Engineering Economics

UNIT 1

What it is in General?

- Is the science of scarcity.
- Scarcity is the condition in which our wants are greater than our limited resources.
- Since we are unable to have everything we desire, we must make choices on how we will use our resources.

Click to add text

- In economics we study the choices of individuals, firms, and governments.

Economics is the study of choices.

Examples:

- You must choose between buying jeans or buying shoes and laptop or tablet.
- Businesses must choose how many people to hire or spend on robots
- Governments must choose how much to spend on welfare or defence.

Economics Defined

Economics-Social science concerned with the efficient use of limited resources to achieve maximum satisfaction of economic wants.

(Study of how individuals and societies deal with Scarcity______)

Economics and Engineering

- Economics is a significant part of an engineer's job.
  - The engineer must translate scientific ideas in products and systems that are financially sustainable.
  - Ideas need to make sense financially and the engineer must be able to convince others that this is so.
- That is true of most organizations.

The Goal

- For-profit organizations have for goal to make profit - now and in the future.
- Not-for-profit must remain financially sound.
- Both types must worry about money or they will probably cease to exist.

Micro vs. Macro

MICROeconomics-

Study of small economic units such as individuals, firms, and industries (competitive markets, labor markets, personal decision making, etc.)

MACROeconomics-

Study of the large economy as a whole or in its basic subdivisions (National Economic Growth, Government Spending, Inflation, Unemployment, etc.)

How is Economics used?

- Economists use the scientific method to make generalizations and abstractions to develop theories. This is called theoretical economics.

- These theories are then applied to fix problems or meet economic goals. This is called policy economics.

Thinking at the Margin

# Times Consuming the food	Benefit	Cost
1st	300	Rs100
2nd	150	Rs100
3rd	50	Rs100
Total	**500**	**Rs300**

Would you consume the food three times?

Notice that the total benefit is more than the total cost but you would NOT take the same meal the 3rd time.

Marginal Analysis

In economics the term marginal = additional

“Thinking on the margin,” or MARGINAL ANALYSIS involves making decisions based on the additional benefit vs. the additional cost.

For Example:

You have been shopping at the mall for a half hour; the additional benefit of shopping for an additional half-hour might outweigh the additional cost (the opportunity cost).

After three hours, the additional benefit from staying an additional half-hour would likely be less than the additional cost.

Diamond vs Water

Use value vs Exchange value

Compare diamond’s use and Water’s use

Compare diamond’s price and price of water.

5 Key Economic Assumptions

1. Society's wants are unlimited, but ALL resources are limited (scarcity).
2. Due to scarcity, choices must be made. Every choice has a cost (a trade-off).
3. Everyone's goal is to make choices that maximize their satisfaction. Everyone acts in their own "self-interest."
4. Everyone acts rationally by comparing the marginal costs and marginal benefits of every choice
5. Real-life situations can be explained and analyzed through simplified models and graphs.

Given the following assumptions, make a rational choice in your own self-interest (hold everything else constant)…

1. You want to visit your friend for the weekend
2. You work every weekday earning Rs1000 per day
3. You have three flights to choose from:

Thursday Night Flight = Rs3000

Friday Early Morning Flight = Rs3450

Friday Night Flight = Rs3800

Which flight should you choose? Why?

Trade-offs

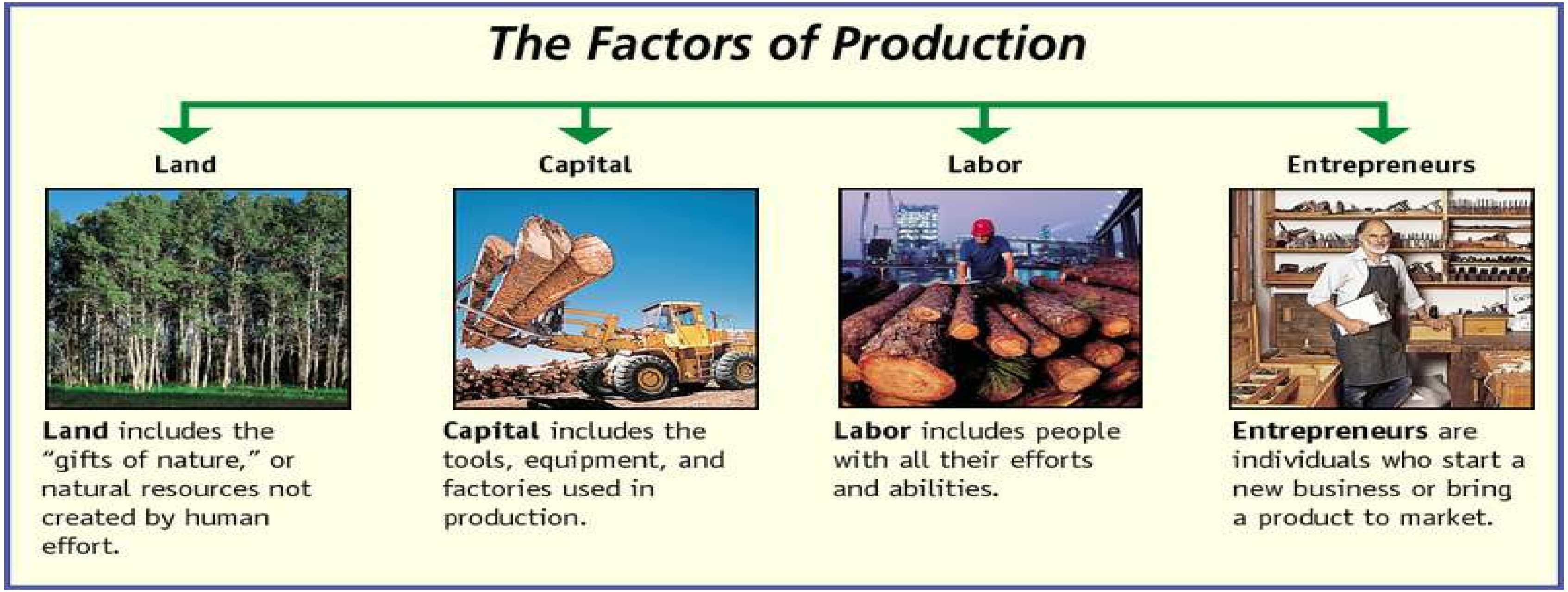
ALL decisions involve trade-offs.

Trade-offs are all the alternatives that we give up whenever we choose one course of action over others.
(Examples: going to the movies)

The most desirable alternative given up as a result of a decision is known as opportunity cost.

What are trade-offs of deciding to go to college?
What is the opportunity cost of going to college?

The Factors of Production



What is the Production Possibilities Curve?

- A production possibilities curve or graph (PPG or PPC) is a model that shows alternative ways that an economy can use its scarce resources
- This model graphically demonstrates scarcity, trade-offs, opportunity costs, and efficiency.

4 Key Assumptions

- Only two goods can be produced
- Full employment of resources
- Fixed Resources (*Ceteris Paribus*)
- Fixed Technology

Production “Possibilities” Table

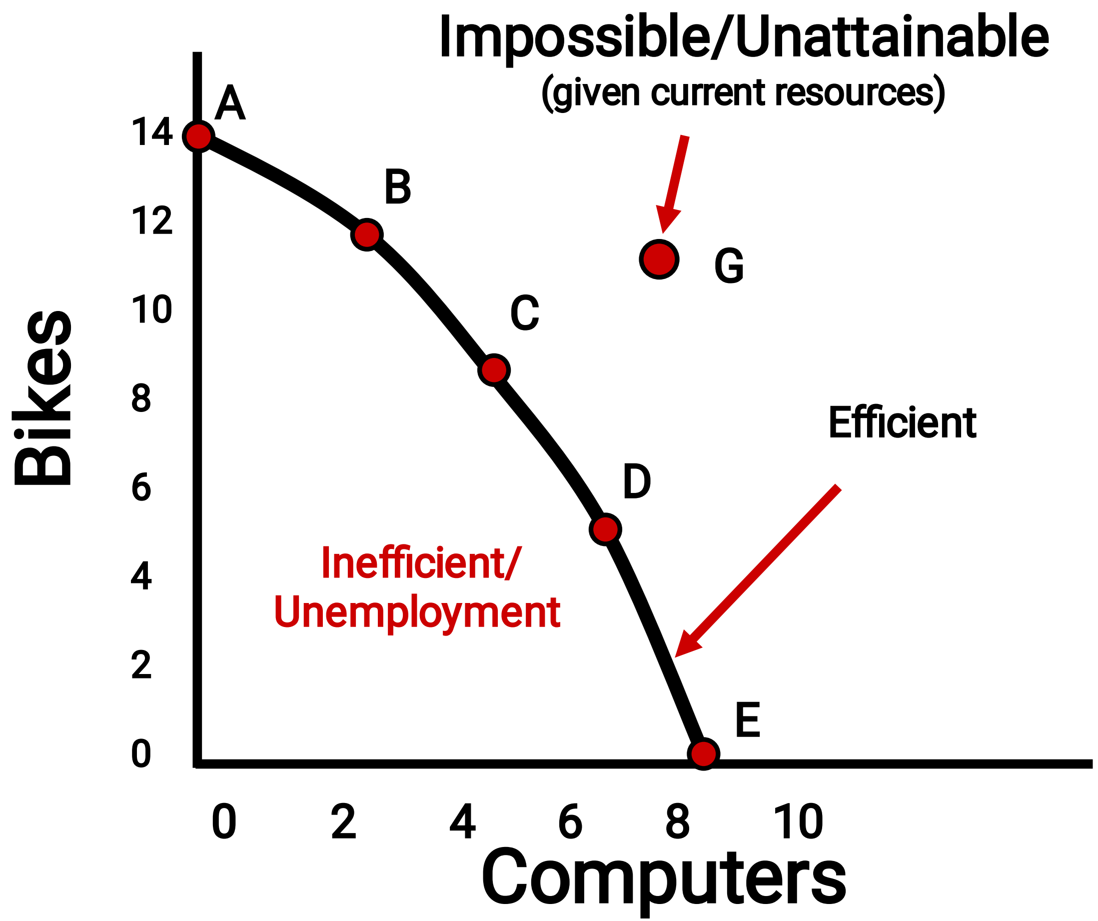
	a	b	c	d	e
Bikes	14	12	9	5	0
Computers	0	2	4	6	8

Each point represents a specific combination of goods that can be produced given full employment of resources.

NOW GRAPH IT: Put bikes on y-axis and computers on x-axis

PRODUCTION POSSIBILITIES

How does the PPG graphically demonstrates scarcity, trade-offs, opportunity costs, and efficiency?



Opportunity Cost

Example:

1. *The opportunity cost of moving from A to B is…* ***2 Bikes***

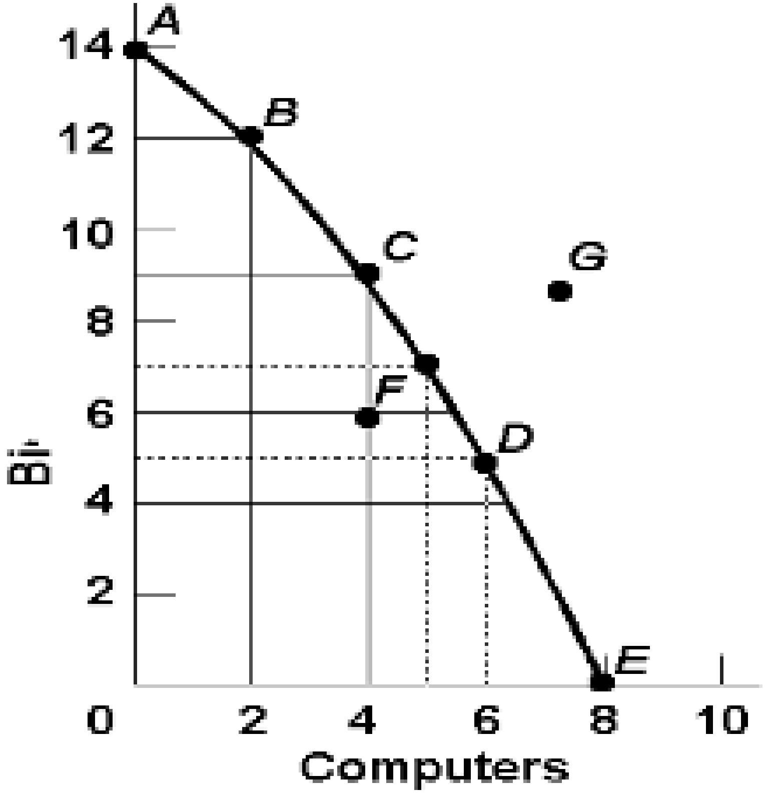
2. *The opportunity cost of moving from B to D is…* ***7 Bikes***

3. *The opportunity cost of moving from D to B is…* ***4 Computers***

4. *The opportunity cost of moving from F to C is…* ***0 Computers***

5. *What can you say about point G?*

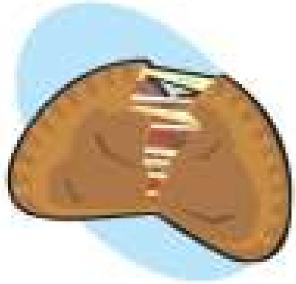
Unattainable

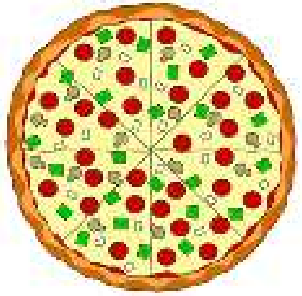


PRODUCTION POSSIBILITIES

	A	B	C	D	E
CALZONES	4	3	2	1	0
PIZZA	0	1	2	3	4

- List the Opportunity Cost of moving from a-b, b-c, c-d, and d-e.
- Constant Opportunity Cost- Resources are easily adaptable for producing either good.
- Result is a straight line PPC





PRODUCTION POSSIBILITIES

	A	B	C	D	E
PIZZA	18	17	15	10	0
TOOLS	0	1	2	3	4

- List the Opportunity Cost of moving from a-b, b-c, c-d, and d-e.
- Law of Increasing Opportunity Cost-
  - As you produce more of any good, the opportunity cost (forgone production of another good) will increase.
  - Why? Resources are NOT easily adaptable to producing both goods.
- Result is a <u>bowed out</u> (Concave) PPC

PER UNIT Opportunity Cost

How much each marginal unit costs = $\frac{\text{Opportunity Cost}}{\text{Units Gained}}$

Example:

1. *The PER UNIT opportunity cost of moving from a to b is…*

   1 Bike

2. *The PER UNIT opportunity cost of moving from b to c is…*

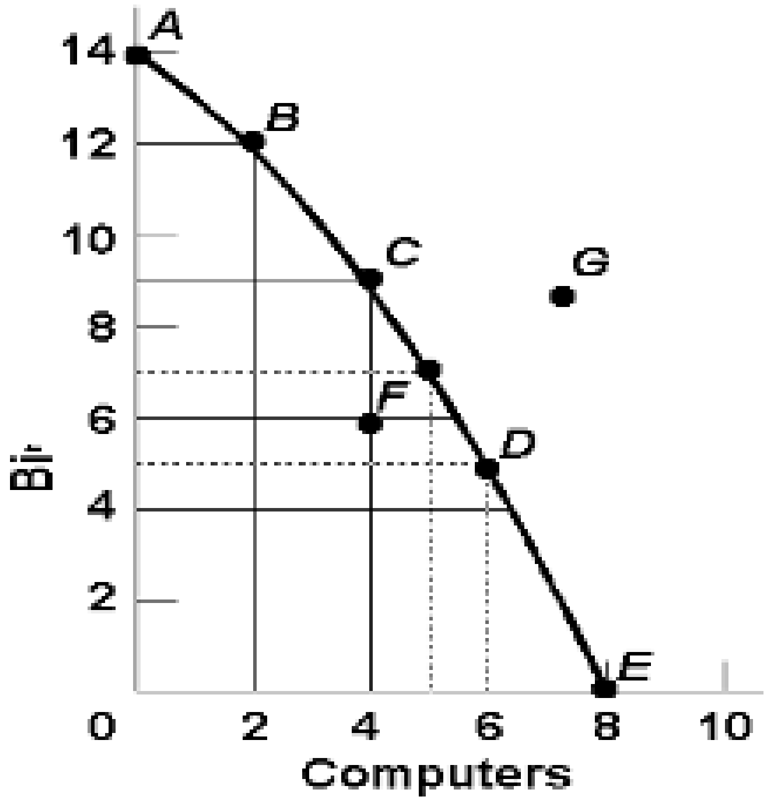
   1.5 (3/2) Bikes

3. *The PER UNIT opportunity cost of moving from c to d is…*

   2 Bikes

4. *The PER UNIT opportunity cost of moving from d to e is…*

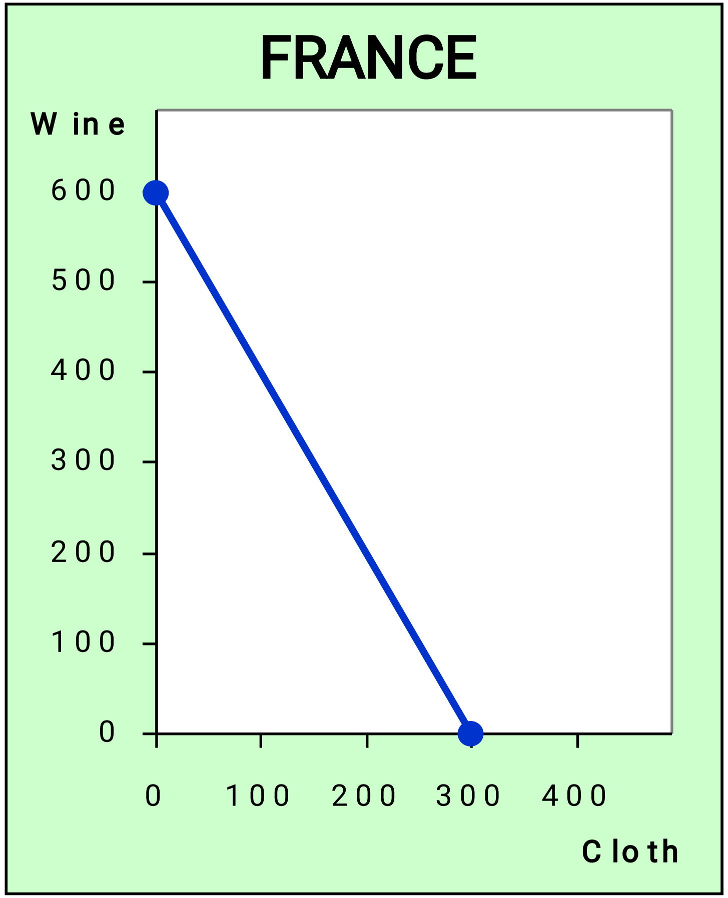
   2.5 (5/2) Bikes

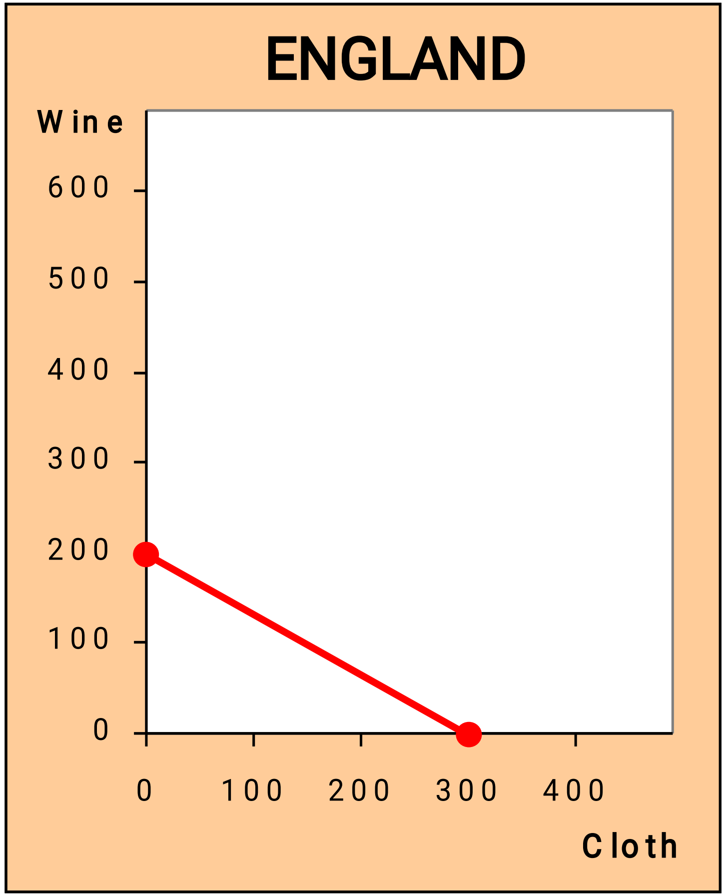


ACTIVE LEARNING 2

PPC and Opportunity Cost

In which country is the opportunity cost of cloth lower?





Shifting the Production Possibilities Curve

PRODUCTION POSSIBILITIES

4 Key Assumptions Revisited

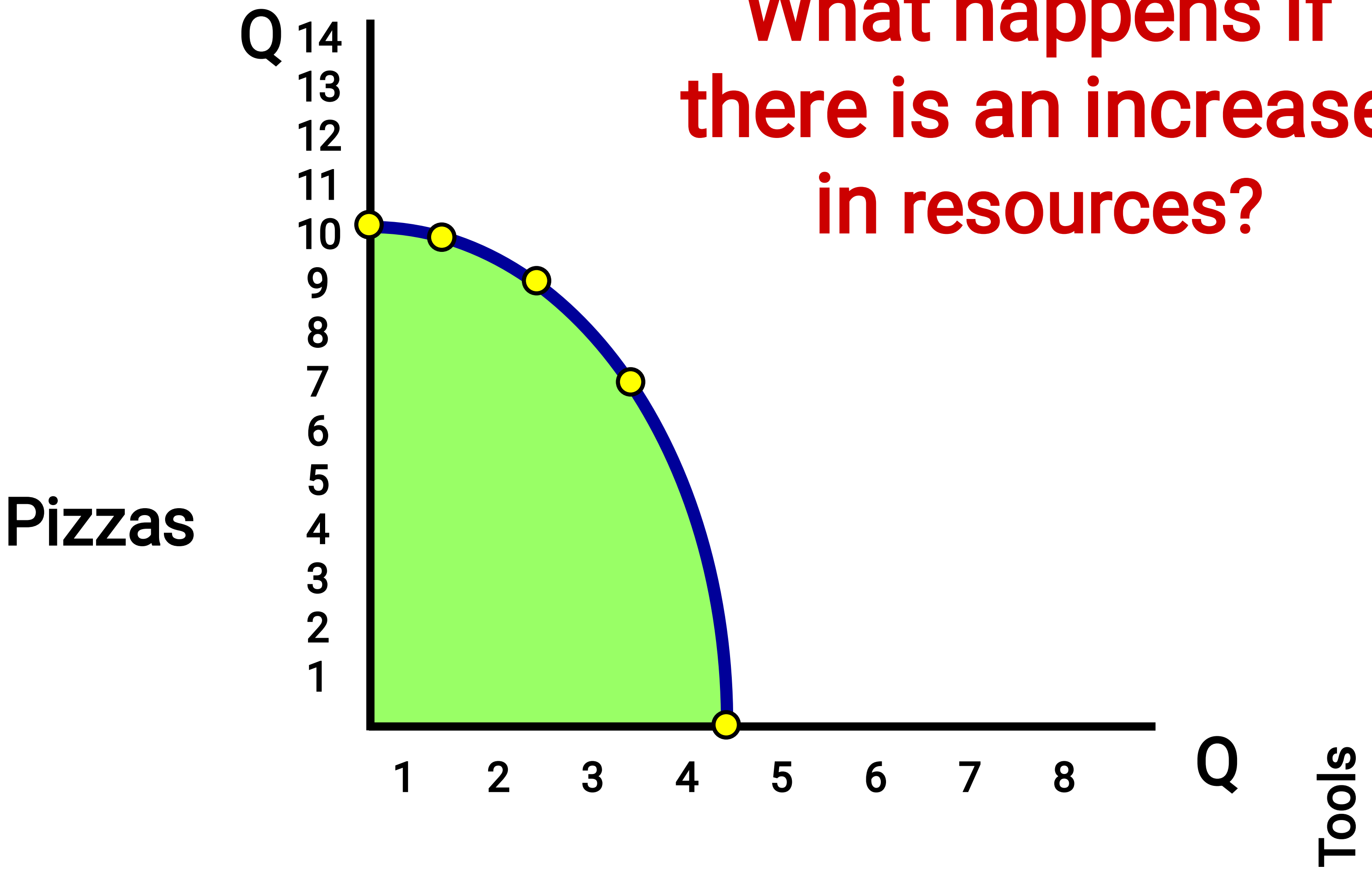
- Only two goods can be produced
- Full employment of resources
- Fixed Resources (4 Factors)
- Fixed Technology

What if there is a change?

Shifters of the PPC

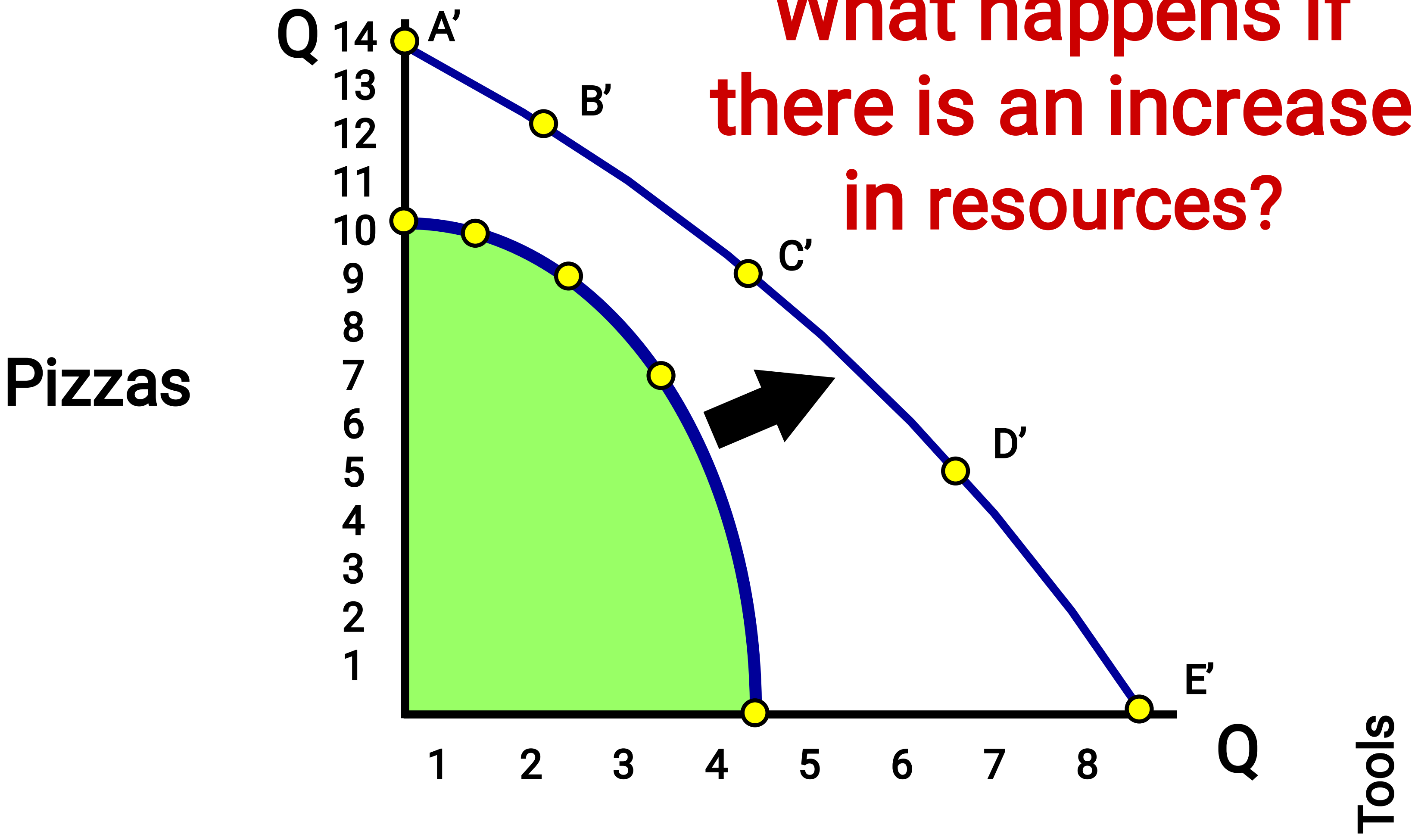
1. Change in resource quantity or quality
2. Change in Technology

PRODUCTION POSSIBILITIES



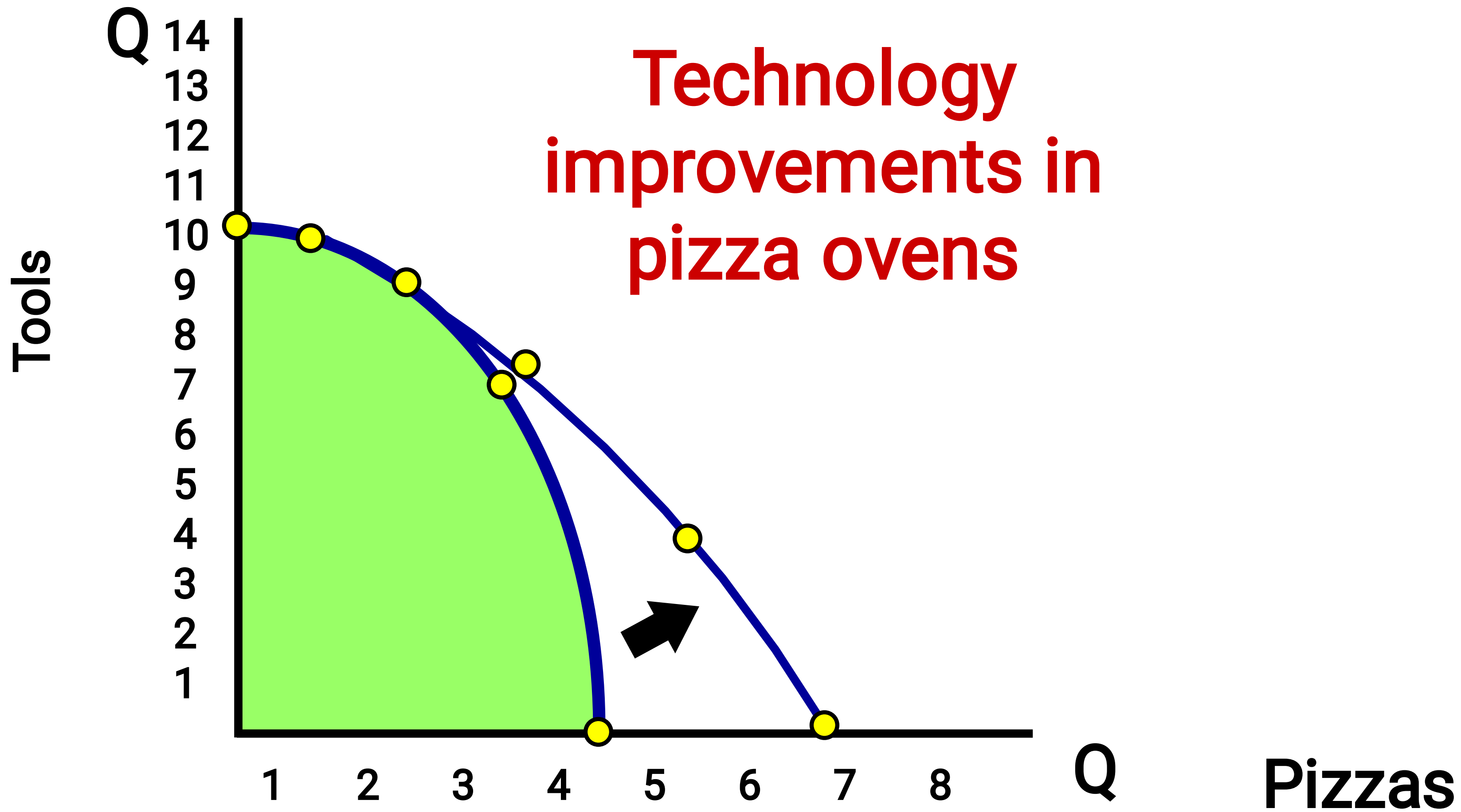
What happens if there is an increase in resources?

PRODUCTION POSSIBILITIES



What happens if there is an increase in resources?

PRODUCTION POSSIBILITIES



The Production Possibilities Curve and Efficiency

Two Types of Efficiency

Productive Efficiency-

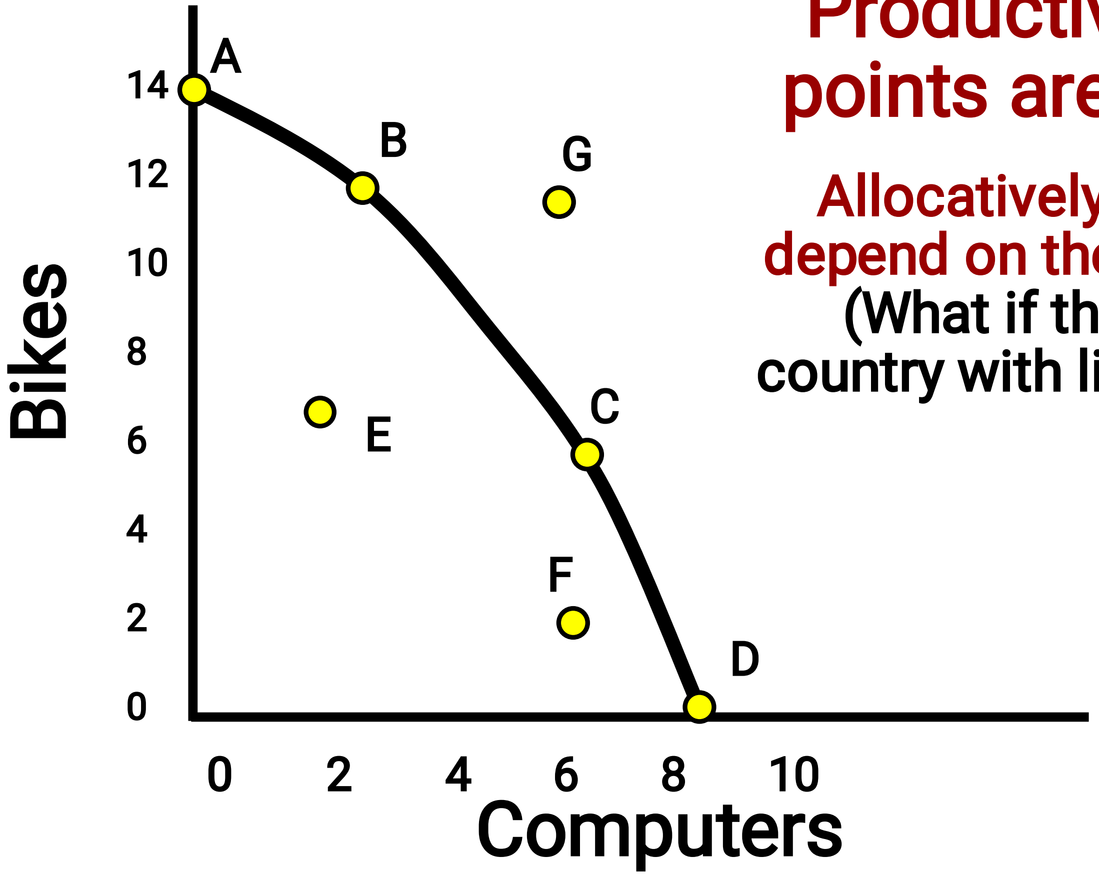
- Products are being produced in the least costly way.
- This is any point ON the Production Possibilities Curve

Allocative Efficiency-

- The products being produced are the ones most desired by society.
- This *optimal* point on the PPC depends on the desires of society.

Productive and Allocative Efficiency

Which points are productively efficient?
Which are allocatively efficient?



Productively Efficient points are A through D

Allocatively Efficient points depend on the wants of society

(What if this represents a country with limited electricity?)

The PPC: What We Know So Far

Points on the PPC (like **A** – **E**)

- possible
- efficient: all resources are fully utilized

Points under the PPC (like **F**)

- possible
- not efficient: some resources underutilized (*e.g.,* workers unemployed, factories idle)

Points above the PPC (like **G**)

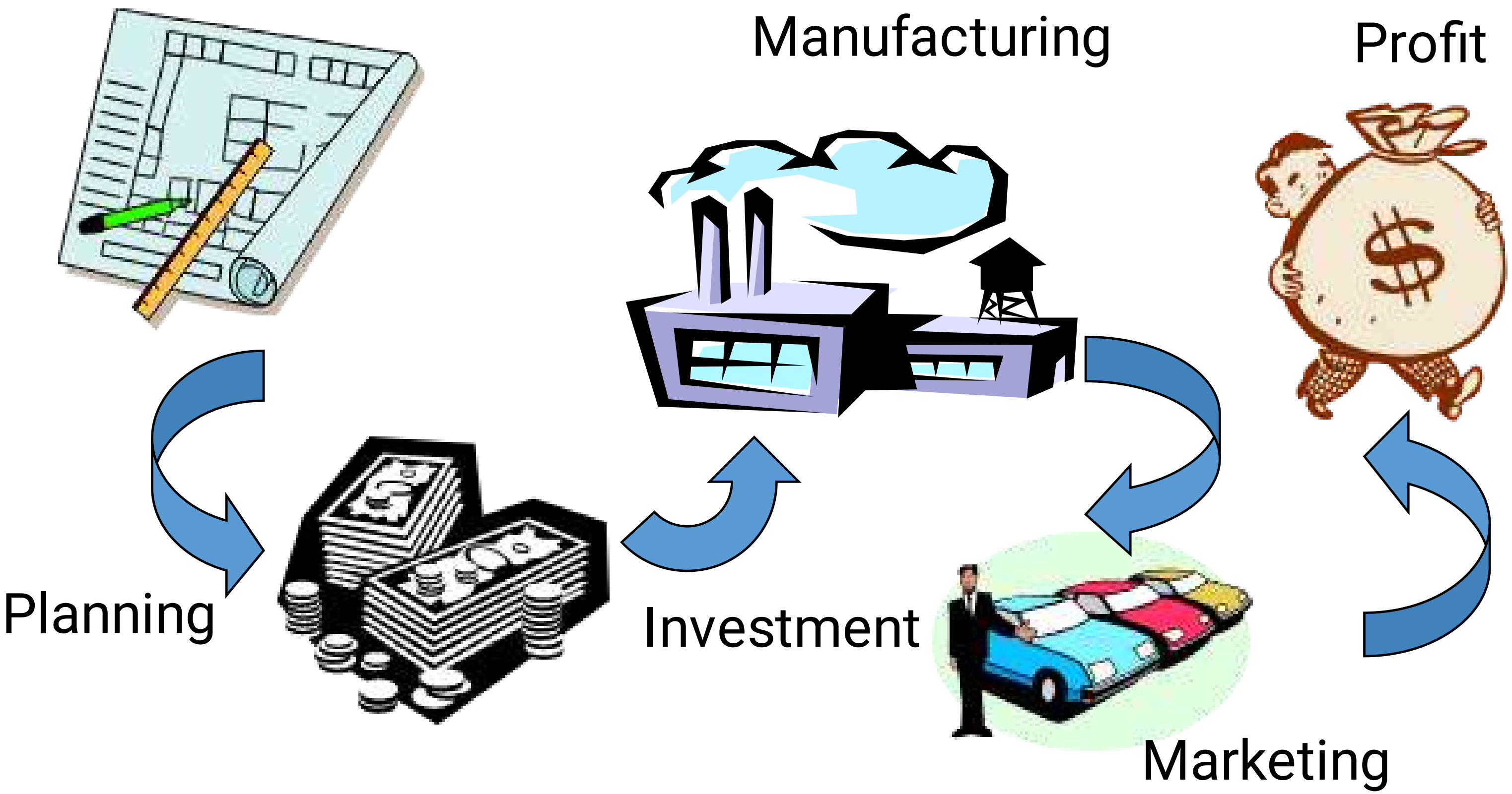
- not possible

The PPC and Opportunity Cost

- Recall: The **opportunity cost** of an item is what must be given up to obtain that item.

- Moving along a PPC involves shifting resources (*e.g.*, labor) from the production of one good to the other.
- Society faces a tradeoff: Getting more of one good requires sacrificing some of the other.
- The slope of the PPC tells you the opportunity cost of one good in terms of the other.

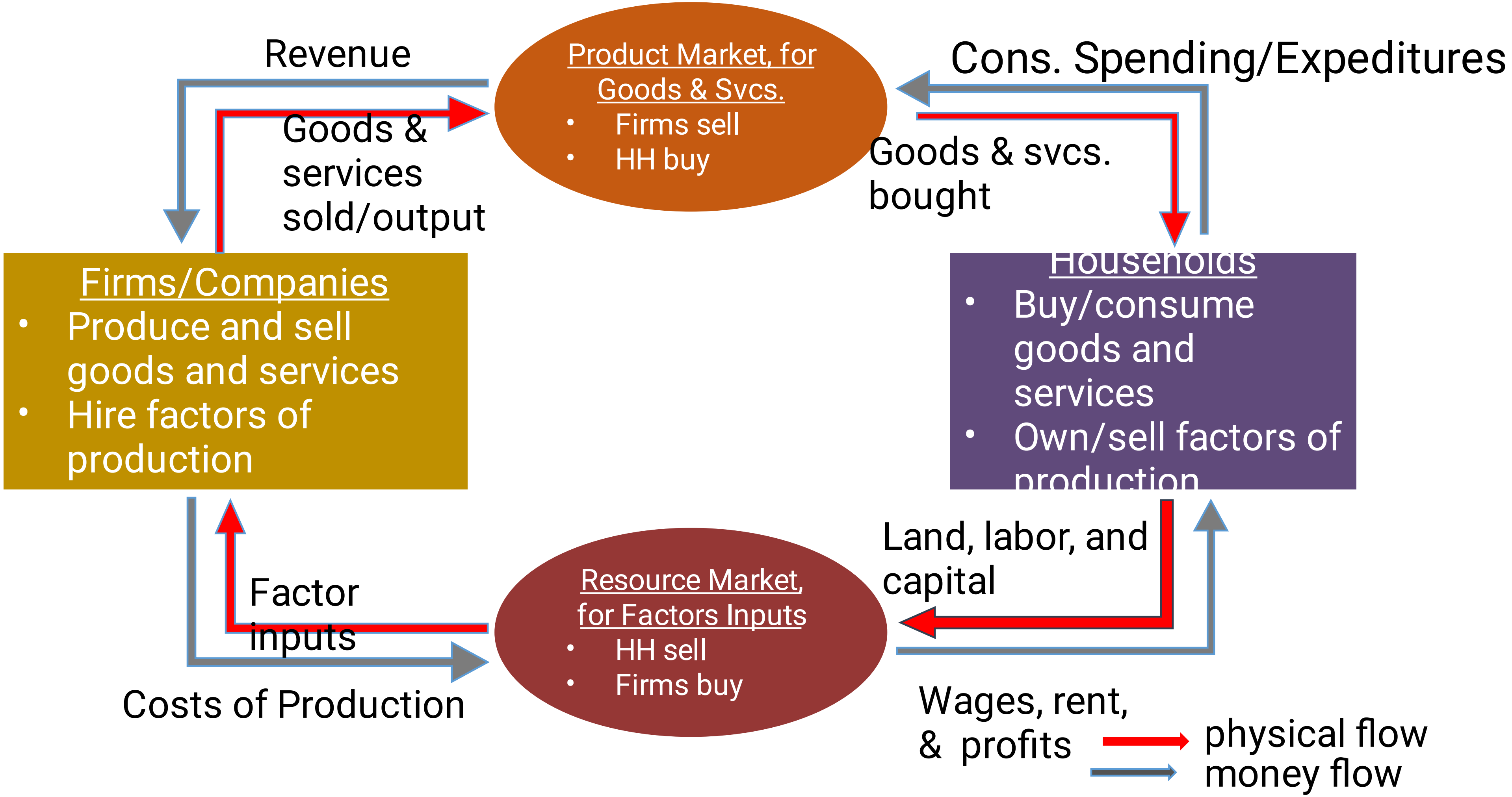
Engineering Economic Decisions



The Circular-Flow Diagram

- The **Circular-Flow Diagram**: a visual model of the system, shows how money flow through markets among households and firms
- Two types of "actors":
  - households
  - firms
- Two markets:
  - the market for goods and services
  - the market for "factors of production"

Circular Flow



A systematic process for making business decisions

1. Understand the problem
2. Identify all technically-feasible solutions.
3. Define the selection criteria (e.g. Return on investment, delivery date, performance, risk, etc.)
4. Evaluate each proposal against selection criteria. Since cost is always a consideration, this step will include the development of **cash flows** and the computation of **present value** (or equivalent) for each alternative. This step also includes consideration of intangible factors (irreducibles).
5. Use professional judgment to select the preferred solution.
6. Monitor performance of solution selected. Use feedback to calibrate decision making process.

