Answers to In-Text Questions

Chapter 2:

2.1
To solve this problem, we take the demand function given and plug in the price of potatoes (0.25) and the price of butter (2). Since we want to know what price will lead consumers to purchase 8 billion bushels of corn per year, we also plug in 8 for $Q^d corn$. Then we just solve algebraically for our unknown: P_{corn}.

$Q^d_{corn} = 20 - 4P_{corn} + 8P_{potatoes} - 0.5P_{butter}$
$(8) = 20 - 4P_{corn} + 8(0.25) - 0.5(2.00)$
$8 = 20 - 4P_{corn} + 2 - 1$
$8 = 21 - 4P_{corn}$
$P_{corn} = 13$
$\mathbf{P_{corn} = 13/4 = 3.25}$

Consumers will demand 8 billion bushels when corn is sold at a price of \$3.25 per bushel.

If butter rises to \$4 a pound, the price at which consumers buy 8 billion bushels of corn will drop to \$3.00 per bushel. We can figure this out just like we did above, only now we plug in 4 for the price of butter.

$Q^d_{corn} = 20 - 4P_{corn} + 8P_{potatoes} - 0.5P_{butter}$
$(8) = 20 - 4P_{corn} + 8(0.25) - 0.5(4.00)$
$8 = 20 - 4P_{corn} + 2 - 2$
$8 = 20 - 4P_{corn}$
$P_{corn} = 12$
$\mathbf{P_{corn} = 12/4 = 3.00}$

2.2
To find the equilibrium in this market, we need to find the price that will clear the market. The market clears when quantity supplied equals quantity demanded.

$Q^s_{corn} = Q^d_{corn}$

Substituting in the supply and demand functions for Q^s and Q^d yields:

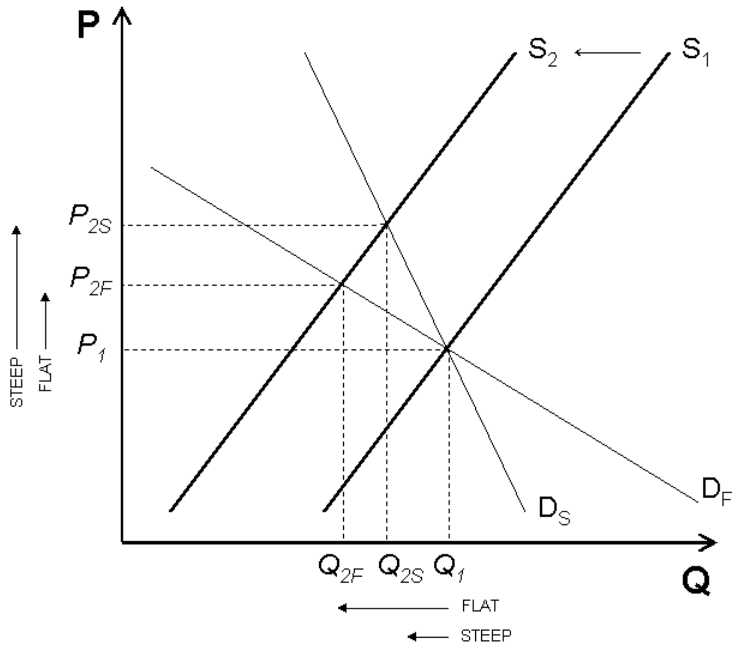
$1.6P_{corn} - 7 = 20 - 2P_{corn}$
$3.6P_{corn} = 27$
$\mathbf{P_{corn} = 27/3.6 = 7.50}$

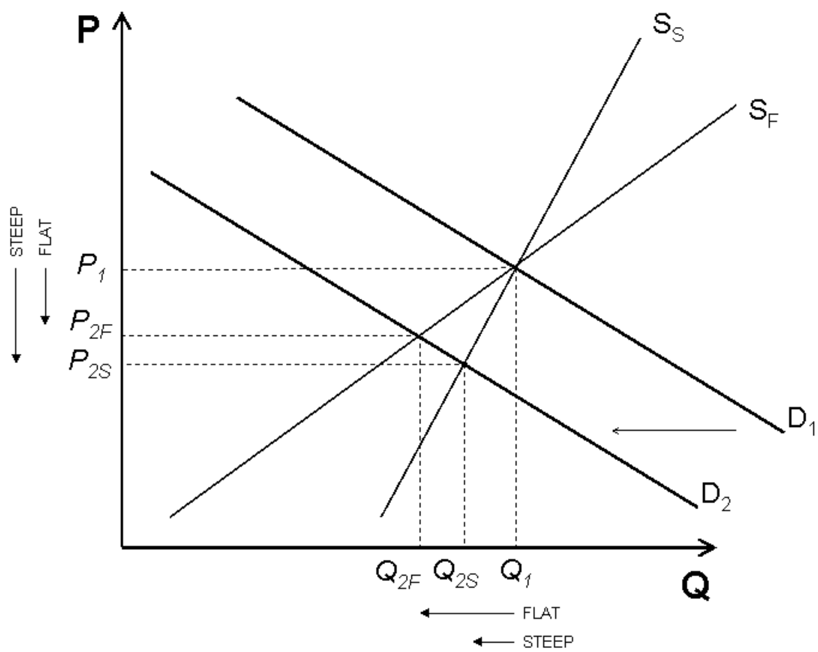
The equilibrium price is \$7.50 because this price satisfies the condition that quantity supplied equal quantity demanded. To find out equilibrium quantity, we substitute the price of \$7.50 into either the supply or demand function. We get 5 either way:

