MICROECONOMICS

Markets, Methods & Models

by Douglas Curtis and Ian Irvine

End of Chapter Exercises & Solutions

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Microeconomics: Markets, Methods & Models

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Exercises for Chapter 1

Exercise 1.1. An economy has 100 workers. Each one can produce four cakes or three shirts, regardless of the number of other individuals producing each good. Assuming all workers are employed, draw the PPF for this economy, with cakes on the vertical axis and shirts on the horizontal axis.

(a) How many cakes can be produced in this economy when all the workers are cooking?

(b) How many shirts can be produced in this economy when all the workers are sewing?

(c) Join these points with a straight line; this is the PPF.

(d) Label the inefficient and unattainable regions on the diagram.

Exercise 1.2. In the table below are listed a series of points that define an economy's production possibility frontier for goods Y and X.

Y	1000	900	800	700	600	500	400	300	200	100	0
X	0	1600	2500	3300	4000	4600	5100	5500	5750	5900	6000

(a) Plot these points to scale, on graph paper, or with the help of a spreadsheet.

(b) Given the shape of this PPF is the economy made up of individuals who are similar or different in their production capabilities?

(c) What is the opportunity cost of producing 100 more Y at the combination $(X = 5500, Y = 300)$.

(d) Suppose next there is technological change so that at every output level of good Y the economy can produce 20 percent more X. Compute the co-ordinates for the new economy and plot the new PPF.

Exercise 1.3. Using the *PPF* that you have graphed using the data in Exercise 1.2, determine if the following combinations are attainable or not: $(X = 3000, Y = 720)$, $(X = 4800, Y = 480)$.

Exercise 1.4. You and your partner are highly efficient people. You can earn \$50 per hour in the workplace; your partner can earn \$60 per hour.

(a) What is the opportunity cost of one hour of leisure for you?

(b) What is the opportunity cost of one hour of leisure for your partner?

(c) Now draw the *PPF* for yourself where hours of leisure is on the horizontal axis and income in dollars is on the vertical axis. You can assume that you have 12 hours of time each day to allocate to work (income generation) or leisure.

(d) Draw the *PPF* for your partner.

(e) If there is no domestic cleaning service in your area, which of you should do the housework, assuming that you are equally efficient at housework?

Exercise 1.5. Louis and Carrie Anne are students who have set up a summer business in their neighbourhood. They cut lawns and clean cars. Louis is particularly efficient at cutting the grass – he requires one hour to cut a typical lawn, while Carrie Anne needs one and one half hours. In contrast, Carrie Anne can wash a car in a half hour, while Louis requires three quarters of an hour.

(a) If they decide to specialize in the tasks, who should cut the grass and who should wash cars?

(b) If they each work a twelve hour day, how many lawns can they cut and how many cars can they wash if they specialize in performing the work?

Exercise 1.6. In Exercise 1.5, illustrate the *PPF* for each individual where lawns are on the horizontal axis and car washes on the vertical axis. Carefully label the intercepts. Then construct the economy-wide *PPF* using this information.

Exercise 1.7. Continuing with the same data set, suppose Carrie Anne's productivity improves so that she can now cut grass as efficiently as Louis; that is, she can cut grass in one hour, and can still wash a car in one half of an hour.

(a) In a new diagram draw the *PPF* for each individual.

(b) In this case does specialization matter if they are to be as productive as possible as a team?

(c) Draw the new *PPF* for the whole economy, labelling the intercepts and kink point coordinates.

Exercise 1.8. Using the economy-wide *PPF* you have constructed in Exercise 1.7, consider the impact of technological change in the economy. The tools used by Louis and Carrie Anne to cut grass and wash cars increase the efficiency of each worker by a whopping 25%. Illustrate graphically how this impacts the aggregate *PPF* and compute the three new sets of coordinates.

Exercise 1.9. Going back to the simple *PPF* plotted for Exercise 1.1 where each of 100 workers can produce either four cakes or three shirts, suppose a recession reduces demand for the outputs to 220 cakes and 129 shirts.

(a) Plot this combination of outputs in the diagram that also shows the *PPF*.

(b) How many workers are needed to produce this output of cakes and shirts?

(c) What percentage of the 100 worker labour force is unemployed?

Exercises for Chapter 2

Exercise 2.1. An examination of a country's recent international trade flows yields the data in the table below.

Year	National Income ($b)	Imports ($b)
2011	1,500	550
2012	1,575	573
2013	1,701	610
2014	1,531	560
2015	1,638	591

(a) Based on an examination of these data do you think the national income and imports are not related, positively related, or negatively related?

(b) Draw a simple two dimensional line diagram to illustrate your view of the import/income relationship. Measure income on the horizontal axis and imports on the vertical axis.

Exercise 2.2. The average price of a medium coffee at *Wakeup Coffee Shop* in each of the past ten years is given in the table below.

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
$1.05	$1.10	$1.14	$1.20	$1.25	$1.25	$1.33	$1.35	$1.45	$1.49

(a) Construct an annual 'coffee price index' for the 2005 time period using 2006 as the base year.

(b) Based on your price index, what was the percentage change in the price of a medium coffee from 2006 to 2013?

(c) Based on your index, what was the average annual percentage change in the price of coffee from 2010 to 2013?

Exercise 2.3. The table below gives unemployment rates for big cities and the rest of the country. Two-thirds of the population lives in the big cities, and one-third in other areas. Construct a national unemployment index, using the year 2000 as the base.

Unemployment (%)		
Year	**Big Cities**	**Other Areas**
2007	5	7
2008	7	10
2009	8	9
2010	10	12
2011	9	11

Exercise 2.4. The prices in the following table below are for three components in a typical consumer's budget: transportation, rent, and food. You must construct an aggregate price index based on these three components on the assumption that rent accounts for 55 percent of the weight in this index, food for 35 percent, and transport for 10 percent. You should start by computing an index for each component, using year 1 as the base period.

	Year 1	Year 2	Year 3	Year 4	Year 5
Transport $	70	70	75	75	75
Rent $	1000	1000	1100	1120	1150
Food $	600	620	610	640	660

Exercise 2.5. The price of carrots per kilogram is given in the table below for several years, as is the corresponding CPI.

	2000	2002	2004	2006	2008	2010
Nominal						
Carrot Price $	2.60	2.90	3.30	3.30	3.10	3.00
CPI	110	112	115	117	120	124

(a) Compute a nominal price index for carrots using 2000 as the base period.

(b) Re-compute the CPI using 2000 as the base year.

(c) Construct a real price index for carrots.

Exercise 2.6. The following table shows hypothetical consumption spending by households and income of households in billions of dollars.

Year	Income	Consumption
2006	476	434
2007	482	447
2008	495	454
2009	505	471
2010	525	489
2011	539	509
2012	550	530
2013	567	548

(a) Plot the scatter diagram with consumption on the vertical axis and income on the horizontal axis.

(b) Fit a line through these points.

(c) Does the line indicate that these two variables are related to each other?

(d) How would you describe the *causal relationship* between income and consumption?

Exercise 2.7. Using the data from Exercise 2.6, compute the percentage change in consumption and the percentage change in income for each pair of adjoining years between 2006 and 2013.

Exercise 2.8. You are told that the relationship between two variables, X and Y, has the form $Y = 10 + 2X$. By trying different values for X you can obtain the corresponding predicted value for Y (e.g., if $X = 3$, then $Y = 10 + 2 \times 3 = 16$). For values of X between 0 and 12, compute the matching value of Y and plot the scatter diagram.

Exercise 2.9. Perform the same exercise as in Exercise 2.8, but use the formula $Y = 10 - 0.5X$. What do you notice about the slope of the relationship?

Exercise 2.10. For the data below, plot a scatter diagram with variable Y on the vertical axis and variable X on the horizontal axis.

Y	40	33	29	56	81	19	20
X	5	7	9	3	1	11	10

(a) Is the relationship between the variables positive or negative?

(b) Do you think that a linear or non-linear line better describes the relationship?

EXERCISES FOR CHAPTER 3

Exercise 3.1. Supply and demand data for concerts are shown below.

Price	\$20	\$24	\$28	\$32	\$36	\$40
Quantity demanded	10	9	8	7	6	5
Quantity supplied	1	3	5	7	9	11

(a) Plot the supply and demand curves to scale and establish the equilibrium price and quantity.

(b) What is the excess supply or demand when price is \$24? When price is \$36?

(c) Describe the market adjustments in price induced by these two prices.

(d) The functions underlying the example in the table are linear and can be presented as $P = 18 + 2Q$ (supply) and $P = 60 - 4Q$ (demand). Solve the two equations for the equilibrium price and quantity values.

Exercise 3.2. Illustrate in a supply/demand diagram, by shifting the demand curve appropriately, the effect on the demand for flights between Calgary and Winnipeg as a result of:

(a) Increasing the annual government subsidy to *Via Rail*.

(b) Improving the Trans-Canada highway between the two cities.

(c) The arrival of a new budget airline on the scene.

Exercise 3.3. A new trend in U.S. high schools is the widespread use of chewing tobacco. A recent survey indicates that 15 percent of males in upper grades now use it – a figure not far below the use rate for cigarettes. Apparently this development came about in response to the widespread implementation by schools of regulations that forbade cigarette smoking on and around school property. Draw a supply-demand equilibrium for each of the cigarette and chewing tobacco markets before and after the introduction of the regulations.

Exercise 3.4. In Exercise 3.1, suppose there is a simultaneous shift in supply and demand caused by an improvement in technology and a growth in incomes. The technological improvement is represented by a lower supply curve: $P = 10 + 2Q$. The higher incomes boost demand to $P = 76 - 4Q$.

(a) Draw the new supply and demand curves on a diagram and compare them with the pre-change curves.

(b) Equate the new supply and demand functions and solve for the new equilibrium price and quantity.

Exercise 3.5. The market for labour can be described by two linear equations. Demand is given by $P = 170 - (1/6)Q$, and supply is given by $P = 50 + (1/3)Q$, where Q is the quantity of labour and P is the price of labour – the wage rate.

(a) Graph the functions and find the equilibrium price and quantity by equating demand and supply.

(b) Suppose a price ceiling is established by the government at a price of \$120. This price is below the equilibrium price that you have obtained in part a. Calculate the amount that would be demanded and supplied and then calculate the excess demand.

Exercise 3.6. In Exercise 3.5, suppose that the supply and demand describe an agricultural market rather than a labour market, and the government implements a price floor of \$140. This is greater than the equilibrium price.

(a) Estimate the quantity supplied and the quantity demanded at this price, and calculate the excess supply.

(b) Suppose the government instead chose to maintain a price of \$140 by implementing a system of quotas. What quantity of quotas should the government make available to the suppliers?

Exercise 3.7. In Exercise 3.6, suppose that, at the minimum price, the government buys up all of the supply that is not demanded, and exports it at a price of \$80 per unit. Compute the cost to the government of this operation.

Exercise 3.8. Let us sum two demand curves to obtain a 'market' demand curve. We will suppose there are just two buyers in the market. The two demands are defined by: $P = 42 - (1/3)Q$ and $P = 42 - (1/2)Q$.

(a) Draw the demands (approximately to scale) and label the intercepts on both the price and quantity axes.

(b) Determine how much would be purchased at prices \$10, \$20, and \$30.

Exercise 3.9. In Exercise 3.8 the demand curves had the same price intercept. Suppose instead that the first demand curve is given by $P = 36 - (1/3)Q$ and the second is unchanged. Graph these curves and illustrate the market demand curve.

Exercise 3.10. Here is an example of a demand curve that is not linear: $P = 5 - 0.2\sqrt{Q}$. The final term here is the square root of Q.

(a) Draw this function on a graph and label the intercepts. You will see that the price intercept is easily obtained. Can you obtain the quantity intercept where $P = 0$?

(b) To verify that the shape of your function is correct you can plot this demand curve in a spreadsheet.

(c) If the supply curve in this market is given simply by $P = 2$, what is the equilibrium quantity traded?

Exercise 3.11. The football stadium of the University of the North West Territories has 30 seats. The demand for tickets is given by $P = 36 - (1/2)Q$, where Q is the number of ticket-buying fans.

(a) At the equilibrium admission price how much revenue comes in from ticket sales for each game?

(b) A local fan is offering to install 6 more seats at no cost to the University. Compute the price that would be charged with this new supply and compute the revenue that would accrue each game. Should the University accept the offer to install the seats?

(c) Redo part (b) of this question, assuming that the initial number of seats is 40, and the University has the option to increase capacity to 46 at no cost to itself. Should the University accept the offer in this case?

Exercise 3.12. Suppose farm workers in Mexico are successful in obtaining a substantial wage increase. Illustrate the effect of this on the price of lettuce in the Canadian winter.

EXERCISES FOR CHAPTER 4

Exercise 4.1. Consider the information in the table below that describes the demand for movie rentals from your on-line supplier Instant Flicks.

Price per movie ($)	Quantity demanded	Total revenue	Elasticity of demand
2	1200		
3	1100		
4	1000		
5	900		
6	800		
7	700		
8	600		

(a) Either on graph paper or a spreadsheet, map out the demand curve.

(b) In column 3, insert the total revenue generated at each price.

(c) At what price is total revenue maximized?

(d) In column 4, compute the elasticity of demand corresponding to each $1 price reduction, using the average price and quantity at each state.

(e) Do you see a connection between your answers in parts (c) and (d)?

Exercise 4.2. Your fruit stall has 100 ripe bananas that must be sold today. Your supply curve is therefore vertical. From past experience, you know that these 100 bananas will all be sold if the price is set at 40 cents per unit.

(a) Draw a supply and demand diagram illustrating the market equilibrium price and quantity.

(b) The demand elasticity is -0.5 at the equilibrium price. But you now discover that 10 of your bananas are rotten and cannot be sold. Draw the new supply curve and calculate the percentage price increase that will be associate with the new equilibrium, on the basis of your knowledge of the demand elasticity.

Exercise 4.3. University fees in the State of Nirvana have been frozen in real terms for 10 years. During this period enrolments increased by 20 percent.

(a) Draw a supply curve and two demand curves to represent the two equilibria described.

(b) Can you estimate a price elasticity of demand for university education in this market?

(c) In contrast, during the same time period fees in a neighbouring state increased by 60 percent and enrolments increased by 15 percent. Illustrate this situation in a diagram.

Exercise 4.4. Consider the demand curve defined by the information in the table below.

Price of movies	Quantity demanded	Total revenue	Elasticity of demand
2	200		
3	150		
4	120		
5	100		

(a) Plot the demand curve to scale and note that it is non-linear.

(b) Compute the total revenue at each price.

(c) Compute the arc elasticity of demand for each price segment.

Exercise 4.5. The demand curve for seats at the Drive-in Delight Theatre is given by $P = 48 - 0.2Q$. The supply of seats is given by $Q = 40$.

(a) Plot the supply and demand curves to scale, and estimate the equilibrium price.

(b) At this equilibrium point, calculate the elasticities of demand and supply.

(c) The owner has additional space in his theatre, and is considering the installation of more seats. He then remembers from his days as an economics student that this addition might not necessarily increase his total revenue. If he hired you as a consultant, would you recommend to him that he install additional seats or that he take out some of the existing seats and install a popcorn concession instead? [Hint: You can use your knowledge of the elasticities just estimated to answer this question.]

(d) For this demand curve, over what range of prices is demand inelastic?

Exercise 4.6. Waterson Power Corporation's regulator has just allowed a rate increase from 9 to 11 cents per kilowatt hour of electricity. The short run demand elasticity is -0.6 and the long run demand elasticity is -1.2.

(a) What will be the percentage reduction in power demanded in the short run?

(b) What will be the percentage reduction in power demanded in the long run?

(c) Will revenues increase or decrease in the short and long runs?

Exercise 4.7. Consider the own- and cross-price elasticity data in the table below.

		% change in price		
		CDs	**Magazines**	**Cappuccinos**
% change in quantity	**CDs**	-0.25	0.06	0.01
	Magazines	-0.13	-1.20	0.27
	Cappuccinos	0.07	0.41	-0.85

(a) For which of the goods is demand elastic and for which is it inelastic?

(b) What is the effect of an increase in the price of CDs on the purchase of magazines and cappuccinos? What does this suggest about the relationship between CDs and these other commodities; are they substitutes or complements?

(c) In graphical terms, if the price of CDs or the price of cappuccinos increases, illustrate how the demand curve for magazines shifts.

Exercise 4.8. You are responsible for running the Speedy Bus Company and have information about the elasticity of demand for bus travel: The own-price elasticity is -1.4 at the current price. A friend who works in the competing railway company also tells you that she has estimated the cross-price elasticity of train-travel demand with respect to the price of bus travel to be 1.7.

(a) As an economic analyst, would you advocate an increase or decrease in the price of bus tickets if you wished to increase revenue for Speedy?

(b) Would your price decision have any impact on train ridership?

Exercise 4.9. A household's income and restaurant visits are observed at different points in time. The table below describes the pattern.

Income ($)	Restaurant visits	Income elasticity of demand
16,000	10	
24,000	15	
32,000	18	
40,000	20	
48,000	22	
56,000	23	
64,000	24	

(a) Construct a scatter diagram showing quantity on the vertical axis and income on the horizontal axis.

(b) Is there a positive or negative relationship between these variables?

(c) Compute the income elasticity for each income increase, using midpoint values.

(d) Are restaurant meals a normal or inferior good?

Exercise 4.10. Consider the following three supply curves: $P = 2.25Q$; $P = 2 + 2Q$; $P = 6 + 1.5Q$.

(a) Draw each of these supply curves to scale, and check that, at $P = \$18$, the quantity supplied in each case is the same.

(b) Calculate the (point) supply elasticity for each curve at this price.

(c) Now calculate the same elasticities at $P = \$12$.

(d) One elasticity value should be unchanged. Which one?

Exercise 4.11. The demand for bags of candy is given by $P = 48 - 0.2Q$, and the supply by $P = Q$.

(a) Illustrate the resulting market equilibrium in a diagram.

(b) If the government now puts a $12 tax on all such candy bags, illustrate on a diagram how the supply curve will change.

(c) Compute the new market equilibrium.

(d) Instead of the specific tax imposed in part (b), a percentage tax (ad valorem) equal to 30 percent is imposed. Illustrate how the supply curve would change.

(e) Compute the new equilibrium.

Exercise 4.12. Consider the demand curve $P = 100 - 2Q$. The supply curve is given by $P = 30$.

(a) Draw the supply and demand curves to scale and compute the equilibrium price and quantity in this market.

(b) If the government imposes a tax of \$10 per unit, draw the new equilibrium and compute the new quantity traded and the amount of tax revenue generated.

(c) Is demand elastic or inelastic in this price range?

Exercise 4.13. In Exercise 4.12: As an alternative to shifting the supply curve, try shifting the demand curve to reflect the \$10 tax being imposed on the consumer.

(a) Solve again for the price that the consumer pays, the price that the supplier receives and the tax revenue generated.

(b) Compare your answers with the previous question; they should be the same.

Exercise 4.14. The supply of Henry's hamburgers is given by $P = 2 + 0.5Q$; demand is given by $Q = 20$.

(a) Illustrate and compute the market equilibrium.

(b) A specific tax of \$3 per unit is subsequently imposed and that shifts the supply curve to $P = 5 + 0.5Q$. Solve for the equilibrium price and quantity after the tax.

(c) Who bears the burden of the tax in parts (a) and (b)?

Exercises for Chapter 5

Exercise 5.1. Four teenagers live on your street. Each is willing to shovel snow from one driveway each day. Their "willingness to shovel" valuations (supply) are: Jean, \$10; Kevin, \$9; Liam, \$7; Margaret, \$5. Several households are interested in having their driveways shoveled, and their willingness to pay values (demand) are: Jones, \$8; Kirpinsky, \$4; Lafleur, \$7.50; Murray, \$6.

(a) Draw the implied supply and demand curves as step functions.

(b) How many driveways will be shoveled in equilibrium?

(c) Compute the maximum possible sum for the consumer and supplier surpluses.

(d) If a new (wealthy) family arrives on the block, that is willing to pay \$12 to have their driveway cleared, recompute the answers to parts (a), (b), and (c).

Exercise 5.2. Consider a market where supply and demand are given by $P = 10$ and $P = 34 - Q$ respectively.

(a) Illustrate the market geometrically, and compute the equilibrium quantity.

(b) Impose a tax of \$2 per unit on the good so that the supply curve is now $P = 12$. Calculate the new equilibrium quantity, and illustrate it in your diagram.

(c) Calculate the tax revenue generated, and also the deadweight loss.

Exercise 5.3. Redo Exercise 5.2 with the demand curve replaced by $P = 26 - (2/3)Q$.

(a) Is this new demand curve more or less elastic than the original at the equilibrium?

(b) What do you note about the relative magnitudes of the DWL and tax revenue estimates here, relative to the previous question?

Exercise 5.4. Next, consider an example of DWL in the labour market. Suppose the demand for labour is given by the fixed gross wage $W = \$16$. The supply is given by $W = 0.8L$.

(a) Illustrate the market geometrically.

(b) Calculate the equilibrium amount of labour supplied, and the supplier surplus.

(c) Suppose a wage tax that reduces the wage to $W = \$12$ is imposed. By how much is the supplier's surplus reduced at the new equilibrium?

Exercise 5.5. Governments are in the business of providing information to potential buyers. The first serious provision of information on the health consequences of tobacco use appeared in the United States Report of the Surgeon General in 1964.

(a) How would you represent this intervention in a supply and demand for tobacco diagram?

(b) Did this intervention "correct" the existing market demand?

Exercise 5.6. In deciding to drive a car in the rush hour, you think about the cost of gas and the time of the trip.

(a) Do you slow down other people by driving?

(b) Is this an externality, given that you yourself are suffering from slow traffic?

Exercise 5.7. Suppose that our local power station burns coal to generate electricity. The demand and supply functions for electricity are given by $P = 12 - 0.5Q$ and $P = 2 + 0.5Q$, respectively. However, for each unit of electricity generated, there is an externality. When we factor this into the supply side of the market, the real social cost is increased, and the supply curve is $P = 3 + 0.5Q$.

(a) Find the free market equilibrium and illustrate it geometrically.

(b) Calculate the efficient (i.e. socially optimal) level of production.

Exercise 5.8. Evan rides his mountain bike down Whistler each summer weekend. The utility value he places on each kilometre ridden is given by $P = 4 - 0.02Q$, where Q is the number of kilometres. He incurs a cost of $2 per kilometre in lift fees and bike depreciation.

(a) How many kilometres will he ride each weekend? [Hint: Think of this "value" equation as demand, and this "cost" equation as a (horizontal) supply.]

(b) But Evan frequently ends up in the local hospital with pulled muscles and broken bones. On average, this cost to the Canadian taxpayer is $0.50 per kilometre ridden. From a societal viewpoint, what is the efficient number of kilometres that Evan should ride each weekend?

Exercise 5.9. Your local dry cleaner, Bleached Brite, is willing to launder shirts at its cost of $1.00 per shirt. The neighbourhood demand for this service is $P = 5 - 0.005Q$.

(a) Illustrate and compute the market equilibrium.

(b) Suppose that, for each shirt, Bleached Brite emits chemicals into the local environment that cause $0.25 damage per shirt. This means the full cost of each shirt is $1.25. Calculate the socially optimal number of shirts to be cleaned.

Exercise 5.10. The supply curve for agricultural labour is given by $W = 6 + 0.1L$, where W is the wage (price per unit) and L the quantity traded. Employers are willing to pay a wage of $12 to all workers who are willing to work at that wage; hence the demand curve is $W = 12$.

(a) Illustrate the market equilibrium, and compute the equilibrium wage (price) and quantity of labour employed.

(b) Compute the supplier surplus at this equilibrium.

Exercise 5.11. The demand for ice cream is given by $P = 24 - Q$ and the supply curve by $P = 4$.

(a) Illustrate the market equilibrium, and compute the equilibrium price and quantity.

(b) Calculate the consumer surplus at the equilibrium.

(c) As a result of higher milk prices to dairy farmers the supply conditions change to $P = 6$. Compute the new quantity traded, and calculate the loss in consumer surplus.

Exercise 5.12. Two firms A and B, making up a sector of the economy, emit pollution (pol) and have marginal abatement costs: $MA_A = 24 - pol$ and $MA_B = 24 - (1/2)pol$. So the total abatement curve for this sector is given by $MA = 24 - (1/3)pol$. The marginal damage function is constant at a value of \$12 per unit of pollution emitted: $MD = \$12$.

(a) Draw the *MD* and market-level *MA* curves and establish the efficient level of pollution for this economy.

Exercise 5.13. In Exercise 5.12, if each firm is permitted to emit half of the efficient level of pollution, illustrate your answer in a diagram which contains the MA_A and MA_B curves.

(a) With each firm producing this amount of pollution, how much would it cost each one to reduce pollution by one unit?

(b) If these two firms can freely trade the right to pollute, how many units will they (profitably) trade?

Exercise 5.14. Once again, in Exercise 5.13, suppose that the government's policy is to allow firms to pollute provided that they purchase a permit valued at \$10 per unit emitted (rather than allocating a pollution quota to each firm).

(a) How many units of pollution rights would be purchased and by the two participants in this market?

Exercise 5.15. The market demand for vaccine XYZ is given by $P = 36 - Q$ and the supply conditions are $P = 20$. There is a positive externality associated with being vaccinated, and the real societal value is known and given by $P = 36 - (1/2)Q$.

(a) What is the market solution to this supply and demand problem?

(b) What is the socially optimal number of vaccinations?

(c) If we decide to give the supplier a given dollar amount per vaccination supplied in order to reduce price and therefore increase the number of vaccinations to the social optimum, what would be the dollar value of that per-unit subsidy?

Exercise 5.16. In Exercise 5.15, suppose that we give buyers the subsidy instead of giving it to the suppliers. By how much would the demand curve have to shift upward in order that the socially optimal quantity is realized?

Exercise 5.17. The demand and supply curves in a regular market (no externalities) are given by $P = 42 - Q$ and $P = 0.2Q$.

(a) Solve for the equilibrium price and quantity.

(b) A percentage tax of 100% is now levied on each unit supplied. Hence the form of the new supply curve $P = 0.4Q$. Find the new market price and quantity.

(c) How much per unit is the supplier paid?

(d) Compute the producer and consumer surpluses after the imposition of the tax and also the DWL.

Exercises for Chapter 6

Exercise 6.1. In the example given in Table 6.1, suppose Neal experiences a small increase in income. Will he allocate it to snowboarding or jazz? [Hint: At the existing equilibrium, which activity will yield the higher MU for an additional dollar spent on it?]

Exercise 6.2. Suppose that utility depends on the square root of the amount of good X consumed: $U = \sqrt{X}$.

(a) In a spreadsheet enter the values 1...25 in the X column, and in the adjoining column compute the value of utility corresponding to each quantity of X.

(b) In the third column enter the marginal utility (MU) associated with each value of X – the change in utility in going from one value of X to the next.

(c) Use the 'graph' tool to map the relationship between U and X.

(d) Use the graph tool to map the relationship between MU and X.

Exercise 6.3. Cappuccinos, C, cost $3 each, and music downloads of your favourite artist, M, cost $1 each from your iTunes store. Income is $24.

(a) Draw the budget line to scale, with cappuccinos on the vertical axis, and compute its slope.

(b) If the price of cappuccinos rises to $4, compute the new slope.

(c) At the initial set of prices, are the following combinations of goods in the affordable set: (4C and 9M), (6C and 2M), (3C and 15M)?

(d) Which combination(s) in part (c) lie inside the affordable set, and which lie on the boundary?

Exercise 6.4. George spends his income on gasoline and "other goods."

(a) First, draw a budget constraint, with gasoline on the horizontal axis. Then, illustrate by how much the intercept on the gasoline axis changes in response to a doubling of the price of gasoline.

(b) Suppose that, in addition to a higher price, the government imposes a *ration* on George that limits his purchase of gasoline to less than some amount within his affordable set. Draw the new effective budget constraint.

Exercise 6.5. Instead of the ration in Exercise 6.4, suppose that the government increases taxes on gasoline, in addition to the market price increase. Illustrate this budget constraint.

