CHAPTER 5

Demand and Consumer Behavior

O, reason not the need: our basest beggars Are in the poorest thing superfluous.

Shakespeare, King Lear

We make countless decisions every day about how to allocate our scarce money and time. Should we buy a pizza or a hamburger? Buy a new car or fix our old one? Spend our income today or save for future consumption? Should we eat breakfast or sleep late? As we balance competing demands and desires, we make the choices that define our lives.

The results of these individual choices are what underlie the demand curves and price elasticities that we met in earlier chapters. This chapter explores the basic principles of consumer choice and behavior. We shall see how patterns of market demand can be explained by the process of individuals’ pursuing their most preferred bundle of consumption goods. We also will learn how to measure the benefits that each of us receives from participating in a market economy.

CHOICE AND UTILITY THEORY

In explaining consumer behavior, economics relies on the fundamental premise that people choose those goods and services they value most highly. To describe the way consumers choose among different consumption possibilities, economists a century ago developed the notion of utility. From the notion of utility, they were able to derive the demand curve and explain its properties.

What do we mean by “utility”? In a word, utility denotes satisfaction. More precisely, it refers to how consumers rank different goods and services. If basket A has higher utility than basket B for Smith, this ranking indicates that Smith prefers A over B. Often, it is convenient to think of utility as the subjective pleasure or usefulness that a person derives from consuming a good or service. But you should definitely resist the idea that utility is a psychological function or feeling that can be observed or measured. Rather, utility is a scientific construct that economists use to understand how rational consumers make decisions. We derive consumer demand functions from the assumption that people make decisions that give them the greatest satisfaction or utility.

In the theory of demand, we assume that people maximize their utility, which means that they choose the bundle of consumption goods that they most prefer.

Marginal Utility and the Law of Diminishing Marginal Utility

How does utility apply to the theory of demand? Say that consuming the first unit of ice cream gives you a certain level of satisfaction or utility. Now imagine consuming a second unit. Your total utility goes up...
CHOICE AND UTILITY THEORY

Because the second unit of the good gives you some additional utility. What about adding a third and fourth unit of the same good? Eventually, if you eat enough ice cream, instead of adding to your satisfaction or utility, it makes you sick!

This leads us to the fundamental economic concept of marginal utility. When you eat an additional unit of ice cream, you will get some additional satisfaction or utility. The increment to your utility is called marginal utility.

The expression “marginal” is a key term in economics and always means “additional” or “extra.” Marginal utility denotes the additional utility you get from the consumption of an additional unit of a commodity.

One of the fundamental ideas behind demand theory is the law of diminishing marginal utility. This law states that the amount of extra or marginal utility declines as a person consumes more and more of a good.

To understand this law, first remember that utility tends to increase as you consume more of a good. However, as you consume more and more, your total utility will grow at a slower and slower rate. This is the same thing as saying that your marginal utility (the extra utility added by the last unit consumed of a good) diminishes as more of a good is consumed.

The law of diminishing marginal utility states that, as the amount of a good consumed increases, the marginal utility of that good tends to decline.

**A Numerical Example**

We can illustrate utility numerically as in Table 5-1. The table shows in column (2) that total utility ($U$) enjoyed increases as consumption ($Q$) grows, but it increases at a decreasing rate. Column (3) measures marginal utility as the extra utility gained when 1 extra unit of the good is consumed. Thus when the individual consumes 2 units, the marginal utility is $7 - 4 = 3$ units of utility (call these units “utils”).

Table 5-1: Utility Rises with Consumption

<table>
<thead>
<tr>
<th>Quantity of a good consumed</th>
<th>Total utility</th>
<th>Marginal utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Q$</td>
<td>$U$</td>
<td>$MU$</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

Focus next on column (3). The fact that marginal utility declines with higher consumption illustrates the law of diminishing marginal utility.

Figure 5-1 on page 86 shows graphically the data on total utility and marginal utility from Table 5-1. In part (a), the blue blocks add up to the total utility at each level of consumption. In addition, the smooth blue curve shows the smoothed utility level for fractional units of consumption. It shows utility increasing, but at a decreasing rate. Figure 5-1(b) depicts marginal utilities. Each of the blue blocks of marginal utility is the same size as the corresponding block of total utility in (a). The straight blue line in (b) is the smoothed curve of marginal utility.

The law of diminishing marginal utility implies that the marginal utility ($MU$) curve in Figure 5-1(b) must slope downward. This is exactly equivalent to saying that the total utility curve in Figure 5-1(a) must look concave, like a dome.

**Relationship of Total and Marginal Utility.** Using Figure 5-1, we can easily see that the total utility of consuming a certain amount is equal to the sum of the marginal utilities up to that point. For example, assume that 3 units are consumed. Column (2) of Table 5-1 shows that the total utility is 9 units. In column (3) we see that the sum of the marginal utilities of the first 3 units is also $4 + 3 + 2 = 9$ units.

Examining Figure 5-1(b), we see that the total area under the marginal utility curve at a particular level of consumption—as measured either by blocks or by the area under the smooth $MU$ curve—must
after 1700, as the basic ideas of mathematical probability were being developed. Thus Daniel Bernoulli, a member of a brilliant Swiss family of mathematicians, observed in 1738 that people act as if the dollar they stand to gain in a fair bet is worth less to them than the dollar they stand to lose. This means that they are averse to risk and that successive new dollars of wealth bring them smaller and smaller increments of true utility.

An early introduction of the utility notion into the social sciences was accomplished by the English philosopher Jeremy Bentham (1748–1832). After studying legal theory, and under the influence of Adam Smith’s doctrines, Bentham turned to the study of the principles necessary
for drawing up social legislation. He proposed that society should be organized on the “principle of utility,” which he defined as the “property in any object . . . to produce pleasure, good or happiness or to prevent . . . pain, evil or unhappiness.” All legislation, according to Bentham, should be designed on utilitarian principles, to promote “the greatest happiness of the greatest number.” Among his other legislative proposals were quite modern-sounding ideas about crime and punishment in which he suggested that raising the “pain” to criminals by harsh punishments would deter crimes.

Bentham’s views about utility seem familiar to many people today. But they were revolutionary 200 years ago because they emphasized that social and economic policies should be designed to achieve certain practical results, whereas legitimacy at that time was usually based on tradition, the divine right of kings, or religious doctrines. Today, many political thinkers defend their legislative proposals with utilitarian notions of what will make the largest number of people best off.

The next step in the development of utility theory came when the neoclassical economists—such as William Stanley Jevons (1835–1882)—extended Bentham’s utility concept to explain consumer behavior. Jevons thought economic theory was a “calculus of pleasure and pain,” and he developed the theory that rational people would base their consumption decisions on the extra or marginal utility of each good.

The ideas of Jevons and his coworkers led directly to the modern theories of ordinal utility and indifference curves developed by Vilfredo Pareto, John Hicks, R. G. D. Allen, Paul Samuelson, and others in which the Benthamite ideas of measurable cardinal utility are no longer needed.

The Equimarginal Principle
Having explained utility theory, we now apply that theory to explain consumer demand and to understand the nature of demand curves.

We assume that each consumer maximizes utility, which means that the consumer chooses the most preferred bundle of goods from what is available. We also assume that consumers have a certain income and face given market prices for goods.

What would be a sensible rule for choosing the preference bundle of goods in this situation? Certainly, I would not expect that the last egg brings the same marginal utility as the last pair of shoes, for shoes cost much more per unit than eggs. A satisfactory rule would be: If good A costs twice as much as good B, then buy good A only when its marginal utility is at least twice as great as good B’s marginal utility.