$Q^s_{corn} = 1.6P_{corn} - 7 = 1.6(7.50) - 7 = 12 - 7 = \mathbf{5}$
$Q^d_{corn} = 20 - 2P_{corn} = 20 - 2(7.50) = 20 - 15 = \mathbf{5}$

Answers to In-Text Questions

2.3





2.4

$$E^d = \left(\frac{\Delta Q}{\Delta P}\right)\left(\frac{P}{Q}\right) = \left(\frac{242 - 150}{\$2.35 - \$3.49}\right)\left(\frac{P}{Q}\right) = \left(\frac{92}{-\$1.14}\right)\left(\frac{P}{Q}\right)$$

When price is \$2.35 per box, quantity demanded is 242 million boxes, so we plug those two numbers in for P and Q to find E^d at a price of \$2.35:

$$E^d = \left(\frac{92}{-\$1.14}\right)\left(\frac{\$2.35}{242}\right) = \left(\frac{92 \times \$2.35}{-\$1.14 \times 242}\right) = \left(\frac{216.2}{-275.88}\right) = -0.78$$

When price is \$3.49 per box, quantity demanded is 150 million boxes, so we use those numbers to find E^d at a price of \$3.49:

$$E^d = \left(\frac{92}{-\$1.14}\right)\left(\frac{\$3.49}{150}\right) = \left(\frac{92 \times \$3.49}{-\$1.14 \times 150}\right) = \left(\frac{321.08}{-171}\right) = -1.88$$

2.5

Recall that the largest total expenditure occurs when price elasticity of demand equals -1. Further recall that the formula for E^d can be written as $E^d = -B(P/Q)$. If we substitute the linear form of the demand function $Q^d = A - BP$ into this equation it yields:

$$E^d = -B\left(\frac{P}{A - BP}\right)$$

Using the values of A and B given by the demand function (431.6 and 80.7, respectively), we can solve for the price, P, that makes E^d equal -1.

$$-1 = -80.7\left(\frac{P}{431.6 - 80.7P}\right)$$

Multiplying both sides by $(431.6 - 80.7P)$ gives $80.7P - 431.6 = -80.7P$, which solves easily to show that $P = \$2.67$ per box.

Answers to In-Text Questions

Chapter 3:

3.1
If the mechanic reduces her price by $25 per hour, then your total cost goes down for any positive number of repair hours. Nothing happens to your total benefit, but since your total cost is lower for repairs, your net benefit is higher. To find the new maximized net benefit, we simply subtract the *savings* from the new lower mechanic rate from the original total cost to get our *new* total cost. Using this *new* total cost and the same total benefit, we can calculate *new* total benefit, which is maximized at 4 hours of repair time. The first three columns below come from Table 3.3 on page 66.

Repair Time (Hours)	Total Benefit	Original Total Cost	*Savings* ($25/hr)	*New* Total Cost	*New* Net Benefit
0	0	0	0	0	0
1	615	150	25	125	490
2	1,150	380	50	330	820
3	1,600	690	75	615	985
4	**1,975**	**1,080**	**100**	**980**	**995**
5	2,270	1,550	125	1,425	845
6	2,485	2,100	150	1,950	535

3.2
Using the formula for marginal benefit given in (2) on page 72, we see that in order to calculate MB, we need ΔB and ΔH. Since we're given information in 15 minute increments, ΔH is always 0.25; ΔB can be found by finding the difference between B from any amount of repair time and B from 15 fewer minutes of repairs. The first and third columns below come from the information in the problem.

