Chapter 3
Consumer Behavior

■ Questions for Review

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

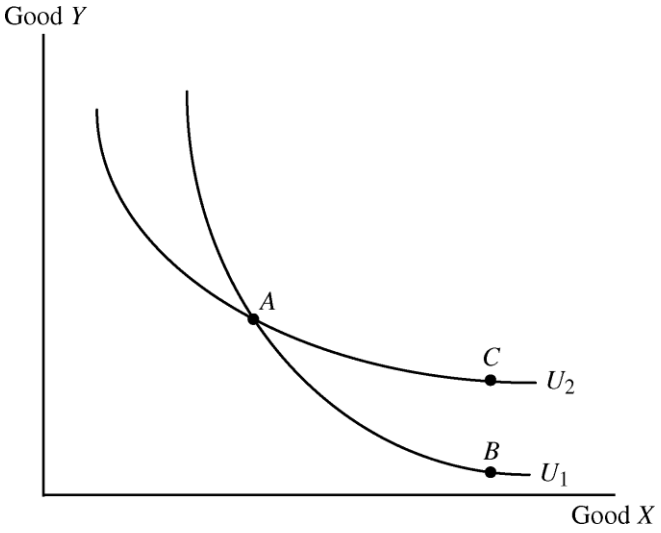
   (1) Preferences are complete: this means that the consumer is able to compare and rank all possible baskets of goods and services. (2) Preferences are transitive: this means that preferences are consistent, in the sense that if bundle *A* is preferred to bundle *B* and bundle *B* is preferred to bundle *C*, then bundle *A* is preferred to bundle *C*. (3) More is preferred to less: this means that all goods are desirable, and that the consumer always prefers to have more of each 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 generally 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" so that the consumer prefers less of that good rather than more. The positive slope means that the consumer will accept more of the bad only if he also receives more of the other good in return. As we move up along the indifference curve the consumer has more of the good he likes, and also more of the good he does not like.

3. **Explain why two indifference curves cannot intersect.**

   The figure below shows two indifference curves intersecting at point *A*. We know from the definition of an indifference curve that the consumer has the same level of utility for every bundle of goods that lies on the 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* because *C* contains more of Good *Y* and the same amount of Good *X* as does *B*, and more is preferred to less. But this violates transitivity, so indifference curves must not intersect.



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.

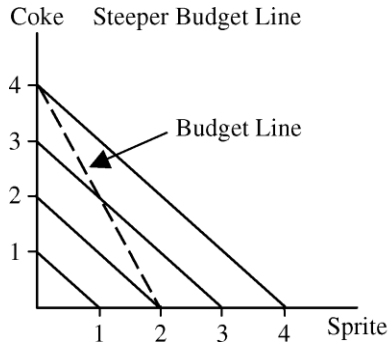
b. Draw a set of indifference curves for Jon.

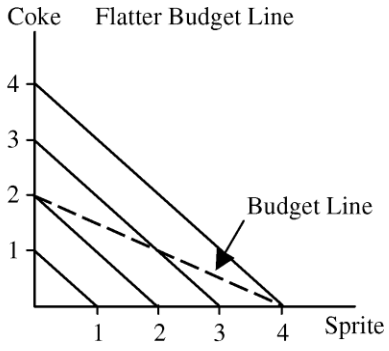
Since Jon is always willing to trade one can of Coke for one can of Sprite, his indifference curves are linear with a slope of −1. See the diagrams below part c.

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, he will choose to consume only the good on the vertical axis. If Jon's budget line is flatter than his indifference curves, he will choose to consume only the good on the horizontal axis. Jon will always choose a corner solution where he buys only the less expensive good, 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 Jon's satisfaction.

The diagrams below show cases where Jon's budget line is steeper than his indifference curves and where it is flatter. Jon's indifference curves are linear with slopes of −1, and four indifference curves are shown in each diagram as solid lines. Jon's budget is $4.00. In the diagram on the left, Coke costs $1.00 and Sprite costs $2.00, so Jon can afford 4 Cokes (if he spends his entire budget on Coke) or 2 Sprites (if he spends his budget on Sprite). His budget line is the dashed line. The highest indifference curve he can reach is the one furthest to the right. He can reach that level of utility by purchasing 4 Cokes and no Sprites. In the diagram on the right, the price of Coke is $2.00 and the price of Sprite is $1.00. Jon's budget line is now flatter than his indifference curves, and his optimal bundle is the corner solution with 4 Sprites and no Cokes.





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. This occurs because as you move down along the indifference curve, you are willing to give up less and less of the good on the vertical axis in exchange for one more unit of the good on the horizontal axis. The *MRS* is also the negative of the slope of the indifference curve, which decreases (becomes closer to zero) as you move down along the indifference curve. The *MRS* is constant along a linear indifference curve because the slope does not change. The 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 off one good for another to maintain the same level of satisfaction. The ratio of prices describes the trade-off that the consumer is able to make between the same two goods in the market. 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, the consumer can trade 4 units of *Y* (the good on the vertical axis) for one unit of *X* (the good on the horizontal axis). If the *MRS* at the current bundle is 6, then the consumer is willing to trade 6 units of *Y* for one unit of *X*. 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 eventually 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 the other is a constant number. In this case, the slopes of the indifference curves are 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 one unit of good 2. If she has more of one good than the other, she does not get any extra satisfaction from the additional units of the first good.

