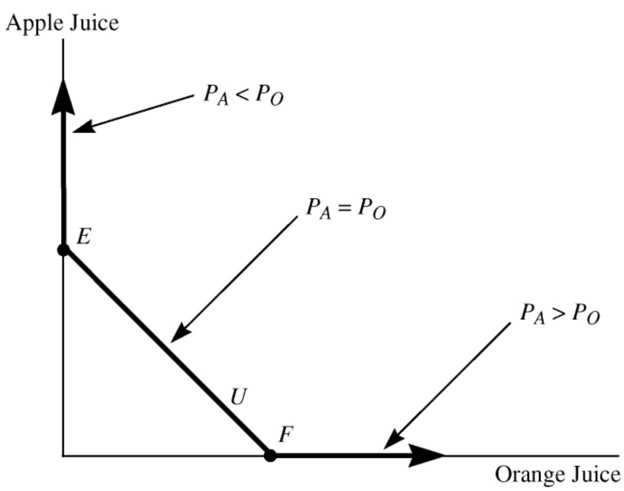
ECON2103 Microeconomics

Chapter 4 Exercises

Solutions

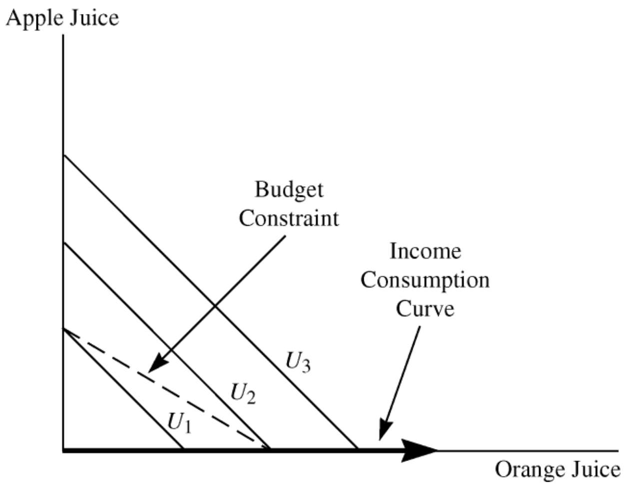
1.

a. We know that indifference curves for perfect substitutes are straight lines like the line *EF* in the price-consumption curve diagram below. In this case, the consumer always purchases the cheaper of the two goods (assuming a one-for-one tradeoff). If the price of orange juice is less than the price of apple juice, the consumer will purchase only orange juice and the price-consumption curve will lie along the orange juice axis of the graph (from point *F* to the right).

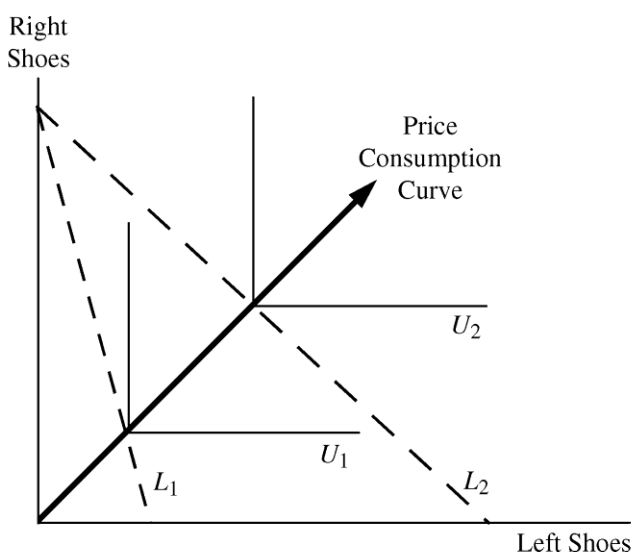


If apple juice is cheaper, the consumer will purchase only apple juice and the price-consumption curve will be on the apple juice axis (above point *E*). If the two goods have the same price, the consumer will be indifferent between the two; the price-consumption curve will coincide with the indifference curve (between *E* and *F*).

