

**This file includes the answers to the problems at the end of Chapters 1, 2, 3, and 5.**

## **Chapter One**

1. The economic surplus from washing your dirty car is the benefit you receive from doing so (\$6) minus your cost of doing the job (\$3.50), or \$2.50.

2. The benefit of adding a pound of compost is the extra revenue you'll get from the extra tomatoes that result. The cost of adding a pound of compost is 50 cents. By adding the fourth pound of compost you'll get 2 extra pounds of tomatoes, or 60 cents in extra revenue, which more than covers the 50-cent cost of the extra pound of compost. But adding the fifth pound of compost gives only 1 extra pound of tomatoes, so the corresponding revenue increase (30 cents) is less than the cost of the compost. You should add 4 pounds of compost and no more.

3. In the first case, the cost is \$6/week no matter how many cans you put out, so the cost of disposing of an extra can of garbage is \$0. Under the tag system, the cost of putting out an extra can is \$2, regardless of the number of the cans. Since the relevant costs are higher under the tag system, we would expect this system to reduce the number of cans collected.

4. At Smith's house, each child knows that the cost of not drinking a can of cola now is that it is likely to end up being drunk by his sibling. Each thus has an incentive to consume rapidly to prevent the other from encroaching on his share. Jones, by contrast, has eliminated that incentive by making sure that neither child can drink more than half the cans. This step permits his children to consume at a slower, more enjoyable pace.

5. If Tom kept the \$200 and invested it in additional mushrooms, at the end of a year's time he would have an additional \$400 worth of mushrooms to sell. Dick must therefore give Tom \$400 in interest in order for Tom not to lose money on the loan.

6. Even though you earned four times as many points from the first question than from the second, the last minute you spent on question 2 added 6 more points to your total score than the last minute you spent on question 1. That means you should have spent more time on question 2.

7. According to the cost-benefit criterion, the two women should make the same decision. After all, the benefit of seeing the play is the same in both cases, and the cost of seeing the play—at the moment each must decide—is exactly \$10. Many people seem to feel that in the case of the lost ticket, the cost of seeing the play is not \$10 but \$20, the price of two tickets. In terms of the financial consequences, however, the loss of a ticket is clearly no different from the loss of a \$10 bill. In each case, the question is whether seeing the play is worth spending \$10. If it is, you should see it; otherwise not. Whichever your answer, it must be the same in both cases.

8. Since you have already bought your ticket, the \$30 you spent on it is a sunk cost. It is money you cannot recover, whether or not you go to the game. In deciding whether to see the game, then, you should compare the benefit of seeing the game (as measured by the largest dollar amount you would be willing to pay to see it) to only those *additional* costs you must incur to see the game (the opportunity cost of your time, whatever cost you assign to driving through the snowstorm, etc.). But you should not include the cost of your ticket. That is \$30 you will never see again, whether you go to the game or not.

Joe, too, must weigh the opportunity cost of his time and the hassle of the drive in deciding whether to attend the game. But he must also weigh the \$25 he will have to spend for his ticket. At the moment of deciding, therefore, the remaining costs Joe must incur to see the game are \$25 higher than the remaining costs for you. And since you both have identical tastes—that is, since your respective benefits

of attending the game are exactly the same—Joe should be less likely to make the trip. You might think the cost of seeing the game is higher for you, since your ticket cost \$30, whereas Joe's will cost only \$25. But at the moment of deciding whether to make the drive, the \$25 is a relevant cost for Joe, whereas your \$30 is a sunk cost—and hence an irrelevant one for you.

9. For a seven-minute call the two phone systems charge exactly the same amount, 70 cents. But at that point under the new plan, the marginal cost is only 2 cents per minute, compared to 10 cents per minute under the current plan. And since the benefit of talking additional minutes is the same under the two plans, Tom will make longer calls under the new plan.

10. In University A, everybody will keep eating until the benefit from eating an extra pound of food is equal to \$0, since that is the extra cost to them for each extra pound of food they eat. In University B, the cost of eating an extra pound of food is \$2, so people will stop eating when the benefit of eating an extra pound falls to \$2. Food consumption will thus be higher at University A.