Exercise 6.6. The price of cappuccinos is $3, the price of a theatre ticket is $12, and consumer income is $72.

(a) In a graph with theatre tickets on the vertical axis and cappuccinos on the horizontal axis, draw the budget constraint to scale, marking the intercepts.

(b) Suppose the consumer chooses the combination of 4 theatre tickets and 8 cappuccinos. Draw such a point on the budget constraint and mark the affordable and non-affordable regions.

(c) Is the combination of 3 tickets and 24 cappuccinos affordable?

(d) Is the combination in part (c) preferred to, or less preferred than, the chosen point in part (b)?

(e) If the price of cappuccinos falls to $2 per cup, is the combination of 24 cappuccinos and 3 tickets affordable?

Exercise 6.7. Suppose that you are told that the indifference curves defining the trade-off for two goods took the form of straight lines. Which of the four properties outlines in Section 6.3 would such indifference curves violate?

Exercise 6.8. A student's income is $50. Lunch at the cafeteria costs $5, and movies at the Student Union cost $2 each.

(a) Draw the budget line to scale, with lunch on the vertical axis; insert some regular-shaped smooth convex indifference curves, and choose the tangency equilibrium, denoted by E_0.

(b) If the price of lunch falls to $2.50, draw the new budget line. What can be said about the new equilibrium relative to E_0 if both goods are normal?

(c) If the price of movies also falls to $1, draw the new budget line and illustrate a new equilibrium.

(d) How does the equilibrium in part (c) differ from the equilibrium in part (b)?

Exercise 6.9. Lionel likes to eat a nice piece of Brie cheese while having a glass of wine. He has a monthly gourmet budget of $120. In a diagram with wine on the vertical axis and cheese on the horizontal axis, suppose that the intercepts are 10 bottles on the wine axis and 4 kilos on the cheese axis. He is observed to purchase 5 bottles of wine and 2 kilos of cheese.

(a) What are the prices of wine and cheese?

(b) Suppose that the price of wine increases to $20 per bottle, but that Lionel's income simultaneously increases by $60. Draw the new budget constraint and mark the intercepts.

(c) Is Lionel better off in the new or old situation? [Hint: ask if he can now afford the bundle he purchased with a lower income and lower wine price.]

Exercise 6.10. An indifference curve is a relationship between two goods, X and Y, such that utility is constant. Consider the following indifference curve: $Y = 12/X$. Since this can also be written as $12 = XY$ then we can think of the value 12 as representing the utility level.

(a) In a spreadsheet enter the values 1...24 in the X column, and in the adjoining Y column compute the value of Y corresponding to each value of X.

(b) Use the graph function to map this indifference curve.

(c) Compute the MRS where X increases from 3 to 4, and again where it increases from 15 to 16. [Hint: Since the MRS is the change in the amount of Y that compensates for a change in the amount of X, you need simply calculate the changes in Y corresponding to each of these changes in X.]

Exercise 6.11. Draw an indifference map with several indifference curves and several budget constraints corresponding to different possible levels of income. Note that these budget constraints should all be parallel because only income changes, not prices. Now find some optimizing (tangency) points. Join all of these points. You have just constructed what is called an income-consumption curve. Can you understand why it is called an income-consumption curve?

Exercise 6.12. Draw an indifference map again, in conjunction with a set of budget constraints. This time the budget constraints should each have a different price of good X and the same price for good Y.

(a) Draw in the resulting equilibria or tangencies and join up all of these points. You have just constructed a price-consumption curve for good X. Can you understand why the curve is so called?

(b) Now repeat part (a), but keep the price of X constant and permit the price of Y to vary. The resulting set of equilibrium points will form a price consumption curve for good Y.

Exercise 6.13. From the equilibrium based on the data in Table 6.1, let us compute some elasticities, using the midpoint formula that we developed in Chapter 4. Suppose that the price of jazz falls to $16 per outing, from the initial price of $20. Income remains at $200.

(a) First compute Neal's new equilibrium – by computing a new MU/P schedule for jazz and reallocating his budget in a utility-maximizing fashion.

(b) What is his price elasticity of demand for jazz at this set of prices? [Hint: Once you compute the new quantity of jazz purchased you can compute the percentage change in quantity demanded. You also know the percentage change in the price of jazz, so you can now compute the ratio of these two numbers.]

(c) What is the cross-price elasticity of demand for snowboarding, with respect to the price of jazz, at this set of prices? [Hint: Calculate the percentage change in the number of snowboard visits to Whistler, relative to the percentage change in the price of jazz.]

Exercise 6.14. Suppose that movies are a normal good, but public transport is inferior. Draw an indifference map with a budget constraint and initial equilibrium. Now let income increase and draw a plausible new equilibrium, noting that one of the goods is inferior.

Exercise 6.15. Consider the set of choices facing the consumer in Figures 6.12, 6.13, and 6.14. The parent chooses between other goods and daycare.

(a) First, replicate this figure with one budget constraint and one indifference curve that together define a tangency (equilibrium) solution.

(b) Suppose now that daycare is subsidized through a price reduction. Draw two possible equilibria, one where "other goods" purchased increase, and the second where they decrease. In which case are daycare and other goods substitutes? In which case are they complements?

Exercises for Chapter 7

Exercise 7.1. Estimate the average dollar outcome of each of the following games. Each dollar outcome has a probability of one-quarter. Then compute the average utility associated with each game, given the utility values that are associated with each dollar outcome.

(a) $\$12,000, U = 109.5; \$11,000, U = 104.9; \$9,000, U = 94.9; \$8,000, U = 89.4.$

(b) $\$32,000, U = 178.9; \$31,000, U = 176.1; \$29,000, U = 170.3; \$28,000, U = 167.3.$

(c) $\$24,000, U = 154.9; \$22,000, U = 148.3; \$18,000, U = 134.2; \$16,000, U = 126.5.$

Exercise 7.2. You see an advertisement for life insurance for everyone 50 years of age and older. No medical examination is required. If you are a healthy 52-year old, do you think you will get a good deal from this company?

Exercise 7.3. In which of the following are risks being pooled, and in which would risks likely be spread by insurance companies?

(a) Insurance against Alberta's Bow River Valley flooding.

(b) Life insurance.

(c) Insurance for the voice of Avril Lavigne or Celine Dion.

(d) Insuring the voices of the lead vocalists in Metallica, Black Eyed Peas, Incubus, Evanescence, Green Day, and Jurassic Five.

Exercise 7.4. (a) Plot the following three utility functions that relate utility U to wealth W, for values of wealth in the range $1\ldots50$, using a spreadsheet tool such as Excel: $U_A = 2W - 0.01W^2$; $U_B = 2W$; $U_C = 2W + 0.02W^2$.

(b) State whether each utility function displays risk neutrality, risk aversion or risk love.

(c) Judging from the shapes of the functions you have plotted, do they display increasing, constant or diminishing marginal utility?

Exercise 7.5. Use the data in Table 7.2 to compute the average utility that each participant gets from his or her income in the different situations under the following assumption about utility: with no pooling of risk, the utilities are either from obtaining \$5000 or from obtaining zero. But, with risk pooling, there is also the possibility of getting the utility associated with an income of \$2500. Suppose that the utility from getting a zero income is zero, the utility from \$2500 is 50, and the utility from \$5000 is 70.7.

(a) How much more utility will each individual get, on average, when sharing his or her income with their partner relative to when not sharing?

Exercise 7.6. In the example developed in Table 7.3, suppose there are four identical firms with the same return pattern, and the investor again has \$200 to invest.

(a) Compute the portfolio variance associated with a strategy of investing \$50 in each stock. To do this you can use a property of the variance of a portfolio: when the stock prices move independently, the variance of the portfolio of stocks is the sum of the variance of each stock. So compute the variance of each stock, where \$50 is invested in each, and the variance of the portfolio will be four times this amount.

Exercise 7.7. A worker has a utility of income function defined by $U = \sqrt{Y}$.

(a) Plot this utility function for values of income in the range $1 \ldots 36$.

(b) Suppose the individual this time period has $Y = 16$, and he has a 50% chance of seeing his income increase or decrease. If it decreases we know it will fall to \$1. If it increases, by how much would income have to increase to leave his expected utility equal to the level he attains when he gets an income of \$16 with certainty?

Exercise 7.8. Once again consider a worker who has a utility function $U = \sqrt{Y}$. In a good week he earns \$25 and in a bad week he earns nothing. Good and bad weeks each have probabilities of 50%.

(a) What is his average or expected utility in numerical terms?

(b) Suppose the government enters the picture and requires him to contribute to an unemployment insurance scheme. He must pay \$9 every time he has a good week. In return the government pays him \$9 whenever he has a bad week. Compute his average or expected utility with the new insurance scheme in place.

Exercise 7.9. Consider the individual in Exercise 7.8 once again. He earns either zero or \$25 with equal probability in every time period. There is no employment insurance scheme.

(a) If this individual thinks about the fact that he may be unemployed in any time period, how much should he save every (good) time period in order to have the maximum average or expected utility over time?

Exercise 7.10. Suppose an individual has utility that increases with the log of his wealth: $U = \ln(W)$, where W is a number that denotes wealth. Compute the value of U for values of W running from $1 \ldots 20$ (not including zero). Then plot the graph of the function and determine if it displays increasing, constant or decreasing marginal utility.

Exercises for Chapter 8

Exercise 8.1. Suppose you are told by a production engineer that the relationship between output Q on the one hand and input, in the form of labour (L), on the other is $Q = 5\sqrt{L}$. Capital is fixed, so we are operating in the short run.

(a) Compute the output that can be produced in this firm using 1 through 9 units of labour by substituting these numbers into the production function.

(b) Draw the resulting TP curve to scale, relating output to labour.

(c) Inspect your graph to see that it displays diminishing MP.

Exercise 8.2. The total product schedule for *Primitive Products* is given in the table below.

Output	1	6	12	20	30	42	53	60	66	70
Labour	1	2	3	4	5	6	7	8	9	10

(a) Draw the total product function for this firm to scale, or by using a spreadsheet.

(b) Calculate the AP and draw the resulting relationship on a separate graph.

(c) Calculate the MP and draw the schedule on the same graph as the AP.

(d) By inspecting the AP and MP curves, can you tell if you have drawn them correctly? Why?

Exercise 8.3. Return to Exercise 8.1 above and now calculate and plot the AP and MP curves.

Exercise 8.4. A short-run relationship between output and total cost is given in the table below.

Output	0	1	2	3	4	5	6	7	8	9
Total Cost	12	27	40	51	61	70	80	91	104	120

(a) What is the total fixed cost of production in this example?

(b) Add some rows to your table and calculate the AFC, AVC, and ATC curves for each level of output.

(c) Calculate the MC of producing additional levels of output.

(d) Graph each of these four cost curves using the information you have developed.

Exercise 8.5. Bernie's Bagels can function with three different oven capacities. For any given amount of labour, a larger output can be produced with a larger-capacity oven. The cost of a small oven is \$100; the cost of a medium-sized oven is \$140; and the cost of a large oven is \$180. Each worker is paid \$60 per shift. The production levels for each plant size are given in the table below.

Labour	Small-oven output	Med-oven output	Large-oven output
1	15	20	22
2	30	40	46
3	48	64	70
4	56	74	80

(a) Compute and graph *AP* and *MP* curves for each size of operation.

(b) Verify that the relationship between the *AP* and *MP* curves is as it should be.

Exercise 8.6. Now consider the cost curves associated with the production functions in Exercise 8.5.

(a) Compute the *ATC* schedule for the medium plant size and verify that it is U shaped.

Exercise 8.7. Now consider Exercise 8.6 in the longer term – with variable plant size.

(a) Compute the *ATC* for the small plant and large plant.

(b) By inspecting all three *ATC* curves, what can you say about scale economies over the range of output being considered?

Exercise 8.8. The table below defines the inputs required in the long run to produce three different output levels using different combinations of capital and labour. The cost of labour is \$5 and the cost of capital is \$2 per unit.

Capital used	4	2	7	4	11	8
Labour used	5	6	10	12	15	16
Output	4	4	8	8	12	12

(a) Calculate the least-cost method of producing each of the three levels of output defined in the bottom row.

(b) On a graph with cost on the vertical axis and output on the horizontal axis, plot the relationship you have calculated in (a) between cost per unit and output. You have now plotted the long-run average cost.

Exercise 8.9. Suppose now that the cost of capital in Exercise 8.8 rises to \$3 per unit. Graph the new long-run average cost curve, and compare its position with the curve in that question.

Exercise 8.10. Consider the long-run total cost structure for the following two firms.

Output	1	2	3	4	5	6	7
Firm A	\$40	\$52	\$65	\$80	\$97	\$119	\$144
Firm B	\$30	\$40	\$50	\$60	\$70	\$80	\$90

(a) Compute the long-run ATC curve for each firm.

(b) Plot these curves and examine the type of scale economies each firm experiences at different output levels.

Exercise 8.11. Use the data in Exercise 8.10 to establish the *LMC* for each of these two firms.

(a) Check that these *LMC* curves intersect with the *LAC* curves appropriately.

Exercise 8.12. Consider a firm whose ATC (in the short run) is given by: $ATC = 2/q + 1 + q/8$.

(a) Using a spreadsheet plot this curve for values of output in the range $1 \ldots 20$. You should first compute the cost values in a table.

(b) Next tabulate the total cost for each level of output, using the fact that total cost is the product of quantity times ATC.

(c) Now compute the marginal cost in the fourth column of your table by observing how total cost changes at each level of output.

(d) Plot the *MC* curve on the same graph as the ATC curve, and verify that it cuts the ATC at its minimum point.

Exercise 8.13. Suppose you are told that a firm has a long run average total cost that is defined by the following relationship: $LATC = 4 + 48/q$.

(a) Plot this curve for several values of q in the range $1 \ldots 24$.

(b) What kind of returns to scale does this firm never experience?

(c) By examining your graph of the $LATC$ curve, what will be the numerical value of the ATC as output becomes very large?

(d) Can you guess what the form of the *LMC* curve is?

Exercises for Chapter 9

Exercise 9.1. Wendy's Window Cleaning is a small local operation. Winnie presently cleans the outside windows in her neighbours' houses for \$36 per house. She does ten houses per day. She is incurring total costs of \$420, and of this amount \$100 is fixed. The cost per house is constant.

(a) What is the marginal cost associated with cleaning the windows of one house – we know it is constant?

(b) At a price of \$36, what is her break-even level of output (number of houses)?

(c) If the fixed cost is 'sunk' and she cannot increase her output in the short run, should she shut down?

Exercise 9.2. A manufacturer of vacuum cleaners incurs a constant variable cost of production equal to \$80. She can sell the appliances to a wholesaler for \$130. Her annual fixed costs are \$200,000. How many vacuums must she sell in order to cover her total costs?

Exercise 9.3. For the vacuum cleaner producer in Exercise 9.2:

(a) Draw the MC curve.

(b) Next, draw her AFC and her AVC curves.

(c) Finally, draw her ATC curve.

(d) In order for this cost structure to be compatible with a perfectly competitive industry, what must happen to her MC curve at some output level?

Exercise 9.4. Consider the supply curves of two firms in a competitive industry: $P = q_A$ and $P = 2q_B$.

(a) On a diagram, draw these two supply curves, marking their intercepts and slopes numerically (remember that they are really MC curves).

(b) Now draw a supply curve that represents the combined supply of these two firms.

Exercise 9.5. Amanda's Apple Orchard Productions Limited produces 10,000 kilograms of apples per month. Her total production costs at this output level are \$8,000. Two of her many competitors have larger-scale operations and produce 12,000 and 15,000 kilos at total costs of \$9,500 and \$11,000 respectively. If this industry is competitive, on what segment of the LAC curve are these producers producing?

Exercise 9.6. Consider the data in the table below. TC is total cost, TR is total revenue, and Q is output.

Q	0	1	2	3	4	5	6	7	8	9	10
TC	10	18	24	31	39	48	58	69	82	100	120
TR	0	11	22	33	44	55	66	77	88	99	110

(a) Add some extra rows to the table below and for each level of output calculate the *MR*, the *MC* and total profit.

(b) Next, compute *AFC*, *AVC*, and *ATC* for each output level, and draw these three cost curves on a diagram.

(c) What is the profit-maximizing output?

(d) How can you tell that this firm is in a competitive industry?

Exercise 9.7. The market demand and supply curves in a perfectly competitive industry are given by: $Q_d = 30,000 - 600P$ and $Q_s = 200P - 2000$.

(a) Draw these functions on a diagram, and calculate the equilibrium price of output in this industry.

(b) Now assume that an additional firm is considering entering. This firm has a short-run *MC* curve defined by $MC = 10 + 0.5q$, where q is the firm's output. If this firm enters the industry and it knows the equilibrium price in the industry, what output should it produce?

Exercise 9.8. Consider Exercise 9.7 again.

(a) Suppose all of the existing firms have the same cost structure as the new entrant, how many firms are there in the industry?

(b) Each firm in the industry has a total cost curve of the form $TC = 400 + 10q + (1/4)q^2$. There is no distinction between the long run and short run – there is only one possible size of firm. Derive the *ATC* by dividing each term in the *TC* curve by q, and calculate the cost per unit at the output being produced by each firm at the existing equilibrium price.

(c) Since you now know the price and cost per unit, calculate the profit that each firm is making.

(d) Is the *ATC* sloping up or down at the current equilibrium? [Hint: is the *MC* above or below the *ATC* at the chosen output?]

Exercise 9.9. Consider the long-run for the industry described in Exercise 9.8.

(a) What will happen to the number of firms in this industry in the long run?

(b) The minimum of the ATC curve for this firm occurs at a value of \$30. Given that you know this, what output will be produced in the industry in the long run?

(c) Once you know the output produced in the industry, and the minimum of the ATC curve, calculate the number of firms that will produce in the long run 'normal profit' equilibrium.

Exercise 9.10. Now consider what will happen in this industry in the very long run – with technological change. The total cost curve becomes $TC = 225 + 10q + (1/4)q^2$. The MC remains unchanged, and the minimum of the ATC now occurs at a value of \$25.

(a) What is the price in the market in this new long run, and what quantity is traded?

(b) What quantity will each firm produce at this price?

(c) How many firms will there be in the industry?

Exercise 9.11. Consider two firms in a perfectly competitive industry. They have the same MC curves and differ only in having higher and lower fixed costs. Suppose the ATC curves are of the form: $400/q + 10 + (1/4)q$ and $225/q + 10 + (1/4)q$. The MC for each is a straight line: $MC = 10 + (1/2)q$.

(a) Each ATC curve is U shaped and has a minimum at the quantities 40 and 30 respectively. Draw two ATC curve on the same diagram as the MC curve that reflect this information.

(b) Compute the break-even price for each firm.

(c) Explain why both of these firms cannot continue to produce in the long run in a perfectly competitive market.

(d) Could you derive an expression for the total variable cost curve for these firms, given the total cost curves are: $400 + 10q + (1/4)q^2$, and $225 + 10q + (1/4)q^2$?

EXERCISES FOR CHAPTER 10

Exercise 10.1. Consider a monopolist with demand curve defined by $P = 100-2Q$. The MR curve is $MR = 100-4Q$ and the marginal cost is $MC = 10+Q$.

(a) Develop a diagram that illustrates this market.

(b) Compute the profit-maximizing price and output combination.

Exercise 10.2. Imagine we have a monopolist who wants to maximize revenue rather than profit. She has the demand curve $P = 72-Q$, with marginal revenue $MR = 72-2Q$, and $MC = 12$.

(a) Graph the three functions.

(b) Calculate the price she should charge in order to maximize revenue. [Hint: where the $MR = 0$.]

(c) Compare her total revenue with the revenue obtained under profit maximization.

(d) How much profit will she make when maximizing total revenue?

Exercise 10.3. In this question you will see why we never consider a supply curve for a monopolist – in the way that is done in perfect competition. So suppose the monopolist faces a demand curve $P = 72-Q$ and a MR curve $MR = 72-2Q$. The Marginal cost is $MC = Q$.

(a) Find the profit maximizing output and price.

(b) Now suppose that the demand curve shifts to become $P = 60-(1/3)Q$ and thus $MR = 60-(2/3)Q$. The MC remains the same. Establish that the profit maximizing price is the same for this demand curve as the one in part (a). You have now shown that there is not a unique relationship between cost and demand for the monopolist because the same price in this example is consistent with profit maximization with two different demand curves.

Exercise 10.4. Suppose that the monopoly in Exercise 10.2 has a large number of plants. Consider what could happen if each of these plants became a separate firm, and acted competitively. In this perfectly competitive world you can assume that the MC curve of the monopolist becomes the industry supply curve.

(a) What output would be produced in the industry?

(b) What price would be charged in the marketplace?

(c) Compute the gain to the economy in dollar terms as a result of the DWL being eliminated [Hint: it resembles the area ABF in Figure 10.13].

Exercise 10.5. A monopolist faces a demand curve $P = 64 - 2Q$ and $MR = 64 - 4Q$. His marginal cost is $MC = 16$.

(a) Graph the three functions and compute the profit maximizing output and price.

(b) Compute the efficient level of output (where MC=demand), and compute the DWL associated with producing the profit maximizing output rather than the efficient output.

(c) Suppose the government gave the monopolist a subsidy of \$4 per unit produced. The MC would be reduced accordingly to \$12 from \$16. Compute the profit maximizing output level and the deadweight loss associated with this new output. Explain intuitively why the DWL has changed.

Exercise 10.6. In the text example in Table 10.1, compute the profit that the monopolist would make if he were able to discriminate between every buyer and charge each buyer their reservation price.

Exercise 10.7. A monopolist is able to discriminate perfectly among his consumers – by charging a different price to each one. The market demand curve facing him is given by $P = 72 - Q$. His marginal cost is given by $MC = 24$ and marginal revenue is $MR = 72 - 2Q$.

(a) In a diagram, illustrate the profit-maximizing equilibrium, where discrimination is not practiced.

(b) Calculate the equilibrium output if he discriminates perfectly.

(c) If he has no fixed cost beyond the marginal production cost of \$24 per unit, calculate his profit in each pricing scenario.

Exercise 10.8. A monopolist faces two distinct markets A and B for her product, and she is able to insure that resale is not possible. The demand curves in these markets are given by $P = 20 - (1/4)Q_A$ and $P = 14 - (1/4)Q_B$. The marginal cost is constant: $MC = 4$. There are no fixed costs.

(a) Calculate the profit maximizing price and quantity in each market.

(b) Compute the total profit made as a result of this discriminatory pricing.

Exercise 10.9. A monopolist with a demand curve given by $P = 240 - 2Q$ has a cost structure made up of a fixed cost of \$500 and a marginal production cost of $MC = 40$.

(a) When maximizing profit, how much profit will she make?

(b) Suppose now that she can outsource some of her assembly work to a plant in Indonesia, and this reduces her marginal production cost to \$32 per unit, but also increases her fixed cost to \$750. Should she outsource?

Exercise 10.10. In Exercise 10.9, prior to being able to outsource, imagine that the supplier is concerned about entry, and must spend $2,000 in lobbying to maintain her position as a monopolist.

(a) Can the firm still make a profit?

(b) What is the maximum amount the firm could afford to spend on lobbying with the objective of maintaining the monopoly position?

Exercise 10.11. A concert organizer is preparing for the arrival of the Grateful Living band in his small town. He knows he has two types of concert goers: one group of 40 people, each willing to spend $60 on the concert, and another group of 70 people, each willing to spend $40. His total costs are purely fixed at $3,500.

(a) Draw the market demand curve faced by this monopolist.

(b) Draw the *MR* and *MC* curves.

(c) With two-price discrimination what will be the monopolist's profit?

(d) If he must charge a single price for all tickets can he make a profit?

Exercises for Chapter 11

Exercise 11.1. Imagine that the biggest four firms in each of the sectors listed below produce the amounts defined in each cell. Compute the three-firm and four-firm concentration ratios for each sector, and rank the sectors by degree of industry concentration.

Sector	Firm 1	Firm 2	Firm 3	Firm 4	Total market
Shoes	60	45	20	12	920
Chemicals	120	80	36	24	480
Beer	45	40	3	2	110
Tobacco	206	84	30	5	342

Exercise 11.2. You own a company in a monopolistically competitive market. Your marginal cost of production is \$12 per unit. There are no fixed costs. The demand for your own product is given by the equation $P = 48 - (1/2)Q$.

(a) Plot the demand curve, the marginal revenue curve, and the marginal cost curve.

(b) Compute the profit-maximizing output and price combination.

(c) Compute total revenue and total profit.

(d) In this monopolistically competitive industry, can these profits continue indefinitely?

Exercise 11.3. Two firms in a particular industry face a market demand curve given by the equation $P = 100 - (1/3)Q$. The marginal cost is \$40 per unit and the marginal revenue is $MR = 100 - (2/3)Q$.

(a) Draw the demand curve to scale on a diagram, and then insert the corresponding marginal revenue curve and the *MC* curve.

(b) If these firms got together to form a cartel, what output would they produce and what price would they charge?

(c) Assuming they each produce half of the total what is their individual profit?

Exercise 11.4. Suppose now that one of the firms in Exercise 11.3 decides to break the cartel agreement and makes a decision to sell 10 additional units.

(a) How many units does he intend to sell?

(b) If the other supplier maintains her output at the cartel level, at what price will the new total output be sold?

(c) What profit will each make in this new situation?

(d) Is the combined profit here greater or less than in the cartel situation?

(e) How is the firm that previously maintained the cartel output level likely to react here?

Exercise 11.5. The classic game theory problem is the "prisoners' dilemma." In this game, two criminals are apprehended, but the police have only got circumstantial evidence to prosecute them for a small crime, without having the evidence to prosecute them for the major crime of which they are suspected. The interrogators then pose incentives to the crooks-incentives to talk. The crooks are put in separate jail cells and have the option to confess or deny. Their payoff depends upon what course of action each adopts. The payoff matrix is given below. The first element in each box is the payoff (years in jail) to the player in the left column, and the second element is the payoff to the player in the top row.

		B's strategy	
		Confess	Deny
A's strategy	Confess	6,6	0,10
	Deny	10,0	1,1

(a) Does a "dominant strategy" present itself for each or both of the crooks?

(b) What is the Nash equilibrium to this game?

(c) Is the Nash equilibrium unique?

(d) Was it important for the police to place the crooks in separate cells?

Exercise 11.6. Taylormade and Titlelist are considering a production strategy for their new golf drivers. If they each produce a small output, they can price the product higher and make more profit than if they each produce a large output. Their payoff/profit matrix is given below.

		Taylormade strategy	
		Low output	High output
Titleist strategy	Low output	50,50	20,70
	High output	70,20	40,40

(a) Does either player have a dominant strategy here?

(b) What is the Nash equilibrium to the game?

(c) Do you think that a cartel arrangement would be sustainable?

Exercise 11.7. The reaction functions for two firms A and B in a duopoly are given by: $Q_A = 104 - 2Q_B$ and $Q_B = 80 - 4Q_A$.

(a) Plot the reaction functions to scale on a graph.

(b) Solve the two reaction functions for the equilibrium output produced by each.

(c) Do you think that these firms have the same cost structure? Explain.

Exercise 11.8. Consider the example developed in Section 11.5 of the text, assuming this time that firm A has a MC of \$4 per unit, and B has a MC of \$6.

(a) Compute the level of output each will produce

(b) Compute the total output produced by both firms.

(c) Compute the profit made by each firm.

(d) Comparing their combined output with the output when the MC of each firm is \$6, explain why the totals differ.

Exercise 11.9. Consider the market demand curve for appliances: $P = 3,200 - (1/4)Q$. There are no fixed production costs, and the marginal cost of each appliance is $MC = \$400$.

(a) Determine the output that will be produced in a 'perfectly competitive' market structure where no profits accrue in equilibrium.

(b) If this market is supplied by a monopolist what is the profit maximizing output?

(c) What will be the total output produced in the Cournot duopoly game? [Hint: you can either derive the reaction functions and solve them, or use the formula from Section 10.6 of the chapter.]

Exercise 11.10. Consider the outputs you have obtained in Exercise 11.9.

