional unit of the good adds nothing to your satisfaction. For someone who almost never gets to eat a banana, the occasional banana is a marvelous treat (as it was in Eastern Europe before the fall of communism, when bananas were very hard to find). For someone who eats them all the time, a banana is just, well, a banana.

The principle of diminishing marginal utility isn't always true. But it is true in the great majority of cases, enough to serve as a foundation for our analysis of consumer behavior.

The **principle of diminishing marginal utility** says that each successive unit of a good or service consumed adds less to total utility than the previous unit.

➤ECONOMICS IN ACTION

Oysters versus Chicken

Is a particular food a special treat, something you consume on special occasions? Or is it an ordinary, take-it-or-leave-it dish? The answer depends a lot on how much of that food people normally consume, which determines how much utility they get *at the margin* from having a bit more.

Consider chicken. Modern Americans eat a lot of chicken, so much that they regard it as nothing special. Yet this was not always the case. Traditionally chicken was a luxury dish because chickens were expensive to raise. Restaurant menus from two centuries ago show chicken dishes as the most expensive items listed. Even as

recently as 1928, Herbert Hoover ran for president on the slogan "A chicken in every pot," a promise of great prosperity.

What changed the status of chicken was the emergence of new, technologically advanced methods for raising and processing the birds. (You don't want to know.) These methods made chicken abundant, cheap, and also—thanks to the principle of diminishing marginal utility—nothing to get excited about.

The reverse evolution took place for oysters. Not everyone likes oysters, or for that matter has ever tried them—they are definitely not ordinary food. But they are regarded as a delicacy by some; at restaurants that serve them, an oyster appetizer often costs more than the main course.

Yet oysters were once very cheap and abundant—and were regarded as poverty food. In *The Pickwick Papers* by Charles Dickens, published in the 1830s, the author remarks that "poverty and oysters always seem to go together."

What changed? Pollution, which destroyed many oyster beds, greatly reduced the supply, but human population growth greatly increased the demand. As a result, thanks to the principle of diminishing marginal utility, oysters went from being a common food, regarded as nothing special, to being a highly prized luxury good. ▲

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➤ CHECK YOUR UNDERSTANDING 10-1

1. Explain why a rational consumer who has diminishing marginal utility for a good would not consume an additional unit when it generates negative marginal utility, even when that unit is free.
2. Marta drinks three cups of coffee a day, for which she has diminishing marginal utility. Which of her three cups generates the greatest increase in total utility? Which generates the least?
3. In each of the following cases, does the consumer have diminishing, constant, or increasing marginal utility? Explain your answers.
   a. The more Mabel exercises, the more she enjoys each additional visit to the gym.
   b. Although Mei's classical CD collection is huge, her enjoyment from buying another CD has not changed as her collection has grown.
   c. When Dexter was a struggling student, his enjoyment from a good restaurant meal was greater than now, when he has them more frequently.

Solutions appear at back of book.

➤➤ QUICK REVIEW

- **Utility** is a measure of a consumer's satisfaction from consumption, expressed in units of **utils.** Consumers try to maximize their utility. A consumer's **utility function** shows the relationship between the **consumption bundle** and the total utility it generates.
- To maximize utility, a consumer considers the **marginal utility** from consuming one more unit of a good or service, illustrated by the **marginal utility curve.**
- In the consumption of most goods and services, and for most people, the **principle of diminishing marginal utility** holds: each successive unit consumed adds less to total utility than the previous unit.

Budgets and Optimal Consumption

The principle of diminishing marginal utility explains why most people eventually reach a limit, even at an all-you-can-eat buffet where the cost of another clam is measured only in future indigestion. Under ordinary circumstances, however, it costs some additional resources to consume more of a good, and consumers must take that cost into account when making choices.

What do we mean by cost? As always, the fundamental measure of cost is *opportunity cost.* Because the amount of money a consumer can spend is limited, a decision to consume more of one good is also a decision to consume less of some other good.

Budget Constraints and Budget Lines

Consider Sammy, whose appetite is exclusively for clams and potatoes (there's no accounting for tastes). He has a weekly income of $20 and since, given his appetite, more of either good is better than less, he spends all of it on clams and potatoes. We will assume that clams cost $4 per pound and potatoes cost $2 per pound. What are his possible choices?

Whatever Sammy chooses, we know that the cost of his consumption bundle cannot exceed the amount of money he has to spend. That is,

(10-1) Expenditure on clams + Expenditure on potatoes ≤ Total income

A **budget constraint** requires that the cost of a consumer's consumption bundle be no more than the consumer's income.

A consumer's **consumption possibilities** is the set of all consumption bundles that can be consumed given the consumer's income and prevailing prices.

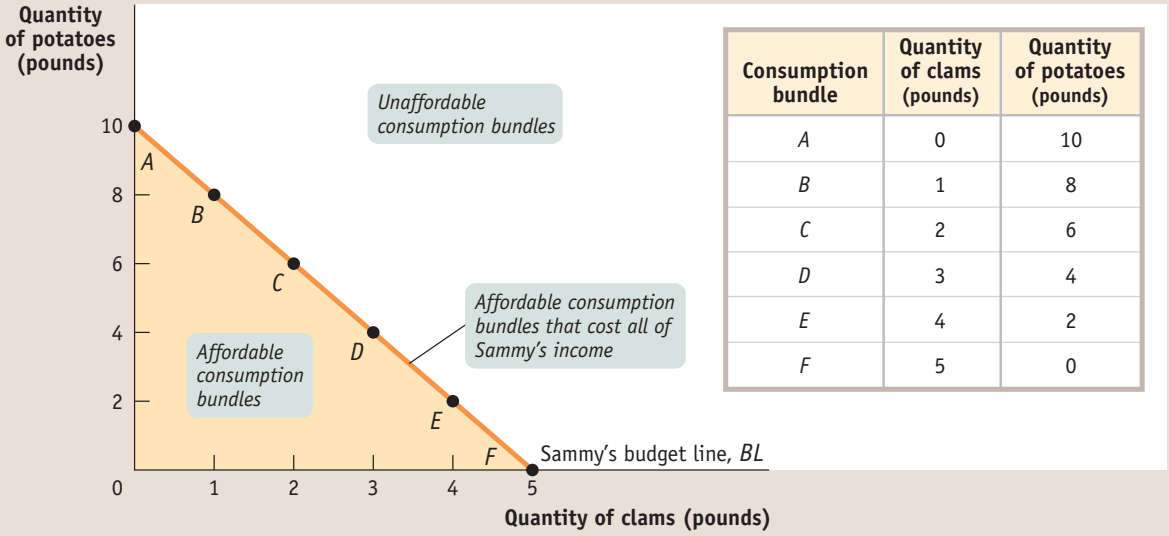
A consumer's **budget line** shows the consumption bundles available to a consumer who spends all of his or her income.

Consumers always have limited income, which constrains how much they can consume. So the requirement illustrated by Equation 10-1—that a consumer must choose a consumption bundle that costs no more than his or her income—is known as the consumer's **budget constraint.** It's a simple way of saying that a consumer can't spend more than the total amount of income available to him or her. In other words, consumption bundles are affordable when they obey the budget constraint. We call the set of all of Sammy's affordable consumption bundles his **consumption possibilities.** In general, whether or not a particular consumption bundle is included in a consumer's consumption possibilities depends on the consumer's income and the prices of goods and services.