Principles of Engineering Economy

1. Develop the Alternatives
2. Focus on the Differences
3. Use a Consistent Viewpoint
4. Use a Common Unit of Measure
5. Consider All Relevant Criteria
6. Make Uncertainty Explicit
7. Revisit Your Decisions

Principles of Engineering Economy

1. Develop the Alternatives

The final choice (decision) is among alternatives. The alternatives need to be identified and then defined for subsequent analysis.

2. Focus on the Differences

Only the differences in expected future outcomes among the alternatives are relevant to their comparison and should be considered in the decision.

3. Use a Consistent Viewpoint

The prospective outcomes of the alternatives, economic and technical, should be consistently developed from a defined viewpoint (perspective).

4. Use a Common Unit of Measure

Using a common unit of measurement to enumerate as many of the prospective outcomes as possible will make easier the analysis and comparison of alternatives.

5. Consider All Relevant Criteria

Selection of a preferred alternative (decision making) requires the use of a criterion (or several criteria).

6. Make Uncertainty Explicit

Uncertainty is inherent in projecting (or estimating) the future outcomes of the alternatives and should be recognized in their analysis and comparison.

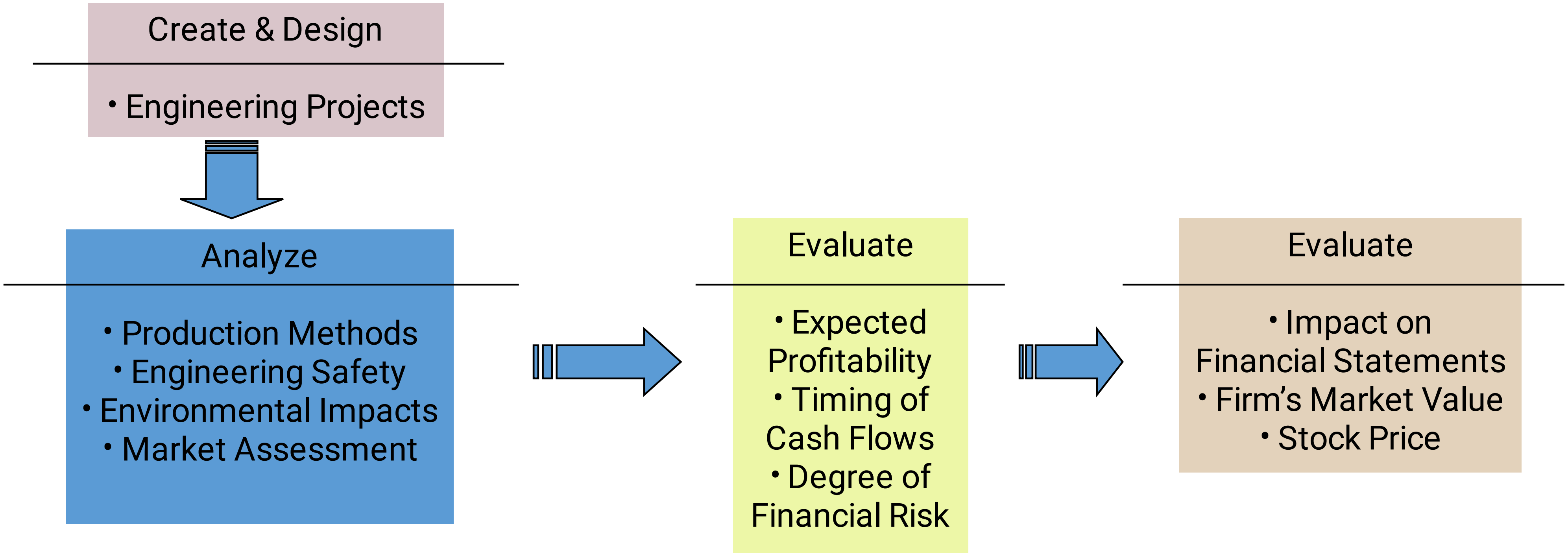
7. Revisit Your Decisions

Improved decision making results from an adaptive process; to the extent practicable, the initial projected outcomes of the selected alternative should be subsequently compared with actual results achieved.

ENGINEERING ECONOMY AND THE DESIGN PROCESS

- An engineering economy study is accomplished using a structured procedure and mathematical modeling techniques. The economic results are then used in a decision situation that involves two or more alternatives and normally includes other engineering knowledge and input.

Role of Engineers in Business



Two Factors in Engineering Economic Decisions

The factors of time and uncertainty are the defining aspects of any engineering economic decisions

Summary

- The term engineering economic decision refers to all investment decisions relating to engineering projects.
- The five main types of engineering economic decisions are (1) service improvement, (2) equipment and process selection, (3) equipment replacement, (4) new product and product expansion, and (5) cost reduction.
- The factors of time and uncertainty are the defining aspects of any investment project.

Unit 1 Summary

- Basic concepts
- Rational decisions / assumptions
- Production possibility diagram/curve
- Circular flow diagram
- Principles of engineering economics

Unit 2

Theory of Demand and Supply

Demand, Supply and concepts of elasticity

Learning Outcomes

- Develop the concepts of demand and its determinants.

- Discuss the factors that lead to shifts and movement along the demand curves.

- Explain price elasticity and its calculations, income and cross elasticity.

Markets

- A market is any institutional structure, or mechanism, that brings together buyers and sellers of particular goods and services

- Markets exists in many forms

- They determine the price and quantity of a good or service transacted

Markets

Demand

- The various amounts of a product that consumers are willing and able to purchase at various prices during some specific period
- Demonstrated by demand schedule and demand curve

Law of Demand

- The inverse relationship between the price and the quantity demanded of a good or service during some period of time

Law of Demand (cont.)

Based on:

1. Income
2. Substitution
3. Diminishing marginal utility

Income Effect

- At a lower price, consumers can buy more of a product without giving up other goods
- A decline in price increases the purchasing power of money/real income

Substitution Effect

- At a lower price, consumers have the incentive to substitute the cheaper good for similar goods that are now relatively more expensive

Diminishing Marginal Utility

- States that successive units of a given product yield less and less extra satisfaction
- Therefore, consumers will only buy more of a good if its price is reduced

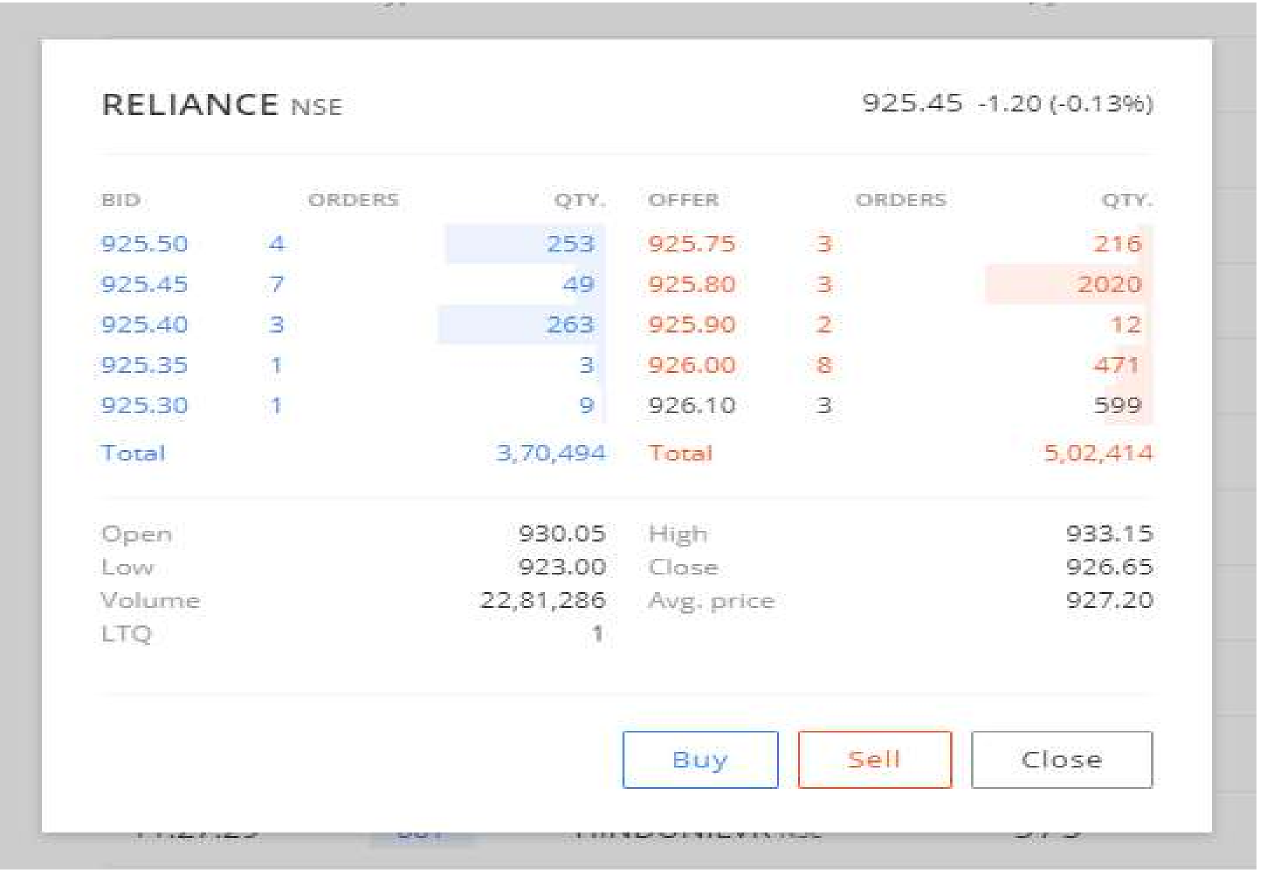
Consumer Demand: guidelines

- Free market economy: customer directs production through purchases:
  - 1) We buy what satisfies us!
  - 2) However, more and more = less satisfaction.

- Example: First piece of pizza (great), 5th piece (not as great), i.e. you have **less** satisfaction.

  -satisfaction level maintained by ordering a salad, bread, vs. one pizza.

Demand and Supply factors at the Stock Exchange



RELIANCE NSE 925.45 -1.20 (-0.13%)

BID	ORDERS	QTY.	OFFER	ORDERS	QTY.
925.50	4	253	925.75	3	216
925.45	7	49	925.80	3	2020
925.40	3	263	925.90	2	12
925.35	1	3	926.00	8	471
925.30	1	9	926.10	3	599
Total		3,70,494	Total		5,02,414

Open	930.05	High	933.15
Low	923.00	Close	926.65
Volume	22,81,286	Avg. price	927.20
LTQ	1		

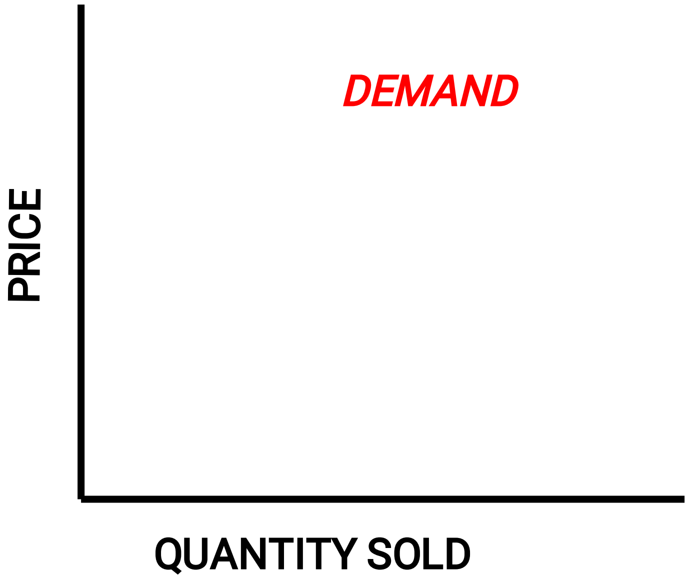
Buy Sell Close

Demand Curve

- Shows the inverse relationship between price and quantity demanded for a good or service
- Derived from a demand schedule showing the quantity demanded at various prices

Demand Schedule

- Higher price = fewer sold
- Negative relationship
- ***Law of demand*:** consumers buy less as the price rises, more as it drops



Role of Price in Demand

- Even the richest people (companies) have budgets (guidelines)
- But, they are still after greatest satisfaction for least cash...
- Price helps consumers/producers maximize finite resources.
- Further, a producer's demand for inputs is related to the consumer's demand for products
- This applies to firms linked together in the system (i.e., they are all linked together by demand)

Factors Influencing Consumer Demand (changers)

1) **Own price (price to own):** the price of the item consumed

2) **Substitute price:** item that could be substituted as price of original increases (tea and coffee; MacBook vs Dell)

3) **Complement price:** item that is often sold or used in conjunction with original (batteries for flashlight; cartridge and printer)

4) **Income:** people tend to trade-up for better goods
5) **Change in population:** increase = greater demand
6) **Tastes and preferences:** varies constantly
7) **Seasonality:** demand influenced by time of year (e.g., umbrella, ice cream)

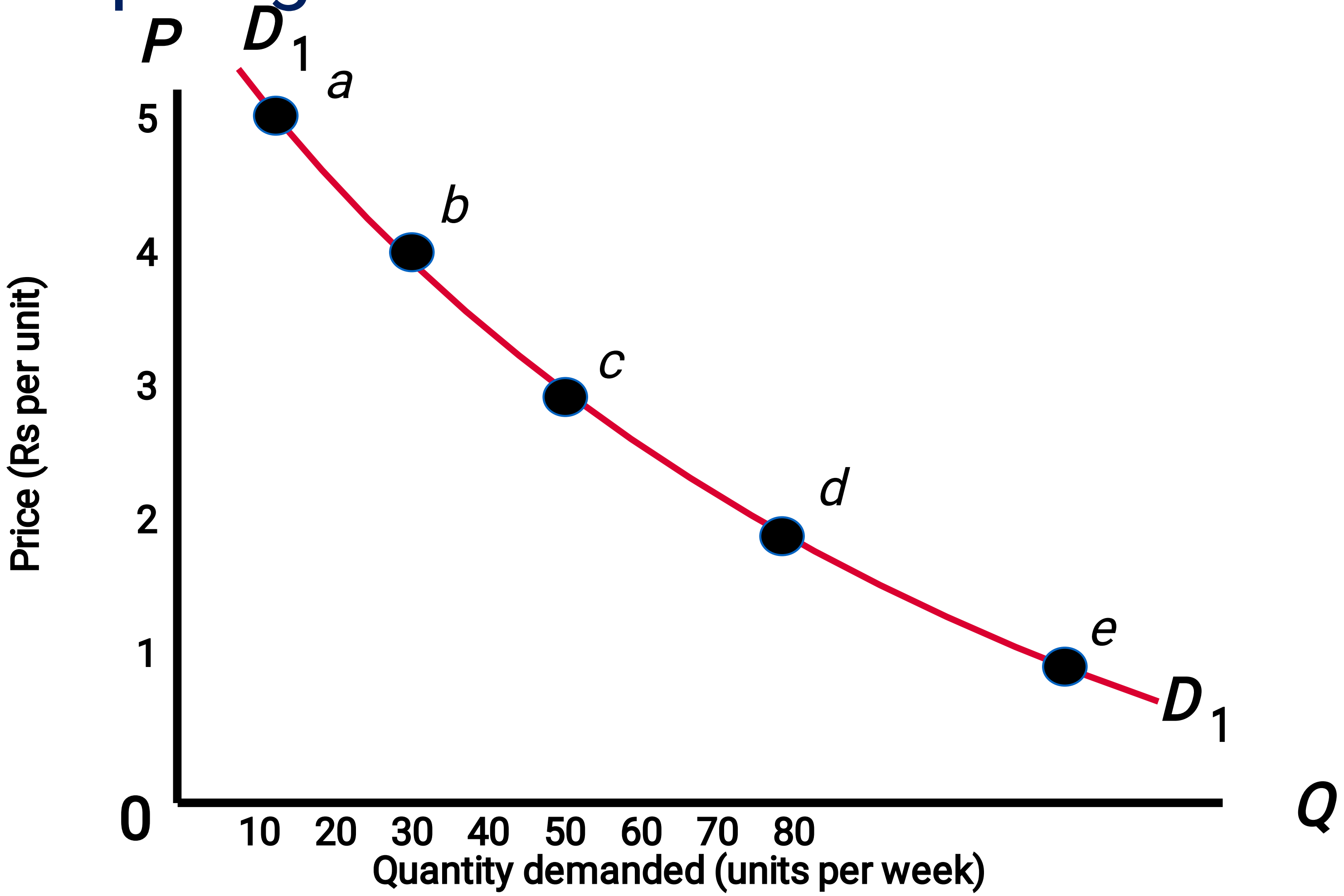
Demand Shifters

- **Demand *"shifters"*** factors which cause an increase/decrease in demand, but are not really price-related
- A ***"change"*** in demand occurs when the demand changes as a result of price
- If the own price increases and the amount of product sold decreases, the change in sales is a result of the law of demand
- If product sold simply increases without a change in price, it is a shift—can work both ways (up or down)

Demand schedule

	Price per unit	Quantity demanded per week
a	5	10
b	4	20
c	3	35
d	2	55
e	1	80

Graphing Demand



Changes in Demand

- Caused by changes in one or other of the determinants of demand
- Represented as a shift of the demand curve either to the right or left
- Represents a change in the quantity demand at every price, so cannot be related to a change in price

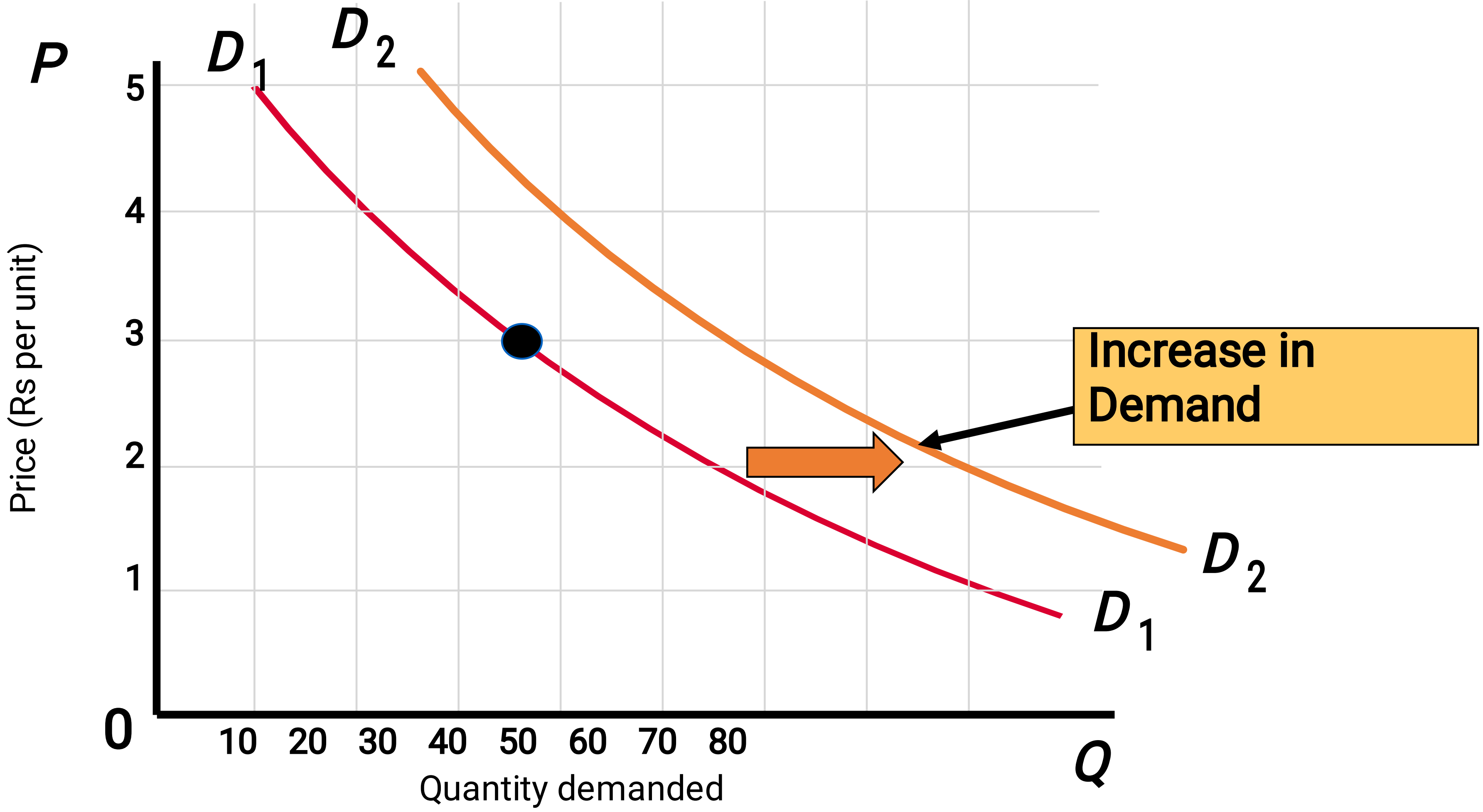
Changes in Demand

- Tastes or preferences
- Number of buyers
- Income
  - Normal or superior goods—demand varies directly with income
  - Inferior goods—demand varies inversely with income

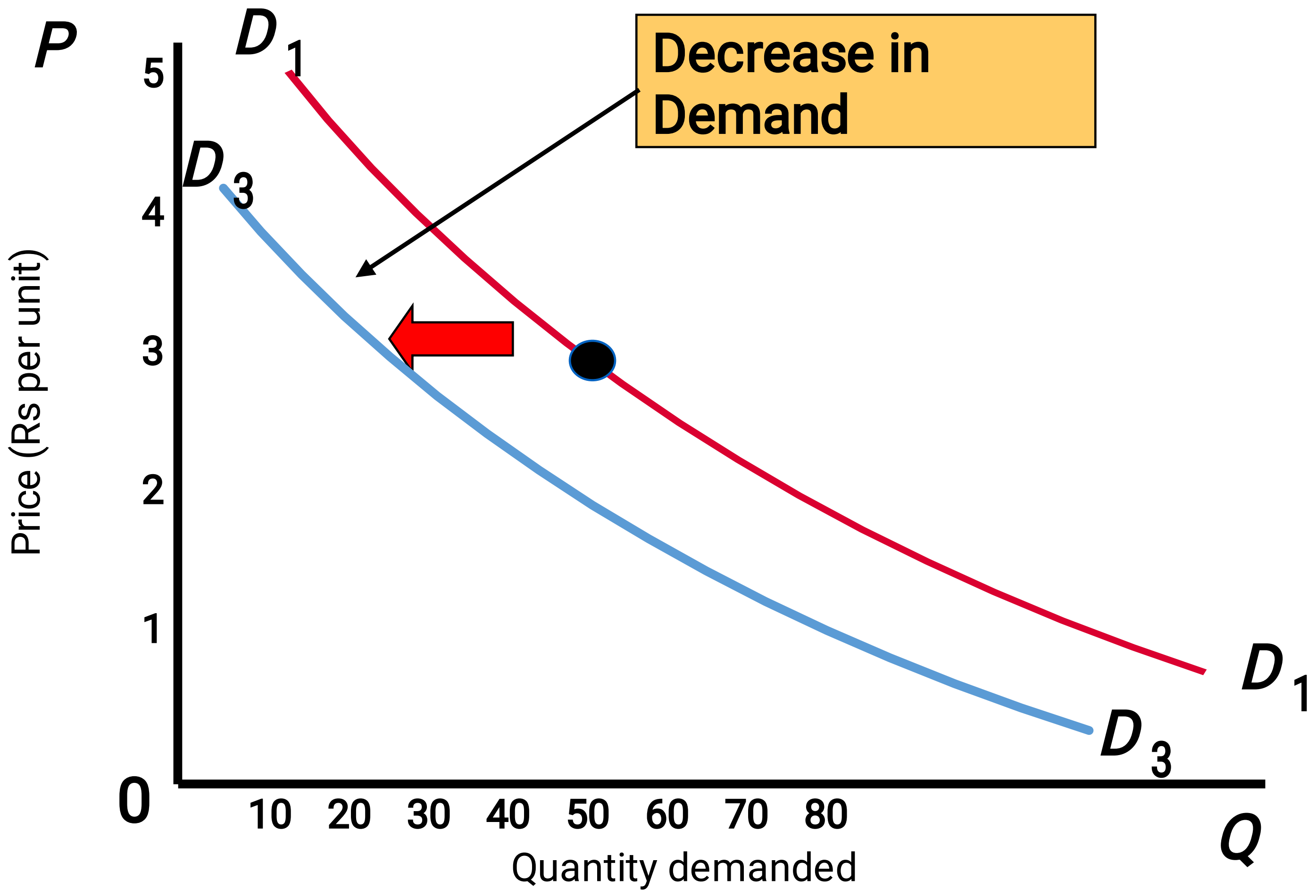
Changes in Demand (cont.)

- Prices of related goods
  - Substitute goods
  - Complementary goods
- Expectations
- Seasons/weather

Increase in Demand



Decrease in Demand



Changes in Quantity Demanded

- caused by changes in price only
- represented as movement along a demand curve
- other factors determining demand are held constant

Movement along a Curve

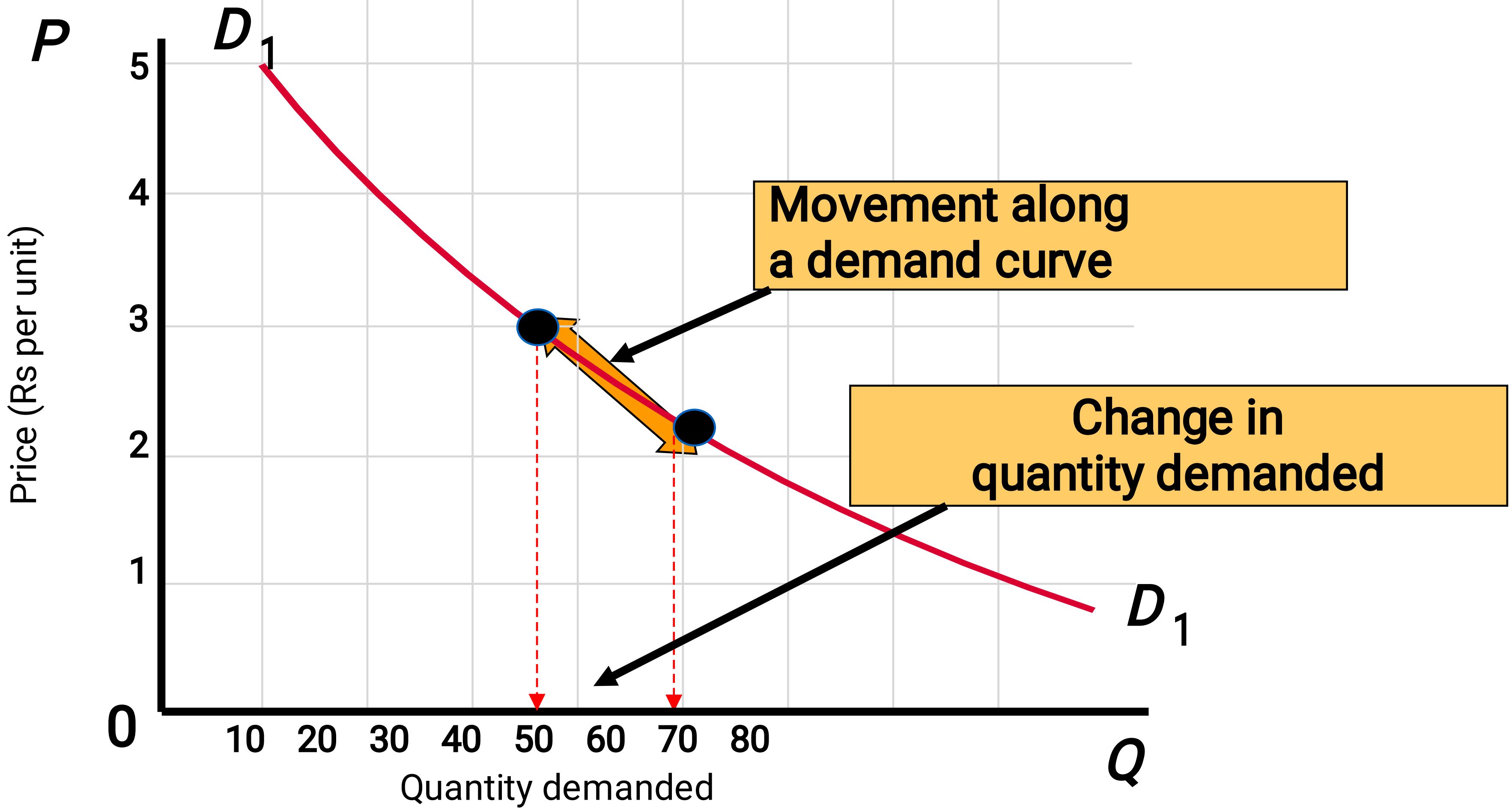
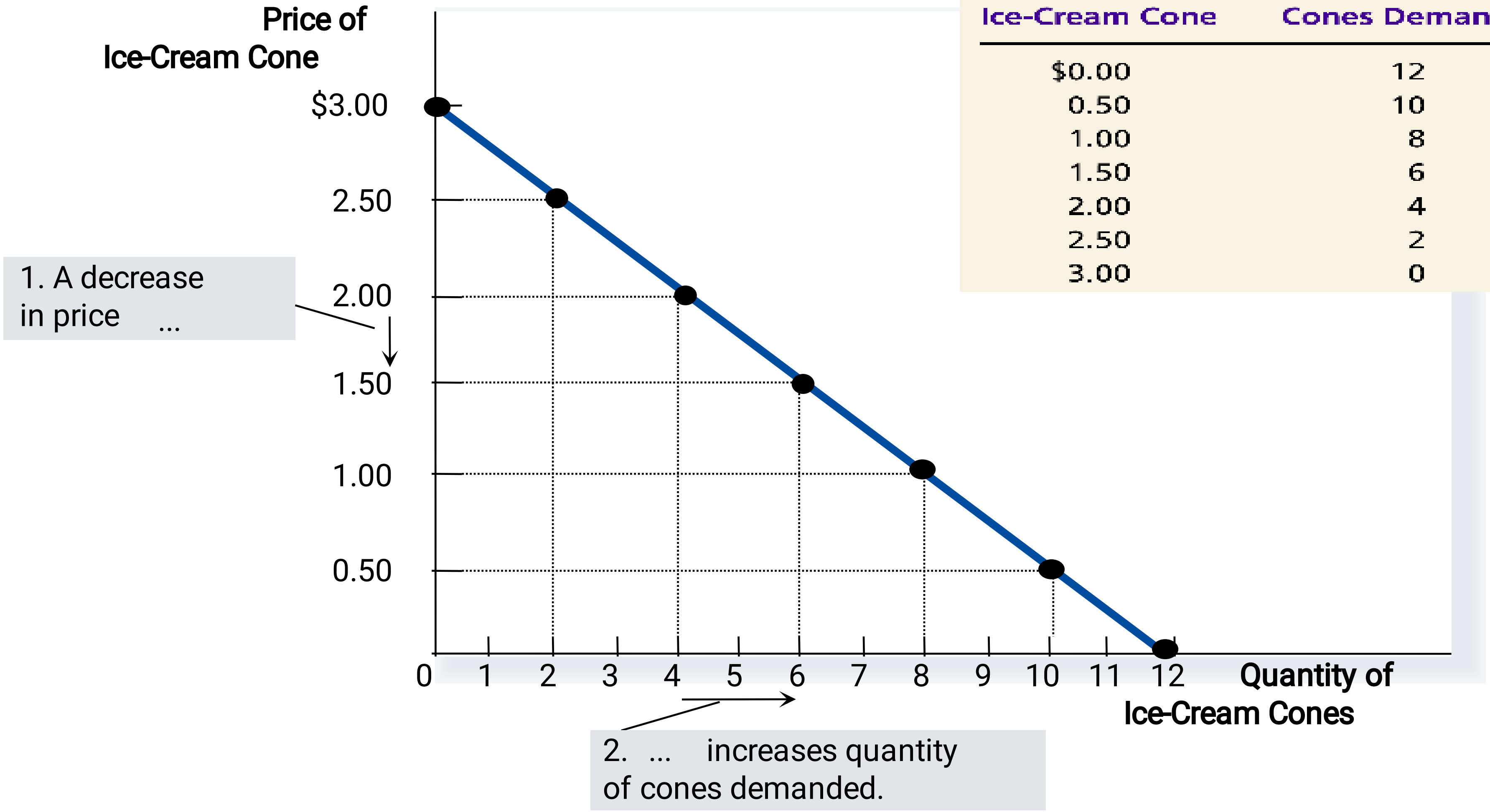


Figure 1 Catherine's Demand Schedule and Demand Curve

Price of Ice-Cream Cone	Quantity of Cones Demanded
$0.00	12
0.50	10
1.00	8
1.50	6
2.00	4
2.50	2
3.00	0



Market Demand versus Individual Demand

- Market demand refers to the sum of all individual demands for a particular good or service.
- Graphically, individual demand curves are summed horizontally to obtain the market demand curve.

The Market Demand Curve

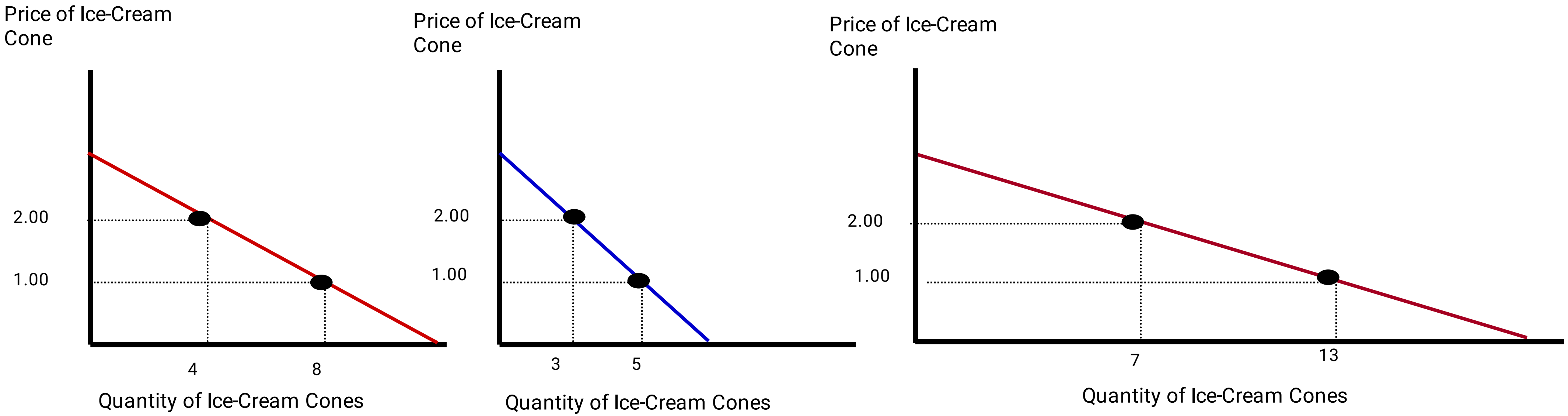
When the price is $2.00, Ca
will demand 4 ice-cream co

When the price is $2.00, Nicholas
will demand 3 ice-cream cones.

The market demand at $2.00 will be
7 ice-cream cones.

The market demand curve is the horizontal sum of the individual demand curves!

Catherine's Demand + Nicholas's Demand = Market Demand



When the price is $1.00, Catherine
will demand 8 ice-cream cones.

When the price is $1.00, Nicholas
will demand 5 ice-cream cones.

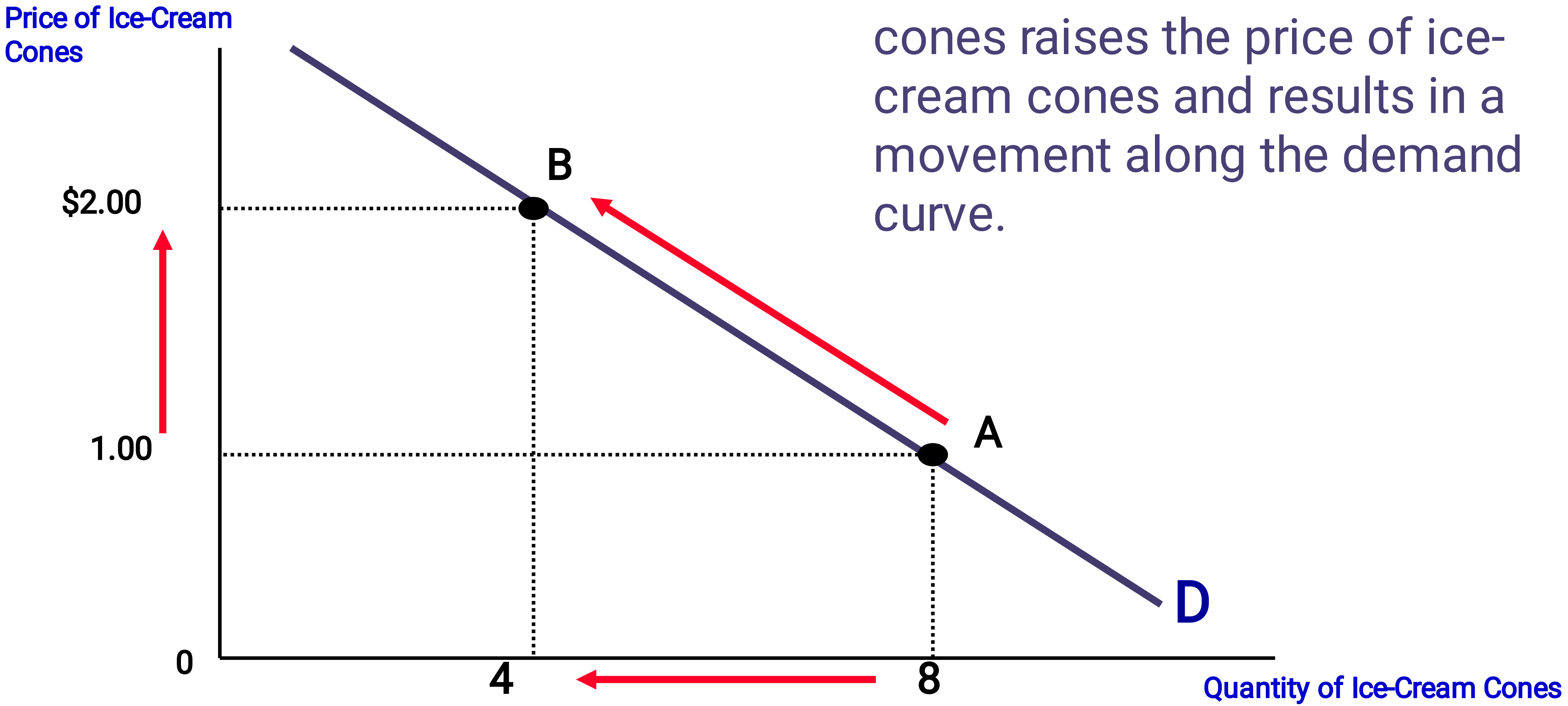
The market demand at $1.00, will
be 13 ice-cream cones.

Shifts in the Demand Curve

- Change in Quantity Demanded
  - Movement along the demand curve.
  - Caused by a change in the price of the product.

Changes in Quantity Demanded

A tax on sellers of ice-cream cones raises the price of ice-cream cones and results in a movement along the demand curve.