This leads to the equimarginal principle that I should arrange my consumption so that the last dollar spent on each good is bringing me the same marginal utility.

Equimarginal principle: The fundamental condition of maximum satisfaction or utility is the equimarginal principle. It states that a consumer will achieve maximum satisfaction or utility when the marginal utility of the last dollar spent on a good is exactly the same as the marginal utility of the last dollar spent on any other good.

Why must this condition hold? If any one good gave more marginal utility per dollar, I would increase my utility by taking money away from other goods and spending more on that good—until the law of diminishing marginal utility drove its marginal utility per dollar down to equality with that of other goods. If any good gave less marginal utility per dollar than the common level, I would buy less of it until the marginal utility of the last dollar spent on it had risen back to the common level. The common marginal utility per dollar of all commodities in consumer equilibrium is called the marginal utility of income. It measures the additional utility that would be gained if the consumer could enjoy an extra dollar’s worth of consumption.

This fundamental condition of consumer equilibrium can be written in terms of the marginal utilities (MUs) and prices (Ps) of the different goods in the following compact way:

$$\frac{MU_{good 1}}{P_1} = \frac{MU_{good 2}}{P_2} = \ldots = \frac{MU_{good n}}{P_n} = MU \text{ per } \$ \text{ of income}$$

Why Demand Curves Slope Downward
Using the fundamental rule for consumer behavior, we can easily see why demand curves slope downward. For simplicity, hold the common marginal
utility per dollar of income constant. Then increase the price of good 1. With no change in quantity consumed, the first ratio \( \frac{MU_{good 1}}{P_1} \) will be below the \( MU \) per dollar of all other goods. The consumer will therefore have to readjust the consumption of good 1. The consumer will do this by (a) lowering the consumption of good 1, thereby (b) raising the \( MU \) of good 1, until (c) at the new, reduced level of consumption of good 1, the new marginal utility per dollar spent on good 1 is again equal to the \( MU \) per dollar spent on other goods.

A higher price for a good reduces the consumer’s desired consumption of that commodity; this shows why demand curves slope downward.

**Leisure and the Optimal Allocation of Time**

A Spanish toast to a friend wishes “health, wealth, and the time to enjoy them.” This saying captures the idea that we must allocate our time budgets in much the same way as we do our dollar budgets. Time is the great equalizer, for even the richest person has but 24 hours a day to “spend.” Let’s see how our earlier analysis of allocating scarce dollars applies to time.

Consider leisure, often defined as “time which one can spend as one pleases.” Leisure brings out our personal eccentricities. The seventeenth-century philosopher Francis Bacon held that the purest of human pleasures was gardening. The British statesman Winston Churchill wrote of his holiday: “I have had a delightful month building a cottage and dictating a book: 200 bricks and 2000 words a day.”

We can apply utility theory to the allocation of time as well as money. Suppose that, after satisfying all your obligations, you have 3 hours a day of free time and can devote it to gardening, laying bricks, or writing history. What is the best way to allocate your time? Let’s ignore the possibility that time spent on some of these activities might be an investment that will enhance your earning power in the future. Rather, assume that these are all pure consumption or utility-yielding pursuits. The principles of consumer choice suggest that you will make the best use of your time when you equalize the marginal utilities of the last minute spent on each activity.

To take another example, suppose you want to maximize your knowledge in your courses but you have only a limited amount of time available. Should you study each subject for the same amount of time? Surely not. You may find that an equal study time for economics, history, and chemistry will not yield the same amount of knowledge in the last minute. If the last minute produces a greater marginal knowledge in chemistry than in history, you would raise your total knowledge by shifting additional minutes from history to chemistry, and so on, until the last minute yields the same incremental knowledge in each subject.

The same rule of maximum utility per hour can be applied to many different areas of life, including engaging in charitable activities, improving the environment, or losing weight. It is not merely a law of economics. It is a law of rational choice.

ARE CONSUMERS WIZARDS? THE VIEW FROM BEHAVIORAL ECONOMICS

All of this discussion makes it sound as if consumers are mathematical wizards who routinely make calculations of marginal utility to the tenth decimal place and solve complicated systems of equations in their everyday lives.

This unrealistic view is definitely not what we assume in economics. We know that most decisions are made in a routine and intuitive way. We may have Cheerios and yogurt for breakfast every day because they are not too expensive, are easy to find in the store, and slake our morning hunger.

Rather, what we assume in consumer demand theory is that consumers are reasonably consistent in their tastes and actions. We expect that people do not flail around and make themselves miserable by constantly making mistakes. If most people act consistently most of the time, avoiding erratic changes in buying behavior and generally choosing their most preferred bundles, our theory of demand will provide a reasonably good approximation to the facts.

As always, however, we must be alert to situations where irrational or inconsistent behavior crops up. We know that people make mistakes. People sometimes buy useless gadgets or are bilked by unscrupulous sales pitches. A new area of research is behavioral economics, which recognizes that people have limited time and memory, that information is incomplete, and that patterns of irrational-looking behavior are persistent. This approach allows for the possibility that imperfect information, psychological biases, and costly decision making may lead to poor decisions.
Behavioral economics explains why households save too little for retirement, why stock market bubbles occur, and how used-car markets behave when people’s information is limited. A significant recent example illustrating behavioral principles came when millions of people took out “subprime mortgages” to buy homes in the 2000s. They did not read or could not understand the fine print, and as a result many people defaulted on their mortgages and lost their homes, triggering a major financial crisis and an economic downturn. It turns out that poor consumers were not the only people who could not read the fine print, however; for they were joined by banks, hedge-fund managers, bond-rating firms, and thousands of investors who bought assets that they did not understand.

Behavioral economics joined the mainstream in 2001 and 2002 when Nobel Prizes were awarded for economic research in this area. George Akerlof (University of California at Berkeley) was cited for developing a better understanding of the role of asymmetric information and the market for “lemons.” Daniel Kahneman (Princeton University) and Vernon L. Smith (George Mason University) received the prize for “the analysis of human judgment and decision-making ... and the empirical testing of predictions from economic theory by experimental economists.”

Analytical Developments in Utility Theory

We pause here to provide an elaboration of some of the advanced issues behind the concept of utility and its application to demand theory. Economists today generally reject the notion of a cardinal (or measurable) utility that people feel or experience when consuming goods and services. Utility does not ring up like numbers on a gasoline pump.

Rather, what counts for modern demand theory is the principle of ordinal utility. Under this approach, consumers need to determine only their preference ranking of bundles of commodities. Ordinal utility asks, “Do I prefer a pastrami sandwich to a chocolate milk shake?” A statement such as “Bundle A is preferred to bundle B” — which does not require that we know how much A is preferred to B — is called ordinal, or dimensionless. Ordinal variables are ones that we can rank in order, but for which there is no measure of the quantitative difference between the situations. We might rank pictures in an exhibition by order of beauty without having a quantitative measure of beauty. Using only such ordinal preference rankings, we can establish firmly the general properties of market demand curves described in this chapter and in its appendix.

The discerning reader will wonder whether the equimarginal principle describing consumer equilibrium behavior implies cardinal utility. In fact, it does not; only ordinal measures are needed. An ordinal utility measure is one that we can stretch while always maintaining the same greater-than or less-than relationship (like measuring with a rubber band). Examine the marginal condition for consumer equilibrium. If the utility scale is stretched (say, by doubling or multiplying times 3.1415), you can see that all the numerators in the condition are changed by exactly the same amount, so the consumer equilibrium condition still holds.

