Solution to Selected Questions: CHAPTER 4
INDIVIDUAL AND MARKET DEMAND

Questions for Review

6. Suppose that a consumer spends a fixed amount of income per month on the following pairs of goods:

a. tortilla chips and salsa
b. tortilla chips and potato chips
c. movie tickets and gourmet coffee
d. travel by bus and travel by subway

If the price of one of the goods increases, explain the effect on the quantity demanded of each of the goods. In each pair, which are likely to be complements and which are likely to be substitutes?

a. If the price of tortilla chips increases, the consumer will demand fewer tortilla chips. Since tortilla chips and salsa are complements, the demand curve for salsa will decrease (shift to the left), and the consumer will demand less salsa.

b. If the price of tortilla chips increases, the consumer will demand fewer tortilla chips. Since tortilla chips and potato chips are substitutes, the demand for potato chips will increase (the demand curve will shift to the right), and the consumer will demand more potato chips.

c. The consumer will demand fewer movies after the price increase. You might think the demands for movies and gourmet coffee would be independent of each other. However, because the consumer spends a fixed amount on the two, the demand for coffee will depend on whether the consumer spends more or less of her fixed budget on movies after the price increase. If the consumer's demand elasticity for movie tickets is elastic, she will spend less on movies and, therefore, more of her fixed income will be available to spend on coffee. In this case, her demand for coffee increases, and she buys more gourmet coffee. The goods are substitutes in this situation. If her demand for movies is inelastic, however, she will spend more on movies after the price increase and, therefore, less on coffee. In this case, she will buy less of both goods in response to the price increase for movies, so the goods are complements. Finally, if her demand for movies is unit elastic, she will spend the same amount on movies and therefore will not change her spending on coffee. In this case, the goods are unrelated, and the demand curve for coffee is unchanged.

d. If the price of bus travel increases, the amount of bus travel demanded will fall, and the demand for subway rides will rise, because travel by bus and subway are substitutes. The demand curve for subway rides will shift to the right.

Excercies

9. The ACME Corporation determines that at current prices the demand for its computer chips has a price elasticity of –2 in the short run, while the price elasticity for its disk drives is –1.

a. If the corporation decides to raise the price of both products by 10%, what will happen to its sales? To its sales revenue?

We know the formula for the elasticity of demand is:

$$E_P = \frac{\%\Delta Q}{\%\Delta P}.$$

For computer chips, $E_P = -2$, so $-2 = \%\Delta Q/10$, and therefore $\%\Delta Q = -2(10) = -20$. Thus a 10% increase in price will reduce the quantity sold by 20%. For disk drives, $E_P = -1$, so a 10% increase in price will reduce sales by 10%.

Sales revenue will decrease for computer chips because demand is elastic and price has increased. We can estimate the change in revenue as follows. Revenue is equal to price times quantity sold. Let $TR_1 = P_1Q_1$ be revenue before the price change and $TR_2 = P_2Q_2$ be revenue after the price change. Therefore

$$\Delta TR = P_2Q_2 - P_1Q_1$$
$$\Delta TR = (1.1P_1)(0.8Q_1) - P_1Q_1 = -0.12P_1Q_1, \text{ or a 12\% decline.}$$

Sales revenue for disk drives will remain unchanged because demand elasticity is –1.

b. Can you tell from the available information which product will generate the most revenue? If yes, why? If not, what additional information do you need?

No. Although we know the elasticities of demand, we do not know the prices or quantities sold, so we cannot calculate the revenue for either product. We need to know the prices of chips and disk drives and how many of each ACME sells.

11. Suppose the income elasticity of demand for food is 0.5 and the price elasticity of demand is –1.0. Suppose also that Felicia spends $10,000 a year on food, the price of food is $2, and that her income is $25,000.

a. If a sales tax on food caused the price of food to increase to $2.50, what would happen to her consumption of food? (*Hint*: Because a large price change is involved, you should assume that the price elasticity measures an arc elasticity, rather than a point elasticity.)

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. Suppose that Felicia gets a tax rebate of $2500 to ease the effect of the sales tax. What would her consumption of food be now?

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.

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

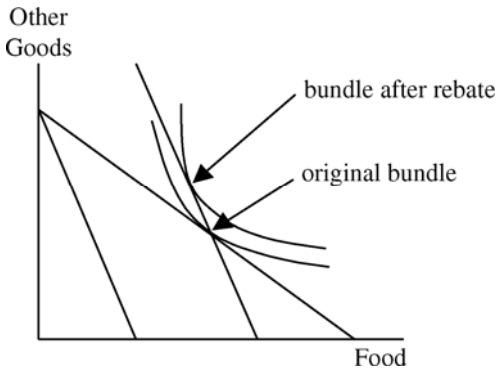
We know that $E_1 = 0.5$, $I_1 = 25{,}000$, $\Delta I = 2500$ (so $I_2 = 27{,}500$), and $Q_1 = 4000$ (from the answer
to 11a). Assuming no change in price, we solve for ΔQ.

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

By cross-multiplying and rearranging terms, we find that $\Delta Q = 195$ (approximately). This means that she increases her consumption of food from 4000 to 4195 units.

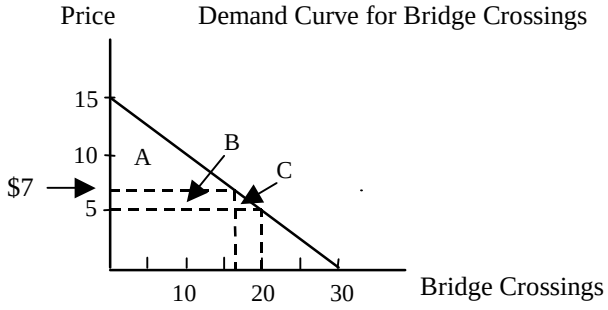
c. Is she better or worse off when given a rebate equal to the sales tax payments? Draw a graph and explain.

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.



13. Suppose you are in charge of a toll bridge that costs essentially nothing to operate. The demand for bridge crossings *Q* is given by $P = 15 - \frac{1}{2}Q$.

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



b. How many people would cross the bridge if there were no toll?

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

c. What is the loss of consumer surplus associated with a bridge toll of $5?

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. The toll-bridge operator is considering an increase in the toll to $7. At this higher price, how many people would cross the bridge? Would the toll-bridge revenue increase or decrease? What does your answer tell you about the elasticity of demand?

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. Since the revenue went up when the toll was increased, demand is inelastic (the 40% increase in price outweighed the 20% decline in quantity demanded).

e. Find the lost consumer surplus associated with the increase in the price of the toll from $5 to $7.

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