(a) Compute the profit levels under each of the three market structures.

(b) Can you figure out how many firms would produce at the perfectly competitive output? If not, can you think of a reason?

Exercise 11.11. Ronnie's Wraps is the only supplier of sandwich food and makes a healthy profit. It currently charges a high price and makes a profit of six units. However, Flash Salads is considering entering the same market. The payoff matrix below defines the profit outcomes for different possibilities. The first entry in each cell is the payoff/profit to Flash Salads and the second to Ronnie's Wraps.

		Ronnie's Wraps	
		High price	Low price
Flash Salads	Enter the market	2,3	-1,1
	Stay out of market	0,6	0,4

(a) If Ronnie's Wraps threatens to lower its price in response to the entry of a new competitor, should Flash Salads stay away or enter?

(b) Explain the importance of threat credibility here.

Exercise 11.12. A monopolistically competitive firm has an average total cost curve given by $ATC = 2/Q + 1 + Q/8$. The slope of this curve is given by $1/8 - 2/Q^2$. The marginal cost is $MC = 1 + Q/4$. Her demand curve is given by $P = 3 - (3/8)Q$, and so the marginal revenue curve is given by $MR = 3 - (3/4)Q$. We know that the equilibrium for this firm (see Figure 11.2) is where the demand curve is tangent to the ATC curve – where the slopes are equal.

(a) What is the equilibrium output for this firm [Hint: find where the slope of the demand curve equals the slope of the ATC curve]?

(b) At what price will the producer sell this output?

(c) Solve for where $MC = MR$, this is the profit maximizing condition – does it correspond to where the slope of the demand curve equals the slope of the ATC?

(d) Since the MC always intersects the ATC at the minimum of the ATC, solve for the output level that defines this ATC minimum.

Exercises for Chapter 12

Exercise 12.1. Aerodynamics is a company specializing in the production of bicycle shirts. It has a fixed capital stock, and sells its shirts for \$20 each. It pays a weekly wage of \$400 per worker. Aerodynamics must maximize its profits by determining the optimal number of employees to hire. The marginal product of each worker can be inferred from the table below. Determine the optimal number of employees. [Hint: you must determine the VMP_L schedule, having first computed the MP_L.]

Employment	0	1	2	3	4	5	6
Total output	0	20	50	75	95	110	120
MP$_L$							
VMP$_L$							

Exercise 12.2. Mini Mine is a small mining firm in Northern Alberta. The going wage rate in the region is \$300 per week. The productivity of the workers in the firm, which has a fixed capital stock, is given below.

Workers	0	1	2	3	4	5	6	7	8	9	10
Output	0	100	190	270	340	400	450	490	520	540	550
MP$_L$											
VMP$_L$											

(a) If the price of ore is \$10 per ton determine the optimal employment level for this firm.

(b) Instead of there being many potential workers, suppose that there are only 6 workers who can be hired in the neighbourhood. If the price of output is still fixed at \$300, and the productivity of workers is still defined by the data in the second row, draw the VMP_L curve, insert the supply limit and determine the equilibrium wage.

Exercise 12.3. Suppose that, in Exercise 12.1 above, wages are not fixed. Instead the firm must pay \$50 more to employ each individual worker: the first worker is willing to work for \$250, the second for \$300, the third for \$350, etc. But once employed, each worker actually earns the same wage. Determine the optimal number of workers to be employed. [Hint: you must recognize that each worker earns the same wage; so when one additional worker is hired, the wage must increase to all workers employed.]

Exercise 12.4. Consider the following supply and demand equations for berry pickers. Demand: $W = 22 - 0.4L$; supply: $W = 10 + 0.2L$.

(a) Plot these functions and calculate the equilibrium wage and employment level.

(b) Illustrate in the diagram the areas defining transfer earnings and rent.

(c) Compute the transfer earnings and rent components of the total wage bill.

Exercise 12.5. The industry demand in for plumbers is given by the equation $W = 50 - 0.08L$, and there is a fixed supply of 300 qualified plumbers.

(a) Draw a diagram illustrating the supply, demand and equilibrium.

(b) Solve the supply and demand equations for the equilibrium wage, W.

(c) If the plumbers now form a union, and supply their labour at a wage of $30 per hour, illustrate the new equilibrium on your diagram and calculate the new level of employment.

Exercise 12.6. The following table describes the income stream for different capital investments. The income flows accrue at the end of years 1 through 4. The interest rate is given in the first column, and the cost in the final column.

Interest rate	Year 1	Year 2	Year 3	Year 4	Cost
8%	8,000	9,000	12,000	12,000	37,000
6%	0	1,000	1,000	1,000	2,750
10%	4,000	5,000	6,000	0	12,000

(a) For each investment calculate the present value of the stream of services.

(b) Decide upon whether the investment should be undertaken or not.

Exercise 12.7. Nihilist Nicotine is a small tobacco farm in south-western Ontario. It has three plots of land, each with a different productivity. The output from each plot is given in the table below. Each plot is the same size and requires 3 workers and one machine to harvest the leaves. The cost of these inputs is $10,000. If the price of each kilogram of leaves is $4, how many fields should be planted?

Land plot	Leaf yield in kilograms
One	3,000
Two	2,500
Three	2,000

Exercise 12.8. The timing of wine sales is a frequent problem encountered by vintners. This is because many red wines improve with age. Let us suppose you own a particular vintage and you envisage that each bottle should increase in value by 10% the first year, 9% the second year, 8% the third year, etc.

(a) Suppose the interest rate is 5%, for how many years would you hold the wine if there is no storage cost?

(b) If in addition to interest rate costs, there is a cost of storing the wine that equals 2% of the wine's value each year, for how many years would you hold the wine before selling?

Exercise 12.9. A monopolist faces a demand curve given by $P = 100 - 2Q$. Labour is his only cost, and the wage rate is fixed at \$8 per worker. Each worker has a constant marginal product $MPL = 2$, meaning that each additional worker produces two units of output.

(a) The MC of each unit of output will be constant here, what is it?

(b) Since you now know the MC of production, what is the profit maximizing output level for the monopolist?

(c) What price will the monopolist charge for his output?

(d) How many units of labour will be employed?

Exercise 12.10. Suppose that instead of a monopolist in Exercise 12.9 the market was perfectly competitive. Production conditions are the same.

(a) How much output would be produced and sold?

(b) How many units of labour would be employed?

Exercises for Chapter 13

Exercise 13.1. In the short run one half of the labour force has high skills and one half low skills (in terms of Figure 13.2 this means that the short-run supply curve is vertical at 0.5). The relative demand for the high-skill workers is given by $W = 100 \times 0.4 \times (1 - f)$, where W is the wage premium and f is the fraction that is skilled. The premium is measured in percent.

(a) Illustrate the supply and demand curves graphically, and compute the skill premium going to the high-skill workers in the short run by solving the two equations.

(b) If demand increases to $W = 100 \times 0.6 \times (1 - f)$ what is the new premium? Illustrate your answer graphically.

Exercise 13.2. Consider the foregoing problem in a long run context, when the fraction of the labour force that is high-skilled is more elastic with respect to the premium. Let this long-run relative supply function be $W = 100 \times 0.4 \times f$.

(a) Verify that this long run function goes through the same equilibrium as in Exercise 13.1.

(b) Illustrate the long run and short run on the same diagram.

(c) What is the numerical value of the premium in the long run after the increase in demand? Illustrate graphically.

Exercise 13.3. Consider a world in which there are two types of workers – high skill and low skill. Low skill workers are willing to work for \$10 per hour and high skill workers for \$18 per hour. Any firm that demands both types of worker has a demand curve (value of the MP_L) for each type. Suppose that the demand for high skill workers lies everywhere above the demand for low skill workers. Illustrate on a diagram the supply and demand functions for each type of labour, and the equilibrium for each type of worker.

Exercise 13.4. Georgina is contemplating entering the job market after graduating from high school. Her future lifespan is divided into three periods. If she goes to university for the first, and earns an income for the following two periods her lifetime balance sheet will be: (i) -\$20,000; (ii) \$40,000; (iii) \$50,000. The negative value implies that she will incur costs in educating herself in the first period. In contrast, if she decides to work for all three periods she will earn \$20,000 in each period. The answer here involves discounting, and you should assume that the first period is today, the second period amount must be discounted back one period, and the final amount discounted back two periods.

(a) If the interest rate is 10% should she go to university or enter the job market immediately?

(b) If the interest rate is 2% what should she do?

(c) Can you find some value for the interest rate that will change her decision?

Exercise 13.5. Laurence has decided that he will definitely go to university rather than go into the workforce directly after high school. He is trying to decide between Law and Economics. Like Georgina, his life can be divided into three parts. He will incur education costs in the first period and earn in the remaining two periods. His income profile is given in the table below. (Discounting need not be applied to the first number, but the following numbers must be discounted back one period and two periods respectively.)

Profession	Period 1	Period 2	Period 3
Economics	-15,000	50,000	60,000
Law	-25,000	40,000	90,000

(a) If the interest rate is 2%, which profession should he choose?

(b) If the interest rate is 30% which profession should he choose?

Exercise 13.6. Imagine that you have the following data on the income distribution for two economies. The first set of quintile shares is as in Table 13.2, and the second set is: 3.0, 9.0, 17.0, 29.0, and 42.0.

	Quintile share of total income	
First quintile	4.1	3.0
Second quintile	9.7	9.0
Third quintile	15.6	17.0
Fourth quintile	23.7	29.0
Fifth quintile	46.8	42.0
Total	100	100

(a) On graph paper, or in a spreadsheet program, plot the Lorenz curves corresponding to the two sets of quintile shares.

(b) Can you say, from a visual analysis, which distribution is more equal?

Exercise 13.7. The distribution of income in the economy is given in the table below. The first numerical column represents the dollars earned by each quintile. Since the numbers add to 100 you can equally think of the dollar values as shares of the total pie. In this economy the government changes the distribution by levying taxes and distributing benefits.

Quintile	Gross income $m	Taxes $m	Benefits $m
First	4	0	9
Second	11	1	6
Third	19	3	5
Fourth	26	7	3
Fifth	40	15	3
Total	100	26	26

(a) Plot the Lorenz curve for gross income to scale.

(b) Plot the Lorenz curve for income after taxes have been levied. Note that the total income will now be less than 100 and so you will have to compute the quintile shares using a new total.

(c) Finally, add in the benefits so that the total post-tax and post-benefit incomes sum to $100m again, and plot the Lorenz curve based on this final set of numbers.

Exercise 13.8. Here is a question on earnings profiles. Consider two individuals, each facing a 45 year horizon at the age of 20. Ivan decides to work immediately and his earnings path takes the following form: earnings $= 20,000 + 1,000t - 10t^2$, where the t is time, and it takes on values from 1 to 25, reflecting the working lifespan.

(a) In a spreadsheet enter values $1 \ldots 25$ in the first column and then compute the value of earnings in each of the 45 years in the second column using the earnings equation.

(b) John decides to study some more and only earns a part-time salary in his first few years. He hopes that the additional earnings in future years will compensate for that. His function is given by $10,000 + 2,000t - 12t^2$. Compute his earnings for his lifespan.

(c) Plot the two earnings functions you have computed. During what year does John pass Ivan?

Exercises for Chapter 14

Exercise 14.1. An economy is composed of two individuals, whose demands for a public good – street lighting – are given by $P = 12 - (1/2)Q$ and $P = 8 - (1/3)Q$.

(a) Graph these demands on a diagram.

(b) Derive the total demand for this public good by summing the demands vertically, and write down a resulting equation for this demand curve.

(c) Let the marginal cost of providing the good be \$5 per unit. Find the efficient supply of the public good in this economy – where the marginal cost equals the total value of a marginal unit.

Exercise 14.2. In Exercise 14.1, suppose a new citizen joins the economy, and her demand for the public good is given by $P = 10 - (5/12)Q$.

(a) Derive the new demand for the public good on the part of the whole economy and compute the new optimal level of supply, given that the MC remains unchanged.

(b) Calculate the total value to the consumers of the amount supplied at this efficient output level.

(c) Compute the net value to society of that choice – the total value minus the total cost.

Exercise 14.3. An industry that is characterized by a decreasing cost structure has a demand curve given by $P = 100 - Q$ and the marginal revenue curve by $MR = 100 - 2Q$. The marginal cost is $MC = 4$, and average cost is $AC = 4 + 188/Q$.

(a) Graph this cost and demand structure.

(b) Calculate the efficient output and the monopoly output for the industry.

(c) What price would the monopolist charge if he were unregulated, and what would be his profit per unit?

Exercise 14.4. Instead of having a monopoly the government decides to regulate this supplier in the interests of the consumer.

(a) What price and output would emerge if the supplier were regulated so that his allowable price equalled average cost?

(b) Compute the value of the deadweight loss associated with having an unregulated monopoly relative to having a regulated monopoly where a price is permitted that covers ATC.

Exercise 14.5. As an alternative to regulating the supplier such that price covers average total cost, suppose that a two part tariff were used to generate revenue. This scheme involves charging the *MC* for each unit that is purchased and in addition charging each buyer in the market a fixed cost that is independent of the amount he purchases. If an efficient output is supplied in the market, estimate the total revenue to be obtained from the component covering a price per unit of the good supplied, and the component covering fixed cost.

Exercises for Chapter 15

Exercise 15.1. The following table shows the labour input requirements to produce a bushel of wheat and a litre of wine in two countries, Northland and Southland, on the assumption of constant cost production technology – meaning that the production possibility curves in each are straight lines.

Labour requirements per unit produced		
	Northland	Southland
Per bushel of wheat	1	3
Per litre of wine	2	4

(a) Which country has an absolute advantage in the production of both wheat and wine?

(b) What is the opportunity cost of wheat in each economy? Of wine?

(c) What is the pattern of comparative advantage here?

(d) Suppose the country with a comparative advantage in wine reduces wheat production by one bushel and reallocates the labour involved to wine production. How much additional wine does it produce?

(e) Which country, if either, gains from this change in production and trade, and what is the gain?

(f) If the country with the comparative advantage in wheat reduced wine production enough to increase wheat production by one bushel, how much wine could it get by selling the additional bushel of wheat to the other country at that economy's opportunity cost?

Exercise 15.2. Canada and the United States can produce two goods, xylophones and yogourt. Each good can be produced with labour alone. Canada requires 60 hours to produce a ton of yogourt and 6 hours to produce a xylophone. The United States requires 40 hours to produce the ton of yogourt and 5 hours to produce a xylophone.

(a) Describe the state of absolute advantage between these economies in producing goods.

(b) In which good does Canada have a comparative advantage? Does this mean the United States has a comparative advantage in the other good?

(c) Draw the production possibility frontier for each economy to scale on a diagram, assuming that each economy has an endowment of 240 hours of labour.

(d) On the same diagram, draw Canada's consumption possibility frontier on the assumption that it can trade with the United States at the United States rate of transformation.

(e) Draw the US consumption possibility frontier under the assumption that it can trade at Canada's rate of transformation.

Exercise 15.3. The domestic demand for bicycles is given by $P = 36 - 0.3Q$. The foreign supply is given by $P = 18$ and domestic supply by $P = 16 + 0.4Q$.

(a) Illustrate the market equilibrium on a diagram, and compute the amounts supplied by domestic and foreign suppliers.

(b) If the government now imposes a tariff of $6 per unit on the foreign good, illustrate the impact geometrically, and compute the new quantities supplied by domestic and foreign producers.

(c) In the diagram, illustrate the area representing tariff revenue and compute its value.

Exercise 15.4. In Exercise 15.3, illustrate the deadweight losses associated with the imposition of the tariff, and compute the amounts.

(a) Compute the additional amount of profit made by the domestic producer as a result of the tariff. [Hint: refer to Figure 15.4 in the text.]

Exercise 15.5. The domestic demand for office printers is given by $P = 40 - 0.2Q$. The supply of domestic producers is given by $P = 12 + 0.1Q$, and international supply by $P = 20$.

(a) Illustrate this market geometrically.

(b) Compute total demand and the amounts supplied by domestic and foreign suppliers.

(c) If the government gives a production subsidy of $2 per unit to domestic suppliers in order to increase their competitiveness, calculate the new amounts supplied by domestic and foreign producers. [Hint: The domestic supply curve becomes $P = 10 + 0.1Q$].

(d) Compute the cost to the government of this scheme.

Exercise 15.6. The domestic demand for turnips is given by $P = 128 - (1/2)Q$. The market supply of domestic suppliers is given by $P = 12 + (1/4)Q$, and the world price is $32 per bushel.

(a) First graph this market and then solve for the equilibrium quantity purchased.

(b) How much of the quantity traded will be produced domestically and how much will be imported?

(c) Assume now that a quota of 76 units is put in place. Illustrate the resulting market equilibrium graphically.

(d) Compute the domestic price of turnips and the associated quantity traded with the quota in place. [Hint: you could shrink the demand curve in towards the origin by the amount of the quota and equate the result with the domestic supply curve].

Exercise 15.7. The domestic market for cheese is given by $P = 108 - 2Q$ and $P = 16 + 1/4Q$. These are the demand and supply conditions. The good can be supplied internationally at a constant price $P = 20$.

(a) Illustrate the domestic market in the absence of trade and solve for the equilibrium price and quantity.

(b) With free trade illustrate the market graphically and compute the total amount purchased, and the amounts supplied by domestic and international suppliers.

(c) Suppose now that the government implements a price floor in the domestic market equal to $28. Illustrate the market outcome graphically.

(d) For the outcome with a price floor, compute the quantity supplied by domestic and international suppliers respectively.

Exercise 15.8. The following are hypothetical production possibilities tables for Canada and the United States. For each line required, plot any two or more points on the line.

	Canada					**United States**			
	A	B	C	D		A	B	C	D
Peaches	0	5	10	15	**Peaches**	0	10	20	30
Apples	30	20	10	0	**Apples**	15	10	5	0

(a) Plot Canada's production possibilities curve by plotting at least 2 points on the curve.

(b) Plot the United States' production possibilities curve by plotting at least 2 points on the curve on the graph above.

(c) What is each country's cost ratio of producing Peaches and Apples?

(d) Which economy should specialize in which product?

(e) Plot the United States' trading possibilities curve (by plotting at least 2 points on the curve) if the actual terms of the trade are 1 apple for 1 peach.

(f) Plot the Canada' trading possibilities curve (by plotting at least 2 points on the curve) if the actual terms of the trade are 1 apple for 1 peach.

(g) Suppose that the optimum product mixes before specialization and trade were B in the United States and C in Canada. What are the gains from specialization and trade?

Solutions to exercises for Chapter 1

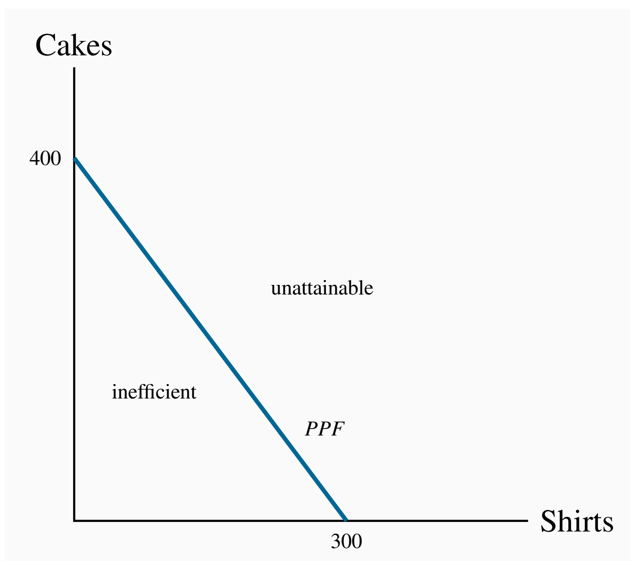
Exercise 1.1.

(a) If all 100 workers make cakes their output is $100 \times 4 = 400$.

(b) If all workers make shirts their output is $100 \times 3 = 300$.

(c) The diagram shows the PPF for this economy.

(d) As illustrated in the diagram.



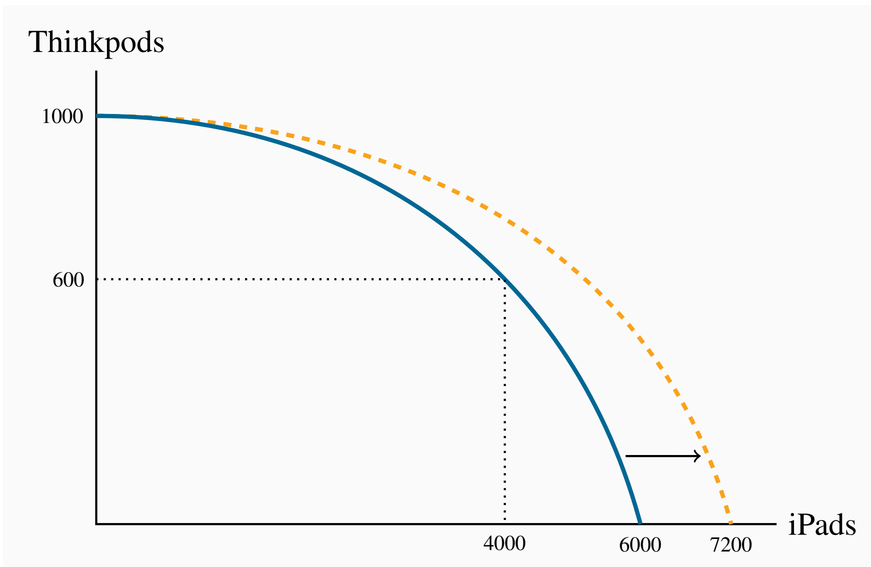
Exercise 1.2.

(a) The PPF is curved outwards with intercepts of 1000 on the Thinkpod axis and 6000 on the iPad axis. Each point on the PPF shows one combination of outputs.

(b) Different.

(c) 400 X.

(d) The new *PPF* in the diagram has the same Thinkpod intercept, 1000, but a new iPad intercept of 7200.



Exercise 1.3. By examining the opportunity cost in the region where the combinations are defined, and by assuming a linear trade-off between each set of combinations, it can be seen that the first combination in the table is feasible, but not the second combination.

Exercise 1.4.

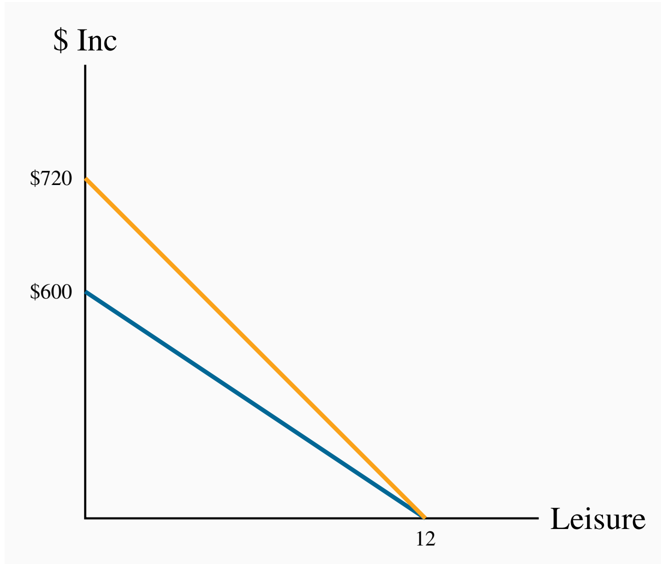
(a) \$50.

(b) \$60.

(c) See diagram.

(d) See diagram.

(e) The person with the lower wage.

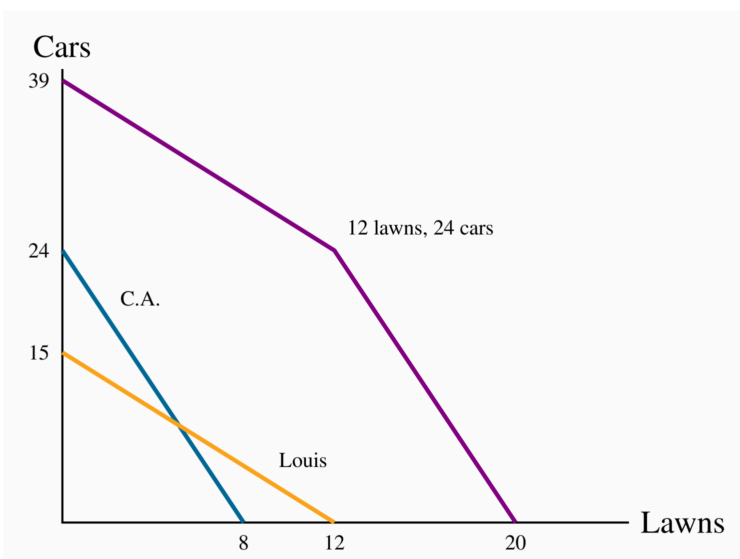


Exercise 1.5.

(a) Louis has an advantage in cutting the grass while Carrie Anne should wash cars.

(b) If they each work a twelve-hour day, between them they can cut 12 lawns and wash 24 cars.

Exercise 1.6. Following the method described in the text:



Exercise 1.7.

(a) Carrie Anne's lawn intercept is now 12 rather than 8.

(b) Yes, specialization still matters because C.A. is more efficient at cars.

(c) The new coordinates will be 39 on the vertical axis, 24 on the horizontal axis and the kink point is the same.

Exercise 1.8. C.A.'s intercepts are now 30 cars and 15 lawns; Louis' intercepts are 18.75 cars and 15 lawns; the economy-wide *PPF* car coordinate is thus 48.75, the lawn coordinate is 30, and the kink point is 15 lawns and 30 cars.

Exercise 1.9.

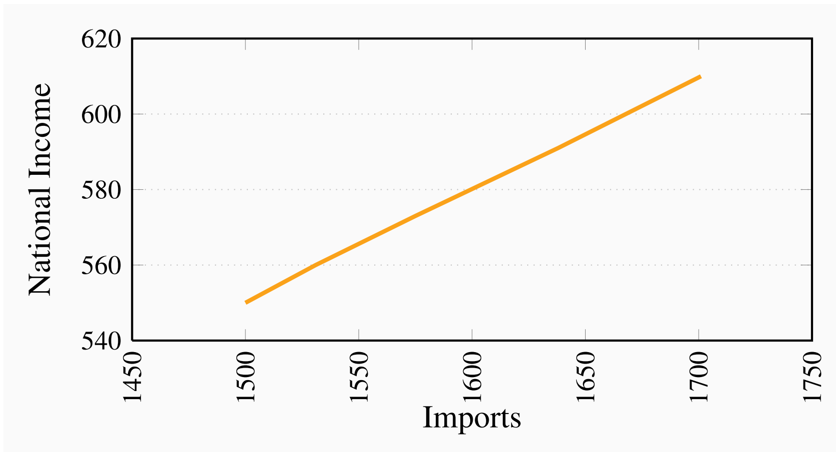
(a) 220 cakes requires 55 workers, the remaining 45 workers can produce 135 shirts. Hence this combination lies inside the *PPF* described in Exercise 1.1.

(b) 98 workers.

(c) 2%.

Solutions to exercises for Chapter 2

Exercise 2.1. These variables are positively related.



Exercise 2.2. For (b) the answer is 32%, and for (c) the answer is 5.26%.

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Index	0.95	1.00	1.04	1.09	1.14	1.14	1.21	1.23	1.32	1.35

Exercise 2.3. To find the national unemployment rate for each year you take a weighted average of the unemployment rate in the big cities and that in other areas. The weights used are the shares of population living in each area. In 2007, for example, the national unemployment rate would be: Big city rate $\times 0.67 +$ other rate $\times 0.33 = 5 \times 0.67 + 7 \times 0.33 = 5.67$. Hence:

Year	2007	2008	2009	2010	2011
Index	5.67	7.99	8.33	10.67	9.67

Exercise 2.4. For years 1 through 5 the index values for transport, rent and food are:

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Weight in total expenditure
Transport	100	100	107	107	107	10%
Rent	100	100	110	112	115	55%
Food	100	103	102	107	110	35%

The aggregate price index is the weighted average of the component price indexes with weights equal to shares in total expenditure. For Year 1 the aggregate index is $(100 \times 0.10 + 100 \times 0.55 + 100 \times 0.35) = 100$. For years 2 through 5 this methodology gives aggregate price indexes of 101, 108, 110, 114.