For certain special situations the concept of cardinal, or dimensional, utility is useful. An example of a cardinal measure comes when we say that one plane is traveling twice as fast as another. People’s behavior under conditions of uncertainty is today analyzed using a cardinal concept of utility. This topic will be examined further when we review the economics of risk, uncertainty, and gambling in Chapter 11.

Our treatment of utility in the equimarginal principle assumed that goods can be divided into indefinitely small units. However, sometimes indivisibility of units is important and cannot be glossed over. Thus, Hondas cannot be divided into arbitrarily small portions the way juice can. Suppose I buy one Honda, but definitely not two. Then the additional utility of the first car is enough larger than the additional utility of the same number of dollars spent elsewhere to induce me to buy this first unit. The additional utility that the second Honda would bring is enough less to ensure I do not buy it. When indivisibility matters, our equality rule for equilibrium can be restated as an inequality rule.

AN ALTERNATIVE APPROACH: SUBSTITUTION EFFECT AND INCOME EFFECT

The concept of marginal utility has helped explain the fundamental law of downward-sloping demand. But over the last few decades, economists have developed an alternative approach to the analysis of demand—one that makes no mention of marginal utility. This alternative approach uses “indifference
We can obtain a quantitative measure of the income effect using a new concept, income elasticity. This term denotes the percentage change in quantity demanded divided by the percentage change in income, holding other things, such as prices, constant.

\[ \text{Income elasticity} = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in income}} \]

High income elasticities, such as those for airline travel or yachts, indicate that the demand for these goods rises rapidly as income increases. Low income elasticities, such as for potatoes or used furniture, denote a weak response of demand to increases in income.

**Calculation of Income Elasticity**

Suppose you are a city planner for Santa Fe, New Mexico, and you are concerned about the growth in the demand for water consumption by households in that arid region. You make inquiries and find the following data for 2000: The population is 62,000; the projected growth rate of the population is 20 percent per decade; per capita annual water consumption in 2000 was 1000 gallons; per capita incomes are projected to grow by 25 percent over the next decade; and the income elasticity of water use per capita is 0.50. You then estimate the water needs for 2010 (with unchanged prices) as

\[
\begin{align*}
\text{Water consumption in 2010} &= \text{population in 2000} \times \text{population growth factor} \times \text{per capita water use} \times [1 + \text{(income growth} \times \text{income elasticity})] \\
&= 62,000 \times 1.2 \times 1000 \times (1 + 0.25 \times 0.50) \\
&= 83,700,000
\end{align*}
\]

From these data, you project a growth in total household water use of 35 percent from 2000 to 2010.

Income and substitution effects combine to determine the major characteristics of demand curves of different commodities. Under some circumstances the resulting demand curve is very price-elastic, as where the consumer has been spending a good deal on the commodity and ready substitutes are available. In this case both the income and the
FROM INDIVIDUAL TO MARKET DEMAND

were 1 million consumers, we could think of the market demand curve as a millionfold enlargement of each consumer’s demand curve.

In fact, of course, people differ in their tastes. Some have high incomes, some low. Some greatly desire coffee; others prefer tea. To obtain the total market demand curve, we calculate the sum total of what all the different consumers consume at each price. We then plot that total amount as a point on the market demand curve. Alternatively, we might construct a numerical demand table by summing the quantities demanded by all individuals at each market price.

As a matter of convention, we label individual demand and supply curves with lowercase letters (dd and ss), while using uppercase letters (DD and SS) for the market demand and supply curves.

The market demand curve is the sum of individual demands at each price. Figure 5-2 shows how to add individual dd demand curves horizontally to get the market DD demand curve.

![Diagram](image-url)

**FIGURE 5-2 Market Demand Derived from Individual Demands**

We add all individual consumers’ demand curves to get the market demand curve. At each price, such as $5, we add quantities demanded by each person to get the market quantity demanded. The figure shows how, at a price of $5, we add horizontally Smith’s 1 unit demanded to Brown’s 2 units to get the market demand of 3 units.
Demand Shifts
We know that changes in the price of coffee affect the quantity of coffee demanded. We know this from budget studies, from historical experience, and from examining our own behavior. We discussed briefly in Chapter 3 some of the important nonprice determinants of demand. We now review the earlier discussion in light of our analysis of consumer behavior.

An increase in income tends to increase the amount we are willing to buy of most goods. Necessities tend to be less responsive than most goods to income changes, while luxuries tend to be more responsive to income. And there are a few anomalous goods, known as inferior goods, for which purchases may shrink as incomes increase because people can afford to replace them with other, more desirable goods. Soup bones, intercity bus travel, and black-and-white TVs are examples of inferior goods for many Americans today.

What does all this mean in terms of the demand curve? The demand curve shows how the quantity of a good demanded responds to a change in its own price. But the demand is also affected by the prices of other goods, by consumer incomes, and by special influences. The demand curve was drawn on the assumption that these other things were held constant. But what if these other things change? Then the whole demand curve will shift to the right or to the left.

Figure 5-3 illustrates changes in factors affecting demand. Given people’s incomes and the prices for other goods, we can draw the demand curve for coffee as $D_D$. Assume that price and quantity are at point $A$. Suppose that incomes rise while the prices of coffee and other goods are unchanged. Because coffee is a normal good with a positive income elasticity, people will increase their purchases of coffee. Hence the demand curve for coffee will shift to the right, say, to $D'D'$, with $A'$ indicating the new quantity demanded of coffee. If incomes should fall, then we would expect a reduction in demand and in quantity bought. This downward shift we illustrate by $D''D''$ and by $A''$.

Substitutes and Complements
Everyone knows that raising the price of beef will decrease the amount of beef demanded. We have seen that it will also affect the demand for other commodities. For example, a higher price for beef will increase the demand for substitutes like chicken. A higher beef price may lower the demand for goods like hamburger buns and ketchup that are used along with beef hamburgers. It will probably have little effect on the demand for economics textbooks.

We say, therefore, that beef and chicken are substitute products. Goods $A$ and $B$ are substitutes if an increase in the price of good $A$ will increase the demand for substitute good $B$. Hamburgers and hamburger buns, or cars and gasoline, on the other hand, are complementary products; they are called complements because an increase in the price of good $A$ causes a decrease in the demand for its complementary good $B$. In between are independent goods, such as beef and textbooks, for which a price change for one has no effect on the demand for the other. Try classifying the pairs turkey and cranberry sauce, oil and coal, college and textbooks, shoes and shoelaces, salt and shoelaces.

Say Figure 5-3 represented the demand for beef. A fall in the price of chickens may well cause consumers to buy less beef; the beef demand curve would therefore shift to the left, say, to $D''D'$. But what if the price of hamburger buns were to fall? The resulting change on $DD$, if there is one, will be in the direction of increased beef purchases, a rightward shift of the demand curve.
Why do we see this difference in response? Because chicken is a substitute product for beef, while hamburger buns are complements to beef.

Review of key concepts:

- **The substitution effect** occurs when a higher price leads to substitution of other goods for the good whose price has risen.
- The **income effect** is the change in the quantity demanded of a good because the change in its price has the effect of changing a consumer’s real income.
- **Income elasticity** is the percentage change in quantity demanded of a good divided by the percentage change in income.
- Goods are **substitutes** if an increase in the price of one increases the demand for the other.
- Goods are **complements** if an increase in the price of one decreases the demand for the other.
- Goods are **independent** if a price change for one has no effect on the demand for the other.

