PART II
PRODUCERS, CONSUMERS, AND COMPETITIVE MARKETS

CHAPTER 3
CONSUMER BEHAVIOR

QUESTIONS FOR REVIEW

1. What are the four basic assumptions about individual preferences? Explain the significance or meaning of each.

   (1) Preferences are complete: this means that the consumer is able to compare and rank all possible baskets; (2) Preferences are transitive: this means that preferences are consistent, in that if bundle A is preferred to bundle B and bundle B is preferred to bundle C, then we should be able to conclude that bundle A is preferred to bundle C; (3) More is preferred to less: this means that all goods are desirable, and that the consumer will always prefer to have more of a good; (4) Diminishing marginal rate of substitution: this means that indifference curves are convex, and that the slope of the indifference curve increases (becomes less negative) as we move down along the curve. As a consumer moves down along her indifference curve she is willing to give up fewer units of the good on the vertical axis in exchange for one more unit of the good on the horizontal axis. This assumption also means that balanced market baskets are preferred to baskets that have a lot of one good and very little of the other good.

2. Can a set of indifference curves be upward sloping? If so, what would this tell you about the two goods?

   A set of indifference curves can be upward sloping if we violate assumption number three; more is preferred to less. When a set of indifference curves is upward sloping, it means one of the goods is a “bad” in that the consumer prefers less of the good rather than more of the good. The positive slope means that the consumer will accept more of the bad good only if she also receives more of the other good in return.

   As we move up along the indifference curve the consumer has more of the good she likes, and also more of the good she does not like.

3. Explain why two indifference curves cannot intersect.

   The explanation is most easily achieved with the aid of a graph such as Figure 3.3, which shows two indifference curves intersecting at point A. We know from the definition of an indifference curve that a consumer has the same level of utility along any given curve. In this case, the consumer is indifferent between bundles A and B because they both lie on indifference curve \( U_1 \). Similarly, the consumer is indifferent between bundles A and C because they both lie on indifference curve \( U_2 \). By the transitivity of preferences this consumer should also be indifferent between C and B. However, we see from the graph that C lies above B, so C must be preferred to B. Thus, the fact that indifference curves cannot intersect is proven.
4. Jon is always willing to trade one can of coke for one can of sprite, or one can of sprite for one can of coke.
   a. What can you say about Jon’s marginal rate of substitution?
      Jon’s marginal rate of substitution can be defined as the number of cans of coke he would be willing to give up in exchange for a can of sprite. Since he is always willing to trade one for one, his MRS is equal to 1.

   b. Draw a set of indifference curves for Jon.
      Since Jon is always willing to trade one can of coke for one can of sprite, his indifference curves are linear with a slope of \(-1\).

   c. Draw two budget lines with different slopes and illustrate the satisfaction-maximizing choice. What conclusion can you draw?
      Jon’s indifference curves are linear with a slope of \(-1\). Jon’s budget line is also linear, and will have a slope that reflects the ratio of the two prices. If Jon’s budget line is steeper than his indifference curves then he will choose to consume only the good on the vertical axis. If Jon’s budget line is flatter than his indifference curves then he will choose to consume only the good on the horizontal axis. Jon will always choose a corner solution, unless his budget line has the same slope as his indifference curves. In this case any combination of Sprite and Coke that uses up his entire income will maximize his satisfaction.

5. What happens to the marginal rate of substitution as you move along a convex indifference curve? A linear indifference curve?
   The MRS measures how much of a good you are willing to give up in exchange for one more unit of the other good, keeping utility constant. The MRS diminishes along a convex indifference curve in that as you move down along the indifference curve, you are willing to give up less and less of the one good in exchange for the other. The MRS is also the slope of the indifference curve, which increases (becomes less negative) as you move down along the indifference curve. The MRS is constant along a linear indifference curve, since in this case the slope does not change.
Chapter 3: Consumer Behavior

consumer is always willing to trade the same number of units of one good in exchange for the other.

6. Explain why an MRS between two goods must equal the ratio of the price of the goods for the consumer to achieve maximum satisfaction.

The MRS describes the rate at which the consumer is willing to trade one good for another to maintain the same level of satisfaction. The ratio of prices describes the trade-off that the market is willing to make between the same two goods. The tangency of the indifference curve with the budget line represents the point at which the trade-offs are equal and consumer satisfaction is maximized. If the MRS between two goods is not equal to the ratio of prices, then the consumer could trade one good for another at market prices to obtain higher levels of satisfaction. For example, if the slope of the budget line (the ratio of the prices) is \( -4 \) then the consumer can trade 4 units of good 2 for one unit of good 1. If the MRS at the current bundle is \( -6 \), then the consumer is willing to trade 6 units of good 2 for one unit of good 1. Since the two slopes are not equal the consumer is not maximizing her satisfaction. The consumer is willing to trade 6 but only has to trade 4, so she should make the trade. This trading continues until the highest level of satisfaction is achieved. As trades are made, the MRS will change and become equal to the price ratio.