Exercise 2.5.

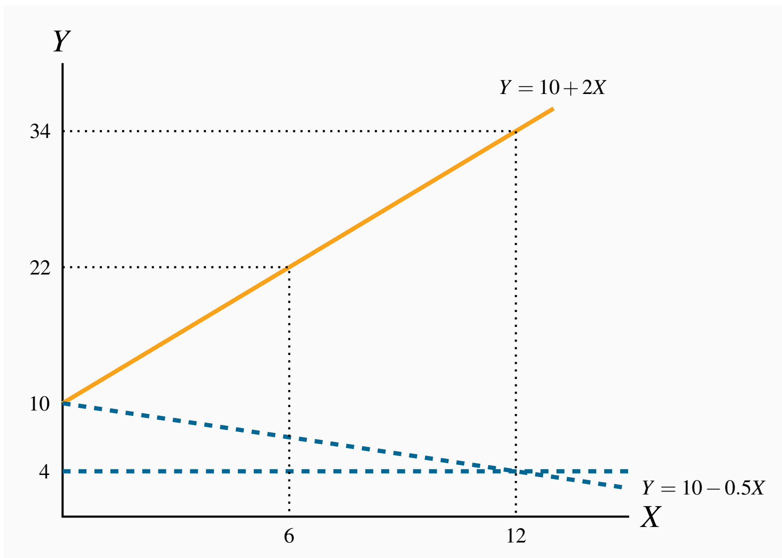
	2000	2002	2004	2006	2008	2010
Nominal	100	111.54	126.92	126.92	119.23	115.38
Carrot price $	2.6	2.9	3.3	3.3	3.1	3
CPI	110	112	115	117	120	124
CPI new base	100	101.82	104.55	106.36	109.09	112.73
Real carrot index	100	109.55	121.40	119.33	109.29	102.36

Exercise 2.6. The scatter diagram plots observed combinations of income and consumption as follows. For parts (c) and (d): the variables are positively related and the causation runs from income to consumption.

Exercise 2.7. The percentage changes in income are:

Pct Inc	1.3	2.7	2.0	4.0	2.7	2.0	3.1
Pct Con	3.0	1.6	3.7	3.8	4.1	4.1	3.4

Exercise 2.8. The relationship given by the equation $Y = 10 + 2X$ when plotted has an intercept on the vertical (Y) axis of 10 and the slope of the line is 2. The maximum value of Y (where X is 12) is 34.



X	0	1	2	3	4	5	6	7	8	9	10	11	12
Y	10	12	14	16	18	20	22	24	26	28	30	32	34

Exercise 2.9. The relationship $Y = 10 - 0.5X$ has a Y intercept of 10 but there is now a negative slope equal to one half (-0.5). When X has a value of 12, Y has a value of 4. If you plot this in the diagram for Exercise 2.8 it is the dashed line sloping downward from 10 to 4 at $X = 12$.

Exercise 2.10.

(a) The relationship is negative.

(b) The relationship is non-linear.

Solutions to exercises for Chapter 3

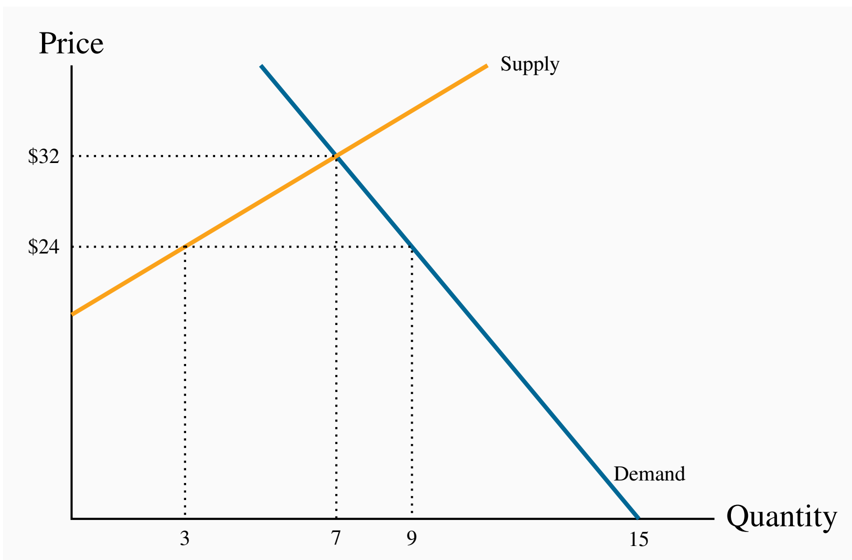
Exercise 3.1.

(a) The diagram shows the supply and demand curves from the data in the table. These curves intersect at the equilibrium price \$32 and the equilibrium quantity 7.

(b) Excess demand is 6 and excess supply is 3.

(c) With excess demand the price is bid up, with excess supply the price is pushed down.

(d) Equate supply P to demand: $18+2Q=60-4Q$, implying $6Q=42$, which is $Q=7$. Hence $P=32$.



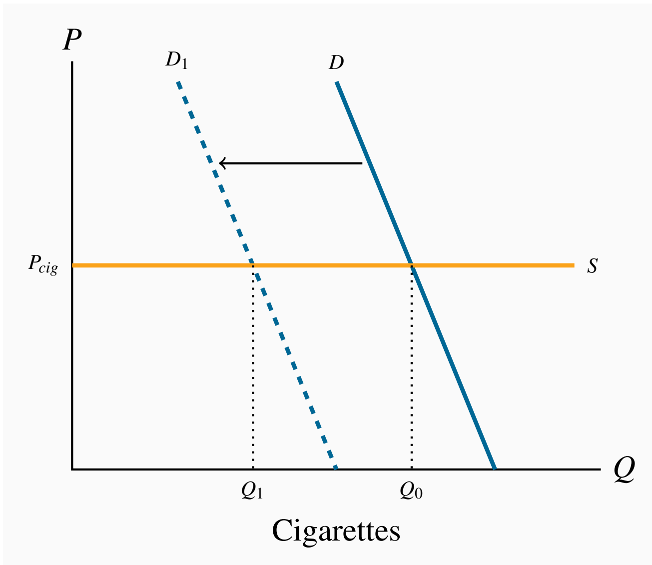
Exercise 3.2.

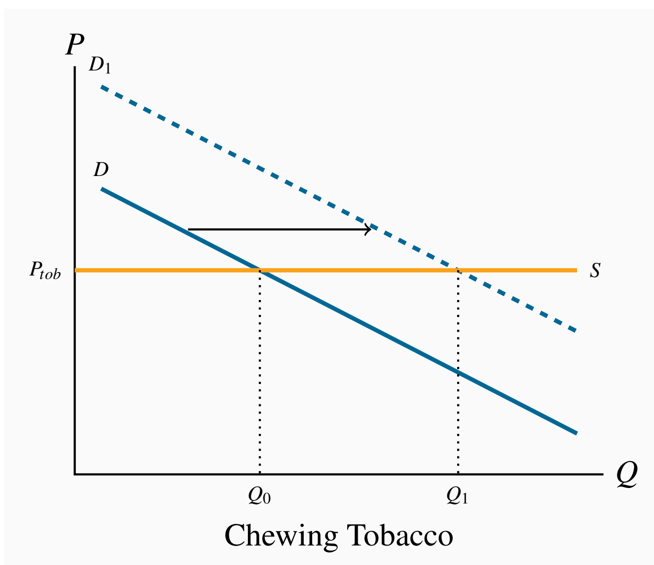
(a) Demand curve facing *Air Canada* shifts left and down. The price of the substitute *Via Rail* has fallen and reduced the quantity of air transport services demanded at any price.

(b) Demand curve facing *Air Canada* shifts left and down. The substitute car travel has improved in quality and perhaps declined in cost.

(c) Demand curve facing *Air Canada* shifts left and down. A new budget air carrier is another substitute for *Air Canada* that will divide the market for air transport.

Exercise 3.3. The market diagrams are drawn on the assumption that each product can be purchased for a given price, the supply curve in each market segment is horizontal. A downward sloping demand should characterize each market. If the cigarette market is ‘quashed’ the demand in the market for chewing tobacco, a substitute, should shift outward, leading to higher consumption at the same price.

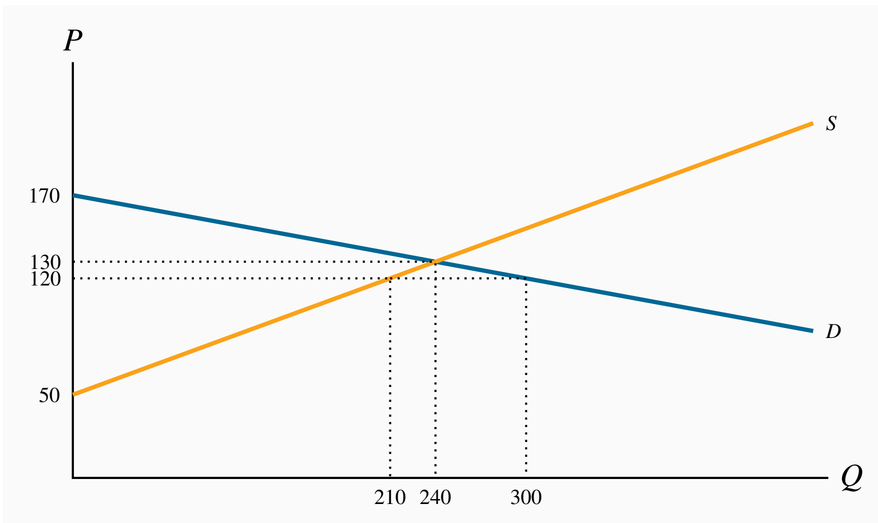




Exercise 3.4. The supply curve shifts down and parallel, the demand curve shifts up and parallel.

(a) Setting the new supply equal to the new demand: $10+2Q=76-4Q$ implies $6Q=66$ and therefore $Q=11$, $P=32$.

Exercise 3.5. The diagram shows that equilibrium quantity is 240, equilibrium price is \$130, which are the values obtained from equating supply and demand. At a price of $120 the quantity demanded is 300 and the quantity supplied 210. Excess demand is therefore 90.



Exercise 3.6.

(a) At a price of $140 quantity demanded is 180 and quantity supplied is 270; excess supply is therefore 90.

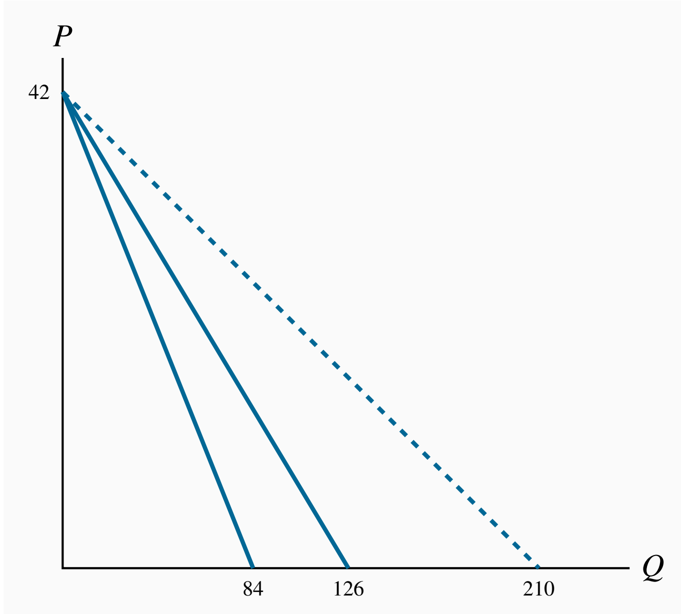
(b) Total quotas of 180 will maintain a price of $140. This is obtained by substituting the price of $140 into the demand curve and solving for Q.

Exercise 3.7. It must buy 90 units at a cost of $140 each. Hence it incurs a loss on each unit of $60, making for a total loss of $5,400.

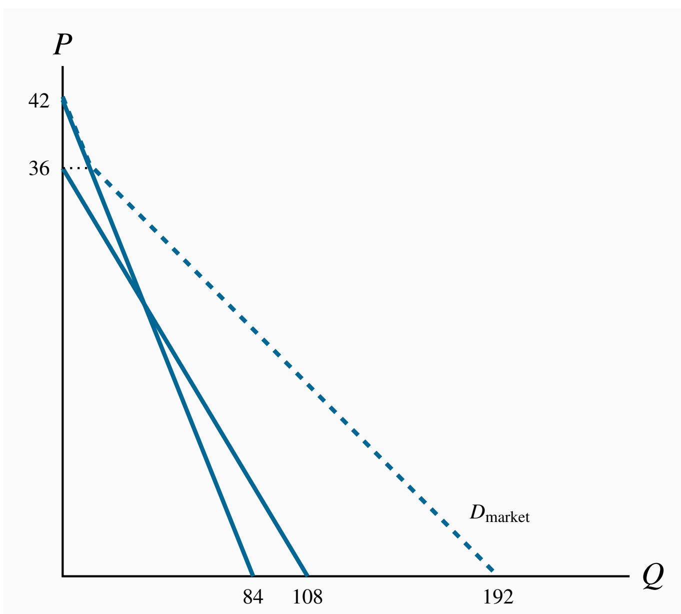
Exercise 3.8.

(a) The quantity axis intercepts are 84 and 126.

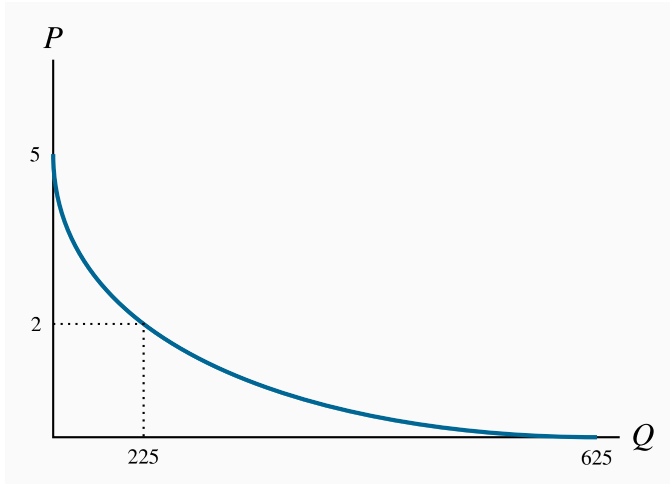
(b) The quantities demanded are 160, 110 and 60 respectively, on the market demand curve in the diagram. These values are obtained by solving the quantity demanded in each demand equation for a given price and summing the quantities.



Exercise 3.9.



Exercise 3.10.



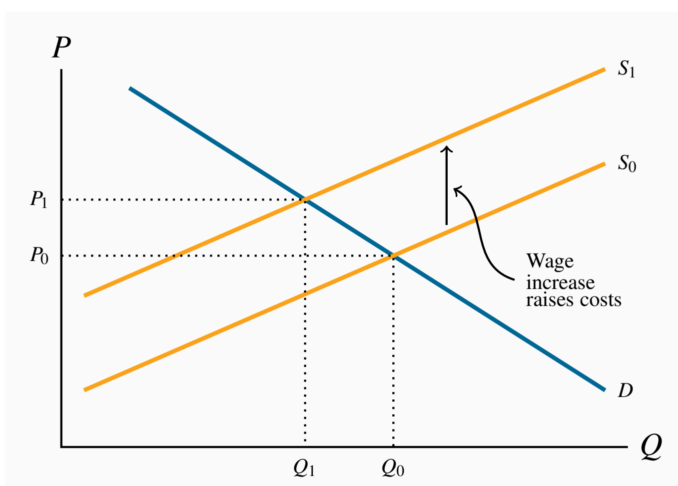
Exercise 3.11.

(a) The equilibrium admission price is $P = \$21$, $TR = \$630$.

(b) The equilibrium price would now become \$18 and $TR = \$648$. Yes.

(c) The answer is no, because total revenue falls.

Exercise 3.12. Wages are a cost of bringing lettuce to market. In the market diagram the supply curve for lettuce shifts upwards to reflect the increased costs. If demand is unchanged the price of lettuce rises from P_0 to P_1 and the quantity demanded falls from Q_0 to Q_1.



Solutions to exercises for Chapter 4

Exercise 4.1.

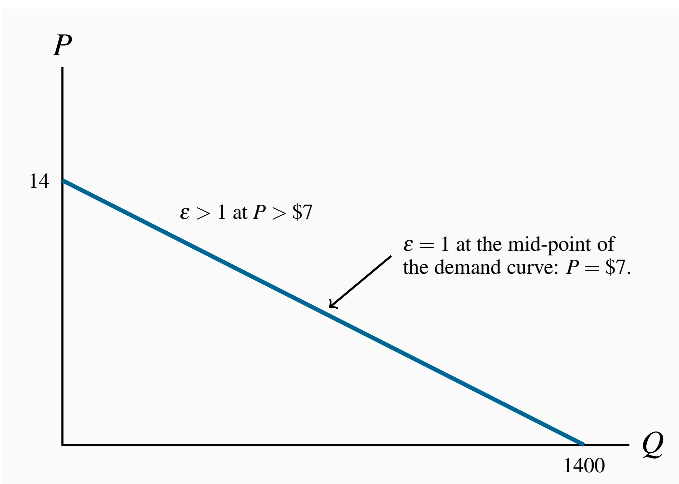
(a) The intercepts for this straight line demand curve are $P = \$14$, $Q = 1400$.

(b) Total revenue is this product of price times quantity. Compute it!

(c) At $P = \$7$, total revenue is \$4,900.

(d) Elasticities, in descending order, are 0.22, 0.33, 0.47, 0.65, 0.87, 1.15.

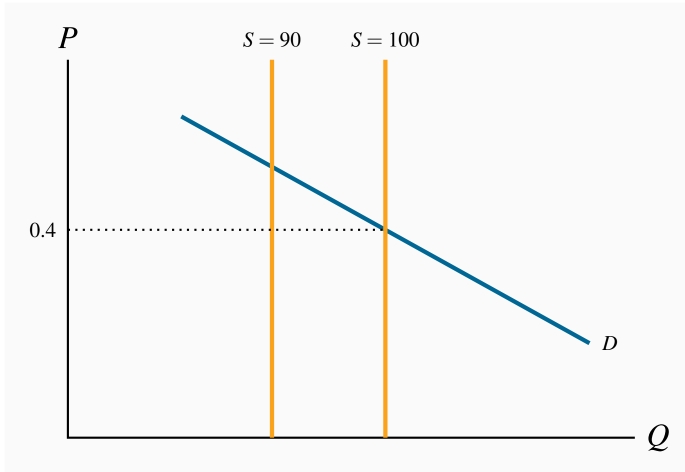
(e) Elasticity becomes greater than one in magnitude at one point where total revenue is maximized.



Exercise 4.2.

(a) The supply curve is vertical at a quantity of 100.

(b) We are told $-0.5 = \%\Delta Q/\%\Delta P$. The percentage change of quantity is $-10/95$; therefore the percentage change in price must be: $\%\Delta P = -(10/95)/-0.5 = 20/95 = 21\%$. The new price is therefore $0.4 \times 1.21 = 0.48$.

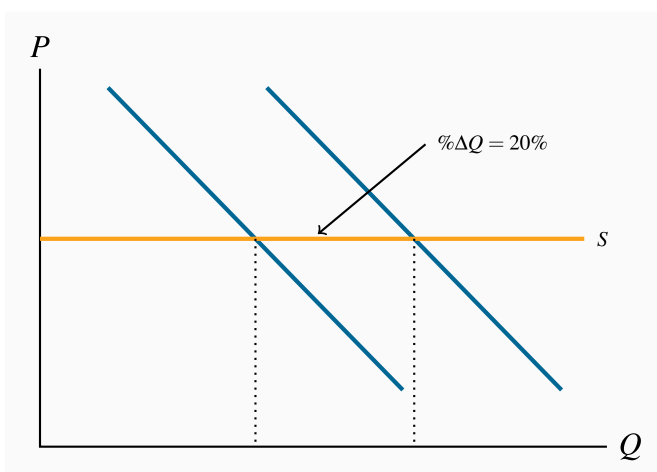


Exercise 4.3.

(a) Since the price is fixed the supply curve is horizontal. See figure below.

(b) You cannot estimate a demand elasticity value since there has been no price change.

(c) Here the (adjoining) horizontal supply curve shifts upwards by 60%. If enrolment has increased the demand curve must also have shifted upwards. Draw an additional supply curve representing a 60% upward shift, and find an intersection between the new demand and new supply such that the percentage increase in quantity is 15% (this diagram is not included here).

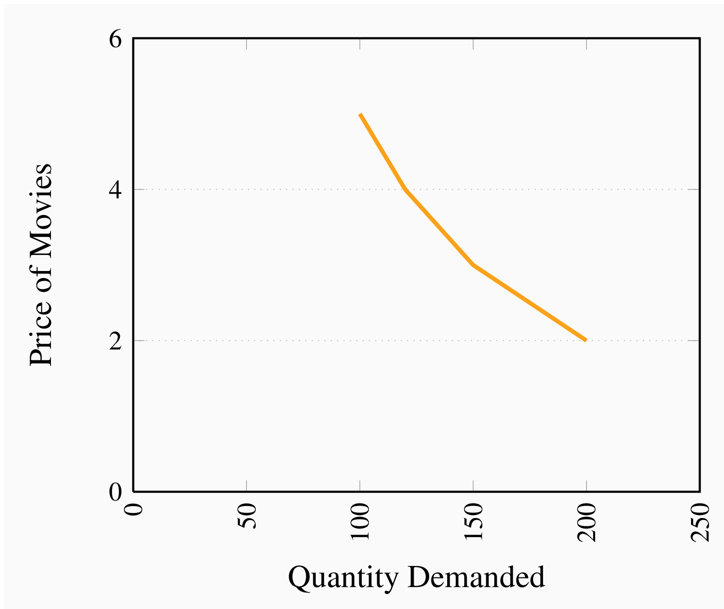


Exercise 4.4.

(a) The demand curve is nonlinear.

(b) Total revenue is price times quantity.

(c) Elasticity values are 0.71, 0.78, and 0.82 respectively.



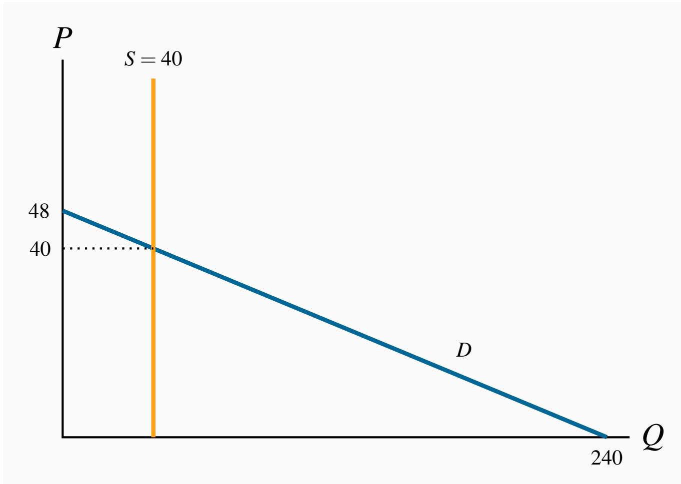
Exercise 4.5. The supply curve is vertical at $Q = 40$. Substituting this quantity into the demand equation yields an equilibrium price of \$40.

(a) The supply curve is vertical at $Q = 40$. Substituting this quantity into the demand equation yields an equilibrium price of \$40.

(b) The supply elasticity is zero and the demand elasticity is -5.0. The latter is obtained by noting that $\Delta P/\Delta Q = -0.2$, and $P = \$40$ at $Q = 40$. Using the elasticity formula yields -5.0.

(c) Since the elasticity value exceeds unity he should reduce the price and install more seats if his objective is to generate more revenue.

(d) Above the price \$24, which is the mid-point on the demand curve, demand is elastic.



Exercise 4.6.

(a) There has been a 20% increase in price. Feeding this into the elasticity formula yields $-0.6 = \%\Delta Q/20\%$. Hence the percentage change (reduction) in quantity is 12%.

(b) Following the same reasoning as in part (a) the result is 24%.

(c) In the short run revenue rises since demand is inelastic (less than one in absolute value); in the long run it falls since demand is elastic (greater than one in absolute value).

Exercise 4.7.

(a) It is elastic for magazines and inelastic for CDs and Cappuccinos.

(b) A reduction in magazines purchased and an increase in cappuccinos purchased. Magazines are complements and cappuccinos are substitutes for CDs.

(c) The demand curve for magazines shifts down in response to an increase in the price of CDs and it increases in response to an increase in the price of cappuccinos.

Exercise 4.8.

(a) Reduce the price, because the elasticity is greater than one.

(b) Yes, it would reduce train ridership because the positive cross-price elasticity indicates that these goods are substitutes.

Exercise 4.9.

(a) Plot the scatter.

(b) The scatter is a positively sloping group of points indicating a positive relationship.

(c) The elasticities estimated at mid values are 1.0, 0.64, 0.47, 0.52, 0.29 and 0.32. For example: the first pair of points yields a $\%\Delta P = 5/12.5$ and $\%\Delta Q = 8,000/20,000$. Hence, $\%\Delta Q/\%\Delta P = (8,000/20,000)/(5/12.5) = 1.0$.

(d) They are normal goods because the income elasticity is positive.

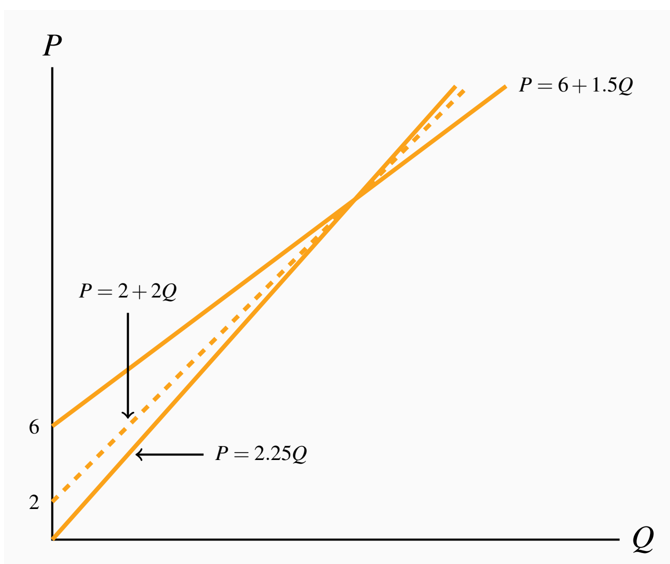
Exercise 4.10.

(a) All three supply curves intersect at $P = \$18$ and $Q = 8$.

(b) The supply elasticities are 1.0, 1.125 and 1.5 respectively. These are obtained from substituting the equilibrium P and Q values into Equation 4.1 Part (c) in the text, and noting that the slopes, $\Delta Q/\Delta P$, from each equation are 2.25, 2, and 1.5.

(c) The elasticities are computed in the same way, once you have calculated the equilibrium quantity for each equation at this new price: 1.0, 1.2 and 2.0.

(d) The supply curve through the origin always has a value of unity.



Exercise 4.11.

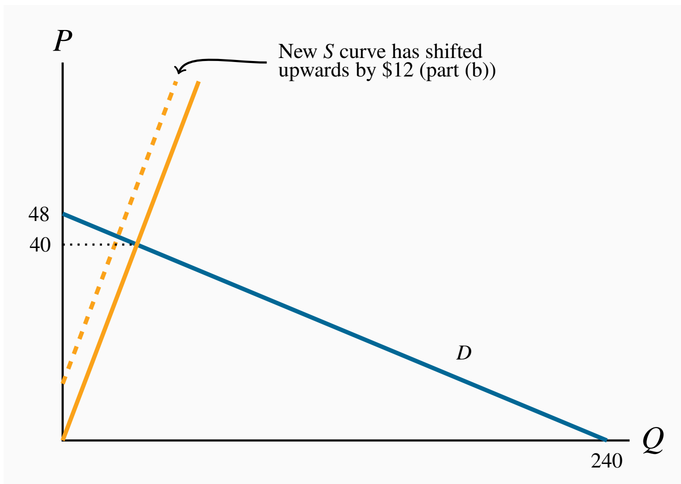
(a) The price intercept for the demand curve is 48 and the quantity intercept is 240. The supply curve goes through the origin with a slope of 1. The equilibrium price is \$40 and the equilibrium quantity is 40.

