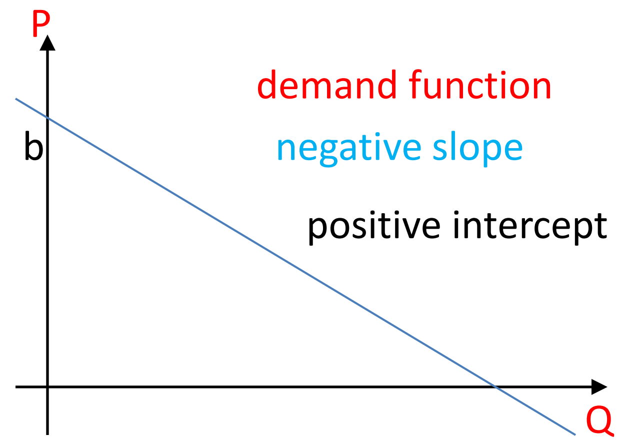
Supply and Demand analysis

- Microeconomics is concerned with analysis of economic theory and policy of individual firms and markets. There is one particular aspect known as **market equilibrium**, in which the supply and demand are balanced (are equal). Mathematic can be used to calculate this equilibrium price as an intersection point of the two graphs (two functions).
- In economics we use functions like $Q = f(P)$ in mathematics $y = f(x)$
- In economics P is incoming variable, in mathematics x is independent variable
- In economics Q is outgoing variable, in mathematics y is dependent variable
- In economics $Q = f(P)$ is demand function, **quantity depends on the market price** and the function $P = g(Q)$ is supply function where quantity is independent variable.
- (in mathematics $x = g(y)$ is inverse function of $y = f(x)$. We note $g = f^{-1}(x)$ the inverse function of the $y = f(x)$
- For these two functions economics consider the x axis as Q axis and y axis as P axis
- The general form of economic functions like $P = g(Q)$, or $Q = f(P)$ give us no information about the precise relationship between these two variables. For the moment we suppose that this relationship is a linear function like $P = aQ + b$ where the constants are called parameters a, b. In reality, the relationship price-quantity is likely to be much more complicated than this, but the result of any analysis at least provides a first approximation to the truth.
- Economics consider always the first quadrant to sketch their graphs. The quantity is the independent variable (Q axis is as x axis) .

Supply and Demand analysis

- So, we have the demand function (a linear function) represented by the formula P = aQ + b.
- The reality shows that demand **usually falls as a price of a good rises** and so the slope of the line is negative. This function has **negative slope**
- To sketch the graph of demand function are necessary
- two points intercept b and intersection with Q axis
- Q = $-\frac{b}{a}$ (intersections with axes)
- Let's be P = – 3Q + 60 a demand function
- Sketch the graph of the demand function and determine
- the value of a) P when Q = 12

  b) Q when P = 18



In this problem we know the value of the parameters a and b. In the reality we observe values of Q and P. Example. A potter makes and sells bowls. He has observed that when the price is \$32, only 9 bowls are sold in a week, but when the price decreases to \$10 , weekly sales rise to 20. Assuming that demand can be modelled by a linear function, find the formula for P in terms of Q, sketch the graph of P against Q and comment the model.

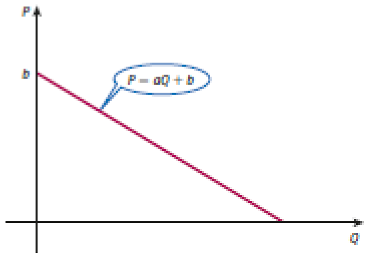
To find the formula we can use two ways.

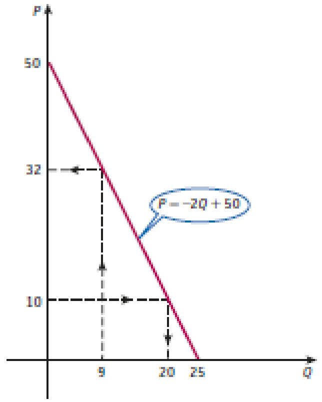
The first method: find the slope of the line

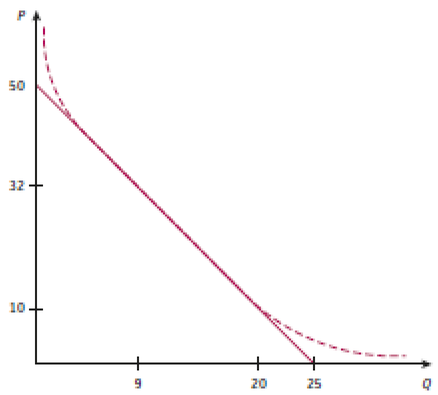
Second method: solve simultaneous equations

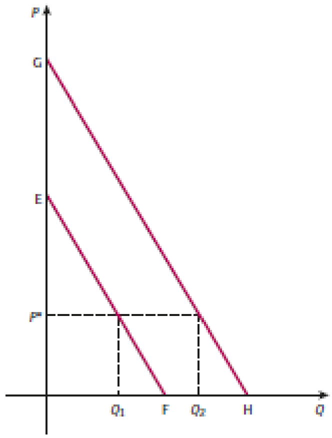
Supply and Demand analysis

- Demand function









Supply and Demand analysis

- The first method
- The general formula for a linear demand function is P = aQ + b. To find the formula means to know the values of the parameters "a" and "b".
- Let's find from the data (information) the slope "a".

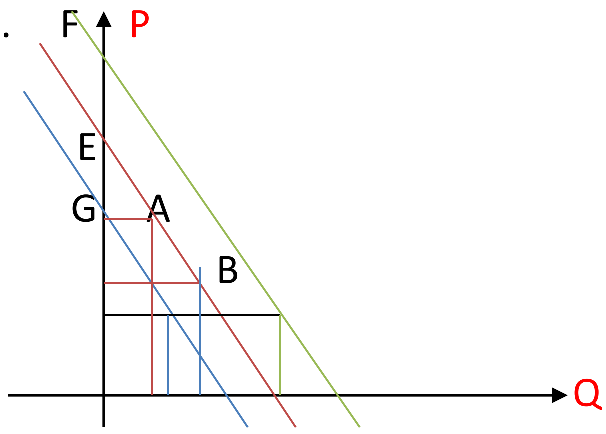
  We know the property of the slope.

Changes for one unit of "x" corresponds "a" units of "y"

- The price decreased from \$32 to \$10 (y_2 - y_1 = 10 – 32 = – 22)
- decreased 22units. The sales increased 11 (x_2 - x_1 = 20 – 9 = 11) units which corresponds to the price 22 units.
- Then the slope is 22÷11 = 2 units decrease, so the slope is" – 2" then P = - 2Q + b.
- To find "b" we can use the fact that when Q = 9, P = 32, so 32 = - 2·9 + b, giving b = 50.
- The demand function is P = - 2Q + 50.
- The second method
- When Q = 9 P = 32 and when Q = 20 P = 10
- 32 = 9a + b and 10 = 20a + b subtracting the second from the first gives
- \- 11a = 22 so a = - 2 substituting obtain 10 = 20·(- 2) + b or b = 50
- The demand function is P = – 2Q + 50.