Empirical Estimates of Price and Income Elasticities

For many economic applications, it is essential to have numerical estimates of price elasticities. For example, an automobile manufacturer will want to know the impact on sales of the higher car prices that result from installation of costly pollution-control equipment; a college needs to know the impact of higher tuition rates on student applications; and a publisher will calculate the impact of higher textbook prices on its sales. All these applications require a numerical estimate of price elasticity.

Similar decisions depend on income elasticities. A government planning its road or rail network will estimate the impact of rising incomes on automobile travel; the federal government must calculate the effect of higher incomes on energy consumption in designing policies for air pollution or global warming; in determining the necessary investments for generating capacity, electrical utilities require income elasticities for estimating electricity consumption.

Economists have developed useful statistical techniques for estimating price and income elasticities. The quantitative estimates are derived from market data on quantities demanded, prices, incomes, and other variables. Tables 5-2 and 5-3 show selected estimates of elasticities.

### TABLE 5-2 Selected Estimates of Price Elasticities of Demand

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Price elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomatoes</td>
<td>4.60</td>
</tr>
<tr>
<td>Green peas</td>
<td>2.80</td>
</tr>
<tr>
<td>Legal gambling</td>
<td>1.90</td>
</tr>
<tr>
<td>Taxi service</td>
<td>1.24</td>
</tr>
<tr>
<td>Furniture</td>
<td>1.00</td>
</tr>
<tr>
<td>Movies</td>
<td>0.87</td>
</tr>
<tr>
<td>Shoes</td>
<td>0.70</td>
</tr>
<tr>
<td>Legal services</td>
<td>0.61</td>
</tr>
<tr>
<td>Medical insurance</td>
<td>0.31</td>
</tr>
<tr>
<td>Bus travel</td>
<td>0.20</td>
</tr>
<tr>
<td>Residential electricity</td>
<td>0.13</td>
</tr>
</tbody>
</table>


### TABLE 5-3 Income Elasticities for Selected Products

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Income elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automobiles</td>
<td>2.46</td>
</tr>
<tr>
<td>Owner-occupied housing</td>
<td>1.49</td>
</tr>
<tr>
<td>Furniture</td>
<td>1.48</td>
</tr>
<tr>
<td>Books</td>
<td>1.44</td>
</tr>
<tr>
<td>Restaurant meals</td>
<td>1.40</td>
</tr>
<tr>
<td>Clothing</td>
<td>1.02</td>
</tr>
<tr>
<td>Physicians’ services</td>
<td>0.75</td>
</tr>
<tr>
<td>Tobacco</td>
<td>0.64</td>
</tr>
<tr>
<td>Eggs</td>
<td>0.37</td>
</tr>
<tr>
<td>Margarine</td>
<td>–0.20</td>
</tr>
<tr>
<td>Pig products</td>
<td>–0.20</td>
</tr>
<tr>
<td>Flour</td>
<td>–0.36</td>
</tr>
</tbody>
</table>

CHAPTER 5 • DEMAND AND CONSUMER BEHAVIOR

THE ECONOMICS OF ADDICTION

In a free-market economy, the government generally lets people decide what to buy with their money. If some want to buy expensive cars while others want to buy expensive houses, we assume that they know what is best for them and that in the interests of personal freedom the government should respect their preferences.

In some cases, but sparingly and with great hesitation, the government decides to overrule private adult decisions. These are cases of merit goods, whose consumption is thought intrinsically worthwhile, and the opposite, which are demerit goods, whose consumption is deemed harmful. For these goods, we recognize that some consumption activities have such serious effects that overriding individuals' private decisions may be desirable. Today, most societies provide for free public education and emergency health care; on the other hand, society also penalizes or forbids consumption of such harmful substances as cigarettes, alcohol, and heroin.

Among the most controversial areas of social policy are demerit goods involving addictions. An addiction is a pattern of compulsive and uncontrolled use of a substance. The heavy smoker or the heroin user may bitterly regret the acquired habit, but such habits are extremely difficult to break after they have become established. A regular user of cigarettes or heroin is much more likely to desire these substances than is a nonuser. Moreover, the demands for addictive substances are quite price-inelastic.

The markets for addictive substances are big business. Consumer expenditures on tobacco products in 2007 were $95 billion, while total expenditures on alcoholic beverages were $155 billion. Numbers for illegal drugs involve guesswork, but recent estimates of spending on illegal drugs place the total at around $75 billion annually.

Consumption of these substances raises major public policy issues because addictive substances may injure users and often impose costs and harms on society. The harms to users include around 450,000 premature deaths annually, along with a wide variety of medical problems attributable to smoking; 10,000 highway fatalities a year attributed to alcohol; and failures in school, job, and family, along with high levels of AIDS, from intravenous heroin use. Harms to society include the predatory crime that addicts of high-price drugs engage in; the costs of providing subsidized medical care to those who consume drugs, cigarettes, or tobacco; the rapid spread of communicable diseases, especially AIDS and pneumonia; and the tendency of existing users to recruit new users.

One policy approach, often followed in the United States, is to prohibit the sale and use of addictive substances and to enforce prohibition with criminal sanctions. Economically, prohibition can be interpreted as a sharp upward shift in the supply curve. After the upward shift, the price of the addictive substance is much higher. During Prohibition (1920–1933), alcohol prices were approximately 3 times higher than before. Estimates are that cocaine currently sells for at least 20 times its free-market price.

What is the effect of supply restrictions on the consumption of addictive substances? And how does the prohibition affect the injuries to self and to society? To answer these questions, we need to consider the nature of the demand for addictive substances. The evidence indicates that casual consumers of illegal drugs have cheap substitutes like alcohol and tobacco and thus will have relatively high price elasticity of demand. By contrast, hard-core users are often addicted to particular substances and have price-inelastic demands.

We can illustrate the market for addictive substances in Figure 5-4. The demand curve DD is extremely price-inelastic for established users. Now consider a policy of discouraging drug use. One approach, used for cigarettes, is to impose a large tax. As we saw in the previous chapter, this can be analyzed as an upward shift in the supply curve. A policy of prohibition such as is used for illegal substances has the same effect of shifting the supply curve from SS to S'S'.

Because demand is price-inelastic, quantity demanded will decline very little. At the higher price, total spending on drugs increases sharply. For illegal drugs, the required outlays may be so great that the user engages in predatory crime. The results, in the view of two economists who have studied the subject, are that “the market in illegal drugs promotes crime, destroys inner cities, spreads AIDS, corrupts law enforcement officials and politicians, produces and exacerbates poverty, and erodes the moral fabric of society.”

A different case would arise for highly price-sensitive consumers such as casual users. For example,
into the impacts of alternative approaches. First, it suggests that raising the prices of harmful addictive substances can reduce the number of casual users who will be attracted into the market. Second, it cautions us that many of the negative consequences of illegal drugs result from the prohibition of addictive substances rather than from their consumption per se. Many thoughtful observers conclude with the paradoxical observation that the overall costs of addictive substances—to users, to other people, and to the ravaged inner cities in which the drug trade thrives—would be lower if government prohibitions were relaxed and the resources currently devoted to supply restrictions were instead put into treatment and counseling.