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 his 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 magnitude of 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?

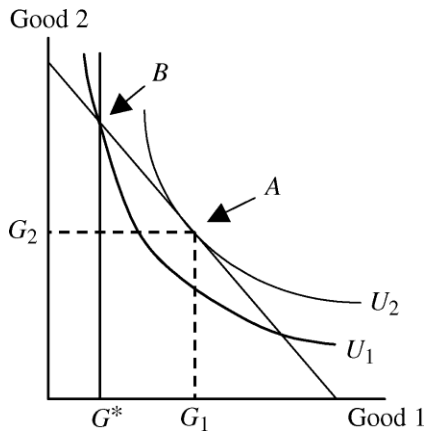
There is no paradox. Preferences do not involve prices, and East German consumers preferred Mercedes based solely on product characteristics. However, Mercedes prices are considerably higher than Volkswagen prices. So, even though East German consumers preferred a Mercedes to a Volkswagen, they either could not afford a Mercedes or they preferred a bundle of other goods plus a Volkswagen to a Mercedes alone. While the marginal utility of consuming a Mercedes exceeded the marginal utility of consuming a Volkswagen, East German consumers considered the marginal utility per dollar for each good and, for most of them, the marginal utility per dollar was higher for Volkswagens. As a result, they flocked to Volkswagen dealerships to buy VWs.

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.

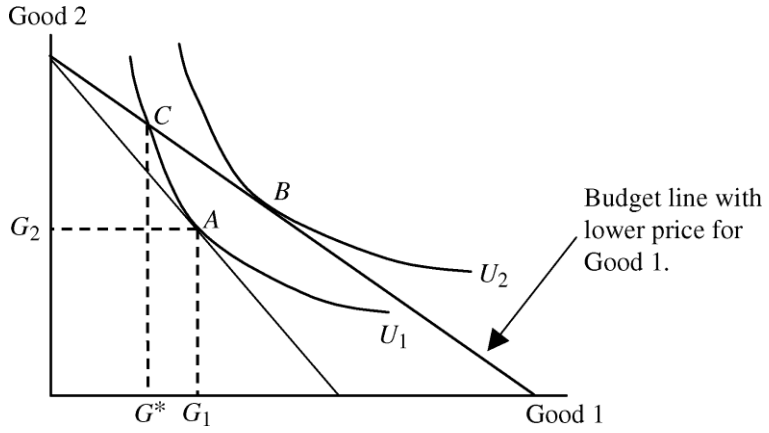
When goods are not rationed, the consumer is able to choose the satisfaction-maximizing bundle where the slope of the budget line is equal to the slope of the indifference curve, or the price ratio is equal to the *MRS*. This is point *A* in the diagram below where the consumer buys G_1 of good 1 and G_2 of good 2 and achieves utility level U_2. If good 1 is now rationed at G^* the consumer will

no longer be able to attain the utility maximizing point. He or she cannot purchase amounts of good 1 exceeding G^*. As a result, the consumer will have to purchase more of the other good instead. The highest utility level the consumer can achieve with rationing is U_1 at point *B*. This is not a point of tangency, and the consumer's utility is lower than at point *A*, so the consumer is worse off as a result of rationing.



b. Suppose 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. Can you tell if the consumer is better off or worse off?

No, the consumer could be better off or worse off. When the price of one good is fixed at a level below the current (equilibrium) price, there will be a shortage of that good, and the good will be effectively rationed. In the diagram below, the price of good 1 has been reduced, and the consumer's budget line has rotated out to the right. The consumer would like to purchase bundle *B*, but the amount of good 1 is restricted because of a shortage. If the most the consumer can purchase is *G**, she will be exactly as well off as before, because she will be able to purchase bundle *C* on her original indifference curve. If there is more than *G** of good 1 available, the consumer will be better off, and if there is less than *G**, the consumer will be worse off.



11. 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 to obtain maximum satisfaction the ratio of the marginal utility to price must be equal across all goods. In other words, utility maximization is achieved when the budget is allocated so that the marginal utility per dollar of expenditure (MU/P) is the same for each good. If the MU/P ratios are not equal, allocating more dollars to the good with the higher MU/P will increase utility. As more dollars are allocated to this good its marginal utility will decrease, which causes its MU/P to fall and ultimately equal that of the other goods.

If marginal utility is increasing, however, allocating more dollars to the good with the larger MU/P causes MU to *increase*, and that good's MU/P just keeps getting larger and larger. In this case, the

consumer should spend all her income on this good, resulting in a corner solution. With a corner solution, the equal marginal principle *does not* hold.

12. 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 basket of goods purchased by a typical 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 typical consumer, and the weights are kept fixed from year to year. One 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. In addition, for non-typical individuals who use 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 for these individuals. The *CPI* will overstate the rise in the cost of living for this type of individual.

13. 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 index because it assumes the individual buys 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 his or her consumption bundle in light of the base year prices. Since the base year cost is overstated, the denominator of the Paasche index will be too large and the index will be too low, or understated.

■ Exercises

1. In this chapter, consumer preferences for various commodities did not change during the analysis. In some situations, however, 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 the consumer's preference for cigarettes in the next period: the consumer desires cigarettes more because he has become more addicted to them.