Figure 10-2 shows Sammy's consumption possibilities. The quantity of clams in his consumption bundle is measured on the horizontal axis and the quantity of potatoes on the vertical axis. The downward-sloping line connecting points *A* through *F* shows which consumption bundles are affordable and which are not. Every bundle on or inside this line (the shaded area) is affordable; every bundle outside this line is unaffordable. As an example of one of the points, let's look at point *C*, representing 2 pounds of clams and 6 pounds of potatoes, and check whether it satisfies Sammy's budget constraint. The cost of bundle *C* is 6 pounds of potatoes × $2 per pound + 2 pounds of clams × $4 per pound = $12 + $8 = $20. So bundle *C* does indeed satisfy Sammy's budget constraint: it costs no more than his weekly income of $20. In fact, bundle *C* costs exactly as much as Sammy's income. By doing the arithmetic, you can check that all the other points lying on the downward-sloping line are also bundles at which Sammy spends all of his income.

The downward-sloping line has a special name, the **budget line.** It shows all the consumption bundles available to Sammy when he spends all of his income. It's

FIGURE 10-2 The Budget Line



Consumption bundle	Quantity of clams (pounds)	Quantity of potatoes (pounds)
A	0	10
B	1	8
C	2	6
D	3	4
E	4	2
F	5	0

The *budget line* represents all the possible combinations of quantities of potatoes and clams that Sammy can purchase if he spends all of his income. Also, it is the boundary between the set of affordable consumption bundles (the *consumption possibilities*) and unaffordable ones. Given that clams cost $4 per pound and potatoes cost $2 per pound, if Sammy spends all of his income on clams (bundle *F*), he can purchase 5 pounds of clams; if he spends all of his income on potatoes (bundle *A*), he can purchase 10 pounds of potatoes.

downward-sloping because when Sammy is consuming all of his income, say consuming at point A on the budget line, then in order to consume more clams he must consume fewer potatoes—that is, he must move to a point like B. In other words, when Sammy is on his budget line, the opportunity cost of consuming more clams is consuming fewer potatoes, and vice versa. As Figure 10-2 indicates, any consumption bundle that lies above the budget line is unaffordable.

A consumer's **optimal consumption bundle** is the consumption bundle that maximizes the consumer's total utility given his or her budget constraint.

Do we need to consider the other bundles in Sammy's consumption possibilities, the ones that lie *within* the shaded region in Figure 10-2 bounded by the budget line? The answer is, for all practical situations, no: as long as Sammy doesn't get satiated—that is, as long as his marginal utility from consuming either good is always positive—and he doesn't get any utility from saving income rather than spending it, then he will always choose to consume a bundle that lies on his budget line.

Given that $20 per week budget, what point on his budget line will Sammy choose?

Optimal Consumption Choice

Because Sammy has a budget constraint, which means that he will consume a consumption bundle on the budget line, a choice to consume a given quantity of clams also determines his potato consumption, and vice versa. We want to find the consumption bundle—the point on the budget line—that maximizes Sammy's total utility. This bundle is Sammy's **optimal consumption bundle,** the consumption bundle that maximizes his total utility given the budget constraint.

Table 10-1 shows how much utility Sammy gets from different levels of consumption of clams and potatoes, respectively. According to the table, Sammy has a healthy appetite; the more of either good he consumes, the higher his utility.

But because he has a limited budget, he must make a trade-off: the more pounds of clams he consumes, the fewer pounds of potatoes, and vice versa. That is, he must choose a point on his budget line.

Table 10-2 on the next page shows how his total utility varies for the different consumption bundles along his budget line. Each of six possible consumption bundles, *A* through *F* from Figure 10-2, is given in the first column. The second column shows the level of clam consumption corresponding to each choice. The third

TABLE 10-1

Sammy's Utility from Clam and Potato Consumption

Utility from clam consumption		Utility from potato consumption	
Quantity of clams (pounds)	Utility from clams (utils)	Quantity of potatoes (pounds)	Utility from potatoes (utils)
0	0	0	0
1	15	1	11.5
2	25	2	21.4
3	31	3	29.8
4	34	4	36.8
5	36	5	42.5
		6	47.0
		7	50.5
		8	53.2
		9	55.2
		10	56.7

TABLE 10-2

Sammy's Budget and Total Utility

Consumption bundle	Quantity of clams (pounds)	Utility from clams (utils)	Quantity of potatoes (pounds)	Utility from potatoes (utils)	Total utility (utils)
A	0	0	10	56.7	56.7
B	1	15	8	53.2	68.2
C	2	25	6	47.0	72.0
D	3	31	4	36.8	67.8
E	4	34	2	21.4	55.4
F	5	36	0	0	36.0

column shows the utility Sammy gets from consuming those clams. The fourth column shows the quantity of potatoes Sammy can afford *given* the level of clam consumption; this quantity goes down as his clam consumption goes up, because he is sliding down the budget line. The fifth column shows the utility he gets from consuming those potatoes. And the final column shows his *total utility*. In this example, Sammy's total utility is the sum of the utility he gets from clams and the utility he gets from potatoes.

Figure 10-3 gives a visual representation of the data shown in Table 10-2. Panel (a) shows Sammy's budget line, to remind us that when he decides to consume more clams he is also deciding to consume fewer potatoes. Panel (b) then shows how his total utility depends on that choice. The horizontal axis in panel (b) has two sets of labels: it shows both the quantity of clams, increasing from left to right, and the quantity of potatoes, increasing from right to left. The reason we can use the same axis to represent consumption of both goods is, of course, the budget line: the more pounds of clams Sammy consumes, the fewer pounds of potatoes he can afford, and vice versa.

Clearly, the consumption bundle that makes the best of the trade-off between clam consumption and potato consumption, the optimal consumption bundle, is the one that maximizes Sammy's total utility. That is, Sammy's optimal consumption bundle puts him at the top of the total utility curve.

As always, we can find the top of the curve by direct observation. We can see from Figure 10-3 that Sammy's total utility is maximized at point *C*—that his optimal consumption bundle contains 2 pounds of clams and 6 pounds of potatoes. But we know that we usually gain more insight into "how much" problems when we use marginal analysis. So in the next section we turn to representing and solving the optimal consumption choice problem with marginal analysis.

FOR INQUIRING MINDS

Food for Thought on Budget Constraints

Budget constraints aren't just about money. In fact, there are many other budget constraints affecting our lives. You face a budget constraint if you have a limited amount of closet space for your clothes. All of us face a budget constraint on time: there are only so many hours in the day.