Individual and Market Demand

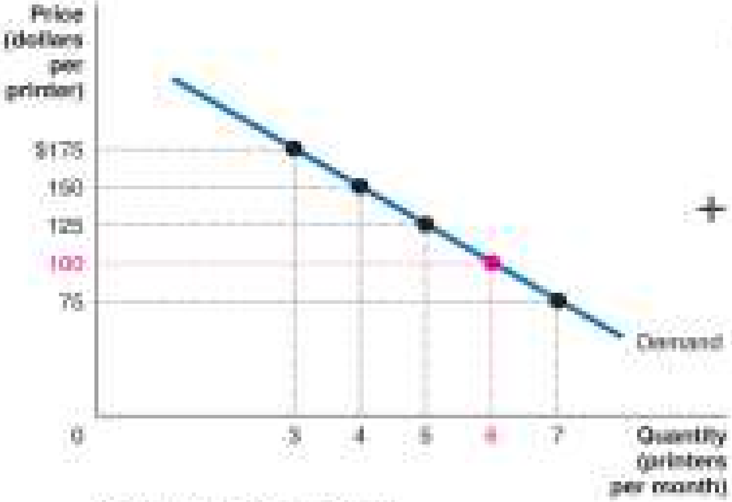
- Market demand is derived by horizontally summing individual demand curves
- Market demand is derived by adding all the quantities demanded in a demand schedule which correspond to their prices

Market Demand Table

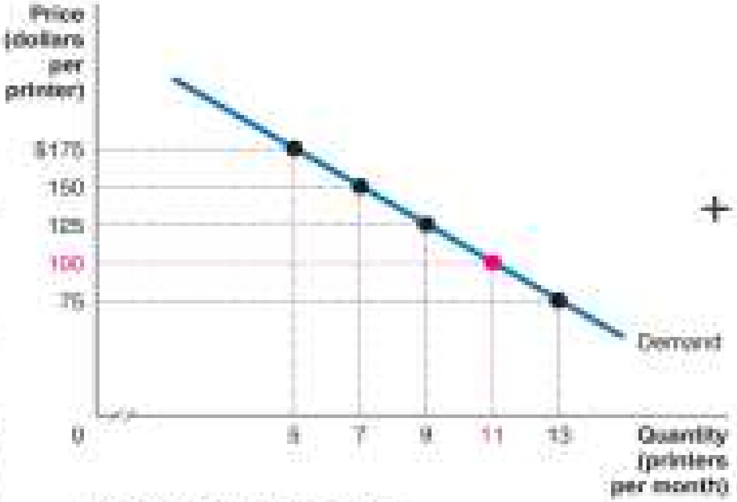
Price	Demand of individual 'A'	Demand of individual 'B'	Demand of individual 'C'	Market Demand
5	20	30	50	100
4	40	60	100	200
3	60	90	150	300
2	80	120	200	400

Deriving the market demand curve from individual curves: Figure 3.3

Price (dollars per printer)	Quantity (printers per month) Group A	Group B	Group C	Market
$175	3	5	6	14
150	4	7	7	18
125	5	9	8	22
100	6	11	9	26
75	7	13	10	30

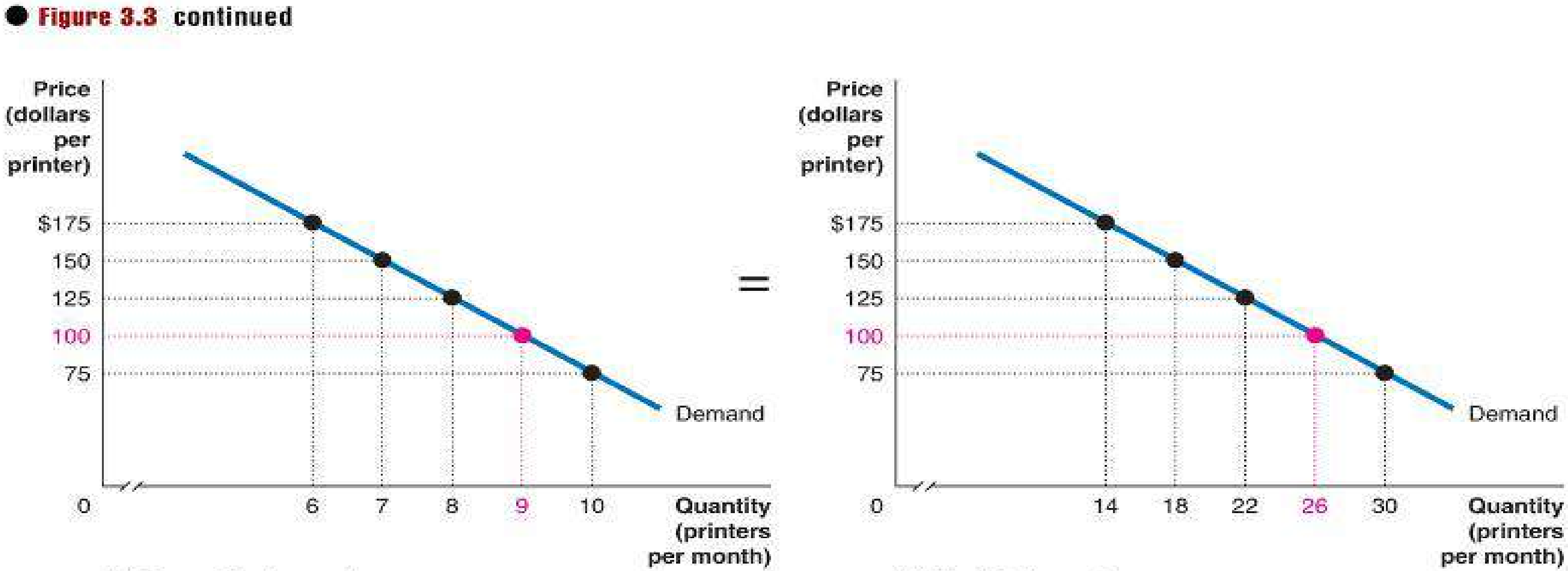


(a) Group A's demand curve



(b) Group B's demand curve

Deriving the market demand curve from individual curves: Figure 3.3, continued



(c) Group C's demand curve

(d) Market demand curve

Elasticity

- Basic idea:
  Elasticity measures how much one variable responds to changes in another variable.
  - One type of elasticity measures how much demand for products will fall if the price is raised.
- Definition:
  Elasticity is a numerical measure of the responsiveness of Q^d or Q^s to one of its determinants.

Price Elasticity of Demand

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in } Q^d}{\text{Percentage change in } P}$$

- **Price elasticity of demand** measures how much Q^d responds to a change in P .

- Loosely speaking, it measures the price-sensitivity of buyers' demand.

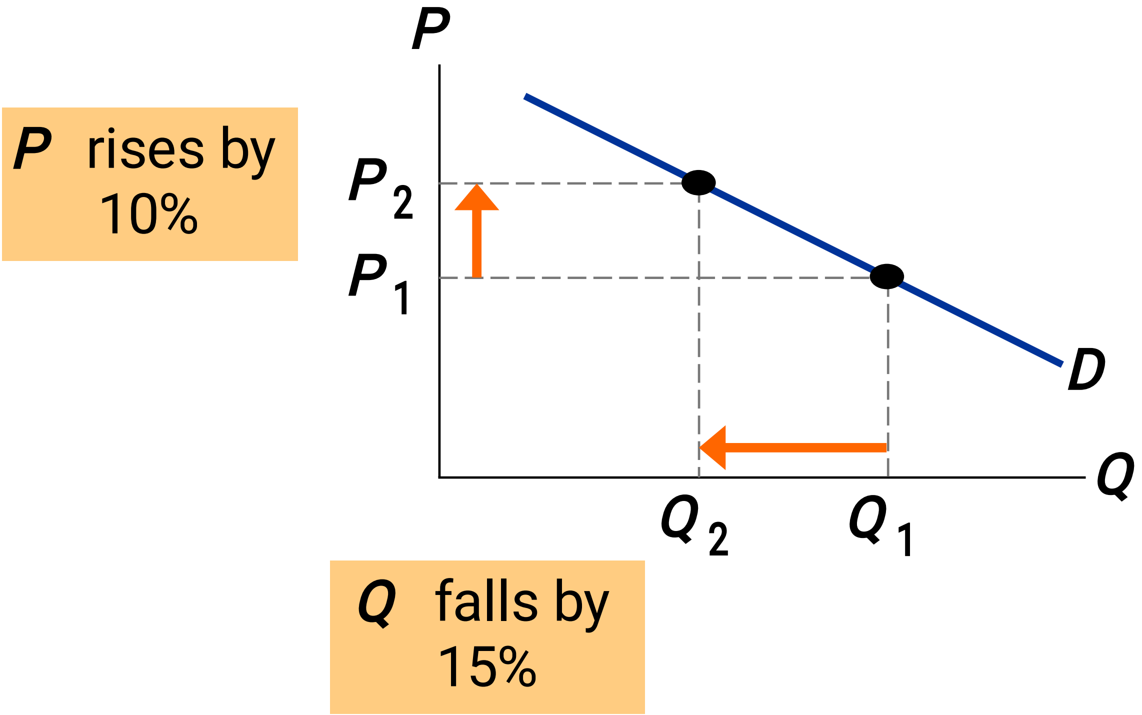
Price Elasticity of Demand

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in } Q^d}{\text{Percentage change in } P}$$

Example:

Price elasticity of demand equals

$$\frac{15\%}{10\%} = 1.5$$

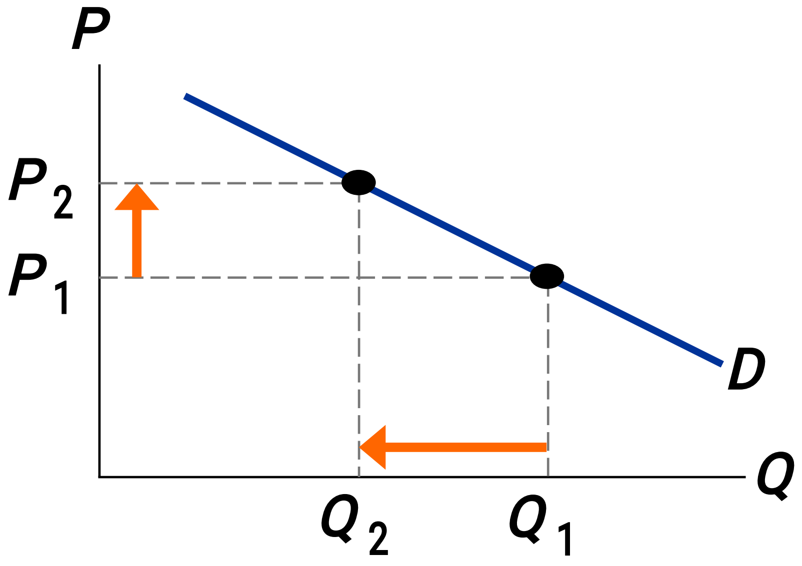


Price Elasticity of Demand

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in } Q^d}{\text{Percentage change in } P}$$

Along a *D* curve, *P* and *Q* move in opposite directions, which would make price elasticity negative.

We will drop the minus sign and report all price elasticities as positive numbers.



Market Demand Table

Price	Demand of individual 'A'	Demand of individual 'B'	Demand of individual 'C'	Market Demand
5	20	30	50	100
4	40	60	100	200
3	60	90	150	300
2	80	120	200	400

What determines price elasticity?

To learn the determinants of price elasticity,
we look at a series of examples.
Each compares two common goods.

In each example:

- Suppose the prices of both goods rise by 20%.
- The good for which Q^d falls the most (in percent) has the highest price elasticity of demand.
  Which good is it? Why?
- What lesson does the example teach us about the determinants of the price elasticity of demand?

The concept of elasticity

- Has the London congestion charge reduced traffic flows and congestion?
- Will most people still fly if there is a new aviation fuel tax?

Price elasticity of demand

- Why is elasticity of demand important for Stelios?

Elasticity of Demand

- Why do hotels hike room-rates at weekends and why do car rental firms charge higher prices at weekend?

Elasticity Questions…are these products Price Elastic or Inelastic?

Dell cuts the price of their desktop PCs by 10%	
A fall in the price of I-max tickets	
An increase in the price of the EconomicTimes	
A taxi home from a night-club on a Friday night	
A rise in average car insurance premiums	
Petrol prices rise by 5% after the budget	
Vodafone cuts their mobile phone charges	
Aviation surcharge rises by 20% due to a rise in world oil prices	
A local leisure club decreases monthly charges by 15% in a bid to increase the number of members	

- In early 2011, Netflix consumers paid about $10 a month for a package consisting of streaming video and DVD rentals. In July 2011, the company announced a packaging change. Customers wishing to retain both streaming video and DVD rental would be charged $15.98 per month – a price increase of about 60%. In 2014, Netflix also raised its streaming video subscription price from $7.99 to $8.99 per month for new U.S. customers. The company also changed its policy of 4K streaming content from $9.00 to $12.00 per month that year.

- How do the customers react?

EXAMPLE 1:
Breakfast cereal vs. Sunscreen

- The prices of both of these goods rise by 20%. For which good does Q^d drop the most? Why?
  - Breakfast cereal has close substitutes (*e.g*., pancakes, Eggo waffles, etc.), so buyers can easily switch if the price rises.
  - Sunscreen has no close substitutes, so consumers would probably not buy much less if its price rises.
- Lesson: ***Price elasticity is higher when close substitutes are available.***

EXAMPLE 2:

“Blue Jeans” vs. “Clothing”

- The prices of both goods rise by 20%.
  For which good does Q^{d} drop the most? Why?
  - For a narrowly defined good such as blue jeans, there are many substitutes (khakis, shorts, Speedos).
  - There are fewer substitutes available for broadly defined goods. (There aren’t too many substitutes for clothing)
- Lesson: ***Price elasticity is higher for narrowly defined goods than broadly defined ones.***

EXAMPLE 3:

Insulin vs. Luxury Caribbean Cruises

- The prices of both of these goods rise by 20%.
  For which good does Q^d drop the most? Why?
  - To millions of diabetics, insulin is a necessity.
    A rise in its price would cause little or no decrease in demand.
  - A cruise is a luxury. If the price rises,
    some people will forego it.
- Lesson: ***Price elasticity is higher for luxuries than for necessities.***

EXAMPLE 4:

Petrol in the Short Run vs. petrol in the Long Run

- The price of petrol rises 20%. Does Q^d drop more in the short run or the long run? Why?
  - There's not much people can do in the short run, other than ride the bus or carpool.
  - In the long run, people can buy smaller cars or live closer to where they work or alternate fuel systems may develop.
- Lesson: ***Price elasticity is higher in the long run than the short run.***

The Determinants of Price Elasticity: A Summary

The price elasticity of demand depends on:

- the extent to which close substitutes are available
- whether the good is a necessity or a luxury
- how broadly or narrowly the good is defined
- the time horizon – elasticity is higher in the long run than the short run

The Variety of Demand Curves

- The price elasticity of demand is closely related to the slope of the demand curve.
- Rule of thumb:
  The flatter the curve, the bigger the elasticity.
  The steeper the curve, the smaller the elasticity.
- Five different classifications of $\boldsymbol{D}$ curves….

"Perfectly inelastic demand" (one extreme case)

$$\text{Price elasticity of demand} = \frac{\%\text{ change in } Q}{\%\text{ change in } P} = \frac{0\%}{10\%} = 0$$

D curve:

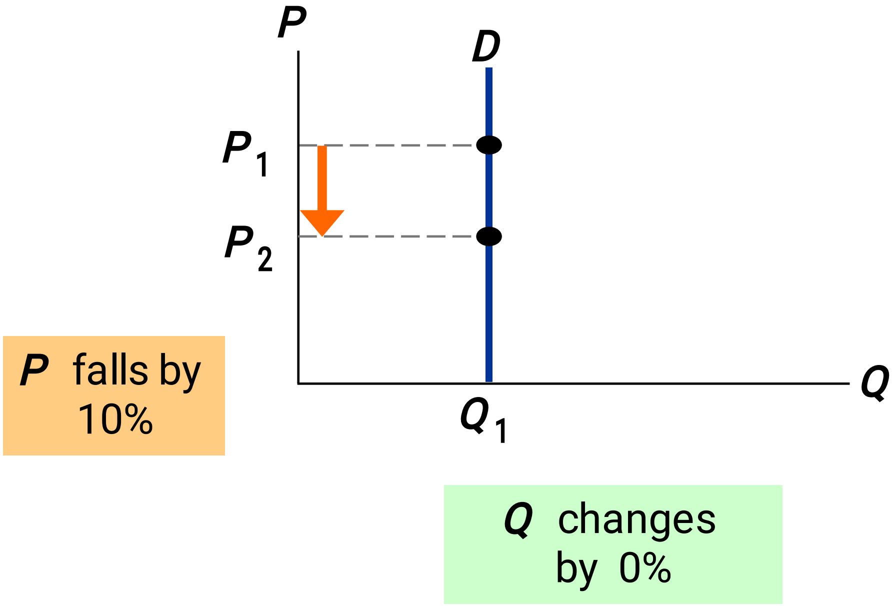
vertical

Consumers' price sensitivity:

none

Elasticity:

0



“Inelastic demand”

$$\text{Price elasticity of demand} = \frac{\%\text{ change in } \boldsymbol{Q}}{\%\text{ change in } \boldsymbol{P}} = \frac{< 10\%}{10\%} < 1$$

D curve:

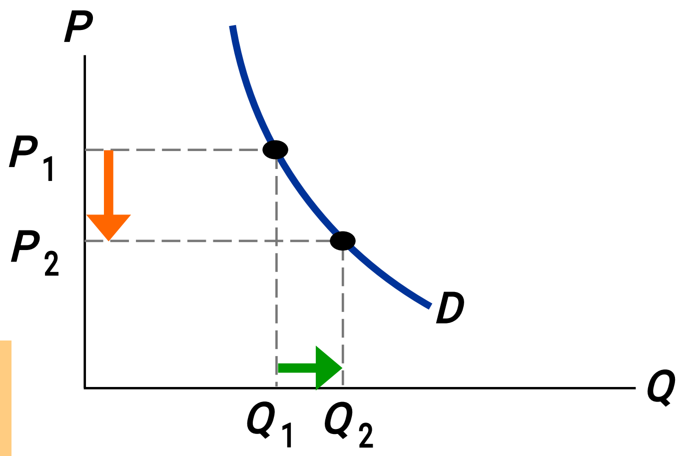
relatively steep

Consumers’ price sensitivity:

relatively low

Elasticity:

< 1



P falls by 10%

Q rises less than 10%

"Unit elastic demand"

$$\text{Price elasticity of demand} = \frac{\%\text{ change in } Q}{\%\text{ change in } P} = \frac{10\%}{10\%} = 1$$

D curve:

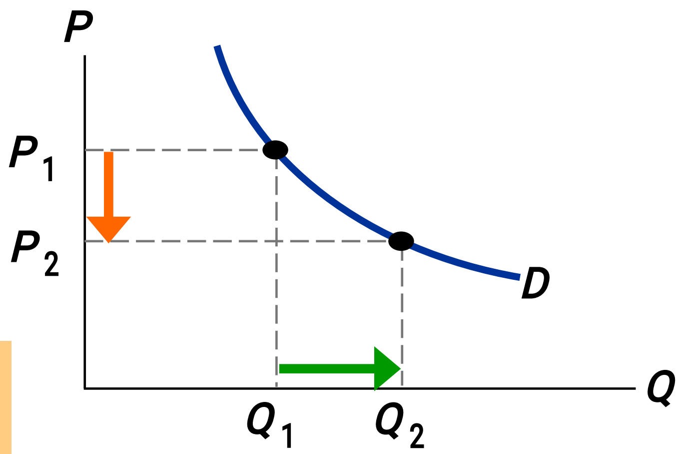
intermediate slope

Consumers' price sensitivity:

intermediate

Elasticity:

1



P falls by 10%

Q rises by 10%

"Elastic demand"

$$\text{Price elasticity of demand} = \frac{\%\text{ change in } \boldsymbol{Q}}{\%\text{ change in } \boldsymbol{P}} = \frac{> 10\%}{10\%} > 1$$

D curve:

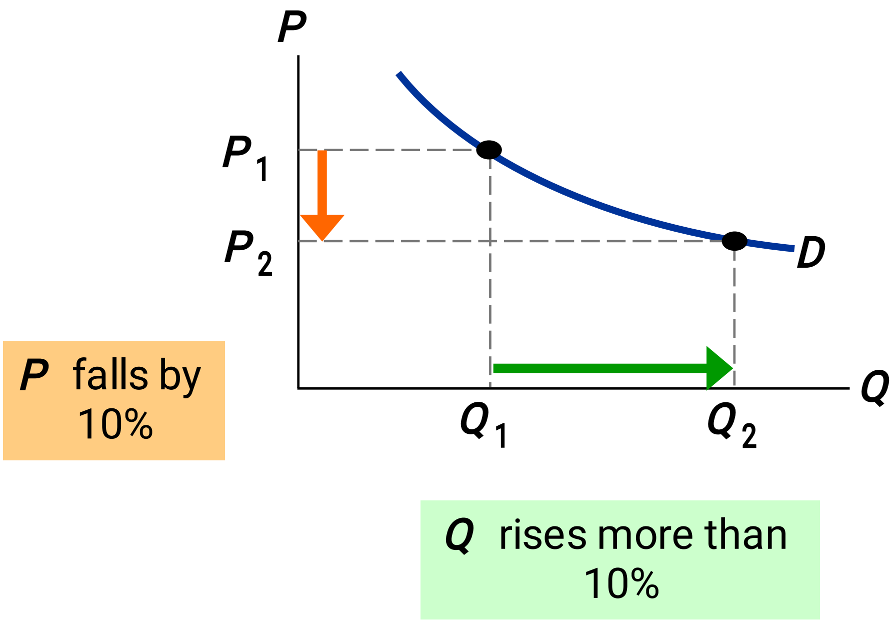
relatively flat

Consumers' price sensitivity:

relatively high

Elasticity:

> 1



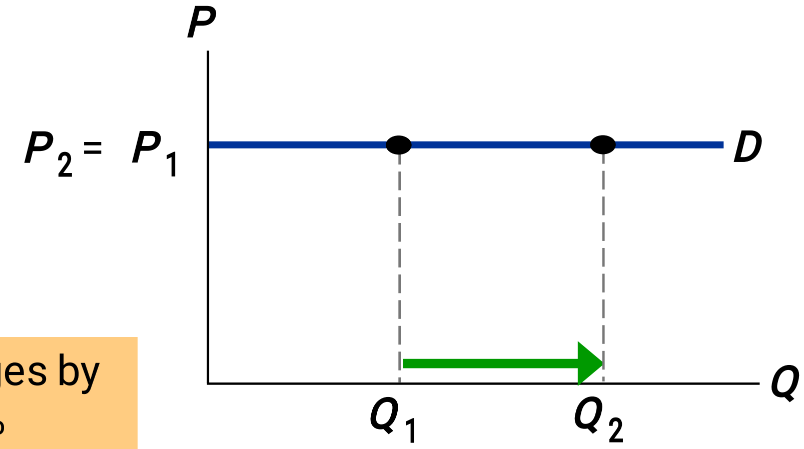
"Perfectly elastic demand" (the other extreme)

$$\text{Price elasticity of demand} = \frac{\%\text{ change in } Q}{\%\text{ change in } P} = \frac{\text{any }\%}{0\%} = \text{infinity}$$

D curve:
horizontal

Consumers' price sensitivity:
extreme

Elasticity:
infinity



P changes by 0%

Q changes by any %

Price Elasticity and Total Revenue

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in } \boldsymbol{Q}}{\text{Percentage change in } \boldsymbol{P}}$$

Revenue = ***P*** x ***Q***

- If demand is inelastic, then

  price elast. of demand < 1

  % change in ***Q*** < % change in ***P***

- The fall in revenue from lower ***Q*** is smaller than the increase in revenue from higher ***P***, so revenue rises.

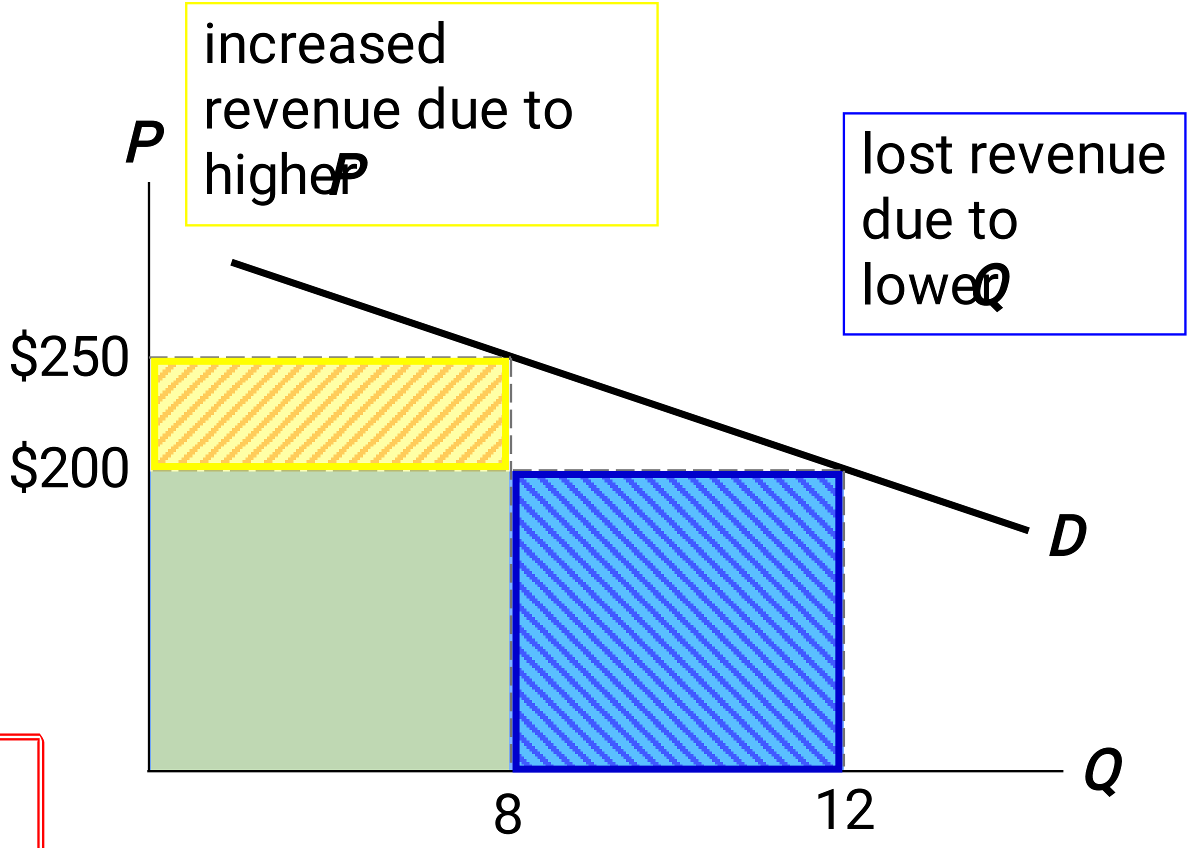
Price Elasticity and Total Revenue

Elastic demand
(elasticity = 1.8)

If ***P*** = $200,
Q = 12 and revenue = $2400.

If ***P*** = $250,
Q = 8 and
revenue = $2000.

When ***D*** is elastic,
a price increase
causes revenue to fall.



Price Elasticity and Total Revenue

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in } Q}{\text{Percentage change in } P}$$

Revenue = P x Q

- If demand is inelastic, then

  price elast. of demand < 1

  % change in Q < % change in P
- The fall in revenue from lower Q is smaller than the increase in revenue from higher P, so revenue rises.
- In our example, suppose that Q only falls to 10 (instead of 8) when you raise your price to $250.

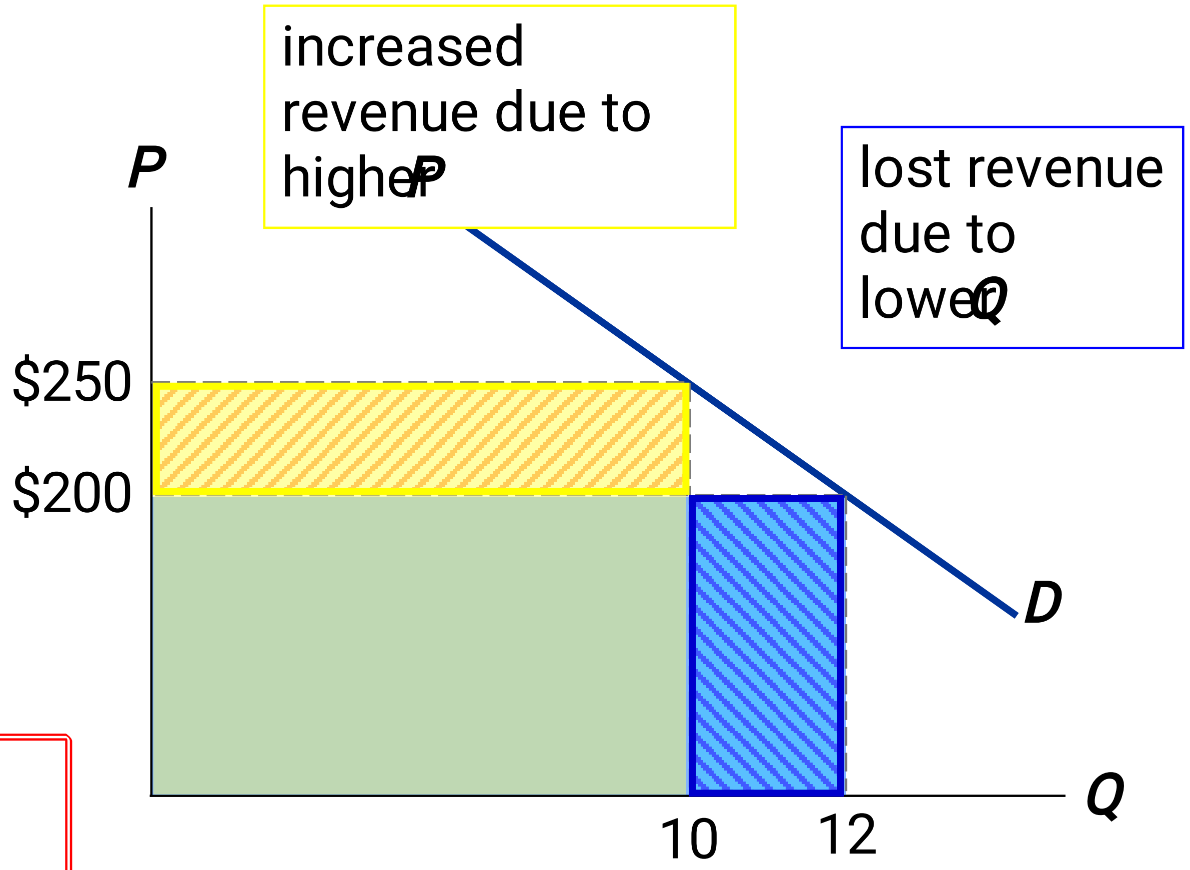
Price Elasticity and Total Revenue

Now, demand is inelastic:
elasticity = 0.82

If *P* = $200,
Q = 12 and revenue = $2400.

If *P* = $250,
Q = 10 and
revenue = $2500.

When *D* is inelastic,
a price increase
causes revenue to rise.



Computing the Price Elasticity of Demand

Example: If the price of an ice cream cone increases from $2.00 to $2.20 and the amount you buy falls from 10 to 8 cones then your elasticity of demand would be calculated as:

Table-2: Demand Schedule	
Price per unit (₹)	Quantity Demanded(units)
60	100
70	90

Elasticity =

Example-1: The demand schedule for coffee is shown in Table-1:

Table-1: Demand Schedule for Coffee	
Price of Coffee (₹)	**Quantity Demanded(Kg)**
20	10
22	9

Elasticity =

Other Elasticities

- **Income elasticity of demand**: measures the response of Q^d to a change in consumer income

$$\text{Income elasticity of demand} = \frac{\text{Percent change in } Q^d}{\text{Percent change in income}}$$

- An increase in income causes an increase in demand for *luxury* and *normal* goods.
- Income elasticity is >1 for luxury products.
- For normal goods, income elasticity > 0 but <1.
- For *inferior* goods, income elasticity < 0.

Other Elasticities

- **Cross-price elasticity of demand**:
  measures the response of demand for one good to changes in the price of another good

$$\text{Cross-price elast. of demand} = \frac{\%\text{ change in } Q^d \text{ for good 1}}{\%\text{ change in price of good 2}}$$

- For substitutes, cross-price elasticity > 0
  (e.g., an increase in price of beef causes an increase in demand for chicken)
- For complements, cross-price elasticity < 0
  (e.g., an increase in price of computers causes decrease in demand for software)

Cross-Price Elasticities in the News

"As Fuel Costs Soar, Buyers Flock to Small Cars"
-*New York Times*, 5/2/2008

"Fuel Prices Drive Students to Online Courses"
-*Chronicle of Higher Education*, 7/8/2008

"Fuel prices knock bicycle sales, repairs into higher gear"
-*Associated Press*, 5/11/2008

"Camel demand soars in India"
(as a substitute for "fuel-guzzling tractors")
-*Financial Times*, 5/2/2008

"High fuel prices drive farmer to switch to mules"
-*Associated Press*, 5/21/2008

Income Elasticity of Demand

Income Elasticity of Demand

- The income is the other factor that influences the demand for a product.

- Hence, the degree of responsiveness of a change in demand for a product due to the change in the income is known as income elasticity of demand.

INCOME ELASTICITY OF DEMAND (cont.)

FORMULA:

$$\varepsilon_Y = \frac{\%\ \Delta\ \text{Quantity Demanded}}{\%\ \Delta\ \text{Income}}$$

$$\varepsilon_Y = \frac{Q_2 - Q_1}{Q_1} \times \frac{Y_1}{Y_2 - Y_1}$$

Income Elasticity of Demand

- Income elasticity (in absolute sense) can be:
  1) Greater than 1 (normal good, income elastic)
     - **luxury goods** - ocean cruises, jewelry
  2) Between zero and 1 (normal good, income inelastic)
     - **necessities** - food, clothing
  3) Less than zero (inferior good)
     - potatoes, rice

Calculate the income elasticity of demand for X when the income of consumers increases from 200 to 400. then demand increases from 100 to 150 ,What type of product is X

Calculate the income elasticity of demand for Z when the income of consumers decreases from 200 to 100. then demand increases from 100 to 120 ,What type of product is Z

Cross Elasticity of Demand

Cross Elasticity of Demand

- The cross elasticity of demand refers to the change in quantity demanded for one commodity as a result of the change in the price of another commodity.
- This type of elasticity usually arises in the case of the interrelated goods such as substitutes and complementary goods.

Cross Elasticity of Demand

- Elasticity measure that looks at the impact a change in the price of one good has on the demand of another good.
- % change in demand Q1/% change in price of Q2.
- Positive-Substitutes
- Negative-Complements.

Substitute Goods

- When the cross elasticity of demand for product A relative to a change in price of product B is positive, it means that in response to an increase (decrease) in price of product B, the quantity demanded of product A has increased (decreased). Since A, say Coke, and B, say Sprite, are substitutes, an increase in price of product B means that more people will consume A instead of B, and this will increase the quantity demanded of product A. Increase in quantity demanded of product A relative to increase in price of product B gives us a positive cross elasticity of demand.

Complementary Goods

- When the cross elasticity of demand for product A relative to change in price of product B is negative, it means that the quantity demanded of A has decreased (increased) relative to an increase (decrease) in price of product B. As A, say car, and B, say fuel, are complimentary goods, and an increase in price of B will reduce the quantity demanded of A. This is because people consume both A and B as a bundle and an increase in price reduces their purchasing power and decreases quantity demanded.

CROSS ELASTICITY OF DEMAND

FORMULA:

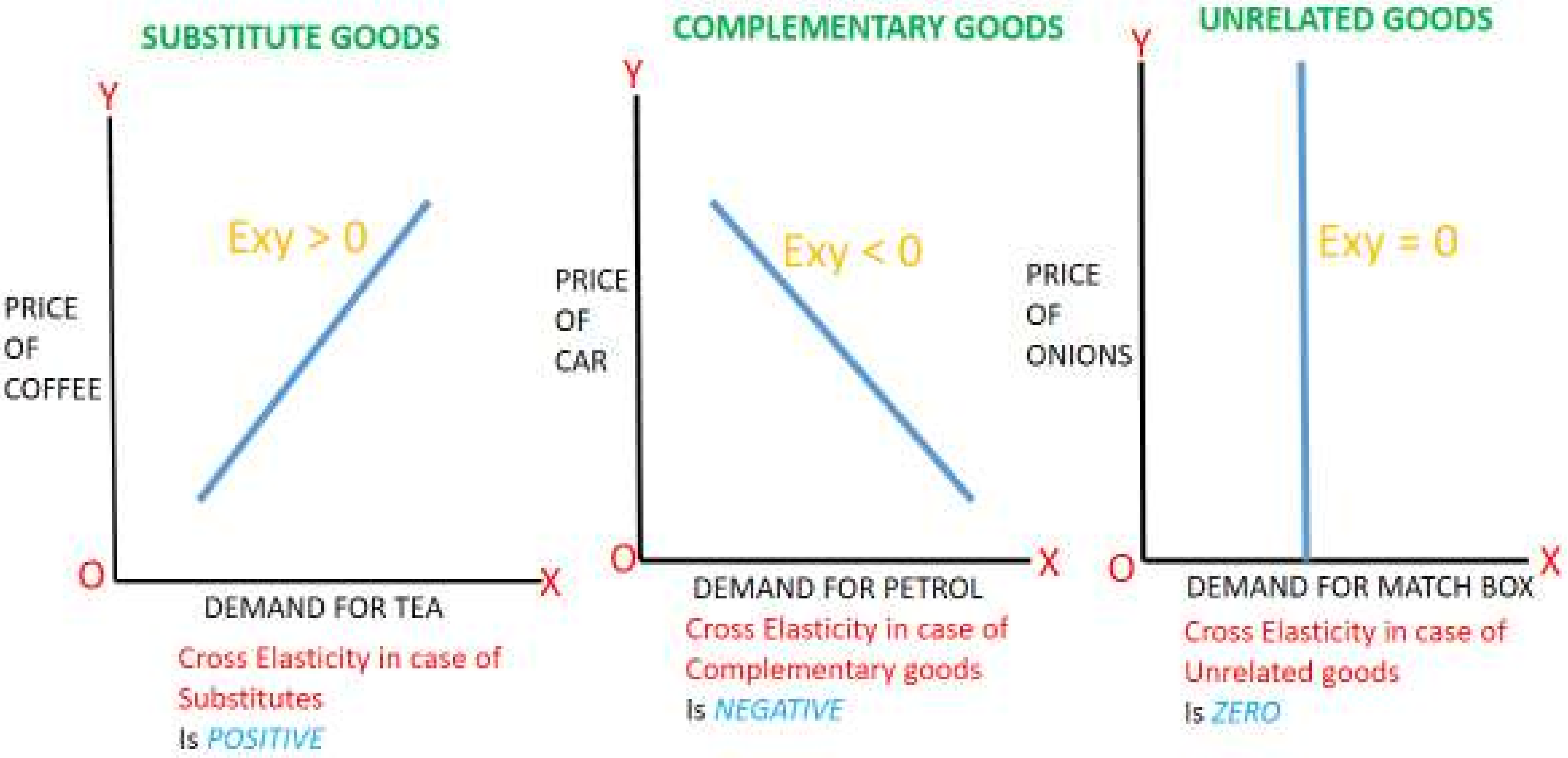
$$\varepsilon_X = \frac{\%\ \Delta\ \text{Quantity Demanded of good X}}{\%\ \Delta\ \text{Price of good Y}}$$

$$\varepsilon_X = \frac{Q_{X2} - Q_{X1}}{Q_{X1}} \times \frac{P_{Y1}}{P_{Y2} - P_{Y1}}$$

Understanding the Coefficient of Cross Price Elasticity

The stronger the relationship between two products, the higher is the co-efficient of cross-price elasticity of demand

- **Substitutes:**
  - **Close substitutes** have a strongly **positive** cross price elasticity of demand i.e. a small change in relative price causes a big switch in consumer demand
- **Complements:**
  - When there is a strong complementary relationship, the cross elasticity will be highly **negative**.
  - An example might be games consoles and software games
- **Unrelated products:**
  - Unrelated products have **zero** cross elasticity e.g. the effect of changes in taxi fares on the market demand for cheese!



SUBSTITUTE GOODS
Y
Exy > 0
PRICE
OF
COFFEE
O
X
DEMAND FOR TEA
Cross Elasticity in case of
Substitutes
Is POSITIVE
COMPLEMENTARY GOODS
Y
Exy < 0
PRICE
OF
CAR
O
X
DEMAND FOR PETROL
Cross Elasticity in case of
Complementary goods
Is NEGATIVE
UNRELATED GOODS
Y
Exy = 0
PRICE
OF
ONIONS
O
X
DEMAND FOR MATCH BOX
Cross Elasticity in case of
Unrelated goods
Is ZERO

Price of X	Demand for X	Demand for Y	Income
25	10	5	100
20	20	10	200
15	30	15	300
10	40	20	400

- Calculate the price elasticity of demand for X, if the price of X increase from Rs10 to Rs 20, and indicate whether the demand is elastic or inelastic.
- Calculate the income elasticity of demand for X when the income of consumers increases from 200 to 400.What type of product is X.
- Calculate the cross elasticity of demand for Y when the price of X decrease from 25 to 15. Are X and Y complements or substitute.

- Income increases from Rs 100 to Rs 110, and quantity demanded also increases from 50 to 55. then income elasticity of demand will be -

- If quantity demanded of X increases by 5 % when the price of Y increases by 20 % the cross price elasticity would be – Qx/Py

- If quantity demanded of A increases by 10 % when the price of B declines by 20 %, the cross price elasticity of demand between A and B would be – QA/PB

3

Production and Costs

Part 1

Production Function –
Variable proportions and Returns to Scale

SHORT-RUN AND LONG-RUN PRODUCTION FUNCTION

- **Two Types of Factor Inputs**
  - **Fixed Input**
    - An input which the quantity **does not change** according to the amount of **output**.
    - Example: Machinery, land, buildings, tools, equipment, etc.
  - **Variable Input**
    - An input which the quantity **changes** according to the amount of **output**.
    - Example: Raw materials, electricity, fuel, transportation, communication, etc.
- **Short-run and Long-run Periods**
  - ***Short run*** period is the time frame, which at least one of the inputs (factor of production) is ***fixed*** and other inputs can be varied.
  - ***Long run*** period is the time frame which all inputs are ***variable***.

SHORT-RUN PRODUCTION FUNCTION

- In the short run, we assume that at least one of the inputs is fixed that is capital.
- Therefore, in the short run the production function can be written as:

$$\mathbf{Q = f(L)}$$

Where: Q = Output

L = Labor

SHORT-RUN PRODUCTION FUNCTION (cont.)

TOTAL PRODUCT (TP)

The amount of output produced when a given number of labor is used along with fixed inputs.

AVERAGE PRODUCT (AP)

Divide the total product by the amount of that input used in the production

$$\textbf{Average Product } (AP_L) = \frac{\textbf{Total Product}}{\textbf{Total Labour}}$$

$$AP_L = TP/L$$

THEORY OF PRODUCTION

SHORT-RUN PRODUCTION FUNCTION (cont.)

MARGINAL PRODUCT (MP)

Change in the total product of that input corresponding to an addition unit change in its labour, assuming other factors that is capital fixed.

$$\text{Marginal Product } (MP_L) = \frac{\text{Change in Total Product}}{\text{Change in Total Labour}}$$

$$MP_L = \Delta TP / \Delta L$$

THEORY OF PRODUCTION

LAW OF DIMINISHING MARGINAL RETURNS

- It states that if the quantities of certain factors (inputs) are increased while the quantities of one or more factors (inputs) are held constant, beyond a certain level of production, the rate of increase in output will decrease.

OR

- "Law of diminishing marginal returns states that as more of a variable input is used while other input and technology are fixed, the marginal product of the variable input will eventually decline".

Assumptions

(i) Constant Technology:

- The state of technology is assumed to be given and constant. If there is an improvement in technology the production function will move upward.

(ii) Factor Proportions are Variable:

- The law assumes that factor proportions are variable. If factors of production are to be combined in a fixed proportion, the law has no validity.

(iii) Homogeneous Factor Units:

- The units of variable factor are homogeneous. Each unit is identical in quality and amount with every other unit.

(iv) Short-Run:

- The law operates in the short-run when it is not possible to vary all factor inputs.

Capital (Fixed input)	Labour (Variable input)	Total Product	Marginal Product	Average Product	Stages of Productio n
10	0	0	0	0	STAGE I
10	1	8	8	8	
10	2	20	12	10	
10	3	33	13	11	
10	4	44	11	11	
10	5	50	6	10	STAGE II
10	6	54	4	9	
10	7	56	2	8	
10	8	56	0	7	
10	9	54	-2	6	STAGE III
10	10	50	-4	5	

$$MP = \frac{54 - 56}{9 - 8} = -2$$

$$AP = \frac{56}{8} = 7$$

THEORY OF PRODUCTION

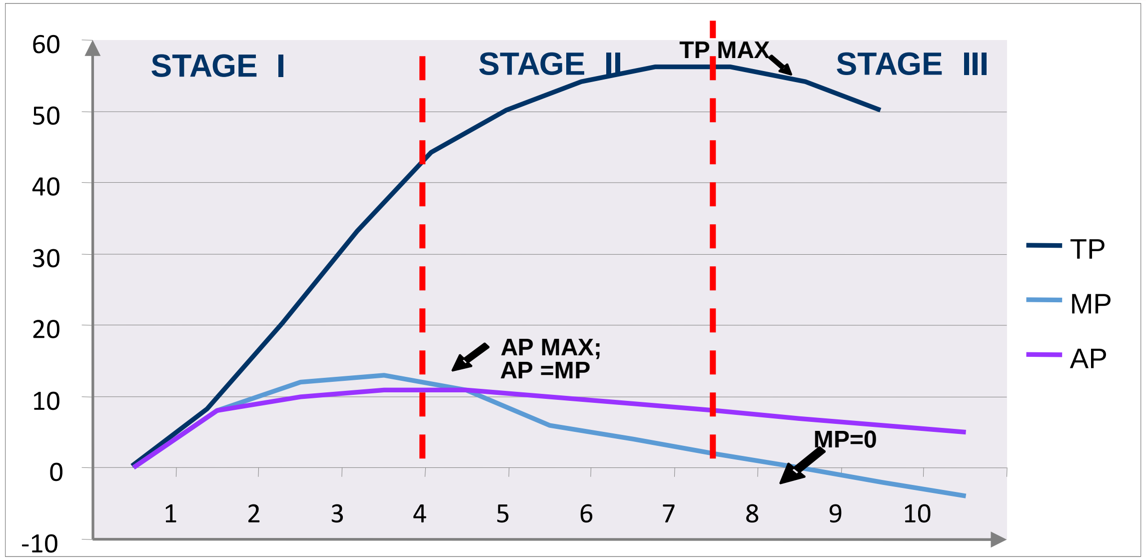
Properties and Relationships between TP, AP and MP

RELATIONSHIP BETWEEN TP AND MP

When ***MP*** is _increasing_, ***TP*** increase at an _increasing rate_.
When ***MP*** *is* _decreasing_, ***TP*** increase at a _decreasing rate_.
When ***MP*** *is* _zero_, ***TP*** at its _maximum_.
When ***MP*** *is* _negative_, ***TP*** _declines_.