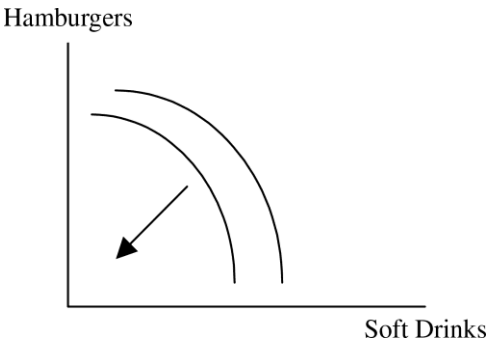
b. Dinner for the first time at a restaurant with a special cuisine

The first time you eat at a restaurant with a special cuisine can be an exciting new dining experience. This may make eating at the restaurant more desirable. But once you've eaten there, it isn't so exciting to do it again ("been there, done that"), and preference changes. On the other hand, some people prefer to eat at familiar places where they don't have to worry about new and unknown cuisine. For them, the first time at the restaurant would be less pleasant, but once they've eaten there and discovered they like the food, they would find further visits to the restaurant more desirable. In both cases, preferences 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.

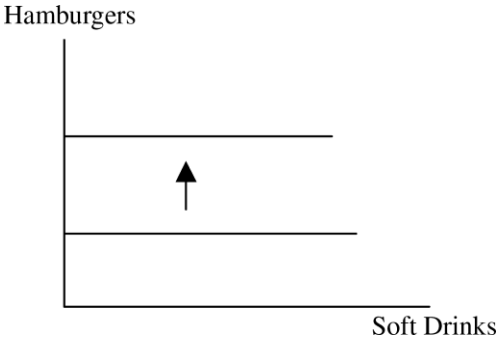
a. Joe has convex preferences and dislikes both hamburgers and soft drinks.

Since Joe dislikes both goods, he prefers less to more, and 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 Joe is indifferent, any linear combination of the two bundles will be in the preferred set, or will leave him at least as well off. This is true of the indifference curves shown in the diagram below.



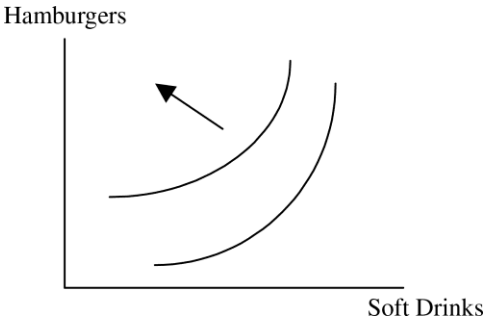
b. Jane loves hamburgers and dislikes soft drinks. If she is served a soft drink, she will pour it down the drain rather than drink it.

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.



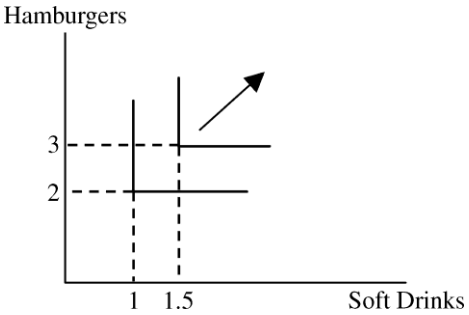
c. Bob loves hamburgers and dislikes soft drinks. If he is served a soft drink, he will drink it to be polite.

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, so his satisfaction increases as we move upward and to the left.



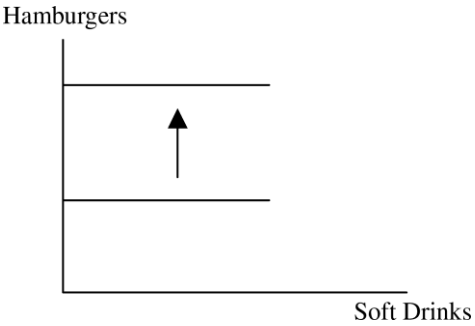
d. Molly loves hamburgers and soft drinks, but insists on consuming exactly one soft drink for every two hamburgers that she eats.

Molly wants to consume the two goods in a fixed proportion so her indifference curves are L-shaped. For a fixed 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.



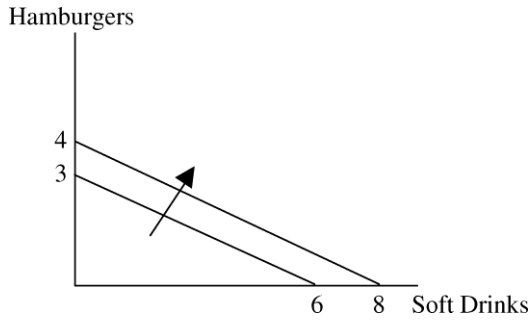
e. Bill likes hamburgers, but neither likes nor dislikes soft drinks.

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, so his satisfaction increases in the upward direction only.



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 and 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 because she will give up one hamburger only if she receives two soft drinks. 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 *MRS*) and is at a bundle where she has a lot of movie tickets relative to basketball tickets. As she gives up movie tickets and acquires more basketball tickets, her *MRS* will fall. If *MRS* falls far enough she might get to the point where she would require, say, two basketball tickets to give up another movie ticket. It would not mean though that she liked basketball better, just that she had a lot of basketball tickets relative to movie tickets. Her willingness to give up a good depends on the quantity of each good in her current basket.