(b) The supply curve shifts upwards everywhere by \$12.

(c) The price will increase to \$42 and the quantity declines to 30.

(d) The curve still goes through the origin but with a slope of 1.3 rather than 1.0 (not illustrated in the figure).

(e) The equilibrium quantity is $Q = 32$; corresponding price is $P = 32 \times 1.3 = 41.6$.

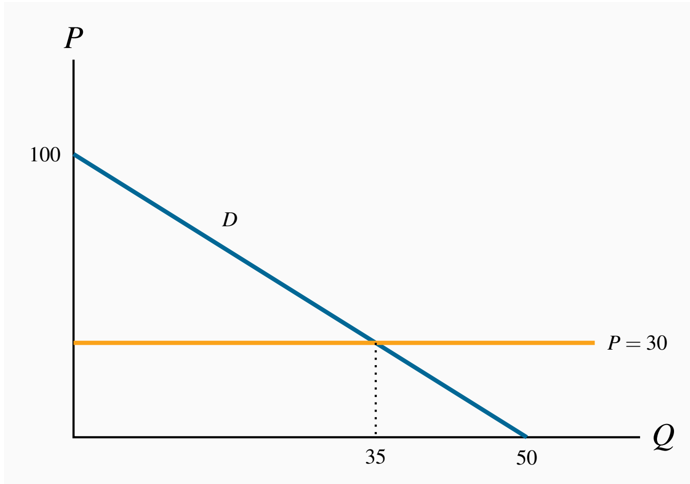


Exercise 4.12.

(a) The demand curve has a price intercept of 100 and a quantity intercept of 50. The supply curve is horizontal at a price of \$30. The equilibrium quantity is 35 units at this price.

(b) The new, tax-inclusive, supply curve is horizontal at $P =$ \$40 (not illustrated in the figure). The equilibrium price is \$40 and the equilibrium quantity becomes 30. With 30 units sold, each generating a tax of \$10, total tax revenue is \$300.

(c) Since the equilibrium is on the lower half of a linear demand curve the demand is inelastic.



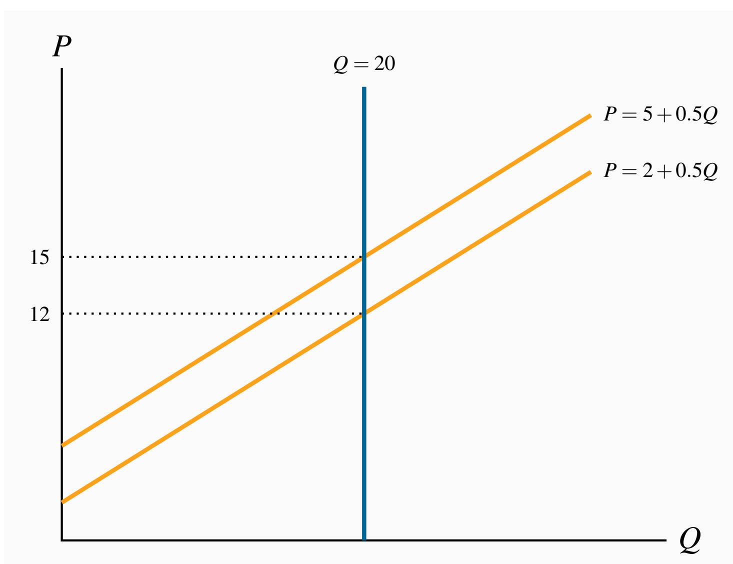
Exercise 4.13. As illustrated in the text, we could equally shift the demand curve down by \$10 to yield $P = 90 - 2Q$. Equating this to $P = 30$ yields $Q = 30$ once again. The price of \$30 here is what goes to the supplier; the buyer must pay this plus the tax – that is \$40.

Exercise 4.14.

(a) The supply and demand curves are illustrated below.

(b) Solving the demand equations for $Q = 20$ yields prices of \$12 and \$15 respectively.

(c) The consumer bears the entire tax burden.



Solutions to exercises for Chapter 5

Exercise 5.1.

(a) The step functions are similar to those in Figure 5.1. In ascending order, Margaret is the first supplier, Liam the second, etc. You must also order the demanders in descending order.

(b) Two: Margaret and Liam will supply, while Jones and Lafleur will purchase. The third highest demander (Murray) is willing to pay \$6, while the third supplier is willing to supply only if the price is \$9. Hence there is no third unit supplied.

(c) The equilibrium price will lie in the range \$7.0-\$7.5. So let us say it is \$7. The consumer surplus of each buyer is therefore \$1 and \$0.5. The supplier surpluses are zero and \$2.

(d) Two driveways will still be cleared. The highest value buyers are now willing to pay \$12 and \$8. The third highest value buyer is willing to pay \$7.0. But on the supply side the third supplier still supplies only if he gets \$9. Therefore two units will be supplied. If the price remains at \$7 (it could fall in the range between \$7 and \$8) the consumer surpluses are now \$5 and \$1, and the supplier surpluses remain the same.

Exercise 5.2.

(a) The supply curve is horizontal at a price of \$10. The demand curve price intercept is \$34 and the quantity intercept is 34. The equilibrium quantity is 24.

(b) The new supply curve is $P = 12$. Substituting this price into the demand curve yields $Q = 22$.

(c) Tax revenue is \$44: each of the 22 units sold yields \$2. The deadweight loss is the standard triangular area in Figure 5.4. It is \$2.

Exercise 5.3.

(a) With a supply curve given by $P = 10$, the new demand curve yields an equilibrium quantity of 24 once again. The new demand curve is ‘flatter’ at the equilibrium than the original, indicating that it is more elastic.

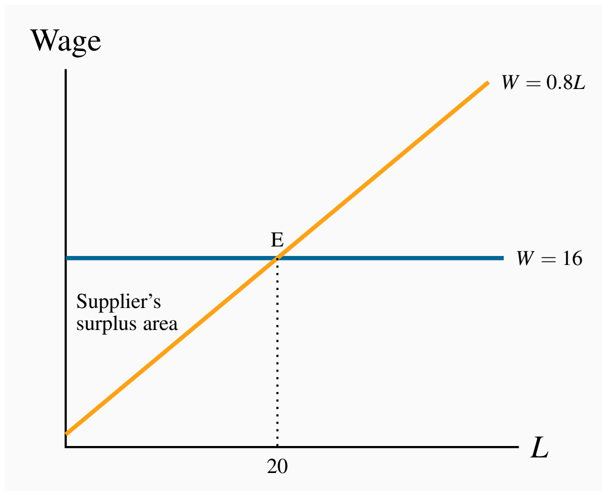
(b) With a tax of \$2 imposed the new equilibrium quantity is 21. Hence tax revenue is \$42. The DWL is \$3.

Exercise 5.4.

(a) The supply curve goes through the origin and the demand curve is horizontal at $W = \$16$ – see diagram below.

(b) The equilibrium amount of labour supplied is 20 units. The supplier surplus is the area above the supply curve below the equilibrium price= \$160.

(c) At a net wage of \$12, labour supplied falls to 15. The downward shift in the wage reduces the quantity supplied. The new supplier surplus is the triangular area bounded by $W = 12$ and $L = 15$. Its value is therefore \$90.



Exercise 5.5.

(a) The demand curve shifts inwards.

(b) Yes, because consumers previously did not have full information about the product.

Exercise 5.6.

(a) Yes.

(b) Yes, because the congestion effect is not incorporated into the price of driving.

Exercise 5.7.

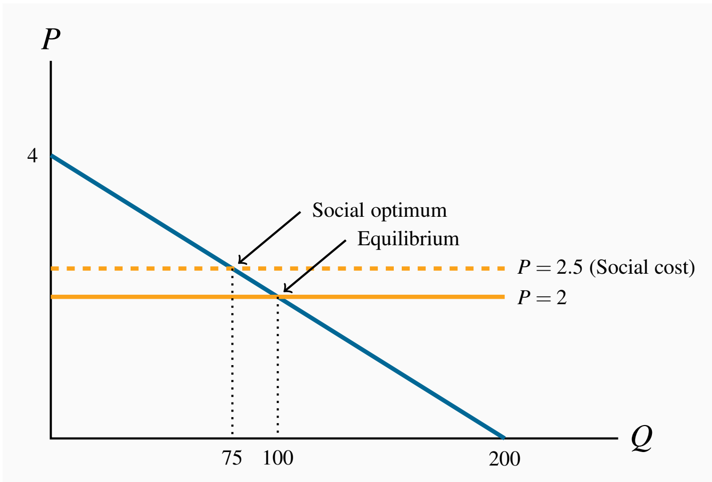
(a) The free market equilibrium is obtained by equating demand and private-cost supply curves: $Q = 10$, $P = \$7$.

(b) Using the social supply curve yields and equilibrium of $Q = 6$. These answers are illustrated graphically in Figure 5.5.

Exercise 5.8.

(a) Equating demand to price yields $Q = 100$km. See figure below.

(b) Using a price of \$2.5 rather than \$2.0 yields a quantity of 75km.



Exercise 5.9.

(a) The supply curve is horizontal at $P = \$1$. The demand curve has a price intercept of 5 and a quantity intercept of 1000. The equilibrium quantity is 800.

(b) The socially optimal quantity is obtained by recognizing that the social cost is \$1.25 rather than \$1.0. Here $Q^* = 750$.

Exercise 5.10.

(a) The demand curve is horizontal at $P = \$12$. The supply curve slopes upwards with a price intercept of \$6. Equilibrium is $L = 60$.

(b) Surplus is the area beneath the demand curve above the supply curve= \$180.

Exercise 5.11.

(a) The equilibrium here is $Q = 20$, $P = \$4$.

(b) Consumer surplus is \$200.

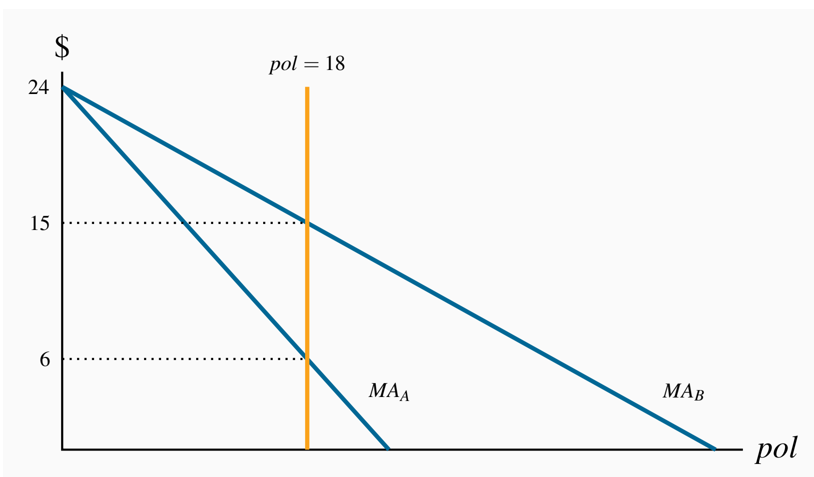
(c) The new quantity is $Q = 18$ and $CS = \$162$.

Exercise 5.12. The marginal abatement curves are essentially the demand for pollution rights on the part of the producers. If we sum these curves horizontally it is easy to see that the price intercept remains at \$24 and the horizontal intercept becomes 72 ($= 24 + 48$). Hence the total demand for abatement becomes $MA = 24 - (1/3)pol$. The MD function is $MD = \$12$. This is the 'supply' function because firms are able to buy the pollution rights at this price. The efficient level of pollution is 36 units.

Exercise 5.13.

(a) See diagram below. The answers are \$15 and \$6.

(b) As long as the abatement costs are different it is profitable to trade. With a total number of permits available of 36 units, the amount they trade will depend upon the price they agree upon. Provided the price lies between \$6 and \$15 they have an incentive to trade.



Exercise 5.14. Firm A would purchase 14 units and Firm B would purchase 28. Clearly the lower price price means that the total amount of pollution emitted is greater.

Exercise 5.15.

(a) The market solution is obtained by equating the market demand and supply. This yields $Q = 16$ and $P = \$20$.

(b) The socially optimal amount takes account of the fact that there are positive externalities. The demand curve that reflects these externalities is above the private demand curve. Hence the socially optimal equilibrium is at a greater output $Q = 32$.

(c) To induce a demand of 32 units in the private marketplace the price would have to be \$4. Hence the subsidy per unit would be \$16.

Exercise 5.16. The demand curve would have to be shifted upwards to the point where it intersects the supply curve at 32 units. The new price intercept would have to be \$52. Hence the subsidy would again be \$16.

Exercise 5.17.

(a) Equating the functions yields $Q = 35$, $P = \$7$.

(b) The solutions becomes $Q = 30$, $P = \$12$.

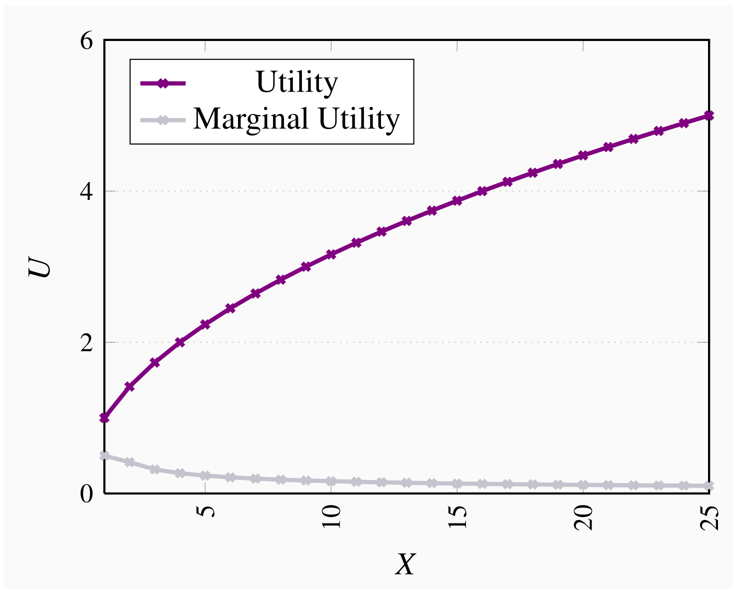
(c) The consumer pays \$12, the supplier gets half of this.

(d) Using the customary triangle formulas yields $CS = \$450$; $PS = \$90$; $DWL = \$15$.

Solutions to exercises for Chapter 6

Exercise 6.1. Since the additional utility per dollar spent on another unit of either activity is the same (1.2 units), he should be indifferent as to where he spends it. However, if he gets an income increase that is sufficient to cover the purchase of one unit of the goods then snowboarding yields the highest MU per dollar spent.

Exercise 6.2. The utility and marginal utility curves are given below.



Exercise 6.3.

(a) The cappuccino intercept is 8 and the M intercept is 24. The slope is $-1/3$.

(b) New slope is $-1/4$.

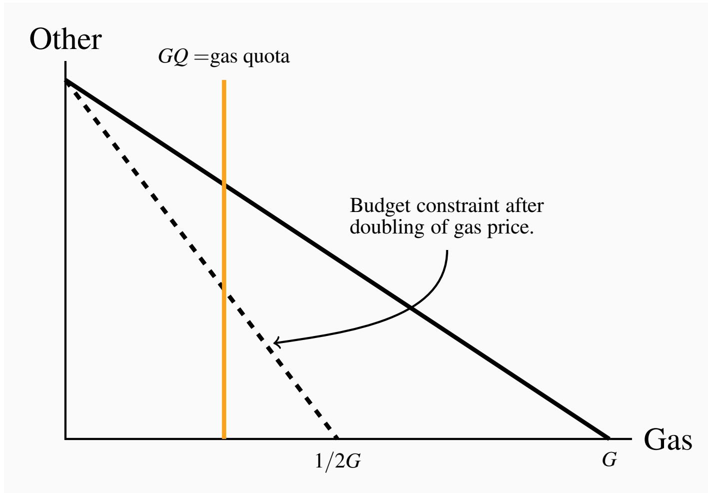
(c) Yes, yes, yes.

(d) All lie inside.

Exercise 6.4.

(a) Let G be the initial intercept on the gasoline axis, then $1/2G$ is the new intercept.

(b) A vertical line at a point less than $1/2G$ reduces the feasible set to the area bounded by the new budget constraint (dashed line) and the vertical line GQ.



Exercise 6.5. The new intercept on the gasoline axis will be less than $1/2G$.

Exercise 6.6.

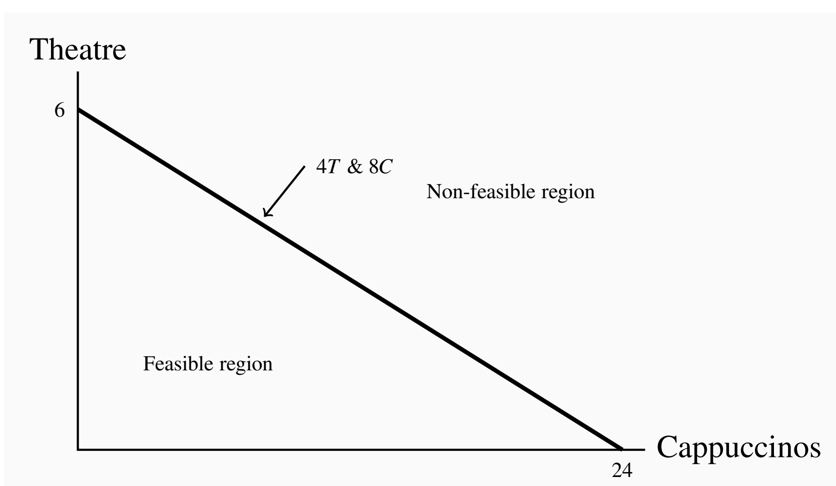
(a) The theatre ticket intercept is 6 and the cappuccino intercept is 24. See below.

(b) See below.

(c) No. The cost exceeds the budget.

(d) We cannot say without knowing the shape of the indifference curves. In this case the individual has more of one good and less of the other.

(e) No. The cost of such a combination would be $84.



Exercise 6.7. They are not strictly convex to the origin, and so they do not display a diminishing marginal rate of substitution.

Exercise 6.8.

(a) The meals intercept is 10, and the movies intercept is 25.

(b) The meals intercept is now 20. More meals will be purchased, but we cannot say about movies – it depends upon whether they are substitutes or complements for meals. However, the individual will reach a higher level of utility.

(c) The new movie intercept is 50. This budget line is parallel to the original line. Since both goods are normal then more of each will be consumed.

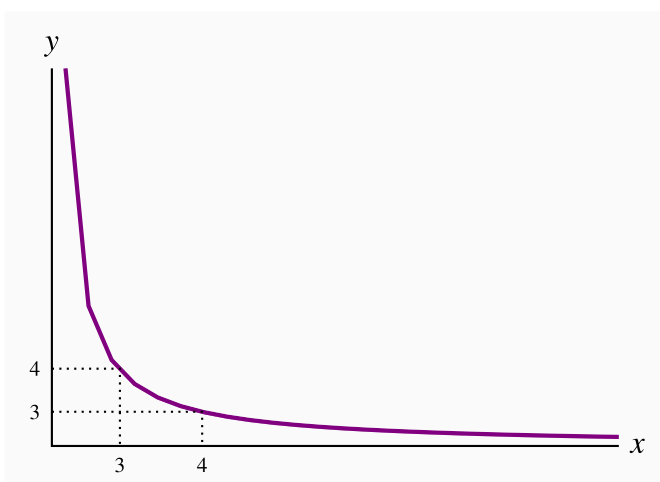
(d) In part (b) we cannot be sure that more of each good is consumed; in part (c) more of each must be consumed. Utility levels increase with each price reduction however.

Exercise 6.9. If Lionel can buy 10 bottles of wine for \$120, then each bottle must cost \$12. Similarly cheese must cost \$30 per kilo.

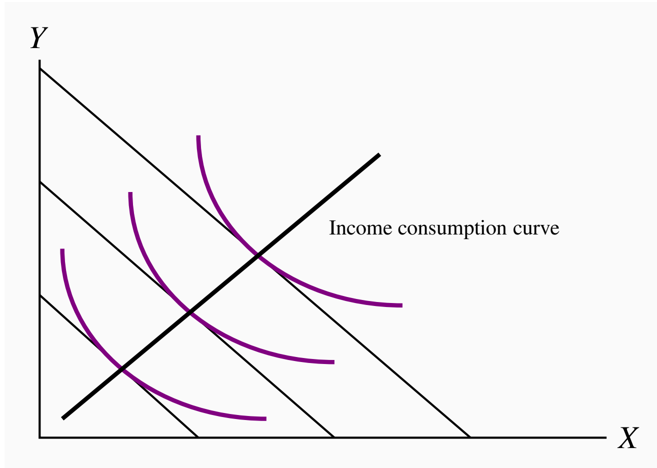
(a) The wine intercept must be 180/20=9. Similarly the cheese intercept must be 180/30=6.

(b) Yes, he can afford the original combination with the new budget constraint and still have \$20 remaining – which he can spend on the goods.

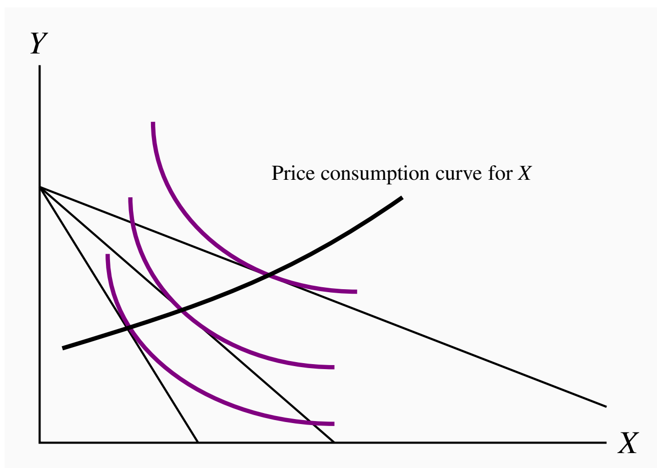
Exercise 6.10. Indifference curve is given below. When x goes from 3 to 4, y declines by 1 unit; when x goes from 15 to 16, y declines by 0.05.



Exercise 6.11. See figure below.



Exercise 6.12. See the figure below. Part (b) will see the rotation point stay at the X intercept.



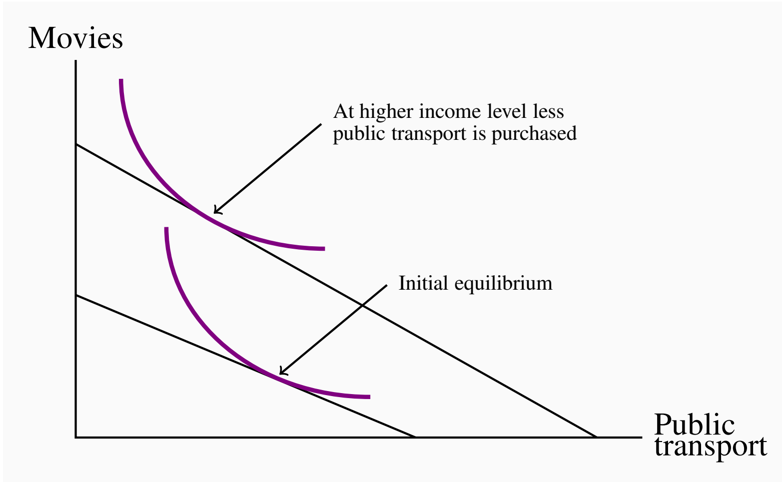
Exercise 6.13.

(a) His new marginal utility per dollar schedule is 3.25, 2.625, 2.125, 1.75, 1.5, 1.32, 1.19. Therefore his new equilibrium will be 4 snowboard outings and 5 jazz.

(b) When the price of jazz was $20 he purchased 4 units of each. Using the mid-point elasticity formula, his jazz consumption has increased by $1/4.5 = 22\%$, and the price of jazz decreased by $4/18 = 22\%$. Hence the elasticity is (minus) one.

(c) There has been no change in the purchase of snowboarding, therefore the cross price elasticity at this set of prices is zero.

Exercise 6.14. With movies on the Y axis and public transport on the X, the higher income equilibrium will lie to the north-west of the lower income equilibrium.



Exercise 6.15. Where more 'other goods' are purchased they are complements; where less of such goods are purchased they are substitutes.

Solutions to exercises for Chapter 7

Exercise 7.1. The dollar outcomes for the three games are: $10,000, $30,000 and $20,000. The average utilities are: 99.7, 173.2 and 141.

Exercise 7.2. If there is no medical exam then it is probable that less healthy individuals will avail of it. Knowing this, the firm should choose its benefit/payout structure to reflect a high cost clientele. It will have lower payouts and/or higher premiums. Therefore a healthy individual would likely not obtain favourable insurance terms.

Exercise 7.3.

(a) Spreading.

(b) Pooled.

(c) Spreading.

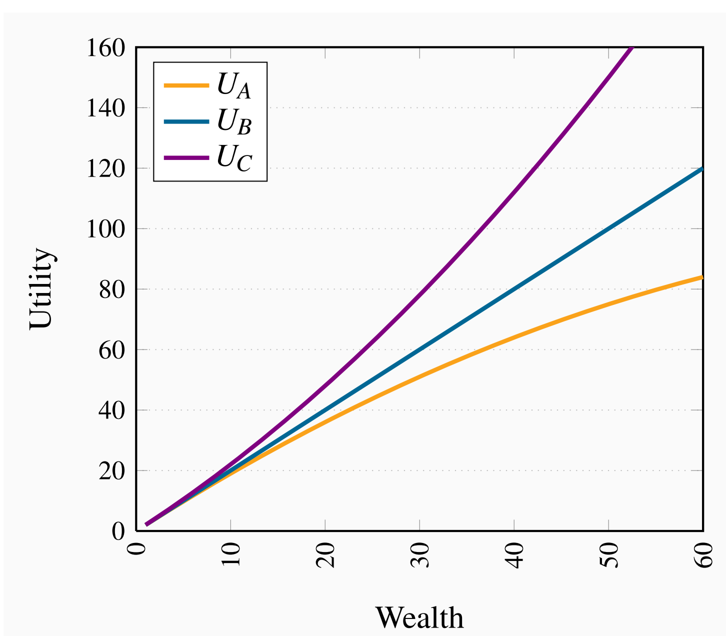
(d) Spreading and pooling.

Exercise 7.4.

(a) See below.

(b) Utility A is risk averse; Utility B is rish neutral; Utility C is risk loving.

(c) A displays diminishing MU, B displays constant MU, C displays increasing MU.



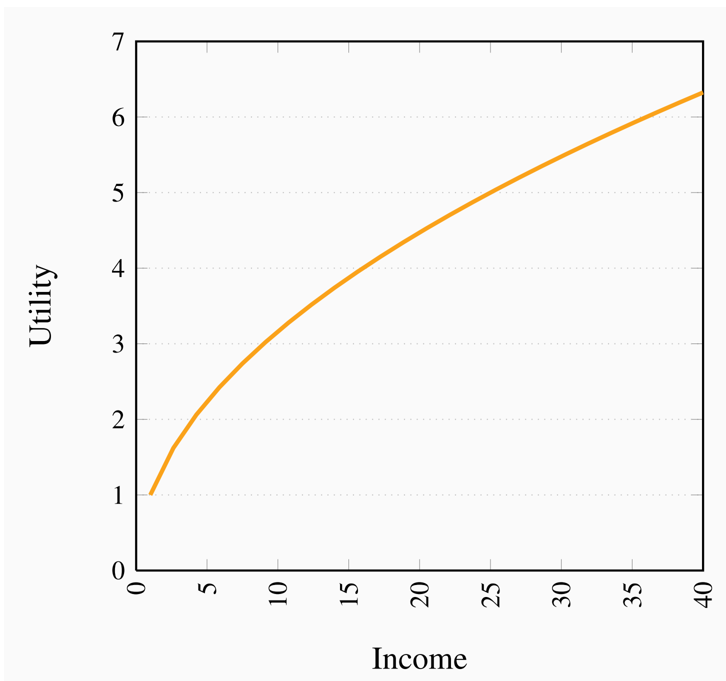
Exercise 7.5. Alone the average utility is 35.35; pooled the average utility is 42.7.