THE PARADOX OF VALUE

More than two centuries ago, in *The Wealth of Nations*, Adam Smith posed the paradox of value:

Nothing is more useful than water; but it will scarce purchase anything. A diamond, on the contrary, has scarce any value in use; but a very great quantity of other goods may frequently be had in exchange for it.

In other words, how is it that water, which is essential to life, has little value, while diamonds, which are generally used for conspicuous consumption, command an exalted price?

Although this paradox troubled Adam Smith 200 years ago, we can imagine a dialogue between a probing student and a modern-day Adam Smith as follows:

**Student:** How can we resolve the paradox of value?

**Modern Smith:** The simplest answer is that the supply and demand curves for water intersect at a very low price, while the supply and demand for diamonds yield a very high equilibrium price.

In other words, how is it that water, which is essential to life, has little value, while diamonds, which are generally used for conspicuous consumption, command an exalted price?

Although this paradox troubled Adam Smith 200 years ago, we can imagine a dialogue between a probing student and a modern-day Adam Smith as follows:

**Student:** How can we resolve the paradox of value?

**Modern Smith:** The simplest answer is that the supply and demand curves for water intersect at a very low price, while the supply and demand for diamonds yield a very high equilibrium price.

**Student:** But you have always taught me to go behind the curves. Why do supply and demand for water intersect at such a low price and for diamonds at a high price?

**Modern Smith:** The answer is that diamonds are very scarce and the cost of getting extra ones is high, while water is relatively abundant and costs little in many areas of the world.

**Student:** But where is utility in this picture?
Modern Smith: You are right that this answer still does not reconcile the cost information with the equally valid fact that the world’s water is vastly more critical than the world’s supply of diamonds. So, we need to add a second truth: The total utility from water consumption does not determine its price or demand. Rather, water’s price is determined by its marginal utility, by the usefulness of the last glass of water. Because there is so much water, the last glass sells for very little. Even though the first few drops are worth life itself, the last few are needed only for watering the lawn or washing the car.

Student: Now I get it. The theory of economic value is easy to understand if you just remember that in economics the tail wags the dog. It is the tail of marginal utility that wags the dog of prices.

Modern Smith: Precisely! An immensely valuable commodity like water sells for next to nothing because its last drop is worth next to nothing.

We can restate this dialogue as follows: The more there is of a commodity, the less is the relative desirability of its last little unit. It is therefore clear why water has a low price and why an absolute necessity like air can become a free good. In both cases, it is the large quantities that pull the marginal utilities so far down and thus reduce the prices of these vital commodities.

CONSUMER SURPLUS

The paradox of value emphasizes that the recorded monetary value of a good (measured by price times quantity) may be a misleading indicator of the total economic value of that good. The measured economic value of the air we breathe is zero, yet air’s contribution to welfare is immeasurably large.

The gap between the total utility of a good and its total market value is called consumer surplus. The surplus arises because we “receive more than we pay for” as a result of the law of diminishing marginal utility.

We have consumer surplus basically because we pay the same amount for each unit of a commodity that we buy, from the first to the last. We pay the same price for each egg or glass of water. Thus we pay for each unit what the last unit is worth. But by our fundamental law of diminishing marginal utility, the earlier units are worth more to us than the last. Thus, we enjoy a surplus of utility on each of these earlier units.

Figure 5-5 illustrates the concept of consumer surplus in the case where money provides a firm measuring rod for utility. Here, an individual consumes water, which has a price of $1 per gallon. This is shown by the horizontal green line at $1 in Figure 5-5. The consumer considers how many gallon jugs to buy at that price. The first gallon is highly valuable, slaking extreme thirst, and the consumer is willing to pay $9 for it. But this first gallon costs only the market price of $1, so the consumer has gained a surplus of $8.

Consider the second gallon. This is worth $8 to the consumer, but again costs only $1, so the surplus is $7. And so on down to the ninth gallon, which is worth only 50 cents to the consumer, and so it is not bought. The consumer equilibrium comes at point E, where 8 gallons of water are bought at a price of $1 each.

But here we make an important discovery: Even though the consumer has paid only $8, the total
CONSUMER SURPLUS

How can the government decide on the value of building a new highway or of preserving a recreation site? Suppose a new highway has been proposed. Being free to all, it will bring in no revenue. The value to users will be found in time saved or in safer trips and can be measured by the individual consumer surplus. To avoid difficult issues of interpersonal utility comparisons, we assume that there are 10,000 users, all identical in every respect.

Suppose that each individual’s consumer surplus is $350 for the highway. The highway will raise consumer economic welfare if its total cost is less than $3.5 million (10,000/350). Economists use consumer surplus when they are performing a cost-benefit analysis, which attempts to determine the costs and benefits of a government program. Generally, an economist would recommend that a free road should be built if its total consumer surplus exceeds its costs. Similar analyses have been used for environmental questions such as whether to preserve wilderness areas for recreation or whether to require new pollution-abatement equipment.

The concept of consumer surplus also points to the enormous privilege enjoyed by citizens of modern societies. Each of us enjoys a vast array of enormously valuable goods that can be bought at low prices. This is a humbling thought. If you know someone who is bragging about his economic productivity, or explaining how high her real wages are, suggest a moment of reflection. If such people were transported with their specialized skills to an uninhabited desert island, how much would their wages buy? Indeed, without capital machinery, without the cooperation of others, and without the technological knowledge which each generation inherits from the past, how much could any of us produce? It is only too clear that all of us reap the benefits of an economic world we never made. As the great British sociologist L. T. Hobhouse said:

The organizer of industry who thinks that he has “made” himself and his business has found a whole social system ready to his hand in skilled workers, machinery, a market, peace and order—a vast apparatus and a pervasive atmosphere, the joint creation of millions of men and scores of generations. Take away the whole social factor and we [are] but . . . savages living on roots, berries, and vermin.

Now that we have surveyed the essentials of demand, we move on to costs and supply.

FIGURE 5-6 Total Consumer Surplus Is the Area under the Demand Curve and above the Price Line

The demand curve measures the amount consumers would pay for each unit consumed. Thus the total area under the demand curve (0REM) shows the total utility attached to the consumption of water. By subtracting the market cost of water to consumers (equal to 0NEM), we obtain the consumer surplus from water consumption as the blue triangle NER. This device is useful for measuring the benefits of public goods and the losses from monopolies and import tariffs.

Applications of Consumer Surplus

The concept of consumer surplus is useful in helping evaluate many government decisions. For example, the value of the water is $44. This is obtained by adding up each of the marginal utility columns ($9 + $8 + $7 + $6 + $5 + $4 + $3 + $2). Thus the consumer has gained a surplus of $36 over the amount paid.

Figure 5-5 examines the case of a single consumer purchasing water. We can also apply the concept of consumer surplus to a market as a whole. The market demand curve in Figure 5-6 is the horizontal summation of the individual demand curves. The logic of the individual consumer surplus carries over to the market as a whole. The area of the market demand curve above the price line, shown as NER in Figure 5-6, represents the total consumer surplus.

Because consumers pay the price of the last unit for all units consumed, they enjoy a surplus of utility over cost. Consumer surplus measures the extra value that consumers receive above what they pay for a commodity.
SUMMARY

1. Market demands or demand curves are explained as stemming from the process of individuals’ choosing their most preferred bundle of consumption goods and services.

2. Economists explain consumer demand by the concept of utility, which denotes the relative satisfaction that a consumer obtains from using different commodities. The additional satisfaction obtained from consuming an additional unit of a good is given the name marginal utility, where “marginal” means the extra or incremental utility. The law of diminishing marginal utility states that as the amount of a commodity consumed increases, the marginal utility of the last unit consumed tends to decrease.