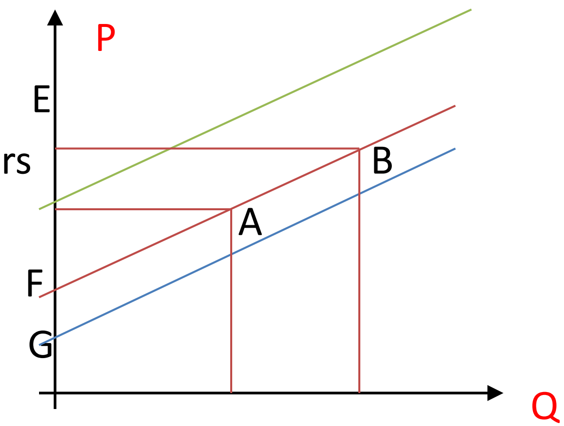
Supply and Demand analysis

- For different values of parameter b we have different parallel lines.
- On this way we explain the influence of other factors on **behavior** of the demand function.
- For example, increases on income Y the consumers can buy a larger number of goods
- In this case we have the same price, but greater demand.
- Increased the intercept b. Demand curve moves
- on the right. The income Y is a variable out of the
- model
- If increases the demand the company sells cheaper
- that means, decreases the prices.
- In this case we just move along the fixed curve.
- If the company increases the prices, it sells less, that means a smaller
- quantity, decreases the demand. Also, in this case we just move along the fixed
- demand curve (line)
- The price and the demand are variables inside the model.



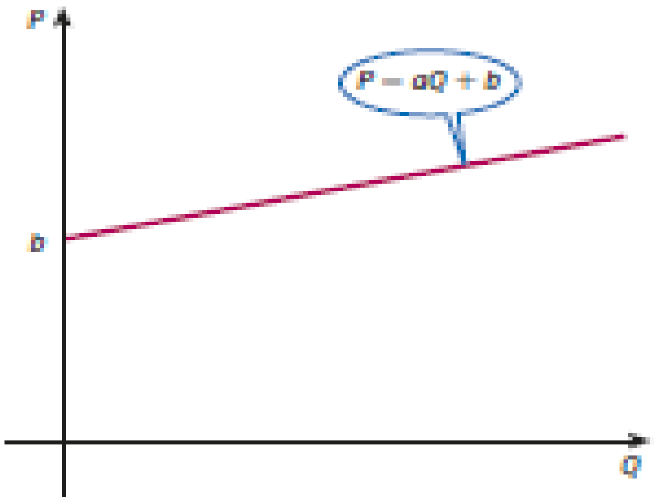
Supply and Demand analysis

- The supply function is the relation between the quantity Q, of a good (product) that producers plans to bring to the market and the price, P, of the good.
- Economic theory indicates that, as the prices rises, so does the supply. **Increasing on the prices corresponds increases on supply**. The function P is increasing function. A price increase encourages existing producers to raise output and entices new firms to enter the market. In general, this dependency is linear function and has the formula $P = aQ + b$.
- It has **positive slope and positive intercept**
- $a > 0 \quad b > 0$.
- The supply function can be influenced by other factors
- as land, capital, labour, taxes etc.
- The influence of these factors gives us parallel lines.
- These factors are out of the model.
- When the prices increased is good to have a better
- supply. In this case just move along the line. The factor is inside of the system
-



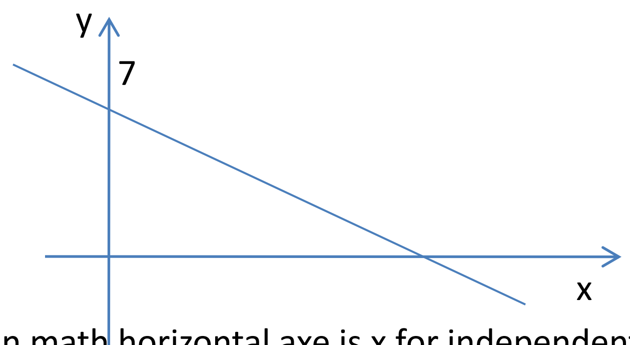
Supply and Demand analysis

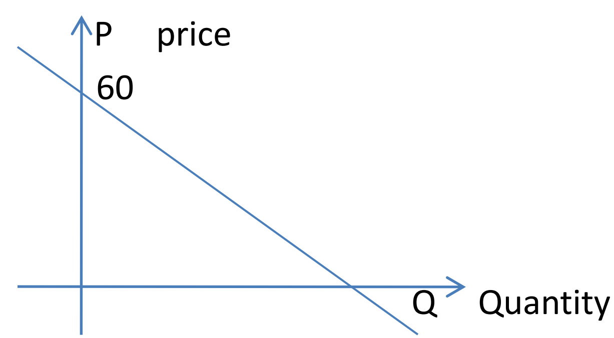
- Supply function



Supply and Demand analysis

- Mathematic is the basic science especially for the science of economy. The simpler applications of the mathematics are in microeconomics. It helps the economists to get the right answer for the problems like equilibrium, supply and demand balance, price and revenue, price and quantity etc. To solve their problems economists must transform (adjust) the real problem in a math problem identifying the key features, variables, interacting factors, etc. Also, they must make simplifications, assumptions, consider or ignore some features, evaluate factors using parameters, etc.
- The process of identifying the key features of the real world and making appropriate simplifications and assumptions is known as **MODELING.**
- The modeling is an approach of a real economic problem with mathematical problem using variables and functions.
- In math variable → x function → y = f(x) value of the function
- In economy income → x model → y value of outcome
- Independent variable x income in economy $y = -5x + 7$ (math linear function)
- Depended variable y outcome in economy $P = -2Q + 60$ (economic demand function)





- In math horizontal axe is x for independent variable. In economy in horizontal axe must be the feature (object) consider as independent. May be price, revenue, supply etc. In our example $Q = 30 - P/2$ (inverse function) price is independent variable

Supply and Demand analysis

- The real problems are more complicated, and the model must be as a function with many variables. Here we must apply simplifications, for example ignoring any variable which has minimum weight or are constant (unchangeable) in all problem. Surely, we study an approximation of the real problem.

- P
- income
- T
- Y

A

Function

outcome Q

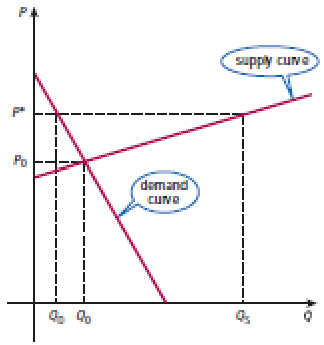
- black box

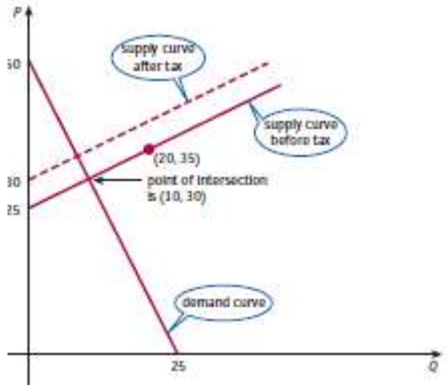
P price; T transport; Y consumers income; A advertising expenditure Considering T; Y; A; as constant (not influence in outcome by change of P. Now problem is transformed in a linear function and we study the approximation of the real problem.