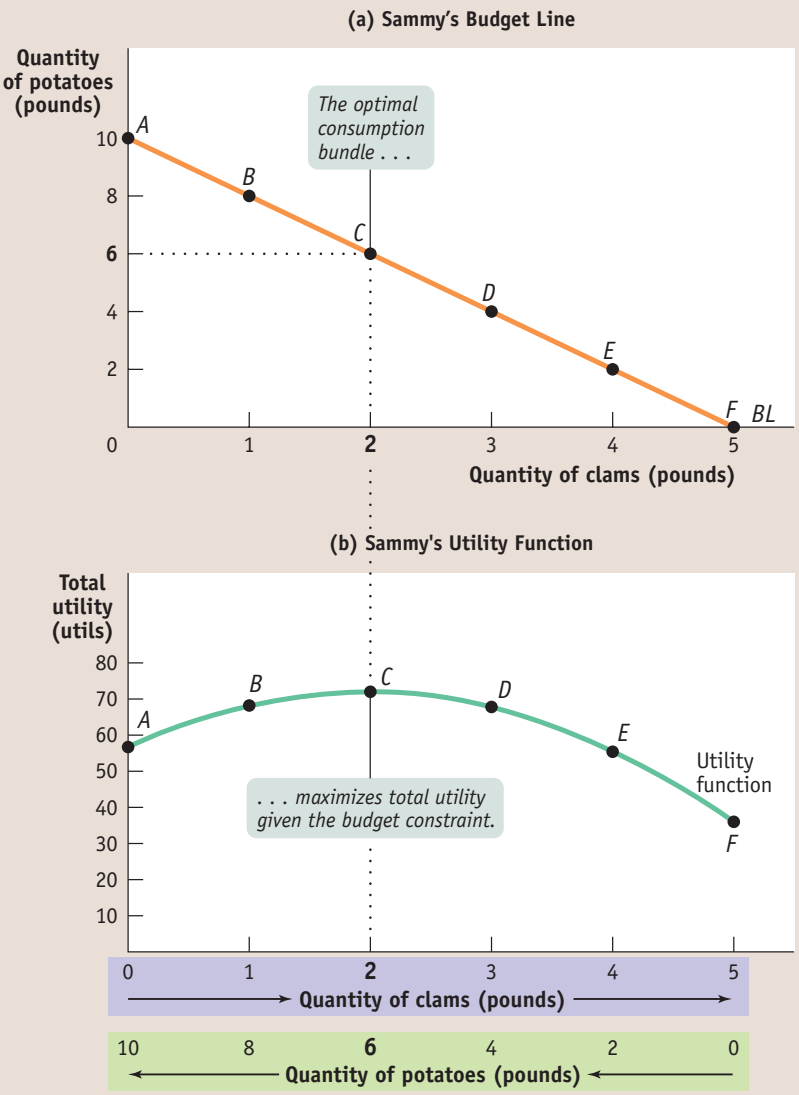
And people trying to lose weight on the Weight Watchers plan face a budget constraint on the foods they eat.

The Weight Watchers plan assigns each food a certain number of "points." A scoop of ice cream gets 4 points, a slice of pizza 7 points, a cup of grapes 1 point. You are allowed a maximum number of points each day but are free to choose which foods you eat. In other words, a dieter on the Weight Watchers plan is just like a consumer choosing a consumption bundle: points are the equivalent of prices, and the overall point limit is the equivalent of total income.

FIGURE 10-3

Optimal Consumption Bundle

Panel (a) shows Sammy's budget line and his six possible consumption bundles. Panel (b) shows how his total utility is affected by his consumption bundle, which must lie on his budget line. The quantity of clams is measured from left to right on the horizontal axis, and the quantity of potatoes is measured from right to left. His total utility is maximized at bundle *C*, where he consumes 2 pounds of clams and 6 pounds of potatoes. This is Sammy's *optimal consumption bundle*.



➤ECONOMICS IN ACTION

The Consumption Possibilities of American Workers, 1895–2000

Over the past century, the consumption possibilities of the average American worker have increased radically as the nation has become vastly richer. A good illustration of this change comes from a comparison made by the economist J. Bradford DeLong.

He compared the cost of a number of items in the 1895 Montgomery Ward catalog to the cost of similar items today by calculating the number of hours an average worker would need to work to earn enough money to buy them. If we assume that a worker puts in 2,000 hours per year—40 hours per week, with two weeks of vacation—

Today, the average American worker's annual income buys a lot more bicycle than it did in 1895.

RTN Productions/Corbis

we can calculate how many units of each good a worker could purchase by spending an entire year's income only on that good.

According to DeLong's estimates, here are the amounts of various goods that workers then and now could have bought:

- In 1895, an average worker's annual income would have bought 7.7 one-speed bicycles; in 2000, it would have bought 278 bicycles.
- In 1895, the worker's income would have bought 45 full sets of dinner plates; in 2000, it would have bought 556 sets.
- In 1895, a worker's income would have bought 0.83 of a Steinway piano; in 2000, it would have bought 1.8 pianos.

By any standard, the average American's consumption possibilities have increased enormously. DeLong estimates that today's workers can on average purchase seven times as much of a randomly chosen good as their predecessors could have in 1895. Of course, in a way this understates the rise in purchasing power: there are many goods, like computers, that were not available in 1895 at any price. ▲

QUICK REVIEW

- The **budget constraint** requires that a consumer's total expenditure be no more than his or her income. The set of consumption bundles that satisfy the budget constraint is the consumer's **consumption possibilities.**
- A consumer who spends all of his or her income chooses a point on his or her **budget line.** The budget line slopes downward because the consumer must consume less of one good in order to consume more of another.
- The consumption choice that maximizes total utility given the consumer's budget constraint is the **optimal consumption bundle.** It must lie on the consumer's budget line.

CHECK YOUR UNDERSTANDING 10-2

1. In the following two examples, find all the consumption bundles that lie on the consumer's budget line. Illustrate these consumption possibilities in a diagram and draw the budget line through them.
   a. The consumption bundle consists of movie tickets and buckets of popcorn. The price of each ticket is $10.00, the price of each bucket of popcorn is $5.00, and the consumer's income is $20.00. In your diagram, put movie tickets on the vertical axis and buckets of popcorn on the horizontal axis.
   b. The consumption bundle consists of underwear and socks. The price of each pair of underwear is $4.00, the price of each pair of socks is $2.00, and the consumer's income is $12.00. In your diagram, put pairs of socks on the vertical axis and pairs of underwear on the horizontal axis.

Solutions appear at back of book.

Spending the Marginal Dollar

As we've just seen, we can find Sammy's optimal consumption choice by finding the total utility he receives from each consumption bundle on his budget line and then choosing the bundle at which total utility is maximized. But we can use marginal analysis instead, turning Sammy's problem of finding his optimal consumption choice into a "how much" problem. How do we do this? By thinking about choosing an optimal consumption bundle as a problem of *how much to spend on each good.* That is, to find the optimal consumption bundle with marginal analysis we ask the question of whether Sammy can make himself better off by spending a little bit more of his income on clams and less on potatoes, or by doing the opposite—spending a little bit more on potatoes and less on clams. In other words, the marginal decision is a question of how to *spend the marginal dollar*—how to allocate an additional dollar between clams and potatoes in a way that maximizes utility.

Our first step in applying marginal analysis is to ask if Sammy is made better off by spending an additional dollar on either good; and if so, by how much is he better off.

PITFALLS

THE RIGHT MARGINAL COMPARISON

Marginal analysis solves "how much" decisions by setting the marginal *benefit* of some activity equal to its marginal *cost*. As we saw in Chapter 9, finding Babette's optimal serving size was a marginal decision: it was found by setting the marginal benefit of increasing her serving size equal to its marginal cost. In production decisions like Babette's, using marginal analysis is particularly simple. If you were to extend the way we solved Babette's problem to Sammy's problem without any change, you would be tempted to say that Sammy's optimal consumption bundle is where the marginal utility of clams is equal to the marginal utility of potatoes. But that would be wrong because in consumption decisions, unlike production decisions, there's a budget constraint. And that budget constraint must be accounted for when doing marginal analysis.

The right answer for marginal decisions involving consumption is that the *marginal utility per dollar* spent on each good must be the same at the optimal consumption bundle. By factoring in prices, this comparison takes into account the fact that a consumer has a limited amount of money to spend. For example, assume you've decided to have pizza for dinner and you have $10 to spend on it. The pizza comes with choices of additional toppings that cost extra. Suppose you really like extra cheese, but you also really like anchovies. If a topping of anchovies costs twice as much as extra cheese, the optimal consumption choice isn't where you gain the same amount of utility from a topping of anchovies as you would from a topping of extra cheese. It's the combination of toppings where a serving of anchovies adds twice as much to utility as a serving of extra cheese. In other words, the marginal utility per dollar has to be the same for anchovies and extra cheese.

To answer this question we must calculate the **marginal utility per dollar** spent on either clams or potatoes—how much additional utility Sammy gets from spending an additional dollar on either good.