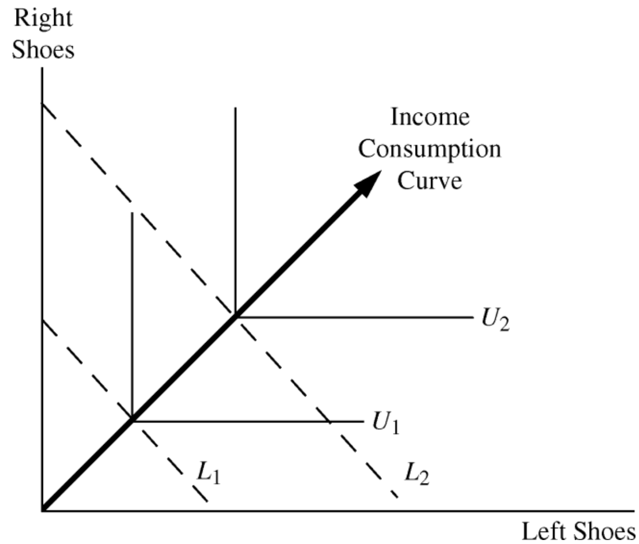
Assuming that the price of orange juice is less than the price of apple juice, the consumer will maximize her utility by consuming only orange juice. As income varies, only the amount of orange juice varies. Thus, the income-consumption curve will be along the orange juice axis as in the figure below. If apple juice were cheaper, the income-consumption curve would lie on the apple juice axis.



b. For perfect complements, such as right shoes and left shoes, the indifference curves are L-shaped. The point of utility maximization occurs when the budget constraints, L_1 and L_2 touch the kink of U_1 and U_2. See the following figure.

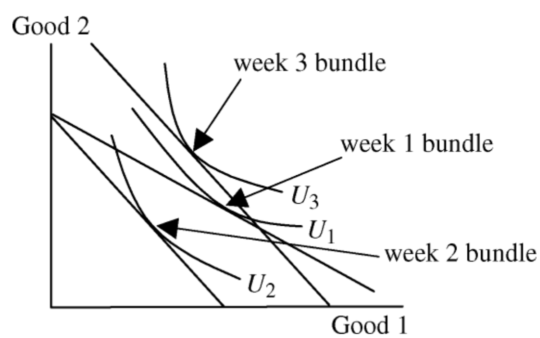


In the case of perfect complements, the income consumption curve is also a line through the corners of the L-shaped indifference curves. See the figure below.



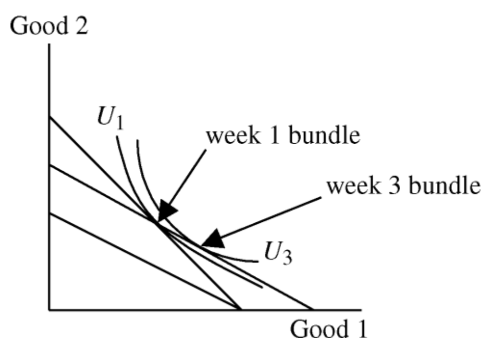
2.

a. Bill's utility fell between weeks 1 and 2 because he consumed less of both goods in week 2. Between weeks 1 and 2 the price of good 1 rose and his income remained constant. The budget line pivoted inward and he moved from U_1 to a lower indifference curve, U_2, as shown in the diagram. Between week 1 and week 3 his utility rose. The increase in income more than compensated him for the rise in the price of good 1. Since the price of good 1 rose by \$1, he would need an extra \$10 to afford the same bundle of goods he chose in week 1. This can be found by multiplying week 1 quantities times week 2 prices. However, his income went up by \$15, so his budget line shifted out beyond his week 1 bundle. Therefore, his original bundle lies within his new budget set as shown in the diagram, and his new week 3 bundle is on the higher indifference curve U_3.