3. Economists assume that consumers allocate their limited incomes so as to obtain the greatest satisfaction or utility. To maximize utility, a consumer must satisfy the equimarginal principle that the marginal utilities of the last dollar spent on each and every good must be equal.

   Only when the marginal utility per dollar is equal for apples, bacon, coffee, and everything else will the consumer attain the greatest satisfaction from a limited dollar income. But be careful to note that the marginal utility of a $50-per-ounce bottle of perfume is not equal to the marginal utility of a 50-cent glass of cola. Rather, their marginal utilities divided by price per unit are all equal in the consumer’s optimal allocation. That is, their marginal utilities per last dollar, \( \frac{MU}{P} \), are equalized.

4. Equal marginal utility or benefit per unit of resource is a fundamental rule of choice. Take any scarce resource, such as time. If you want to maximize the value or utility of that resource, make sure that the marginal benefit per unit of the resource is equalized in all uses.

5. The market demand curve for all consumers is derived by adding horizontally the separate demand curves of each consumer. A demand curve can shift for many reasons. For example, a rise in income will normally shift \( DD \) rightward, thus increasing demand; a rise in the price of a substitute good (e.g., chicken for beef) will also create a similar upward shift in demand; a rise in the price of a complementary good (e.g., hamburger buns for beef) will in turn cause the \( DD \) curve to shift downward and leftward. Still other factors—changing tastes, population, or expectations—can affect demand.

6. We can gain added insight into the factors that cause downward-sloping demand by separating the effect of a price rise into substitution and income effects. (a) The substitution effect occurs when a higher price leads to substitution of other goods to meet satisfactions; (b) the income effect means that a price increase lowers real income and thereby reduces the desired consumption of most commodities. For most goods, substitution and income effects of a price increase reinforce one another and lead to the law of downward-sloping demand. We measure the quantitative responsiveness of demand to income by the income elasticity, which is the percentage change in quantity demanded divided by the percentage change in income.

7. Remember that it is the tail of marginal utility that wags the market dog of prices. This point is emphasized by the concept of consumer surplus. We pay the same price for the last quart of milk as for the first. But, because of the law of diminishing marginal utility, marginal utilities of earlier units are greater than that of the last unit. This means that we would have been willing to pay more than the market price for each of the earlier units. The excess of total value over market value is called consumer surplus. Consumer surplus reflects the benefit we gain from being able to buy all units at the same low price. In simplified cases, we can measure consumer surplus as the area between the demand curve and the price line. It is a concept relevant for many public decisions—such as deciding when the community should incur the heavy expenses of a road or bridge or set aside land for a wilderness area.

CONCEPTS FOR REVIEW

utility, marginal utility
utilitarianism
law of diminishing marginal utility
ordinal utility
demand shifts from income and other sources

equimarginal principle: \( \frac{MU_1}{P_1} = \frac{MU_2}{P_2} = \cdots = MU \) per $ of income
QUESTIONS FOR DISCUSSION

1. Explain the meaning of utility. What is the difference between total utility and marginal utility? Explain the law of diminishing marginal utility and give a numerical example.

2. Each week, Tom Wu buys two hamburgers at $2 each, eight cokes at $0.50 each, and eight slices of pizza at $1 each, but he buys no hot dogs at $1.50 each. What can you deduce about Tom’s marginal utility for each of the four goods?

3. Which pairs of the following goods would you classify as complementary, substitute, or independent goods? beef, ketchup, lamb, cigarettes, gum, pork, radio, television, air travel, bus travel, taxis, and paperbacks? Illustrate the resulting shift in the demand curve for one good when the price of another good goes up. How would a change in income affect the demand curve for air travel? The demand curve for bus travel?

4. Why is it wrong to say, “Utility is maximized when the marginal utilities of all goods are exactly equal”? Correct the statement and explain.

5. Here is a way to think about consumer surplus as it applies to movies:
   a. How many movies did you watch last year?
   b. How much in total did you pay to watch movies last year?
   c. What is the maximum you would pay to see the movies you watched last year?
   d. Calculate c minus b. That is your consumer surplus from movies.

FURTHER READING AND INTERNET WEBSITES

Further Reading

An advanced treatment of consumer theory can be found in intermediate textbooks; see the Further Reading section in Chapter 3 for some good sources.

Utilitarianism was introduced in Jeremy Bentham, An Introduction to the Principles of Morals (1789).


Consumers often need help in judging the utility of different products. Look at Consumer Reports for articles that attempt to rate products. They sometimes rank products as “Best Buys,” which might mean the most utility per dollar of expenditure.

Jeffrey A. Miron and Jeffrey Zwiebel, “The Economic Case against Drug Prohibition,” Journal of Economic Perspectives, Fall 1995, pp. 175–192, is an excellent nontechnical survey of the economics of drug prohibition.

Websites


Practical guides for consumers are provided at the government site www.consumer.gov. The organization Public Citizen lobbies in Washington “for safer drugs and medical devices, cleaner and safer energy sources, a cleaner environment, fair trade, and a more open and democratic government.” Its website at www.citizen.org contains articles on many consumer, labor, and environmental issues.

You can read the Nobel lectures of laureates Akerlof, Kahneman, and Smith, with their views on behavioral economics, at nobelprize.org/nobel_prizes/economics/laureates/.
6. Consider the following table showing the utility of different numbers of days skied each year:

<table>
<thead>
<tr>
<th>Number of days skied</th>
<th>Total utility ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>70</td>
</tr>
<tr>
<td>2</td>
<td>110</td>
</tr>
<tr>
<td>3</td>
<td>146</td>
</tr>
<tr>
<td>4</td>
<td>176</td>
</tr>
<tr>
<td>5</td>
<td>196</td>
</tr>
<tr>
<td>6</td>
<td>196</td>
</tr>
</tbody>
</table>

Construct a table showing the marginal utility for each day of skiing. Assuming that there are 1 million people with preferences shown in the table, draw the market demand curve for ski days. If lift tickets cost $40 per day, what are the equilibrium price and quantity of days skied?

7. For each of the commodities in Table 5-2, calculate the impact of a doubling of price on quantity demanded. Similarly, for the goods in Table 5-3, what would be the impact of a 50 percent increase in consumer incomes?

8. As you add together the identical demand curves of more and more people (in a way similar to the procedure in Figure 5-2), the market demand curve becomes flatter and flatter on the same scale. Does this fact indicate that the elasticity of demand is becoming larger and larger? Explain your answer carefully.

9. An interesting application of supply and demand to addictive substances compares alternative techniques for supply restriction. For this problem, assume that the demand for addictive substances is inelastic.
   a. One approach (used today for heroin and cocaine and for alcohol during Prohibition) is to reduce supply at the nation’s borders. Show how this raises price and increases the total income of the suppliers in the drug industry.
   b. An alternative approach (followed today for tobacco and alcohol) is to tax the goods heavily. Using the tax apparatus developed in Chapter 4, show how this reduces the total income of the suppliers in the drug industry.
   c. Comment on the difference between the two approaches.

10. Demand may be price-elastic for casual users of drugs—ones who are not addicted or for whom substitute products are readily available. In this case, restrictions or price increases will have a significant impact on use. Draw a supply and demand diagram like Figure 5-4 where the demand curve is price-elastic. Show the effect of a steep tax on quantity demanded. Show that, because demand is price-elastic, total spending on drugs with restrictions will fall. Explain why this analysis would support the argument of those who would severely limit the availability of addictive substances.