- Q, P, are called **endogenous variables** determined within the model (have direct dependency) (born inside)
- T, Y, A, are called **exogenous variables** determined outside the model (have not direct dependency) (born outside)
- Here are two examples of these functions which we know **Demand** function and **Supply** function.
- Demand function is dependency between the price and the quantity for sell (for share).
- Supply function is dependency between the price and the quantity of a product planed, to bring to the market.
- To study interaction between the demand and supply functions we sketch them on the same diagram. Of
- particular significance is the point of intersection. At this point the market is in **equilibrium**

Supply and Demand analysis

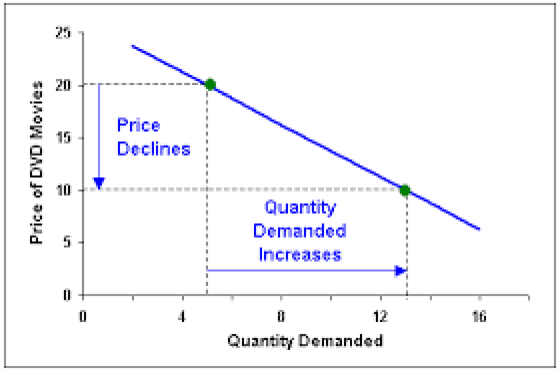
- In practice it is often the deviation of the market price away from equilibrium price. Suppose that the market price is increased, so do and supply. There are stocks of unsold goods which tends to depress the prices and causes firms to cut back production. This effect is for ’market forces’ to shift the market down towards the equilibrium.



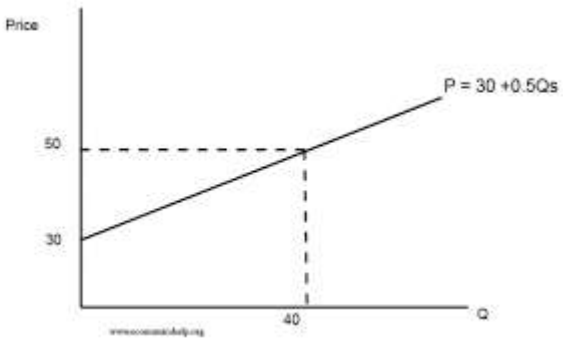


Supply and Demand analysis

- Demand function negative slope



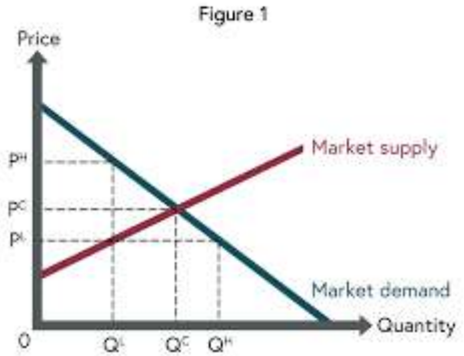
Supply function positive slope

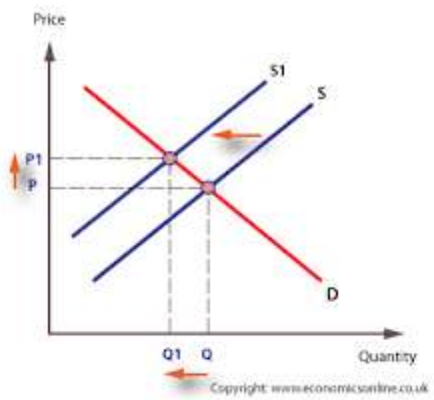


- Supply and Demand functions

Changes in supply equal slopes

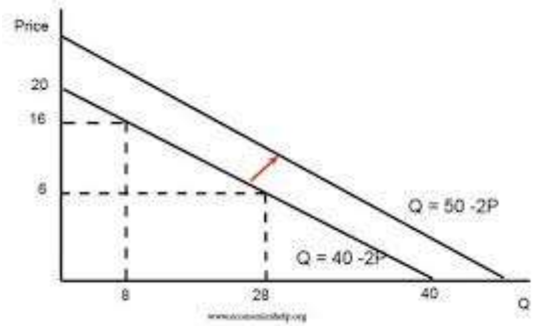
- The slope "a" is negative for the demand function and positive for supply function.





Supply and Demand analysis

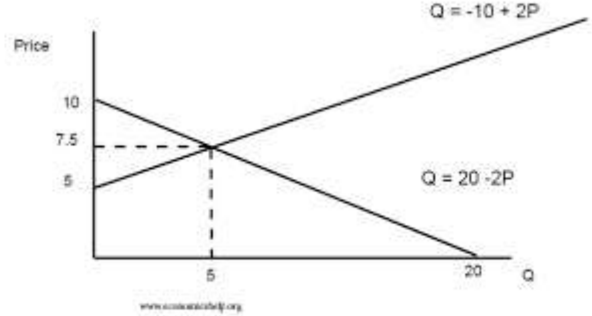
- Change demand equal slopes
- Change of "b"



Demand change equal slopes
price)

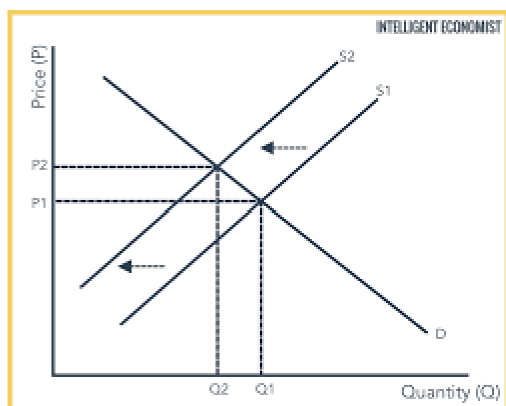
Change of "b"

Inverse demand



Supply change equal slopes

Change of "b"



The general formula for a linear demand and supply function is

P = aQ + b

a; b; are parameters

"a" is the slope. In general it is **negative** for the demand line and it is **positive** for the supply line. One unit change demand (decrease quantity) two units change (increase

$\tan \alpha = -1/2$ **rate of change**

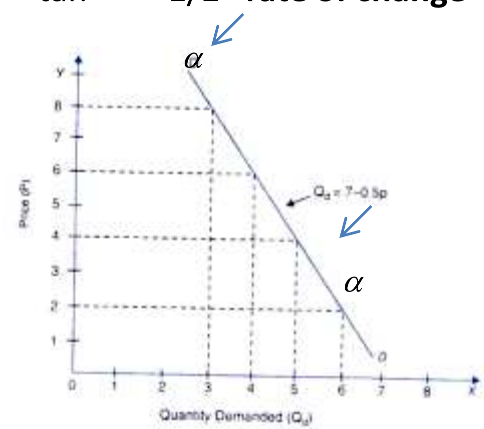


Fig. 5.1. Graph of a Linear Demand Function ($Q_d = 7 - 0.5P$)