7. Describe the indifference curves associated with two goods that are perfect substitutes. What if they are perfect complements?

Two goods are perfect substitutes if the MRS of one for another is a constant number. Given the MRS is a constant number, the slope of the indifference curves will be constant, and the indifference curves are therefore linear. If two goods are perfect complements, the indifference curves are \( L \)-shaped. In this case the consumer wants to consume the two goods in a fixed proportion, say one unit of good 1 for every 1 unit of good 2. If she has more of one good but not more of the other then she does not get any extra satisfaction.

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

Ordinal utility implies an ordering among alternatives without regard for intensity of preference. For example, if the consumer’s first choice is preferred to their second choice, then utility from the first choice will be higher than utility from the second choice. How much higher is not important. An ordinal utility function generates a ranking of bundles and no meaning is given to the utility number itself. Cardinal utility implies that the intensity of preferences may be quantified, and that the utility number itself has meaning. An ordinal ranking is all that is needed to rank consumer choices. It is not necessary to know how intensely a consumer prefers basket \( A \) over basket \( B \); it is enough to know that \( A \) is preferred to \( B \).

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

Three assumptions are required to address this question: 1) that a Mercedes costs more than a Volkswagen; 2) that the East German consumers’ utility function comprises two goods, automobiles and all other goods evaluated in deutsche marks; and 3) that East Germans have incomes. Based on these assumptions, we can surmise that while East German consumers may prefer a Mercedes to a Volkswagen, they either cannot afford a Mercedes or they prefer a bundle of other goods plus a Volkswagen to a Mercedes alone.

While the marginal utility of consuming a Mercedes exceeds the marginal utility of consuming a Volkswagen, the consumer will consider marginal utility per dollar for each good. This means the marginal utility per dollar must have been higher for the
Chapter 3: Consumer Behavior

Volkswagen since consumers flocked to the Volkswagen dealerships and not the Mercedes dealerships.

10. Draw a budget line and then draw an indifference curve to illustrate the satisfaction maximizing choice associated with two products. Use your graph to answer the following questions.

a. Suppose that one of the products is rationed. Explain why the consumer is likely to be worse off.

When goods are not rationed, the consumer is able to choose the satisfaction-maximizing bundle where the slope of the budget line is equal to the slope of the indifference curve, or the price ratio is equal to the MRS. This is point A in the graph below. If good 1 is now rationed the consumer will not be able to attain the utility maximizing point. He or she will have to consume more of the other good instead. This is point B below.
Chapter 3: Consumer Behavior

b. Suppose now that the price of one of the products is fixed at a level below the current price. As a result, the consumer is not able to purchase as much as she would like of the product. Can you tell if the consumer is better off or worse off?

When the price of the good is fixed at a level below the current (equilibrium) price, there will be a shortage of the good and the good will have to be effectively rationed. As in the question above, the consumer is worse off because she is not able to attain her utility maximizing point.

11. Based on his preferences, Bill is willing to trade 4 movie tickets for 1 ticket to a basketball game. If movie tickets cost $8 each and a ticket to the basketball game costs $40, should Bill make the trade? Why or why not?

No Bill should not make the trade. If he gives up the 4 movie tickets then he will save $8 per ticket for a total of $32. However, this is not enough for a basketball ticket. He would in fact have to give up 5 movie tickets if he wanted to buy another basketball ticket. Notice also, that the marginal utility per dollar is higher for movie tickets so Bill will be better off if he consumes more movie tickets and fewer basketball tickets. To figure this out recall that what Bill is willing to do defines his MRS. His MRS is 4 so this means that the marginal utility of a basketball game is 4 and the marginal utility of a movie is 1:

\[ MRS = -4 = -\frac{MU_{\text{basketball}}}{MU_{\text{movie}}} = -\frac{4}{1}. \]

Now the marginal utility per dollar can be computed:

\[ \frac{MU_{\text{basketball}}}{P_{\text{basketball}}} = \frac{4}{40} = \frac{1}{10}, \]
\[ \frac{MU_{\text{movie}}}{P_{\text{movie}}} = \frac{1}{8}. \]

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

The equal marginal principle states that the ratio of the marginal utility to price must be equal across all goods to obtain maximum satisfaction. In other words, utility maximization is achieved when the budget is allocated so that the marginal utility per dollar of expenditure is the same for each good. If the marginal utility per dollar is not equal then utility can be increased by allocating more dollars to the good with the higher marginal utility per dollar. The consumer will obtain more “bang for the buck” if they reallocate their dollars.