## **Chapter Two**

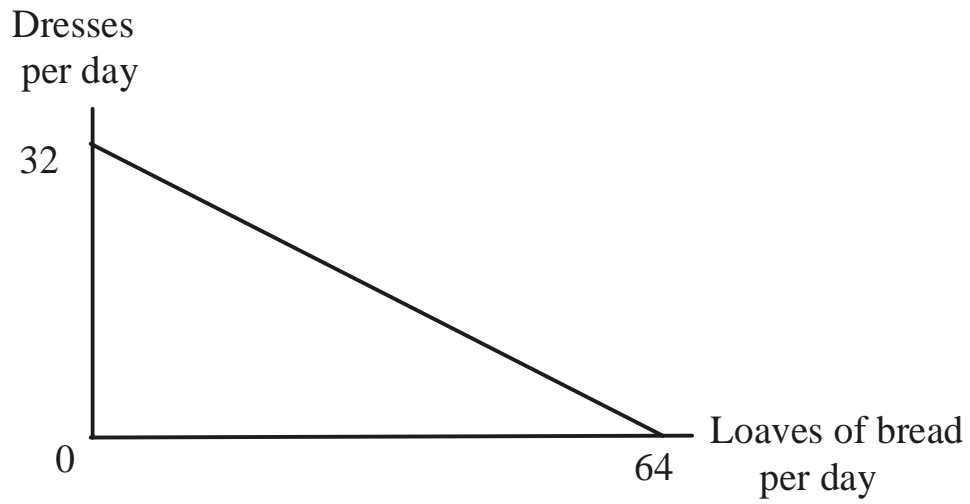
1. In time it takes Ted to wash a car he can wax one-third of a car. So his opportunity cost of washing one car is one-third of a wax job. In the time it takes Tom to wash a car, he can wax one-half of a car. So his opportunity cost of washing one car is one-half of a wax job. Because Ted's opportunity cost of washing a car is lower than Tom's, Ted has a comparative advantage in washing cars.

2. In time it takes Ted to wash a car he can wax three cars. So his opportunity cost of washing one car is three wax jobs. In the time it takes Tom to wash a car, he can wax two cars. So his opportunity cost of washing one car is two wax jobs. Because Tom's opportunity cost of washing a car is lower than Ted's, Tom has a comparative advantage in washing cars.

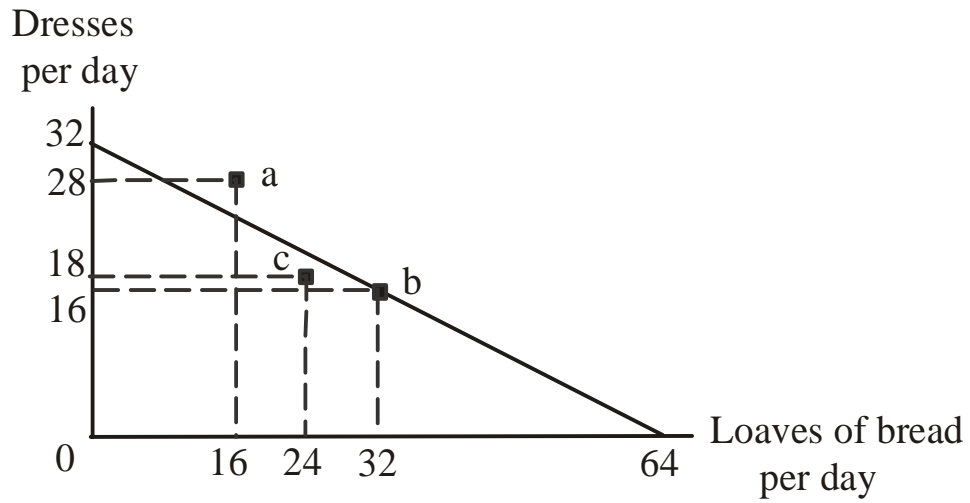
3. Since Kyle and Toby face the same opportunity cost of producing a gallon of cider, they cannot gain from specialization and trade.