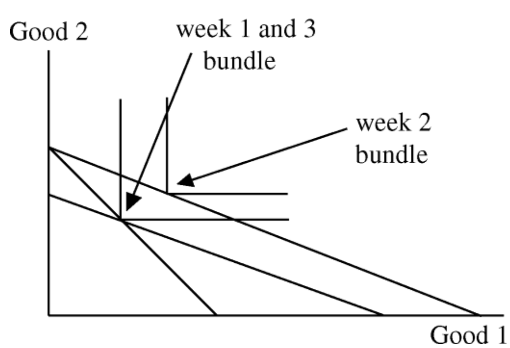


b. Mary's utility went up. To afford the week 1 bundle at the new prices, she would need an extra \$20, which is exactly what happened to her income. However, since she could have chosen the original bundle at the new prices and income but did not, she must have found a bundle that left her slightly better off. In the graph to the right, the week 1 bundle is at the point where the week

1 budget line is tangent to indifference curve U_1, which is also the intersection of the week 1 and week 3 budget lines. The week 3 bundle is somewhere on the week 3 budget line that lies above the week 1 indifference curve. This bundle will be on a higher indifference curve, U_3 in the graph, and hence Mary's utility increased. A good is normal if more is chosen when income increases. Good 1 is normal because Mary consumed more of it when her income increased (and prices remained constant) between weeks 2 and 3. Good 2 is not normal, however, because when Mary's income increased from week 2 to week 3 (holding prices the same), she consumed less of good 2. Thus good 2 is an inferior good for Mary.



c. In week 2, the price of good 1 drops, Jane's budget line pivots outward, and she consumes more of both goods. In week 3 the prices remain at the new levels, but Jane's income is reduced. This leads to a parallel leftward shift of her budget line and causes Jane to consume less of both goods. Notice that Jane always consumes the two goods in a fixed 1:2 ratio. This means that Jane views the two goods as perfect complements, and her indifference curves are L-shaped. Intuitively, if the two goods are complements, there is no reason to substitute one for the other during a price change, because they have to be consumed in a set ratio. Thus the substitution effect is zero. When the price ratio changes and utility is kept at the same level (as happens between weeks 1 and 3), Jane chooses the same bundle (12, 24), so the substitution effect is zero.

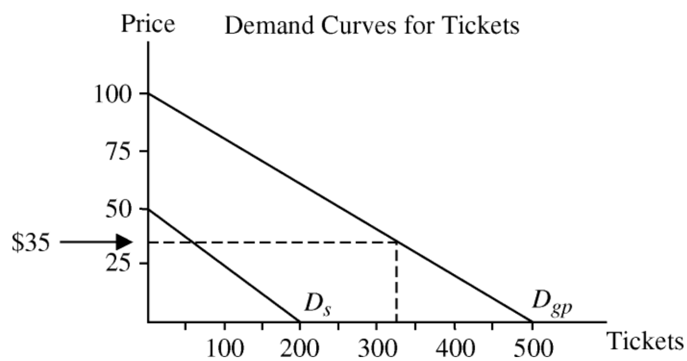


The income effect can be deduced from the changes between weeks 1 and 2 and also between weeks 2 and 3. Between weeks 2 and 3 the only change is the $12 drop in income. This causes

Jane to buy 4 fewer units of good 1 and 8 less units of good 2. Because prices did not change, this is purely an income effect. Between weeks 1 and 2, the price of good 1 decreased by $1 and income remained the same. Since Jane bought 12 units of good 1 in week 1, the drop in price increased her purchasing power by ($1)(12) = $12. As a result of this $12 increase in real income, Jane bought 4 more units of good 1 and 8 more of good 2. We know there is no substitution effect, so these changes are due solely to the income effect, which is the same (but in the opposite direction) as we observed between weeks 1 and 2.