Exercise 7.6. If each asset has a 10% return with probability 1/2 and zero with probability 1/2, then if \$50 is invested in such an asset the variance is $1/2(55-52.5)^2+1/2(50-52.5)^2=6.25$. With 4 such assets each having the same variance then the variance of the portfolio is 25 when the returns on each asset are independent of the returns on the others.

Exercise 7.7.

(a) See below.

(b) If income falls to \$1 then utility from that outcome is the square root of 1. Hence we need to figure out x such that $0.5\times 1+0.5\times\sqrt(x)=4$. It follows that $x=70$. You can check that outcomes of 1 and 70 with equal probability yield an expected utility of 4.

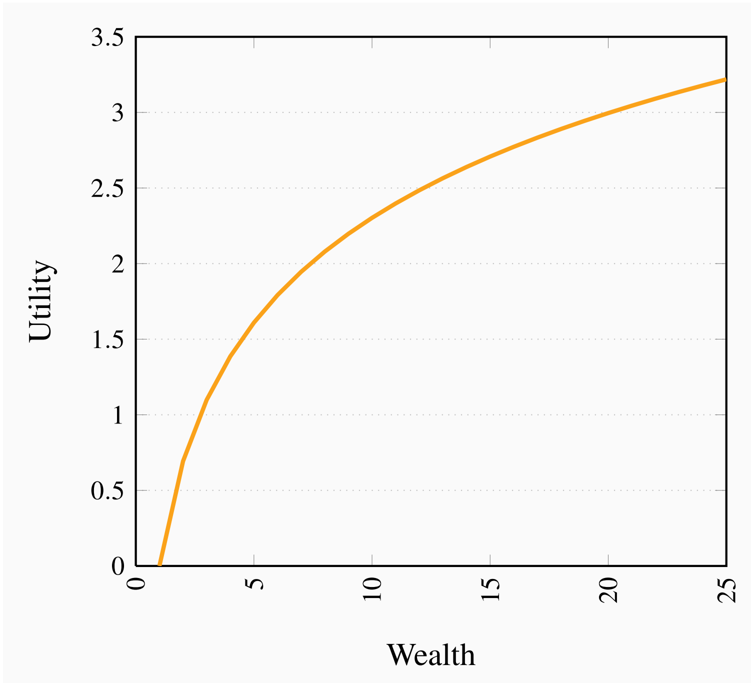


Exercise 7.8.

(a) His expected utility is $0.5\times 0+0.5\times\sqrt{25}=2.5$.

(b) Expected utility becomes $0.5\sqrt{9}+0.5\times\sqrt{16}=3.5$.

Exercise 7.9. He should smooth his income completely and save 12.5 each good time period.
Exercise 7.10. See below. Clearly this displays diminishing marginal utility.


3.5
3
2.5
2
1.5
1
0.5
0
Utility
0
5
10
15
20
25
Wealth

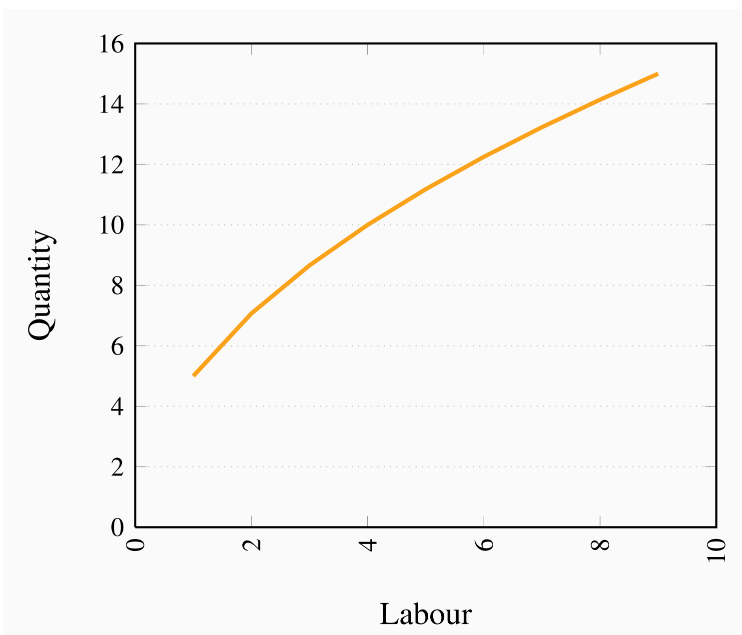
Solutions to exercises for Chapter 8

Exercise 8.1.

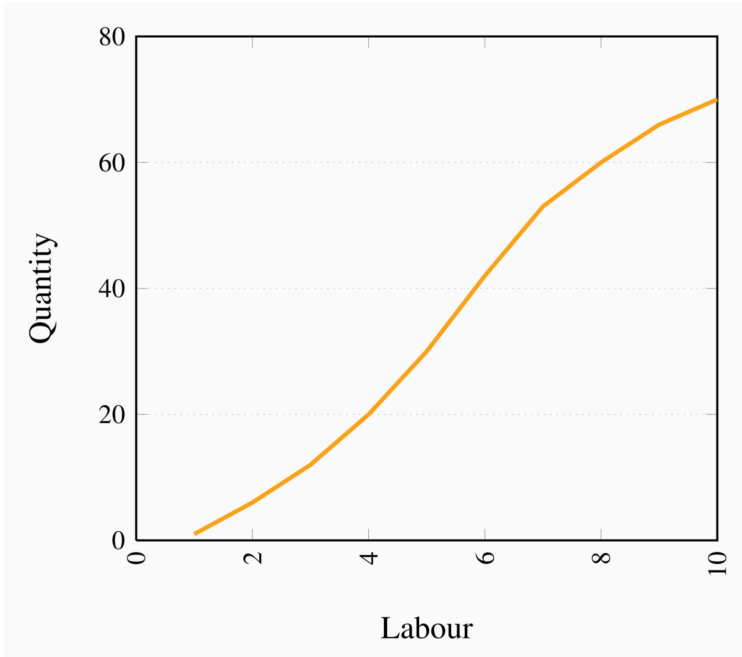
(a) For 1 = 1 through 9 the output produced is 5.0, 7.07, 8.66, 10.0, 11.18, 12.25, 13.23, 14.14, 15.0.

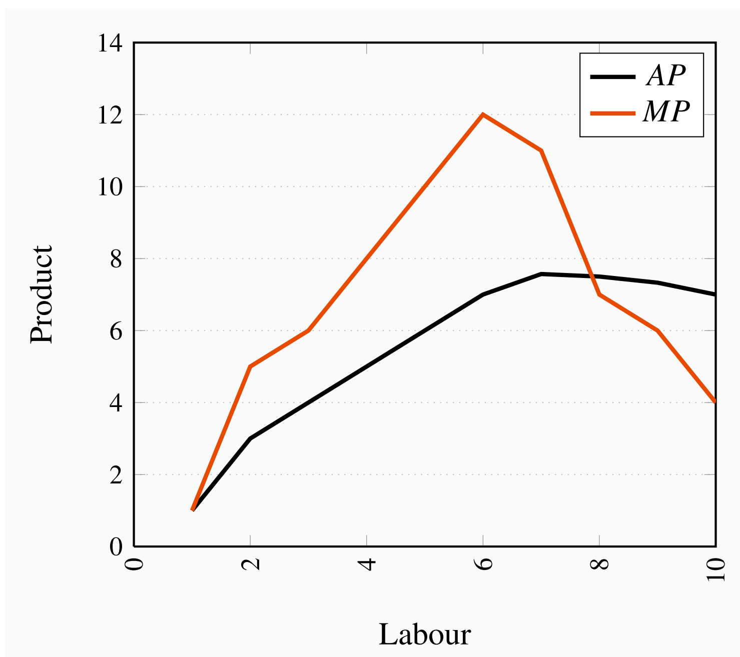
(b) See the figure below.

(c) Note that total output increases at a diminishing rate – the *MP* is declining.



Exercise 8.2. For each level of labour used, its *AP* is: 1.0, 3.0, 4.0, 5.0, 6.0, 7.0, 7.57, 7.5, 7.33, 7.0. and the *MP* is: 1, 5, 6, 8, 10, 12, 11, 7, 6, 4. The *AP* and *MP* are graphed below. If the *MP* cuts the *AP* at the latter's maximum, your graph is likely correct.





Exercise 8.3. The *AP* schedule is 5.0, 3.54, 2.89, 2.5, 2.24, 2.04, 1.89, 1.77, 1.67. The *MP* schedule is: 5.0, 2.07, 1.59, 1.34, 1.18, 1.07, 0.98, 0.91, 0.86.

Exercise 8.4.

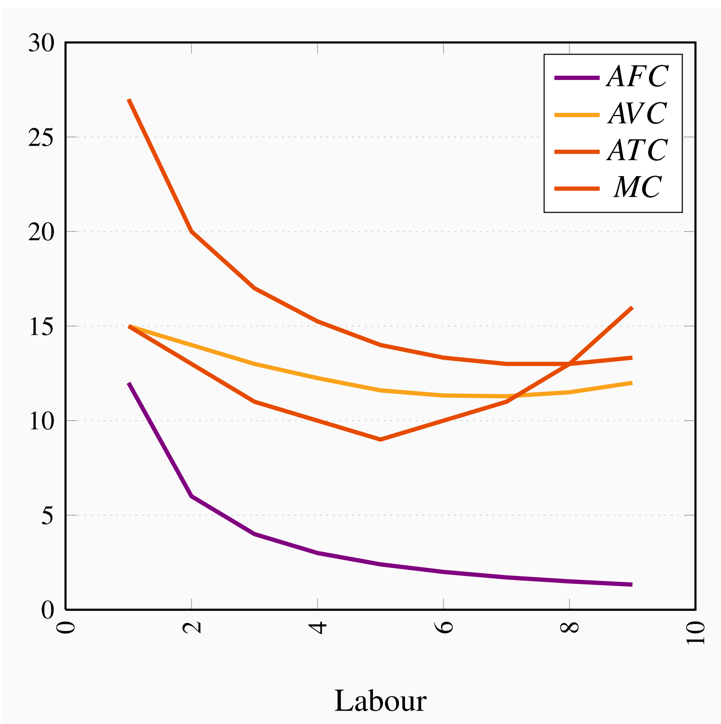
(a) Fixed cost is $12.

(b) See below.

(c) See below.

Q	TC	AFC	AVC	ATC	MC
0	12				
1	27	12.00	15.00	27.00	15
2	40	6.00	14.00	20.00	13
3	51	4.00	13.00	17.00	11
4	61	3.00	12.25	15.25	10
5	70	2.40	11.60	14.00	9
6	80	2.00	11.33	13.33	10
7	91	1.71	11.29	13.00	11
8	104	1.50	11.50	13.00	13
9	120	1.33	12.00	13.33	16

(d) See below.



Exercise 8.5. See table below. By this point you should be able to take these data and put them into Excel, or some spreadsheet tool, and plot.

L	Q_s	Q_m	Q_l	AP_s	AP_m	AP_l	MP_s	MP_m	MP_l	ATC_s	ATC_m	ATC_l
1	15	20	22	15	20.00	22.00	15.00	20.00	22.00	10.67	10.00	10.91
2	30	40	46	15	20.00	23.00	15.00	20.00	24.00	7.33	6.50	6.52
3	48	64	70	16	21.33	23.33	18.00	24.00	24.00	5.83	5.00	5.14
4	56	74	80	14	18.50	20.00	8.00	10.00	10.00	6.07	5.14	5.25
	100	140	180									

Exercise 8.6. The ATC for each plant size is given in the table accompanying the preceeding question. Each one has a U shape.

Exercise 8.7. Since the minimum point on the ATC curve of the large plant size lies above the minimum point on the ATC curve for the medium plant size in the table above, diminishing returns to scale eventually set in.

Exercise 8.8.

(a) The least cost method can be ascertained from the table below.

(b) The TC will have the cost points 33, 64 and 96, corresponding to the output levels 4, 8, 12. The ATC will have the values $8.25, 8.0, 8.0. These values can be plotted easily.

K	L	Q	TC
4	5	4	33
2	6	4	34
7	10	8	64
4	12	8	68
11	15	12	97
8	16	12	96

Exercise 8.9. The total cost column is now 37, 36; 71, 72; 108, 104, and the relevant least-cost values are therefore 36, 71, 104. The new LR ATC will lie everywhere above the LR ATC defined for the lower price of capital.

Exercise 8.10.

(a) The costs are given in the table below.

(b) Firm A experiences decreasing returns to scale at high outputs, whereas B does not.

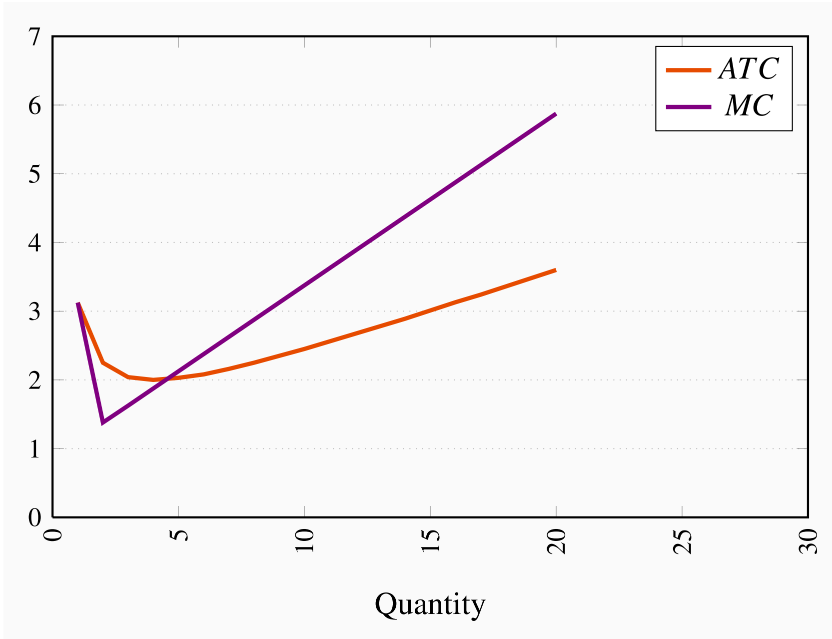
Q	TC_A	LAC_A	TC_B	LAC_B
1	40	40.00	30.00	30.00
2	52	26.00	40.00	20.00
3	65	21.67	50.00	16.67
4	80	20.00	60.00	15.00
5	97	19.40	70.00	14.00
6	119	19.83	80.00	13.33
7	144	20.57	90.00	12.86

Exercise 8.11. *MC* curve data are given in the table below. Firm B has constant marginal costs in the LR; hence never encounters decreasing returns to scale. Firm A's LR *MC* intersects its LR *ATC* at an output between 5 and 6 units, where the *ATC* is at a minimum. Firm A's *MC* lies everywhere below its *ATC*.

Output	1	2	3	4	5	6	7
MC **Firm A**	40	12	13	15	17	22	25
MC **Firm B**	30	10	10	10	10	10	10

Exercise 8.12. The table and graphic that answer all parts of this question are given below.

Output	*ATC*	*TC*	*MC*
1	3.125	3.125	3.125
2	2.25	4.50	1.38
3	2.04	6.13	1.625
4	2.00	8.00	1.875
5	2.03	10.13	2.125
6	2.08	12.50	2.375
7	2.16	15.13	2.625
8	2.25	18.00	2.875
9	2.35	21.13	3.125
10	2.45	24.50	3.375
11	2.56	28.13	3.625
12	2.67	32.00	3.875
13	2.78	36.13	4.125
14	2.89	40.50	4.375
15	3.01	45.13	4.625
16	3.13	50.00	4.875
17	3.24	55.13	5.125
18	3.36	60.50	5.375
19	3.48	66.13	5.625
20	3.60	72.00	5.875



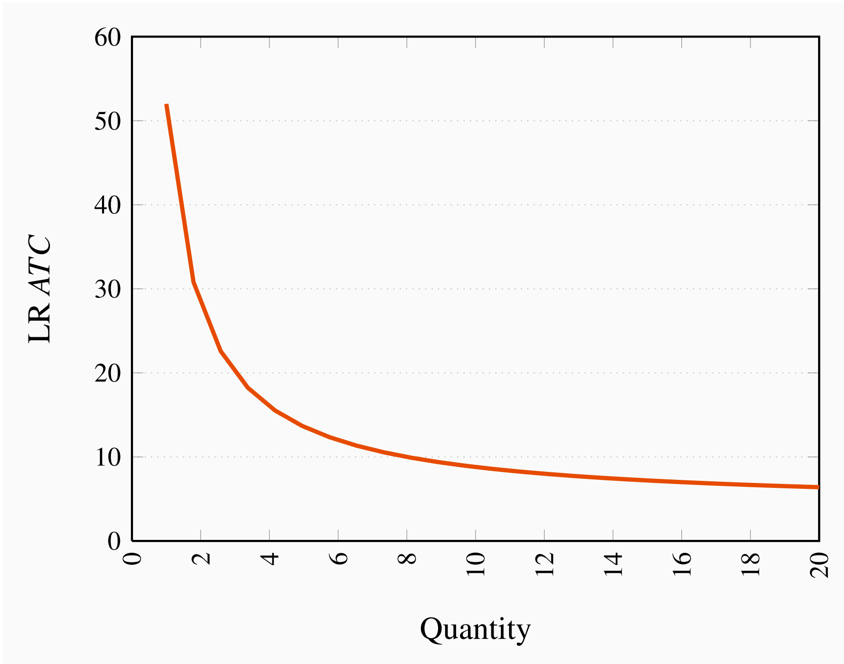
Exercise 8.13.

(a) See graphic below.

(b) Decreasing returns to scale.

(c) As q becomes infinitely large the second term tends to zero, hence ATC tends to $.

(d) $LMC = 4$.



60
50
40
30
20
10
0
LR *ATC*
0
2
4
6
8
10
12
14
16
18
20
Quantity

Solutions to exercises for Chapter 9

Exercise 9.1.

(a) The MC is \$32.

(b) Her break-even level of output is 25 units.

(c) No, because she can cover her variable costs. $TVC = \$320$; $TR = \$360$.

Exercise 9.2. For total revenue to equal total cost it must be the case that $130 \times Q = 200,000 + 80 \times Q$. Therefore $Q = 4,000$.

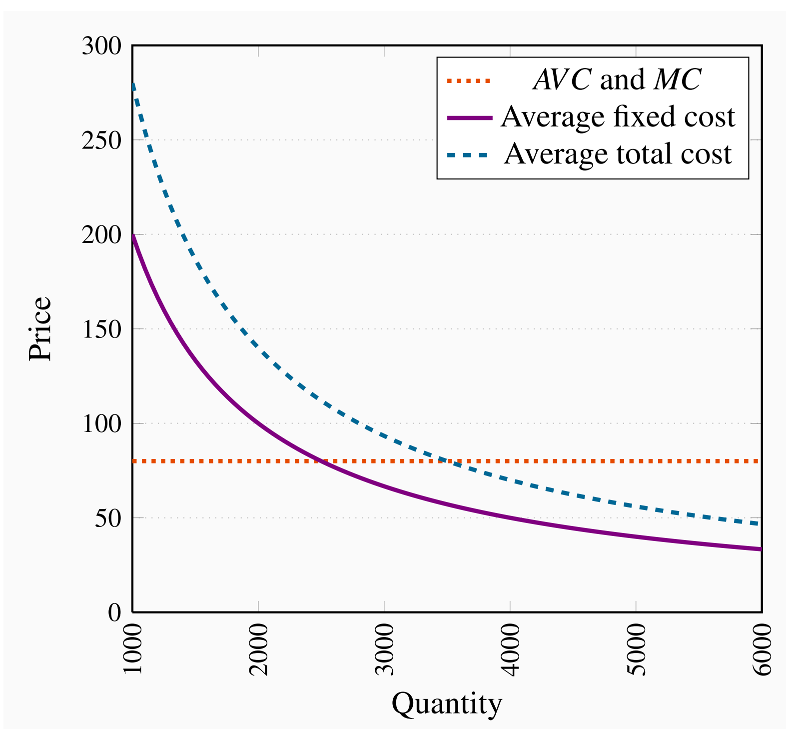
Exercise 9.3.

(a) The MC is horizontal at \$80.

(b) See diagram below.

(c) See diagram below.

(d) The MC would have to increase at some point.



Exercise 9.4. The market supply curve goes through the origin with a slope of 2/3. This follows from the fact that we can write the supply curves as $q_A = P$ and $q_B = 0.5P$. Hence $Q = q_A + q_B = 1.5P$; or $P = (2/3)Q$.

Exercise 9.5. Since the costs per unit are declining with output, they are producing on the downward-sloping segment of the *LATC*. To see this we need just calculate *ATC* at each output.

Exercise 9.6.

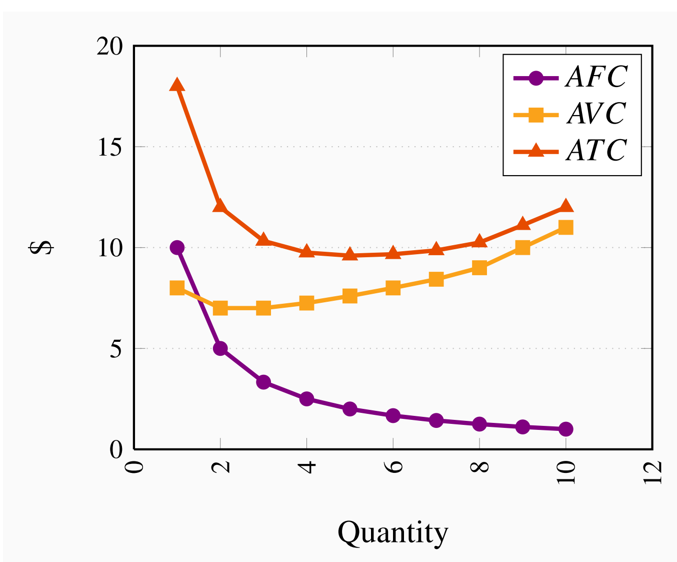
(a) See the table.

(b) See the figure below.

(c) $Q = 7$. At this output $MC = MR$.

(d) Price is fixed.

Q	0	1	2	3	4	5	6	7	8	9	10
TC	10	18	24	31	39	48	58	69	82	100	120
TR	0	11	22	33	44	55	66	77	88	99	110
Profit	−10.00	−7.00	−2.00	2.00	5.00	7.00	8.00	8.00	6.00	−1.00	−10.00
MR		11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
MC		8.00	6.00	7.00	8.00	9.00	10.00	11.00	13.00	18.00	20.00
AFC		10.00	5.00	3.33	2.50	2.00	1.67	1.43	1.25	1.11	1.00
AVC		8.00	7.00	7.00	7.25	7.60	8.00	8.43	9.00	10.00	11.00
ATC		18.00	12.00	10.33	9.75	9.60	9.67	9.86	10.25	11.11	12.00



Exercise 9.7.

(a) The equilibrium price is \$40 and the equilibrium quantity is 6,000. The price intercept for the demand equation 50, the quantity intercept 30,000. The price intercept for the supply equation is 10 and the quantity intercept 2,000.

(b) With a perfectly competitive structure, this new firm cannot influence the price. Therefore it maximizes profit by setting $P = MC$. That is $40 = 10 + 0.5q$. Solving this equation yields a quantity value $q = 60$.

Exercise 9.8.

(a) If each firm produces 60 units then there must be 100 firms.

(b) The ATC is of the form $ATC = 400/q + 10 + q/4$. Thus at an output of 60, $ATC = 400/60 + 10 + 60/4 = 31.67$.

(c) Profit is $(P - ATC) \times q = 60 \times (40 - 31.67) =$ \$500.

(d) ATC must slope upwards because MC is greater than ATC here.

Exercise 9.9.

(a) Entry will take place in view of supernormal profits.

(b) Since this is a competitive industry the price in the LR equilibrium must equal the minimum of the LR ATC. Hence $P = 30$. From the demand curve it follows that $Q = 12,000$.

(c) At a $MC = ATC =$ \$30, it follows that $q = 40$ for each firm. Hence there will be 300 firms.

Exercise 9.10.

(a) In a competitive industry the LR price equals the minimum of the LR ATC curve. Hence $P =$ \$25. From the demand curve above it follows that quantity demanded at this price is 15,000.

(b) Each firm will produce where its $MC = P$. Hence equating $MC = P$ yields $10 + 0.5q = 25$ implying $q = 30$.

(c) With a total quantity demand of 15,000 at this price there will be 500 firms. The reason we have more firms is that, with lower fixed costs, each firm attains the minimum of its ATC at a lower level of output.

Exercise 9.11.

(a) Each ATC curve must intersect the MC at the minimum of the ATC.

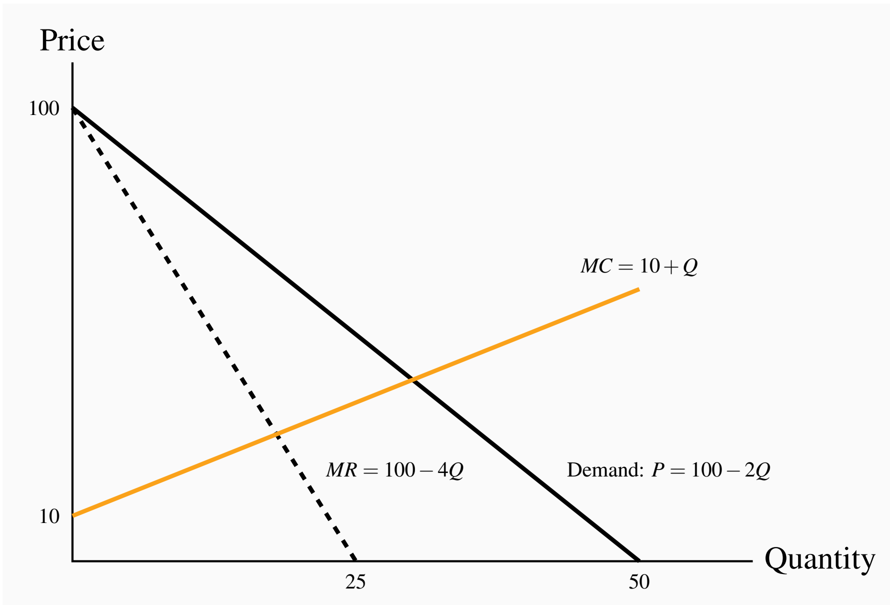
(b) The breakeven price for each firm is the minimum of the firm's ATC.

(c) The price in the market will be forced down to the level at which the most efficient producers can supply the market. Consequently the producer with the higher fixed cost will either have to adopt the technology of the lower-cost producer or exit the industry.

(d) The total variable cost is the part of the total cost excluding the fixed component. Since the terms '400' and '225' are independent of output then the total variable cost curves for these firms are $10q + (1/4)q^2$.

Solutions to exercises for Chapter 10

Exercise 10.1. This is a standard diagram for the monopolist. See the figure below. Equating $MC = MR$ yields $Q = 18$, $P = \$64$.