If marginal utility is increasing, the consumer maximizes satisfaction by consuming ever larger amounts of the good. Thus, the consumer would spend all income on one good, assuming a constant price, resulting in a corner solution. With a corner solution, the equal marginal principle cannot hold.

13. The price of computers has fallen substantially over the past two decades. Use this drop in price to explain why the Consumer Price Index is likely to overstate substantially the cost-of-living index for individuals who use computers intensively.

The consumer price index measures the cost of a typical basket of goods purchased by the consumer in the current year relative to the cost of the basket in the base year. Each good in the basket is assigned a weight, which reflects the importance of the good to the consumer, and the weights are kept fixed from year to year. The problem with fixing the weights is that consumers will shift their purchases from year to year to give more weight to goods whose prices have fallen, and less weight to goods whose prices have risen. The CPI will therefore give too much weight to goods whose prices have risen, and too little weight to goods whose prices have fallen. For the individual who
uses computers intensively, the fixed weight for computers in the basket will understate the importance of this good, and will hence understate the effect of the fall in the price of computers. The CPI will overstate the rise in the cost of living for this type of individual.

14. Explain why the Paasche index will generally understate the ideal cost-of-living index.

The Paasche index measures the current cost of the current bundle of goods relative to the base year cost of the current bundle of goods. The Paasche index will understate the ideal cost of living because it assumes the individual will buy the current year bundle in the base period. In reality, at base year prices the consumer would have been able to attain the same level of utility at a lower cost by altering their consumption bundle. Since the base year cost is overstated, the denominator will be larger and the index will be lower, or understated.

**EXERCISES**

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

   a. **cigarettes**
   
   The assumption that preferences do not change is a reasonable one if choices are independent across time. It does not hold, however, when “habit-forming” or addictive behavior is involved, as in the case of cigarettes: the consumption of cigarettes in one period influences their consumption in the next period.

   b. **dinner for the first time at a restaurant with a special cuisine**
   
   This example is parallel to examples of adventure seeking. For some, a new dining experience creates enthusiasm to seek out more exciting and different cuisines and dishes. For others, they develop a fondness for regularity and consistency or fear of the new and unknown. In either of these cases, choices change as consumption occurs.

2. Draw indifference curves that represent the following individuals’ preferences for hamburgers and soft drinks. Indicate the direction in which the individuals’ satisfaction (or utility) is increasing.

   a. **Joe has convex preferences and dislikes both hamburgers and soft drinks.**
   
   Since Joe dislikes both goods, his set of indifference curves will be bowed inwards towards the origin instead of outwards, as in the normal case where more is preferred to less. Given he dislikes both goods, his satisfaction is increasing in the direction of the origin. Convexity of preferences implies his indifference curves will have the normal shape in that they are bowed towards the direction of increasing satisfaction. Convexity also implies that given any two bundles between which the consumer is indifferent, the “average” of the two bundles will be in the preferred set, or will leave him at least as well off.
Chapter 3: Consumer Behavior

b. Jane loves hamburgers and dislikes soft drinks. If she is served a soft drink, she will pour it down the drain rather than drink it.
Since Jane can freely dispose of the soft drink if it is given to her, she considers it to be a neutral good. This means she does not care about soft drinks one way or the other. With hamburgers on the vertical axis, her indifference curves are horizontal lines. Her satisfaction increases in the upward direction.

c. Bob loves hamburgers and dislikes soft drinks. If he is served a soft drink, he will drink it to be polite.
Since Bob will drink the soft drink in order to be polite, it can be thought of as a “bad”. When served another soft drink, he will require more hamburgers at the same time in order to keep his satisfaction constant. More soft drinks without more hamburgers will worsen his utility. More hamburgers and fewer soft drinks will increase his utility.

d. Molly loves hamburgers and soft drinks, but insists on consuming exactly one soft drink for every two hamburgers that she eats.
Molly wants to consume the two goods in a fixed proportion so her indifference curves are L-shaped. For any given amount of one good, she gets no extra satisfaction from having more of the other good. She will only increase her satisfaction if she has more of both goods.
e. **Bill likes hamburgers, but neither likes nor dislikes soft drinks.**