Repair Time, H	Change in Repair Time, ΔH	Total Benefit, B	Change in Benefit, ΔB	Marginal Benefit ($\Delta B/\Delta H$)
0.00	—	0	—	—
0.25	0.25	30	30	120
0.50	0.25	60	30	120
0.75	0.25	90	30	120
1.00	0.25	120	30	120
1.25	0.25	140	20	80
1.50	0.25	160	20	80
1.75	0.25	180	20	80
2.00	0.25	200	20	80

3.3
Since we can hire the mechanic for anywhere from 0 to 6 hours, the best choice is one of the following three choices: hire the mechanic for 0 hours, hire the mechanic for 6 hours, or hire the mechanic for the number of hours at which $MB = MC$. To decide which is best, we should compare the total benefits of these three choices. First we need to find out where $MB = MC$:

$MB(H) = MC(H)$
$654 - 80H = 110 + 48H$
$544 = 128H$
$\mathbf{H = 4.25}$

So the correct answer is 0, 4.25 or 6. To figure out which, we calculate the net benefit (benefit minus cost) of each. The highest net benefit occurs at 4.25 hours of repair time.

Repair time, H	**Total benefit, $B(H)$ $654H - 40H^2$**	**Total cost, $C(H)$ $110H + 24H^2$**	**Net benefit, $B(H) - C(H)$**
0	0	0	0
4.25	**2,057**	**901**	**1,156**
6	2,484	1,524	960

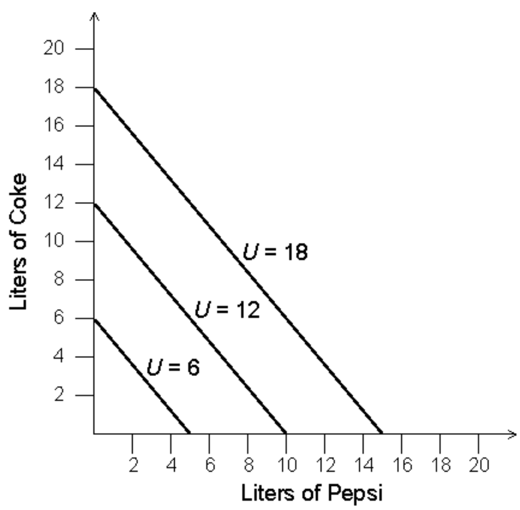
3.4
You want to hire your mechanic to perform every hour of work for which the marginal benefit is greater than the marginal cost. According to Figure 3.10(b), *MB* is always greater than *MC* (at least for the 0 to 6 hours you have available to you as choices). In other words, every hour of work that you have done provides a benefit that is greater than the cost of that hour, so every hour increases your net benefit. **You should hire your mechanic for all 6 available hours.**

Answers to In-Text Questions

Chapter 4:

4.1
Trade (a): Her beginning consumption bundle (one loaf of bread and one bowl of soup) is ranked 9th; the trade would give her 3 loaves of bread and no bowls of soup, a bundle ranked 11th. She would not be willing to make this trade.
Trade (b): She would make this trade; three loaves of bread and no bowls of soup comprise a bundle ranked 11th, while two bowls of soup and no loaves of bread comprise a bundle that is ranked 12th.
Trade (c): She would not make this trade. Her current consumption bundle (three bowls of soup and one loaf of bread) is ranked 5th; the trade would move her to a bundle ranked 7th (one bowl of soup and three loaves of bread).

4.2



To determine how Judy would rank these two bundles, we can solve the formula for her indifference curves for *U*, thereby making a utility function.

$U = C + 1.2P$

Now, we can plug the two bundles into the utility function to compare them.

$U(C, P) = C + 1.2P$
$U(1, 0) = 1 + 1.2(0) = 1$
$U(0, 1) = 0 + 1.2(1) = 1.2$

Since the bundle consisting of one liter of Pepsi and no Coke provides the greater level of utility, Judy prefers this bundle.

4.3
Since Kate gave up eight M&Ms for five Milk Duds, we know that she values Milk Duds more than M&Ms. Her MRS for Milk Duds with M&Ms must be greater than one. In fact, it must be greater than 1.6 (M&Ms / Milk Duds = 8 / 5 = 1.6). This means that Kate believes that one Milk Dud is a perfect substitute for at least 1.6 M&Ms—probably more (if exactly equal to 1.6, she would be indifferent about this trade). For example, if she believed that one Milk Dud was worth 2 M&Ms she would have still made this trade, because she's giving up less than she would be willing to. On the other hand, if she believed one Milk Dud was worth fewer than 1.6 M&Ms, say 1.5, then she would not make this trade because she would be paying more for Milk Duds than she is willing to.