RELATIONSHIP BETWEEN AP AND MP

When ***MP*** is above ***AP*** , ***AP*** is _increasing_
When ***MP*** is below ***AP***, ***AP*** is _decreasing._
When ***MP*** equals to ***AP***, ***AP*** is at _maximum._



THEORY OF PRODUCTION

Increasing returns

- It becomes cheaper to produce the additional output
- Thus, the producer will always expand through this stage

Causes

- Fixed factor is used more intensively and production increases rapidly.
- Division of labour and specialization
- The fixed factors are indivisible and which means they must be used in an fixed minimum size.

Diminishing returns

- This is the stage in which production is feasible and more profitable
- In this stage the marginal productivity of labour is positive though, it is diminishing but is non-negative

Causes

- The distribution in the combination of factors
- Control and supervision becomes difficult
- There may be shortage of trained labour or raw materials

Negative returns

- It clearly shows loss and no business would like to operate in this stage
- Stage II is the best because it utilizes the resources / inputs very well.

Total Product	Marginal Product	Average Product
Stage I		
First increases at increasing rate then at diminishing rate.	Increases in the beginning then reaches a maximum and begins to decrease.	First increases, continues to increase and becomes maximum.
Stage II		
Continues to increase at diminishing rate and becomes maximum.	Continues to diminish and becomes equal to zero.	Becomes equal to MP and then begins to diminish.
Stage III		
Diminishes	Becomes negative.	Continues to diminish but will always be greater than zero.

Rational Decision

- Stage II becomes the relevant and important stage of production.
- Mainstream production will not take place in either of the other two stages.
- Thus, a rational producer will operate in stage II

SHORT-RUN PRODUCTION FUNCTION (cont.)

Stage I

- Proportion of fixed factors are greater than variable factors
- Under utilization of fixed factor
- Operation involves a waste of resources

Stage II

- Called law of diminishing returns
- The most efficient stage of production because the combinations of inputs are fully utilized

STAGES OF PRODUCTION

Stage III

- Proportion of fixed factors is lower than variable factors
- Increase in variable factors decline the TP because of overcrowding
- A producer would not like to operate at this stage

THEORY OF PRODUCTION

- **ISOQUANT ANALYSIS**
  - An isoquant or iso-product represents all the possible combination of two factor inputs, which gives the same level of output (total product).
  - Represents all the possible combinations of variable inputs that used to generate the same level of output (total product).

LONG-RUN PRODUCTION FUNCTION (cont.)

ISOQUANT SCHEDULE
Production with two variable inputs

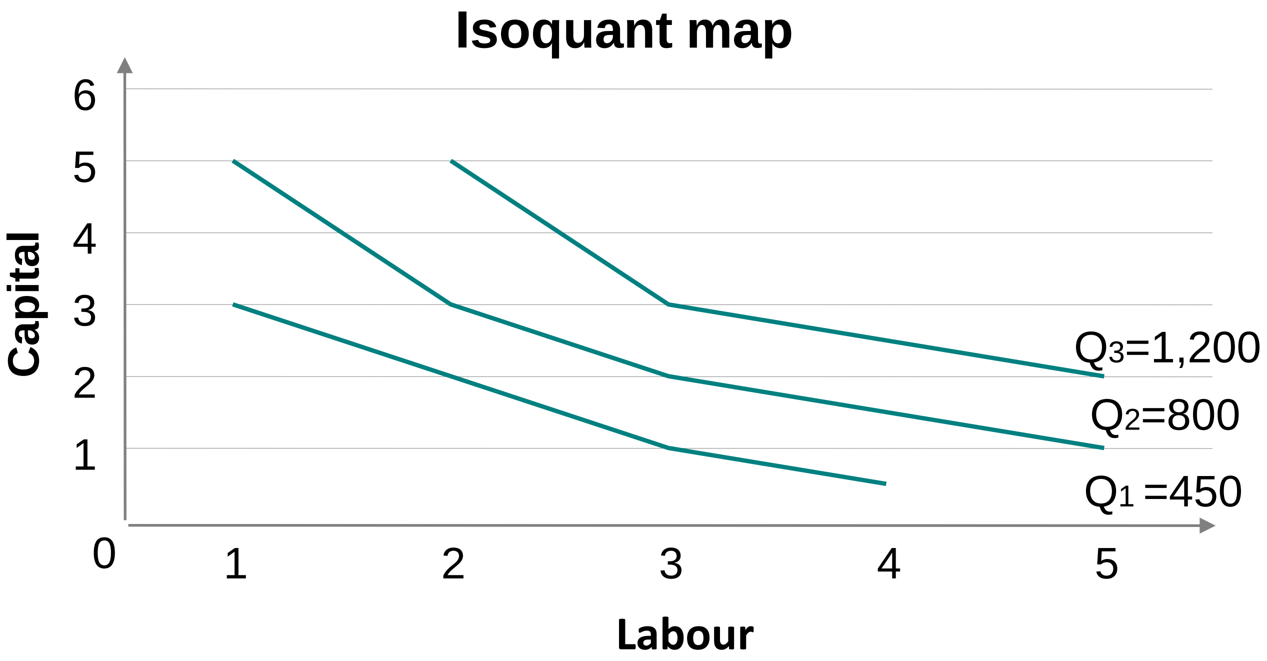
Capital	Labour				
	1	**2**	3	4	5
1	250	450	550	700	800
2	450	650	800	900	950
3	600	800	950	1050	1100
4	700	900	1050	1150	1200
5	800	950	1100	1200	1250

There are various combination of capital and labour. Using 2 units of capital and 2 units of labour, the total output would be 650 units. If a firm needs 900 units of output, there are a few combinations such as 2 labour and 4 capital or 4 labour with 2 capital.

LONG-RUN PRODUCTION FUNCTION (cont.)

- **Isoquant Map**
  - Refers to a number of isoquants that are combined in a single graph.
  - Can be used to estimate the maximum attainable output from different combinations of inputs.
  - higher isoquant curve represents a higher level of output.

LONG-RUN PRODUCTION FUNCTION (cont.)



LONG-RUN PRODUCTION FUNCTION (cont.)

Marginal Rate of Technical Substitution

- The technique to estimate the amount of capital input to be replaced by labour input without increasing or decreasing output.

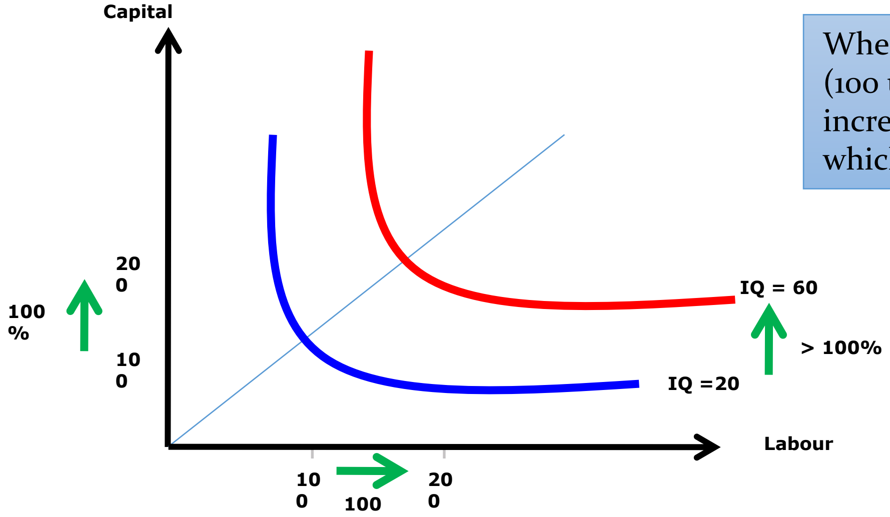
$$MRTS = -\frac{\text{Change in Capital}}{\text{Change in Labour}}$$

$$MRTS = -\Delta K / \Delta L$$

SCALE OF PRODUCTION

INCREASING RETURNS TO SCALE

❖ ***All the factors of production are increased in a given proportion, output would increase by a greater proportion.***



When labour and capital are doubled (100 units to 200 units), output increases from 20 units to 60 units, which is more than double.

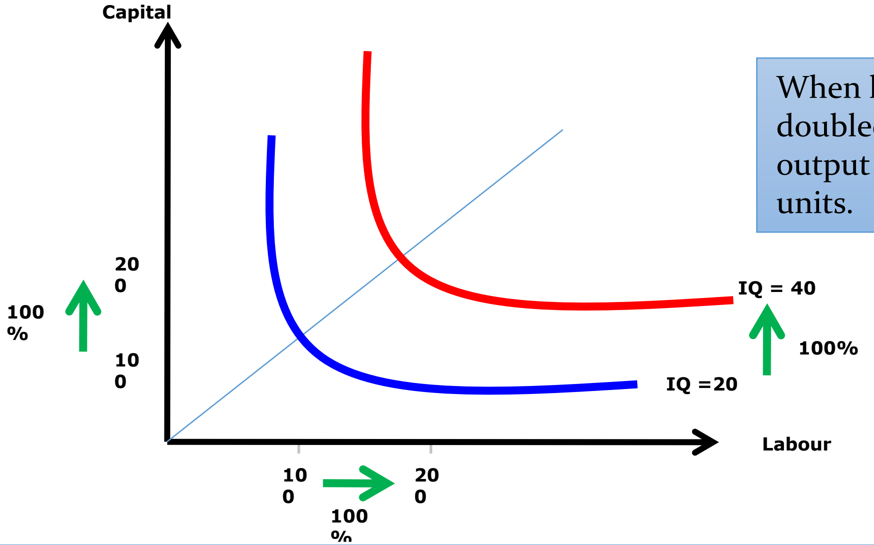
The causes of increasing returns to scale are specialization, technical economies, managerial economies which are also known as **economies of scale**.

THEORY OF PRODUCTION

SCALE OF PRODUCTION (cont.)

CONSTANT RETURNS TO SCALE

- ***All the factors of production are increased in a given proportion, output would increase by same proportion.***



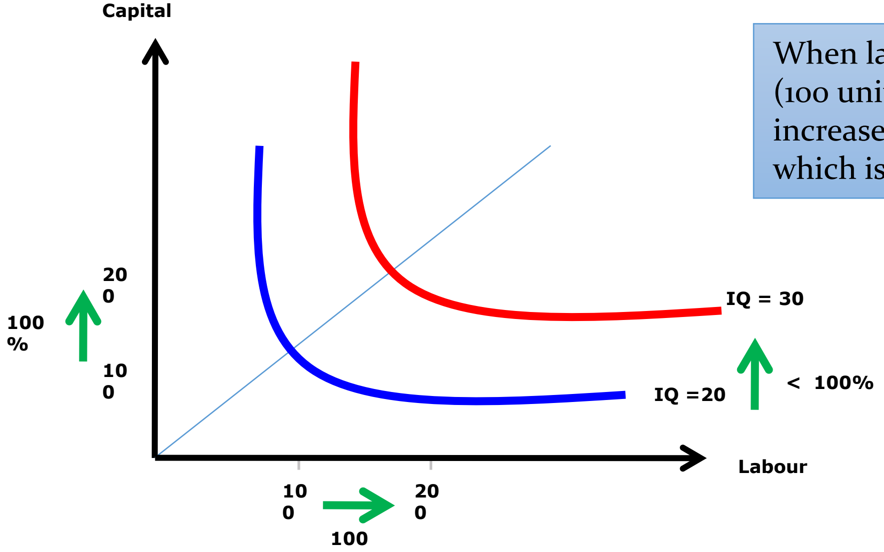
When labour and capital are doubled (100 units to 200 units), output increases from 20 units to 40 units.

THEORY OF PRODUCTION

SCALE OF PRODUCTION (cont.)

DECREASING RETURNS TO SCALE

- ***All the factors of production are increased in a given proportion, output would increase by a smaller proportion.***



When labour and capital are doubled (100 units to 200 units), output increases from 20 units to 30 units, which is less than double.

The causes of decreasing returns to scale are internal and external diseconomies of scale.

Economies of Scale

Economies of Scale

- As businesses grow – costs of production decrease
- Bigger businesses gain some advantages over smaller businesses through Economies of Scale
- There are two types of Economies of Scale:
  - Internal Economies
  - External Economies

Internal and External Economies

Internal Economies

- Those Specifically related to the business itself eg:-

1. Production
2. Purchasing
3. Marketing
4. Financial
5. Managerial

External Economies

- Benefits the whole industry and not specific firms

1. Skilled labour in the area
2. Better road and rail networks
3. Improves the reputation of the area
4. Attracts other businesses

Economies of Scale

- The advantages of large scale production that result in lower unit (average) costs (cost per unit)
- AC = TC / Q
- Economies of scale – spreads total costs over a greater range of output

Economies of Scale

- **Internal: Technical**
  - Specialisation – large organisations can employ specialised labour
  - Indivisibility of plant – machines can’t be broken down to do smaller jobs!
  - Principle of multiples – firms using more than one machine of different capacities - more efficient
  - Increased dimensions – bigger containers can reduce average cost

Economies of Scale

- **Indivisibility of Plant:**
- Not viable to produce products
  like oil, chemicals on small scale – need large amounts of capital
- Agriculture – machinery appropriate for large scale work – combines, etc.

Economies of Scale

- **Principle of Multiples:**
- Some production processes need more than one machine
- Different capacities
- May need more than one machine to be fully efficient

Economies of Scale

- **Commercial**
- Large firms can negotiate favourable prices as a result of buying in bulk
- Large firms may have advantages in keeping prices higher because of their market power

Economies of Scale

- **Financial**
- Large firms able to negotiate cheaper finance deals
- Large firms able to be more flexible about finance – share options, rights issues, etc.
- Large firms able to utilise skills of merchant banks to arrange finance

Economies of Scale

- **Managerial**
  - Use of specialists – accountants, marketing, lawyers, production, human resources, etc.

Economies of Scale

- **Risk Bearing**
  - Diversification
  - Markets across regions/countries
  - Product ranges
  - R&D

Diseconomies of Scale

- **The disadvantages of large scale production that can lead to increasing average costs**
  - Problems of management
  - Maintaining effective communication
  - Co-ordinating activities – often across the globe!
  - De-motivation and alienation of staff
  - Divorce of ownership and control

Part 2

Concepts of Costs, Short-run and Long-run

In this part, look for the answers to these questions:

- What are the various costs, and how are they related to each other and to output?
- How are costs different in the short run vs. the long run?
- What are “economies of scale”?

Total Revenue, Total Cost, Profit

- We assume that the firm's goal is to maximize profit.

Profit = Total revenue – Total cost

the amount a firm receives from the sale of its output

the market value of the inputs a firm uses in production

Costs: Explicit vs. Implicit

- **Explicit costs** require an outlay of money, *e.g.*, paying wages to workers.
- **Implicit costs** do not require a cash outlay, *e.g.*, the opportunity cost of the owner's time.
- One of the Ten Principles:

  The cost of something is what you give up to get it.
- This is true whether the costs are implicit or explicit. Both matter for firms' decisions.

Explicit vs. Implicit Costs: An Example

You need $100,000 to start your business.
The interest rate is 5%.

- Case 1: borrow $100,000
  - explicit cost = $5000 interest on loan
- Case 2: use $40,000 of your savings, borrow the other $60,000
  - explicit cost = $3000 (5%) interest on the loan
  - implicit cost = $2000 (5%) *foregone* interest you could have earned on your $40,000.

In both cases, total (exp + imp) costs are $5000.

Economic Profit vs. Accounting Profit

- **Accounting profit**

  = total revenue minus total explicit costs

- **Economic profit**

  = total revenue minus total costs (including explicit and implicit costs)

- Accounting profit ignores implicit costs, so it's higher than economic profit.

ACTIVE LEARNING 2
Economic profit vs. accounting profit

The equilibrium rent on office space has just increased by $500/month.

Compare the effects on accounting profit and economic profit if

a. you rent your office space

b. you own your office space

ACTIVE LEARNING **2**

Answers

The rent on office space increases $500/month.

a. You rent your office space.

Explicit costs increase $500/month.
Accounting profit & economic profit each fall $500/month.

b. You own your office space.

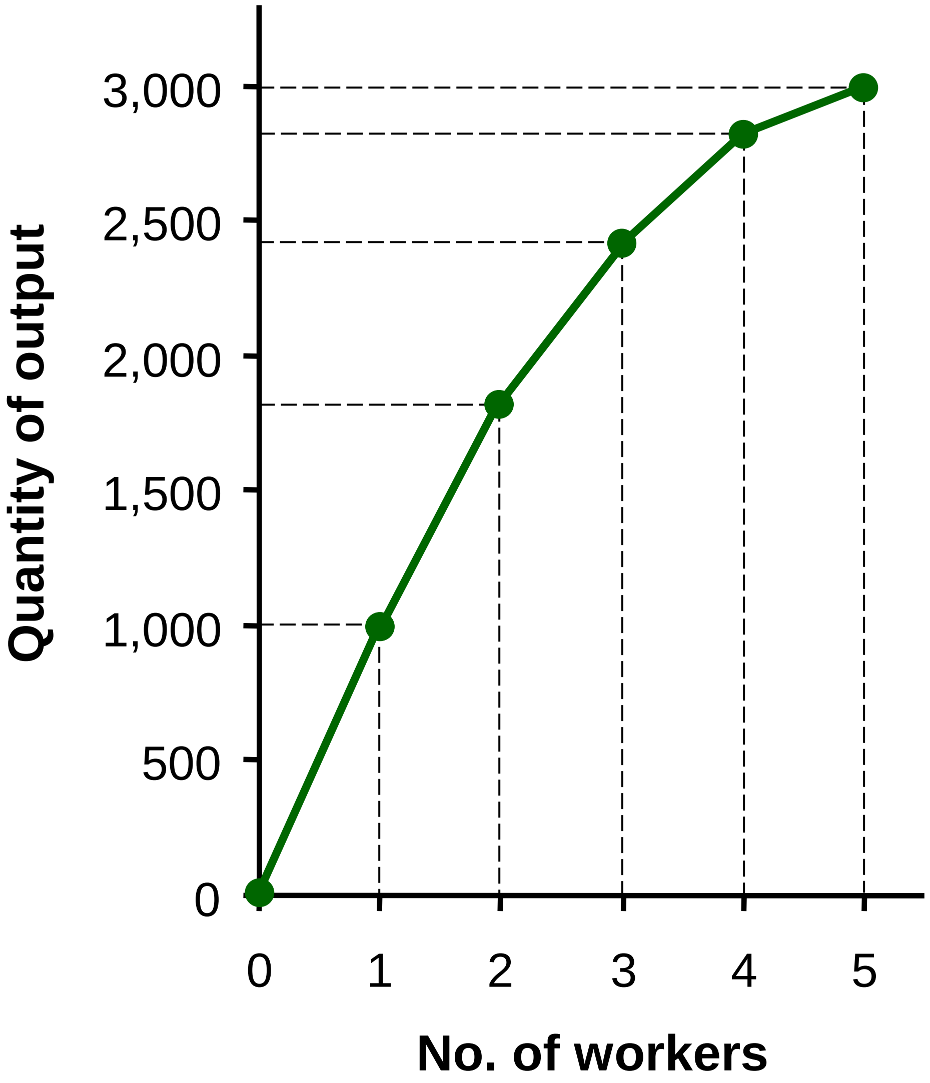
Explicit costs do not change,
so accounting profit does not change.
Implicit costs increase $500/month (opp. cost of using your space instead of renting it),
so economic profit falls by $500/month.

The Production Function

- A **production function** shows the relationship between the quantity of inputs used to produce a good and the quantity of output of that good.
- It can be represented by a table, equation, or graph.
- Example 1:
  - Farmer Jack grows wheat.
  - He has 5 acres of land.
  - He can hire as many workers as he wants.

Example 1: Farmer Jack's Production Function

L (no. of workers)	***Q*** (bushels of wheat)
0	0
1	1000
2	1800
3	2400
4	2800
5	3000



Marginal Product

- If Jack hires one more worker, his output rises by the *marginal product of labor*.
- The **marginal product** of any input is the increase in output arising from an additional unit of that input, holding all other inputs constant.
- Notation:
  Δ (delta) = "change in…"

  Examples:
  ΔQ = change in output, ***ΔL*** = change in labor
- Marginal product of labor (*MPL*) =

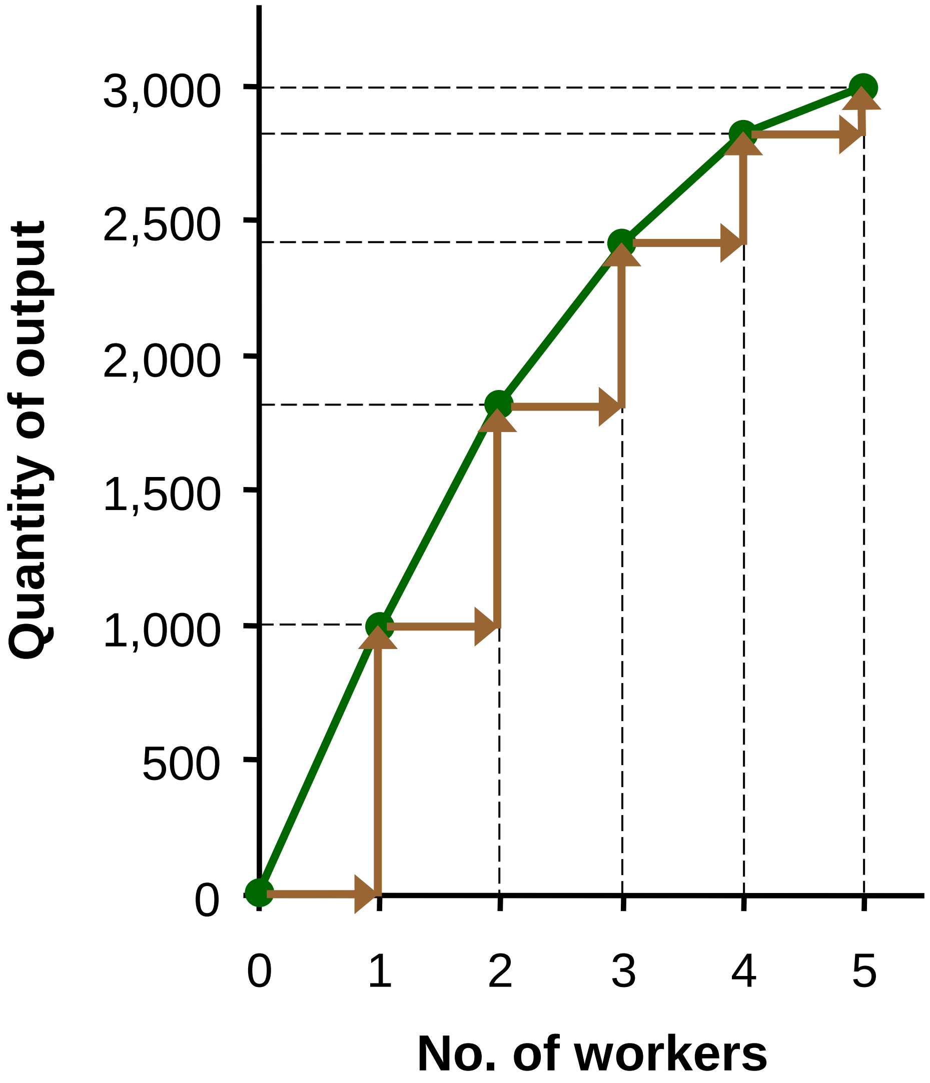
$$\frac{\Delta \boldsymbol{Q}}{\Delta \boldsymbol{L}}$$

EXAMPLE 1: Total & Marginal Product

	L (no. of workers)	***Q*** (bushels of wheat)		*MPL*
	0	0		
Δ***L*** = 1			Δ***Q*** = 1000	1000
	1	1000		
Δ***L*** = 1			Δ***Q*** = 800	800
	2	1800		
Δ***L*** = 1			Δ***Q*** = 600	600
	3	2400		
Δ***L*** = 1			Δ***Q*** = 400	400
	4	2800		
Δ***L*** = 1			Δ***Q*** = 200	200
	5	3000		

EXAMPLE 1: MPL = Slope of Prod Function

L (no. of workers)	***Q*** (bushels of wheat)	*MPL*
0	0	
		1000
1	1000	
		800
2	1800	
		600
3	2400	
		400
4	2800	
		200
5	3000	



EXAMPLE 1: Farmer Jack's Costs

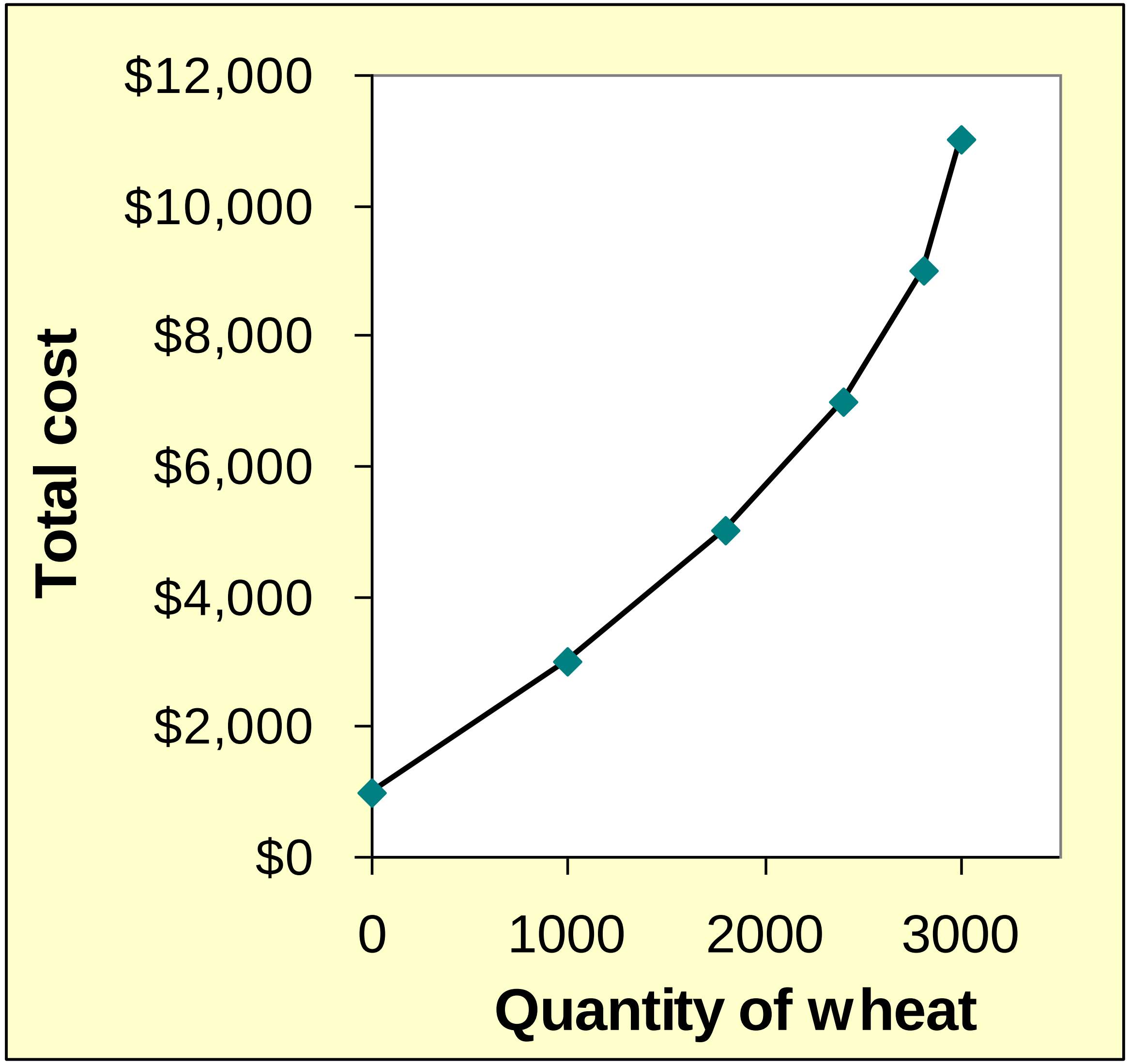
- Farmer Jack must pay $1000 per month for the land, regardless of how much wheat he grows.
- The market wage for a farm worker is $2000 per month.
- So Farmer Jack's costs are related to how much wheat he produces….

EXAMPLE 1: Farmer Jack's Costs

L (no. of workers)	***Q*** (bushels of wheat)	Cost of land	Cost of labor	Total Cost
0	0	$1,000	$0	$1,000
1	1000	$1,000	$2,000	$3,000
2	1800	$1,000	$4,000	$5,000
3	2400	$1,000	$6,000	$7,000
4	2800	$1,000	$8,000	$9,000
5	3000	$1,000	$10,000	$11,000

EXAMPLE 1: Farmer Jack's Total Cost Curve

Q (bushels of wheat)	Total Cost
0	$1,000
1000	$3,000
1800	$5,000
2400	$7,000
2800	$9,000
3000	$11,000



Marginal Cost

- **Marginal Cost** (*MC*)
  is the increase in Total Cost from producing one more unit:

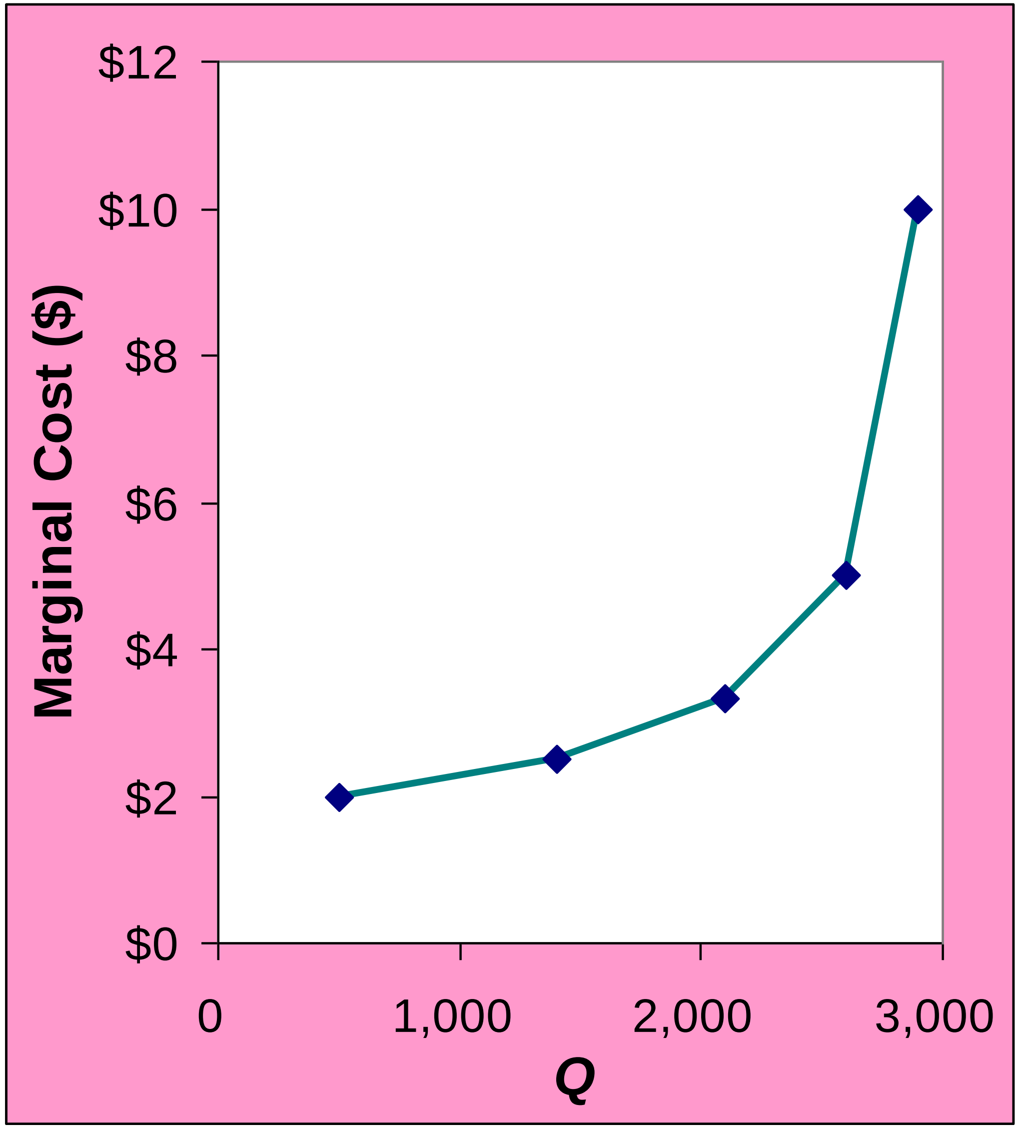
$$MC = \frac{\Delta TC}{\Delta Q}$$

EXAMPLE 1: Total and Marginal Cost

	Q (bushels of wheat)	Total Cost		Marginal Cost (*MC*)
	0	$1,000		
Δ***Q*** = 1000			Δ**TC** = $2000	$2.00
	1000	$3,000		
Δ***Q*** = 800			Δ**TC** = $2000	$2.50
	1800	$5,000		
Δ***Q*** = 600			Δ**TC** = $2000	$3.33
	2400	$7,000		
Δ***Q*** = 400			Δ**TC** = $2000	$5.00
	2800	$9,000		
Δ***Q*** = 200			Δ**TC** = $2000	$10.00
	3000	$11,000		

EXAMPLE 1: The Marginal Cost Curve

Q (bushels of wheat)	*TC*	*MC*
0	$1,000	
		$2.00
1000	$3,000	
		$2.50
1800	$5,000	
		$3.33
2400	$7,000	
		$5.00
2800	$9,000	
		$10.00
3000	$11,000	



Fixed and Variable Costs

- **Fixed costs (*FC*)** do not vary with the quantity of output produced.
  - For Farmer Jack, *FC* = \$1000 for his land
  - Other examples:
    cost of equipment, loan payments, rent
- **Variable costs (*VC*)** vary with the quantity produced.
  - For Farmer Jack, *VC* = wages he pays workers
  - Other example: cost of materials
- **Total cost (*TC*)** = *FC* + *VC*

Importance of Various Costs

- Costs are a critical variable to consider when plotting business strategy. After all, if you can't recover the expenses required to create your product through revenue and profit, then the business just isn't viable.

- Yet costs change as a company grows.

- In most cases, expenses fall, relatively speaking, as volume rises. That's a key reason why businesses aim to ramp up their production as quickly as possible so they can achieve economies of scale. But that trend can't continue forever.

- That's where the concept of marginal cost comes into play. Simply put, marginal cost is the cost of producing one additional unit of your product. And depending on where you are on the cost curve, the marginal cost can be falling, rising, or horizontal.

What is marginal cost?

Let's first define marginal cost by using an example. If one is producing a physical item, say a ceiling fan, then there are a host of costs that go into this. These include things like parts, labor, and machining expenses.

Let's say a production line is currently generating 100 of these fans, for a total cost of $1,000 (or $10 per fan). If the production pace is increased to 101 fans, and the total cost rises to $1,009, then my marginal cost is $9.00, and average cost falls to $9.99 per fan. In other words, it cost $9.00 to produce one additional fan.

The marginal-cost curve

- The scenario describes a situation where marginal cost is falling (the average cost of producing X items is higher than the average cost of producing X + 1 items).

- This is a happy environment for most businesses, and usually occurs while the company is in a period of growth. Production lines are getting more efficient, fixed costs are being spread out over greater sales volumes, and variable costs are dropping as a company gains pricing power with its raw material purchases.

- In this situation, the marginal cost curve is *sloping downwards*, and the company has a strong incentive to increase production.

- By contrast, you can imagine a time when marginal costs are rising (the average cost of producing X items is lower than the average cost of producing X + 1 items).
- For example, a motorcycle factory is running at its 10,000-unit capacity, and will require an entirely new production line to get to unit number 10,001.
- Or let's assume that we've purchased all the cheap raw materials we can to satisfy our current level of production, and buying more will increase our average cost.
- In these scenarios, the marginal-cost curve is *sloping upwards*, and the company is pressured to lower production volume or keep it steady.

When the marginal cost is horizontal

- Finally, we have the situation where the marginal cost curve *is flat* (the average cost of producing X items is equal to the average cost of producing X + 1 items). This is a special case because it can describe an equilibrium that's persistent. A company can't hope to have declining marginal costs forever, but it can organize itself in such a way that average costs don't rise, even as production ramps up.

- Think of a business that sells software, like **Microsoft**. The firm has every incentive to deliver as many copies of its flagship Windows operating system that it can, since the cost of producing one more CD is negligible compared to the development expenses that went into creating the underlying code.

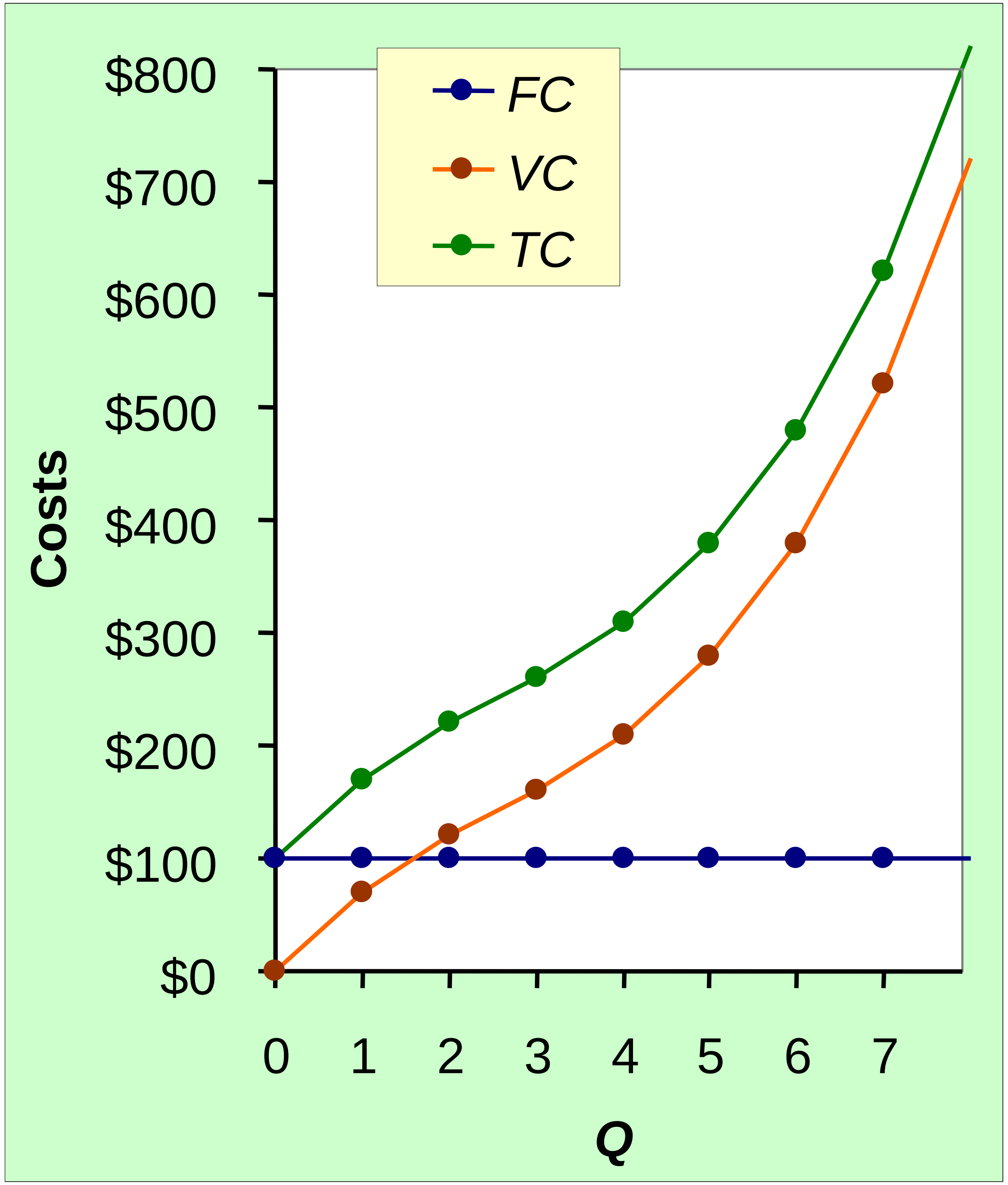
- Or consider the example of **Netflix**, which provides a streaming-video service. The marginal cost of delivering content to one more subscriber is insignificant compared to its fixed costs for securing rights to that content. In this situation, Netflix would seek to sign up as many members as it can convince to join its service, because marginal costs effectively don't matter.

EXAMPLE 2

- Our second example is more general,
  applies to any type of firm
  producing any good with any types of inputs.