4. In time it takes Nancy to replace a set of brakes she can complete one-half of a clutch replacement. So her opportunity cost of replacing a set of brakes is one-half of a clutch replacement. In the time it takes Bill to replace a set of brakes, he can he can complete one-third of a clutch replacement. So his opportunity cost of replacing a set of brakes is one-third of a clutch replacement. Because Bill's opportunity cost of replacing a set of brakes is lower than Nancy's, Bill has a comparative advantage in replacing brakes. That means that Nancy has a comparative advantage in replacing clutches. Nancy also has an absolute advantage over Bill in replacing clutches, since it takes her two hours less than it takes Bill to perform that job. Since each takes the same amount of time to replace a set of brakes, neither person has an absolute advantage in that task.

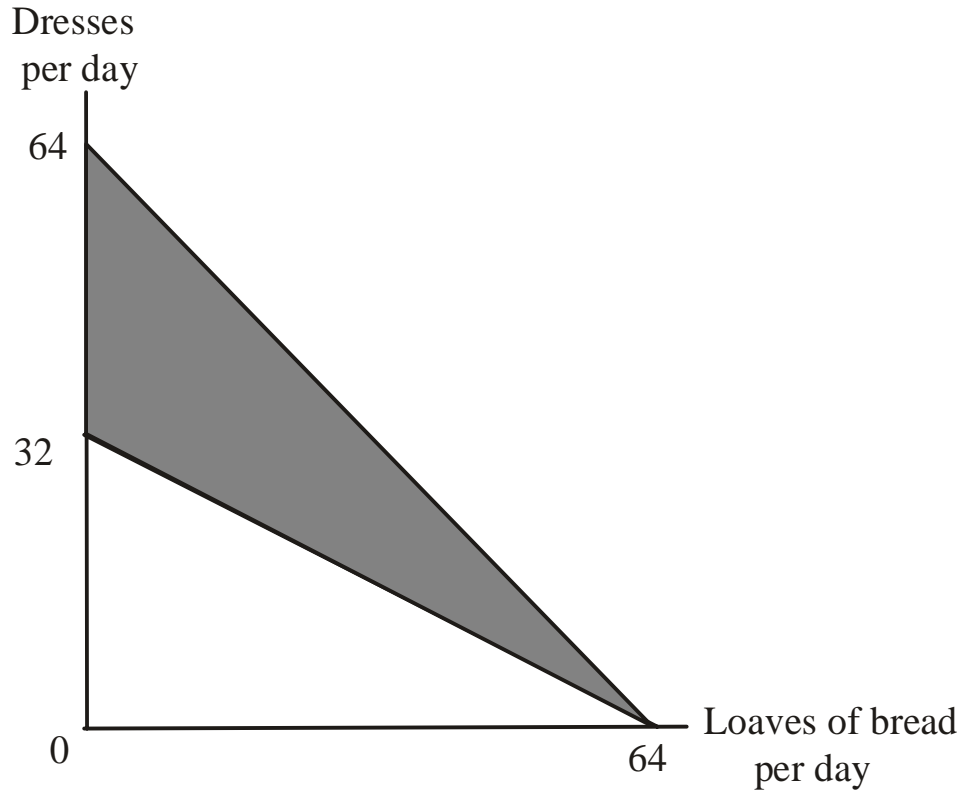
5.