Since Antonio willingly gave up five Milk Duds for eight M&Ms, he probably believes that eight M&Ms have a greater value than five Milk Duds or, equivalently, he probably believes that 1.6 M&Ms have a greater value than one Milk Dud. Therefore, Antonio's MRS for Milk Duds with

M&Ms is *at most* 1.6, but it is most likely less. If his MRS were equal to 1, so that he thought one M&M was the same as one Milk Dud, then he would definitely make this trade with Kate. However, if his MRS were greater than 1.6, say 2, so that he believed that it took two M&Ms to equal one Milk Dud, then Antonio would not accept only eight M&Ms for his five Milk Duds; he would require ten.

In summary, Kate's MRS $\geq$ 1.6 while Antonio's MRS $\leq$ 1.6.

4.4
To determine how Bert ranks the five bundles, we should calculate the utility that Bert receives from each bundle. Even before we do that, however, we can already conclude that bundles (1) and (5) cannot be the most preferred, since bundle (4) contains more Coke and more Mountain Dew than either of them and must therefore be strictly better than both of them.

$U(C, M) = C + 3\sqrt{M}$
(1): $U(5, 4) = 5 + 3\sqrt{4} = 5 + 3(2) = 11$
(2): $U(20, 0) = 20 + 3\sqrt{0} = 20 + 3(0) = 20$
(3): $U(0, 10) = 0 + 3\sqrt{10} = 0 + 3(3.162) = 9.486$
(4): $U(8, 7) = 8 + 3\sqrt{7} = 8 + 3(2.646) = 15.938$
(5): $U(1, 6) = 1 + 3\sqrt{6} = 1 + 3(2.449) = 8.347$

Therefore, Bert would rank the five bundles in the following order, starting with the most preferred: (2), (4), (1), (3), (5).

4.5
To turn the utility function into an indifference curve, we simply solve the function for one of the two goods and then plug in a level of utility, say 20.

$C = U - 3\sqrt{M}$ or $M = (U - C)^2 / 9$
$C = 20 - 3\sqrt{M}$ or $M = (20 - C)^2 / 9$

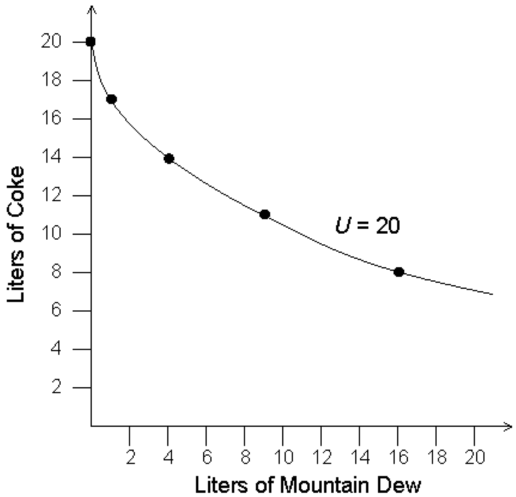
Then, we can plot points just by picking values for *M* (or *C*) and finding the corresponding value for *C* (or *M*), using a spreadsheet. Below are a few points for each possible construction of the indifference curves above.

M	***C***
0	20
1	17
4	14
9	11
16	8

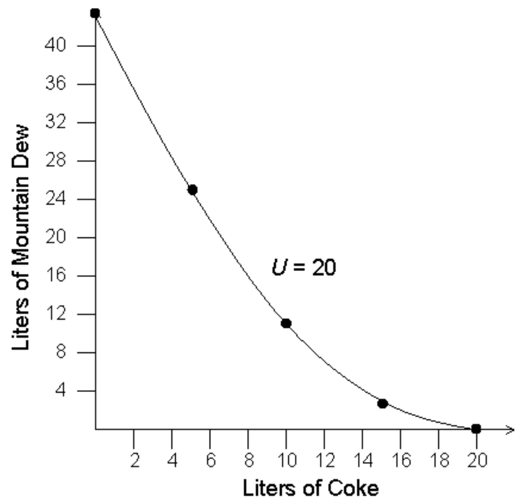
or

C	***M***
0	44.44
5	25
10	11.11
15	2.78
20	0

Then, all we need to do is to plot the points.



or



These goods are neither perfect substitutes (which would be indicated by straight-line indifference curves) nor perfect complements (which would be indicated by right-angle indifference curves).

In evaluating the transformations, we find that none of them would change the above response. In fact, none of them change the shape of the indifference curves drawn above, only the scale used to measure utility.

$U = C + 3\sqrt{M} + 4$: Adding 4 to the utility function does not change the order of preferences, because the utility associated with any choice would be 4 higher for every choice. Rankings would stay the same. It would be like changing the “*U* = 20” label on the indifference curves above to read “*U* = 24”.