The **marginal utility per dollar** spent on a good or service is the additional utility from spending one more dollar on that good or service.

Marginal Utility per Dollar

We've already introduced the concept of marginal utility, the additional utility a consumer gets from consuming one more unit of a good or service; now let's see how this concept can be used to derive the related measure of marginal utility per dollar.

Table 10-3 shows how to calculate the marginal utility per dollar spent on clams and potatoes, respectively.

TABLE 10-3

Sammy's Marginal Utility per Dollar

(a) Clams (price of clams = $4 per pound)				(b) Potatoes (price of potatoes = $2 per pound)			
Quantity of clams (pounds)	Utility from clams (utils)	Marginal utility per pound of clams (utils)	Marginal utility per dollar (utils)	Quantity of potatoes (pounds)	Utility from potatoes (utils)	Marginal utility per pound of potatoes (utils)	Marginal utility per dollar (utils)
0	0			0	0		
		15	3.75			11.5	5.75
1	15			1	11.5		
		10	2.50			9.9	4.95
2	25			2	21.4		
		6	1.50			8.4	4.20
3	31			3	29.8		
		3	0.75			7.0	3.50
4	34			4	36.8		
		2	0.50			5.7	2.85
5	36			5	42.5		
						4.5	2.25
				6	47.0		
						3.5	1.75
				7	50.5		
						2.7	1.35
				8	53.2		
						2.0	1.00
				9	55.2		
						1.5	0.75
				10	56.7		

In panel (a) of the table, the first column shows different possible amounts of clam consumption. The second column shows the utility Sammy derives from each amount of clam consumption; the third column then shows the marginal utility, the increase in utility Sammy gets from consuming an additional pound of clams. Panel (b) provides the same information for potatoes. The next step is to derive marginal utility *per dollar* for each good. To do this, we must divide the marginal utility of the good by its price in dollars.

To see why we must divide by the price, compare the third and fourth columns of panel (a). Consider what happens if Sammy increases his clam consumption from 2 pounds to 3 pounds. As we can see, this increase in clam consumption raises his total utility by 6 utils. But he must spend \$4 for that additional pound, so the increase in his utility per additional dollar spent on clams is 6 utils/\$4 = 1.5 utils per dollar. Similarly, if he increases his clam consumption from 3 pounds to 4 pounds, his marginal utility is 3 utils but his marginal utility per dollar is 3 utils/\$4 = 0.75 utils per dollar. Notice that because of diminishing marginal utility, Sammy's marginal utility per pound of clams falls as the quantity of clams he consumes rises. As a result, his marginal utility per dollar spent on clams also falls as the quantity of clams he consumes rises.

So the last column of panel (a) shows how Sammy's marginal utility per dollar spent on clams depends on the quantity of clams he consumes. Similarly, the last column of panel (b) shows how his marginal utility per dollar spent on potatoes depends on the quantity of potatoes he consumes. Again, marginal utility per dollar spent on each good declines as the quantity of that good consumed rises, because of diminishing marginal utility.

We will use the symbols MU_C and MU_P to represent the marginal utility per pound of clams and potatoes, respectively. And we will use the symbols P_C and P_P to represent the price of clams (per pound) and the price of potatoes (per pound). Then the marginal utility per dollar spent on clams is MU_C/P_C and the marginal utility per dollar spent on potatoes is MU_P/P_P. In general, the additional utility generated from an additional dollar spent on a good is equal to:

(10-2) Marginal utility per dollar spent on a good
= Marginal utility of one unit of the good/Price of one unit of the good
= MU_{good}/P_{good}

Now let's see how this concept helps us derive a consumer's optimal consumption using marginal analysis.

Optimal Consumption

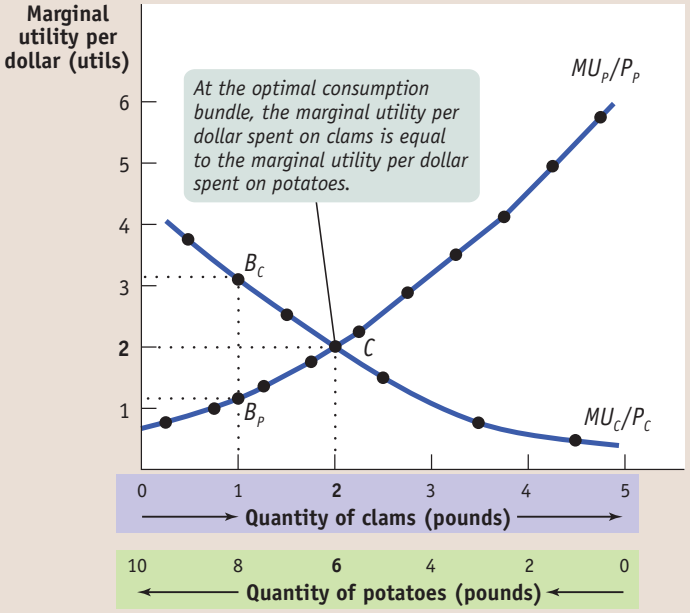
Let's consider Figure 10-4. As in Figure 10-3, we can measure both the quantity of clams and the quantity of potatoes on the horizontal axis due to the budget constraint. Along the horizontal axis of Figure 10-4—also as in Figure 10-3—the quantity of clams increases as you move from left to right, and the quantity of potatoes increases as you move from right to left. The curve labeled MU_C/P_C in Figure 10-4 shows Sammy's marginal utility per dollar spent on clams as derived in Table 10-3. Likewise, the curve labeled MU_P/P_P shows his marginal utility per dollar spent on potatoes. Notice that the two curves, MU_C/P_C and MU_P/P_P, cross at the optimal consumption bundle, point C, consisting of 2 pounds of clams and 6 pounds of potatoes. Moreover, Figure 10-4 illustrates an important feature of Sammy's optimal consumption bundle: when Sammy consumes 2 pounds of clams and 6 pounds of potatoes, his marginal utility per dollar spent is the same, 2, for both goods. That is, at the optimal consumption bundle $MU_C/P_C = MU_P/P_P = 2$.

This isn't an accident. Consider another one of Sammy's possible consumption bundles—say, *B* in Figure 10-3, at which he consumes 1 pound of clams and 8 pounds

FIGURE 10-4

Marginal Utility per Dollar

Sammy's optimal consumption bundle is at point C, where his marginal utility per dollar spent on clams, MU_C/P_C, is equal to his marginal utility per dollar spent on potatoes, MU_P/P_P. This illustrates the *optimal consumption rule:* at the optimal consumption bundle, the marginal utility per dollar spent on each good and service is the same. At any other consumption bundle on Sammy's budget line, such as bundle *B* in Figure 10-3, represented here by points B_C and B_P, consumption is not optimal: Sammy can increase his utility at no additional cost by reallocating his spending.



of potatoes. The marginal utility per dollar spent on each good is shown by points B_C and B_P in Figure 10-4. At that consumption bundle, Sammy's marginal utility per dollar spent on clams would be approximately 3, but his marginal utility per dollar spent on potatoes would be only approximately 1. This shows that he has made a mistake: he is consuming too many potatoes and not enough clams.

How do we know this? If Sammy's marginal utility per dollar spent on clams is higher than his marginal utility per dollar spent on potatoes, he has a simple way to make himself better off while staying within his budget: spend \$1 less on potatoes and \$1 more on clams. By spending an additional dollar on clams, he adds about 3 utils to his total utility; meanwhile, by spending \$1 less on potatoes, he subtracts only about 1 util from his total utility. Because his marginal utility per dollar spent is higher for clams than for potatoes, reallocating his spending toward clams and away from potatoes would increase his total utility. On the other hand, if his marginal utility per dollar spent on potatoes is higher, he can increase his utility by spending less on clams and more on potatoes. So if Sammy has in fact chosen his optimal consumption bundle, his marginal utility per dollar spent on clams and potatoes must be equal.