6. Point a is unattainable. Point b is efficient and attainable. Point c is inefficient and attainable.



7. The new machine doubles the value of the vertical intercept of Helen's PPC.



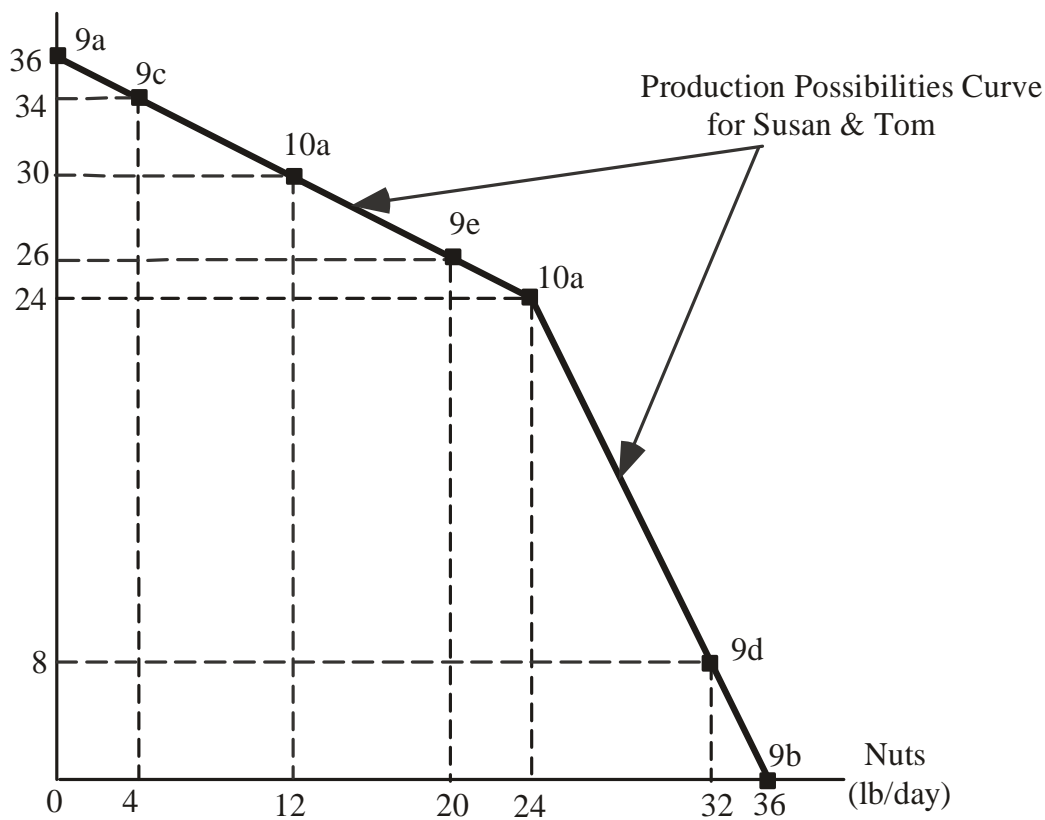
8. The upward rotation of Helen's PPC means that she is now able for the first time to produce any of the points in the shaded region. Not only has her menu of opportunity increased with respect to dresses, but it has increased with respect to bread as well.

- 9a. Their maximum possible coffee output is 36 pounds per day (12 from Tom, 24 from Susan).
- b. Their maximum possible output of nuts is also 36 pounds per day (12 from Susan, 24 from Tom).
- c. Tom should be sent to pick nuts, since his opportunity cost (half a pound of coffee per pound of nuts) is lower than Susan's (2 pounds of coffee per pound of nuts). Since it would take Tom only one hour to pick four pounds of nuts, he can still pick 10 pounds of coffee in his 5 working hours that remain. Added to Susan's 24 pounds, they will have a total of 34 pounds of coffee per day.
- d. Susan should be sent to pick coffee, since her opportunity cost (half a pound of nuts per pound of coffee) is lower than Tom's (2 pounds of nuts per pound of coffee). It will take Susan 2 hours to pick 8 pounds of coffee, which means that she can still pick 8 pounds of nuts. So they will have a total of 32 pounds per day of nuts.
- e. To pick 26 pounds of nuts per day, Tom should work full time picking nuts (24 pounds per day) and Susan should spend one hour per day picking nuts (2 pounds per day). Susan would still have 5 hours available to devote to coffee picking, so she can pick 20 pounds of coffee per day.

- 10a. The point (12 pounds of nuts per day, 30 pounds of coffee per day) can be produced by having Susan work full time picking coffee (24 pounds of coffee per day) while Tom spends 3 hours picking coffee (6 pounds of coffee) and 3 hours picking nuts (12 pounds of nuts). The point (24 pounds of coffee per day, 24 pounds of nuts per day) can be achieved if each works full time at his or her activity of comparative advantage. Both points are attainable and efficient.
- b. The points and the straight lines connecting them are shown in the diagram below. The resulting line is the production possibilities curve for the two-person economy consisting of Susan and Tom. For any

given quantity of daily nut production on the horizontal axis, it shows the maximum possible amount of coffee production on the vertical axis.