$U = \left(C + 3\sqrt{M}\right)^2$: Squaring the utility associated with every possible choice does not change the order of the preferences, only the scale used to measure utility. Like the transformation above, this change can be shown easily on the drawing. In this case, the “*U* = 20” label would be changed to read “*U* = 400”.

$U = 2\left(C + 3\sqrt{M}\right)$: Similarly to the first two transformations above, this one simply changes the scale used to measure utility, but does not change the ranking of choices. This change can be shown on the above drawings by changing the “*U* = 20” label to read “*U* = 40”.

Answers to In-Text Questions

Chapter5:

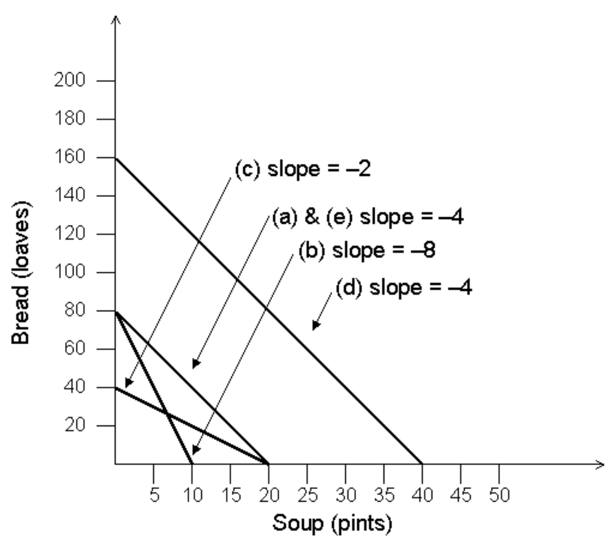
5.1
As in Example 5.1 on page 125, Madeline can afford all of the shaded combinations of soup and bread in the table below, because they all cost $6 or less.

Bread (loaves)				
3	$6	$10	$14	$18
2	4	8	12	16
1	2	6	10	14
0	0	4	8	12
	0	1	2	3
	Soup (bowls)			

5.2
For each of the cases below, the following three things are calculated as described. (As in the book, soup is placed on the horizontal axis and bread on the vertical axis.) The horizontal (soup) intercept is the maximum amount of soup the consumer could buy, calculated as M/P_S. The vertical (bread) intercept is the maximum amount of bread the consumer could buy calculated as M/P_B. The slope of the budget line is the opposite of the ratio of the horizontal axis good's price and the vertical axis good's price, or $–P_S/P_B$.

(a) Horizontal intercept: 20 Vertical intercept: 80 Slope: –4
(b) Horizontal intercept: 10 Vertical intercept: 80 Slope: –8
(c) Horizontal intercept: 20 Vertical intercept: 40 Slope: –2
(d) Horizontal intercept: 40 Vertical intercept: 160 Slope: –4
(e) Horizontal intercept: 20 Vertical intercept: 80 Slope: –4

The budget lines are graphed at the right. Students should notice that (a) and (e) are the same budget line, since every number in (e) is exactly two times every number in (a).



5.3
Example 5.2 on page 131 provides an example of how students are to do this problem.

Below is the table of Madeline's preferences (Table 4.2, page 96) with the affordable bundles shaded in (as in In-Text Exercise 5.1). As in Table 4.2, the numbers represent rankings, not expenditures.

Bread (loaves)				
3	11	*7*	*3*	*1*
2	13	*8*	*4*	*2*
1	15	**9**	*6*	*5*
0	16	14	12	10
	0	1	2	3
	Soup (bowls)			

Of the five affordable bundles, the one ranked highest (9th) is one loaf of bread and one bowl of soup. This is the bundle Madeline will choose. Students may also notice that the bundles in which the numbers are italicized are all the bundles that Madeline prefers to this (1,1) bundle, but that she cannot afford.

5.4
If Natasha's MRS_{CF} is $3F/2C$, we notice that it decreases as C rises and F falls, so her indifference curves display declining MRS. Her optimal choice will satisfy the tangency condition (P_C and P_F are given in Worked-Out Problem 5.2):

$MRS_{CF} = P_C/P_F$
$3F/2C = \$15/\$10$
$3F/2C = 1.5$
$3F = 3C$
$F = C$

Therefore, we know that she will always purchase the same number of film and concert tickets. To figure out what this number is, we look to the budget constraint (M is given in Worked-Out Problem 5.2), where we can substitute F for C (or C for F):

$M = P_C C + P_F F$
$\$300 = \$15C + \$10F$
$\$300 = \$15F + \$10F$
$\$300 = \$25F$
$\boldsymbol{F = 12}$

Since $F = C$, we know that $\boldsymbol{C = 12}$ as well.