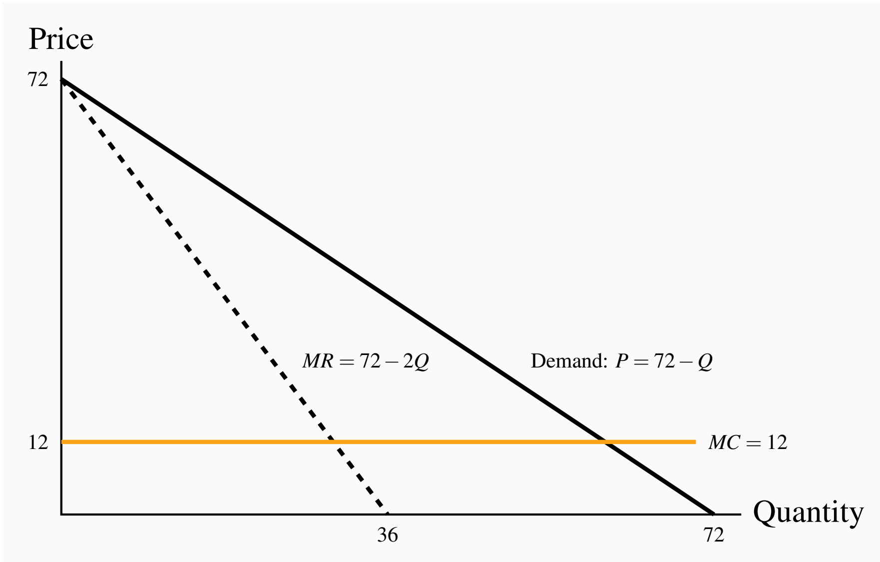
Exercise 10.2.

(a) See below.

(b) Total revenue is a maximum where MR becomes zero. This is at $P = \$36$ and $Q = 36$.

(c) TR under revenue maximization is $36 \times 36 = \$1,296$. Under profit maximization the optimal output is where $MC = MR$ – an output $Q = 30$. Using the demand curve, this output of 30 units will be sold at a price of \$42. Hence $TR = 30 \times 42 = \$1,260$.

(d) Profit here is \$864 since total cost is \$12 per each of the 36 units (\$432) and revenue is \$1,296.



Exercise 10.3.

(a) Equating $MC = MR$ yields $72 - 2Q = Q$. Therefore $Q = 24$. Substituting this into the demand curve yields a price of $P = \$48$.

(b) Equating $MC = MR$ yields $60 - (2/3)Q = Q$. Solving yields $Q = 36$. This quantity will sell at a price derived from the demand curve: $P = 60 - (1/3) \times (36)$; therefore $P = 48$. Hence both demand curves yield an equilibrium price of \$48, but different quantities.

Exercise 10.4.

(a) Where demand equals MC, we obtain $72 - Q = 12$. Therefore $Q = 60$.

(b) From the demand curve, if $Q = 60$ then $P = \$12$.

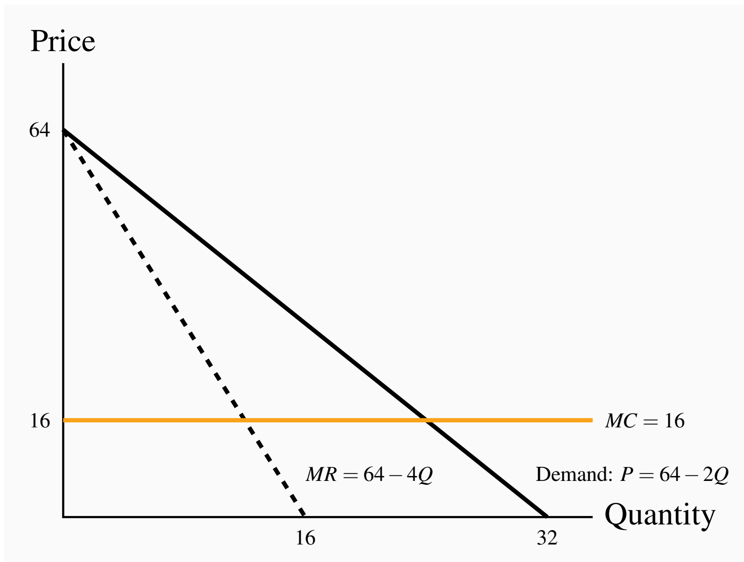
(c) The efficiency gain in going from a profit maximizing monopoly ($Q = 30$) to perfect competition ($Q = 60$) is given by the area under the demand curve and above the MC curve between these output levels. This is $q/2 \times 30 \times 30 = \$450$.

Exercise 10.5.

(a) Setting $MC = MR$ yields $Q = 12$ and from the demand curve, $P = \$40$. See the figure below.

(b) Where MC equals demand the output is $Q = 24$. In moving from the output level $Q = 24$ to $Q = 12$, the DWL is the area bounded by the demand curve and the MC between these output levels: $1/2 \times 12 \times 24 = \$144$.

(c) With the subsidy the monopolist's new MC is $MC = 12$. Equating the MC to this MR yields: $12 = 64 - 4Q$. Therefore the new profit maximizing level is $Q = 13$. The new deadweight loss is the area below the demand curve and above the actual MC curve between the outputs $Q = 13$ and $Q = 24$: $1/2 \times (24 - 13) \times (38 - 16) = 11 \times 22 = \$121$.



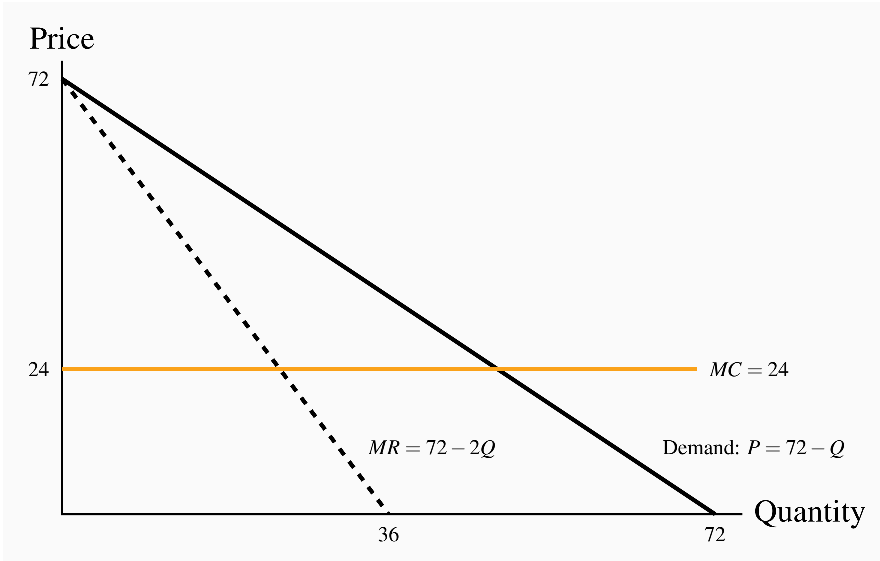
Exercise 10.6. The buyers' reservation prices are given in row P. The cost of producing each unit is given in row MC. The profit on the first unit is therefore $\$(14 - 2) = \$12$; on the second unit is $\$(12 - 3) = \$9$, etc. On the fifth unit the additional profit is zero. Therefore, four units should be produced and sold. Total profit is $\$12 + \$9 + \$6 + \$3 = \$30$.

Exercise 10.7.

(a) See figure below. The profit maximizing outcome is $Q = 24$ and $P = \$48$ – obtained from $MC = MR$.

(b) With perfect price discrimination the monopolist's revenue is the area under the demand curve. He should continue to produce and sell as long as the demand price greater than MC. Where the demand price equals MC profit is maximized. This occurs at $P = \$24$, $Q = 48$.

(c) Profit is $TR - TC$ at $Q = 24$. This is \$576. In (b) the profit is the area under the demand curve up to the output $Q = 48$ minus the area under the MC curve up to this same output. This is \$1152.



Exercise 10.8.

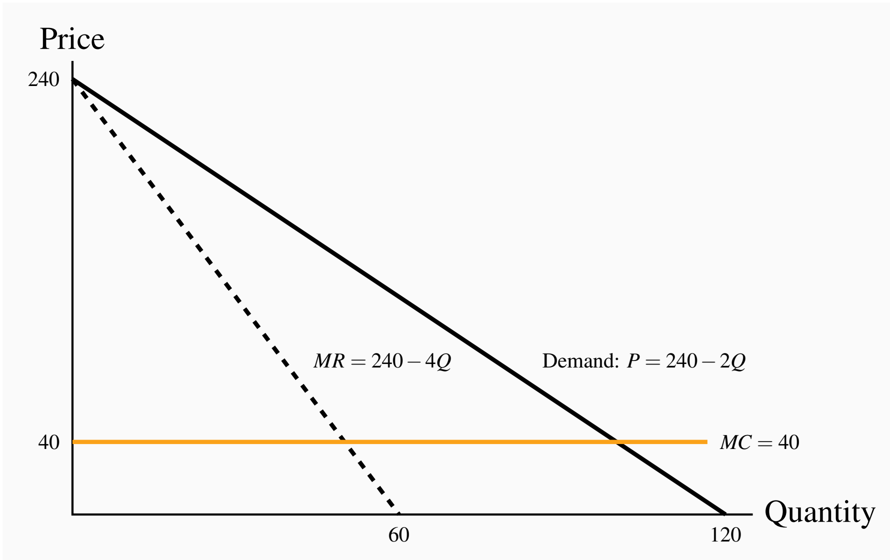
(a) Profit maximizing output is where $MC = MR$ in each market. The MRs are $MR_A = 20 - (1/2)Q_A$, $MR_B = 14 - (1/2)Q_B$. Equating each of these in turn to $MC = 4$ yields $Q_A = 32$ and $Q_B = 20$. These outputs can be sold at a price obtained from their demand curves: $P_A = \$12$ and $P_B = \$9$.

(b) Total profit is the sum of profit in each market: $(P_A \times Q_A - TC_A) + (P_B \times Q_B - TC_B) = \$256 + \$100 = \$356$.

Exercise 10.9.

(a) Profit maximizing output is where $MC = MR$: $Q = 50$. Therefore, from the demand curve, $P = \$140$. TR is thus \$7,000 and $TC = 500 + 50 \times 40 = \$2,500$. Profit is thus \$4,500.

(b) Here the profit maximizing outcome is obtained by setting the MR curve equal to the new MC curve: $240 - 4Q = 32$. This yields $Q = 52$, $P = \$136$. Profit is obtained as before – total revenue minus the sum of the variable cost plus (higher) fixed cost. Total revenue is $52 \times 136 = \$7,072$ and total cost is $750 + 52 \times 32 = \$2,414$. Profit is therefore \$4,658. Yes, she should outsource.



Exercise 10.10.

(a) Yes, this lobbying is a fixed cost and her profits are more than enough to cover it.

(b) The total of her profits – normal profits are included in the cost structure.

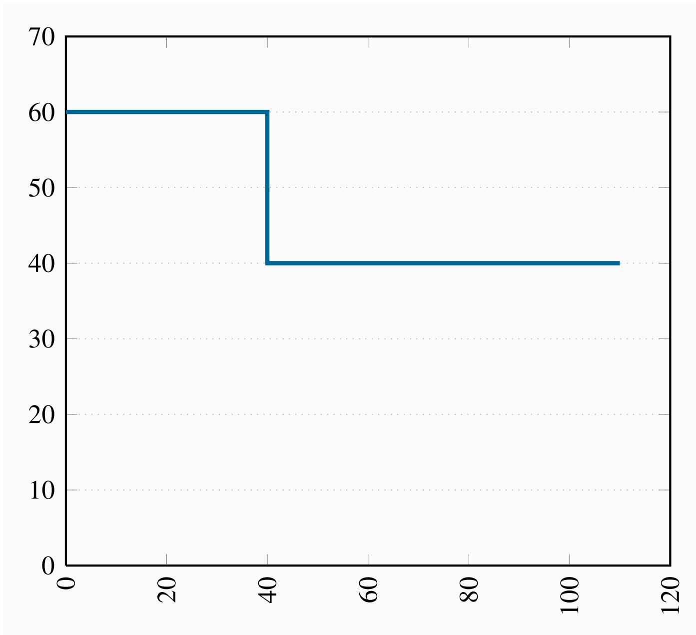
Exercise 10.11.

(a) The diagram here is equivalent to the one in Figure 10.10 in the text. The first segment, up to an output of 40 units, has a price of \$60; the second, from an output of 40 to 110, has a price of \$40.

(b) The MC curve runs along the horizontal axis – after the fixed cost is incurred, the MC is zero. The demand curve is the MR curve here, composed of the two horizontal segments.

(c) A price of \$60 can be charged to 40 buyers, and a price of \$40 charged to 70 buyers. Hence $TR = \$5,200$. Since $TC = \$3,500$, profit is \$1,700.

(d) Yes; 110 buyers at \$40 each yields a $TR = \$4,400$. Subtract the TC to yield a profit of \$900.


70
60
50
40
30
20
10
0
0
20
40
60
80
100
120

Solutions to exercises for Chapter 11

Exercise 11.1. The three-firm ratios are 0.14, 0.49, 0.80, 0.94. The four-firm ratios are 0.15, 0.54, 0.82, 0.95.

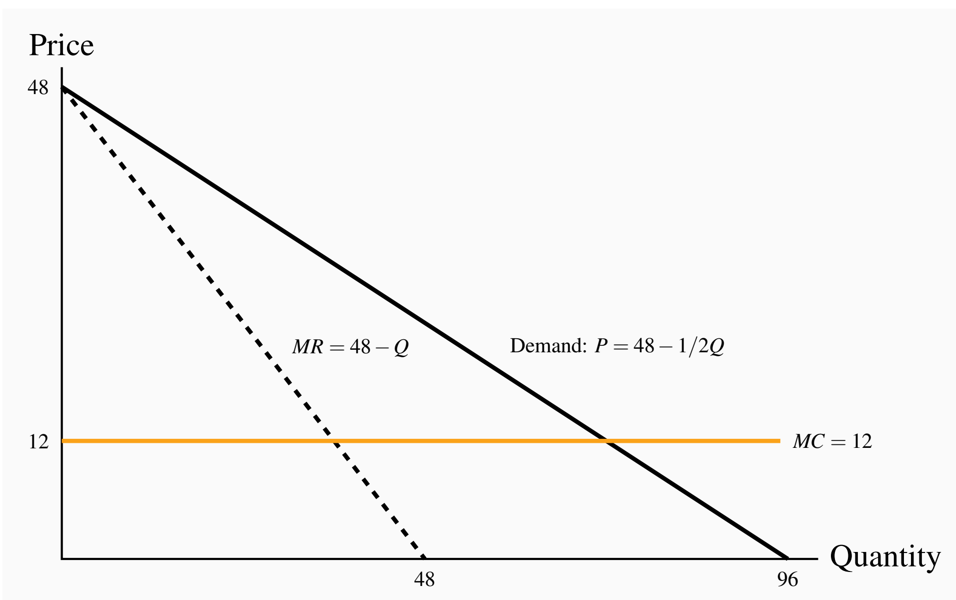
Exercise 11.2.

(a) See graph below.

(b) Equating MC to MR yields $Q = 36$ and therefore, from the demand curve, $P = \$30$ when $Q = 30$.

(c) TR is \$1,080, total cost is \$432 and therefore profit is \$648.

(d) Profits plus freedom of entry will see new firms take some of this firm's market share, and therefore reduce profit.



Exercise 11.3.

(a) The diagram here is similar to the one above.

(b) Acting as a monopolist they would set $MR = MC$, hence $Q = 90$, $P = \$70$.

(c) Combined profit is $\$90 \times (70 - 40) = \$2,700$. Individual profit is half of this amount.

Exercise 11.4.

(a) 55 units.

(b) If the cheater intends to sell 55 units then the total sold is 100 units. This necessitates a price of 66.67.

(c) One firm makes $\$(66.67-40)\times 45 = \$1,200$; the other makes $\$(66.67-40)\times 55 = \$1,467$.

(d) It must be less since the cartel profit maximizing output is globally profit maximizing.

(e) By increasing its output.

Exercise 11.5.

(a) Yes. If A confesses then B's best strategy is also to confess. If A denies, B's best strategy is also to confess. Hence, either way B's best choice is to confess – this is a dominant strategy. The same reasoning applies to A.

(b) The Nash Equilibrium is that they both confess.

(c) Yes.

(d) If the crooks could communicate with each other they could cooperate and agree to deny. This would be better for each.

Exercise 11.6.

(a) Each firm has a 'high output' dominant strategy, since their profit is greater here regardless of the output chosen by the other firm.

(b) From (a) it follows that high/high is the Nash Equilibrium.

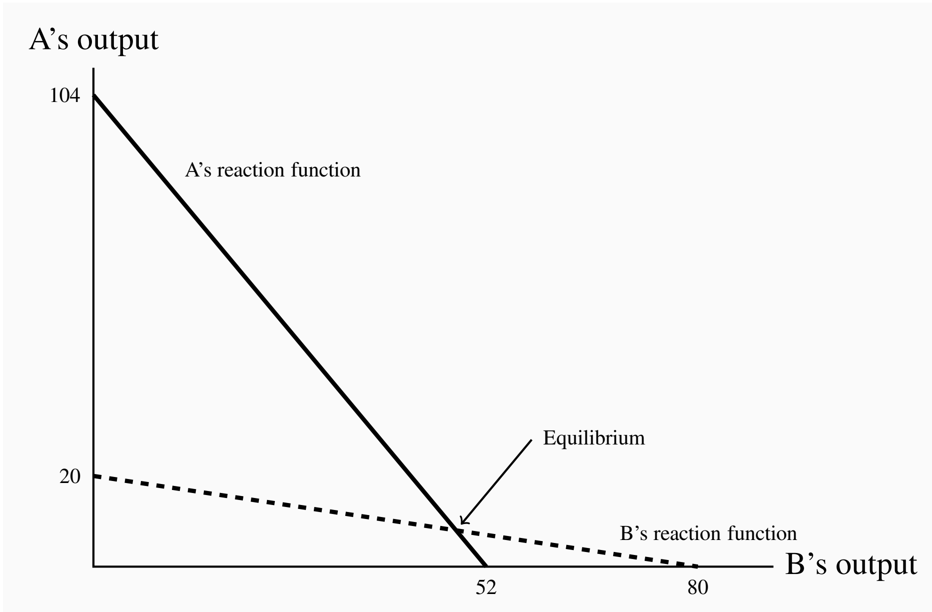
(c) Since low/low yields more profit for each firm, a cartel is an attractive possibility. But it may not be sustainable, given that each player has the incentive to renege on the cartel agreement.

Exercise 11.7.

(a) The reaction functions are of the standard type illustrated in the figure below.

(b) Solving the two functions yields $q_A = 8$ and $q_B = 48$.

(c) Since the reaction functions are not symmetric the cost structures are different if they face the same demand.



Exercise 11.8.

(a) The reaction functions are obtained in the normal manner – by equating MR to MC for each player, conditional upon some output being produced by the other player. Since demand is given by $P = 24 - Q$, this process yields $Q_A = 10 - 1/2Q_B$ as A's reaction function, and $Q_B = 8 - 1/2Q_A$ as B's reaction function. Solving yields $Q_A = 8$ and $Q_B = 4$.

(b) The combined output is as before: 12 units.

(c) The price in the market remains at $12, since the total output is still 12 units. Combined profit is $96.

(d) The producer with the lower production cost can now gain a larger market share.

Exercise 11.9.

(a) Equating price to MC yields $Q = 11,200$.

(b) Equating MR to MC yields $Q = 5,600$.

(c) Using the formula $Q = n/(n+1) \times$ (perfectly competitive output) yields market $Q = 2/3 \times 11,200 = 7,466.67$.

Exercise 11.10.

(a) Profit under perfect competition is zero (only normal profit). Under monopoly the price charged is \$1,800. Cost per unit is \$400, and quantity produced is 5,600. Hence profit $= 5,600 \times (1,800 - 400) =$ \$7.84m. Since the output in the duopoly market is 2/3 times the perfectly competitive output, then $Q = 7,466.67$. The price is thus $P = 3,200 - (1/4) \times 7,466.67 = \$1,333.33$. Profit per unit is thus \$933.33, and total profit is \$6.97m.

(b) Since the unit costs are constant we could have any number of firms producing in this market.

Exercise 11.11.

(a) While Ronnie can threaten to lower its price if Flash enters the market it would not be profitable for Ronnie to do that because a higher price, even with Flash in the market, yields a superior profit to Ronnie. Hence Flash should enter.

(b) The issue here is that the threat to lower price is not credible.

Exercise 11.12.

(a) Equating the slope of the demand curve to the slope of the ATC curve yields $Q = 2$.

(b) Clearly $P = 2.25$ from the demand curve.

(c) Equating $MC = MR$ again yields $Q = 2$, as illustrated in Figure 11.2.

(d) Equating MC to the ATC yields $Q = 4$.

Solutions to exercises for Chapter 12

Exercise 12.1. At $L = 4$ the VMP of labour is \$400, which is also the wage rate. Therefore this is the profit maximizing output level. The table below contains the calculations.

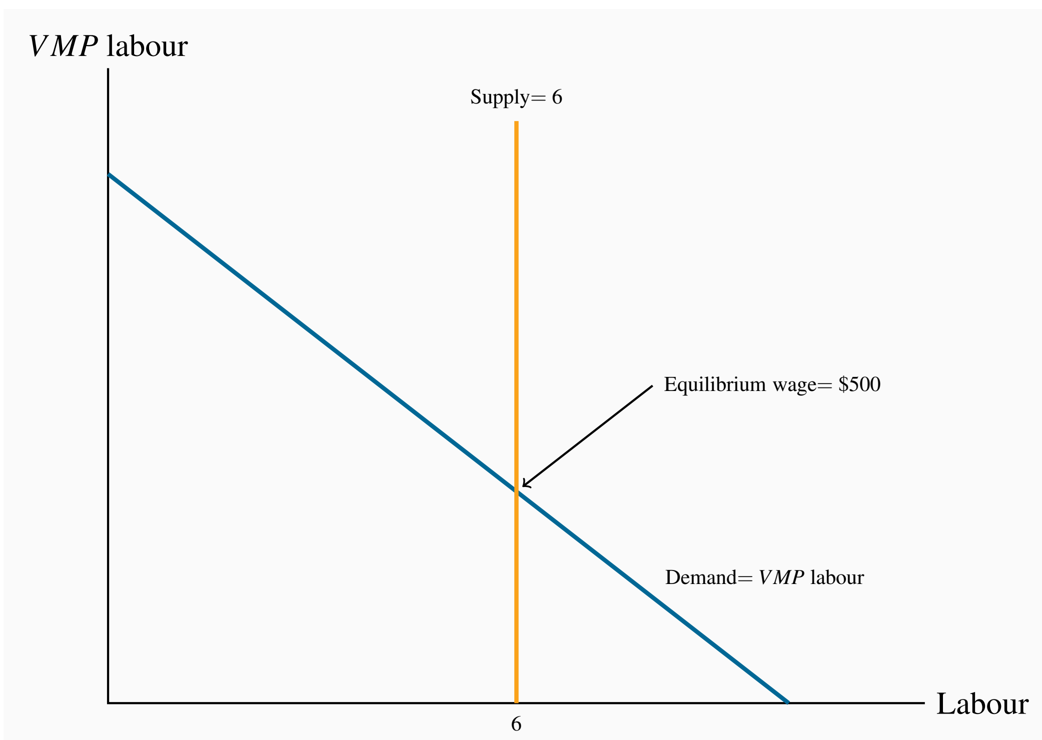
Labour	Output	MP Labour	VMP Labour	TR	TC	Profit
0	0					
1	20	20	400	400	400	0
2	50	30	600	1000	800	200
3	75	25	500	1500	1200	300
4	95	20	400	1900	1600	300
5	110	15	300	2200	2000	200
6	120	10	200	2400	2400	0

Exercise 12.2.

(a) $L = 8$. The value of the MP of labour equals the wage rate where 8 units are employed.

(b) Having computed the VMP of labour you will see that the VMP of the sixth employee is \$500. Hence if the supply curve is vertical at $L = 6$ and the demand curve is the VMP of labour it follows that the equilibrium wage is \$500.

Labour	Output	MP Labour	VMP Labour
0	0		
1	100	100	1000
2	190	90	900
3	270	80	800
4	340	70	700
5	400	60	600
6	450	50	500
7	490	40	400
8	520	30	300
9	540	20	200
10	550	10	100



Exercise 12.3. Here you must calculate the additional cost of each employee. The first costs $250; the second $350 ($300 plus an additional $50 to the first employee); the third $450; the fourth

\$550, etc. The additional revenue from each employee is the VMP of labour. As long as this exceeds the MC of hiring another employee then that employee should be hired. The answer is thus $L = 3$.

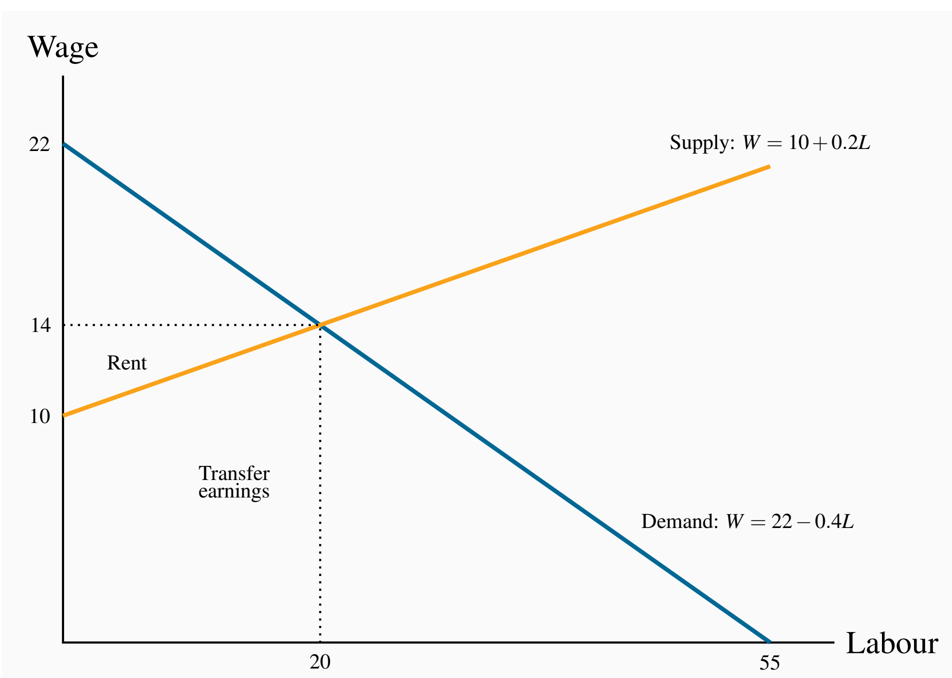
Labour	Output	MP Labour	VMP Labour	Marginal Wage	MC Labour
0	0				
1	20	20	400	250	250
2	50	30	600	300	350
3	75	25	500	350	450
4	95	20	400	400	550
5	110	15	300	450	650

Exercise 12.4.

(a) The equilibrium is $L = 20$, $W = \$14$. See figure below.

(b) Transfer earnings are the area under the supply curve up to $L = 20$; rent is the triangle above the supply curve and below the wage line $W = \$14$.

(c) Total wage bill is \$280, of which transfer earnings account for \$240 and rent \$40.

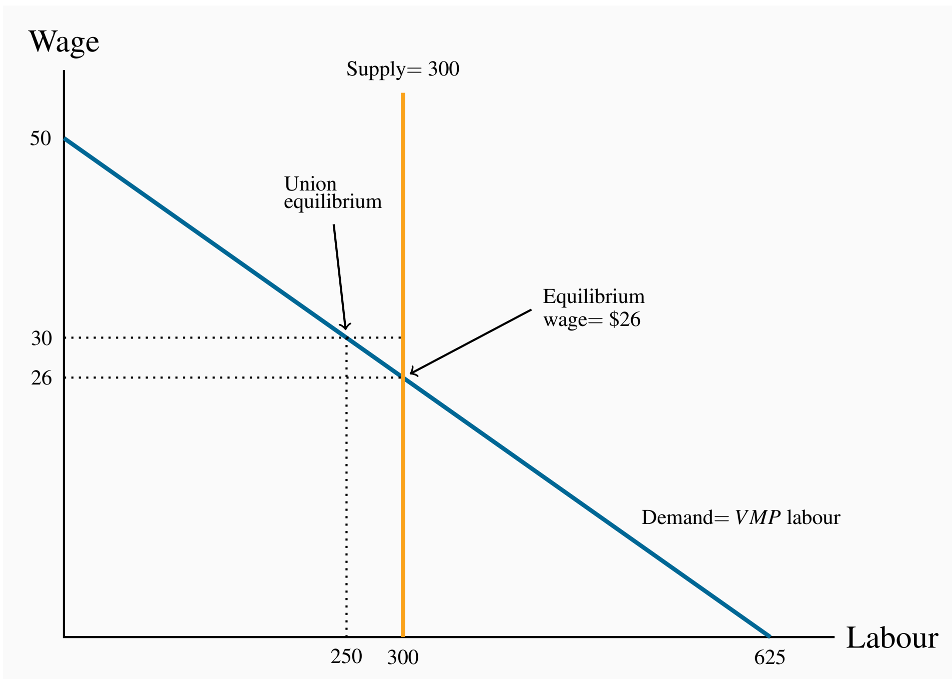


Exercise 12.5.