Coffee  
(lb/day)



- c. By specializing completely, they can produce 24 pounds of coffee per day and 24 pounds of nuts (the point at which the kink occurs in the PPC in the diagram). If they sell this output in the world market at the stated prices, they will receive a total of \$96/day.
- d. With \$96 per day to spend, the maximum amount of coffee they could buy is 48 pounds per day. Or they could buy 48 pounds per day of nuts. 40 pounds of nuts would cost \$80, and 8 pounds of coffee would cost \$16, so they would have just enough money (\$96 per day) to buy this combination of goods.
- e. With the ability to buy or sell each good at \$2/lb in world markets, Tom and Susan can consume as many as 48 pounds per day of coffee (point E in the diagram below), or as many as 48 pounds of nuts (point F). We have also seen that point G (40 pounds of coffee per day, 8 pounds of nuts per day) is an attainable point, and they can still attain point C (24 pounds of each good), even without trading in world markets. Their new menu of consumption possibilities is shown by the straight line EF in the diagram. This menu is called their “consumption possibilities curve.” Note how the ability to trade in world markets expands their consumption possibilities relative to what they were before.

### Chapter 3

1a. Substitutes

b. Complements

c. Probably substitutes for most people, but complements for some others who like to eat ice cream and chocolate together.

d. Substitutes.

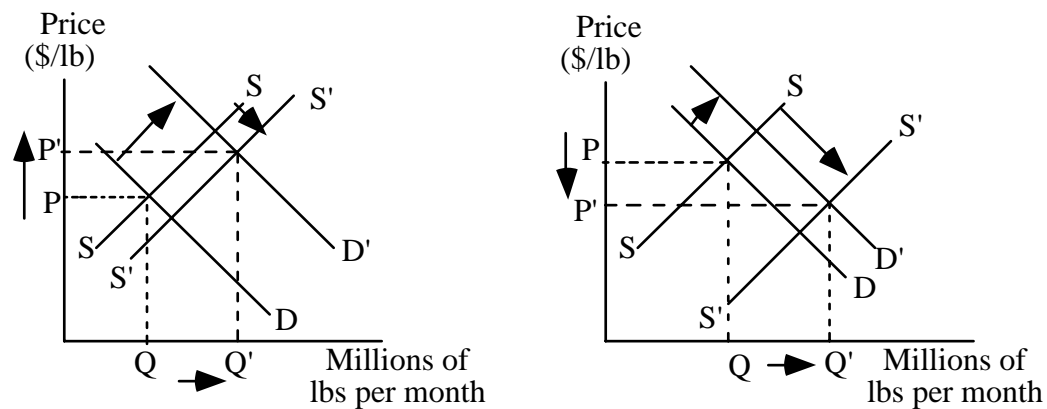
2. The supply curve would shift:
  - a. Right. The discovery is a technological improvement. The improved technique would enable more crops to be produced with the same inputs.
  - b. Right. Fertilizer is an input. Lower input prices shift the supply curve to the right.
  - c. Right. The new tax breaks make farming relatively more profitable than before. Thus those who were employed in a job that was just a little better than being a farmer would switch to farming.
  - d. Left. Tornadoes destroy corn.
- 3a. Demand shifts right: income has risen and vacations are a normal good.
  - b. Demand shifts right: preferences have shifted from hamburger to pizza and other substitutes.
  - c. Demand shifts right: the price of a substitute has risen.
  - d. Demand is unaffected; there will be a movement along the curve—i.e., quantity demanded will fall.
4. The demand for binoculars might increase, leading to an increase in the quantity of binoculars supplied, but no change in the supply of binoculars should occur. The UFO sighting does nothing to change the factors that govern the supply of binoculars.
5. An increase in the cost of an input used in orange production will shift the supply curve of oranges to the left, resulting in an increase in the equilibrium price and a decline in the equilibrium quantity of oranges.
6. An increase in the birth rate will increase the population of potential buyers of land, and hence shift the demand curve for land to the right, resulting in an increase in the equilibrium price of land.
7. The discovery will shift the demand curve for fish to the right, increasing both the equilibrium price and the equilibrium quantity of fish.
8. An increase in the price of chickenfeed shifts the supply curve of chickens to the left, resulting in an increase in the equilibrium price of chickens, which are a substitute for beef. This shifts the demand curve for beef to the right, increasing both the equilibrium price and the equilibrium quantity of beef.
9. Compared with the rest of the year, there are more people who want to stay in hotel rooms near campus during parents' weekend and graduation weekend. Thus the demand curve shifts to the right during these weekends. This implies a higher equilibrium price for hotel rooms (and, of course, a higher equilibrium quantity of rooms rented).
10. Automobile insurance and automobiles are complements. An increase in automobile insurance rates will thus shift the demand curve for automobiles to the left. Some people who would have bought new automobiles with the lower insurance rates will choose not to, maybe choosing a used car, public transportation or perhaps just getting some more miles from their current vehicle.
11. The mad cow disease announcement is likely to cause many consumers to forsake beef for substitute sources of protein—and hence produce a rightward shift in the demand for chicken. The discovery of the new chicken breed will cause a rightward shift in the supply curve of chicken. The two developments together will increase the equilibrium quantity of chicken sold in the United States, but we cannot determine the net effect on equilibrium price from the information given.