This is a general principle, known as the **optimal consumption rule:** when a consumer maximizes utility in the face of a budget constraint, the marginal utility per dollar spent on each good or service in the consumption bundle is the same. That is, for any two goods *C* and *P* the optimal consumption rule says that at the optimal consumption bundle

$$\text{(10-3)} \quad \frac{MU_C}{P_C} = \frac{MU_P}{P_P}$$

It's easiest to understand this rule using examples in which the consumption bundle contains only two goods, but it applies no matter how many goods or services a consumer buys: in the optimal consumption bundle, the marginal utilities per dollar spent for each and every good or service in that bundle are equal.

The **optimal consumption rule** says that when a consumer maximizes utility, the marginal utility per dollar spent must be the same for all goods and services in the consumption bundle.

FOR INQUIRING MINDS

But Are Consumers Really Rational?

Many companies offer retirement plans that allow their employees to put aside part of their salaries tax-free. Such a plan, called a 401(k), can save a worker thousands of dollars in taxes each year. But the plans sometimes have disadvantages: some companies invest their employees' savings mainly in their own stock, which can be disastrous if the company gets in trouble, leaving the employee with no savings *and* no job. That's what happened to the employees of Enron back in 2001. When the company went under, employees who invested heavily in company stock lost everything. In 2008, many employees of Bear Stearns also lost most of their savings when the company went under.

Clearly, then, people should carefully decide how much of their money to put in an employer-administered retirement plan. They should compare the marginal utility of a dollar spent on current consumption with the marginal utility of a dollar saved for retirement. They should weigh the tax advantages of saving through the employer plan against the risks of letting the employer decide where their savings are invested.

But recent economic research suggests that most people aren't careful at all. For example, some companies have an "opt-in" system for their 401(k); that is, in some companies employees must ask to be enrolled. Other companies have an "opt-out" system; employees are automatically enrolled unless they request otherwise. This

Mark Richards/Photo Edit

Great new car, but are you saving enough for retirement?

shouldn't make a difference—if the plan is managed well, people should opt in; if it's managed poorly (that is, investing mainly in the company's own stock), they should opt out. Yet when companies switch to automatic enrollment, the number of employees in their 401(k) plans rises dramatically. As the National Bureau of Economic Research puts it, workers seem to follow the path of least resistance, instead of comparing their options and maximizing their utility.

Studies of saving behavior are one example of a growing field known as "behavioral economics." Behavioral economists question the whole concept of the rational consumer. Their research focuses on situations in which people don't seem to be rational—that is, when they behave in ways that can't easily be explained by utility maximization.

One key insight in behavioral economics comes from the work of Herbert Simon, who won the Nobel Prize in economics in 1978. Simon argued that sometimes individuals find that it isn't actually rational to go to great lengths to maximize utility, since searching for the perfect answer is itself a costly activity. Instead, he argued, they engage in *bounded rationality:* individuals save time and effort by making decisions that are "good enough," rather than perfect. In the case of savings plans, this might involve following the path of least resistance: not bothering to participate in a well-managed opt-in plan, and not bothering to opt out of a poorly managed automatic plan.

Today's behavioral economists use insights from psychology to understand behavior seemingly at odds with rationality. The 2002 Nobel Prize went to Daniel Kahneman, a psychologist who, with his late co-author Amos Tversky, laid out a theory of how people make choices in the face of uncertainty. This work and other insights into nonrational behavior are having an important influence on the analysis of financial markets, labor markets, and other economic concerns.

But it's hard to find a behavioral economist who thinks that the insights of this field should replace the analysis of utility maximization. The theory of the rational consumer remains the main way in which economists analyze consumer behavior.

➤ECONOMICS IN ACTION

Buying Your Way Out of Temptation

It might seem odd to pay more to get less. But snack food companies have discovered that consumers are indeed willing to pay more for smaller portions, and exploiting this trend is a recipe for success. Over the last few years, sales of 100-calorie packs of crackers, chips, cookies, and candy have passed the $20 million-a-year mark. During 2006, sales of 100-calorie snack packs grew nearly 30%, while the snack industry as a whole grew only 3.5%. A company executive explained why small packages are popular—they help consumers eat less without having to count calories themselves. "The irony," said David Adelman, a food industry analyst, "is if you take Wheat Thins or

Goldfish, buy a large-size box, count out the items and put them in a Ziploc bag, you'd have essentially the same product." He estimates that snack packs are about 20% more profitable for snack makers than larger packages.

It's clear that in this case consumers are making a calculation: the extra utility gained from not having to worry about whether they've eaten too much is worth the extra cost. As one shopper said, "They're pretty expensive, but they're worth it. It's individually packaged for the amount I need, so I don't go overboard." So it's clear that consumers aren't being irrational here. Rather, they're being entirely rational: in addition to their snack, they're buying a little hand-to-mouth restraint. ▲

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➤ CHECK YOUR UNDERSTANDING 10-3

1. In Table 10-3 you can see that marginal utility per dollar spent on clams and marginal utility per dollar spent on potatoes are equal when Sammy increases his consumption of clams from 3 pounds to 4 pounds and his consumption of potatoes from 9 pounds to 10 pounds. Explain why this is not Sammy's optimal consumption bundle. Illustrate your answer using the budget line in Figure 10-3.
2. Explain what is faulty about the following statement, using data from Table 10-3: "In order to maximize utility, Sammy should consume the bundle that gives him the maximum marginal utility per dollar for each good."

Solutions appear at back of book.

➤➤ QUICK REVIEW

- A utility-maximizing consumer allocates spending so that the **marginal utility per dollar**—the marginal utility of a good, divided by its price—is the same for all goods. This is known as the **optimal consumption rule.** The optimal consumption bundle satisfies this rule.
- Whenever marginal utility per dollar is higher for one good than for another good, the consumer should spend $1 more on the good with the higher marginal utility per dollar and $1 less on the other. By doing this the consumer will move closer to his or her optimal consumption bundle.

From Utility to the Demand Curve

We have now analyzed the optimal consumption choice of a consumer with a given amount of income and who faces one particular set of prices—in our Sammy example, $20 of income per week, $4 per pound of clams, and $2 per pound of potatoes.

But the main reason for studying consumer behavior is to go behind the market demand curve—to understand how the downward slope of the market demand curve is explained by the utility-maximizing behavior of individual consumers.

Marginal Utility, the Substitution Effect, and the Law of Demand

Suppose that the price of fried clams, P_C, rises. This doesn't change the marginal utility a consumer gets from an additional pound of clams, MU_C, at any given level of clam consumption. However, it reduces the marginal utility *per dollar spent* on fried clams, MU_C/P_C. And the decrease in marginal utility per dollar spent on clams gives the consumer an incentive to consume fewer clams when the price of clams rises.

To see why, recall the optimal consumption rule: a utility-maximizing consumer chooses a consumption bundle for which the marginal utility per dollar spent on all goods is the same. If the marginal utility per dollar spent on clams falls because the price of clams rises, the consumer can increase his or her utility by purchasing fewer clams and more of other goods.

The opposite happens if the price of clams falls. In that case the marginal utility per dollar spent on clams, MU_C/P_C, increases at any given level of clam consumption. As a result, a consumer can increase his or her utility by purchasing more clams and less of other goods when the price of clams falls.