Like Jane, Bill considers soft drinks to be a neutral good. Since he does not care about soft drinks one way or the other we can assume that no matter how many he has, his utility will be the same. His level of satisfaction depends entirely on how many hamburgers he has.

f. **Mary always gets twice as much satisfaction from an extra hamburger as she does from an extra soft drink.**

How much extra satisfaction Mary gains from an extra hamburger or soft drink tells us something about the marginal utilities of the two goods, or about her MRS. If she always receives twice the satisfaction from an extra hamburger then her marginal utility from consuming an extra hamburger is twice her marginal utility from consuming an extra soft drink. Her MRS, with hamburgers on the vertical axis, is 1/2. Her indifference curves are straight lines with a slope of 1/2.
3. If Jane is currently willing to trade 4 movie tickets for 1 basketball ticket then she must like basketball better than movies. True or false? Explain.

This statement is not necessarily true. If she is always willing to trade 4 movie tickets for 1 basketball ticket then yes she likes basketball better because she will always gain the same satisfaction from 4 movie tickets as she does from 1 basketball ticket. However, it could be that she has convex preferences (diminishing marginal rate of substitution) and is at a bundle where she has a lot of movie tickets relative to basketball tickets. This would make her willing to give up more movie tickets to get another basketball ticket. It would not mean though that she liked basketball better. Her willingness to give up a good would in this case depend on the quantity of each good in her current basket.

4. Janelle and Brian each plan to spend $20,000 on the styling and gas mileage features of a new car. They can each choose all styling, all gas mileage, or some combination of the two. Janelle does not care at all about styling and wants the best gas mileage possible. Brian likes both equally and wants to spend an equal amount on the two features. Using indifference curves and budget lines, illustrate the choice that each person will make.

Assume styling is on the vertical axis and gas mileage is on the horizontal axis. Janelle has indifference curves that are vertical. If the styling is there she will take it, but she otherwise does not care about it. As her indifference curves move over to the right, she gains more gas mileage and more satisfaction. She will spend all $20,000 on gas mileage. Brian has indifference curves that are L-shaped. He will not spend more on one feature than on the other feature. He will spend $10,000 on styling and $10,000 on gas mileage.

5. Suppose that Bridget and Erin spend their income on two goods, food (F) and clothing (C). Bridget’s preferences are represented by the utility function \( U(F,C) = 10FC \), while Erin’s preferences are represented by the utility function \( U(F,C) = .20F^2C^2 \).

a. On a graph, with food on the horizontal axis and clothing on the vertical axis, identify the set of points that give Bridget the same level of utility as the bundle (10,5). Do the same for Erin on a separate graph.

Bridget receives a utility of 10*10*5=500 from this bundle. The indifference curve is represented by the equation 10FC=500 or FC=50. Some bundles on this indifference curve are (5,10), (10,5), (25,2), and (2,25). Erin receives a utility of .2*10*10*5*5=500 from the bundle (10,5). Her indifference curve is represented by the equation \( 500 = .2F^2C^2 \), or FC=120. This is the same indifference curve as Bridget. Both indifference curves have the normal, convex shape.

b. On the same two graphs, identify the set of bundles that give Bridget and Erin the same level of utility as the bundle (15,8).

For each person, plug in F=15 and C=8 into their respective utility functions. For Bridget, this gives her a utility of 1200, so her indifference curve is given by the equation 10FC=1200, or FC=120. Some bundles on this indifference curve are (12,10), (10,12), (3,40), and (40,3). For Erin, this bundle gives her a utility of 2880, so her indifference curve is given by the equation \( 2880 = .2F^2C^2 \), or FC=120. This is the same indifference curve as Bridget.

c. Do you think Bridget and Erin have the same preferences or different preferences? Explain.

They have the same preferences because for any given bundle they have the same level of utility. This means that they will rank all bundles in the same order. Note however, that it is not necessary that they receive the same level of utility to have the same set of preferences. All that is necessary is that they rank the bundles in the same order.
6. Suppose that Jones and Smith have each decided to allocate $1,000 per year to an entertainment budget in the form of hockey games or rock concerts. They both like hockey games and rock concerts and will choose to consume positive quantities of both goods. However, they differ substantially in their preferences for these two forms of entertainment. Jones prefers hockey games to rock concerts, while Smith prefers rock concerts to hockey games.