If Natasha's MRS_{CF} is $\sqrt{F/C}$, we solve the problem in the same way. Students should confirm that increasing C and decreasing F cause the MRS to decrease, indicating declining MRS and well-behaved indifference curves.

$MRS_{CF} = P_C/P_F$
$\sqrt{F/C} = \$15/\$10$
$\sqrt{F/C} = 1.5$
$F/C = 2.25$
$F = 2.25C$

Therefore, we know that she will always purchase the 2.25 times as many film tickets as concert tickets. In the budget constraint, we can substitute $2.25C$ for F:

$M = P_C C + P_F F$
$\$300 = \$15C + \$10F$
$\$300 = \$15C + \$10(2.25C)$
$\$300 = \$15C + \$22.5C$
$\$300 = \$37.5C$
$\boldsymbol{C = 8}$

Since $F = 2.25C$, we know that $\boldsymbol{F = 18}$.

5.5
In order to answer this question without calculus, students need to construct a table similar to Table 5.3 on page 140, where utility levels (not rankings) are given in each cell. Students need to be aware of the affordable bundles, however, so it might be smart to start with a table as in Example 5.1 on page 125 where cells contain expenditures. The utility function is $U = SB$ as given in the problem.

***Expenditures*, used to identify affordable bundles:**

Bread (loaves) \ Soup (bowls)	0	1	2	3	4
4	$8	$10	$12	$14	$16
3	6	8	10	12	14
2	4	6	8	10	12
1	2	4	6	8	10
0	0	2	4	6	8

***Utility* for each bundle ($S \times B$), used to identify the utility-maximizing bundle:**

Bread (loaves) \ Soup (bowls)	0	1	2	3	4
4	0	4	8	12	16
3	0	3	6	9	12
2	0	2	**4**	6	8
1	0	1	2	3	4
0	0	0	0	0	0

Of all of the affordable (shaded) bundles, the bundle where Madeline chooses two loaves of bread and two bowls of soup is the bundle that provides the most utility ($U = 4$).

If bread costs $4 per loaf instead of $2 per loaf, then the set of affordable bundles changes. The two tables above become like the two tables below and the new utility-maximizing choice is two bowls of soup and one loaf of bread.

***Expenditures*, used to identify affordable bundles:**

Bread (loaves) \ Soup (bowls)	0	1	2	3	4
4	$16	$18	$20	$22	$24
3	12	14	16	18	20
2	8	10	12	14	16
1	4	6	8	10	12
0	0	2	4	6	8

***Utility* for each bundle ($S \times B$), used to identify the utility-maximizing bundle:**

Bread (loaves) \ Soup (bowls)	0	1	2	3	4
4	0	4	8	12	16
3	0	3	6	9	12
2	0	2	4	6	8
1	0	1	**2**	3	4
0	0	0	0	0	0

If the utility function were to change to $U = 4SB$, the only changes to the above two situations would be that every number in every cell of the *Utility* tables on the right would be multiplied by 4. Multiplying every number by 4 would not change which of the affordable bundles provided the *most* utility; it would only change the level of utility itself. This transformation would not change the results at all.

Likewise, changing the utility function to $U = (SB)^2$ would not change the results because raising a set of positive numbers to an even power does not change the order (only the magnitude) of the numbers in that set.

These comparisons reveal that utility functions are used only for their *ordinal* properties only, to show how consumers rank different choices. *Cardinal* measures of utility that come from evaluating the utility function (like the values in the right-most tables above) serve no function in utility-maximization.

5.6

From Worked-Out Problem 5.2 on page 142, we find that $U = C \times F$, with $MU_C = F$ and $MU_F = C$. Natasha's income, M, is $300. In this problem, $P_C = \$30$ and $P_F = \$15$. Just like in Worked-Out Problem 5.2, we start with the tangency condition as given in formula (6) from page 141:

$$\frac{MU_C}{P_C} = \frac{MU_F}{P_F}$$

$$\frac{F}{\$30} = \frac{C}{\$15}$$

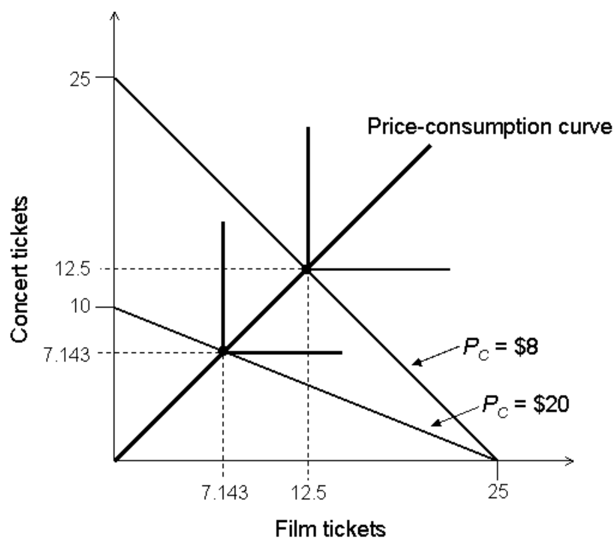
$15F = 30C$
$\boldsymbol{F = 2C}$

This result can be plugged into the budget constraint.

$M = P_C C + P_F F$
$\$300 = \$30C + \$15F$
$\$300 = \$30C + \$15(2C)$
$\$300 = \$30C + \$30C$
$\$300 = \$60C$
$\boldsymbol{C = 5}$

Since $F = 2C$, it must be that $\boldsymbol{F = 10}$. Natasha purchases five concert tickets and ten film tickets per month.

5.7
Alejandro believes that films and concerts are perfect 1:1 complements, so he will always purchase the same number of both. He has right-angle indifference curves. If the price of film tickets, P_F, is \$8 and his total budget for tickets is \$200, he can always purchase a maximum of 25 film tickets. Students may use different values for P_C to construct the price-consumption curve; below the possible prices of \$8 and \$20 are used.



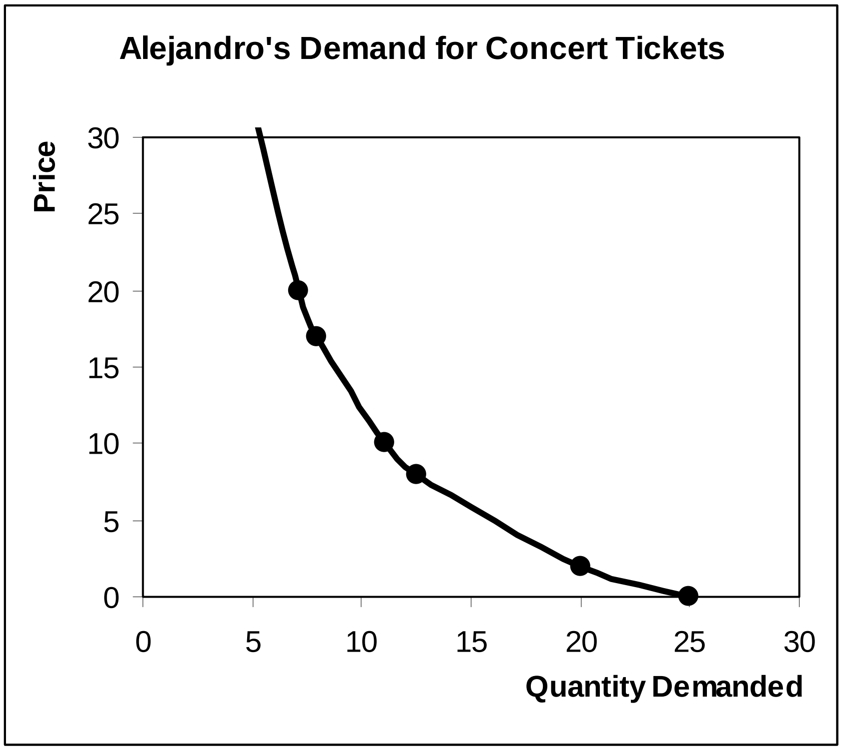
Alejandro's price-consumption curve is the line $C = F$. To construct Alejandro's demand curve for concert tickets, we plug this solution into his budget constraint and solve for C, letting P_C vary.

$M = P_C C + P_F F$
$\$200 = P_C C + \$8F$
$\$200 = P_C C + \$8C$

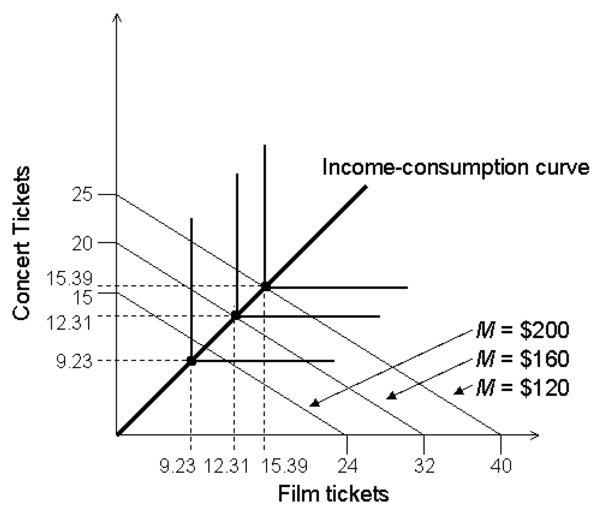
$\$200 = (\$8 + P_C)C$
$\mathbf{C = 200 / (8 + P_C)}$

Because this demand curve is not linear, it should be graphed by plugging in values for P_C to get different values of C. Below are some sample numbers and a demand curve drawn in Excel based on these numbers is to the right.