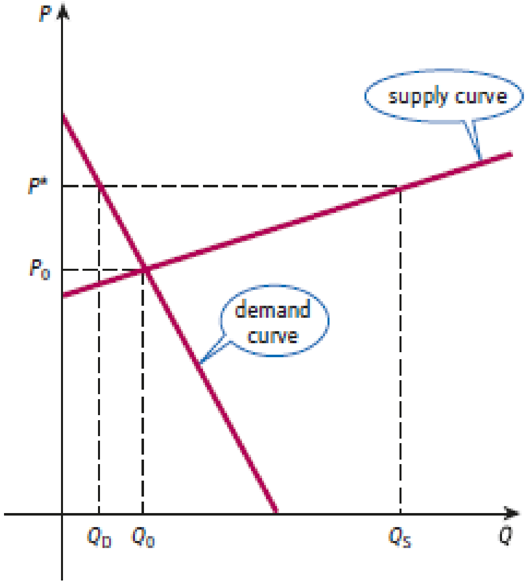
Supply and Demand analysis

- We have demand function P = f(Q) independent variable is quantity. In reality independent variable may be the price. So. demand function is Q = f(P). They are inverse functions. Change the price to sell more or change the demand for the higher price. Price and quantity changes in opposite directions. Increasing of the price corresponds to the decreasing of quantity and vise-versa decreasing of the price corresponds to the increasing the quantity. The demand function is about the quantity we sell, we share. Demand function is **decreasing function**

  In demand function in the form **P = aQ + b** must find "a" and "b".
- First method: From data we calculate the **rate of change** "a" (slope) and later the coefficient "b"
- Second method : From data we apply the formula substituting two real values of "P" and "Q" getting a system two equations and two unknown(variables) or simultaneous equations. Solving the system, we determine the values of "a" and "b".
- Having the values for "a" and "b" we can sketch the graph (curve; the line) of this function**, demand curve.** If one of **exogenous** variables changes, then the whole **demand curve moves** (change parameter b) If one of the **endogenous** variable's changes, we simply **move along the fixed curve** (don't change the parameter "a" ,the slope).
- The **supply function** is the relation between the quantity, Q, of a good that producers plan to bring to the market and the price, P, of the good. As the price rises, so does the supply. We can say that P is an **increasing function** of Q. After simplifications, the supply function has the form **P = aQ + b**. Knowing the values of "a" and "b" we can sketch the graph (curve; line). Also, we have here exogenous variables which are related with production.
- Sketching these lines at the same plane we can find the intersection point which is called equilibrium point. The values P, Q, of this point we can find solving the system of two equations.

Supply and Demand analysis

- In microeconomics we are concerned with interaction of supply and demand function, so we sketch their graphs on the same diagram.
- Intersection point has values Q_0 and P_0 which are equilibrium quantity and price.
- Q_S (quantity supply) Q_D (quantity demand)
- In practice the price may be greater than P_0.
- Q_D is smaller than Q_S so there is excess supply
- or stock of unsold goods. These stocks depress the
- prices to come down (decrease the prices) and
- and the firms to cut production.
- If the price is smaller than P_0 then the demand exceeds
- supply. This shortage pushes prices up and encourages
- firms to produce more goods, so the market drifts back
- up towards equilibrium.



Supply and Demand analysis

- Different of $Q_S Q_D$ according the changes of equilibrium price.

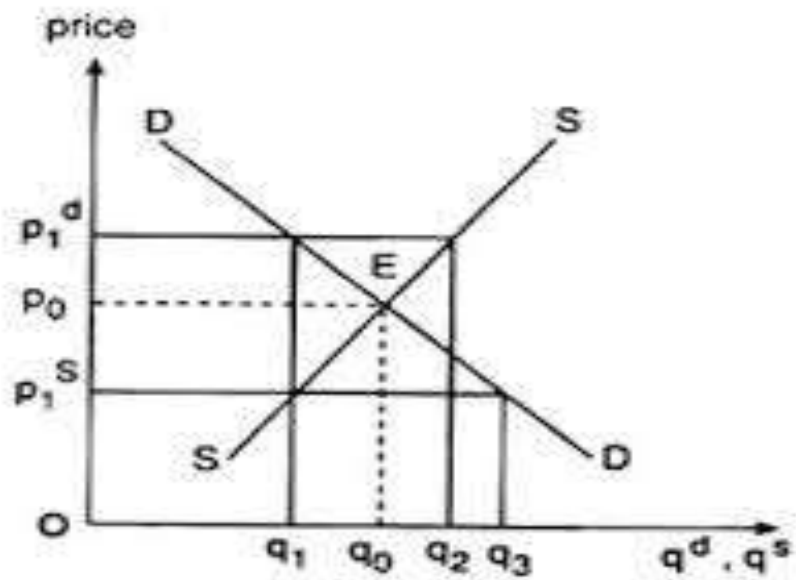
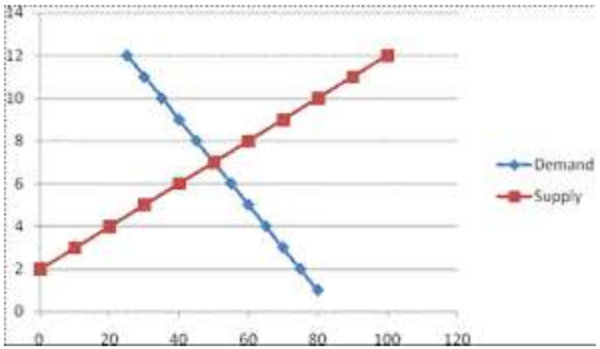
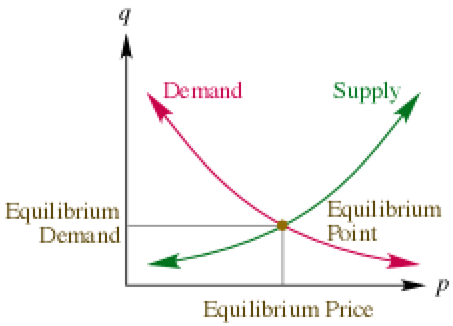


Fig. 1.17 Market equilibrium interms of demand price and supply price

Supply and Demand analysis

- On the graph we can **see, study and predict** the positions of the equilibrium point, for different values of the parameters "a" and "b".

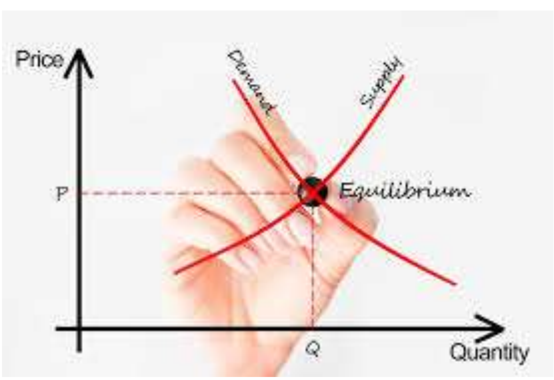




- The real graph is "the set of points".

The real graph is a curve instead of a line.

- We can keep the same equilibrium point changing the supply and demand functions. (change "a" and "b"). Just turn on the right or on the left two curves having the equilibrium point as a center.