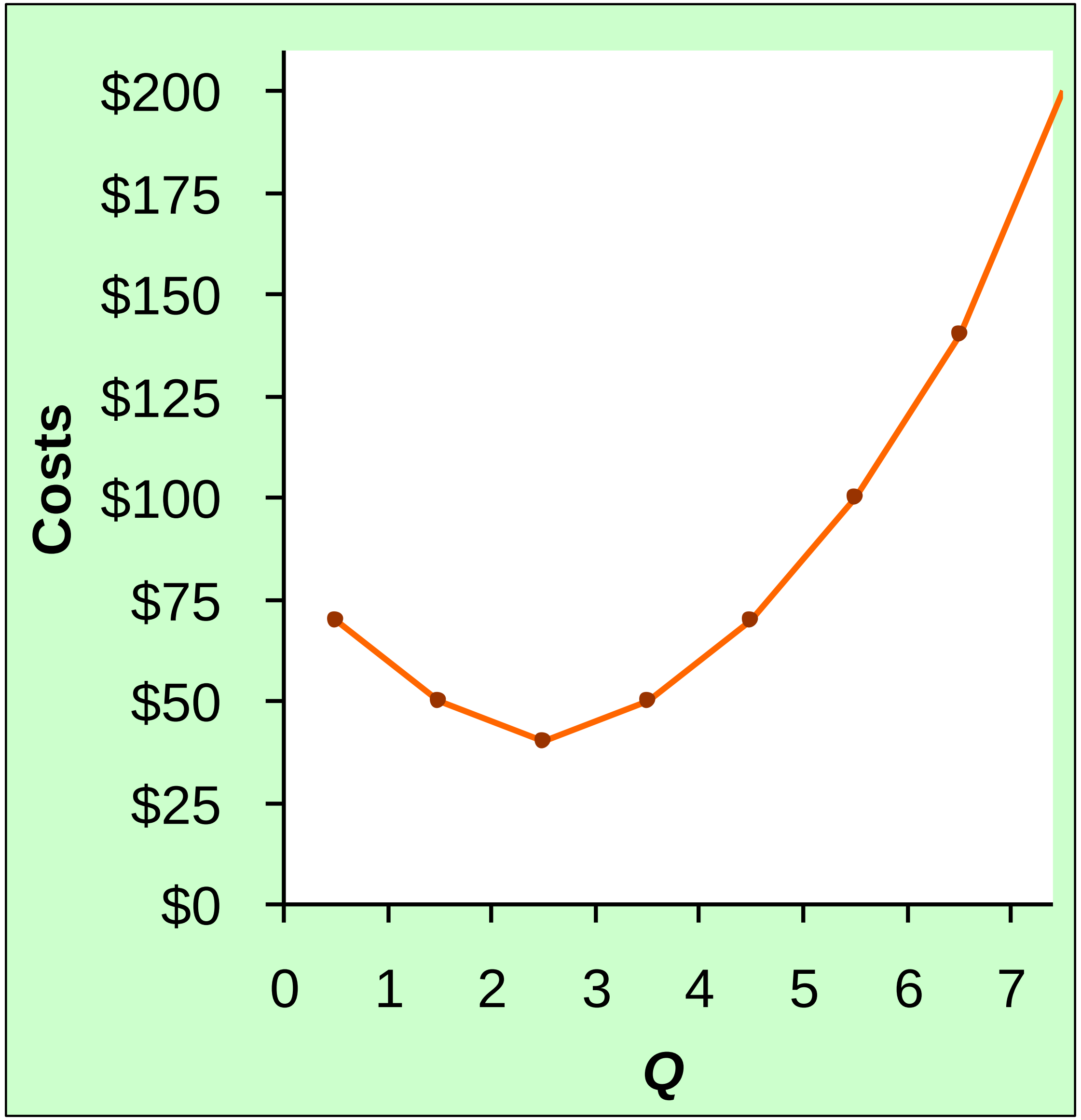
EXAMPLE 2: Costs

Q	*FC*	*VC*	*TC*
0	$100	$0	$100
1	100	70	170
2	100	120	220
3	100	160	260
4	100	210	310
5	100	280	380
6	100	380	480
7	100	520	620



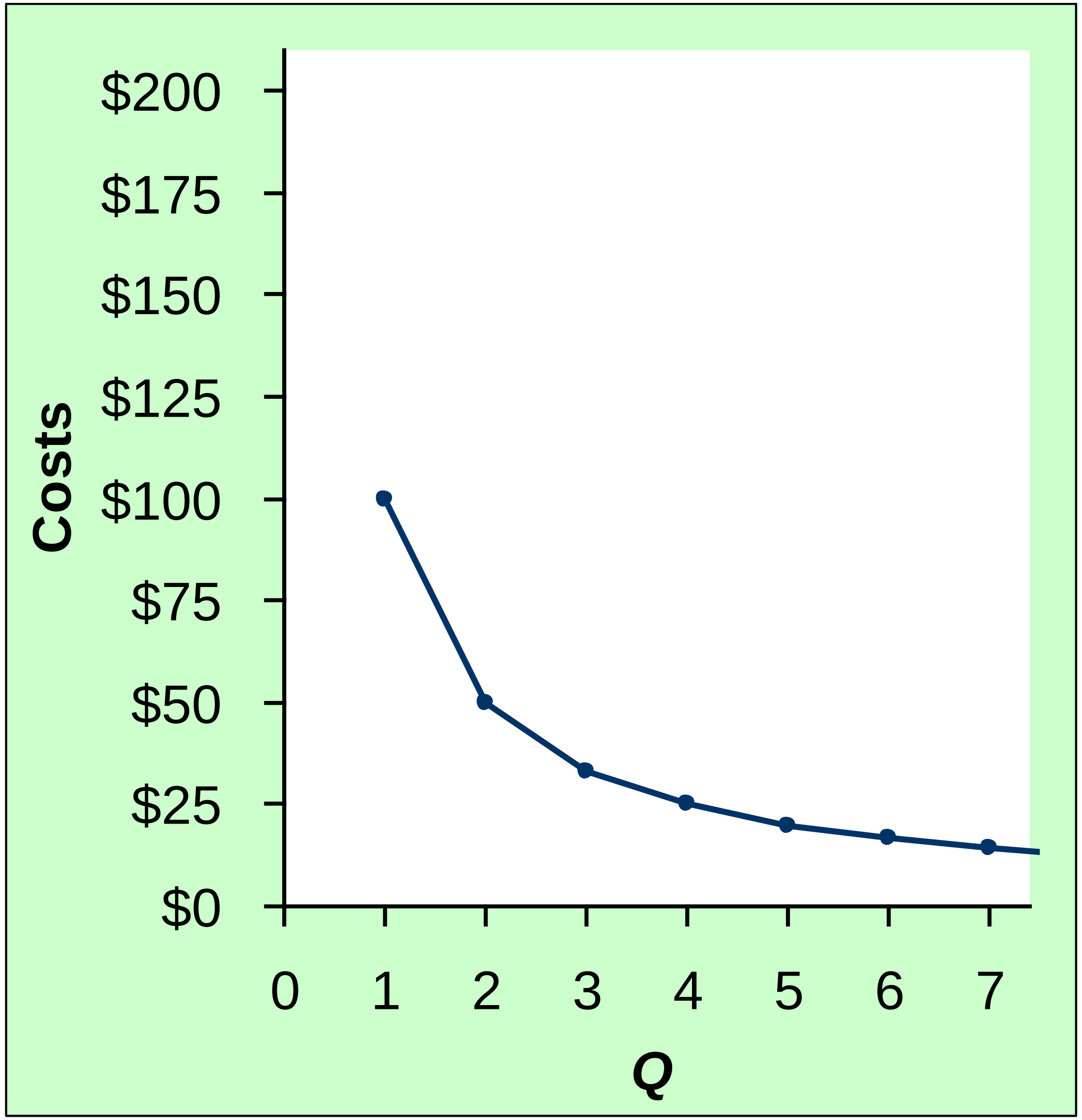
EXAMPLE 2: Marginal Cost

Q	*TC*	*MC*
0	$100	
		$70
1	170	
		50
2	220	
		40
3	260	
		50
4	310	
		70
5	380	
		100
6	480	
		140
7	620	



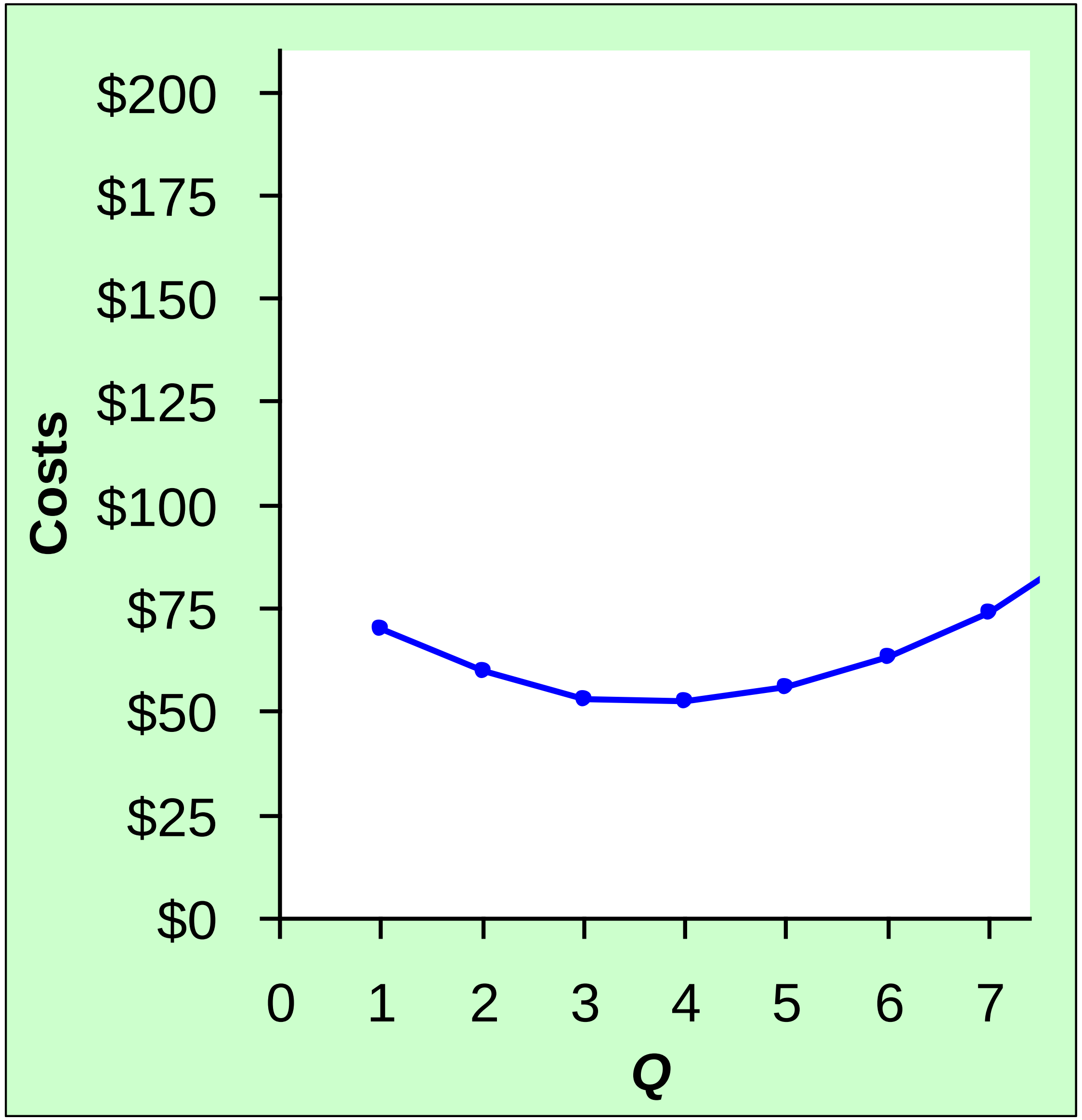
EXAMPLE 2: Average Fixed Cost

Q	*FC*	*AFC*
0	$100	n/a
1	100	$100
2	100	50
3	100	33.33
4	100	25
5	100	20
6	100	16.67
7	100	14.29



EXAMPLE 2: Average Variable Cost

Q	*VC*	*AVC*
0	$0	n/a
1	70	$70
2	120	60
3	160	53.33
4	210	52.50
5	280	56.00
6	380	63.33
7	520	74.29



EXAMPLE 2: Average Total Cost

Q	*TC*	*ATC*	*AFC*	*AVC*
0	$100			
1	170	$170	$100	$70
2	220	110	50	60
3	260	86.67	33.33	53.33
4	310	77.50	25	52.50
5	380	76	20	56.00
6	480	80	16.67	63.33
7	620	88.57	14.29	74.29

Average total cost (*ATC*) equals total cost divided by the quantity of output:

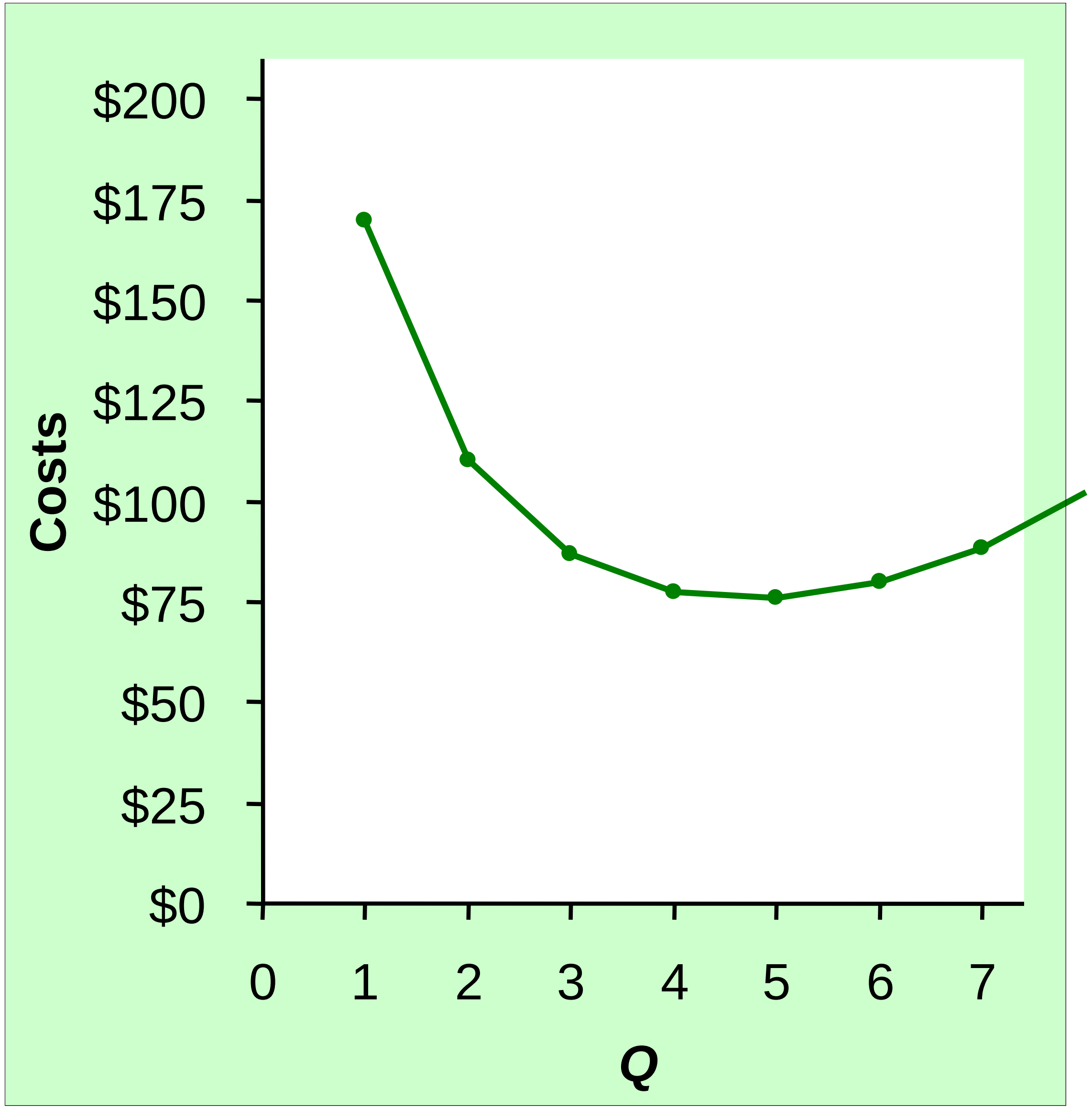
$$ATC = TC/\mathbf{Q}$$

Also,

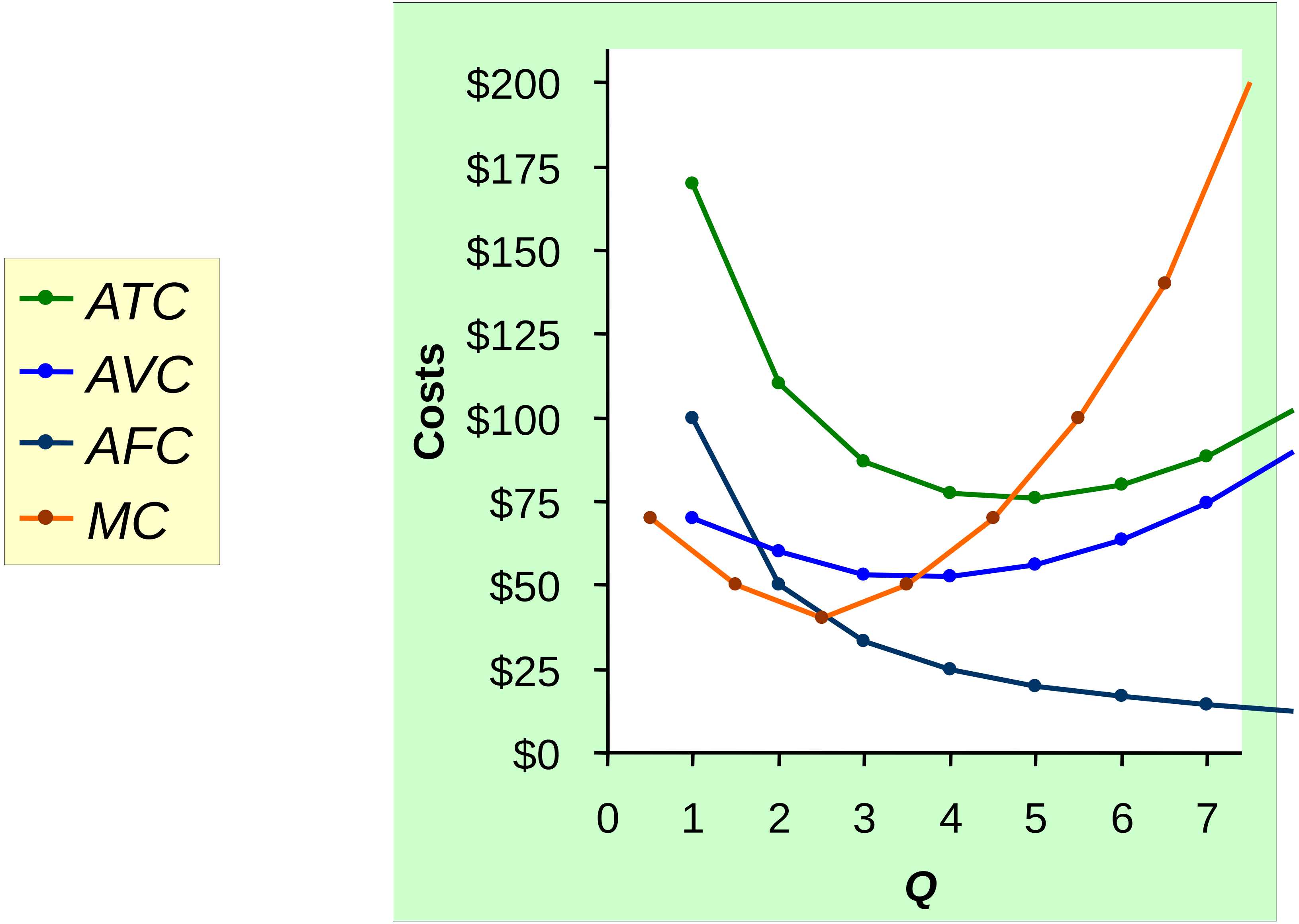
$$ATC = AFC + AVC$$

EXAMPLE 2: Average Total Cost

Q	*TC*	*ATC*
0	$100	n/a
1	170	$170
2	220	110
3	260	86.67
4	310	77.50
5	380	76
6	480	80
7	620	88.57



EXAMPLE 2: The Various Cost Curves Together

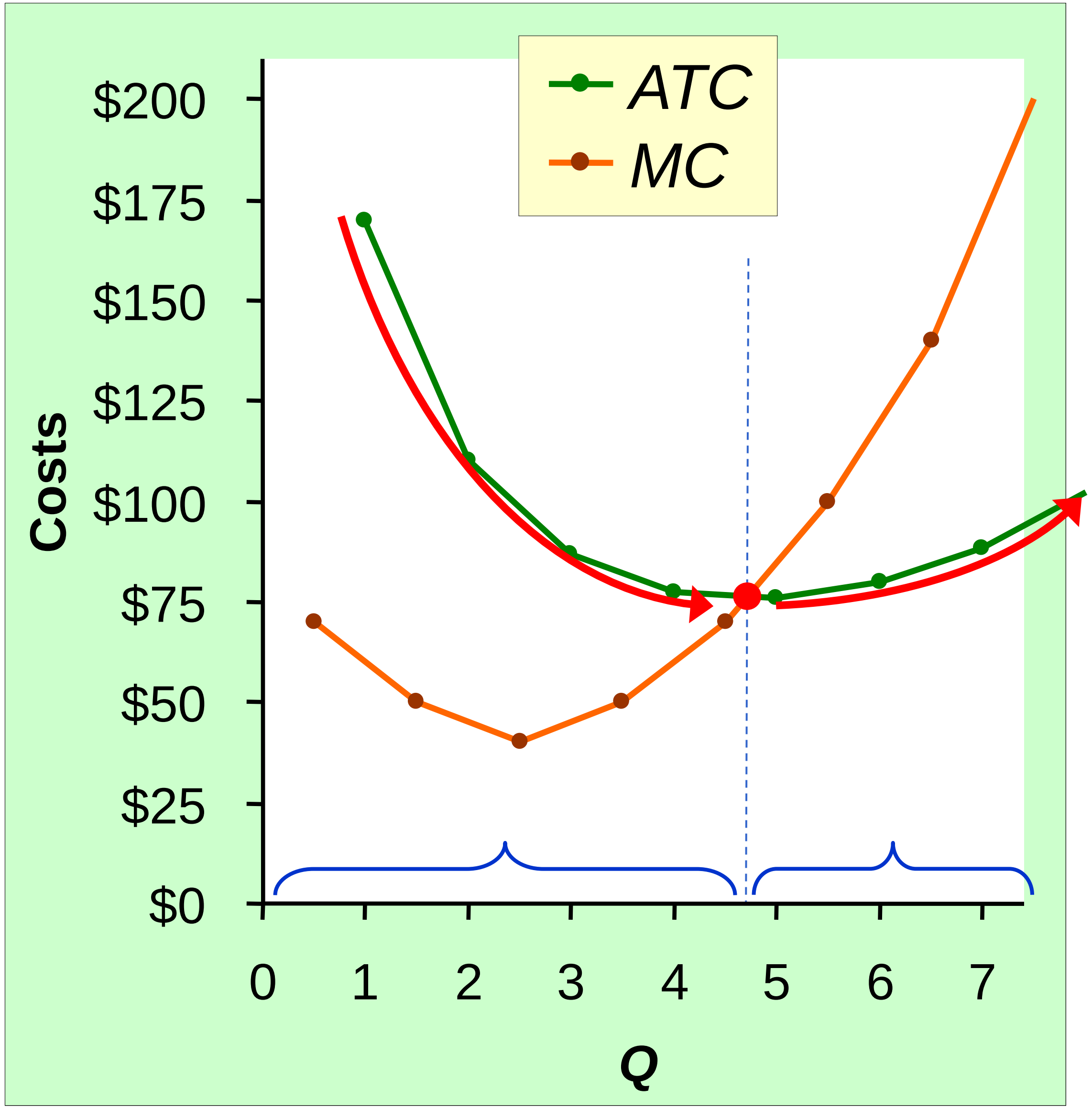


EXAMPLE 2: ATC and MC

When *MC* < *ATC*,
ATC is falling.

When *MC* > *ATC*,
ATC is rising.

The *MC* curve crosses the *ATC* curve at the *ATC* curve's minimum.



Costs in the Short Run & Long Run

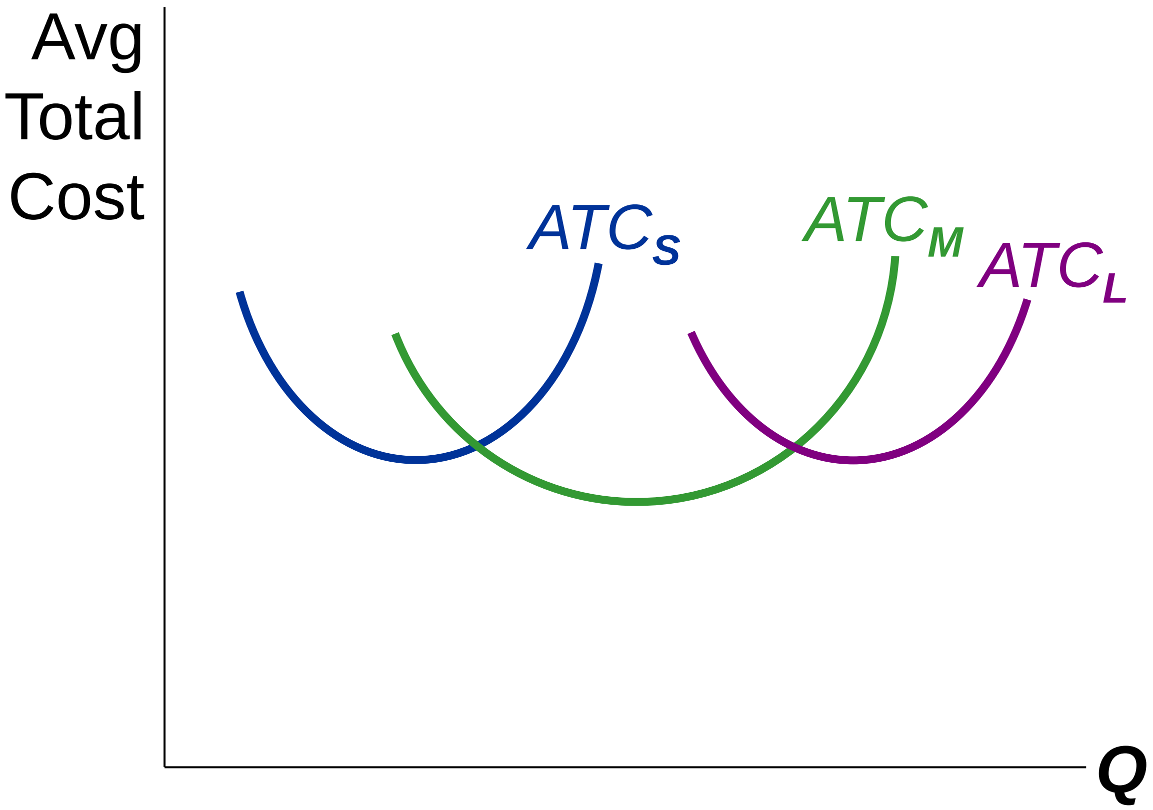
- Short run:
  Some inputs are fixed (*e.g.,* factories, land).
  The costs of these inputs are *FC*.
- Long run:
  All inputs are variable
  (*e.g.,* firms can build more factories,
  or sell existing ones).
- In the long run, *ATC* at any ***Q*** is cost per unit using the most efficient mix of inputs for that ***Q*** (*e.g*., the factory size with the lowest *ATC*).

EXAMPLE 3: LRATC with 3 factory Sizes

Firm can choose from 3 factory sizes: **S**, **M**, **L**.

Each size has its own *SRATC* curve.

The firm can change to a different factory size in the long run, but not in the short run.

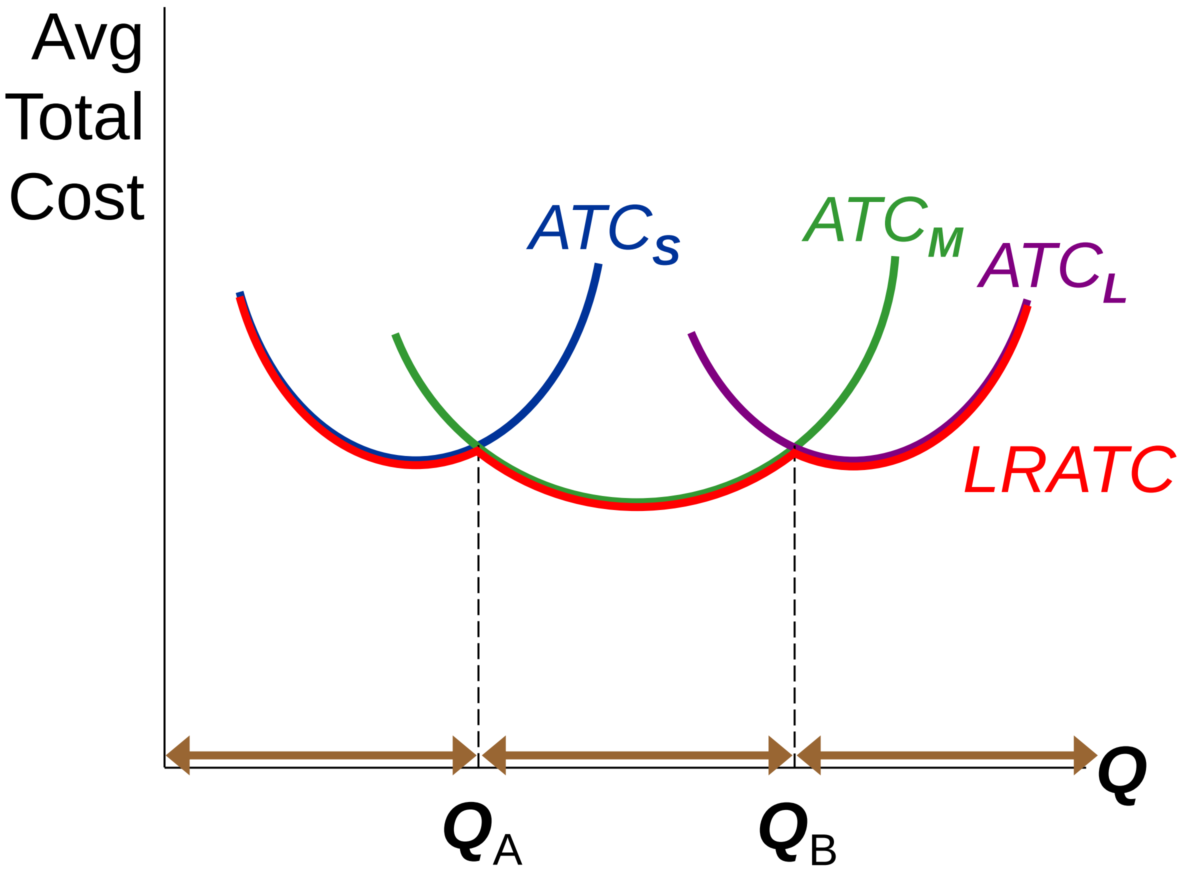


EXAMPLE 3: LRATC with 3 factory Sizes

To produce less than $\boldsymbol{Q}_A$, firm will choose size **S** in the long run.

To produce between $\boldsymbol{Q}_A$ and $\boldsymbol{Q}_B$, firm will choose size **M** in the long run.

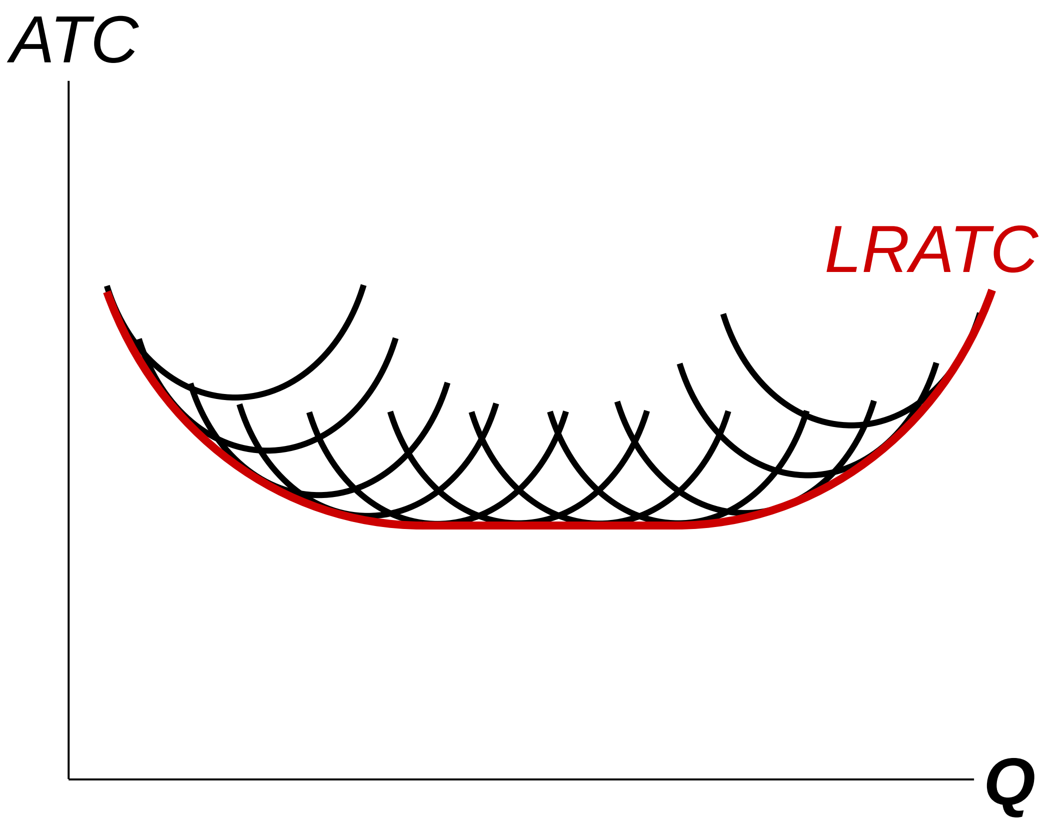
To produce more than $\boldsymbol{Q}_B$, firm will choose size **L** in the long run.



A Typical LRATC Curve

In the real world, factories come in many sizes, each with its own *SRATC* curve.

So a typical *LRATC* curve looks like this:

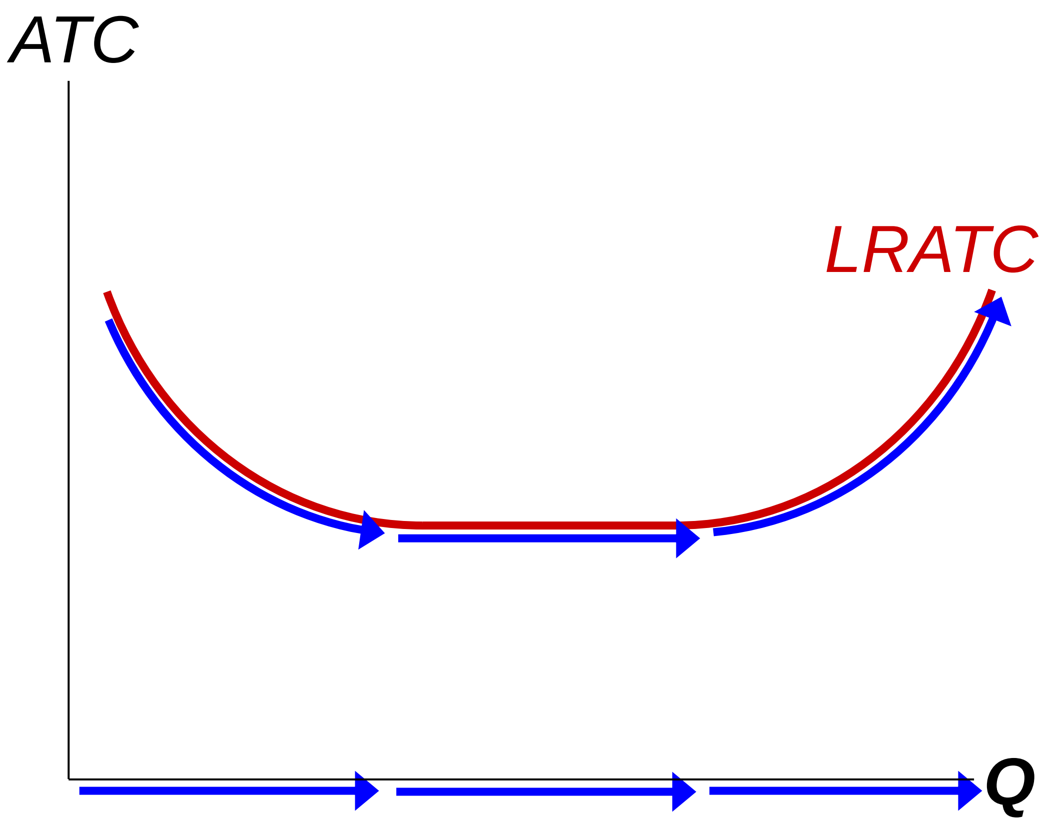


How ATC Changes as the Scale of Production Changes

Economies of scale: *ATC* falls as ***Q*** increases.

Constant returns to scale: *ATC* stays the same as ***Q*** increases.

Diseconomies of scale: *ATC* rises as ***Q*** increases.



How ATC Changes as the Scale of Production Changes

- Economies of scale occur when increasing production allows greater specialization:
  workers more efficient when focusing on a narrow task.
  - More common when ***Q*** is low.
- Diseconomies of scale are due to coordination problems in large organizations.
  E.g., management becomes stretched, can't control costs.
  - More common when ***Q*** is high.

BREAK EVEN ANALYSIS (BEA)

The BEA helps in understanding the relationship between revenues and costs of a firm in relation to its volume of sales.

It helps in determining the volume at which the firm’s cost and revenue are in equilibrium.

It is a technique which helps to analyse the effect of change in the level of production and total profit of a company.

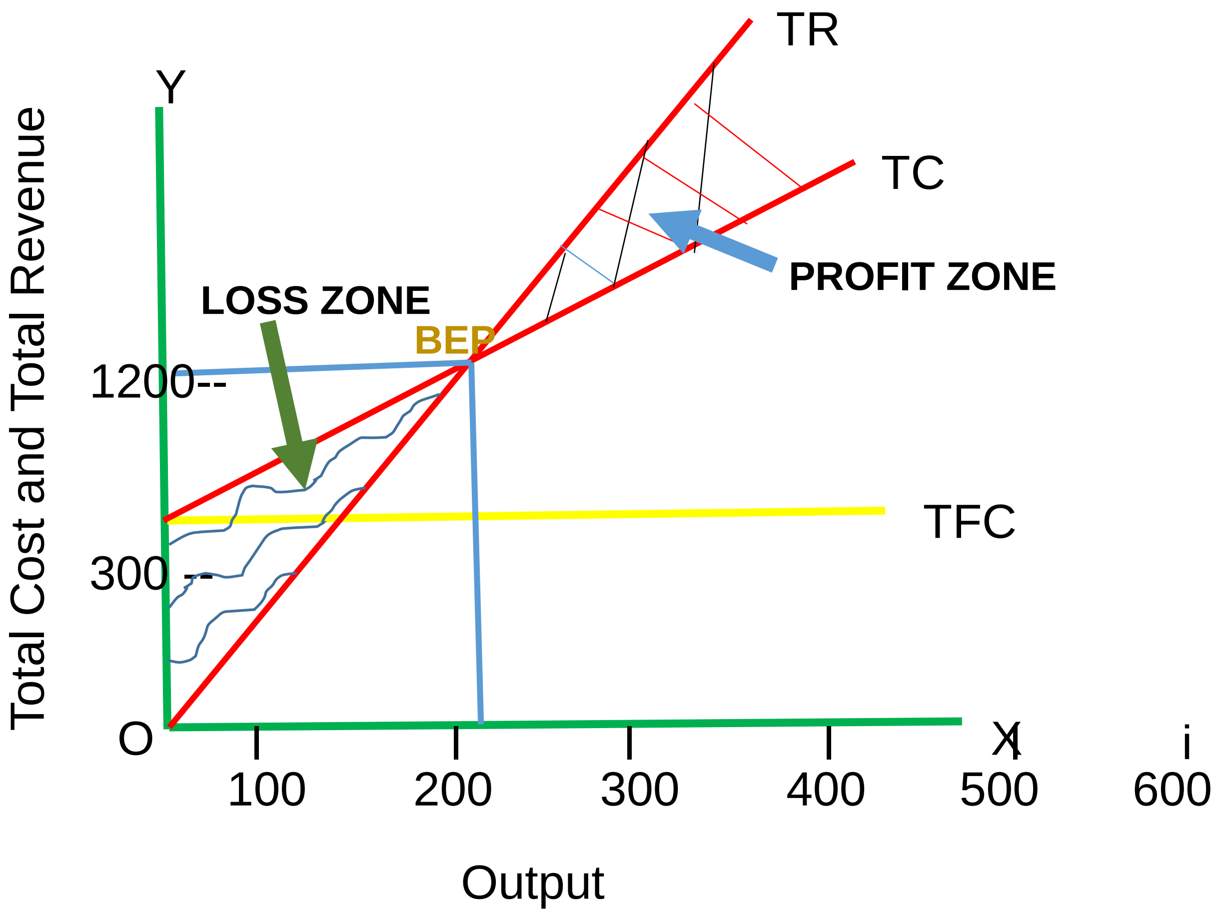
The BEA establishes the relationship between cost, volume and profits. Hence it is also known as “Cost-Volume-Profit analysis”.

In BEA more prominence to identify the Break Even Point (BEP).
BEP refers to that level of sales volume at which there is neither profit nor loss,
Costs being equal to its sales value and the contribution is equal to fixed costs.
BEP is defined as “that level of sales at which the total revenue is equal to total costs and the net income is equal to zero.

Break even chart and diagrammatic representation

Selling Price is Rs. 4 per unit

Output (Q)	Total Revenue (TR)	Fixed Cost (TFC)	Variable Cost (TVC)	Total Cost (TC)
0	0	300	0	300
100	400 (100 x 4)	300	300	600
200	800 (200 x 4)	300	600	900
300	1200 (300 x 4)	300	900	1200
400	1600 (400 x 4)	300	1200	1500
500	2000 (500 x 4)	300	1500	1800
600	2400 (600 x 4)	300	1800	2100



TR
Y
TC
PROFIT ZONE
LOSS ZONE
BEP
1200--
TFC
300 --
Total Cost and Total Revenue
O
X
100
200
300
400
500
600
Output

CALCULATION OF BREAK EVEN POINT

The two methods of calculation of BEP are 1) BEP in terms of physical units 2) BEP in terms of sales value

BEP in terms of physical units is suitable for a firm producing a single product.

BEP in terms of sales value is suitable for a firm producing multi products.

Illustration for calculating BEP in terms of physical units

Selling Price Rs. 15 per engg component

Variable cost Rs. 10 per engg component

Fixed cost (FC) Rs. 1,50,000

First step is to calculate Contribution Margin (CM)

Selling Price – Variable cost per unit.

Rs. 15 – Rs. 10 = Rs. 5 is the CM

$$\text{Now, BEP} = \frac{\text{TFC}}{\text{CM}} = \frac{\text{Rs. 1,50,000}}{\text{Rs. 5}} = \text{30,000 Units}$$

Hence, the firm reaches BEP by producing 30,000 units

Illustration for calculating BEP in terms of sales value
This method is useful for a firm producing multi products

Total Sales Value Rs. 10,000 (TR)
Variable Costs Rs. 6,000 (TVC)
Fixed Cost Rs. 3,000 (TFC)

First step is to calculate Contribution Ratio

$$\frac{TR - VC}{TR} = \frac{\text{Rs. } 10{,}000 - \text{Rs. } 6{,}000}{\text{Rs. } 10{,}000} = 0.4 \text{ (CR)}$$

It implies that for every one rupee sales value the FC is 0.40 paise

$$\text{Now BEP} = \frac{FC}{CR} = \frac{\text{Rs. } 3{,}000}{0.4} = \text{Rs. } 7{,}500$$

Hence it is clear from this calculations that at sales value of Rs. 7500 (BEP)
There is no profit and no loss.

CHAPTER SUMMARY

- Implicit costs do not involve a cash outlay, yet are just as important as explicit costs to firms’ decisions.
- Accounting profit is revenue minus explicit costs. Economic profit is revenue minus total (explicit + implicit) costs.
- The production function shows the relationship between output and inputs.