So when the price of a good increases, an individual will normally consume less of that good and more of other goods. Correspondingly, when the price of a good decreases, an individual will normally consume more of that good and less of other goods. This explains why the individual demand curve, which relates an individual's consumption of a good to the price of that good, normally slopes downward—that is, it obeys the law of demand. And since—as we learned in Chapter 3—the market

The **substitution effect** of a change in the price of a good is the change in the quantity of that good consumed as the consumer substitutes the good that has become relatively cheaper in place of the good that has become relatively more expensive.

The **income effect** of a change in the price of a good is the change in the quantity of that good consumed that results from a change in the consumer's purchasing power due to the change in the price of the good.

demand curve is the horizontal sum of all the individual demand curves of consumers, it, too, will slope downward.

An alternative way to think about why demand curves slope downward is to focus on opportunity costs. When the price of clams decreases, an individual doesn't have to give up as many units of other goods in order to buy one more unit of clams. So consuming clams becomes more attractive. Conversely, when the price of a good increases, consuming that good becomes a less attractive use of resources, and the consumer buys less.

This effect of a price change on the quantity consumed is always present. It is known as the **substitution effect**—the change in the quantity consumed as the consumer substitutes the good that has become relatively cheaper in place of the good that has become relatively more expensive. When a good absorbs only a small share of the consumer's spending, the substitution effect is essentially the complete explanation of why the individual demand curve of that consumer slopes downward. And, by implication, when a good absorbs only a small share of the typical consumer's spending, the substitution effect is essentially the sole explanation of why the market demand curve slopes downward. However, some goods, such as housing, absorb a large share of a typical consumer's spending. For such goods, the story behind the individual demand curve and the market demand curve becomes slightly more complicated.

The Income Effect

For the vast majority of goods, the substitution effect is pretty much the entire story behind the slopes of the individual and market demand curves. There are, however, some goods, like food or housing, that account for a substantial share of many consumers' spending. In such cases another effect, called the *income effect,* also comes into play.

Consider the case of a family that spends half its income on rental housing. Now suppose that the price of housing increases everywhere. This will have a substitution effect on the family's demand: other things equal, the family will have an incentive to consume less housing—say, by moving to a smaller apartment—and more of other goods. But the family will also, in a real sense, be made poorer by that higher housing price—its income will buy less housing than before. The amount of income adjusted to reflect its true purchasing power is often termed "real income," in contrast to "money income" or "nominal income," which has not been adjusted. And this reduction in a consumer's real income will have an additional effect, beyond the substitution effect, on the family's consumption bundle, including its consumption of housing.

The change in the quantity of a good consumed that results from a change in the overall purchasing power of the consumer due to a change in the price of that good is known as the **income effect** of the price change. In this case, a change in the price of a good effectively changes a consumer's income because it alters the consumer's purchasing power. Along with the substitution effect, the income effect is another means by which changes in prices alter consumption choices.

It's possible to give more precise definitions of the substitution effect and the income effect of a price change, and we do this in Chapter 11. For most purposes, however, there are only two things you need to know about the distinction between these two effects.

First, for the great majority of goods and services, the income effect is not important and has no significant effect on individual consumption. So most market demand curves slope downward solely because of the substitution effect—end of story.

Second, when it matters at all, the income effect usually reinforces the substitution effect. That is, when the price of a good that absorbs a substantial share of

FOR INQUIRING MINDS

Giffen Goods

Back when Ireland was a desperately poor country—not the prosperous "Celtic Tiger" it has lately become—it was claimed that the Irish would eat *more* potatoes when the price of potatoes went up. That is, some observers claimed that Ireland's demand curve for potatoes sloped upward, not downward.

Can this happen? In theory, yes. If Irish demand for potatoes actually sloped upward, it would have been a real-life case of a "Giffen good," named after a nineteenth-century statistician who thought (probably wrongly) that he saw an upward-sloping demand curve in some data he was studying.

Here's the story. Suppose that there is some good that absorbs a large share of consumers' budgets and that this good is also *inferior*—people demand less of it when their income rises. The classic supposed example was, as you might guess, potatoes in Ireland, back when potatoes were an inferior good—they were what poor people ate—and when the Irish were very poor.

Now suppose that the price of potatoes increases. This would, *other things equal,* cause people to substitute other goods for potatoes. But other things are not equal: given the higher price of potatoes, people are poorer. And this *increases* the demand for potatoes, because potatoes are an inferior good.

If this income effect outweighs the substitution effect, a rise in the price of potatoes would increase the quantity demanded; the law of demand would not hold.

In a way the point of this story—which has never been validated in any real situation, nineteenth-century Ireland included—is how unlikely such an event is. The law of demand really is a law, with few exceptions.

income rises, consumers of that good become a bit poorer because their purchasing power falls. And the vast majority of goods are *normal* goods, goods for which demand decreases when income falls. So this effective reduction in income leads to a reduction in the quantity demanded and reinforces the substitution effect.

However, in the case of an *inferior* good, a good for which demand increases when income falls, the income and substitution effects work in opposite directions. Although the substitution effect tends to produce a decrease in the quantity of any good demanded as its price increases, in the case of an inferior good the income effect of a price increase tends to produce an *increase* in the quantity demanded.

As a result, there are hypothetical cases involving inferior goods in which the distinction between income and substitution effects are important (see For Inquiring Minds). As a practical matter, however, it's not a subject we need to worry about when discussing the demand for most goods. Typically, income effects are important only for a very limited number of goods.

➤ECONOMICS IN ACTION

Mortgage Rates and Consumer Demand

Most people buy houses with mortgages—loans backed by the value of the house. The interest rates on such mortgages change over time; for example, they fell quite a lot over the period from 2000 to 2003. And compared to historical standards, mortgage rates continued to be low through early 2008. When mortgage rates fall, the cost of housing falls for millions of people—even people who have mortgages at high interest rates are often able to "refinance" them at lower rates. The percentage of American households who owned their home increased from 67.1% in 2000 to a historical high of 69.2% in 2004. (Since 2004 it has fallen back slightly, to 67.8% in late 2007, because of turmoil in the financial market for mortgages.)

It's not surprising that the demand for housing goes up when mortgage rates go down. Economists have noticed, however, that the demand for many other goods also rises when mortgage rates fall. Some of these goods are items connected with new or

>> QUICK REVIEW

- Most goods absorb only a small fraction of a consumer's spending. For such goods, the **substitution effect** of a price change is the only important effect of the price change on consumption. It causes individual demand curves and the market demand curve to slope downward.
- When a good absorbs a large fraction of a consumer's spending, the **income effect** of a price change is present in addition to the substitution effect.
- For normal goods, demand rises when a consumer is richer and falls when a consumer is poorer, so that the income effect reinforces the substitution effect. For inferior goods, demand rises when a consumer is poorer and falls when a consumer is richer, so that the income and substitution effects move in opposite directions.

bigger houses, such as furniture. But people also buy new cars, eat more meals in restaurants, and take more vacations. Why?

The answer illustrates the distinction between substitution and income effects. When housing becomes cheaper, there is a *substitution effect:* people have an incentive to substitute housing in place of other goods in their consumption bundle. But housing also happens to be a good that absorbs a large part of consumer spending, with many families spending a quarter or more of their income on mortgage payments. So when the price of housing falls, people are in effect richer—there is a noticeable *income effect.*

The increase in the quantity of housing demanded when mortgage rates fall is the result of both effects: housing becomes a better buy compared with other consumer goods, and people also buy more and bigger houses because they feel richer. And because they feel richer, they also buy more of all other normal goods, such as cars, restaurant meals, and vacations. ▲

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CHECK YOUR UNDERSTANDING 10-4

1. In each of the following cases, state whether the income effect, the substitution effect, or both are significant. In which cases do they move in the same direction? In opposite directions? Why?
   a. Orange juice represents a small share of Clare's spending. She buys more lemonade and less orange juice when the price of orange juice goes up. She does not change her spending on other goods.
   b. Apartment rents have risen dramatically this year. Since rent absorbs a major part of her income, Delia moves to a smaller apartment. Assume that rental housing is a normal good.
   c. The cost of a semester-long meal ticket at the student cafeteria rises, representing a significant increase in living costs. As a result, many students have less money to spend on weekend meals at restaurants and eat in the cafeteria instead. Assume that cafeteria meals are an inferior good.