(a) The demand curve has a regular downward-sloping form, while the supply curve is vertical at $L = 300$. See figure below.

(b) At $L = 300$ the demand curve indicates that the wage is \$26.

(c) At $W = \$30$, the corresponding demand is $L = 250$.



Exercise 12.6. The present values of the three streams are: \$33,470; \$2,522; \$12,277. Therefore only the third project should be adopted because it alone generates revenue in excess of costs.

Exercise 12.7. Only the first plot generates sufficient revenue to yield a profit.

Exercise 12.8.

(a) You would hold it for 5 years because the wine is appreciating by more than the cost of borrowing for each of the first five years. The sixth year the wine grows in value by the same as the borrowing cost.

(b) In this case the carrying has increased to 7% per year. So it would be profitable to hold the wine for three years – until the growth in the value of the wine equals the carrying cost.

Exercise 12.9.

(a) The marginal cost of each unit of output will be \$4 – each worker costs \$8 but produces two units of output.

(b) Equate the MC to the MR and the answer is: $4 = 100 - 4Q$, implying $Q = 24$.

(c) At this output the demand curve indicates that the price will be \$52.

(d) 24 units of output will require 12 units of labour.

Exercise 12.10.

(a) Equating the price to MC yields $4 = 100 - 2Q$, implying $Q = 48$.

(b) $L = 24$.

Solutions to exercises for Chapter 13

Exercise 13.1.

(a) Solving the demand and supply involves equating $Q = 40 - 40f$ to $f = 0.5$. Thus the equilibrium premium is 20, which is interpreted in percentage terms. See figure below.

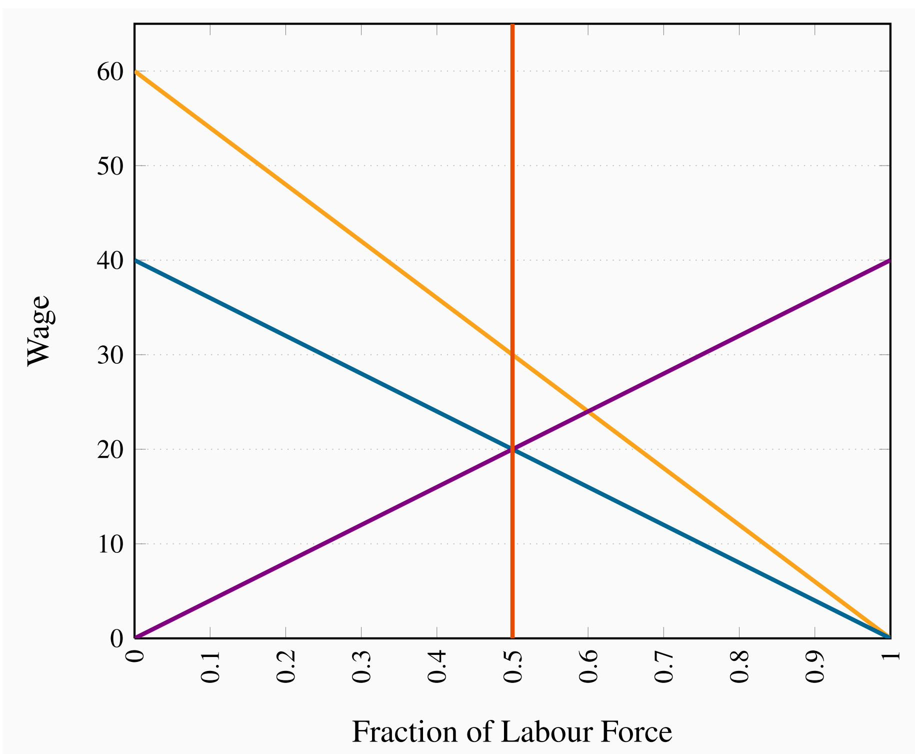
(b) If demand shifts upwards to $W = 60 - 60f$, the new equilibrium is 30 percent, as illustrated in the figure below again.

Exercise 13.2.

(a) See diagram below.

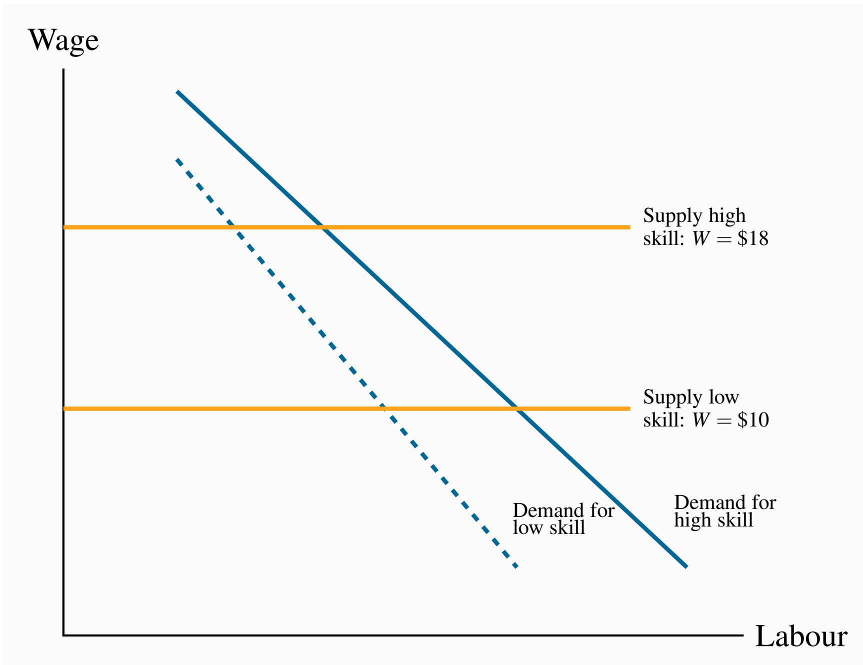
(b) See diagram below.

(c) In the long run the relative supply is $W = 40f$, and equating this with demand yields a 24 percent premium rather than a 30 percent premium and $f = 0.6$.



Exercise 13.3. Here the supply curves are horizontal at wage of \$10 for low skill workers and wage of \$18 for high skill workers. The two demands are such that the demand for the high skill worker

is above the demand for the low skill workers. The equilibrium for the high skill type is where the demand and supply for high skill workers intersect; likewise for the low skill equilibrium.



Exercise 13.4.

(a) The present value of going to university is higher at an interest rate of 10%. If you discount the first stream of values you will obtain $-20,000$, 36,360 and 41,320 yielding a net present value of 57,680. With 20,000 dollars each period in contrast, the net present value is 54,710 dollars.

(b) By performing the same set of calculations using the 2% discount rate, you will find that university is still preferred.

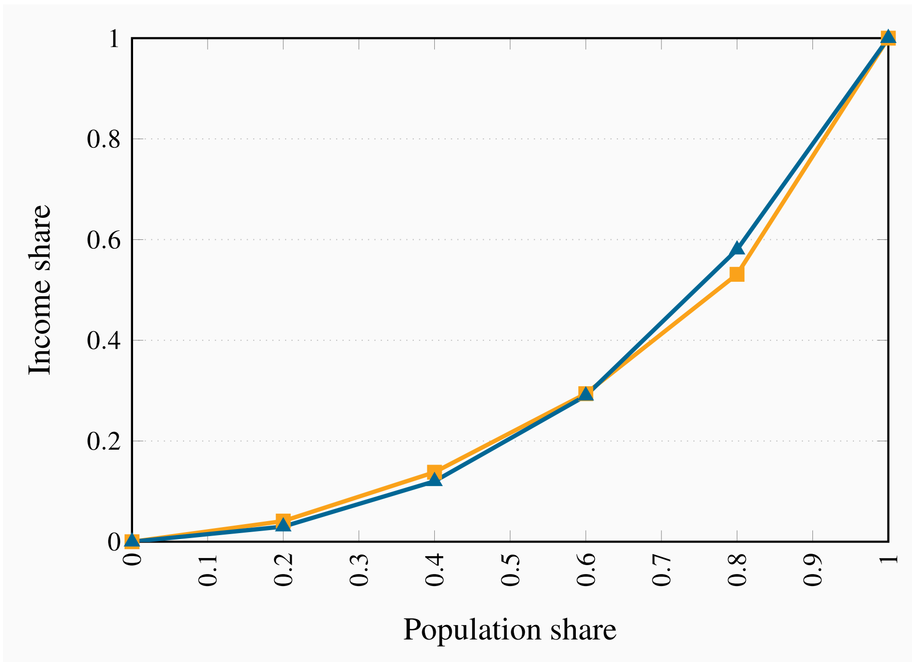
(c) At an interest rate above 15% the 'no university' option will yield a higher net present value. Try discounting the two income streams using a rate of 16% and you will see.

Exercise 13.5.

(a) Using the same discounting techniques as in the previous question you will see that the present value of the income from law exceeds that from economics when the interest rate is 2%: 100,721 for law and 91,690 for economics.

(b) Law should still be chosen at a rate of 30%, but only just.

Exercise 13.6. These two distributions have intersecting Lorenz curves, so it is difficult to say which is more unequal without further analysis.

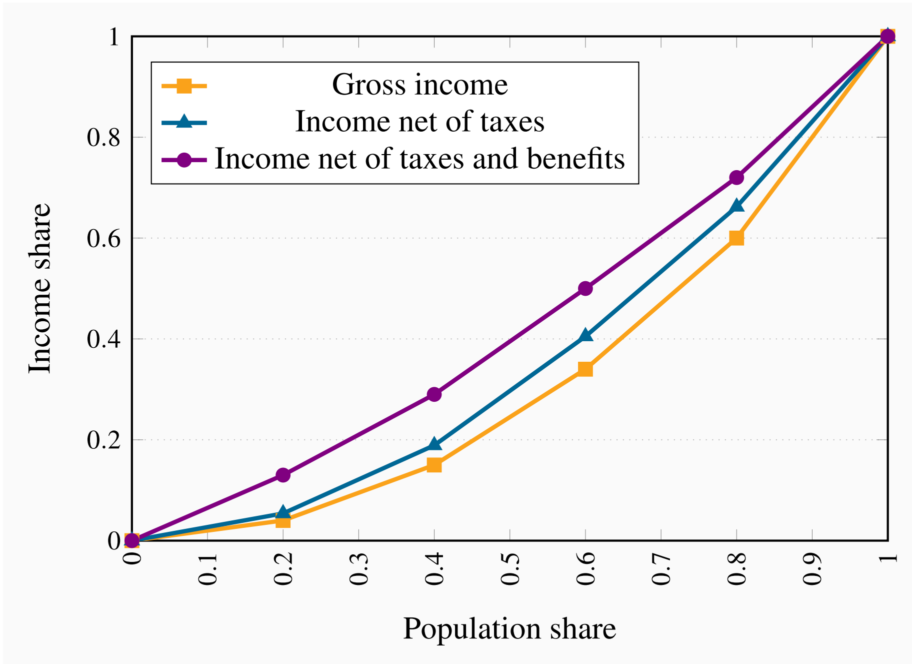


Exercise 13.7.

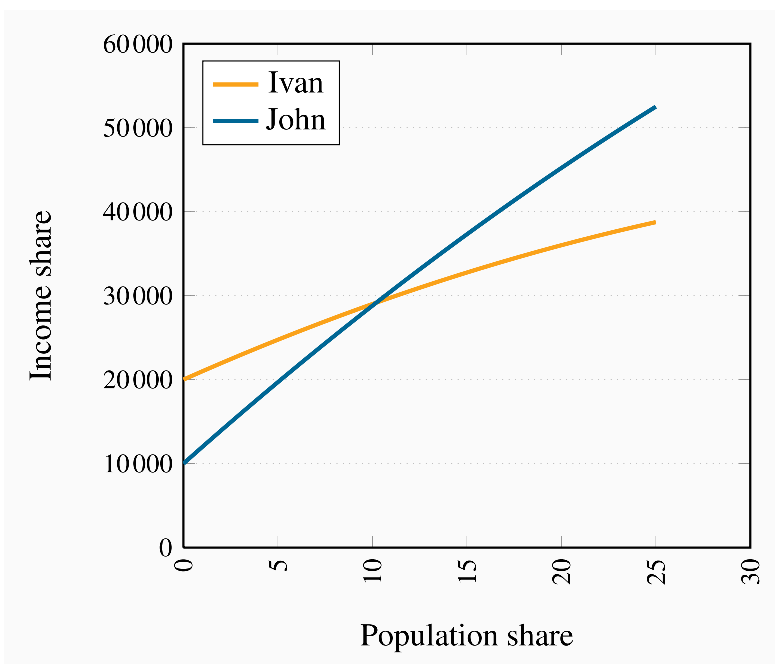
(a) The coordinates on the vertical axis measured in percentages are: 4, 15, 34, 60, 100. See the figure below for the graphic.

(b) The new coordinates are: 5.4, 18.9, 40.5, 66.2, 100.

(c) The coordinates for post government income are: 13, 29, 50, 72, 100. The three Lorenz curves are plotted below.



Exercise 13.8. The profiles are shown in the figure below. John passes Ivan about year ten.



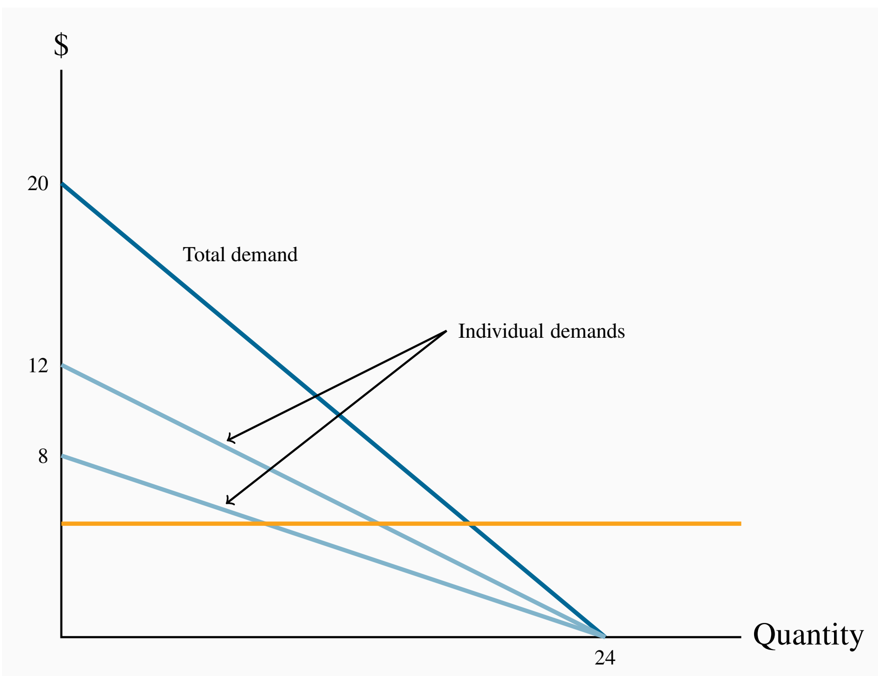
Solutions to exercises for Chapter 14

Exercise 14.1.

(a) See figure below.

(b) The total demand for the public good has a vertical intercept of 20 and a horizontal intercept of 24. The form of the equation is therefore $P = 20 - (5/6)Q$.

(c) Equate the MC of \$5 to the total demand curve to obtain $Q = 18$. This is the 'optimal' output – where the cost of the last unit produced equals the value placed on it by both individuals. At this quantity the individual valuations (the price that each is willing to pay) are obtained from the individual demand curves. Substituting $Q = 18$ into each yields \$3 and \$2.



Exercise 14.2.

(a) The demand curve in the economy becomes $P = 30 - (5/4)Q$. Equating this to the $MC = 5$ yields $Q = 20$.

(b) The answer here is the area under the demand curve up to an output of 20 units, which equals \$350.

(c) The net value to society is \$350 minus the supply cost of \$100=\$250.

Exercise 14.3.

(a) The demand, MR, and MC all have straightforward shapes. The ATC curve falls from a value of 192 where $Q = 1$, to a value of \$4 when Q becomes very large. For example when $Q = 4$, $ATC = \$51$; when $Q = 94$, $ATC = \$6$; etc. This function curves downwards and approaches a value of \$4 asymptotically.

(b) The efficient output is where the $MC = P$, as given by the demand curve. Hence equating demand to MC yields $Q = 96$. He would maximize profit by producing where $MC = MR$, which occurs at $Q = 48$.

(c) He would choose a price of \$52 from the demand equation at an output of 48 units. At this output the ATC is $(4 + 188/48)$. Hence profit is $\$(52 - (4 + 188/48)) \times 48 = \$2,116$.

Exercise 14.4.

(a) Equating the ATC to the demand curve yields $100 - Q = 4 + 188/Q$. The solution is $Q = 94$.

(b) The deadweight loss when acting as a monopoly is $0.5 \times 48 \times 48 = \$1,152$. When regulated, the DWL is $0.5 \times 2 \times 2 = \$2$.

Exercise 14.5. An efficient output is where $P = MC$, that is $Q = 96$. At this output he charges a price of \$4. Hence his loss per unit is the difference between price and ATC which is 188/96. Since he produces 96 units, then charging a price of just \$4 leads to a revenue shortfall of $96 \times (188/96) =$ \$188. This amount would have to be spread as a charge over the number of buyers in the market as a fixed cost associated with purchasing. In essence each buyer would have to pay a certain entry fee just to purchase the good.

Solutions to exercises for Chapter 15

Exercise 15.1.

(a) Northland has an absolute advantage in the production of both goods, as it has lower labour requirements for each.

(b) The opportunity cost of 1 bushel of wheat is 1/2 litre of wine in Northland and 3/4 litre of wine in Southland.

(c) Northland has a comparative advantage in wheat while Southland does in wine.

(d) By reducing wheat production by 1 bushel, Southland can produce an additional 3/4 litre of wine.

(e) Both countries can gain if Northland shifts production from wine to wheat and the countries trade wine for wheat at a rate between 1/2 litre of wine for 1 bushel of wheat and 3/4 litre of wine for one bushel of wheat.

(f) By reducing wine production by 1/2 litre, Northland can increase wheat production by 1 bushel, which, at Southland's opportunity cost, exchanges for 3/4 litre of wine, giving Northland a gain of 1/4 litre of wine.

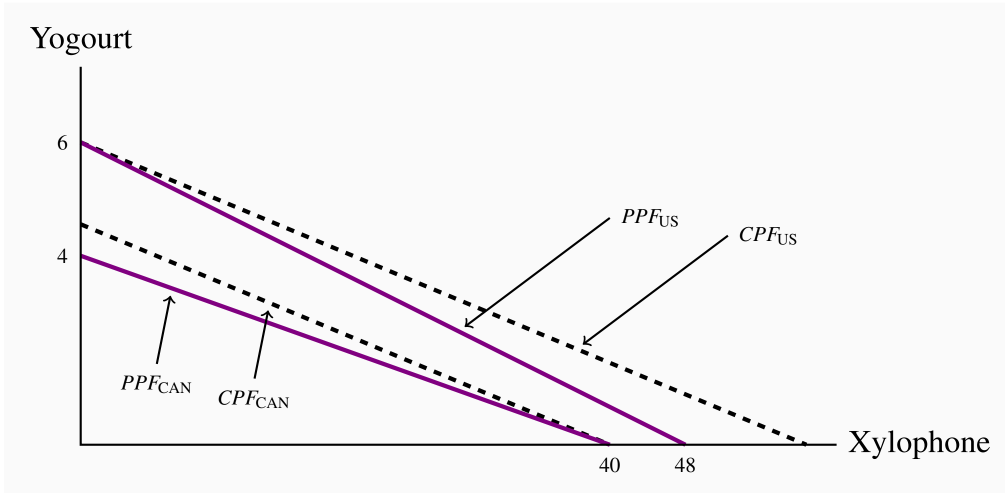
Exercise 15.2.

(a) The US has an absolute advantage in both goods.

(b) Canada has a comparative advantage in xylophones. The US has a comparative advantage in yogourt.

(c) See diagram below.

(d) See diagram below.

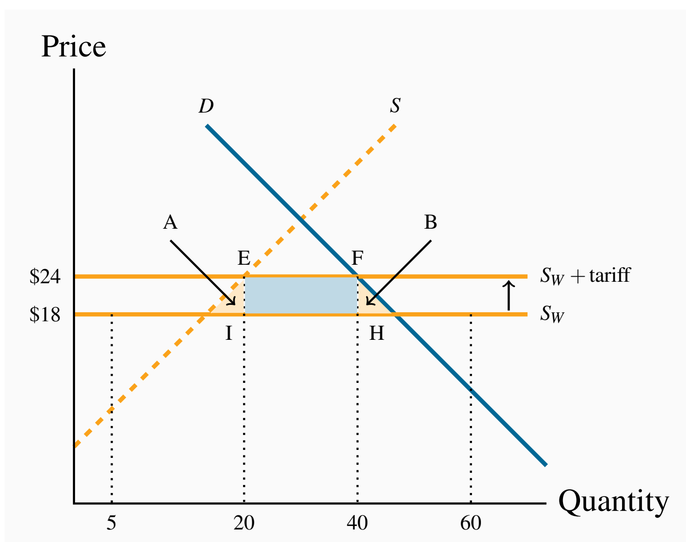


Exercise 15.3.

(a) The diagram shows that the amount traded is 60 units; of which domestic producers supply 5 and 55 are imported.

(b) In this case, the foreign supply curve SW shifts up from a price of \$18 to \$24. The amount traded is now 40 units, 20 of which are supplied domestically.

(c) Tariff revenue is EFHI= \$120.



Exercise 15.4.

(a) The deadweight losses correspond to the two triangles, A and B, in the diagram, and amount to \$105.

(b) The amount of additional profit for domestic producers is $75.

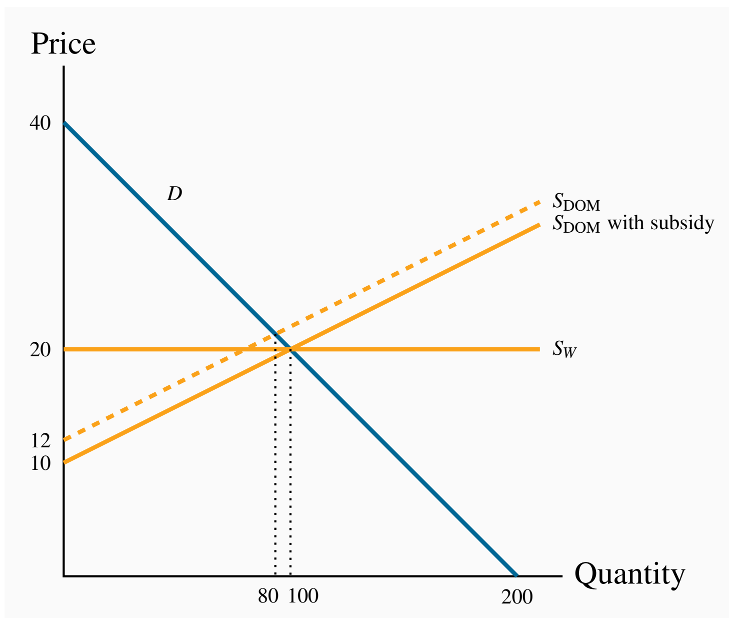
Exercise 15.5.

(a) See figure below.

(b) The total quantity of trade is 100 units, of which 80 are supplied domestically.

(c) The subsidy shifts the domestic supply curve down by $2 at each quantity. This supply intersects the demand curve at $Q = 100$. Foreign producers are squeezed out of the market completely.

(d) Cost to the government is $200.



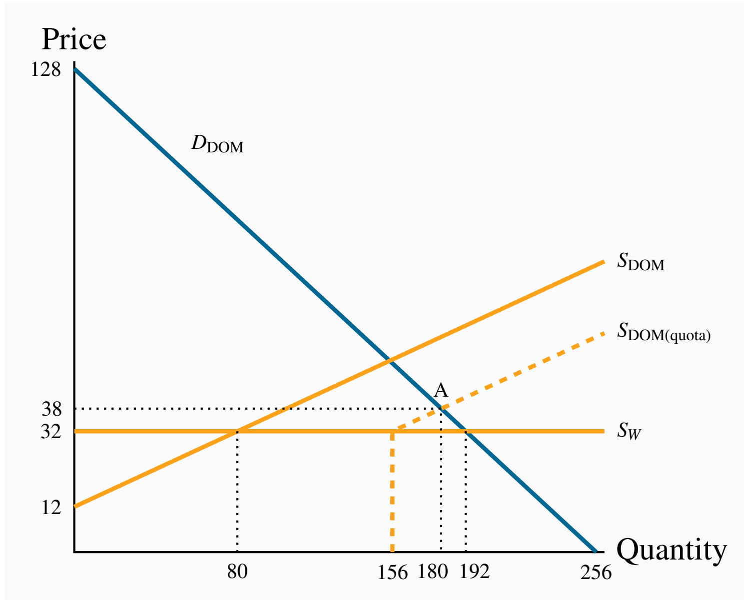
Exercise 15.6.

(a) See diagram below.

(b) Domestic producers will supply 80 and imports will be 112.

(c) The equilibrium with the quota is point A in the diagram with imports equal to the quota of 76.

(d) The equilibrium quantity with the quota is 180, with 76 imported and 104 supplied by domestic producers. The equilibrium market price is $38.

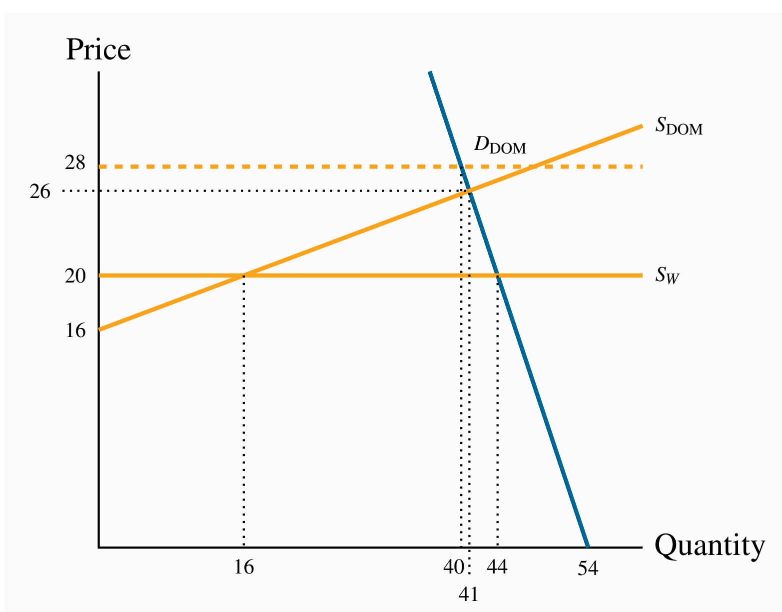


Exercise 15.7.

(a) See diagram below.

(b) See diagram below.

(c) The quantity permitted to be brought to market would be 40 units, even though the supply side would be willing to supply more at this price, buyers will demand just 40 at a price of \$28.



Exercise 15.8. The figure below illustrates parts (a) through (f). Since the total production before trade was 20 of each, and after specialization it is 30 of each, the gain is 10 of each good.