12. The population increase causes a rightward shift in the demand curve for potatoes, and the development of the higher yielding variety causes a rightward shift in the supply curve for potatoes. The equilibrium quantity of potatoes goes up, but the equilibrium price may go either down or up.

13. The discovery of the cold-fighting property causes a rightward shift in the demand curve for apples, and the fungus causes a leftward shift in the supply curve. The equilibrium price of apples will rise, but the equilibrium quantity may go either down or up.

14. Since butter and corn are complements, an increase in the price of butter will cause the demand curve for corn to shift leftward. The fertilizer price decrease causes the supply curve for corn to shift rightward. The equilibrium price of corn falls, but the equilibrium quantity may go either down or up.

15. Since both the demand and supply curves for tofu have shifted outward, the equilibrium quantity of tofu sold is higher than before. The equilibrium price may be either higher (left panel) or lower (right panel).



## Chapter 5

1. Because willingness to pay for food quality is likely to be an increasing function of income, we expect patrons of the gourmet restaurant to have higher incomes, on average, than the patron of the diner. And since willingness to pay for service is also likely to be an increasing function of income, we expect higher service quality in the gourmet restaurant. Since diners tend to leave tips of about 15 percent of the prices of their meals, gourmet restaurant patrons do, in fact, pay for, and receive, higher service quality.

2. Since the marginal cost of an additional morsel of food is zero, a rational person will continue eating until the marginal benefit of the last morsel (its marginal utility) falls to zero.

3. Martha is currently receiving  $(75 \text{ utils/ounce})/(\$0.25/\text{ounce}) = 300$  utils per dollar from her last dollar spent on orange juice, but only  $(50 \text{ utils/ounce})/(\$0.20/\text{ounce}) = 250$  utils per dollar from her last dollar spent on coffee. Since the two are not equal, she is not maximizing her utility. She should spend more on orange juice and less on coffee.

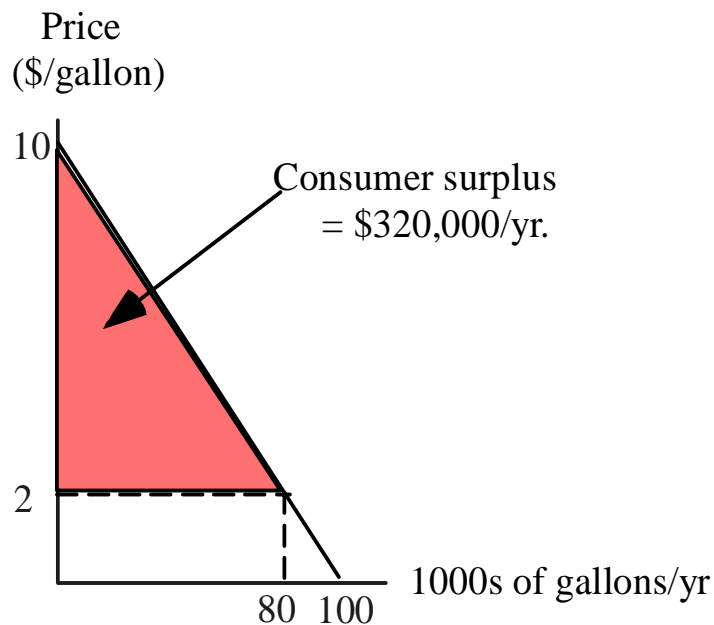
4. Toby is currently receiving  $(100 \text{ utils/ounce})/(\$0.10/\text{ounce}) = 1000$  utils per dollar from his last dollar spent on peanuts, and  $(400 \text{ utils/ounce})/(\$0.25/\text{ounce}) = 1600$  utils per dollar from his last dollar spent on cashews. Since the two are not equal, he is not maximizing her utility. He should spend more on cashews and less on peanuts.