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

Given they each like both goods and they will each choose to consume positive quantities of both goods, we can assume their indifference curves have the normal convex shape. However since Jones has an overall preference for hockey and Smith has an overall preference for rock concerts, their two sets of indifference curves will have different slopes. Suppose that we place rock concerts on the vertical axis and hockey games on the horizontal axis, Jones will have a larger MRS than Smith. Jones is willing to give up more rock concerts in exchange for a hockey game since he prefers hockey games. The indifference curves for Jones will be steeper.

b. **Using the concept of marginal rate of substitution, explain why the two sets of curves are different from each other.**

At any combination of hockey games and rock concerts, Jones is willing to give up more rock concerts for an additional hockey game, whereas, Smith is willing to give up fewer rock concerts for an additional hockey game. Since the MRS is a measure of how many of one good (rock concerts) an individual is willing to give up for an additional unit of the other good (hockey games), then the MRS, and hence the slope of the indifference curves, will be different for the two individuals.

7. The price of DVDs (D) is $20 and the price of CDs (C) is $10. Philip has a budget of $100 to spend on the two goods. Suppose that he has already bought one DVD and one CD. In addition there are 3 more DVDs and 5 more CDs that he would really like to buy.

a. **Given the above prices and income, draw his budget line on a graph with CDs on the horizontal axis.**

His budget line is \( P_D D + P_C C = I \), or 20D+10C=100. If he spends his entire income on DVD's he could afford to buy 5. If he spends his entire income on CD's he could afford to buy 10.

b. **Considering what he has already purchased, and what he still wants to purchase, identify the three different bundles of CDs and DVDs that he could choose. Assume that he cannot purchase fractional units for this part of the question.**

Given he has already purchased one of each, for a total of $30, he has $70 left. Since he wants 3 more DVD's he can buy these for $60 and spend his remaining $10 on 1 CD. This is the first bundle below. He could also choose to buy only 2 DVD's for $40 and spend the remaining $30 on 3 CD's. He can choose the following bundles:

<table>
<thead>
<tr>
<th>Purchased Quantities</th>
<th>Total Quantities</th>
</tr>
</thead>
<tbody>
<tr>
<td>D  C</td>
<td>D   C</td>
</tr>
<tr>
<td>3  1</td>
<td>2   6</td>
</tr>
<tr>
<td>2  3</td>
<td>3   4</td>
</tr>
<tr>
<td>1  5</td>
<td>4   2</td>
</tr>
</tbody>
</table>
8. Anne has a job that requires her to travel three out of every four weeks. She has an annual travel budget and can either travel by train or by plane. The airline she typically flies with has a frequent traveler program that reduces the cost of her tickets depending on the number of miles she has flown in a given year. When she reaches 25,000 miles the airline will reduce the price of her tickets by 25% for the remainder of the year. When she reached 50,000 miles, the airline will reduce the price of her tickets by 50% for the remainder of the year. Graph Anne's budget line, with train miles on the vertical axis and plane miles on the horizontal axis.

The typical budget line is linear (with a constant slope) because the prices of the two goods do not change as the consumer buys more or less of a particular good. In this case, the price of airline miles will change depending on how many miles she purchases. As the price changes, the slope of the budget line will change. Since there are three prices, there will be three slopes, or two kinks, to the budget line. Since the price falls as she flies more miles, the budget line will become flatter with every price change. See the graph in the problem below.

9. Debra usually buys a soft drink when she goes to a movie theater, where she has a choice of three sizes: the 8 ounce drink costs $1.50, the 12 ounce drink, $2.00, and the 16 ounce drink, $2.25. Describe the budget constraint that Debra faces when deciding how many ounces of the drink to purchase. (Assume that Debra can costlessly dispose of any of the soft drink that she does not want.

First notice that as the size of the drink increases, the price per ounce decreases. When she buys the 8-ounce soft drink she pays \( \frac{1.50}{8 \text{ oz}} = 0.19 \text{ per oz}. \) When she buys the 12-ounce size she pays $0.17 per ounce, and when she buys the 16-ounce size, she pays $0.14 per ounce. Given that there are three different prices per ounce of soft drink, the budget line will have two kinks in it, as illustrated below. Notice that at each kink, the slope of the budget line gets flatter (due to the decreasing cost per ounce relative to the “other good” on the vertical axis).
10. Antonio buys 5 new college textbooks during his first year at school at a cost of $80 each. Used books cost only $50 each. When the bookstore announces that there will be a 10% increase in the price of new books and a 5% increase in the price of used books, Antonio’s father offers him $40 extra.

a. What happens to Antonio’s budget line? Illustrate the change with new books on the vertical axis.