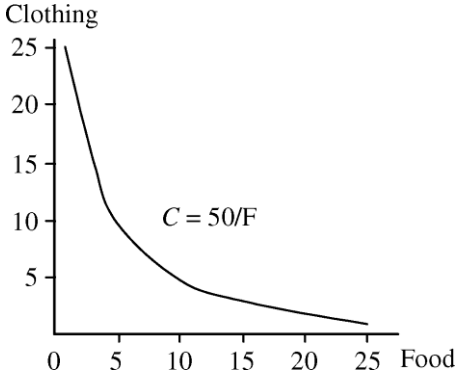
4. Janelle and Brian each plan to spend $20,000 on the styling and gas mileage features of a new car. They can each choose all styling, all gas mileage, or some combination of the two. Janelle does not care at all about styling and wants the best gas mileage possible. Brian likes both equally and wants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

Plot thousands of dollars spent on styling on the vertical axis and thousands spent on gas mileage on the horizontal axis as shown above. Janelle, on the left, 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 at point *J*. Brian, on the right, 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. His optimal bundle is at point *B*.

5. Suppose that Bridget and Erin spend their incomes 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 $U(F,C) = 0.20F^2C^2$.

a. With food on the horizontal axis and clothing on the vertical axis, identify on a graph 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.

The bundle (10,5) contains 10 units of food and 5 of clothing. Bridget receives a utility of 10(10)(5) = 500 from this bundle. Thus, her indifference curve is represented by the equation $10FC = 500$ or $C = 50/F$. Some bundles on this indifference curve are (5,10), (10,5), (25,2), and (2,25). It is plotted in the diagram below. Erin receives a utility of $0.2(10^2)(5^2) = 500$ from the bundle (10,5). Her indifference curve is represented by the equation $0.2F^2C^2 = 500$, or $C = 50/F$. 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 $F = 15$ 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 $C = 120/F$. Some bundles on this indifference curve are (12,10), (10,12), (3,40), and (40,3). The indifference curve will lie above and to the right of the curve diagrammed in part a. This bundle gives Erin a utility of 2880, so her indifference curve is given by the equation $0.2F^2C^2 = 2880$, or $C = 120/F$. 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 their indifference curves are identical. This means they will rank all bundles in the same order. Note that it is not necessary that they receive the same level of utility for each bundle 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 $1000 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. Thus, indifference curves for Jones will be steeper than the indifference curves for Smith.

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), 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 DVDs he can afford to buy 5. If he spends his entire income on CDs he can afford to buy 10. His budget line is linear with these two points as intercepts.

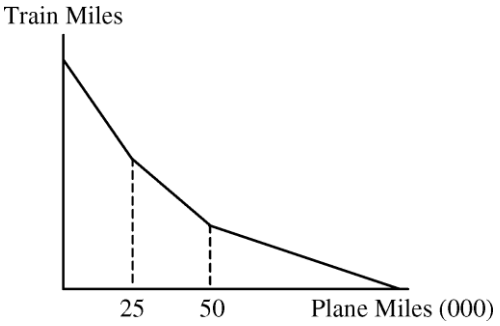
b. Considering what he has already purchased and what he still wants to purchase, identify the three different bundles of CDs and DVDs that he could choose. For this part of the question, assume that he cannot purchase fractional units.

He has already purchased one of each for a total of $30, so he has $70 left. Since he wants 3 more DVDs, 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 DVDs for $40 and spend the remaining $30 on 3 CDs. This is the second bundle. Finally, he could purchase 1 more DVD for $20 and spend the remaining $50 on the 5 CDs he would like. This is the final bundle shown in the table below.

Purchased Quantities		**Total Quantities**	
DVDs	**CDs**	**DVDs**	**CDs**
3	1	4	2
2	3	3	4
1	5	2	6

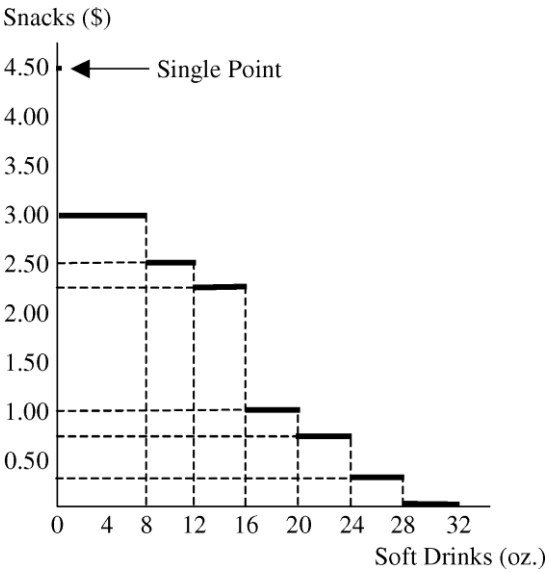
8. Anne has a job that requires her to travel three out of every four weeks. She has an annual travel budget and can travel either by train or by plane. The airline on which she typically flies has a frequent-traveler program that reduces the cost of her tickets according to the number of miles she has 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 reaches 50,000 miles, the airline will reduce the price 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 prices do not change. In this case, the price of airline miles changes depending on how many miles Anne purchases. As the price changes, the slope of the budget line changes. Because there are three prices, there will be three slopes (and two kinks) to the budget line. Since the price falls as Anne flies more miles, her budget line will become flatter with each price change.