CHAPTER SUMMARY

- The marginal product of labor is the increase in output from a one-unit increase in labor, holding other inputs constant. The marginal products of other inputs are defined similarly.
- Marginal product usually diminishes as the input increases. Thus, as output rises, the production function becomes flatter, and the total cost curve becomes steeper.
- Variable costs vary with output; fixed costs do not.

CHAPTER SUMMARY

- Marginal cost is the increase in total cost from an extra unit of production. The MC curve is usually upward-sloping.
- Average variable cost is variable cost divided by output.
- Average fixed cost is fixed cost divided by output. AFC always falls as output increases.
- Average total cost (sometimes called “cost per unit”) is total cost divided by the quantity of output. The ATC curve is usually U-shaped.

CHAPTER SUMMARY

- The MC curve intersects the ATC curve at minimum average total cost. When MC < ATC, ATC falls as ***Q*** rises. When MC > ATC, ATC rises as ***Q*** rises.
- In the long run, all costs are variable.
- Economies of scale: ATC falls as ***Q*** rises. Diseconomies of scale: ATC rises as ***Q*** rises. Constant returns to scale: ATC remains constant as ***Q*** rises.

Unit 1 Summary

- Basic concepts
- Rational decisions / assumptions
- Production possibility diagram/curve
- Circular flow diagram
- Principles of engineering economics

Unit 2

Theory of Demand and Supply

Demand, Supply and concepts of elasticity

Learning Outcomes

- Develop the concepts of demand and its determinants.
- Discuss the factors that lead to shifts and movement along the demand curves.
- Explain price elasticity and its calculations, income and cross elasticity.

Markets

- A market is any institutional structure, or mechanism, that brings together buyers and sellers of particular goods and services

- Markets exists in many forms

- They determine the price and quantity of a good or service transacted

Markets

Demand

- The various amounts of a product that consumers are willing and able to purchase at various prices during some specific period

- Demonstrated by demand schedule and demand curve

Law of Demand

- The inverse relationship between the price and the quantity demanded of a good or service during some period of time

Law of Demand (cont.)

Based on:

1. Income
2. Substitution
3. Diminishing marginal utility

Income Effect

- At a lower price, consumers can buy more of a product without giving up other goods

- A decline in price increases the purchasing power of money/real income

Substitution Effect

- At a lower price, consumers have the incentive to substitute the cheaper good for similar goods that are now relatively more expensive

Diminishing Marginal Utility

- States that successive units of a given product yield less and less extra satisfaction
- Therefore, consumers will only buy more of a good if its price is reduced

Consumer Demand: guidelines

- Free market economy: customer directs production through purchases:
  - 1) We buy what satisfies us!
  - 2) However, more and more = less satisfaction.

- Example: First piece of pizza (great), 5th piece (not as great), i.e. you have **less** satisfaction.

  -satisfaction level maintained by ordering a salad, bread, vs. one pizza.

Demand and Supply factors at the Stock Exchange

RELIANCE NSE

925.45 -1.20 (-0.13%)

BID	ORDERS	QTY.	OFFER	ORDERS	QTY.
925.50	4	253	925.75	3	216
925.45	7	49	925.80	3	2020
925.40	3	263	925.90	2	12
925.35	1	3	926.00	8	471
925.30	1	9	926.10	3	599
Total		3,70,494	Total		5,02,414

Open	930.05	High	933.15
Low	923.00	Close	926.65
Volume	22,81,286	Avg. price	927.20
LTQ	1		

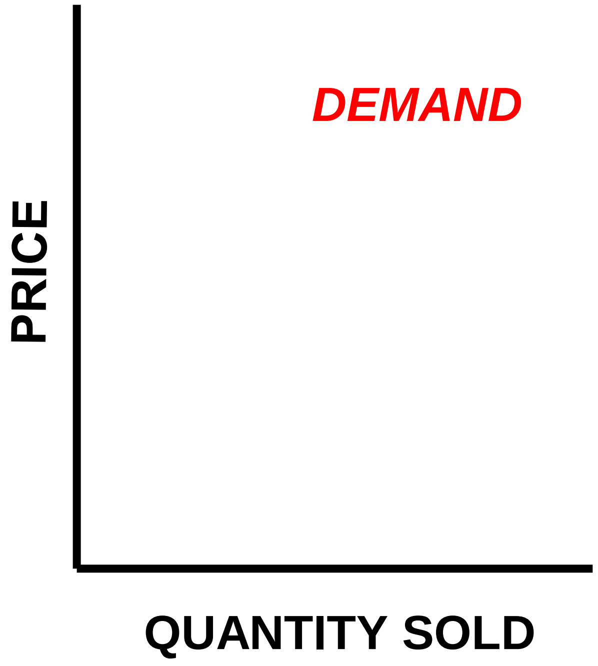
Buy Sell Close

Demand Curve

- Shows the inverse relationship between price and quantity demanded for a good or service
- Derived from a demand schedule showing the quantity demanded at various prices

Demand Schedule

- Higher price = fewer sold
- Negative relationship
- ***Law of demand***: consumers buy less as the price rises, more as it drops



Role of Price in Demand

- Even the richest people (companies) have budgets (guidelines)
- But, they are still after greatest satisfaction for least cash...
- Price helps consumers/producers maximize finite resources.
- Further, a producer's demand for inputs is related to the consumer's demand for products
- This applies to firms linked together in the system (i.e., they are all linked together by demand)

Factors Influencing Consumer Demand (changers)

1) **Own price (price to own):** the price of the item consumed

2) **Substitute price:** item that could be substituted as price of original increases (tea and coffee; MacBook vs Dell)

3) **Complement price:** item that is often sold or used in conjunction with original (batteries for flashlight; cartridge and printer)

4) **Income:** people tend to trade-up for better goods
5) **Change in population:** increase = greater demand
6) **Tastes and preferences:** varies constantly
7) **Seasonality:** demand influenced by time of year (e.g., umbrella, ice cream)

Demand Shifters

- **Demand *"shifters"*** factors which cause an increase/decrease in demand, but are not really price-related

- A ***"change"*** in demand occurs when the demand changes as a result of price

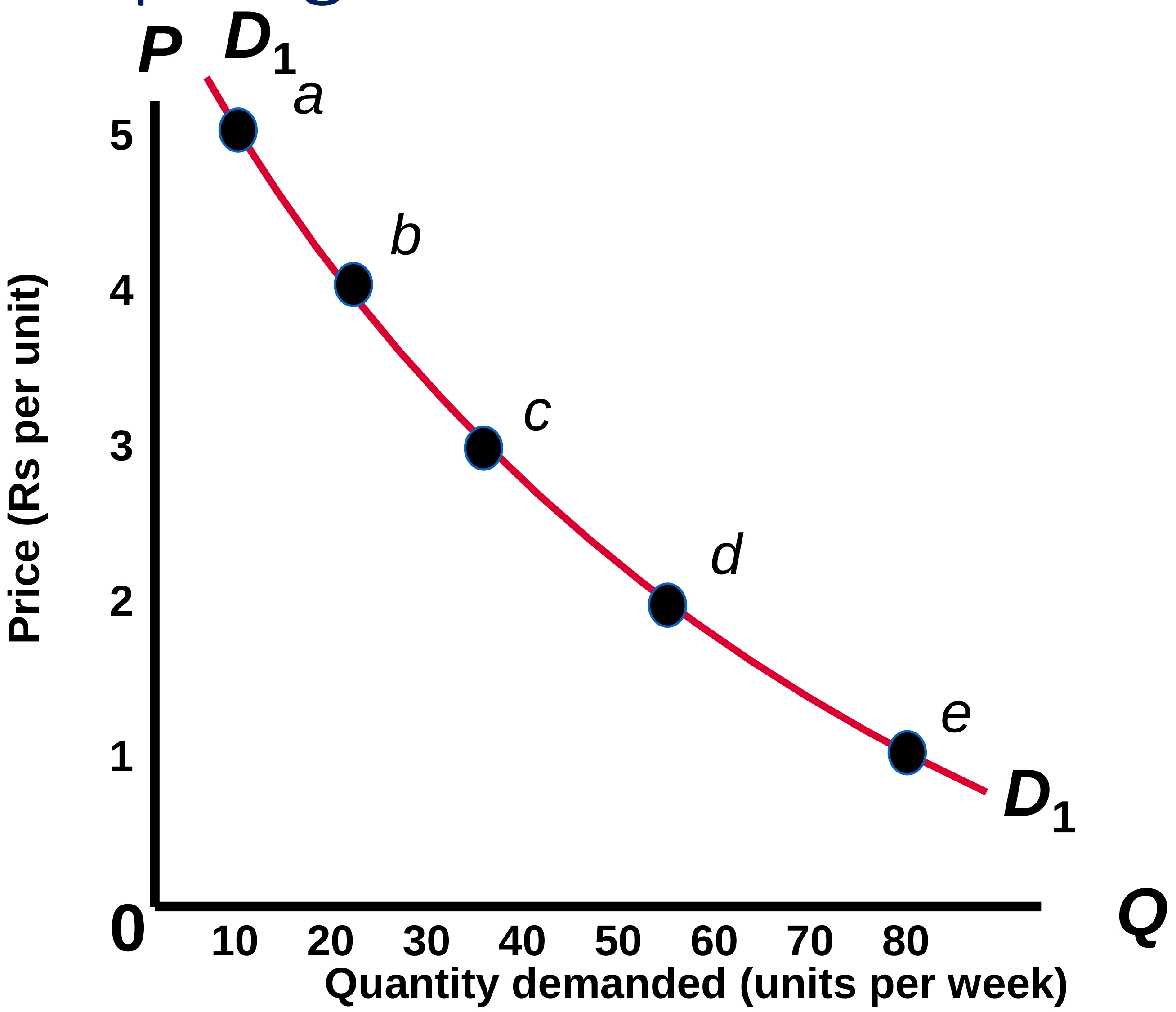
- If the own price increases and the amount of product sold decreases, the change in sales is a result of the law of demand

- If product sold simply increases without a change in price, it is a shift—can work both ways (up or down)

Demand schedule

	Price per unit	Quantity demanded per week
a	5	10
b	4	20
c	3	35
d	2	55
e	1	80

Graphing Demand



Changes in Demand

- Caused by changes in one or other of the determinants of demand
- Represented as a shift of the demand curve either to the right or left
- Represents a change in the quantity demand at every price, so cannot be related to a change in price

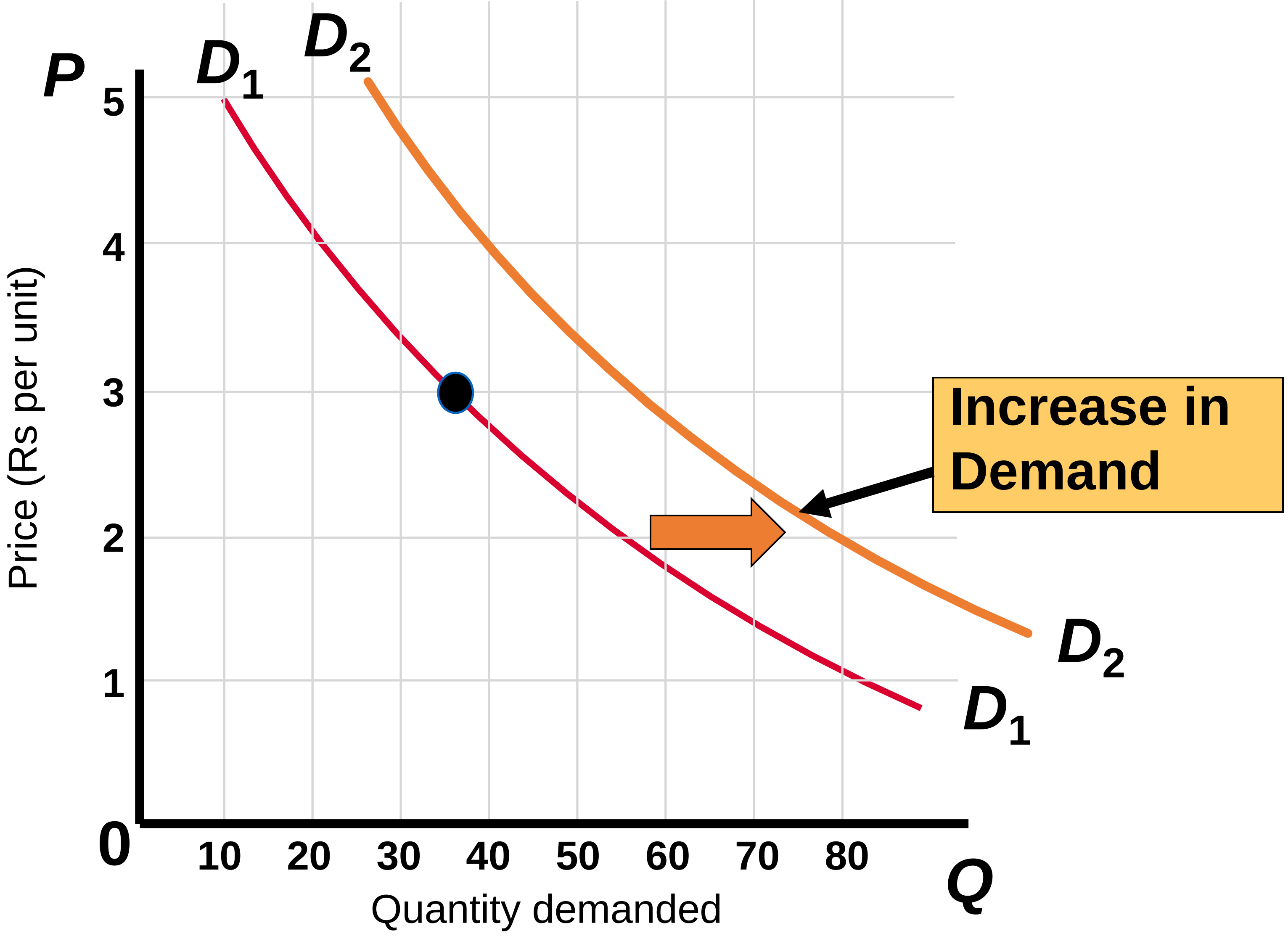
Changes in Demand

- Tastes or preferences
- Number of buyers
- Income
  - Normal or superior goods—demand varies directly with income
  - Inferior goods—demand varies inversely with income

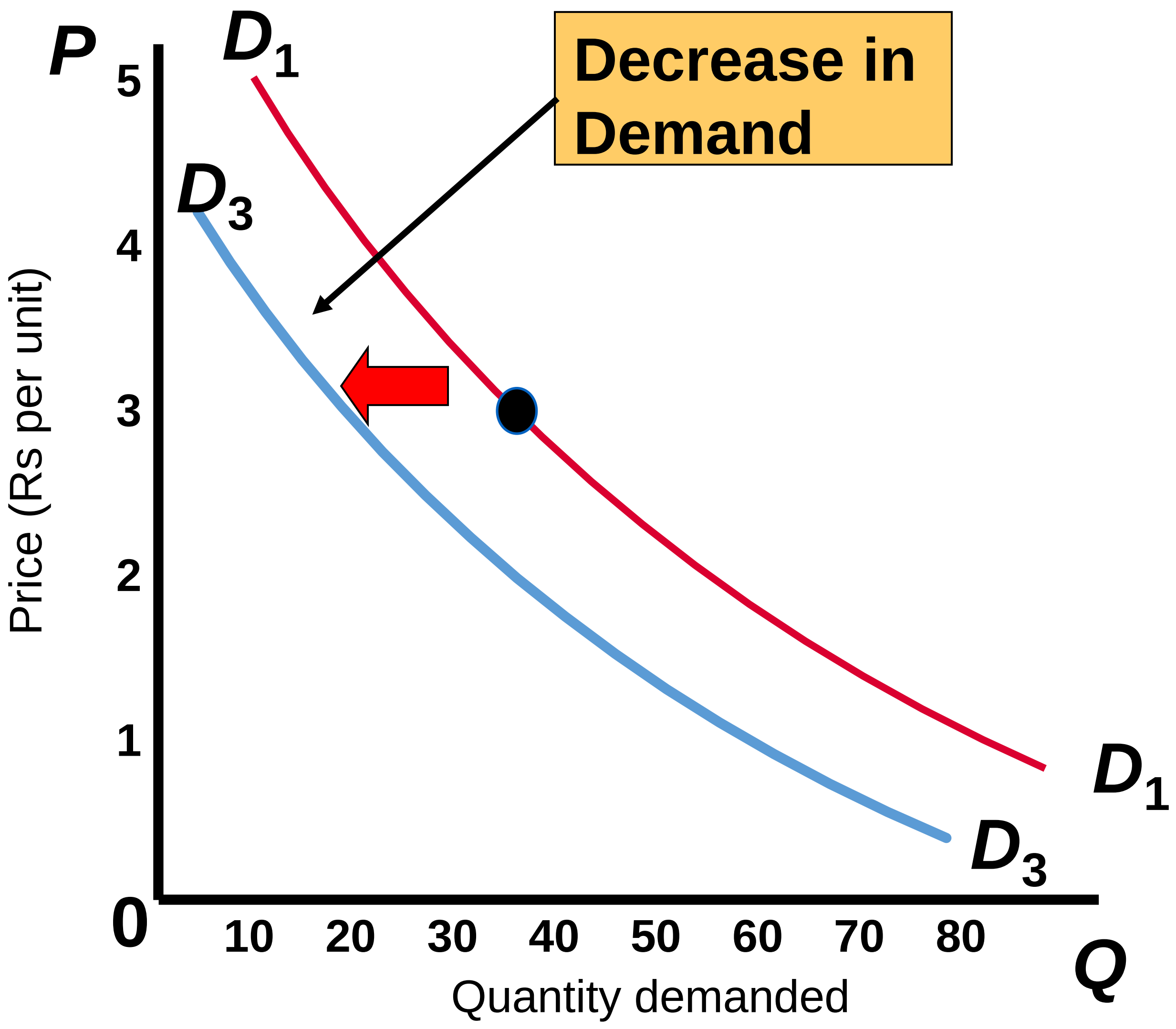
Changes in Demand (cont.)

- Prices of related goods
  - Substitute goods
  - Complementary goods
- Expectations
- Seasons/weather

Increase in Demand



Decrease in Demand



Changes in Quantity Demanded

- caused by changes in price only
- represented as movement along a demand curve
- other factors determining demand are held constant

Movement along a Curve

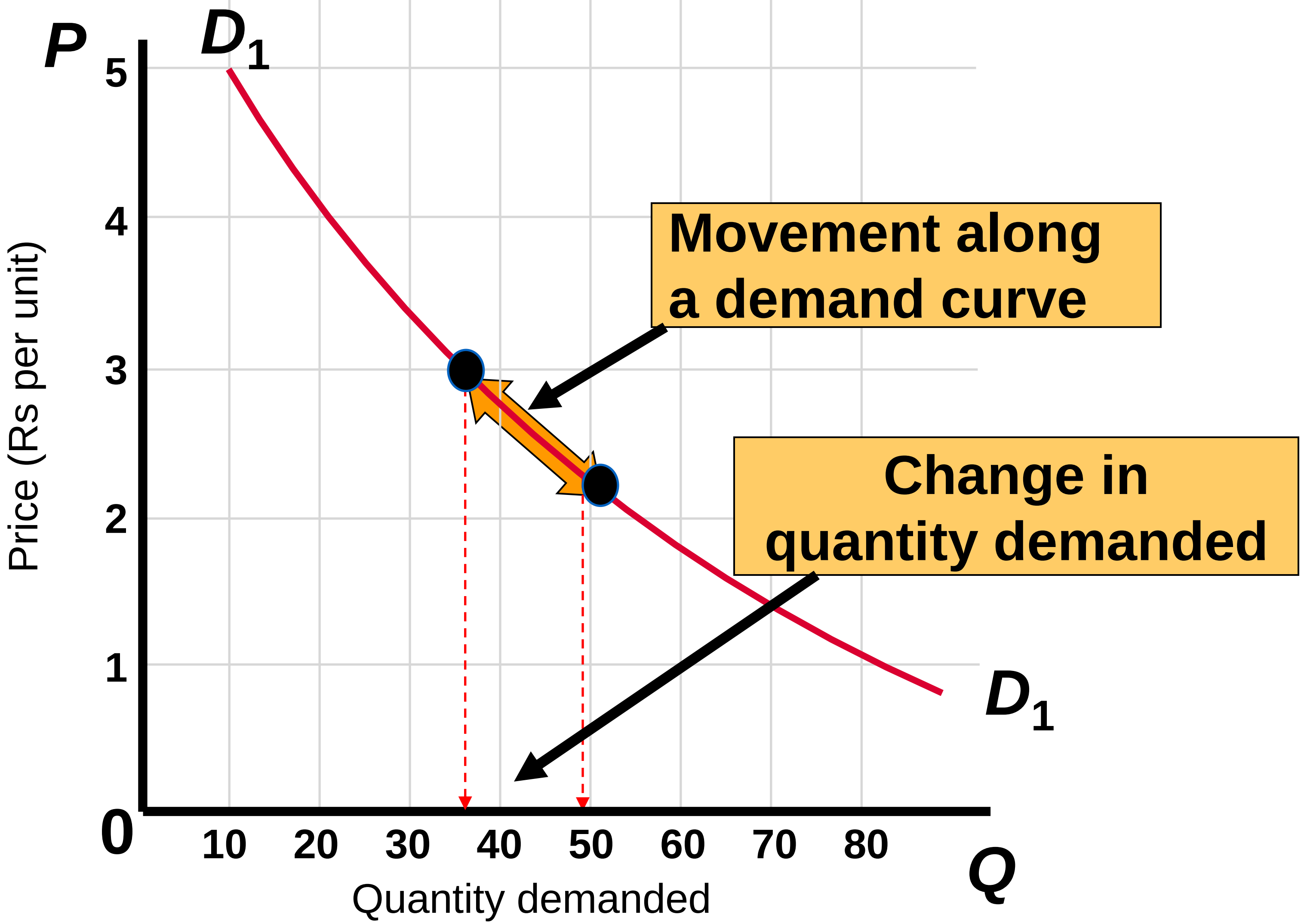
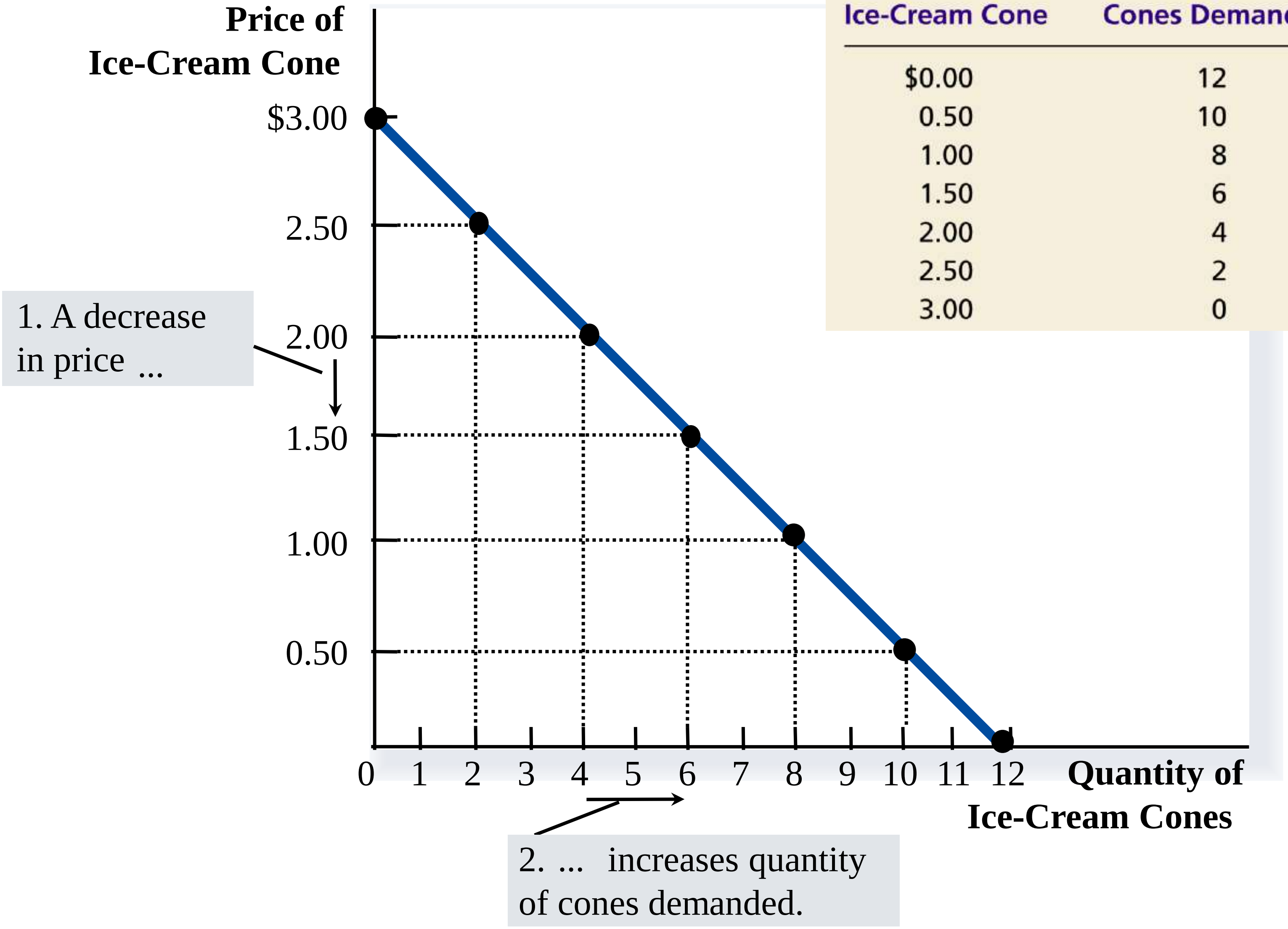


Figure 1 Catherine’s Demand Schedule and Demand Curve

Price of Ice-Cream Cone	Quantity of Cones Demanded
$0.00	12
0.50	10
1.00	8
1.50	6
2.00	4
2.50	2
3.00	0



Market Demand versus Individual Demand

- Market demand refers to the sum of all individual demands for a particular good or service.
- Graphically, individual demand curves are summed horizontally to obtain the market demand curve.

The Market Demand Curve

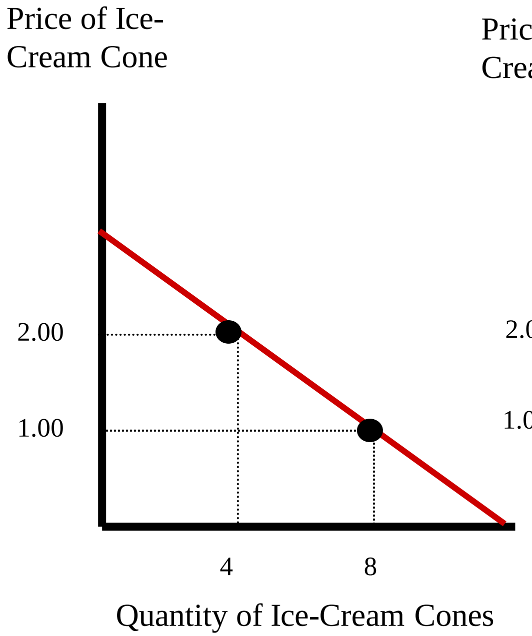
When the price is $2. Catherine will deman cream cones.

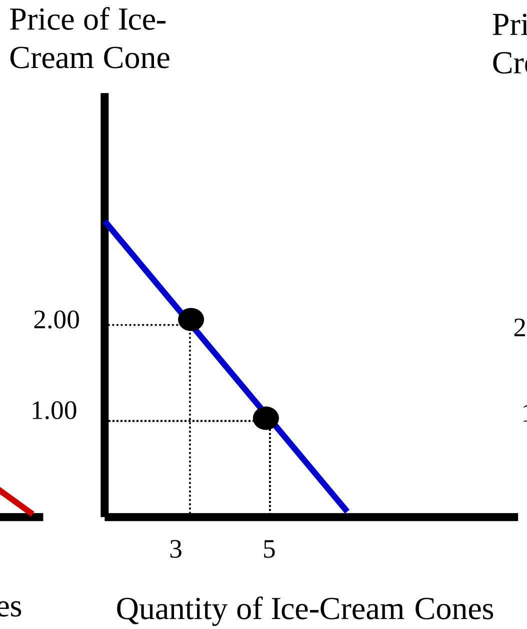
When the price is $2.00, Nicholas will demand 3 ice-cream cones.

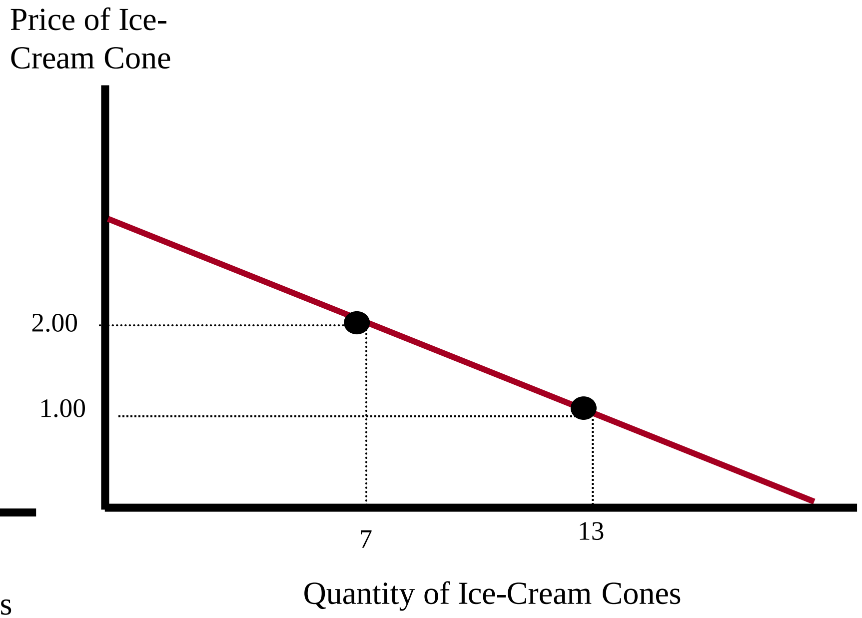
The market demand at $2.00 will be 7 ice-cream cones.

The market demand curve is the horizontal sum of the individual demand curves!

Catherine's Demand + Nicholas's Demand = Market Demand







When the price is $1.00, Catherine will demand 8 ice cream cones.

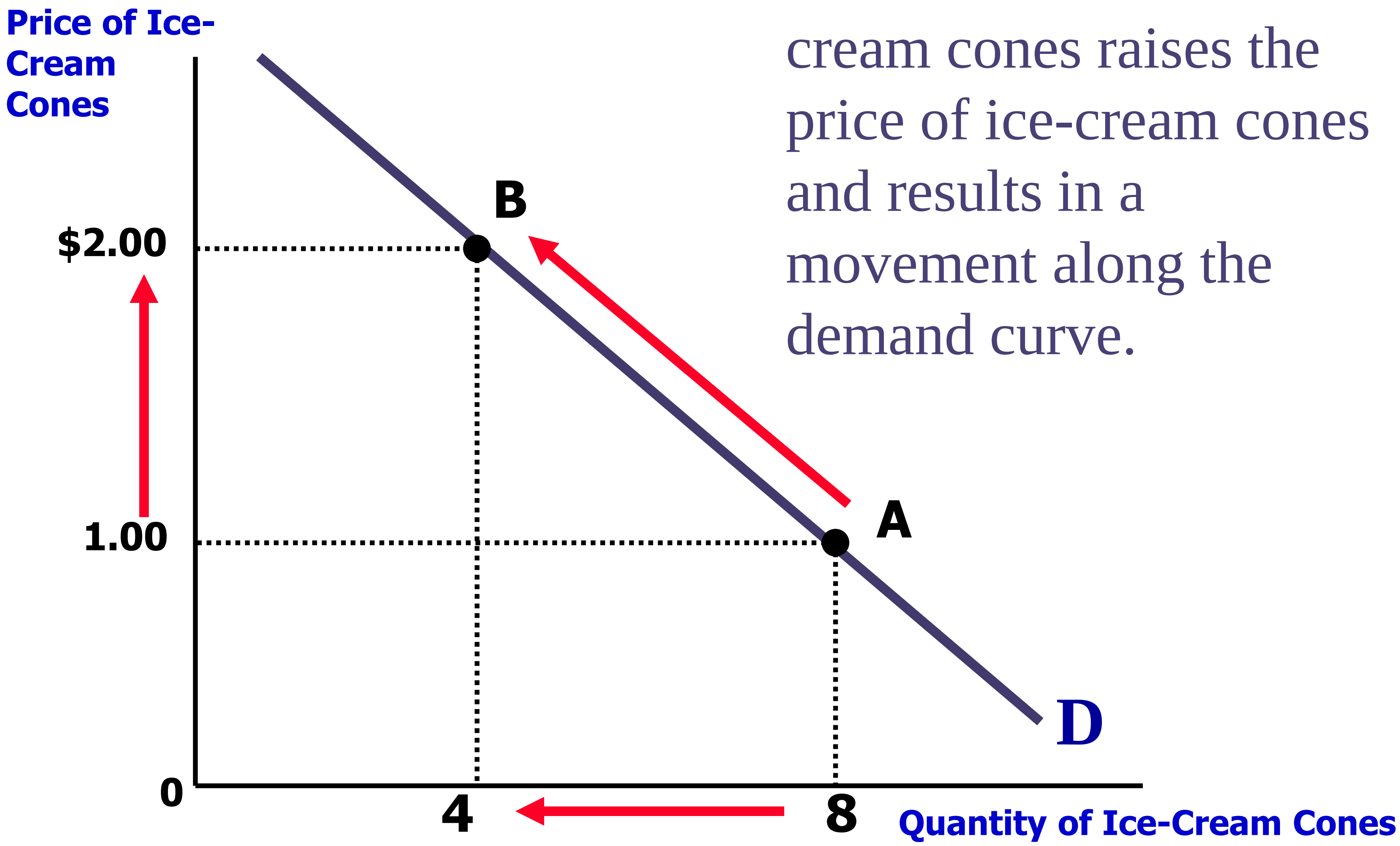
When the price is $1.00, Nicholas will demand 5 ice-cream cones.

The market demand at $1.00, will be 13 ice-cream cones.

Shifts in the Demand Curve

- Change in Quantity Demanded
  - Movement along the demand curve.
  - Caused by a change in the price of the product.

Changes in Quantity Demanded



A tax on sellers of ice-cream cones raises the price of ice-cream cones and results in a movement along the demand curve.

Individual and Market Demand

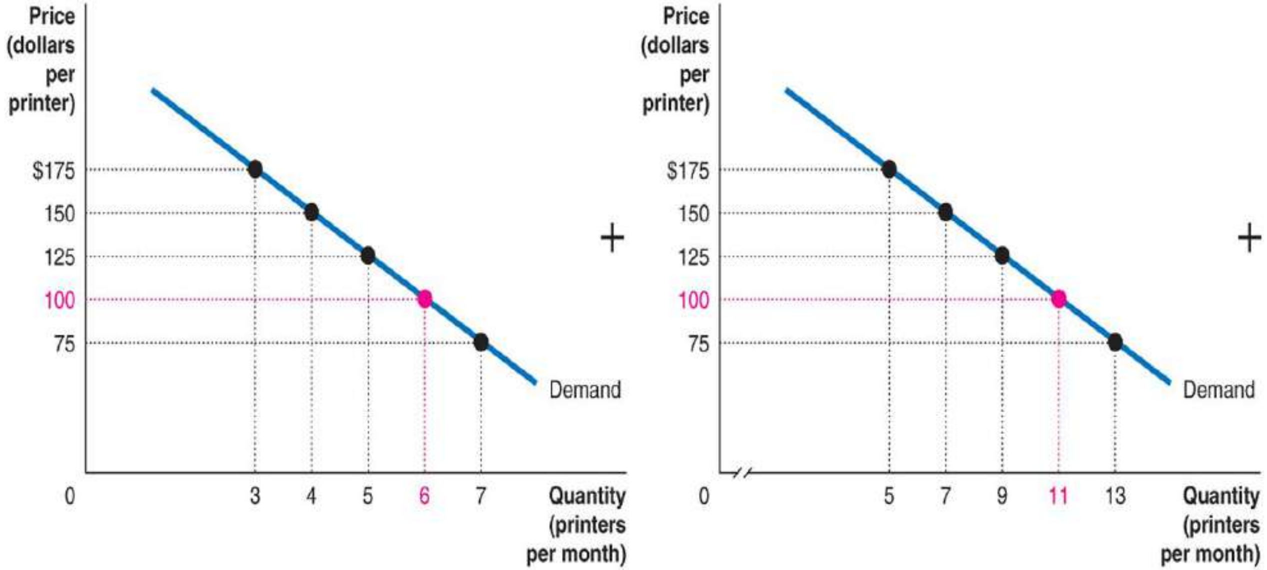
- Market demand is derived by horizontally summing individual demand curves
- Market demand is derived by adding all the quantities demanded in a demand schedule which correspond to their prices

Market Demand Table

Price	Demand of individual 'A'	Demand of individual 'B'	Demand of individual 'C'	Market Demand
5	20	30	50	100
4	40	60	100	200
3	60	90	150	300
2	80	120	200	400

Deriving the market demand curve from individual curves: Figure 3.3

Quantity (printers per month)				
Price (dollars per printer)	Group A	Group B	Group C	Market
$175	3	5	6	14
150	4	7	7	18
125	5	9	8	22
100	6	11	9	26
75	7	13	10	30

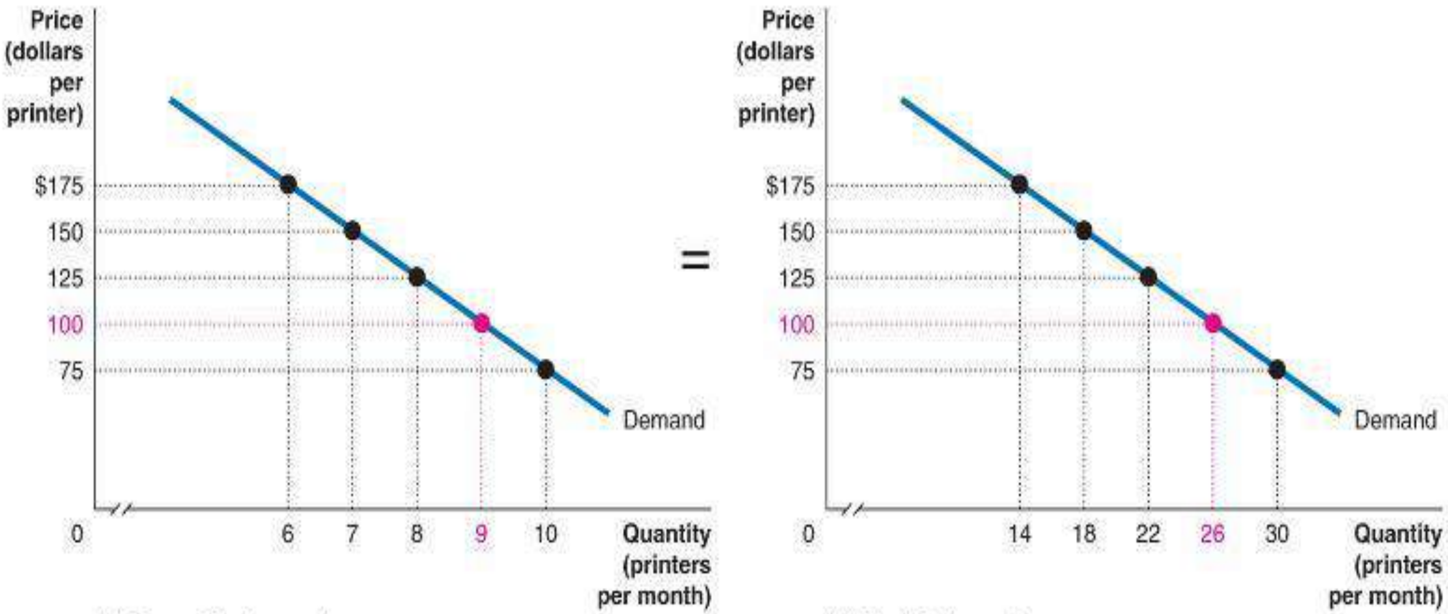


(a) Group A's demand curve

(b) Group B's demand curve

Deriving the market demand curve from individual curves: Figure 3.3, continued

Figure 3.3 continued



(c) Group C's demand curve

(d) Market demand curve

Elasticity

- Basic idea:
  Elasticity measures how much one variable responds to changes in another variable.
  - One type of elasticity measures how much demand for products will fall if the price is raised.
- Definition:
  Elasticity is a numerical measure of the responsiveness of $\boldsymbol{Q^d}$ or $\boldsymbol{Q^s}$ to one of its determinants.

Price Elasticity of Demand

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in } \boldsymbol{Q^d}}{\text{Percentage change in } \boldsymbol{P}}$$

- **Price elasticity of demand** measures how much Q^d responds to a change in P.

- Loosely speaking, it measures the price-sensitivity of buyers' demand.

Price Elasticity of Demand

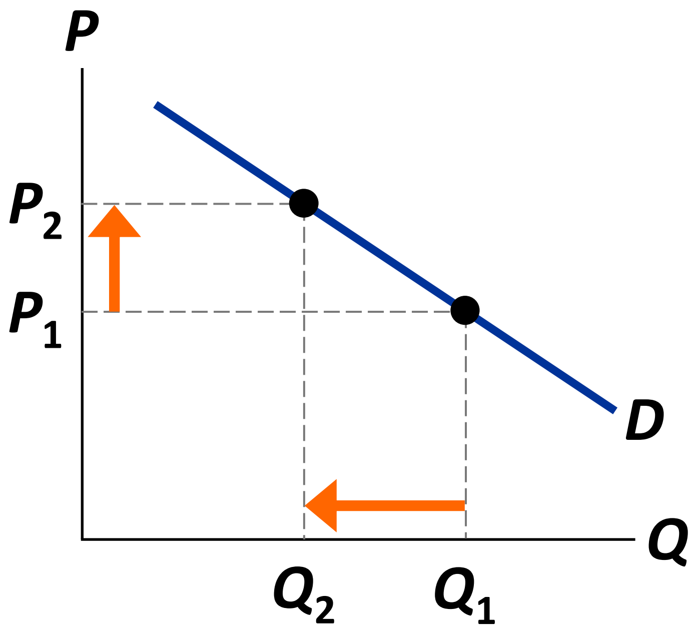
$$\text{Price elasticity of demand} = \frac{\text{Percentage change in } Q^d}{\text{Percentage change in } P}$$

Example:

Price elasticity of demand equals

$$\frac{15\%}{10\%} = 1.5$$

P rises by 10%



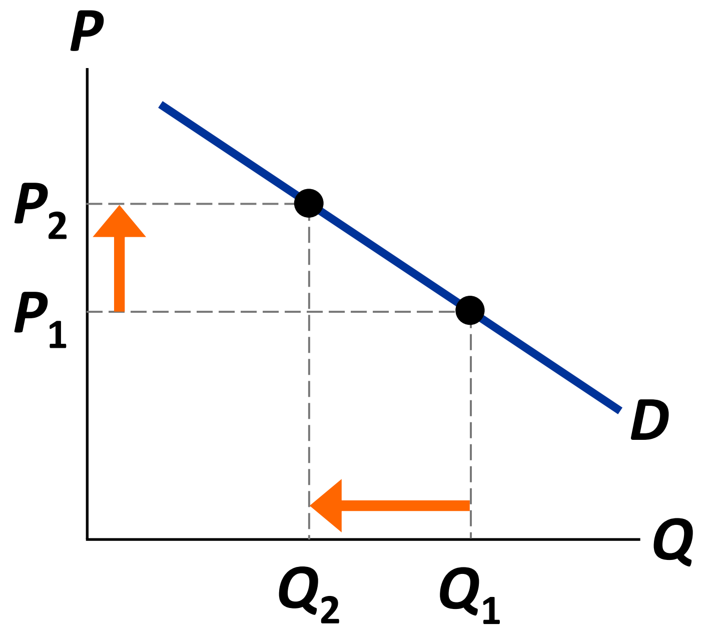
Q falls by 15%

Price Elasticity of Demand

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in } \boldsymbol{Q^d}}{\text{Percentage change in } \boldsymbol{P}}$$

Along a ***D*** curve, ***P*** and ***Q*** move in opposite directions, which would make price elasticity negative.