3.

a. Both demand curves are downward sloping and linear. For the general public, D_{gp}, the vertical intercept is 100 and the horizontal intercept is 500. For the students, D_s, the vertical intercept is 50 and the horizontal intercept is 200. When the price is $35, the general public demands $Q_{gp} = 500 - 5(35) = 325$ tickets and students demand $Q_s = 200 - 4(35) = 60$ tickets.



b. The elasticity for the general public is $\varepsilon_{gp} = \frac{P}{Q}\frac{\Delta Q}{\Delta P} = \frac{35}{325}(-5) = -0.54,$ and the elasticity for students is $\varepsilon_S = \frac{P}{Q}\frac{\Delta Q}{\Delta P} = \frac{35}{60}(-4) = -2.33.$ If the price of tickets increases by 10% then the general public will demand 5.4% fewer tickets and students will demand 23.3% fewer tickets.

c. No, he is not maximizing revenue because neither of the calculated elasticities is equal to –1. The general public's demand is inelastic at the current price. Thus the director could increase the price for the general public, and the quantity demanded would fall by a smaller percentage, causing revenue to increase. Since the students' demand is elastic at the current price, the director could decrease the price students pay, and their quantity demanded would increase by a larger amount in percentage terms, causing revenue to increase.

d. To figure this out, use the formula for elasticity, set it equal to −1, and solve for price and quantity. For the general public:

$$\varepsilon_{gp} = \frac{-5P}{Q} = -1$$
$$5P = Q = 500 - 5P$$
$$P = 50$$
$$Q = 250.$$

For the students:

$$\varepsilon_{s} = \frac{-4P}{Q} = -1$$
$$4P = Q = 200 - 4P$$
$$P = 25$$
$$Q = 100.$$

These prices generate a larger total revenue than the \$35 price. When price is \$35, revenue is $(35)(Q_{gp} + Q_s) = (35)(325 + 60) =$ \$13,475. With the separate prices, revenue is $P_{gp}Q_{gp} + P_sQ_s =$ $(50)(250) + (25)(100) =$ \$15,000, which is an increase of \$1525, or 11.3%.

4.

a. Books are a normal good since his consumption of books increases with income. Coffee is a neutral good since consumption of coffee stayed the same when income increased.

b. When Bill's income decreased by \$10 he decided to own fewer books, so books are a normal good. Coffee appears to be a neutral good because Bill's purchase of the double espresso did not change as his income changed.

c. Books and coffee are both normal goods because Bill's response to a decline in real income is to decrease consumption of both goods. In addition, the income elasticities for both goods are the same because Bill reduces consumption of both by the same percentage.

d. His tastes have changed completely, and we do not know how he would respond to price and income changes. We need to observe how his consumption of the *WSJ* and bottled water change as his income changes.

5.

a. The arc elasticity formula is:

$$E_P = \left(\frac{\Delta Q}{\Delta P}\right)\left(\frac{(P_1+P_2)/2}{(Q_1+Q_2)/2}\right).$$

We know that $E_P = -1$, $P_1 = 2$, $P_2 = 2.50$ (so $\Delta P = 0.50$), and $Q_1 = 5000$ units (because Felicia spends \$10,000 and each unit of food costs \$2). We also know that Q_2, the new quantity, is $Q_2 = Q_1 + \Delta Q$. Thus, if there is no change in income, we may solve for ΔQ:

$$-1 = \left(\frac{\Delta Q}{0.5}\right)\left(\frac{(2+2.5)/2}{(5000+(5000+\Delta Q))/2}\right).$$

By cross-multiplying and rearranging terms, we find that $\Delta Q = -1000$. This means that she decreases her consumption of food from 5000 to 4000 units. As a check, recall that total spending should remain the same because the price elasticity is –1. After the price change, Felicia spends (\$2.50)(4000) = \$10,000, which is the same as she spent before the price change.