Solutions appear at back of book.

>> A LOOK AHEAD •••

At this point we have the basic tools to understand consumer behavior and how it gives rise to the market demand curve. Yet there is more to say about consumer choice, and those who want to pursue the subject further should proceed to Chapter 11. Those eager to move on can, however, skip to Chapter 12, where we begin our study of producer behavior and the various types of production costs that producers face. Chapter 13 then focuses on how producers behave in a competitive market. Once you've completed these two chapters, you'll have a good grasp of what underlies both the demand and supply curves.]

SUMMARY

1. Consumers maximize a measure of satisfaction called **utility.** Each consumer has a **utility function** that determines the level of total utility generated by his or her **consumption bundle,** the goods and services that are consumed. We measure utility in hypothetical units called **utils.**
2. A good's or service's **marginal utility** is the additional utility generated by consuming one more unit of the good or service. We usually assume that the **principle of diminishing marginal utility** holds: consumption of another unit of a good or service yields less additional utility than the previous unit. As a result, the **marginal utility curve** slopes downward.
3. A **budget constraint** limits a consumer's spending to no more than his or her income. It defines the consumer's **consumption possibilities,** the set of all affordable consumption bundles. A consumer who spends all of his or her income will choose a consumption bundle on the **budget line.** An individual chooses the consumption bundle that maximizes total utility, the **optimal consumption bundle.**
4. We use marginal analysis to find the optimal consumption bundle by analyzing how to allocate the marginal dollar. The **optimal consumption rule** says that at the optimal consumption bundle the **marginal utility per dollar** spent on each good and service—the marginal utility of a good divided by its price—is the same.
5. Changes in the price of a good affect the quantity consumed in two possible ways: the **substitution effect** and the **income effect.** Most goods absorb only a small share of a consumer's spending; for these goods, only the substitution effect—buying less of the good that has become relatively more expensive and more of the good that has become relatively cheaper—is significant. It causes the individual and the market demand curves to slope downward. When a good absorbs a large fraction of spending, the income effect is also significant: an increase in a good's price makes a consumer poorer, but a decrease in price makes a consumer richer. This change in purchasing power makes consumers demand more or less of a good, depending on whether the good is normal or inferior. For normal goods, the substitution and income effects reinforce each other. For inferior goods, however, they work in opposite directions.

KEY TERMS

Utility, p. 250
Consumption bundle, p. 250
Utility function, p. 250
Util, p. 250
Marginal utility, p. 251
Marginal utility curve, p. 251
Principle of diminishing marginal utility, p. 252
Budget constraint, p. 254
Consumption possibilities, p. 254
Budget line, p. 254
Optimal consumption bundle, p. 255
Marginal utility per dollar, p. 259
Optimal consumption rule, p. 261
Substitution effect, p. 264
Income effect, p. 264

PROBLEMS

1. For each of the following situations, decide whether Al has increasing, constant, or diminishing marginal utility.
   - **a.** The more economics classes Al takes, the more he enjoys the subject. And the more classes he takes, the easier each one gets, making him enjoy each additional class even more than the one before.
   - **b.** Al likes loud music. In fact, according to him, "the louder, the better." Each time he turns the volume up a notch, he adds 5 utils to his total utility.
   - **c.** Al enjoys watching reruns of the old sitcom *Friends.* He claims that these episodes are always funny, but he does admit that the more he sees an episode, the less funny it gets.
   - **d.** Al loves toasted marshmallows. The more he eats, however, the fuller he gets and the less he enjoys each additional marshmallow. And there is a point at which he becomes satiated: beyond that point, more marshmallows actually make him feel worse rather than better.
2. Use the concept of marginal utility to explain the following: Newspaper vending machines are designed so that once you have paid for one paper, you could take more than one paper at a time. But soda vending machines, once you have paid for one soda, dispense only one soda at a time.
3. Brenda likes to have bagels and coffee for breakfast. The accompanying table shows Brenda's total utility from various consumption bundles of bagels and coffee.

Consumption bundle		
Quantity of bagels	Quantity of coffee (cups)	Total utility (utils)
0	0	0
0	2	28
0	4	40
1	2	48
1	3	54
2	0	28
2	2	56
3	1	54
3	2	62
4	0	40
4	2	66

Suppose Brenda knows she will consume 2 cups of coffee for sure. However, she can choose to consume different quantities of bagels: she can choose either 0, 1, 2, 3, or 4 bagels.

a. Calculate Brenda's marginal utility from bagels as she goes from consuming 0 bagel to 1 bagel, from 1 bagel to 2 bagels, from 2 bagels to 3 bagels, and from 3 bagels to 4 bagels.

b. Draw Brenda's marginal utility curve of bagels. Does Brenda have increasing, diminishing, or constant marginal utility of bagels?

4. Brenda, the consumer in Problem 3, now has to make a decision about how many bagels and how much coffee to have for breakfast. She has $8 of income to spend on bagels and coffee. Use the information given in the table in Problem 3 to answer the following questions.

a. Bagels cost $2 each, and coffee costs $2 per cup. Which bundles are on Brenda's budget line? For each of these bundles, calculate the level of utility (in utils) that Brenda enjoys. Which bundle is her optimal bundle?

b. The price of bagels increases to $4, but the price of coffee remains at $2 per cup. Which bundles are now on Brenda's budget line? For each bundle, calculate Brenda's level of utility (in utils). Which bundle is her optimal bundle?

c. What do your answers to parts a and b imply about the slope of Brenda's demand curve for bagels? Describe the substitution effect and the income effect of this increase in the price of bagels, assuming that bagels are a normal good.

5. Bruno can spend his income on two different goods: Beyoncé CDs and notebooks for his class notes. For each of the following three situations, decide if the given consumption bundle is within Bruno's consumption possibilities. Then decide if it lies *on* the budget line or not.

a. CDs cost $10 each, and notebooks cost $2 each. Bruno has income of $60. He is considering a consumption bundle containing 3 CDs and 15 notebooks.

b. CDs cost $10 each, and notebooks cost $5 each. Bruno has income of $110. He is considering a consumption bundle containing 3 CDs and 10 notebooks.

c. CDs cost $20 each, and notebooks cost $10 each. Bruno has income of $50. He is considering a consumption bundle containing 2 CDs and 2 notebooks.

6. Bruno, the consumer in Problem 5, is best friends with Bernie, who shares his love for notebooks and Beyoncé CDs. The accompanying table shows Bernie's utilities from notebooks and Beyoncé CDs.

Quantity of notebooks	Utility from notebooks (utils)	Quantity of CDs	Utility from CDs (utils)
0	0	0	0
2	70	1	80
4	130	2	150
6	180	3	210
8	220	4	260
10	250	5	300

The price of a notebook is $5, the price of a CD is $10, and Bernie has $50 of income to spend.

a. Which consumption bundles of notebooks and CDs can Bernie consume if he spends all his income? Illustrate Bernie's budget line with a diagram, putting notebooks on the horizontal axis and CDs on the vertical axis.

b. Calculate the marginal utility of each notebook and the marginal utility of each CD. Then calculate the marginal utility per dollar spent on notebooks and the marginal utility per dollar spent on CDs.

c. Draw a diagram like Figure 10-4 in which both the marginal utility per dollar spent on notebooks and the marginal utility per dollar spent on CDs are illustrated. Using this diagram and the optimal consumption rule, predict which bundle—from all the bundles on his budget line—Bernie will choose.