Supply and Demand analysis

- **Example**

The demand and supply functions of a good are given by

$$P = -2Q_D + 50$$

$$P = \frac{1}{2}Q_S + 25$$

where P, Q_D and Q_S denote the price, quantity demanded and quantity supplied, respectively.

(a) Determine the equilibrium price and quantity.

(b) Determine the effect on the market equilibrium if the government decides to impose a fixed tax of $5 on each good.

Solution

(a) The demand curve has already been sketched in Figure 1.15. For the supply function

$$P = \frac{1}{2}Q_S + 25$$

we have $a = \frac{1}{2}$, $b = 25$, so the line has a slope of $\frac{1}{2}$ and an intercept of 25. It therefore passes through (0, 25). For a second point, let us choose $Q_S = 20$, say. The corresponding value of P is

$$P = \frac{1}{2}(20) + 25 = 35$$

so the line also passes through (20, 35). The points (0, 25) and (20, 35) can now be plotted and the supply curve sketched. Figure 1.21 shows both the demand and supply curves sketched on the same diagram. The point of intersection has coordinates (10, 30), so the equilibrium quantity is 10 and the equilibrium price is 30.

Supply and Demand analysis

It is possible to calculate these values using algebra. In equilibrium, $Q_D = Q_S$. If this common value is denoted by Q, then the demand and supply equations become

$$P = -2Q + 50 \quad \text{and} \quad P = \tfrac{1}{2}Q + 25$$

This represents a pair of simultaneous equations for the two unknowns P and Q and so could be solved using the elimination method described in the previous section. However, this is not strictly necessary because it follows immediately from the above equations that

$$-2Q + 50 = \tfrac{1}{2}Q + 25$$

since both sides are equal to P. This can be rearranged to calculate Q:

$$\begin{aligned} -2\tfrac{1}{2}Q + 50 &= 25 && \text{(subtract } \tfrac{1}{2}Q \text{ from both sides)} \\ -2\tfrac{1}{2}Q &= -25 && \text{(subtract 50 from both sides)} \\ Q &= 10 && \text{(divide both sides by } -2\tfrac{1}{2}\text{)} \end{aligned}$$

Finally, P can be found by substituting this value into either of the original equations.

The demand equation gives

$$P = -2(10) + 50 = 30$$

As a check, the supply equation gives

$$P = \tfrac{1}{2}(10) + 25 = 30 \quad \checkmark$$

Supply and Demand analysis

(b) If the government imposes a fixed tax of \$5 per good, then the money that the firm actually receives from the sale of each good is the amount, P, that the consumer pays, less the tax, 5: that is, $P - 5$. Mathematically, this problem can be solved by replacing P with $P - 5$ in the supply equation to get the new supply equation

$$P - 5 = \tfrac{1}{2}Q_S + 25$$

that is,

$$P = \tfrac{1}{2}Q_S + 30$$

The remaining calculations proceed as before. In equilibrium, $Q_D = Q_S$. Again, setting this common value to be Q gives

$$P = -2Q + 50$$
$$P = \tfrac{1}{2}Q + 30$$

Hence

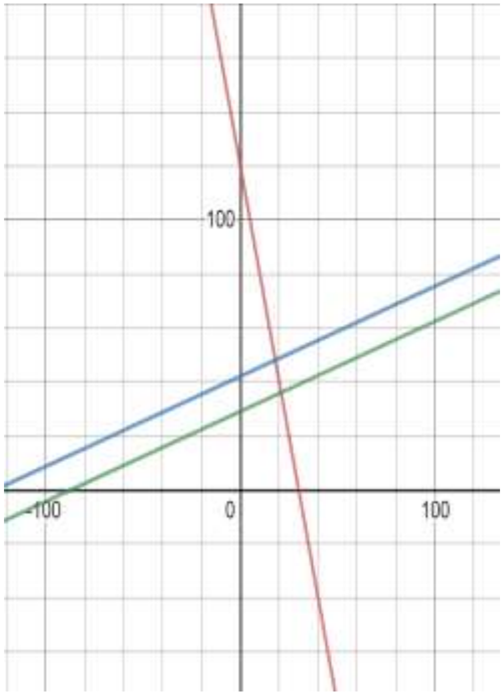
$$-2Q + 50 = \tfrac{1}{2}Q + 30$$

which can be solved as before to give $Q = 8$. Substitution into either of the above equations gives $P = 34$. (Check the details.)

Graphically, the introduction of tax shifts the supply curve upwards by 5 units. Obviously, the demand curve is unaltered. The dashed line in Figure 1.21 shows the new supply curve, from which the new equilibrium quantity is 8 and equilibrium price is 34. Note the effect that government taxation has on the market equilibrium price. This has risen to \$34 and so not all of the tax is passed on to the consumer. The consumer pays an additional \$4 per good. The remaining \$1 of tax must, therefore, be paid by the firm.

Supply and Demand analysis

- The demand and supply functions of a good are given by
- P = - 4Q_D + 120 and P = 1/3Q_S + 29 where P, Q_D and Q_S denote the price ,quantity demand and quantity supplied, respectively
- a) calculate the equilibrium price and quantity
- b) calculate the new equilibrium price and quantity after the imposition of a fixed tax of
- $13 per good. Who pays the tax
- Graphically solution
- Algebraic solution Q_D = Q_S = Q
- P = - 4Q + 120
- P = 1/3Q + 29 -4Q + 120 = 1/3Q + 29
- $\frac{13}{3}$Q = 91 Q = 21 P = - 4·21 + 120 P = 36
- The money that the firm receives is P – 13 so the
- supply equation is
- P – 13 = 1/3Q + 29 P = 1/3Q + 42
- - 4Q + 120 = $\frac{1}{3}$ Q + 42 $\frac{13}{3}$ Q = 78 Q = 18 P = - 72 + 120
- P = 48. The consumer pays $12 more, and the firm pays
- $1 (the remaining from $13)



Supply and Demand analysis

A substitutable good is one that could be consumed instead of the good under consideration
A complementary good is one that is used in conjunction with other good (laptop and printers)

We conclude this section by considering a more realistic model of supply and demand, taking into account substitutable and complementary goods. Let us suppose that there are two goods in related markets, which we call good 1 and good 2. The demand for either good depends on the prices of both good 1 and good 2. If the corresponding demand functions are linear, then

$$Q_{D_1} = a_1 + b_1P_1 + c_1P_2$$
$$Q_{D_2} = a_2 + b_2P_1 + c_2P_2$$

where P_i and Q_{D_i} denote the price and demand for the ith good and a_i, b_i and c_i are parameters. For the first equation, $a_1 > 0$ because there is a positive demand when the prices of both goods are zero. Also, $b_1 < 0$ because the demand of a good falls as its price rises. The sign of c_1 depends on the nature of the goods. If the goods are substitutable, then an increase in the price of good 2 would mean that consumers would switch from good 2 to good 1, causing Q_{D_1} to increase. Substitutable goods are therefore characterised by a positive value of c_1. On the other hand, if the goods are complementary, then a rise in the price of either good would see the demand fall, so c_1 is negative. Similar results apply to the signs of a_2, b_2 and c_2. The calculation of the equilibrium price and quantity in a two-commodity market model is demonstrated in the following example.