In the first year he spends $80 each on 5 new books for a total of $400. For the same amount of money he could have bought 8 used textbooks. His budget line is therefore $80*New+50*Used=400. After the price change, new books cost $88, used books cost $52.5, and he has an income of $440. If he spends all of his income on new books, he can still afford to buy 5 new books, but can now afford to buy 8.4 used books if he buys only used books. The new budget line is $88*New+52.5*Used=440. The budget line has changed its slope and become flatter if we place used books on the horizontal axis.

b. Is Antonio worse or better off after the price change? Explain.

The first year he bought 5 books at a cost of $80 each for a total of $400. The new price of books is $88 and the cost of 5 new books is now $440. The $40 extra income will cover the price increase. Antonio is definitely not worse off since he can still afford the same number of new books. He may in fact be better off if he decides to switch to used books.

11. Consumers in Georgia pay twice as much for avocados as they do for peaches. However, avocados and peaches are equally priced in California. If consumers in both states maximize utility, will the marginal rate of substitution of peaches for avocados be the same for consumers in both states? If not, which will be higher?

The marginal rate of substitution of peaches for avocados is the amount of avocados that a person is willing to give up to obtain one additional peach. When consumers maximize utility, they set their marginal rate of substitution equal to the price ratio, which in this case is \( \frac{P_{peach}}{P_{avocado}} \). In Georgia, \( P_{avocado} = 2P_{peach} \), which means that when consumers are maximizing utility, \( MRS = \frac{P_{peach}}{P_{avocado}} = \frac{1}{2} \). In California, \( P_{avocado} = P_{peach} \), which means that when consumers are maximizing utility, \( MRS = \frac{P_{peach}}{P_{avocado}} = 1 \). The marginal rate of substitution is therefore not the same in both states, and will be higher in California.

12. Ben allocates his lunch budget between two goods, pizza and burritos.

a. Illustrate Ben’s optimal bundle on a graph with pizza on the horizontal axis.

This is the standard graph, where Ben’s budget line is linear and he consumes at the point where his indifference curve is tangent to his budget line. This places him on the highest possible indifference curve.

b. Suppose now that pizza is taxed, causing the price to increase by 20%. Illustrate Ben’s new optimal bundle.

When the price of pizza increases, the budget line will pivot inwards. This will shrink the size of Ben’s budget set and he will no longer be able to afford his old bundle. His new optimal bundle is where the indifference curve is tangent to his new budget line and this indifference curve is below his original indifference curve.
Chapter 3: Consumer Behavior

c. Suppose instead that pizza is rationed at a quantity less than Ben's desired quantity. Illustrate Ben's new optimal bundle.

Rationing the quantity of pizza that can be purchased will result in Ben not being able to choose his optimal bundle. He will have to choose a bundle on the budget line that is above his original bundle. This new bundle will have a lower level of utility.

13. Brenda wants to buy a new car and has a budget of $25,000. She has just found a magazine that assigns each car an index for styling and an index for gas mileage. Each index runs from 1-10, with 10 representing either the most styling or the best gas mileage.

While looking at the list of cars, Brenda observes that on average, as the style index rises by one unit, the price of the car increases by $5,000. She also observes that as the gas mileage index rises by one unit, the price of the car increases by $2,500.

a. Illustrate the various combinations of style (S) and gas mileage (G) that Brenda could select with her $25,000 budget. Place gas mileage on the horizontal axis.

For every $5,000 she spends on style the index rises by one so the most she can achieve is a car with a style index of 5. For every $2,500 she spends on gas mileage, the index rises by one so the most she can achieve is a car with a gas mileage index of 10. The slope of her “budget line” is -1/2.

b. Suppose Brenda’s preferences are such that she always receives three times as much satisfaction from an extra unit of styling as she does from gas mileage. What type of car will Brenda choose?

If Brenda always receives three times as much satisfaction from an extra unit of styling as she does from an extra unit of gas mileage then she is willing to trade one unit of styling for three units of gas mileage, and still maintain the same level of satisfaction. This is her MRS or the slope of her indifference curves, which is constant. Since the MRS is 1/3 and the slope of her budget line is -1/2, Brenda will choose all styling. You can also compute the marginal utility per dollar for styling and gas mileage and note that styling will be higher. In the graph below, she will move up to the highest possible indifference curve where she chooses all styling and no gas mileage.
c. Suppose that Brenda’s marginal rate of substitution (of gas mileage for styling) was equal to \( \frac{S}{4G} \). What value of each index would she like to have in her car?

To find the optimal value of each index, set MRS equal to the price ratio of 1/2 and cross multiply to get \( S=2G \). Now substitute into the budget \( 5000S+2500G=25000 \) to get \( G=2 \) and \( S=4 \).

d. Suppose that Brenda’s marginal rate of substitution (of gas mileage for styling) was equal to \( \frac{3S}{G} \). What value of each index would she like to have in her car?