7. For each of the following situations, decide whether the bundle Lakshani is considering optimal or not. If it is not optimal, how could Lakshani improve her overall level of utility? That is, determine which good she should spend more on and which good should she spend less on.

a. Lakshani has $200 to spend on sneakers and sweaters. Sneakers cost $50 per pair, and sweaters cost $20 each. She is thinking about buying 2 pairs of sneakers and 5 sweaters. She tells her friend that the additional utility she would get from the second pair of sneakers is the same as the additional utility she would get from the fifth sweater.

b. Lakshani has $5 to spend on pens and pencils. Each pen costs $0.50 and each pencil costs $0.10. She is thinking about buying 6 pens and 20 pencils. The last pen would add five times as much to her total utility as the last pencil.

c. Lakshani has $50 per season to spend on tickets to foot-

ball games and tickets to soccer games. Each football ticket costs $10 and each soccer ticket costs $5. She is thinking about buying 3 football tickets and 2 soccer tickets. Her marginal utility from the third football ticket is twice as much as her marginal utility from the second soccer ticket.

8. Cal "Cool" Cooper has $200 to spend on cell phones and sunglasses.

a. Each cell phone costs $100 and each pair of sunglasses costs $50. Which bundles lie on Cal's budget line? Draw a diagram like Figure 10-4 in which both the marginal utility per dollar spent on cell phones and the marginal utility per dollar spent on sunglasses are illustrated. Use this diagram and the optimal consumption rule to decide how Cal should allocate his money. That is, from all the bundles on his budget line, which bundle will Cal choose? The accompanying table gives his utility of cell phones and sunglasses.

Quantity of cell phones	Utility from cell phones (utils)	Quantity of sunglasses (pairs)	Utility from sunglasses (utils)
0	0	0	0
1	400	2	600
2	700	4	700

b. The price of cell phones falls to $50 each, but the price of sunglasses remains at $50 per pair. Which bundles lie on Cal's budget line? Draw a diagram like Figure 10-4 in which both the marginal utility per dollar spent on cell phones and the marginal utility per dollar spent on sunglasses are illustrated. Use this diagram and the optimal consumption rule to decide how Cal should allocate his money. That is, from all the bundles on his budget line, which bundle will Cal choose? The accompanying table gives his utility of cell phones and sunglasses.

Quantity of cell phones	Utility from cell phones (utils)	Quantity of sunglasses (pairs)	Utility from sunglasses (utils)
0	0	0	0
1	400	1	325
2	700	2	600
3	900	3	825
4	1,000	4	700

c. How does Cal's consumption of cell phones change as the price of cell phones falls? In words, describe the income effect and the substitution effect of this fall in the price of cell phones, assuming that cell phones are a normal good.

9. Damien Matthews is a busy actor. He allocates his free time to watching movies and working out at the gym. The accompanying table shows his utility from the number of times per week he watches a movie or goes to the gym.

Quantity of gym visits per week	Utility from gym visits (utils)	Quantity of movies per week	Utility from movies (utils)
1	100	1	60
2	180	2	110
3	240	3	150
4	280	4	180
5	310	5	190
6	330	6	195
7	340	7	197

Damien has 14 hours per week to spend on watching movies and going to the gym. Each movie takes 2 hours and each gym visit takes 2 hours. (*Hint:* Damien's free time is analogous to income he can spend. The hours needed for each activity are analogous to the price of that activity.)

a. Which bundles of gym visits and movies can Damien consume per week if he spends all his time either going to the gym or watching movies? Draw Damien's budget line in a diagram with gym visits on the horizontal axis and movies on the vertical axis.

b. Calculate the marginal utility of each gym visit and the marginal utility of each movie. Then calculate the marginal utility per hour spent at the gym and the marginal utility per hour spent watching movies.

c. Draw a diagram like Figure 10-4 in which both the marginal utility per hour spent at the gym and the marginal utility per hour spent watching movies are illustrated. Use this diagram and the optimal consumption rule to decide how Damien should allocate his time.

10. Anna Jenniferson is an actress, who currently spends several hours each week watching movies and going to the gym. On the set of a new movie she meets Damien, the consumer in Problem 9. She tells him that she likes watching movies much more than going to the gym. In fact, she says that if she had to give up seeing 1 movie, she would need to go to the gym twice to make up for the loss in utility from not seeing the movie. A movie takes 2 hours, and a gym visit also lasts 2 hours. Damien tells Anna that she is not watching enough movies. Is he right?

11. Sven is a poor student who covers most of his dietary needs by eating cheap breakfast cereal, since it contains most of the important vitamins. As the price of cereal increases, he decides to buy even less of other foods and even more breakfast cereal to maintain his intake of important nutrients. This makes breakfast cereal a Giffen good for Sven. Describe in words the substitution effect and the income effect from this increase in the price of cereal. In which direction does each effect move, and why? What does this imply for the slope of Sven's demand curve for cereal?

12. In each of the following situations, describe the substitution effect and, if it is significant, the income effect. In which direction does each of these effects move? Why?

a. Ed spends a large portion of his income on his children's education. Because tuition fees rise, one of his children has to withdraw from college.

b. Homer spends much of his monthly income on home mortgage payments. The interest on his adjustable-rate mortgage falls, lowering his mortgage payments, and Homer decides to move to a larger house.

c. Pam thinks that Spam is an inferior good. Yet as the price of Spam rises, she decides to buy less of it.

13. Restaurant meals and housing (measured in the number of rooms) are the only two goods that Neha buys. She has income of $1,000. Initially, she buys a consumption bundle such that she spends exactly half her income on restaurant meals and the other half of her income on housing. Then her income increases by 50%, but the price of restaurant meals increases by 100% (it doubles). The price of housing remains the same. After these changes, if she wanted to, could Neha still buy the same consumption bundle as before?

14. Scott finds that the higher the price of orange juice, the more money he spends on orange juice. Does that mean that Scott has discovered a Giffen good?

15. Margo's marginal utility of one dance lesson is 100 utils per lesson. Her marginal utility of a new pair of dance shoes is 300 utils per pair. The price of a dance lesson is $50 per lesson. She currently spends all her income, and she buys her optimal consumption bundle. What is the price of a pair of dance shoes?

16. According to data from the U.S. Department of Energy, the average retail price of regular gasoline rose from $0.93 in 1985 to $1.81 in 2005, a 95% increase.

a. Other things equal, describe the effect of this price increase on the quantity of gasoline demanded. In your explanation, make use of the optimal consumption rule and describe income and substitution effects.

In fact, however, other things were not equal. Over the same time period, the prices of other goods and services rose as well. According to data from the Bureau of Labor Statistics, the overall price of a bundle of goods and services consumed by an average consumer rose by 82%.

b. Taking into account the rise in the price of gasoline and in overall prices, other things equal, describe the effect on the quantity of gasoline demanded.

However, this is not the end of the story. Between 1985 and 2005, the typical consumer's nominal income increased, too: the U.S. Census Bureau reports that U.S. median household nominal income rose from $23,618 in 1985 to $46,326 in 2005, an increase of 96%.

c. Taking into account the rise in the price of gasoline, in overall prices, and in consumers' incomes, describe the effect on the quantity of gasoline demanded.

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