Supply and Demand analysis

Example

The demand and supply functions for two interdependent commodities are given by

$$Q_{D_1} = 10 - 2P_1 + P_2$$
$$Q_{D_2} = 5 + 2P_1 - 2P_2$$
$$Q_{S_1} = -3 + 2P_1$$
$$Q_{S_2} = -2 + 3P_2$$

where Q_{D_i}, Q_{S_i} and P_i denote the quantity demanded, quantity supplied and price of good i, respectively. Determine the equilibrium price and quantity for this two-commodity model.

Solution

In equilibrium, we know that the quantity supplied is equal to the quantity demanded for each good, so that

$$Q_{D_1} = Q_{S_1} \quad \text{and} \quad Q_{D_2} = Q_{S_2}$$

Supply and Demand analysis

Let us write these respective common values as Q_1 and Q_2. The demand and supply equations for good 1 then become

$$Q_1 = 10 - 2P_1 + P_2$$
$$Q_1 = -3 + 2P_1$$

Hence

$$10 - 2P_1 + P_2 = -3 + 2P_1$$

since both sides are equal to Q_1. It makes sense to tidy this equation up a bit by collecting all of the unknowns on the left-hand side and putting the constant terms on to the right-hand side:

$$10 - 4P_1 + P_2 = -3 \qquad \text{(subtract } 2P_1 \text{ from both sides)}$$
$$-4P_1 + P_2 = -13 \qquad \text{(subtract 10 from both sides)}$$

We can perform a similar process for good 2. The demand and supply equations become

$$Q_2 = 5 + 2P_1 - 2P_2$$
$$Q_2 = -2 + 3P_2$$

because $Q_{D_2} = Q_{S_2} = Q_2$ in equilibrium. Hence

$$5 + 2P_1 - 2P_2 = -2 + 3P_2$$
$$5 + 2P_1 - 5P_2 = -2 \qquad \text{(subtract } 3P_2 \text{ from both sides)}$$
$$2P_1 - 5P_2 = -7 \qquad \text{(subtract 5 from both sides)}$$

We have therefore shown that the equilibrium prices, P_1 and P_2, satisfy the simultaneous linear equations

$$-4P_1 + P_2 = -13 \qquad (1)$$
$$2P_1 - 5P_2 = -7 \qquad (2)$$

which can be solved by elimination. Following the steps described in Section 1.4, we proceed as follows.

Supply and Demand analysis

- The demand and supply functions for two interdependent commodities are given by
- Q_{D_1} = 40 - 5P_1- P_2 Q_{S_1}= - 3 + 4P_1
- Q_{D_2} = 50 - 2P_1 - 4P_2 Q_{S_2}= - 7 + 3P_2
- Determine the equilibrium price and quantity for this two-commodity model. Are these goods substitutable or complementary?
- Q_{D_1}= Q_{S_1} = Q_1 40 - 5P_1- P_2= - 3 + 4P_1 - 9P_1- P_2 = - 43 63P_1 + 7P_2 = 301
- Q_{D_2}= Q_{S_2}= Q_2 50 - 2P_1 - 4P_2= - 7 + 3P_2 - 2P_1- 7P_2= - 57 - 2P_1- 7P_2= - 57
- 61P_1 = 244 P_1 = 4 - 2· 4 - 7P_2= - 57 - 7P_2 = - 49 P_2 = 7

After substitutions, the values P_1 = 4 and P_2 = 7 obtain Q_1 = 13 and Q_2 = 14

We see the parameters a_1 ; a_2 are positive numbers

b_1 ; b_2 are negative numbers

c_1 negative number (complementary) ; c_2 negative number(complementary)

National income

- Macroeconomics is concerned with the analysis of economic theory and policy at a national level. Suppose that the economy has two sectors, households and firms. Firms use **resources** such as land, capital, labour and raw materials to produce goods and services. These resources are known as **factors of production** and are taken to belong to households. **National income** (Y) represents the flow of income from firms to households as a payment for these factors. Households can then spend this money in one of the two ways. In consumption of goods produced by firms or can be put into savings. Consumption, C, and savings, S, are therefore functions of income $C = f(Y)$ $S = g(Y)$. If "Y" increases normally we expected to increase "C" and "S". So, f, g, are increasing functions.

National income

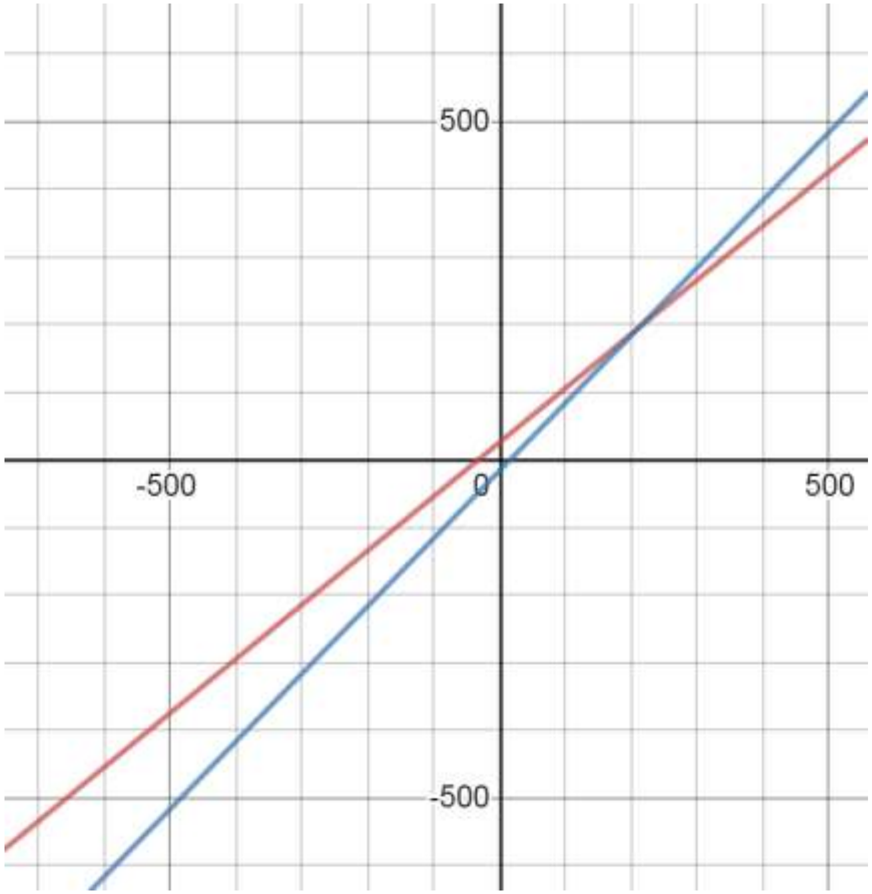
- The simpler consumption function is linear in form $C = aY + b$
- Increasing function, $a > 0$ and less than one (slope) ; $b > 0$ (intercept). The intercept "b" is the level of consumption when $Y = 0$ and is known as autonomous consumption. The slope "a" is known as the marginal propensity to consume and it is the change in C when Y increases by 1-unit. It is true that $Y = C + S$.
- From this formula get $S = Y – C = Y – (aY + b) = (1 – a)Y + b$. the slope of this function "$1 – a$"is called marginal propensity to save
- MPC   Marginal Propensity to Consume
- MPS   Marginal Propensity to Save
- MPC + MPS = 1