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. So, for example, if Debra wants 16 ounces of soft drink, she should buy the 16-ounce size and not two 8-ounce size drinks. Also, if Debra wants 14 ounces, she should buy the 16-ounce drink and dispose of the last 2 ounces. The problem assumes she can do this without cost. As a result, Debra's budget constraint is a series of horizontal lines as shown in the diagram below.

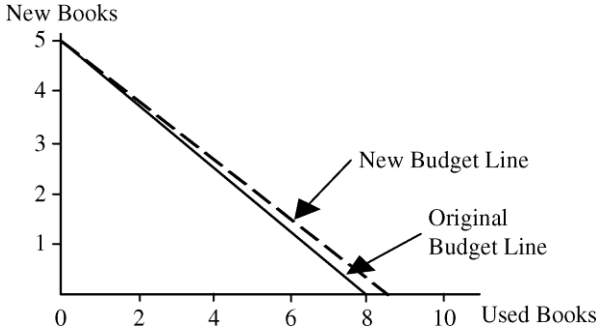


The diagram assumes Debra has a budget of $4.50 to spend on snacks and soft drinks at the movie. Dollars spent on snacks are plotted on the vertical axis and ounces of soft drinks on the horizontal. If Debra wants just an ounce or two of soft drink, she has to purchase the 8-ounce size, which costs $1.50. Thus, she would have $3.00 to spend on snacks. If Debra wants more than 16 ounces of soft drink, she has to purchase more than one drink, and we have to figure out the least-cost way for her to do that. If she wants, say, 20 ounces, she should purchase one 8-ounce and one 12-ounce drink. All of this must be considered in drawing her budget line.

10. Antonio buys five 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 Antonio 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 $80N + 50U = 400$, where N is the number of new books and U is the number of used books. After the price change, new books cost \$88, used books cost \$52.50, 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 he can now afford to buy 8.4 used books if he buys only used books. The new budget line is $88N + 52.50U = 440$. The line has rotated out to the right and become slightly flatter as shown in the diagram.



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

The first year he bought 5 new books at a cost of \$80 each, which is a corner solution. The new price of new 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 some used books, although the slight shift in his budget line suggests that the new optimum will most likely be at the same corner solution as before.

11. Consumers in Georgia pay twice as much for avocados as they do for peaches. However, avocados and peaches are the same price 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 maximum amount of avocados that a person is willing to give up to obtain one additional peach, or $MRS = -\frac{\Delta A}{\Delta P}$, where A is the number of avocados and P the number of peaches. When consumers maximize utility, they set their MRS equal to the price ratio, $\frac{p_P}{p_A}$, where p_P is the price of a peach and p_A is the price of an avocado. In Georgia, avocados cost twice as much as peaches, so the price ratio is ½, but in California, the prices are the same, so the price ratio is 1. Therefore, when consumers are maximizing utility (assuming they buy positive amounts of both goods), the marginal rates of substitution will not be the same for consumers in both states. Consumers in California will have an MRS that is twice as large as consumers in Georgia.

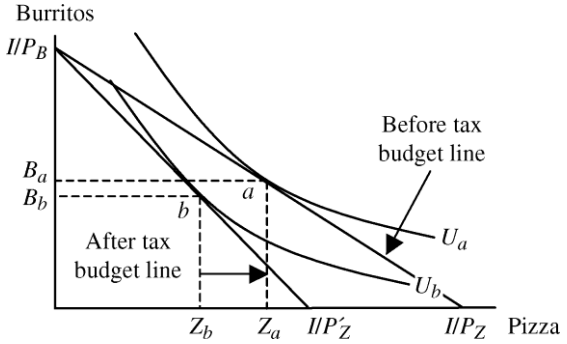
12. Ben allocates his lunch budget between two goods, pizza and burritos.

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

In the diagram below, Ben's income is I, the price of pizza is P_Z, and the price of burritos is P_B. Ben's budget line is linear, and he consumes at the point where his indifference curve is tangent to his budget line at point a in the diagram. This places him on the highest possible indifference curve, which is labeled U_a. Ben buys Z_a pizza and B_a burritos.

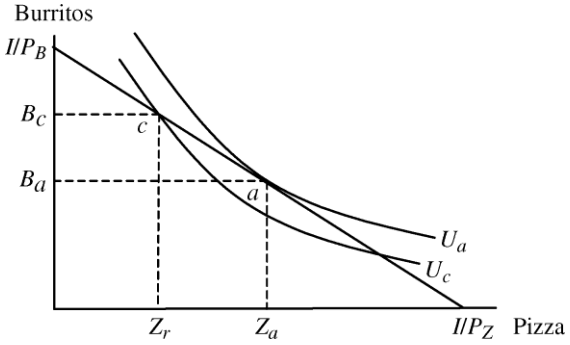
b. Suppose now that pizza is taxed, causing the price to increase by 20%. Illustrate Ben's new optimal bundle.