5. The information given enables us to conclude that Ann's average utility per dollar is the same for both pizza and yogurt. But this information does not enable us to say whether her current combination of the two goods is optimal. To do that, we must be able to compare their respective values of marginal utility per dollar.

6a. Even at twice the original price, the marginal utility per dollar of the 20<sup>th</sup> train trip may be higher than the corresponding ratio for any other good that Ann might consume, in which case she would be perfectly rational not to alter the number of trips she takes. After all, missing a trip would be to miss a whole day's work.

b. The higher price of train tickets makes Ann poorer. The income effect of the price increase is what leads to the reduction in the number of restaurant meals she eats.

7. Consumer surplus is the area of the shaded triangle =  $(1/2)bh = (1/2) \times (80,000 \text{ gal/yr}) \times (\$8/\text{gal}) = \$320,000/\text{yr}$ .



8 and 9. The affordable combinations and their corresponding utilities are as listed in the table, which shows that the optimal combination is 3 pizzas per week and 2 movie rentals.

Combinations of pizza and rentals that cost \$24 per week	Total Utility
0 pizzas, 8 rentals	$0 + 57 = 57$
1 pizza, 6 rentals	$20 + 57 = 77$
2 pizzas, 4 rentals	$38 + 54 = 92$
3 pizzas, 2 rentals	$54 + 46 = 100$
4 pizzas, 0 rentals	$68 + 0 = 68$

10a. The market demand curve (right panel) is the horizontal summation of the two individual demand curves (left and center panels).

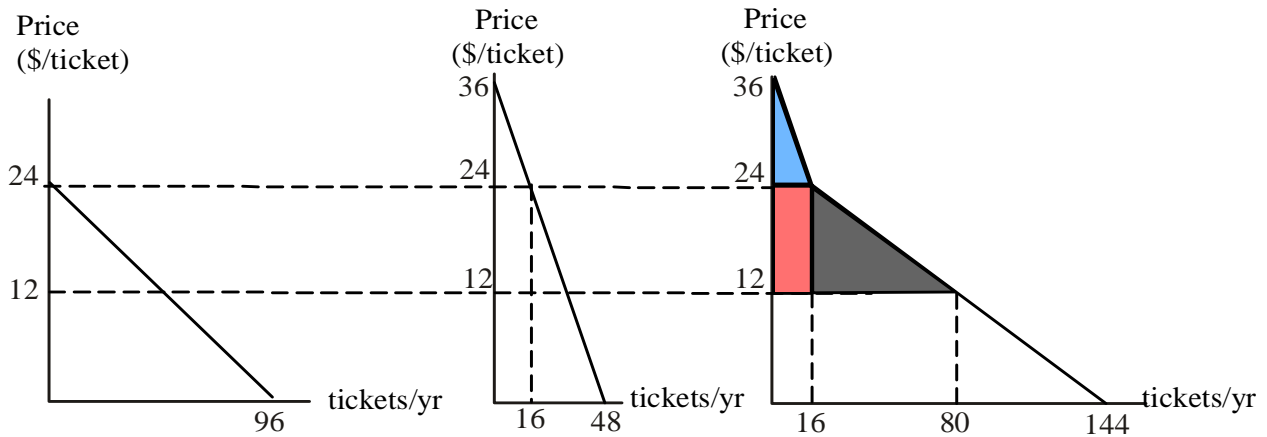
b. Total consumer surplus is the sum of the three shaded areas:

area of small triangle =  $(1/2)bh = (1/2) \times (16 \text{ tickets/yr}) \times (\$12/\text{ticket}) = \$96/\text{yr}$ ;

area of rectangle =  $bh = (16 \text{ tickets/yr}) \times (\$12/\text{ticket}) = \$192/\text{yr}$ ;

area of large triangle =  $(1/2)bh = (64 \text{ tickets/yr}) \times (\$12/\text{ticket}) = \$768/\text{yr}$ ;

Total consumer surplus =  $\$96/\text{yr} + \$192/\text{yr} + \$768/\text{yr} = \$1056/\text{yr}$ .