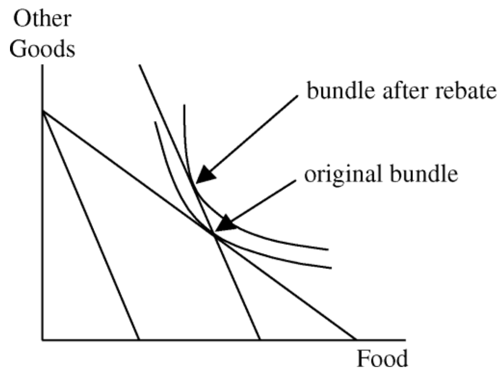
b. A tax rebate of \$2500 is an income increase of \$2500. To calculate the response of demand to the tax rebate, use the definition of the arc elasticity of income.

$$E_I = \left(\frac{\Delta Q}{\Delta I}\right)\left(\frac{(I_1+I_2)/2}{(Q_1+Q_2)/2}\right).$$

We know that $E_1 = 0.5$, $I_1 = 25{,}000$, $\Delta I = 2500$ (so $I_2 = 27{,}500$), and $Q_1 = 4000$ (from the answer to a). Assuming no change in price, we solve for ΔQ. $\Delta Q \approx 195$

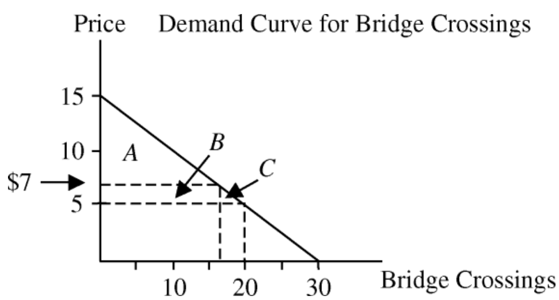
$$0.5 = \left(\frac{\Delta Q}{2500}\right)\left(\frac{(25{,}000+27{,}500)/2}{(4000+(4000+\Delta Q))/2}\right).$$

c. Felicia is better off after the rebate. The amount of the rebate is enough to allow her to purchase her original bundle of food and other goods. Recall that originally she consumed 5000 units of food. When the price went up by fifty cents per unit, she needed an extra (5000)(\$0.50) = \$2500 to afford the same quantity of food without reducing the quantity of the other goods consumed. This is the exact amount of the rebate. However, she did not choose to return to her original bundle. We can therefore infer that she found a better bundle that gave her a higher level of utility. In the graph below, when the price of food increases, the budget line pivots inward. When the rebate is given, this new budget line shifts out to the right in a parallel fashion. The bundle after the rebate is on that part of the new budget line that was previously unaffordable, and that lies above the original indifference curve. It is on a higher indifference curve, so Felicia is better off after the rebate.



6.

a. The demand curve is linear and downward sloping. The vertical intercept is 15 and the horizontal intercept is 30.



b. At a price of zero, $0 = 15 - (1/2)Q$, so $Q = 30$. The quantity demanded would be 30.

c. If the toll is $5 then the quantity demanded is 20. The lost consumer surplus is the difference between the consumer surplus when price is zero and the consumer surplus when price is $5. When the toll is zero, consumer surplus is the entire area under the demand curve, which is (1/2)(30)(15) = 225. When $P = 5$, consumer surplus is area $A + B + C$ in the graph above. The base of this triangle is 20 and the height is 10, so consumer surplus = (1/2)(20)(10) = 100. The loss of consumer surplus is therefore $225 – 100 = $125.

d. At a toll of $7, the quantity demanded would be 16. The initial toll revenue was $5(20) = $100. The new toll revenue is $7(16) = $112, so revenue increases by $12. Since the revenue goes up when the toll is increased, demand is inelastic (the 40% increase in price outweighs the 20% decline in quantity demanded).

e. The lost consumer surplus is area $B + C$ in the graph above. Thus, the loss in consumer surplus is $(16) \times (7 - 5) + (1/2) \times (20 - 16) \times (7 - 5) = \$36$.