The price of pizza increases 20% because of the tax, and Ben's budget line pivots inward. The new price of pizza is $P'_Z = 1.2P_Z$. This shrinks 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 lower indifference curve U_b is tangent to his new budget line. Ben now consumes Z_b pizza and B_b burritos. ***Note*:** The diagram shows that Ben buys fewer burritos after the tax, but he could buy more if his indifference curves were drawn differently.



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 preferred bundle, a. The rationed amount of pizza is Z_r in the diagram. Ben will choose bundle c on the budget line that is above and to the left of his original bundle. He buys more burritos, B_c, and the rationed amount of pizza, Z_r. The new bundle gives him a lower level of utility, U_c.



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 to 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 increases by one unit, the price of the car increases by $5000. She also observes that as the gas-mileage index rises by one unit, the price of the car increases by $2500.

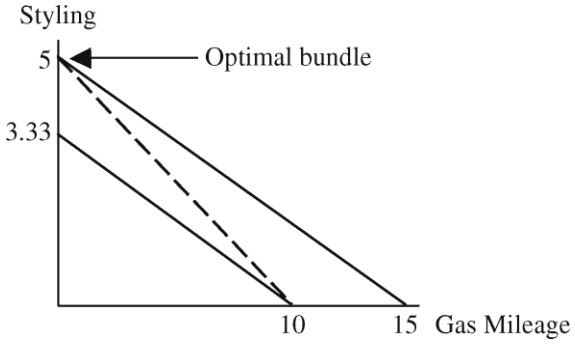
a. Illustrate the various combinations of style (*S*) and gas mileage (*G*) that Brenda could select with her $25,000 budget. Place gas mileage on the horizontal axis.

For every $5000 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 $2500 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 therefore −1/2 as shown by the dashed line in the diagram for part b.

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. Her indifference curves are straight lines with slopes of −1/3. Two are shown in the graph as solid lines. Since her *MRS* is a constant 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 the MU/P for styling is always greater, so there is a corner solution. Two indifference curves are shown on the graph as solid lines. The higher one starts with styling of 5 on the vertical axis. Moving down the indifference curve, Brenda gives up one unit of styling for every 3 additional units of gas mileage, so this indifference curve intersects the gas mileage axis at 15. The other indifference curve goes from 3.33 units of styling to 10 of gas mileage. Brenda reaches the highest indifference curve when she chooses all styling and no gas mileage.



c. Suppose that Brenda's marginal rate of substitution (of gas mileage for styling) is equal to $S/(4G)$. 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 constraint, $5000S + 2500G = 25{,}000$, to get $5000(2G) + 2500G = 25{,}000$ or $12{,}500G = 25{,}000$. Therefore, $G = 2$ and $S = 4$.

d. Suppose that Brenda's marginal rate of substitution (of gas mileage for styling) is equal to $(3S)/G$. What value of each index would she like to have in her car?

Now set her new *MRS* equal to the price ratio of 1/2 and cross multiply to get $G = 6S$. Substitute into the budget constraint, $5000S + 2500G = 25{,}000$, to get $5000S + 2500(6S) = 25{,}000$. Solving, $G = 7.5$ and $S = 1.25$.

14. Connie has a monthly income of $200 that she allocates among two goods: meat and potatoes.

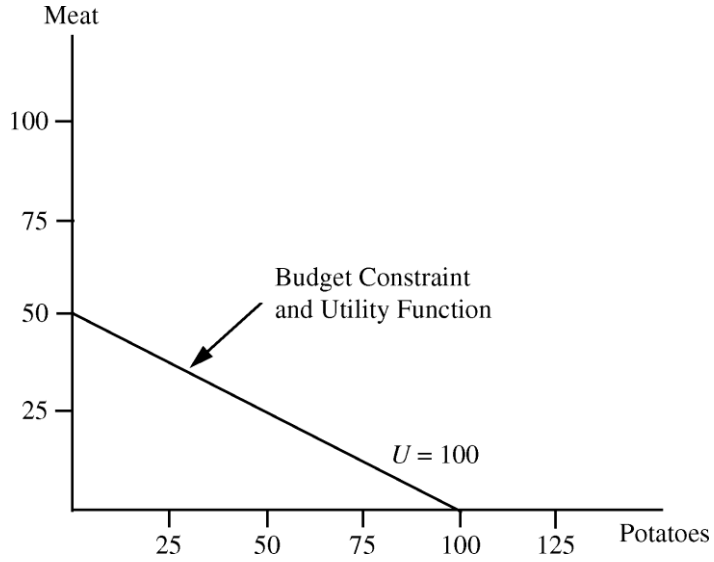
a. Suppose meat costs $4 per pound and potatoes $2 per pound. Draw her budget constraint.

Let M = meat and P = potatoes. Connie's budget constraint is

$$4M + 2P = 200, \text{ or}$$

$$M = 50 - 0.5P.$$

As shown in the graph below, with M on the vertical axis, the vertical intercept is 50 pounds of meat. The horizontal intercept may be found by setting $M = 0$ and solving for P. The horizontal intercept is therefore 100 pounds of potatoes.