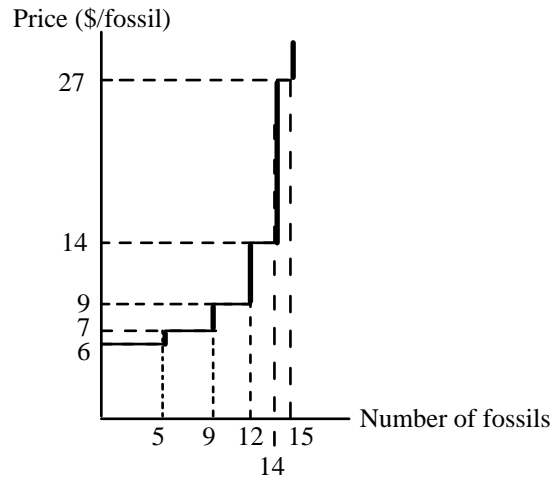


## Chapter 6

1. If the price of a fossil is less than \$6, Zoe should devote all her time to photography because when the price is, say, \$5 per fossil, an hour spent looking for fossils will give her  $5(\$5) = \$25$ , or \$2 less than she'd earn doing photography. If the price of fossils is 6, Zoe should spend one hour searching, will supply 5 fossils, and will get \$30 revenue, which is \$3 more than she'd earn from photography. However, an additional hour would yield only 4 additional fossils or \$24 additional revenue, so she should not spend any further time looking for fossils. If the price of fossils rises to \$7, however, the additional hour gathering fossils would yield an additional \$28, so gathering fossils during that hour would then be the best choice, and Zoe would therefore supply 9 fossils per day. Using this reasoning, we can derive a price-quantity supplied relationship for fossils as follows:

Price of fossils (\$)	Number of fossils supplied per day
0-5	0
6	5
7, 8	9
9-13	12
14-26	14
27+	15

If we plot these points, we get Zoe's daily supply curve for fossils:



2. The marginal cost of each of the first 6 air conditioners produced each day is less than \$120, but the marginal cost of the 7<sup>th</sup> air conditioner is \$140. So the company should produce 6 air conditioners per day.

Air Conditioners/day	Total Cost (\$/day)
1	100
2	150
3	220
4	310
5	405
6	510
7	650
8	800

3a. As indicated by the entries in the last column of the table below, the profit-maximizing quantity of bats for Paducah is 20/day, which yields daily profit of \$35.

b. Same quantity as in part a, but now profit is \$65, or \$30 more than before.

Q (bats/day)	Total Revenue (\$/day)	Total labor cost (\$/day)	Total cost (\$/day)	Profit (\$/day)
0	0	0	60	-60
5	50	15	75	-25
10	100	30	90	10
15	150	60	120	30
20	200	105	165	35
25	250	165	225	25
30	300	240	300	0
35	350	330	390	-40

4. A tax of \$10 per day would decrease Paducah's profit by \$10 per day at every level of output. But the company would still maximize its profit by producing 20 bats per day. A tax that is independent of output does not change marginal cost, and hence does not change the profit-maximizing level of output.

But a tax of \$2 per bat has exactly the same effect as any other \$2 increase in the marginal cost of making each bat. As we see in the last column of the table below, the company's profit-maximizing level of output now falls to 15 bats per day. At that level it earns exactly 0 profit, but at any other level of output it would sustain a loss.

Q (bats/day)	Total Revenue (\$/day)	Total labor cost (\$/day)	Total cost (\$/day)	Profit (\$/day)
0	0	0	60	-60
5	50	15	85	-35
10	100	30	110	-10
15	150	60	150	0
20	200	105	205	-5
25	250	165	275	-25
30	300	240	360	-60
35	350	330	460	-110

6. Producer surplus is the area of the shaded triangle, \$18,000/day.