To find the optimal value of each index set MRS equal to the price ratio of 1/2 and cross multiply to get \( G=6S \). Now substitute into the budget \( 5000S+2500G=25000 \) to get \( G=7.5 \) and \( S=1.25 \).

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

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

Let \( M = \text{meat} \) and \( P = \text{potatoes} \). Connie’s budget constraint is

\[
\$200 = 4M + 2P, \text{ or } \quad M = 50 - 0.5P.
\]

As shown in the figure below, with \( M \) on the vertical axis, the vertical intercept is 50. The horizontal intercept may be found by setting \( M = 0 \) and solving for \( P \).
b. Suppose also that her utility function is given by the equation \( u(M, P) = 2M + P \). What combination of meat and potatoes should she buy to maximize her utility? (Hint: Meat and potatoes are perfect substitutes.)

When the two goods are perfect substitutes, the indifference curves are linear. To find the slope of the indifference curve, choose a level of utility and find the equation for a representative indifference curve. Suppose \( u=50 \), then \( 2M+P=50 \), or \( M=25-0.5P \). Therefore, Connie’s budget line and her indifference curves have the same slope. Connie’s utility is equal to 100 when she buys 50 pounds of meat and no potatoes or no meat and 100 pounds of potatoes. The indifference curve for \( U = 100 \) coincides with her budget constraint. Any combination of meat and potatoes along this line will provide her with maximum utility.

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

Assume that potatoes are on the horizontal axis. Connie’s budget constraint has a slope of \(-1/2\) until Connie has purchased twenty pounds of potatoes, is then flat from 20 to 30 pounds of potatoes, since the ten next pounds of potatoes are free, and then has a slope of \(-1/2\) until it intercepts the potato axis at 110.

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

With the price of potatoes at $4, Connie may buy either 50 pounds of meat or 50 pounds of potatoes, or some combination in between. See Figure 3.14.d. She maximizes utility at \( U = 100 \) at point \( A \) when she consumes 50 pounds of meat and no potatoes. This is a corner solution.
15. Jane receives utility from days spent traveling on vacation domestically (D) and days spent traveling on vacation in a foreign country (F), as given by the utility function \( U(D,F) = 10DF \). In addition, the price of a day spent traveling domestically is $100, the price of a day spent traveling in a foreign country is $400, and Jane’s annual travel budget is $4,000.

a. Illustrate the indifference curve associated with a utility of 800 and the indifference curve associated with a utility of 1200.

The indifference curve with a utility of 800 has the equation \( 10DF = 800 \), or \( DF = 80 \). Choose combinations of D and F whose product is 80 to find a few bundles. The indifference curve with a utility of 1200 has the equation \( 10DF = 1200 \), or \( DF = 120 \). Choose combinations of D and F whose product is 120 to find a few bundles.

b. Graph Jane’s budget line on the same graph.

If Jane spends all of her budget on domestic travel she can afford 40 days. If she spends all of her budget on foreign travel she can afford 10 days.

c. Can Jane afford any of the bundles that give her a utility of 800? What about a utility of 1200?

Yes she can afford some of the bundles that give her a utility of 800 as part of this indifference curve lies below the budget line. She cannot afford any of the bundles that give her a utility of 1200 as this whole indifference curve lies above the budget line.

d. Find Jane’s utility maximizing choice of days spent traveling domestically and days spent in a foreign country.

The optimal bundle is where the slope of the indifference curve is equal to the slope of the budget line, and Jane is spending her entire income. The slope of the budget line is

\[
-\frac{P_D}{P_F} = -\frac{1}{4}.
\]

The slope of the indifference curve is
\[ MRS = - \frac{MU_D}{MU_F} = - \frac{10F}{10D} = - \frac{F}{D}. \]

Setting the two equal we get:
\[
\frac{F}{D} = \frac{1}{4}
\]
\[
4F = D.
\]

We now have two equations and two unknowns:
\[
4F = D
\]
\[
100D + 400F = 4000.
\]

Solving the above two equations gives \( D = 20 \) and \( F = 5 \). Utility is 1000.

This bundle is on an indifference curve between the two you had previously drawn.

16. Julio receives utility from consuming food (F) and clothing (C) as given by the utility function \( U(F,C) = FC \). In addition, the price of food is $2 per unit, the price of clothing is $10 per unit, and Julio's weekly income is $50.

a. What is Julio’s marginal rate of substitution of food for clothing when utility is maximized? Explain.