National income

- Let's denote by T taxation, G government expenditure, I investments and C consumption. The general formula is $Y = C + I$.
- The more realistic model is given by the formula $Y = C + I + G$, which express the national income and its equilibrium level. If $C = Y$ have equilibrium level of income and consumption. The formula $Y_d = Y – T$ express the disposable income.
- Practice problem. Find the equilibrium level of income and consumption if $C = 0.8Y + 25$ and $I = 17$. Find the new equilibrium if investments rises by 1 unit.
- $Y = C + I = C + 17$ and $C = 0.8Y + 25$ or $Y = 0.8Y + 25 + 17$ or $Y = 0.8Y + 42$
- and $0.2Y = 42$ or $Y = 210$ so $C = 0.8Y + 25 = 0.8·210 + 25 = 193$
- If $I = 17 + 1 = 18$, so $Y = C + I = C + 18$, or $Y = 0.8Y + 25 + 18$ or $Y = 0.8Y + 43$
- and $0.2Y = 42$ or $Y = 215$ so $C = 0.8Y + 25 = 0.8·215 + 25 = 197$

National income

- Below are the graphs of these functions C = 0.8Y + 25 and C = Y – 17
- Red color C = 0.8Y + 25
- Blue color C = Y – 17
- As “x” axes is “Y” the
- national income



Exercises

- Equation of the line y = ax + b or ax + by = c
- Equations of two lines a_1x + b_1y = c_1
- a_2x + b_2y = c_2 which may be parallel; may intersect; may be one line (coincident)
- System of two linear equation with two variable (system of two simultaneous linear equations)
- a_1x + b_1y = c_1 may have not solution (represent two parallel lines); may have a single solution ordered pair
- a_2x + b_2y = c_2 (x ,y) (represent two intersecting lines (x, y) is the intersection point); may have infinite solutions
- (two equations represent one line, or the same line)
- Equation y = ax + b represent a straight line where “a” is the slope and “b” is intercept.
- Find which points P(2, -4) Q(-3, 5) R(0.2, -2.5) M(-1, 8) N(5, -6) K(-2.4, 3.5)
- lies on the lines x – y = 6 10x + 4y = 10 3x – 2y = -19. For each line write coordinates of two points lies on them and one point which is not point of the line
- Solve graphically, by elimination method and by substitution method the systems below.
- 3x + 4y = 12 2x + y = 4 -2x – y = 6
- x + 4y = 8 4x – 3y = 12 5x + 3y = 15
- Solve system of inequalities (graphically) 4x – 3y < 12 7x + 2y > 14
- 3x + 2y > 6 3x – 5y < 15

Exercises

- Solve the systems by substitution method explaining the operations.
- $x + 5y = 7$
- $-2x + 7y = -5$
- Solve the systems by elimination method explaining the operations
- $5x - 7y = -11$
- $4x + 3y = -1$

Exercises

- To solve our system, we must express from one $3x + 2y = 3$
- of the equations one variable in terms to the other $7x + 3y = 2$
- from the **first** equation express y in terms of x $2y = 3 - 3x$ or $y = 1.5 - 1.5x$ (1)
- substitute this variable to the **second** equation $7x + 3(1.5 - 1.5x) = 2$
- $7x - 4.5x = 2 - 4{,}5$
- solve the equation with one variable $2.5x = -2.5$ $\mathbf{x = -1}$
- find the value and substitute to the (1) formula $y = 1.5 - 1.5 \cdot (-1)$
- $y = 1.5 + 1.5$
- solve equation with one variable to find the other value $\mathbf{y = 3}$
- write the solution as an ordered pair $(-1, 3)$

Exercises

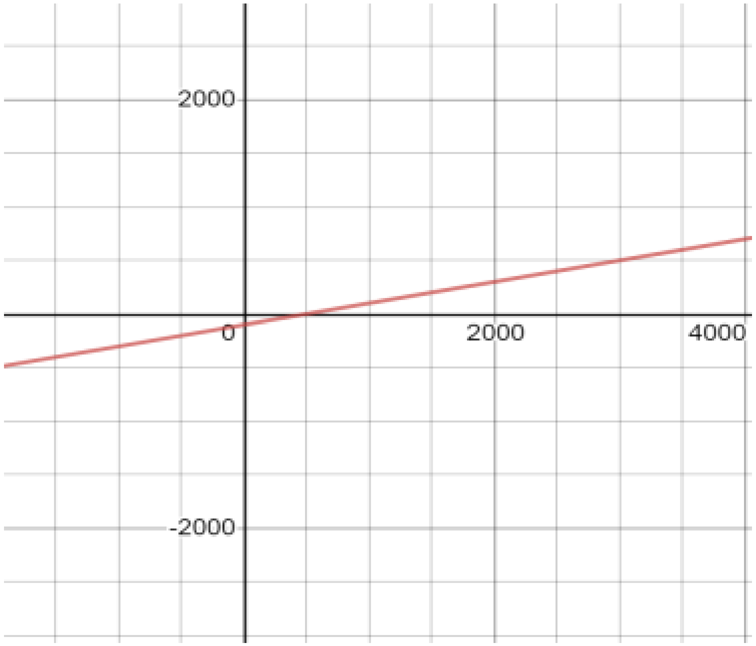
- For our system, we will seek to **eliminate** the *x* variable. (y variable) $4x - 3y = -4$
- The coefficients are 4 and 7 (- 3 and - 5) $7x - 5y = -6$
- Our goal is to obtain coefficients of *x* that are additive inverses of each other.
- We can accomplish this by **multiplying** the first equation by 7, (5) $28x - 21y = -28$ $20x - 15y = -20$
- and the second equation by - 4. (-3) $-28x + 20y = 24$ $-21x + 15y = 18$
- Next, we can **add** the two equations to eliminate the *x*-variable.(y variable) $0x - 1y = -4$ $-x + 0y = -2$
- Solve for *y* (x) $y = 4$ $x = 2$
- Substitute *y* value into original equation and solve for *x* $4x - 3 \cdot 4 = -4$ $4x = 8$ $x = 2$
- $4 \cdot 2 - 3y = -4$ $y = 4$
- Write solution as an ordered pair (2 ,4) (2, 4)

Exercises

- 1. An airline charges $ 300 for a flight of 2000 km and $ 700 for a flight of 4000 km.
- a) Plot these points on the Cartesian plane with distance on horizontal axis and cost on the vertical axis. Find the slope.
- b) Find the equation of the line pass through these points.
- c) Write the equation in slope intercept form. Which is the linear model?
- d) Sketch the graph of the line.
- e) Find from the graph the cost of a flight of 3400 km; 4200 km.
- g) Find from the graph the distance costing $ 400; $ 600.
- h) Answer questions e; g; using the linear model.
- 2. A taxi firm charges a fixed cost of $ 4 plus a charge of $ 2.50 a mile.
- a) Write down a formula for the cost , C, of a journey of x miles.
- b) Plot the graph of C against x for $0 \leq x \leq 20$.
- c) Find the distance of a journey which costs $ 24