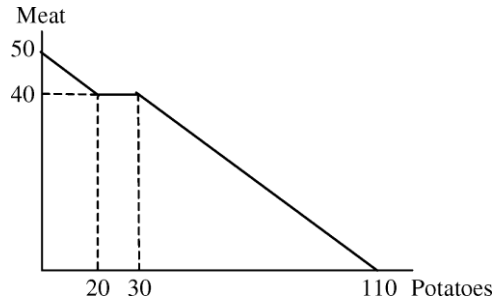


b. Suppose also that her utility function is given by the equation $U(M, P) = 2M + P$. What combination of meat and potatoes should she buy to maximize her utility? (*Hint*: Meat and potatoes are perfect substitutes.)

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. This indifference curve lies below the one shown in the diagram above. 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.

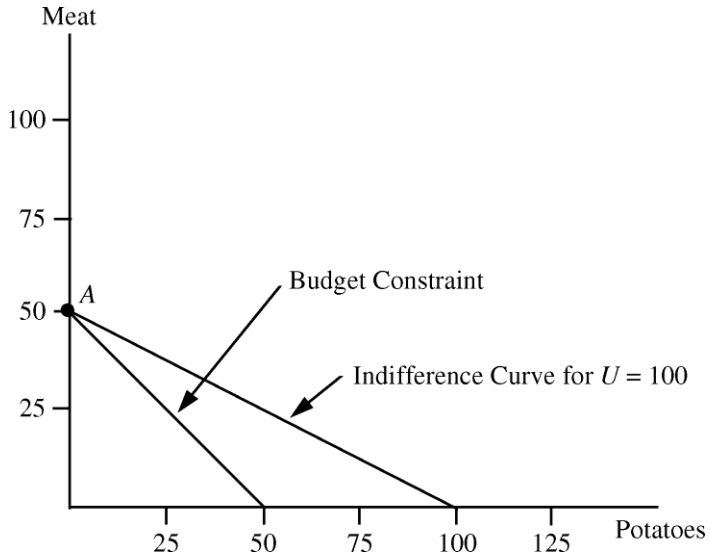
c. Connie's supermarket has a special promotion. If she buys 20 pounds of potatoes (at $2 per pound), she gets the next 10 pounds for free. This offer applies only to the first 20 pounds she buys. All potatoes in excess of the first 20 pounds (excluding bonus potatoes) are still $2 per pound. Draw her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

With potatoes on the horizontal axis, Connie's budget constraint has a slope of –1/2 until Connie has purchased 20 pounds of potatoes. Then her budget line is flat from 20 to 30 pounds of potatoes, because the next 10 pounds of potatoes are free, and she does not have to give up any meat to get these extra potatoes. After 30 pounds of potatoes, the slope of her budget line becomes –1/2 again 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 any combination in between. See the diagram below. She maximizes utility at $U = 100$ at point A when she consumes 50 pounds of meat and no potatoes. *This is a corner solution*.



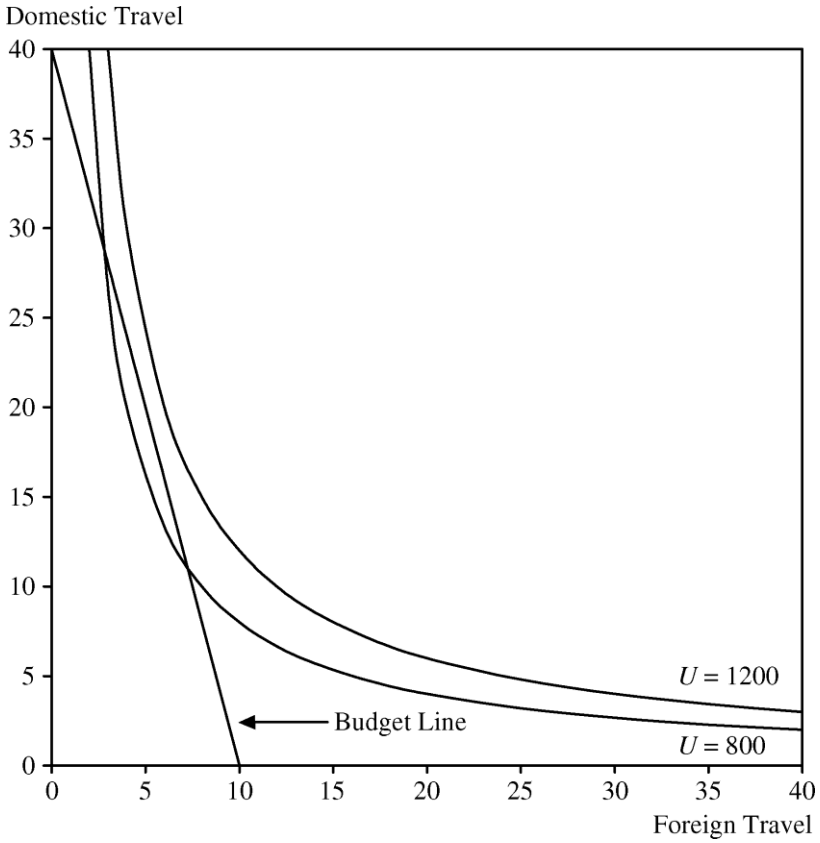
15. Jane receives utility from days spent traveling on vacation domestically (D) and days spent traveling on vacation in a foreign country (F), as given by the utility function $U(D,F) = 10DF$. In addition, the price of a day spent traveling domestically is $100, the price of a day spent traveling in a foreign country is $400, and Jane's annual travel budget is $4000.