11. Suppose you are very rich and very fat. Your doctor has advised you to limit your food intake to 2000 calories per day. What is your consumer equilibrium for food consumption?

12. Numerical problem on consumer surplus: Assume that the demand for travel over a bridge takes the form

\[ Y = 1,000,000 - 50,000P \]

where \( Y \) is the number of trips over the bridge and \( P \) is the bridge toll (in dollars).
   a. Calculate the consumer surplus if the bridge toll is $0, $1, and $20.
   b. Assume that the cost of the bridge is $1,800,000. Calculate the toll at which the bridge owner breaks even. What is the consumer surplus at the break-even toll?
   c. Assume that the cost of the bridge is $8 million. Explain why the bridge should be built even though there is no toll that will cover the cost.
Appendix 5

GEOMETRICAL ANALYSIS OF CONSUMER EQUILIBRIUM

An alternative and more advanced approach to deriving demand curves uses the approach called indifference curves. This appendix derives the major conclusions of consumer behavior with this new tool.

THE INDIFFERENCE CURVE

Start by assuming that you are a consumer who buys different combinations of two commodities, say, food and clothing, at a given set of prices. For each combination of the two goods, assume that you prefer one to the other or are indifferent between the pair. For example, when asked to choose between combination A of 1 unit of food and 6 units of clothing and combination B of 2 units of food and 3 of clothing, you might (1) prefer A to B, (2) prefer B to A, or (3) be indifferent between A and B.

Now suppose that A and B are equally good in your eyes—that you are indifferent as to which of them you receive. Let us consider some other combinations of goods about which you are likewise indifferent, as listed in the table for Figure 5A-1.

Figure 5A-1 shows these combinations diagrammatically. We measure units of clothing on one axis and units of food on the other. Each of our four combinations of goods is represented by its point, A, B, C, D. But these four are by no means the only combinations among which you are indifferent. Another batch, such as 1½ units of food and 4 of clothing, might be ranked as equal to A, B, C, or D, and there are many others not shown. The curved contour of Figure 5A-1, linking up the four points, is an indifference curve. The points on the curve represent consumption bundles among which the consumer is indifferent; all are equally desirable.

Law of Substitution

Indifference curves are drawn as bowl-shaped, or convex to the origin. Hence, as you move downward and to the right along the curve—a movement that implies increasing the quantity of food and reducing the units of clothing—the curve becomes flatter. The curve is drawn in this way to illustrate a property that seems most often to hold true in reality and which we call the law of substitution:

The scarcer a good, the greater its relative substitution value; its marginal utility rises relative to the marginal utility of the good that has become plentiful.

Thus, in going from A to B in Figure 5A-1, you would swap 3 of your 6 clothing units for 1 extra food unit. But from B to C, you would sacrifice only 1 unit of your remaining clothing supply to obtain a third food unit—a 1-for-1 swap. For a fourth unit of food, you would sacrifice only ½ unit from your dwindling supply of clothing.

If we join the points A and B of Figure 5A-1, we find that the slope of the resulting line (neglecting its negative sign) has a value of 3. Join B and C, and the slope is 1; join C and D, and the slope is ½. These figures—3, 1, ½—are the substitution ratios (sometimes called the marginal rates of substitution) between the two goods. As the size of the movement along the curve becomes very small, the closer the substitution ratio comes to the actual slope of the indifference curve.

The slope of the indifference curve is the measure of the goods’ relative marginal utilities, or of the substitution terms on which—for very small changes—the consumer would be willing to exchange a little less of one good in return for a little more of the other.

An indifference curve that is convex in the manner of Figure 5A-1 conforms to the law of substitution. As the amount of food you consume goes up—and the quantity of clothing goes down—food must become relatively cheaper in order for you to be persuaded to take a little extra food in exchange for a little sacrifice of clothing. The precise shape and slope of an indifference curve will, of course, vary from one consumer to the next, but the typical shape will take the form shown in Figures 5A-1 and 5A-2.

The Indifference Map

The table in Figure 5A-1 is one of an infinite number of possible tables. We could start with a more preferred consumption situation and list some of the different combinations that would bring the consumer this higher level of satisfaction. One such table might have begun with 2 food units and 7 clothing units.
another with 3 food units, 8 clothing units. Each table could be portrayed graphically, each with a corresponding indifference curve.

Figure 5A-2 shows four such curves; the curve from Figure 5A-1 is labeled $U_3$. This diagram is analogous to a geographic contour map. A person who walks along the path indicated by a particular height contour on such a map is neither climbing nor descending; similarly, the consumer who moves from one position to another along a single indifference curve enjoys neither increasing nor decreasing satisfaction from the change in consumption. Only a few of the possible indifference curves are shown in Figure 5A-2.

Note that as we increase both goods and thus move in a northeasterly direction across this map, we are reaching higher and higher levels of satisfaction (assuming that the consumer gets greater satisfaction from receiving increased quantities of both goods). Curve $U_3$ stands for a higher level of satisfaction than

![A Consumer's Indifference Curve](image1)

**FIGURE 5A-1 Indifference Curve for a Pair of Goods**

Getting more of one good compensates for giving up some of the other. The consumer likes situation $A$ exactly as much as $B$, $C$, or $D$. The food-clothing combinations that yield equal satisfaction are plotted as a smooth indifference curve. This is convex from below in accord with the law of substitution, which says that as you get more of a good, its substitution ratio, or the indifference curve’s slope, diminishes.

<table>
<thead>
<tr>
<th>Food</th>
<th>Clothing</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
</tr>
</tbody>
</table>

![Indifference Combinations](image2)

**FIGURE 5A-2 A Family of Indifference Curves**

The curves labeled $U_1$, $U_2$, $U_3$, and $U_4$ represent indifference curves. Which indifference curve is most preferred by the consumer?
The budget limit on expenditures can be seen in a numerical table. The total cost of each budget (reckoned as \($1.50F + $1C\)) adds up to exactly $6 of income. We can plot the budget constraint as a straight line whose absolute slope equals the \(P_F/P_C\) ratio. \(NM\) is the consumer’s budget line. When income is $6, with food and clothing prices $1.50 and $1, the consumer can choose any point on this budget line. (Why is its slope $1.50/$1 = \(3/2\)?)

We call \(NM\) the consumer’s budget line or budget constraint.

$U_2 > U_1$ for a higher level of satisfaction than $U_3$; and so forth.

**FIGURE 5A-3 Income Constrains Consumer Spending**

The budget limit on expenditures can be seen in a numerical table. The total cost of each budget (reckoned as \($1.50F + $1C\)) adds up to exactly $6 of income. We can plot the budget constraint as a straight line whose absolute slope equals the \(P_F/P_C\) ratio. \(NM\) is the consumer’s budget line. When income is $6, with food and clothing prices $1.50 and $1, the consumer can choose any point on this budget line. (Why is its slope $1.50/$1 = \(3/2\)?)

We call \(NM\) the consumer’s budget line or budget constraint.