We will drop the minus sign and report all price elasticities as
positive numbers.

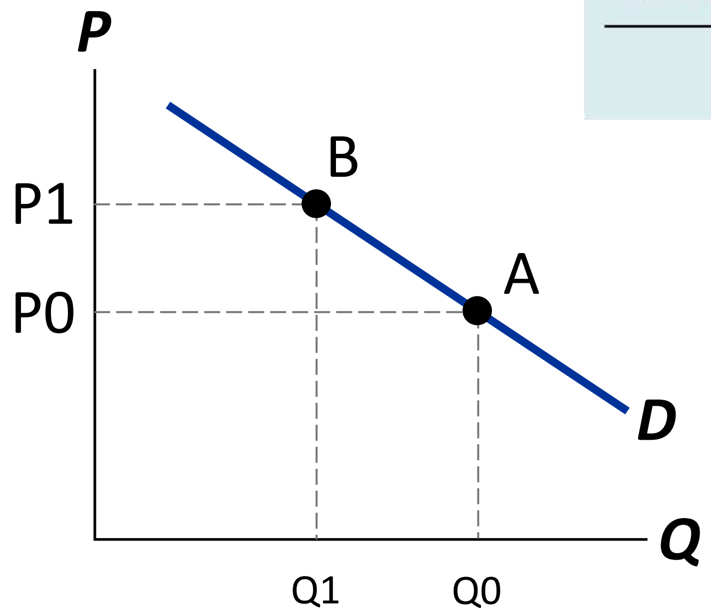


Market Demand Table

Price	Demand of individual 'A'	Demand of individual 'B'	Demand of individual 'C'	Market Demand
5	20	30	50	100
4	40	60	100	200
3	60	90	150	300
2	80	120	200	400

Calculating Percentage Changes

Standard method (Point elasticity)
of computing the percentage (%) change:



$$\frac{\text{end value} - \text{start value}}{\text{start value}} \times 100\%$$

Calculating Percentage Changes

Problem:

The standard method gives different answers depending on where you start.

Point elasticity calculation **(Point method)** gives rise to different values of elasticity based on where you start and end,

But elasticity calculation based on average values between the points **(ARC method)** where the average is chosen as denominator, avoids this problem

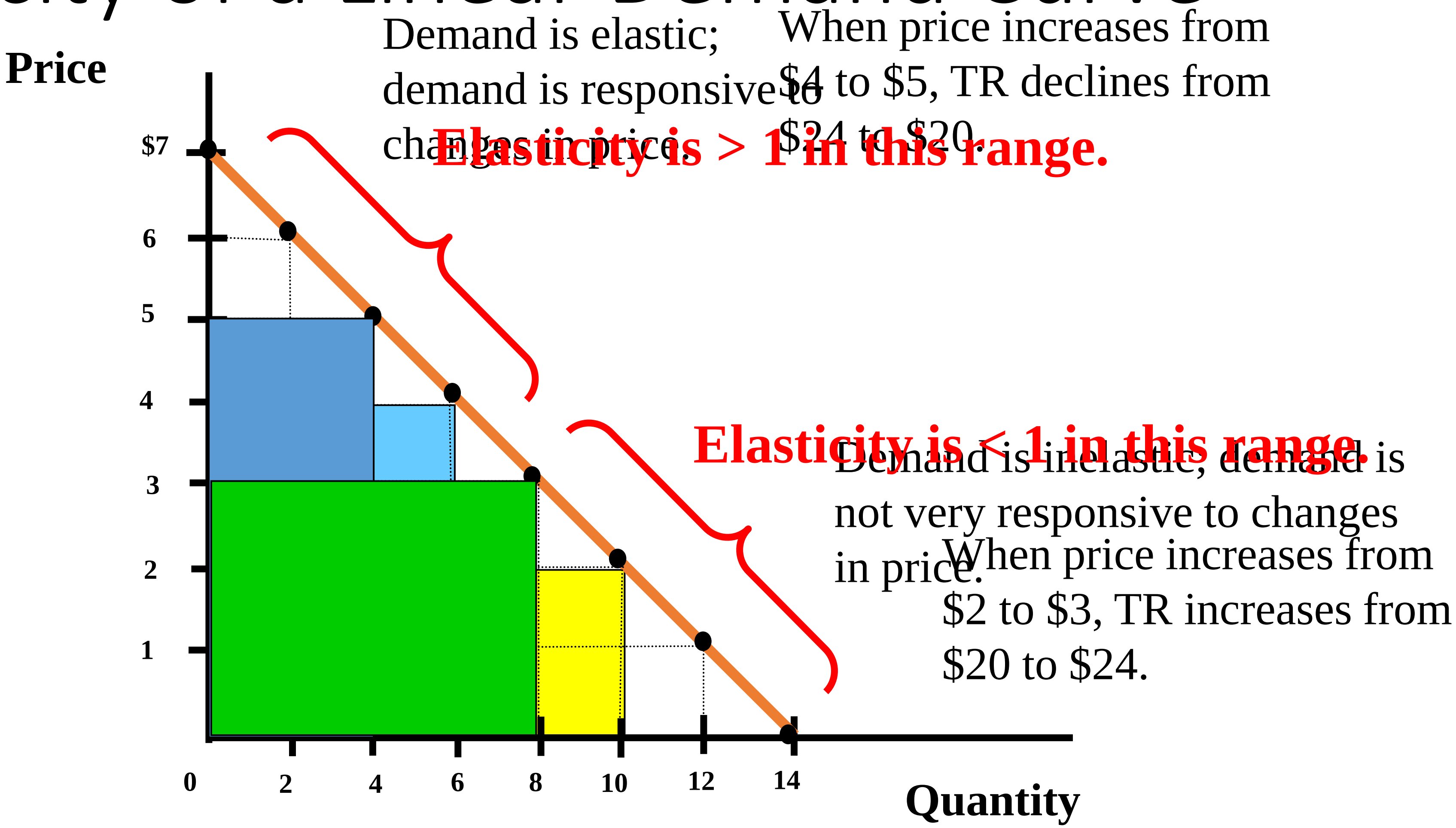
Calculating Percentage Changes

- So, we instead use the **midpoint method (ARC elasticity)**:

$$\frac{\text{end value} - \text{start value}}{\text{midpoint}} \times 100\%$$

- The midpoint is the number halfway between the start & end values, the average of those values.
- It doesn't matter which value you use as the "start" and which as the "end" – you get the same answer either way!

Elasticity of a Linear Demand Curve



What determines price elasticity?

To learn the determinants of price elasticity,
we look at a series of examples.
Each compares two common goods.

In each example:

- Suppose the prices of both goods rise by 20%.
- The good for which $\boldsymbol{Q}^{\mathbf{d}}$ falls the most (in percent) has the highest price elasticity of demand.
  Which good is it? Why?
- What lesson does the example teach us about the determinants of the price elasticity of demand?

The concept of elasticity

- Has the London congestion charge reduced traffic flows and congestion?
- Will most people still fly if there is a new aviation fuel tax?

Price elasticity of demand

- Why is elasticity of demand important for Stelios?

Elasticity of Demand

⑩ Why do hotels hike room-rates at weekends and why do car rental firms charge higher prices at weekend?

Elasticity Questions…are these products Price Elastic or Inelastic?

Dell cuts the price of their desktop PCs by 10%	
A fall in the price of I-max tickets	
An increase in the price of the EconomicTimes	
A taxi home from a night-club on a Friday night	
A rise in average car insurance premiums	
Petrol prices rise by 5% after the budget	
Vodafone cuts their mobile phone charges	
Aviation surcharge rises by 20% due to a rise in world oil prices	
A local leisure club decreases monthly charges by 15% in a bid to increase the number of members	

- In early 2011, Netflix consumers paid about $10 a month for a package consisting of streaming video and DVD rentals. In July 2011, the company announced a packaging change. Customers wishing to retain both streaming video and DVD rental would be charged $15.98 per month – a price increase of about 60%. In 2014, Netflix also raised its streaming video subscription price from $7.99 to $8.99 per month for new U.S. customers. The company also changed its policy of 4K streaming content from $9.00 to $12.00 per month that year.

- How do the customers react?

EXAMPLE 1:

Breakfast cereal vs. Sunscreen

- The prices of both of these goods rise by 20%. For which good does Q^d drop the most? Why?
  - Breakfast cereal has close substitutes (*e.g.*, pancakes, Eggo waffles, etc.), so buyers can easily switch if the price rises.
  - Sunscreen has no close substitutes, so consumers would probably not buy much less if its price rises.
- Lesson: ***Price elasticity is higher when close substitutes are available.***

EXAMPLE 2:
"Blue Jeans" vs. "Clothing"

- The prices of both goods rise by 20%.
  For which good does $\boldsymbol{Q}^d$ drop the most? Why?
  - For a narrowly defined good such as blue jeans, there are many substitutes (khakis, shorts, Speedos).
  - There are fewer substitutes available for broadly defined goods.
    (There aren't too many substitutes for clothing)
- Lesson: ***Price elasticity is higher for narrowly defined goods than broadly defined ones.***

EXAMPLE 3:
Insulin vs. Luxury Caribbean Cruises

- The prices of both of these goods rise by 20%. For which good does $\boldsymbol{Q}^{d}$ drop the most? Why?
  - To millions of diabetics, insulin is a necessity. A rise in its price would cause little or no decrease in demand.
  - A cruise is a luxury. If the price rises, some people will forego it.
- Lesson: ***Price elasticity is higher for luxuries than for necessities.***

EXAMPLE 4:

Petrol in the Short Run vs. petrol in the Long Run

- The price of petrol rises 20%. Does Q^d drop more in the short run or the long run? Why?
  - There's not much people can do in the short run, other than ride the bus or carpool.
  - In the long run, people can buy smaller cars or live closer to where they work or alternate fuel systems may develop.
- Lesson: ***Price elasticity is higher in the long run than the short run.***

The Determinants of Price Elasticity: A Summary

The price elasticity of demand depends on:

- the extent to which close substitutes are available
- whether the good is a necessity or a luxury
- how broadly or narrowly the good is defined
- the time horizon – elasticity is higher in the long run than the short run

The Variety of Demand Curves

- The price elasticity of demand is closely related to the slope of the demand curve.
- Rule of thumb:
  The flatter the curve, the bigger the elasticity.
  The steeper the curve, the smaller the elasticity.
- Five different classifications of ***D*** curves.…

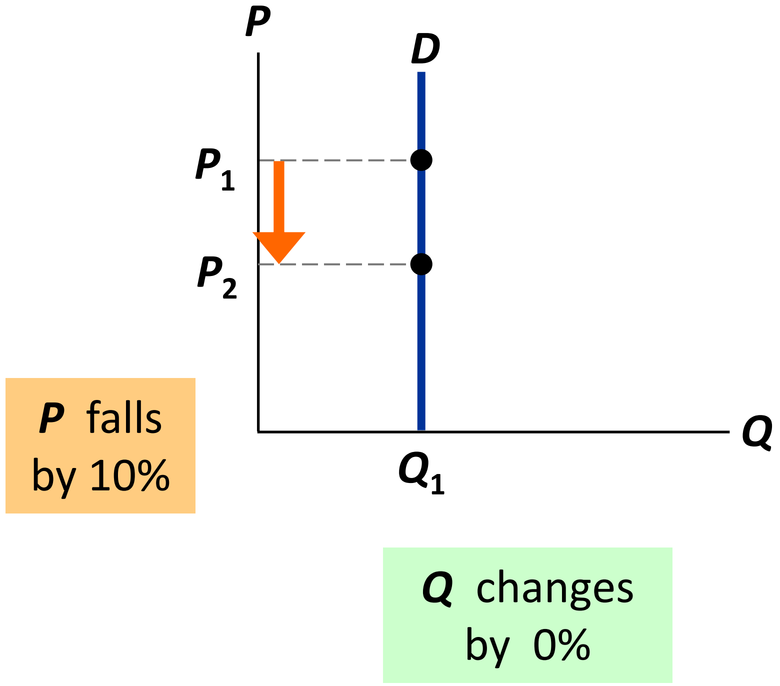
“Perfectly inelastic demand” (one extreme case)

$$\text{Price elasticity of demand} = \frac{\%\text{ change in } \boldsymbol{Q}}{\%\text{ change in } \boldsymbol{P}} = \frac{0\%}{10\%} = 0$$

D curve:
vertical

Consumers' price sensitivity:
none

Elasticity
: 0



“Inelastic demand”

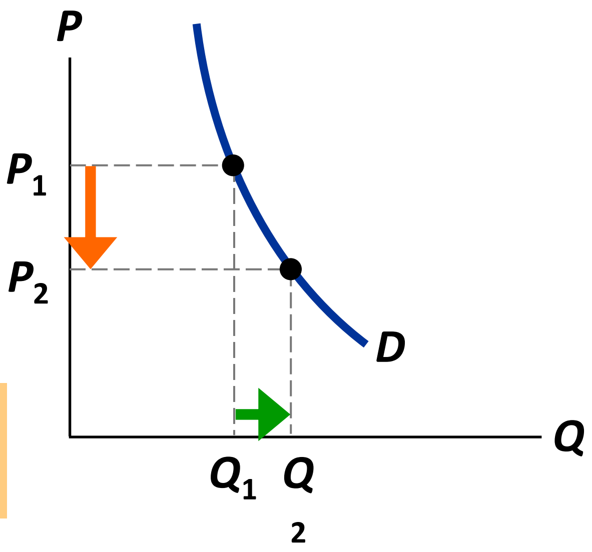
$$\text{Price elasticity of demand} = \frac{\%\ \text{change in } \boldsymbol{Q}}{\%\ \text{change in } \boldsymbol{P}} = \frac{< 10\%}{10\%} < 1$$

D curve:
relatively steep

Consumers’ price sensitivity:
relatively low

Elasticity: < 1

P falls by 10%



Q rises less than 10%

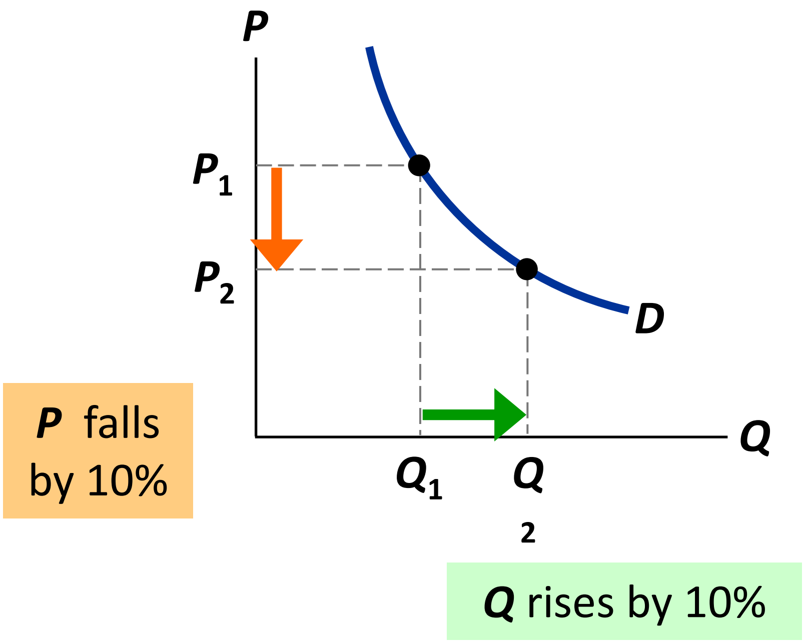
"Unit elastic demand"

$$\text{Price elasticity of demand} = \frac{\%\text{ change in } \boldsymbol{Q}}{\%\text{ change in } \boldsymbol{P}} = \frac{10\%}{10\%} = 1$$

D curve:
intermediate slope

Consumers' price sensitivity:
intermediate

Elasticity: 1



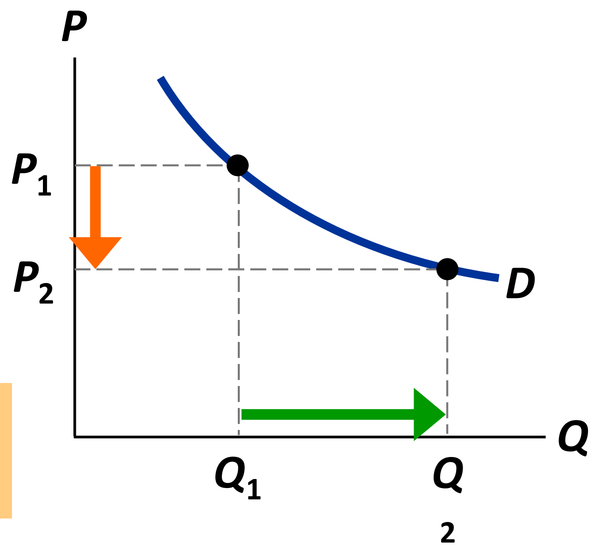
"Elastic demand"

Price elasticity of demand = $\dfrac{\text{\% change in } \boldsymbol{Q}}{\text{\% change in } \boldsymbol{P}}$ = $\dfrac{> 10\%}{10\%}$ > 1

D curve:
relatively flat

Consumers' price sensitivity:
relatively high

Elasticity: > 1



P falls by 10%

Q rises more than 10%

"Perfectly elastic demand" (the other extreme)

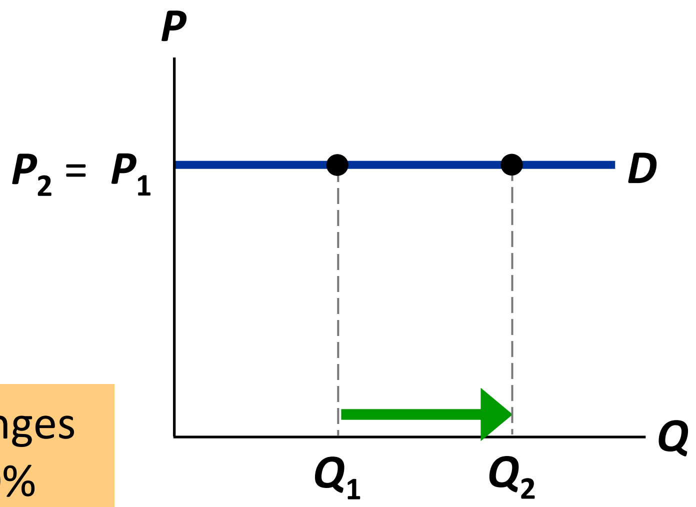
$$\text{Price elasticity of demand} = \frac{\%\text{ change in } \boldsymbol{Q}}{\%\text{ change in } \boldsymbol{P}} = \frac{\text{any }\%}{0\%} = \text{infinity}$$

D curve:
horizontal

Consumers' price sensitivity:
extreme

Elasticity: infinity

P changes by 0%



Q changes by any %

Price Elasticity and Total Revenue

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in } \boldsymbol{Q}}{\text{Percentage change in } \boldsymbol{P}}$$

Revenue = ***P*** x ***Q***

- If demand is inelastic, then

  price elast. of demand < 1

  % change in ***Q*** < % change in ***P***

- The fall in revenue from lower ***Q*** is smaller than the increase in revenue from higher ***P***, so revenue rises.

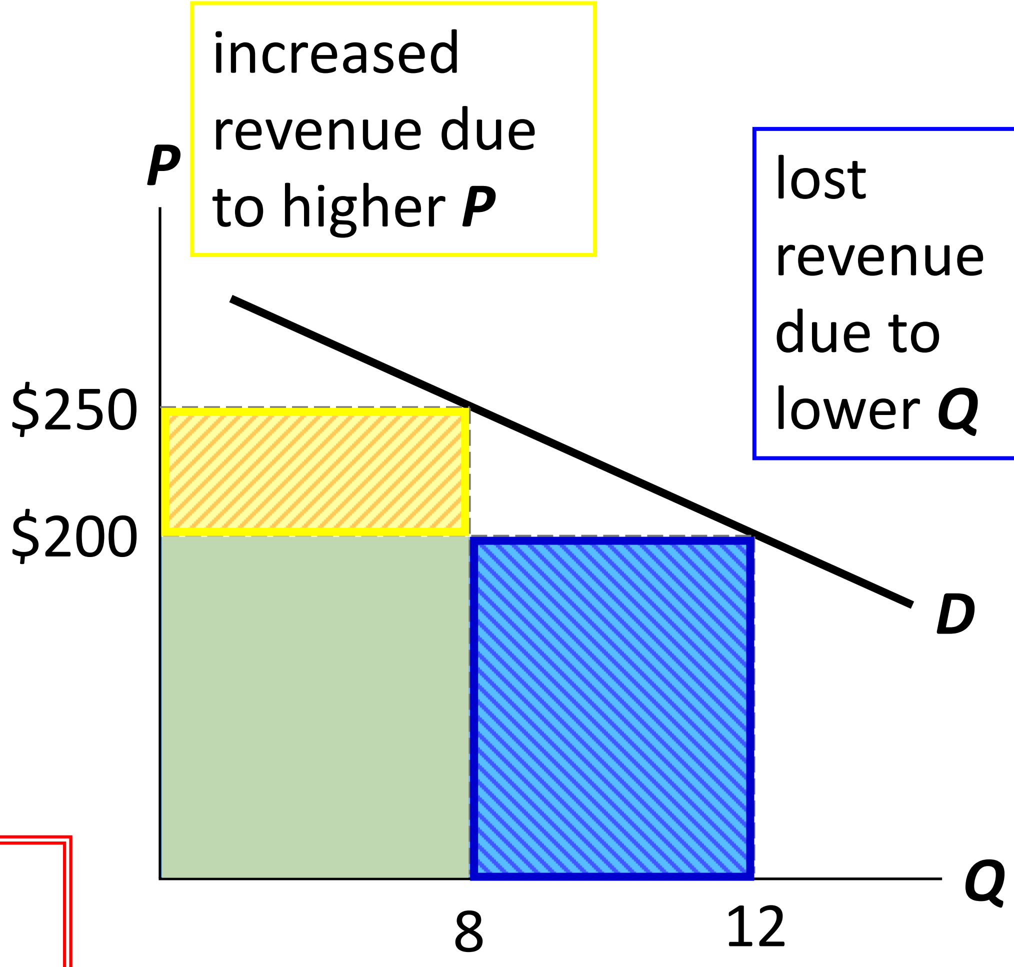
Price Elasticity and Total Revenue

Elastic demand
(elasticity = 1.8)

If ***P*** = $200,
Q = 12 and revenue
= $2400.

If ***P*** = $250,
Q = 8 and
revenue = $2000.

When ***D*** is elastic,
a price increase
causes revenue to fall.



Price Elasticity and Total Revenue

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in } \boldsymbol{Q}}{\text{Percentage change in } \boldsymbol{P}}$$

Revenue = ***P*** x ***Q***

- If demand is inelastic, then

  price elast. of demand < 1

  % change in ***Q*** < % change in ***P***

- The fall in revenue from lower ***Q*** is smaller than the increase in revenue from higher ***P***, so revenue rises.
- In our example, suppose that ***Q*** only falls to 10 (instead of 8) when you raise your price to $250.

Price Elasticity and Total Revenue

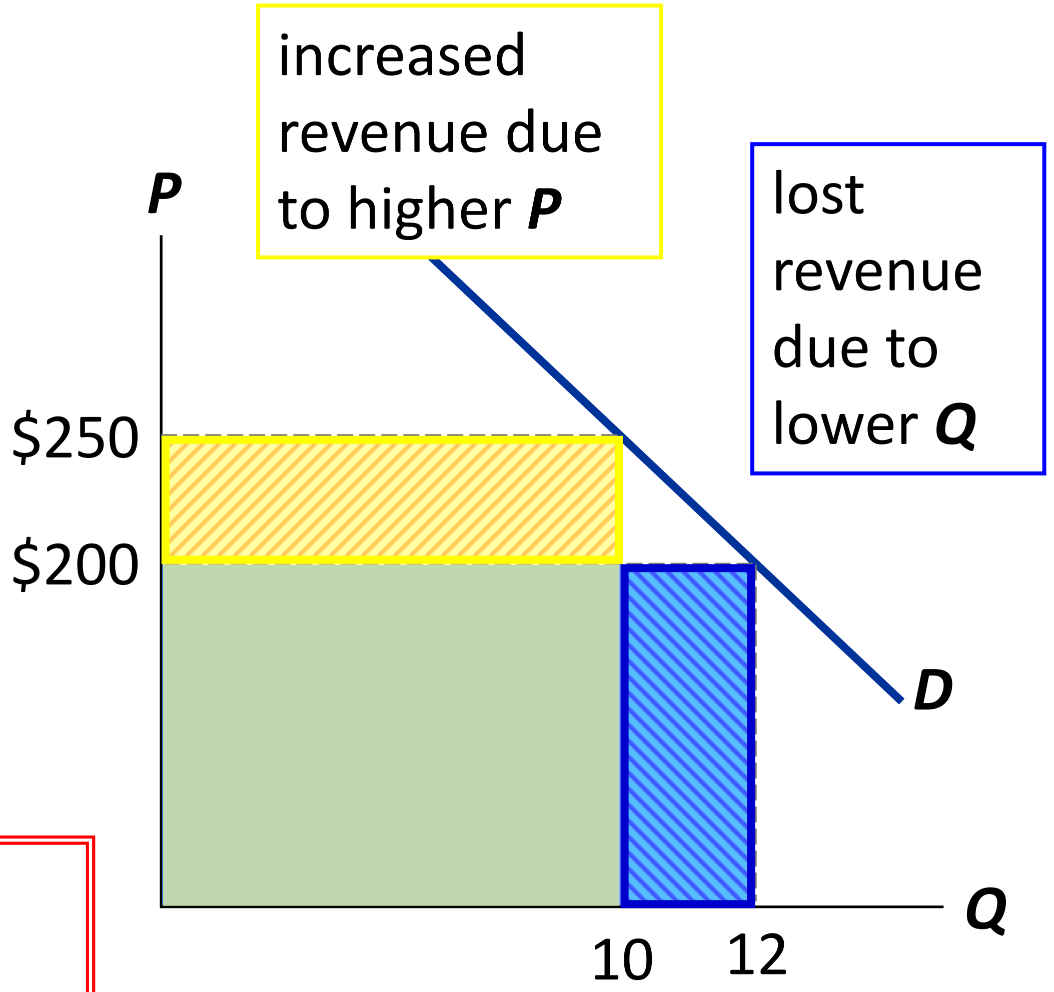
Now, demand is inelastic:

elasticity = 0.82

If ***P*** = \$200, ***Q*** = 12 and revenue = \$2400.

If ***P*** = \$250, ***Q*** = 10 and revenue = \$2500.

When ***D*** is inelastic, a price increase causes revenue to rise.



Computing the Price Elasticity of Demand

Example: If the price of an ice cream cone increases from \$2.00 to \$2.20 and the amount you buy falls from 10 to 8 cones then your elasticity of demand would be calculated as:

$$\frac{8-10}{10} X \frac{2}{2.20-2} = 2$$

Table-2: Demand Schedule	
Price per unit (₹)	Quantity Demanded(units)
60	100
70	90

Elasticity =

Example-1: The demand schedule for coffee is shown in Table-1:

Table-1: Demand Schedule for Coffee	
Price of Coffee (₹)	Quantity Demanded(Kg)
20	10
22	9

Elasticity =

Other Elasticities

- **Income elasticity of demand**: measures the response of Q^d to a change in consumer income

$$\text{Income elasticity of demand} = \frac{\text{Percent change in } Q^d}{\text{Percent change in income}}$$

- An increase in income causes an increase in demand for *luxury* and *normal* goods.
- Income elasticity is >1 for luxury products.
- For normal goods, income elasticity > 0 but <1.
- For *inferior* goods, income elasticity < 0.

Other Elasticities

- **Cross-price elasticity of demand**: measures the response of demand for one good to changes in the price of another good

$$\text{Cross-price elast. of demand} = \frac{\text{\% change in } \boldsymbol{Q^d} \text{ for good 1}}{\text{\% change in price of good 2}}$$

- For substitutes, cross-price elasticity > 0 (e.*g*., an increase in price of beef causes an increase in demand for chicken)
- For complements, cross-price elasticity < 0 (*e.g*., an increase in price of computers causes decrease in demand for software)

Cross-Price Elasticities in the News

"As Fuel Costs Soar, Buyers Flock to Small Cars"
-*New York Times*, 5/2/2008

"Fuel Prices Drive Students to Online Courses"
-*Chronicle of Higher Education*, 7/8/2008

"Fuel prices knock bicycle sales, repairs into higher gear"
-*Associated Press*, 5/11/2008

"Camel demand soars in India"
(as a substitute for "fuel-guzzling tractors")
-*Financial Times*, 5/2/2008

"High fuel prices drive farmer to switch to mules"
-*Associated Press*, 5/21/2008

Income Elasticity of Demand

Income Elasticity of Demand

- The income is the other factor that influences the demand for a product.

- Hence, the degree of responsiveness of a change in demand for a product due to the change in the income is known as income elasticity of demand.

INCOME ELASTICITY OF DEMAND (cont.)

FORMULA:

$$\varepsilon_Y = \frac{\%\ \Delta\ \text{Quantity Demanded}}{\%\ \Delta\ \text{Income}}$$

$$\varepsilon_Y = \frac{Q_2 - Q_1}{Q_1} \times \frac{Y_1}{Y_2 - Y_1}$$

Income Elasticity of Demand

- Income elasticity (in absolute sense) can be:

  1) Greater than 1 (normal good, income elastic)

    - **luxury goods** - ocean cruises, jewelry

  2) Between zero and 1 (normal good, income inelastic)

    - **necessities** - food, clothing

  3) Less than zero (inferior good)

    - potatoes, rice

Calculate the income elasticity of demand for X when the income of consumers increases from 200 to 400. then demand increases from 100 to 150 ,What type of product is X

Calculate the income elasticity of demand for Z when the income of consumers decreases from 200 to 100. then demand increases from 100 to 120 ,What type of product is Z

Cross Elasticity of Demand

Cross Elasticity of Demand

- The cross elasticity of demand refers to the change in quantity demanded for one commodity as a result of the change in the price of another commodity.
- This type of elasticity usually arises in the case of the interrelated goods such as substitutes and complementary goods.

Cross Elasticity of Demand

- Elasticity measure that looks at the impact a change in the price of one good has on the demand of another good.
- % change in demand Q1/% change in price of Q2.
- Positive-Substitutes
- Negative-Complements.

Substitute Goods

- When the cross elasticity of demand for product A relative to a change in price of product B is positive, it means that in response to an increase (decrease) in price of product B, the quantity demanded of product A has increased (decreased). Since A, say Coke, and B, say Sprite, are substitutes, an increase in price of product B means that more people will consume A instead of B, and this will increase the quantity demanded of product A. Increase in quantity demanded of product A relative to increase in price of product B gives us a positive cross elasticity of demand.

Complementary Goods

- When the cross elasticity of demand for product A relative to change in price of product B is negative, it means that the quantity demanded of A has decreased (increased) relative to an increase (decrease) in price of product B. As A, say car, and B, say fuel, are complimentary goods, and an increase in price of B will reduce the quantity demanded of A. This is because people consume both A and B as a bundle and an increase in price reduces their purchasing power and decreases quantity demanded.

CROSS ELASTICITY OF DEMAND

FORMULA:

$$\varepsilon_X = \frac{\%\ \Delta \text{ Quantity Demanded of good X}}{\%\ \Delta \text{ Price of good Y}}$$

$$\varepsilon_X = \frac{Q_{X2} - Q_{X1}}{Q_{X1}} \times \frac{P_{Y1}}{P_{Y2} - P_{Y1}}$$

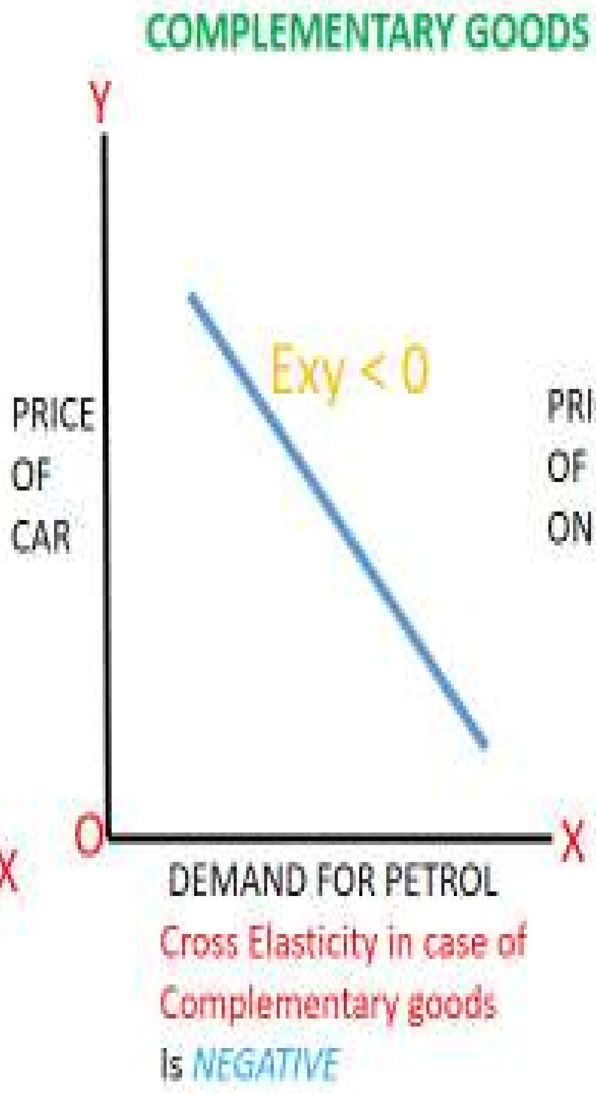
Understanding the Coefficient of Cross Price Elasticity

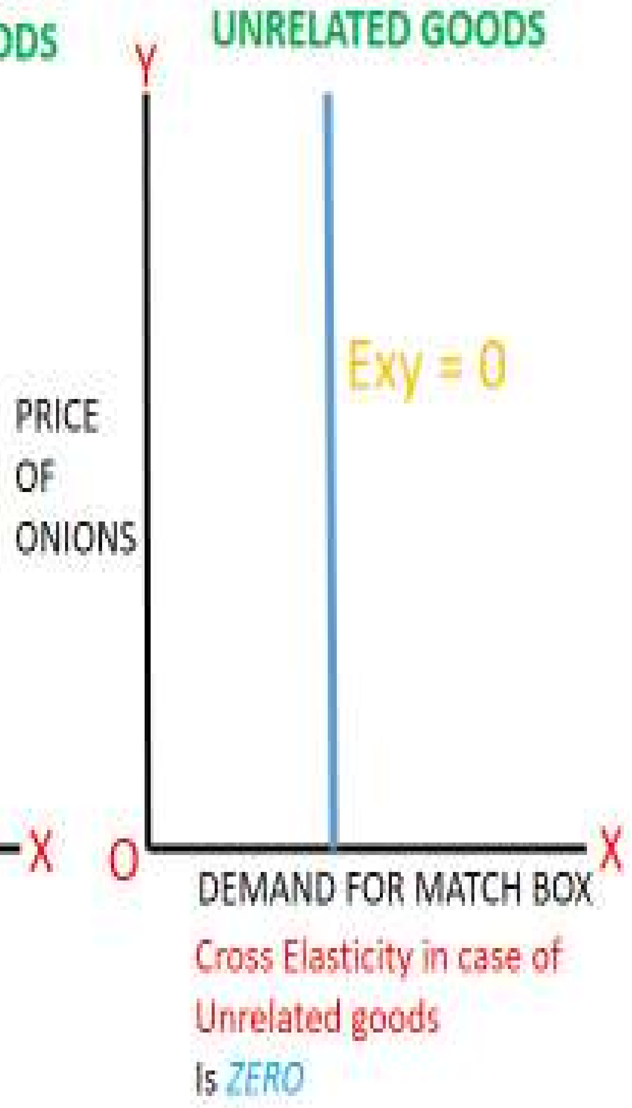
The stronger the relationship between two products, the higher is the co-efficient of cross-price elasticity of demand

- **Substitutes:**
  - **Close substitutes** have a strongly **positive** cross price elasticity of demand i.e. a small change in relative price causes a big switch in consumer demand
- **Complements:**
  - When there is a strong complementary relationship, the cross elasticity will be highly **negative**.
  - An example might be games consoles and software games
- **Unrelated products:**
  - Unrelated products have **zero** cross elasticity e.g. the effect of changes in taxi fares on the market demand for cheese!

tutor2u


SUBSTITUTE GOODS
Y
PRICE
OF
COFFEE
Exy > 0
O
X
DEMAND FOR TEA
Cross Elasticity in case of
Substitutes
Is POSITIVE


COMPLEMENTARY GOODS
Y
PRICE
OF
CAR
Exy < 0
O
X
DEMAND FOR PETROL
Cross Elasticity in case of
Complementary goods
Is NEGATIVE


UNRELATED GOODS
Y
PRICE
OF
ONIONS
Exy = 0
O
X
DEMAND FOR MATCH BOX
Cross Elasticity in case of
Unrelated goods
Is ZERO

Price of X	Demand for X	Demand for Y	Income
25	10	5	100
20	20	10	200
15	30	15	300
10	40	20	400

- Calculate the price elasticity of demand for X, if the price of X increase from Rs10 to Rs 20, and indicate whether the demand is elastic or inelastic.
- Calculate the income elasticity of demand for X when the income of consumers increases from 200 to 400.What type of product is X.
- Calculate the cross elasticity of demand for Y when the price of X decrease from 25 to 15. Are X and Y complements or substitute.

$$\frac{20-40}{40} \; X \; \frac{10}{20-10}$$

Ep = 20/40 X 10/10

Ep = 0.5

Inelastic demand

$$\frac{Q2 - Q1}{Q1} X \frac{Y1}{Y2 - Y1}$$

$$\frac{40 - 20}{20} X \frac{200}{400 - 200}$$

- Ep = 20 / 20 X 200 / 200
- Ep = 1
- Since its equal to 1 and positive , so A is Normal good

$$\frac{Qy2 - Qy1}{Qy1} \times \frac{Px1}{Px2 - Px1}$$

$$\frac{15 - 5}{5} \times \frac{25}{15 - 25}$$

Ep = 10/5 X 25/-10

Ep = 2 X -2.5

Ep = - 5 (Complementary Goods)

Income Elasticity of Demand

- Income elasticity of demand measures how much the quantity demanded of a good responds to a change in consumers' income.
- It is computed as the percentage change in the quantity demanded divided by the percentage change in income.

Computing Income Elasticity

$$\textbf{Income Elasticity of Demand} = \frac{\textbf{Percentage Change in Quantity Demanded}}{\textbf{Percentage Change in Income}}$$

- Income increases from Rs 100 to Rs 110, and quantity demanded also increases from 50 to 55. then income elasticity of demand will be -

Income Elasticity
- Types of Goods -

Normal Goods

Income Elasticity is positive.

Inferior Goods

Income Elasticity is negative.

Higher income *raises* the quantity demanded for normal goods but *lowers* the quantity demanded for inferior goods.

Elasticity

- **Cross Elasticity:**
- The responsiveness of demand of one good to changes in the price of a related good – either a substitute or a complement

$$\text{Xed} = \frac{\%\ \Delta\ \text{Qd of good t}}{\%\ \Delta\ \text{Price of good y}}$$

- If quantity demanded of X increases by 5 % when the price of Y increases by 20 % the cross price elasticity would be – Qx/Py

- If quantity demanded of A increases by 10 % when the price of B declines by 20 %, the cross price elasticity of demand between A and B would be – QA/PB

Supply

- The various amounts of a product that producers are willing and able to supply at various prices during some specific period
- Demonstrated by the supply schedule and supply curve

Law of Supply and illustrations

- Corn crops are very plentiful over the course of the year and there is more corn than people would normally buy. To get rid of the excess supply, producers need to lower the price of corn and thus the price is driven down for everyone.

- There is a drought and very few strawberries are available. More people want the strawberries than there are berries available. The price of strawberries increases dramatically.

- A huge wave of new, unskilled workers come to a city and all of the workers are willing to take jobs at low wages. Because there are more workers than there are available jobs, the excess supply of workers drives wages downward.

On the other side

- A popular artist dies and, thus, he obviously will be producing no more art. Demand for his art increases substantially as people want to purchase the few pieces that exist.

- A new restaurant opens up in town and gets great reviews. There are only 12 tables in the restaurant but everyone wants to get a reservation. Demand for the reservations goes up.