PC	***C***
$0	25
2	20
8	12.5
10	11.11
17	8
20	7.143
32	5

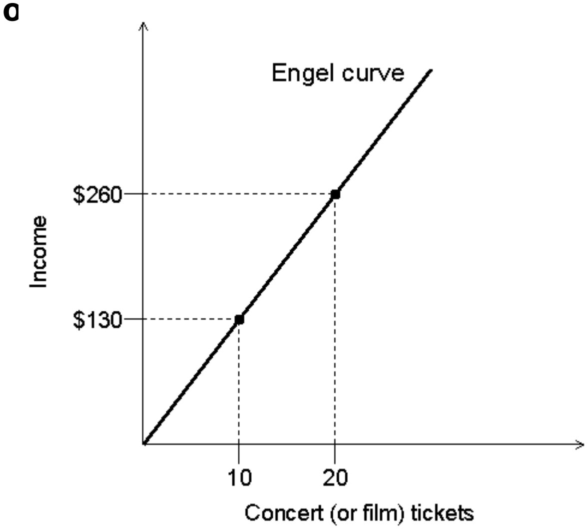


5.8
Since Alejandro believes films and concerts to be perfect 1:1 complements, he will always buy film tickets and concert tickets in equal numbers, or in "pairs." According to this problem, film tickets have a price, P_F, of \$8 each, and concert tickets have a price, P_C of \$5 each. This means that a pair of one film ticket and one concert ticket costs \$13. Therefore, the number of film and concert tickets he buys will always be equal to M/\$13, which makes finding the utility maximizing choices easy to find.



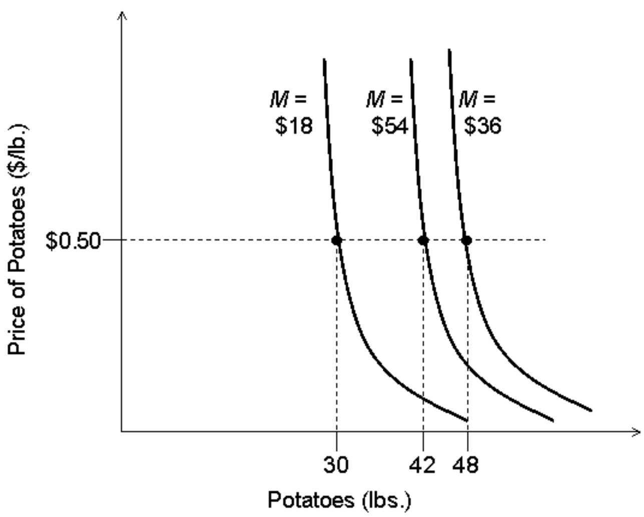
To the right is an example of an income-consumption curve, constructed using the possible incomes \$200, \$160 and \$120. The income used by your students will vary, but the income-consumption curve should be the line $C = F$.

Because Alejandro always buys the same number of concert and film tickets, his Engel curves for concert and film tickets will be identical. Also, as discussed above, the number of tickets he wants will always be equal to M/\$13. Suppose we were to construct his Engel curve for concert tickets; we know the relationship between the number of concert tickets he will buy is $C = M$/\$13. To draw this as an Engel curve, it might be easier to solve this for M, which is on the vertical axis of an Engel curve. When we solve for M, we get $M = \$13C$. So the Engel curve for concert (and film) tickets is just a straight line with a slope of 13, like the one depicted to the right.



Because both Engel curves are always upward-sloping, both goods are normal goods.

5.9
This exercise is fairly straightforward. Students plot the points the three quantities of potatoes demanded by Erin, all at a price of \$0.50, but each on demand curves representing different amounts of income.



Whether an increase in her income moves her demand curve to the left or to the right depends on her current level of income. An increase in income from \$18 to either \$36 or \$54 would shift the demand curve out to the right (increasing demand). However, an increase in income from \$36 to \$54 shifts her demand curve to the left (decreases demand). We know that at an income of \$18, potatoes are a normal good, and we know that at an income of \$36 are an inferior good.