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 $D = 80/F$. Find combinations of D and F that satisfy this equation (such as $D = 8$ and $F = 10$) and plot the indifference curve, which is the lower of the two on the graph in part b. The indifference curve with a utility of 1200 has the equation $10DF = 1200$, or $D = 120/F$. Find combinations of D and F that satisfy this equation and plot the indifference curve, which is the upper curve on the graph.

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. Her budget line is $100D + 400F = 4000$, or $D = 40 - 4F$. This straight line is plotted in the graph below.



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

Jane can afford some of the bundles that give her a utility of 800 because part of the $U = 800$ indifference curve lies below the budget line. She cannot afford any of the bundles that give her a utility of 1200 as this indifference curve lies entirely 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 ratio of prices is equal to the *MRS*, and Jane is spending her entire income. The ratio of prices is $\frac{P_F}{P_D} = 4$, and $MRS = \frac{MU_F}{MU_D} = \frac{10D}{10F} = \frac{D}{F}$. Setting these two equal and solving for D, we get $D = 4F$.

Substitute this into the budget constraint, $100D + 400F = 4000$, and solve for F. The optimal solution is $F = 5$ and $D = 20$. Utility is 1000 at the optimal bundle, which is on an indifference curve between the two drawn in the graph above.

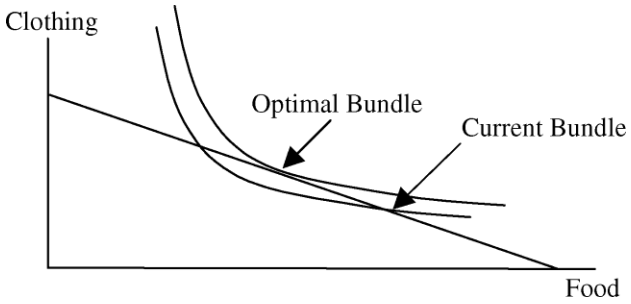
16. Julio receives utility from consuming food (*F*) and clothing (*C*) as given by the utility function $U(F, C) = FC$. In addition, the price of food is \$2 per unit, the price of clothing is \$10 per unit, and Julio's weekly income is \$50.

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

Plotting clothing on the vertical axis and food on the horizontal, as in the textbook, Julio's utility is maximized when his *MRS* (of food for clothing) equals P_F/P_C, the price ratio. The price ratio is 2/10 = 0.2, so Julio's *MRS* will equal 0.2 when his utility is maximized.

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 less than the slope of his budget line, because the indifference curve is flatter than the budget line. He is willing to give up more food than he has to at market prices to obtain one more unit of clothing. His *MRS* is less than the answer in part a.



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 $1200 and that the prices of food and clothing are $1 per unit for each. By 2000, however, 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 2000. (*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 that 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, she must spend half her income on each. Therefore, $P_F F = P_C C = \$1200/2 = \$600$. Since $P_F = P_C = \$1$, *F* and *C* are both equal to 600 units, and Meredith's utility is $U = (600)(600) = 360{,}000$.

***Note*:** You can verify the hint mathematically as follows. The marginal utilities with this utility function are $MU_C = \Delta U/\Delta C = F$ and $MU_F = \Delta U/\Delta F = C$. To maximize utility, Meredith chooses a consumption bundle such that $MU_F/MU_C = P_F/P_C$, which yields $P_F F = P_C C$.

Laspeyres Index:

The Laspeyres index represents how much more Meredith would have to spend in 2000 versus 1990 if she consumed the same amounts of food and clothing in 2000 as she did in 1990. That is, the Laspeyres index (*LI*) for 2000 is given by:

$$LI = 100\ (I')/I,$$

where I' represents the amount Meredith would spend at 2000 prices consuming the same amount of food and clothing as in 1990. In 2000, 600 clothing and 600 food would cost \$3(600) + \$2(600) = \$3000.

Therefore, the Laspeyres cost-of-living index is:

$$LI = 100(\$3000/\$1200) = 250.$$

Ideal Index:

The ideal index represents how much Meredith would have to spend on food and clothing in 2000 (using 2000 prices) to get the same amount of utility as she had in 1990. That is, the ideal index (II) for 2000 is given by:

$$II = 100(I'')/I, \text{ where } I'' = P'_F F' + P'_C C' = 2F' + 3C',$$

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 2000 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, and $2F' = 3C'$ because Meredith spends the same amount on each good.

We now have two equations: $F'C' = 360{,}000$ and $2F' = 3C'$. Solving for F' yields:

$$F'[(2/3)F'] = 360{,}000 \text{ or } F' = \sqrt{[(3/2)360{,}000)]} = 734.85.$$

From this, we obtain C',

$$C' = (2/3)F' = (2/3)734.85 = 489.90.$$

In 2000, the bundle of 734.85 units of food and 489.90 units of clothing would cost 734.85($2) + 489.9($3) = $2939.40, and Meredith would still get 360,000 in utility.

We can now calculate the ideal cost-of-living index:

$$II = 100(\$2939.40/\$1200) = 245.$$

This is slightly less than the Laspeyres Index of 250 and illustrates the fact that a Laspeyres type index tends to overstate inflation compared to the ideal cost-of-living index.