---

1. This is so because, if we designate quantities of food and clothing bought as $F$ and $C$, respectively, total expenditure on food must be $1.50F$ and total expenditure on clothing $1C$. If daily income and expenditure are $6$, the following equation must hold: $6 = 1.50F + 1C$. This is a linear equation, the equation of the budget line $NM$. Note:

$$\text{Arithmetic slope of } NM = \frac{1.50}{1} = \frac{\text{price of food}}{\text{price of clothing}}$$
THE EQUILIBRIUM POSITION OF TANGENCY

Now we are ready to put our two parts together. The axes of Figure 5A-3 are the same as those of Figures 5A-1 and 5A-2. We can superimpose the blue budget line $NM$ upon this green consumer indifference map, as shown in Figure 5A-4. The consumer is free to move anywhere along NM. Positions to the right and above NM are not allowed because they require more than $6 of income; positions to the left and below NM are irrelevant because the consumer is assumed to spend the full $6.

Where will the consumer move? Obviously, to that point which yields the greatest satisfaction—that is, to the highest possible indifference curve—which in this case must be at the green point $B$. At $B$, the budget line just touches, but does not cross, the indifference curve $U_4$. At this point of tangency, where the budget line just kisses but does not cross an indifference contour, is found the highest utility contour the consumer can reach.

Geometrically, the consumer is at equilibrium where the slope of the budget line (which is equal to the ratio of food to clothing prices) is exactly equal to the slope of the indifference curve (which is equal to the ratio of the marginal utilities of the two goods).

Consumer equilibrium is attained at the point where the budget line is tangent to the highest indifference curve. At that point, the consumer’s substitution ratio is just equal to the slope of the budget line.

Put differently, the substitution ratio, or the slope of the indifference curve, is the ratio of the marginal utility of food to the marginal utility of clothing. So our tangency condition is just another way of stating that the ratio of prices must be equal to the ratio of marginal utilities; in equilibrium, the consumer is getting the same marginal utility from the last penny spent on food as from the last penny spent on clothing. Therefore, we can derive the following equilibrium condition:

$$\frac{P_F}{P_C} = \text{substitution ratio} = \frac{MU_F}{MU_C}$$

This is exactly the same condition as we derived for utility theory in the main part of this chapter.

CHANGES IN INCOME AND PRICE

Two important applications of indifference curves are frequently used to consider the effects of (a) a change in money income and (b) a change in the price of one of the two goods.

Income Change

Assume, first, that the consumer’s daily income is halved while the two prices remain unchanged. We could prepare another table, similar to the table for Figure 5A-3, showing the new consumption possibilities. Plotting these points on a diagram such as Figure 5A-5, we should find that the new budget line occupies the position $NM'$ in Figure 5A-5. The line has made a parallel shift inward. The consumer is...
DERIVING THE DEMAND CURVE

We are now in a position to derive the demand curve. Look carefully at Figure 5A-6. Note that as we increased the price of food from $1.50 per unit to $3 per unit, we kept other things constant. Tastes as represented by the indifference curves did not change, and money income and the price of clothing stayed constant. Therefore, we are in the ideal position to trace the demand curve for food. At a price of $1.50, the consumer buys 2 units of food, shown as equilibrium point B. When the price rises to $3 per unit, the food purchased is 1 unit, at equilibrium point B′. A tangency condition for consumer equilibrium applies here as before.

The common sense of such a shift is clear. Since the price of clothing is unchanged, point N is just as available as it was before. But since the price of food has risen, point M (which represents 4 food units) is no longer attainable. With food costing $3 per unit, only 2 units can now be bought with a daily income of $6. So the new budget line still passes through N, but it must pivot at N and pass through M′, which is to the left of M.

Equilibrium is now at B′, and we have a new tangency point. Higher food price has definitely reduced food consumption, but clothing consumption may move in either direction. To clinch your understanding, work out the cases of an increase in income and a fall in the price of clothing or food.

**DERIVING THE DEMAND CURVE**

We are now in a position to derive the demand curve. Look carefully at Figure 5A-6. Note that as we increased the price of food from $1.50 per unit to $3 per unit, we kept other things constant. Tastes as represented by the indifference curves did not change, and money income and the price of clothing stayed constant. Therefore, we are in the ideal position to trace the demand curve for food. At a price of $1.50, the consumer buys 2 units of food, shown as equilibrium point B. When the price rises to $3 per unit, the food purchased is 1 unit, at equilibrium point B′. A tangency condition for consumer equilibrium applies here as before.

The common sense of such a shift is clear. Since the price of clothing is unchanged, point N is just as available as it was before. But since the price of food has risen, point M (which represents 4 food units) is no longer attainable. With food costing $3 per unit, only 2 units can now be bought with a daily income of $6. So the new budget line still passes through N, but it must pivot at N and pass through M′, which is to the left of M.

Equilibrium is now at B′, and we have a new tangency point. Higher food price has definitely reduced food consumption, but clothing consumption may move in either direction. To clinch your understanding, work out the cases of an increase in income and a fall in the price of clothing or food.

**Single Price Change**

Now return our consumer to his previous daily income of $6, but assume that the price of food rises from $1.50 to $3 while the price of clothing is unchanged. Again we must examine the change in the budget line. This time we find that it has pivoted on point N and is now NM′, as illustrated in Figure 5A-6.3

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Equilibrium is now at B′, and we have a new tangency point. Higher food price has definitely reduced food consumption, but clothing consumption may move in either direction. To clinch your understanding, work out the cases of an increase in income and a fall in the price of clothing or food.
If you draw in the budget line corresponding to a price of $6 per unit of food, the equilibrium occurs at point $B'$, and food purchases are 0.45 unit. Now plot the price of food against the purchases of food, again holding other things constant. You will have derived a neat downward-sloping demand curve from indifference curves. Note that we have done this without ever needing to mention the term “utility”—basing the derivation solely on measurable indifference curves.

**SUMMARY TO APPENDIX**

1. An indifference curve depicts the points of equally desirable consumption bundles. The indifference contour is usually drawn convex (or bowl-shaped) in accordance with the law of diminishing relative marginal utilities.

2. When a consumer has a fixed money income, all of which she spends, and is confronted with market prices of two goods, she is constrained to move along a straight line called the budget line or budget constraint. The line’s slope will depend on the ratio of the two market prices; how far out it lies will depend on the size of her income.

3. The consumer will move along this budget line until reaching the highest attainable indifference curve. At this point, the budget line will touch, but not cross, an indifference curve. Hence, equilibrium is at the point of tangency, where the slope of the budget line (the ratio of the prices) exactly equals the slope of the indifference curve (the substitution ratio or the ratio of the marginal utilities of the two goods). This gives additional proof that, in equilibrium, marginal utilities are proportional to prices.

4. A fall in income will move the budget line inward in a parallel fashion, usually causing less of both goods to be bought. A change in the price of one good alone, other things being constant, will cause the budget line to pivot so as to change its slope. After a price or income change, the consumer will again attain a new tangency point of highest satisfaction. At every point of tangency, the marginal utility per dollar is equal for every good. By comparing the new and old equilibrium points, we trace the usual downward-sloping demand curve.

**CONCEPTS FOR REVIEW**

- indifference curves
- convexity of indifference curves
- slope or substitution ratio
- budget line or budget constraint
- law of diminishing relative marginal utilities

**OPTIMAL TANGENCY CONDITION:**

\[ \frac{P_f}{P_c} = \frac{MU_f}{MU_c} \]

**QUESTIONS FOR DISCUSSION**

1. Draw the indifference curves (a) between complementary goods like left shoes and right shoes and (b) between perfect substitutes like two bottles of cola sitting next to each other in a store.

2. Consider noodles and yachts. Draw a set of indifference curves and budget lines like those in Figure 5A-5 which show noodles as an inferior good and yachts as a “luxury” with an income elasticity greater than 1.