Exercises

- The graph of the function y = 0.2x – 100. M_1(2000; 300) M_2(4000; 700)

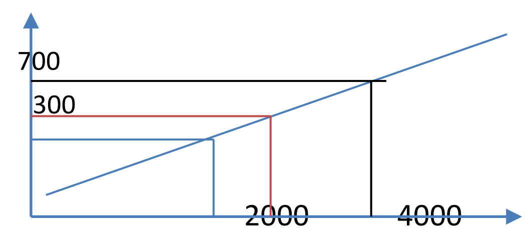


a = $\frac{y_2 - y_1}{x_2 - x_1} = \frac{700 - 300}{4000 - 2000} = \frac{400}{2000}$ = 0.2

$\frac{y - 300}{700 - 300} = \frac{x - 2000}{4000 - 2000}$ 400(x – 2000) = 2000(y – 300)

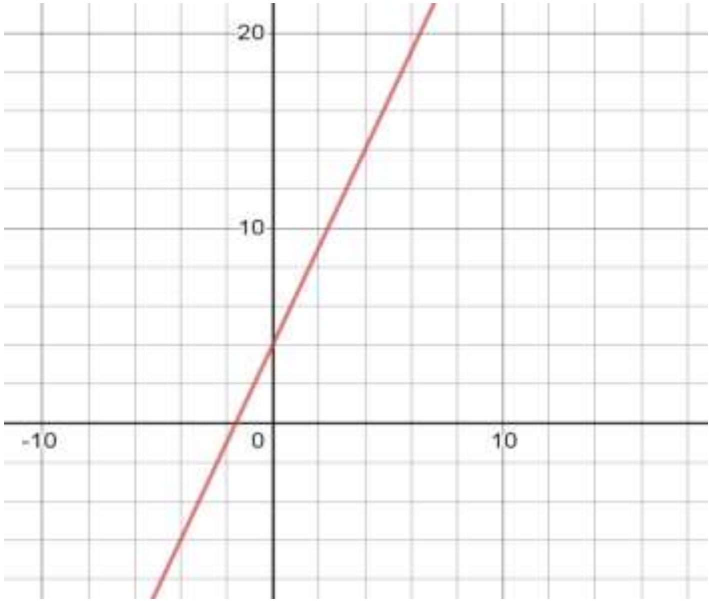
x – 2000 = 5y – 1500 x – 5y = 500 y = 0.2x – 100

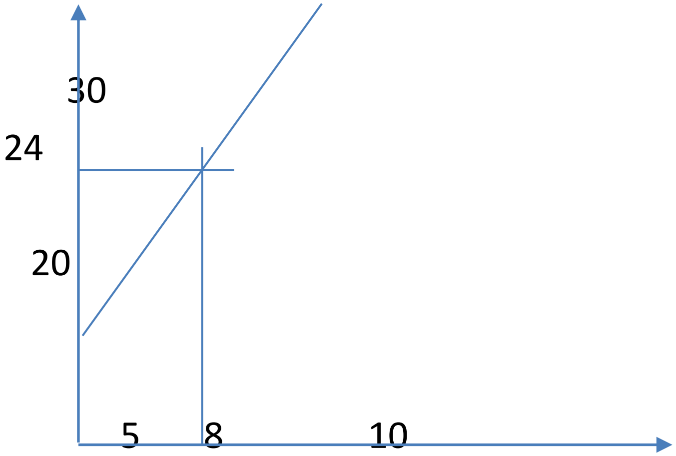
C = 0.2 D – 100 C is cost, and D is distance



Exercises

- Cost of a journey of x miles is $C = 4 + 2.5x$
-
-
-



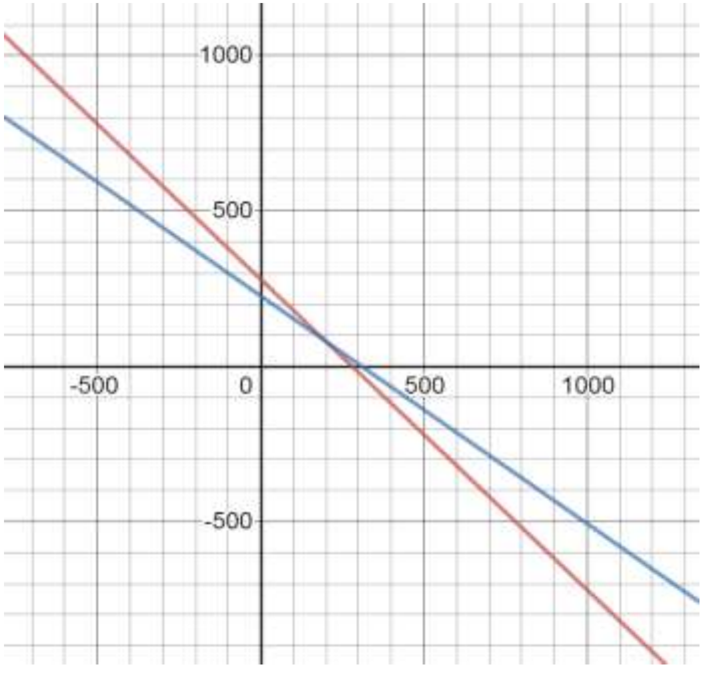


Exercises

- A gas station sells two types of gas: regular at \$ 1.1 per gallon and premium at \$ 1.5 per gallon. At the end of the day the cashier has \$ 340 and has sold 280 gallons of gasoline.
- How many gallons of each type of gasoline were sold?

Exercises

- denote x the number of gallons of regular.
- denote y the number of gallons of premium.
- $x + y = 280$ $\qquad$ $x + y = 280$
- $1.1x + 1.5y = 340$ $\qquad$ $11x + 15y = 3400$
- Solve applying substitution method



Exercises

- The number of people , N, employed in a chain of cafes is related to the number of cafes , n, by the equation
- $N = 10n + 120$
- Illustrate this relation by plotting the graph of
- N against n for $0 \leq n \leq 20$.
- Calculate the number of employees
- when the company has 14 cafes.
- Calculate the number of cafes
- when the company employs 190 people.
- State the values of the slope and intercept
- of the graph and give an interpretation
- $N = 10 \cdot 14 + 120 = 260$
- $190 = 10n + 120$
- $10n = 70 \qquad n = 7$

Supply and Demand analysis

- Key words
- Simplification. Assumption. Modeling.
- Income-Outgoing Model.
- Endogenous variables. Exogenous variables.
- Demand function. Supply function.
- Graphs of the demand and supply functions.
- Increasing function, Decreasing function.
- Real graphs of the demand and the supply functions.
- Parameters "a" and "b". Properties of "a" and "b" on supply and demand functions
- Changes on "a" and "b" reflected on changes on demand and supply function
- "a" and "b" related with endogenous and exogenous variables
- Substitutable goods, complementary goods
- Equilibrium point.
- Inferior good, normal good

  Note

- **On every key word add the question "what is " and try to answer it.**
- Thank You