Utility is maximized when MRS (food for clothing) equals \( P_C/P_F \), the price ratio. Given that clothing is on the horizontal axis and food is on the vertical axis, then the price ratio is the slope of the budget line, which is price of clothing divided by the price of food or -5.

b. Suppose instead that Julio is consuming a bundle with more food and less clothing than his utility maximizing bundle. Would his marginal rate of substitution of food for clothing be greater than or less than your answer in part a? Explain.

In absolute value terms, the slope of his indifference curve at this non-optimal bundle is greater than the slope of his budget line. He is willing to give up more food than he has to at market prices to obtain one more unit of clothing. He will therefore find it optimal to give up some food in exchange for clothing.

17. The utility that Meredith receives by consuming food \( F \) and clothing \( C \) is given by \( u(F,C) = FC \). Suppose that Meredith's income in 1990 is $1,200 and the prices of food and clothing are $1 per unit for each. However, by 1995 the price of food has increased to $2 and the price of clothing to $3. Let 100 represent the cost of living index for 1990. Calculate the ideal and the Laspeyres cost-of-living index for Meredith for 1995. (Hint: Meredith will spend equal amounts on food and clothing with these preferences.)

First, we need to calculate \( F \) and \( C \), which make up the bundle of food and clothing which maximizes Meredith's utility given 1990 prices and her income in 1990. Use the hint to simplify the problem: Since she spends equal amounts on both goods, \( P_F F = P_C C \). Or, you can derive this same equation mathematically: With this utility function, \( MU_C = \Delta U/\Delta C = F \),
and \( MU_F = \frac{\Delta U}{\Delta F} = C \). To maximize utility, Meredith chooses a consumption bundle such that \( MU_F / MU_C = P_F / P_C \), which again yields \( P_F F = P_C C \).

From the budget constraint, we also know that:
\[
P_F F + P_C C = Y.
\]

Combining these two equations and substituting the values for the 1990 prices and income yields the system of equations:
\[
C = F \text{ and } C + F = 1,200.
\]

Solving these two equations, we find that:
\[
C = 600 \text{ and } F = 600.
\]

Laspeyres Index

The Laspeyres index represents how much more Meredith would have to spend in 1995 versus 1990 if she consumed the same amounts of food and clothing in 1995 as she did in 1990. That is, the Laspeyres index for 1995 (L) is given by:
\[
L = 100 \left( \frac{Y'}{Y} \right)
\]
where \( Y' \) represents the amount Meredith would spend at 1995 prices consuming the same amount of food and clothing as in 1990. In 1995, 600 clothing and 600 food would cost \((3)(600) + (2)(600) = 3000\).

Therefore, the Laspeyres cost-of-living index is:
\[
L = 100 \left( \frac{3000}{1200} \right) = 250.
\]

Ideal Index

The ideal index represents how much Meredith would have to spend on food and clothing in 1995 to get the same amount of utility as she had in 1990. That is, the ideal index for 1995 (I) is given by:
\[
I = 100 \left( \frac{Y''}{Y} \right), \text{ where } Y'' = P'_F F' + P'_C C' = 2F' + 3C'
\]
where \( F' \) and \( C' \) are the amount of food and clothing that give Meredith the same utility as she had in 1990. \( F' \) and \( C' \) must also be such that Meredith spends the least amount of money at 1995 prices to attain the 1990 utility level.

The bundle \((F',C')\) will be on the same indifference curve as \((F,C)\) so \( F'C' = FC = 360,000 \) in utility. If Meredith’s income is adjusted in 1995 so that the bundle \((F',C')\) is maximizing her utility given her income, then the indifference curve at this point will be tangent to the budget line with slope \(-P'_F/P'_C\), where \( P'_F \) and \( P'_C \) are the prices of food and clothing in 1995.

Using \( MU_F / MU_C = P_F / P_C \) we know that \( 2F' = 3C' \).

We now have two equations: \( F'C' = 360,000 \) and \( 2F' = 3C' \).

Solving for \( F' \) yields:
\[
F' \left[ \frac{2}{3} F' \right] = 360,000 \text{ or } F' = \sqrt[3]{\frac{3\times360,000}{2}} = 734.8.
\]

From this, we obtain \( C' \):
\[
C' = \frac{2}{3} F' = \frac{2}{3} \times 734.8 = 489.9.
\]

In 1995, the bundle of 734.8 food and 489.9 clothing would cost $2939.60 and Meredith would still get 360,000 in utility.

We can now calculate the ideal index:
\[
I = 100 \left( \frac{2939.60}{1200} \right) = 244.9.
\]