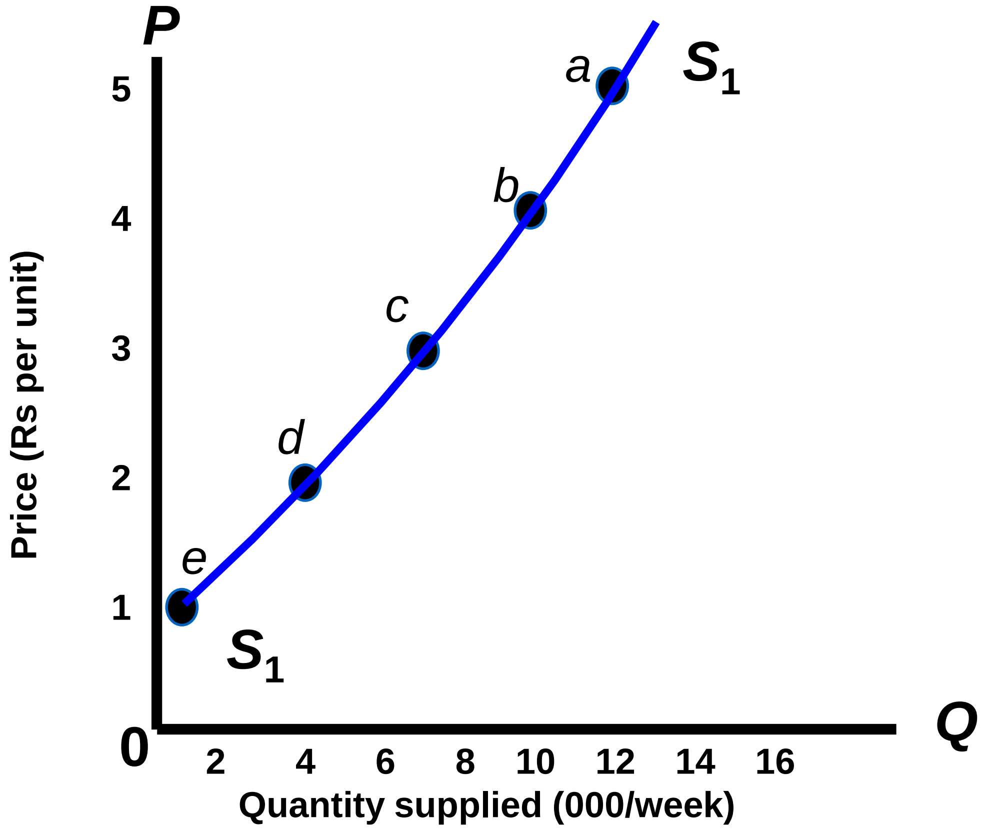
Law of Supply

- Direct relationship between the price and quantity supplied
- Increased price causes increased quantity supplied
- Decreased price causes decreased quantity supplied

Market Supply

	Price per unit (Rs)	Quantity supplied per week
a	5	12 000
b	4	10 000
c	3	7 000
d	2	4 000
e	1	1 000

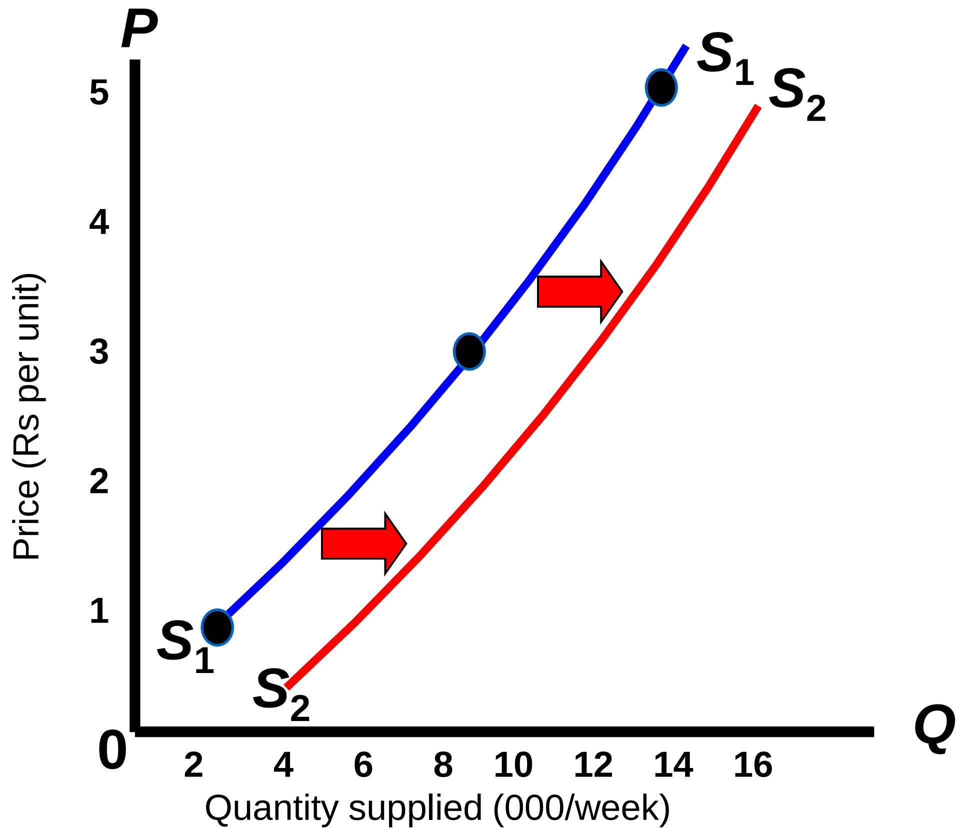
Supply Curve



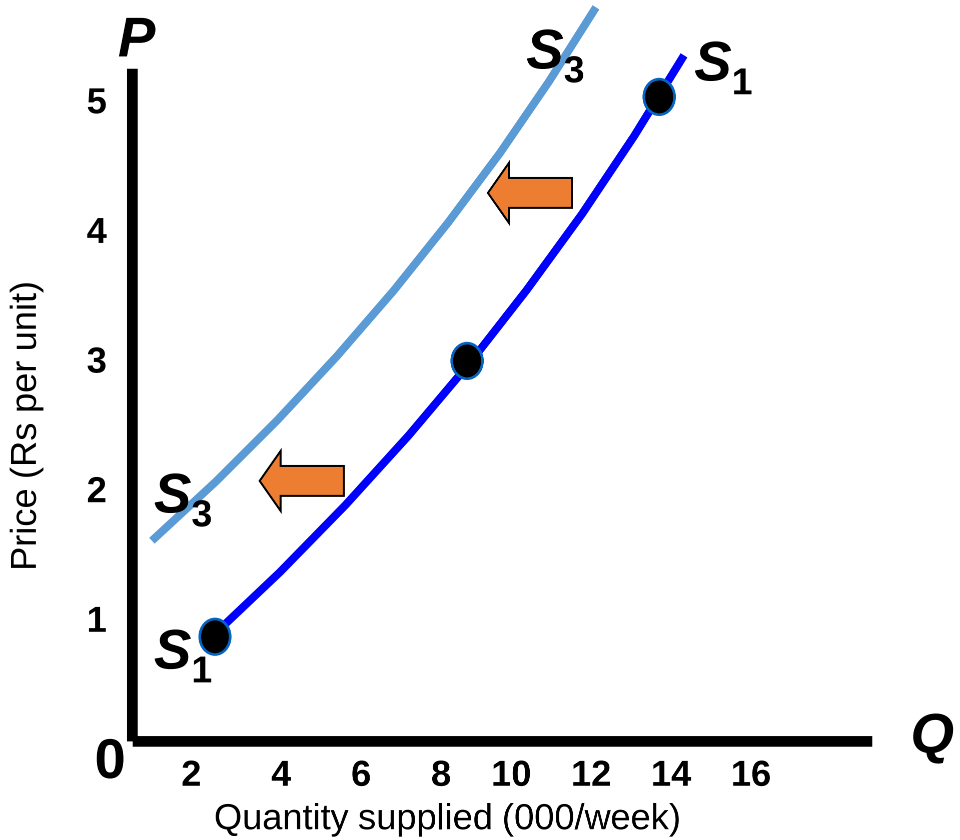
Change in Supply

- represented as a shift of the supply curve
- caused by changes in determinants of supply other than price

Increase in Supply



Decrease in Supply



Non-price determinants of Supply

- Resource price
- Technology
- Prices of other goods
- Expectations
- Number of sellers
- [Note mostly related to changing costs of production reflecting marginal cost curve]

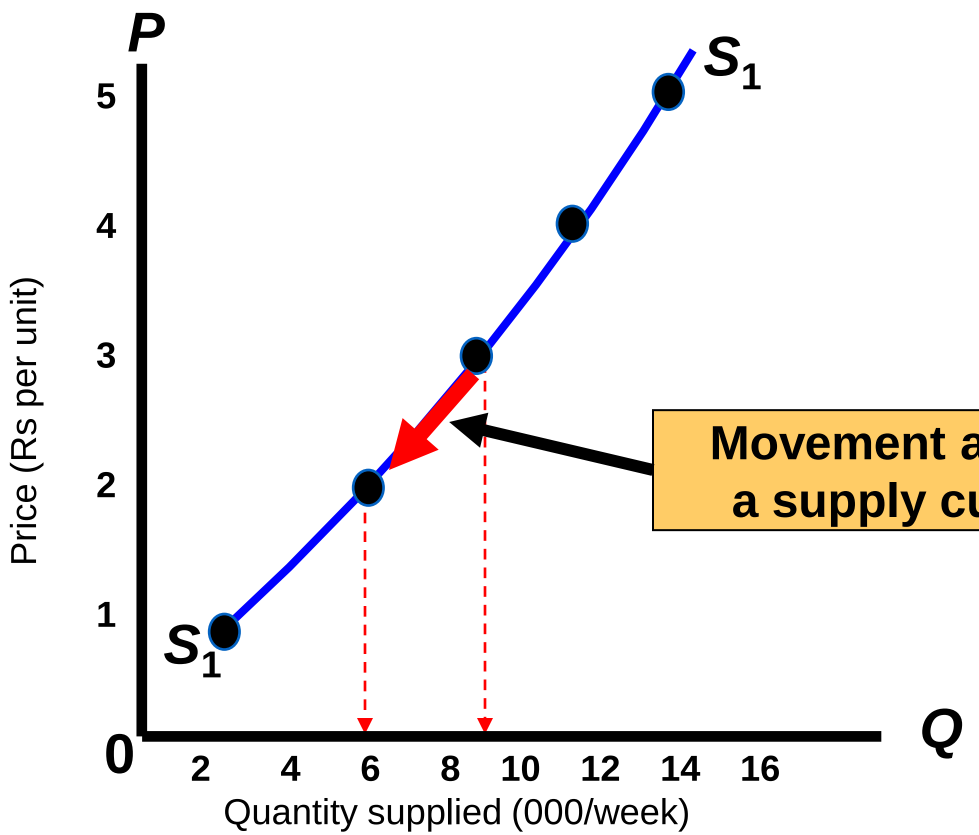
Variables that Influence Sellers

Variable	A change in this variable…
Price	…causes a movement along the ***S*** curve
Input Prices	…shifts the ***S*** curve
Technology	…shifts the ***S*** curve
# of Sellers	…shifts the ***S*** curve
Expectations	…shifts the ***S*** curve

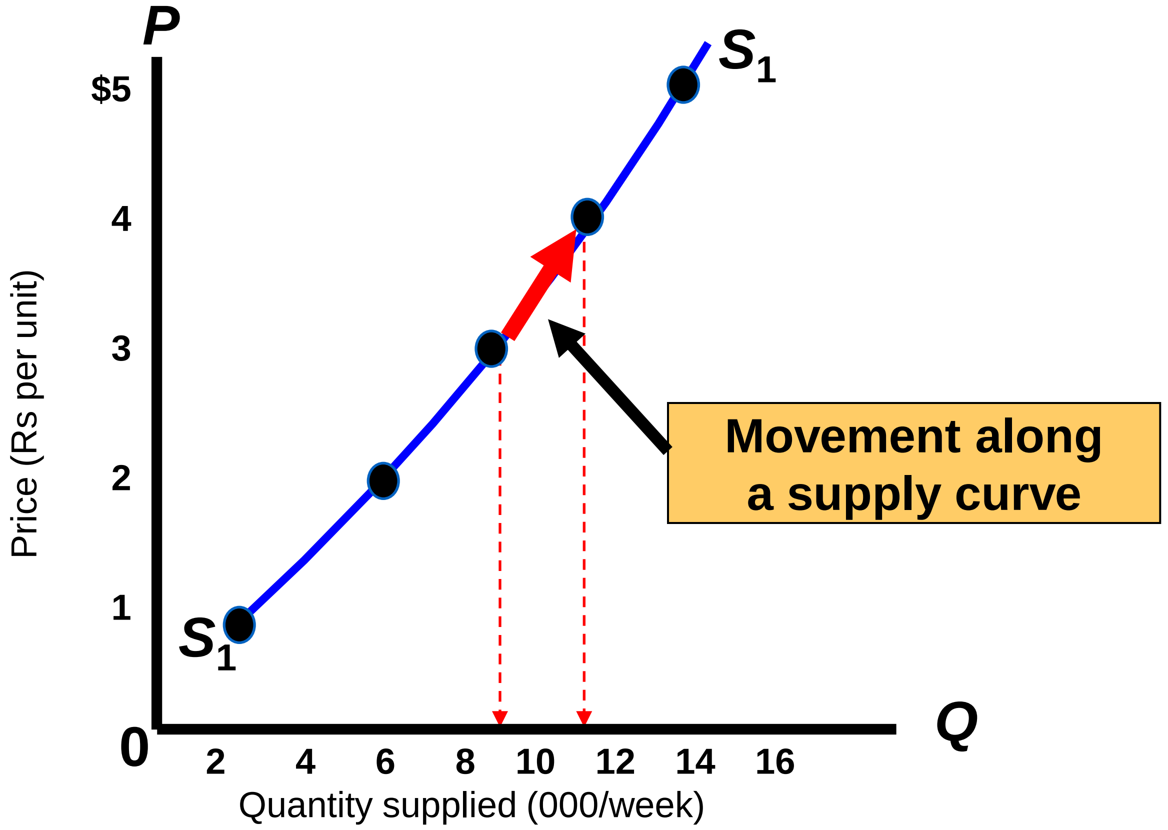
Changes in Quantity Supplied

- Caused by changes in price only
- Represented as a movement along a supply curve

Movement along a Supply Curve

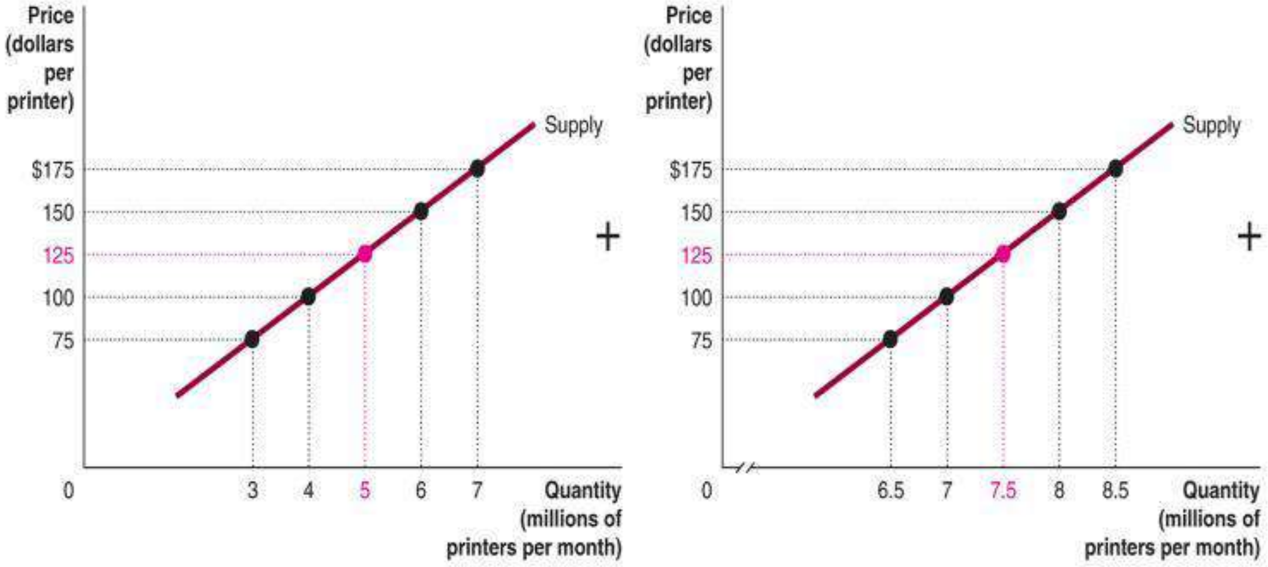


Movement along a Supply Curve



Deriving the market supply curve from individual curves

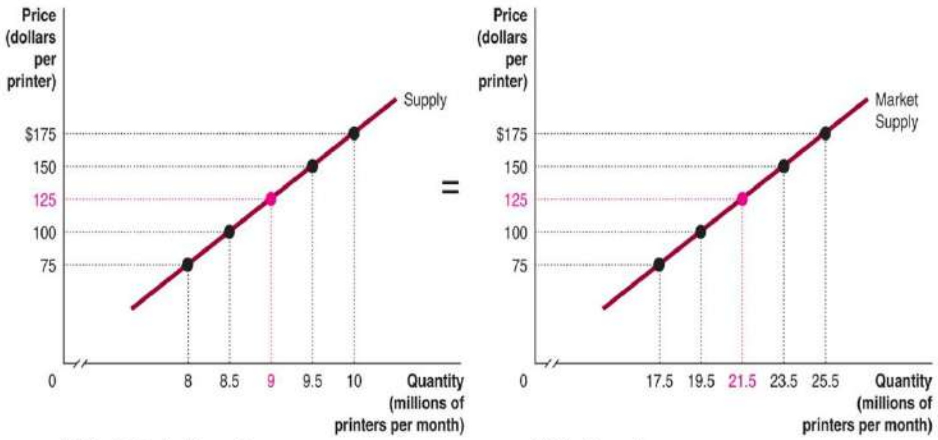
Quantity (millions of printers per month)				
Price (dollars per printer)	Epson	Lexmark	Hewlett-Packard	Market
$175	7	8.5	10	25.5
150	6	8	9.5	23.5
125	5	7.5	9	21.5
100	4	7	8.5	19.5
75	3	6.5	8	17.5



(a) Epson's supply curve

(b) Lexmark's supply curve

Deriving the market supply curve from individual curves



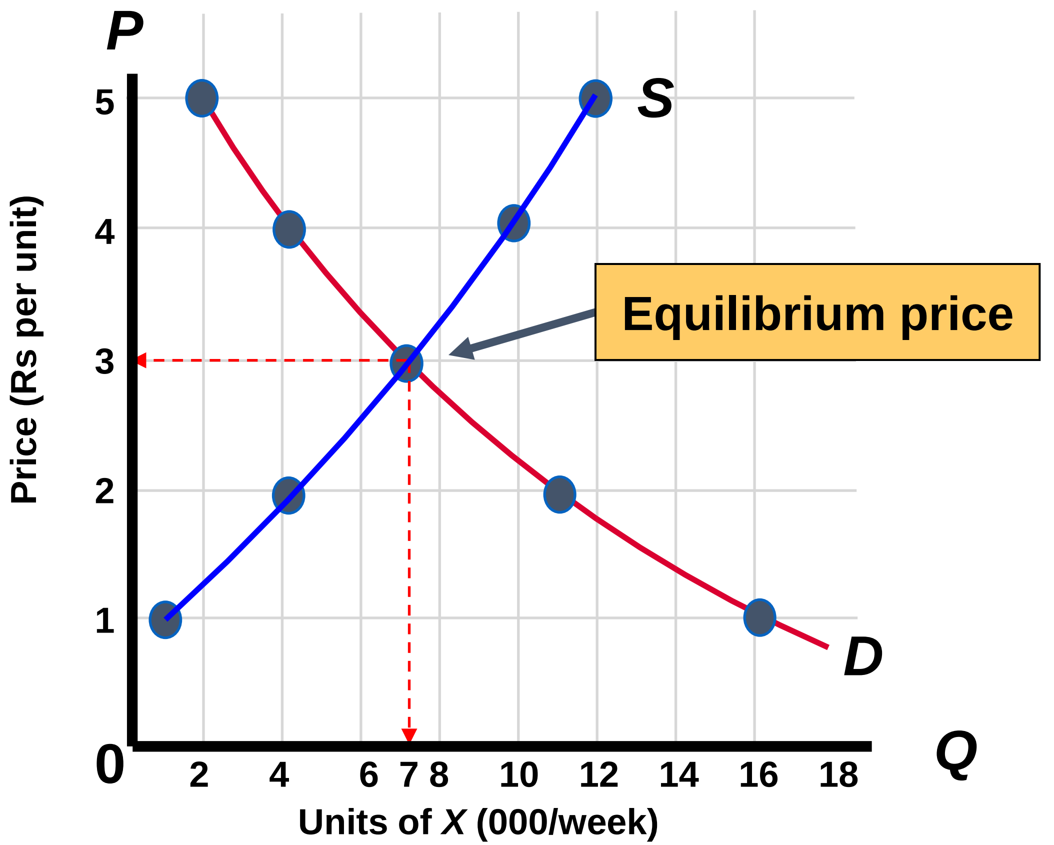
(c) Hewlett-Packard's supply curve

(d) Market supply curve

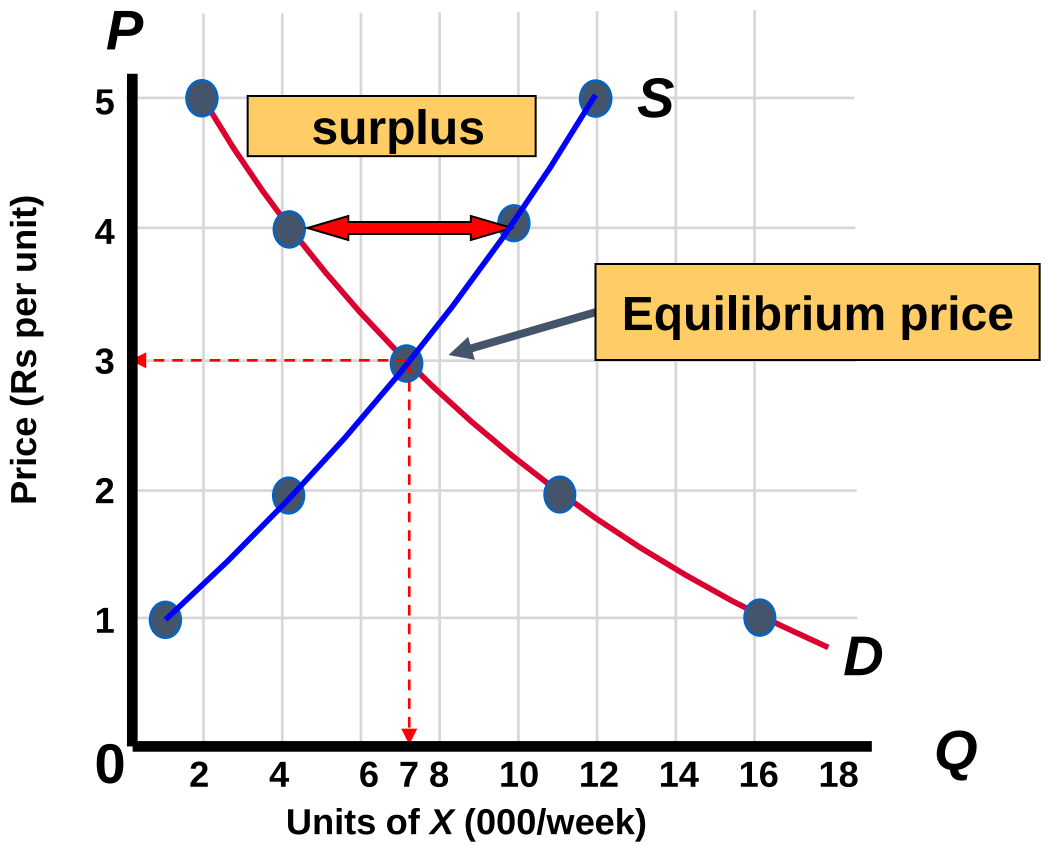
Market Equilibrium

- Occurs when the buying decisions of households and the selling decisions of producers are equated
- Determines the equilibrium price and equilibrium quantity bought and sold in the market

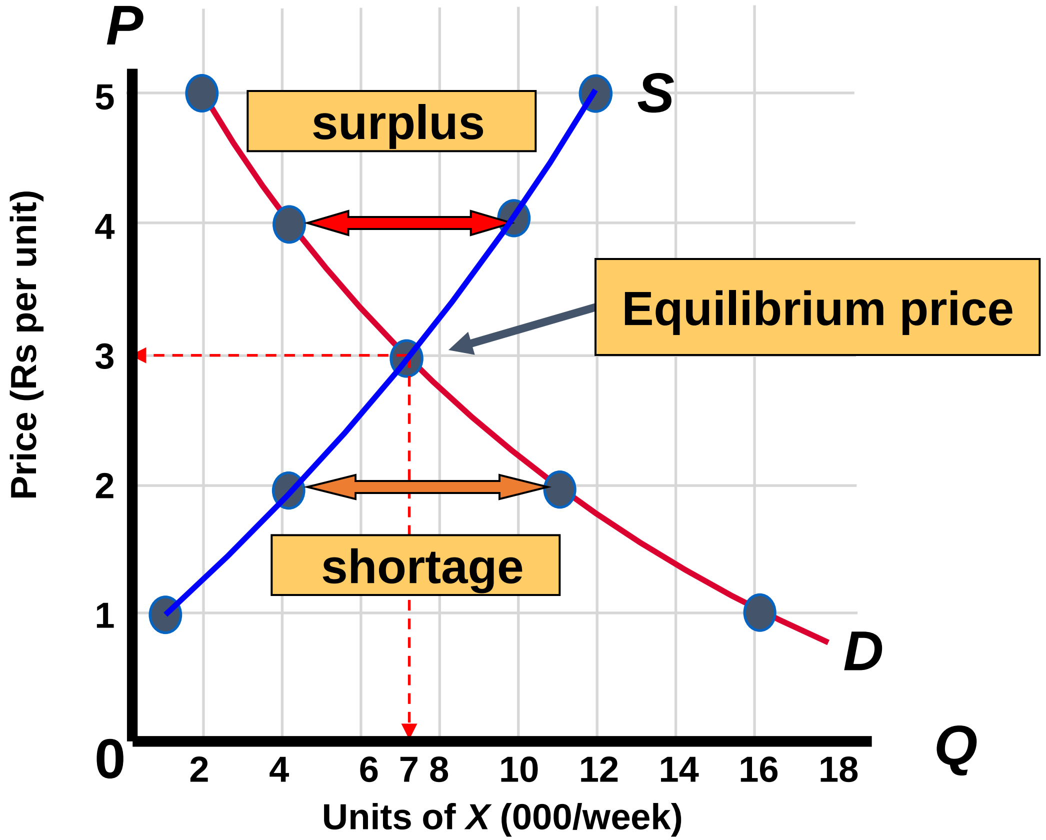
Market Equilibrium (cont.)



Market Equilibrium (cont.)



Market Equilibrium (cont.)



How the Law of Supply and Demand Works

- A company sets the price of its product at Rs 10.00. No one wants the product, so the price is lowered to Rs 9.00. Demand for the product increases at the new lower price point and the company begins to make money and a profit.

- The company could lower the price to Rs 5.00 to increase demand even more, but the increase in the number of people buying the product would not make up money lost when the price point was lowered from Rs 9.00 to Rs 5.00. The company leaves the price set at Rs 9.00 because that is the point at which supply and demand are in equilibrium. Raising the price would reduce demand and make the company less profitable, while lowering the price would not increase demand by enough to make up the money lost.

Shortage (Excess Demand)

- Occurs when the quantity demanded exceeds the quantity supplied at the current price
- Competition amongst buyers eventually bids up the price until equilibrium is reached

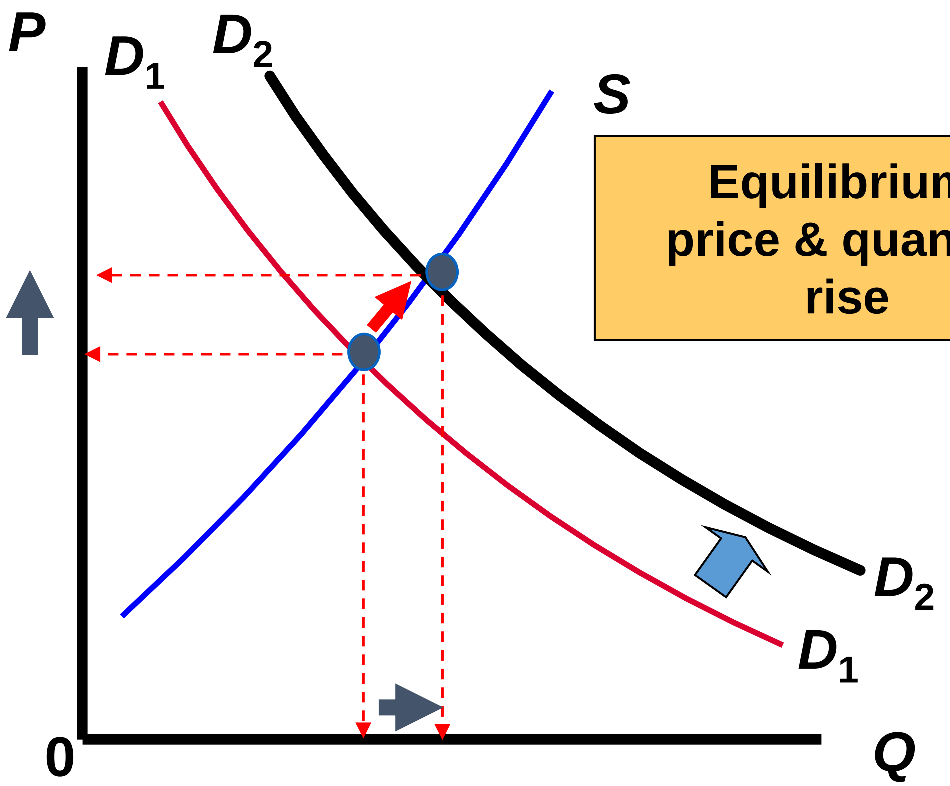
Surplus (Excess Supply)

- Occurs when the quantity supplied exceeds the quantity demanded at the current price
- Competition amongst producers eventually causes the price to decline until equilibrium is reached

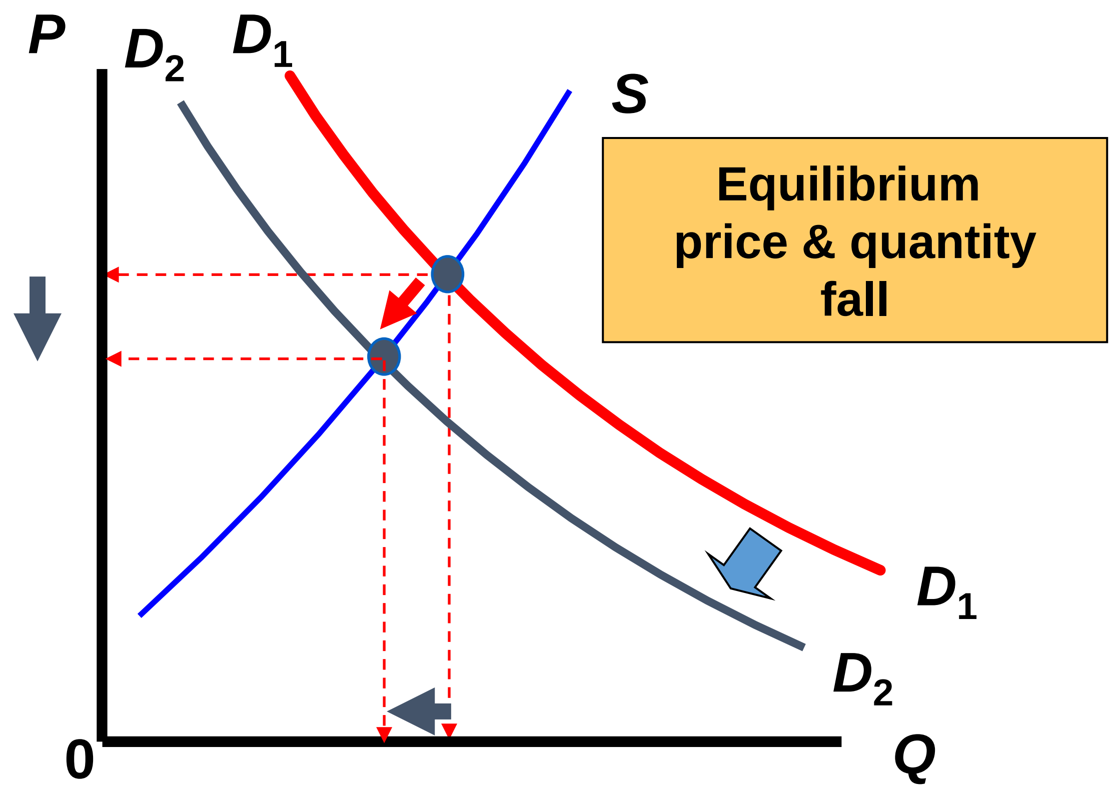
Changes in Demand and Supply

- Changes or shifts will disrupt the equilibrium
- The market will adjust until once again an equilibrium is reached
- The equilibrium price and quantity traded will change

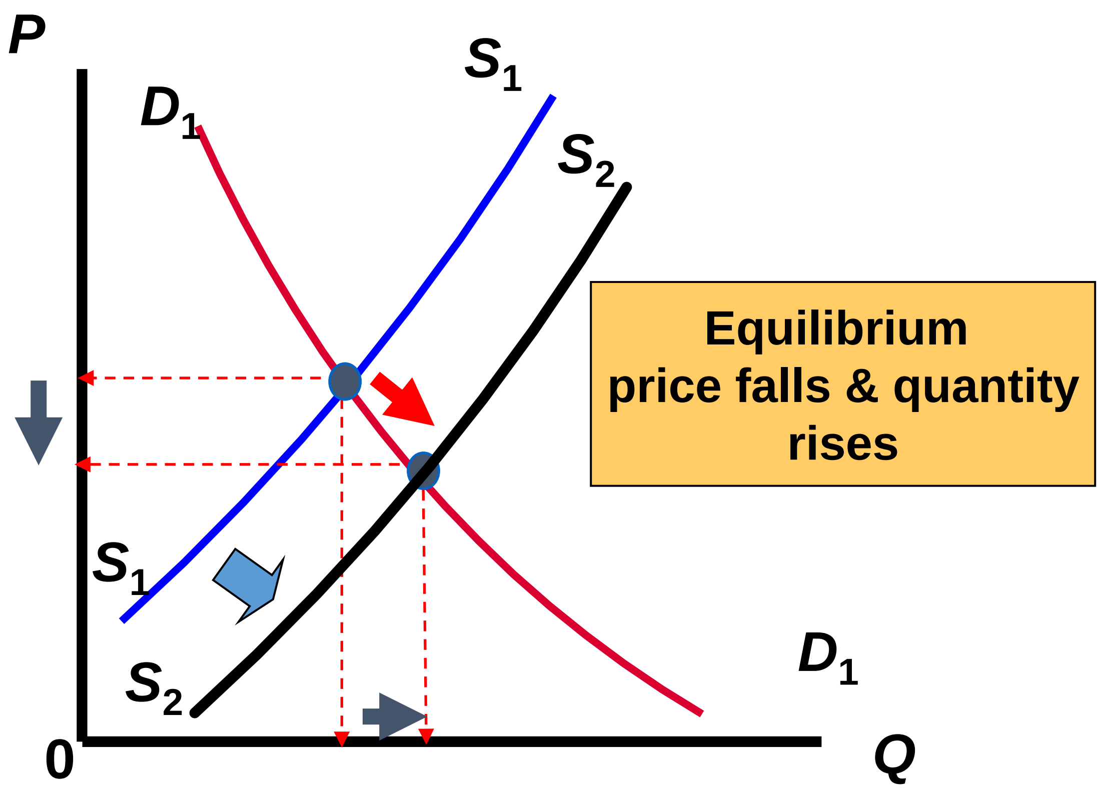
Increase in Demand



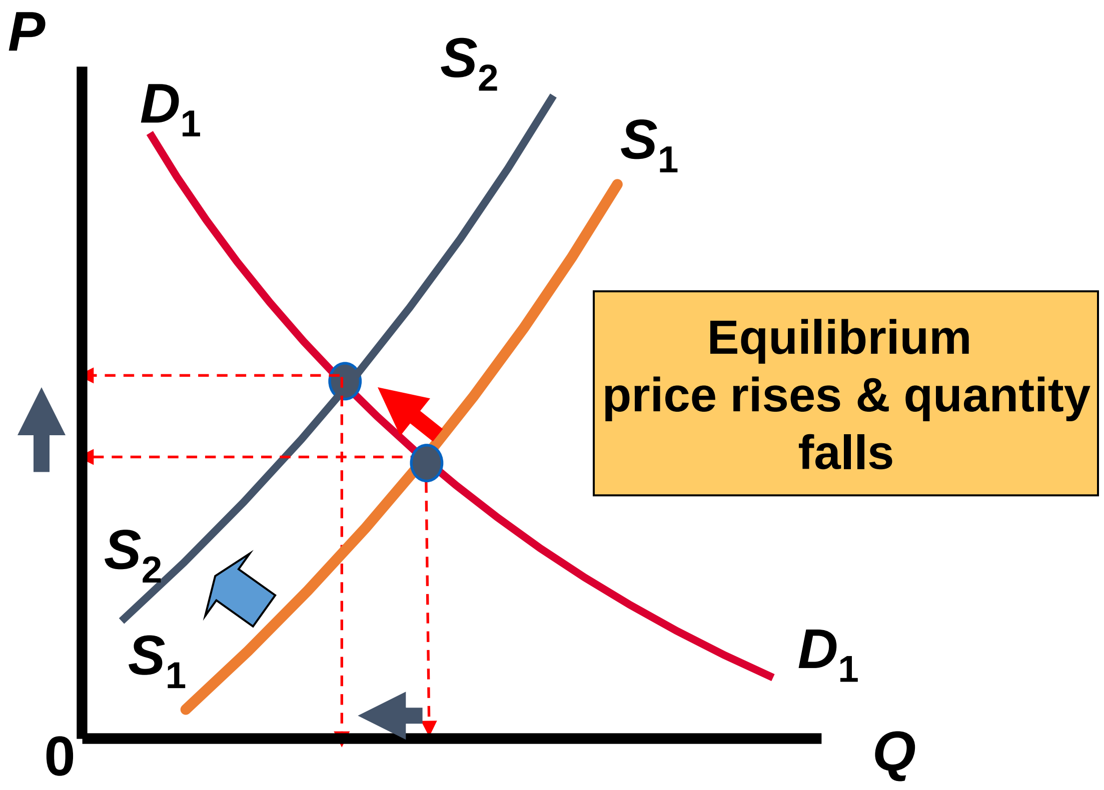
Decrease in Demand



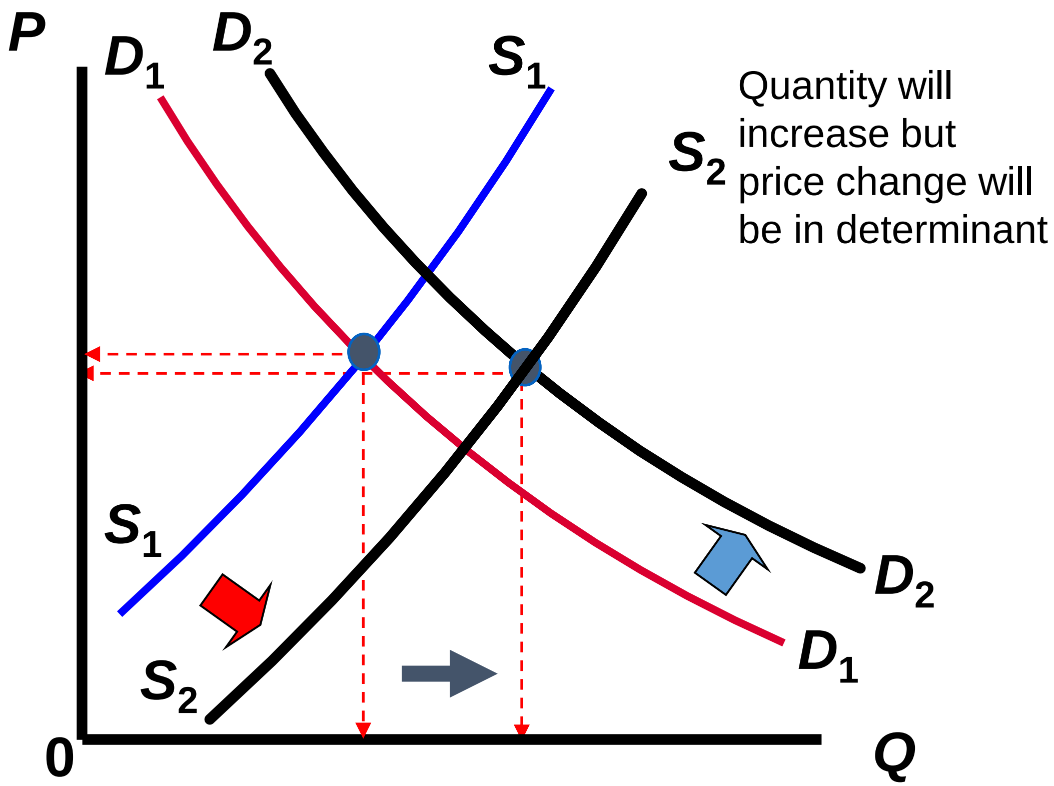
Increase in Supply



Decrease in Supply



Both Demand & Supply Increase



Demand or Supply change

- Increase in D: P increases; Q decreases
- Decrease in D: P decreases; Q increases
- Increase in S: P decreases; Q increases
- Decrease in S: P increases; Q decreases

Both Demand & Supply change

- Demand increases and supply increases;
  Q must rise but P??
- Demand increases and supply decreases;
  P must rise but Q??
- Demand decreases and supply increases;
  P must fall but Q??
- Demand decreases and supply decreases;
  Q must fall but P??

Both Demand & Supply change

- The overall change in the indeterminate side of the market, i.e. P or Q depends on the relative shifts in DD and SS.

Unit 4

Time Value of Money and Depreciation

The Terminology of Time Value

- **Present Value - An amount of money today, or the current value of a future cash flow**
- **Future Value - An amount of money at some future time period**
- **Period - A length of time (often a year, but can be a month, week, day, hour, etc.)**

Why TIME?

Why is TIME such an important element in your decision?

TIME allows you the *opportunity* to postpone consumption and earn INTEREST.

Types of Interest

- **Simple Interest**

  Interest paid (earned) on only the original amount, or principal, borrowed (lent).

- **Compound Interest**

  Interest paid (earned) on any previous interest earned, as well as on the principal borrowed (lent).

General Future Value Formula

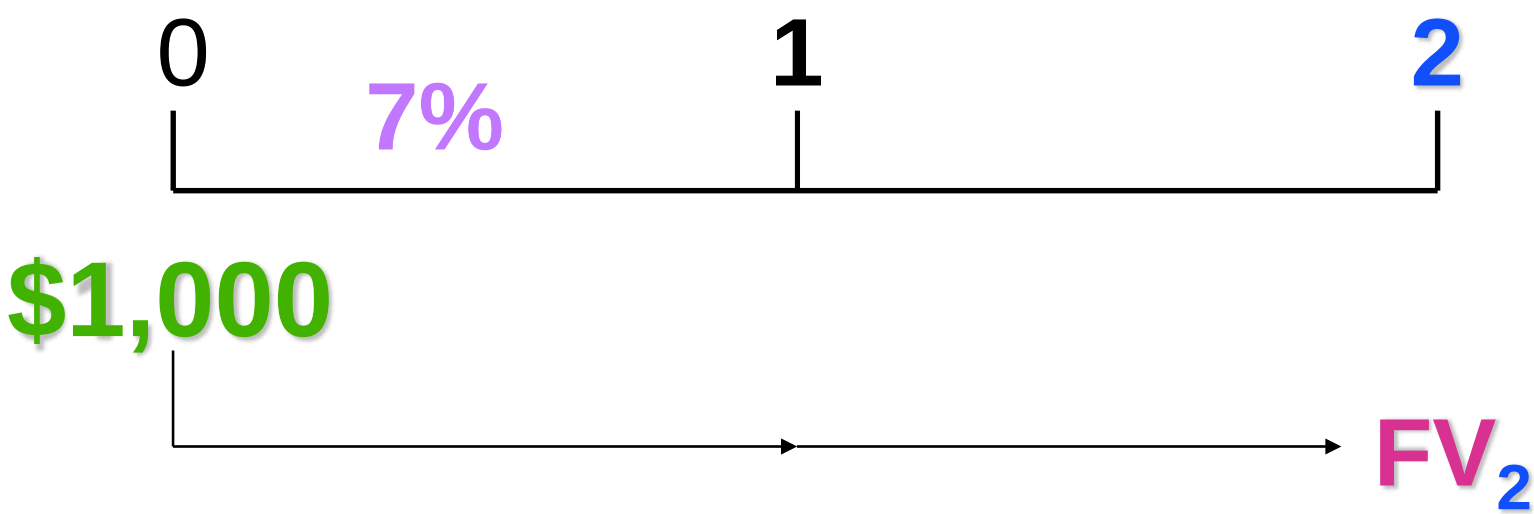
General Future Value Formula:

$$FV_n = PV(1+i)^n$$

$$= \text{Cash flow } (1+i)^n$$

Future Value Single Deposit (Graphic)

Assume that you deposit $1,000 at a compound interest rate of 7% for 2 years.



Future Value
Single Deposit (Formula)

$FV_2 = PV(1+i)^2 = \$1{,}000(1.07)^2$

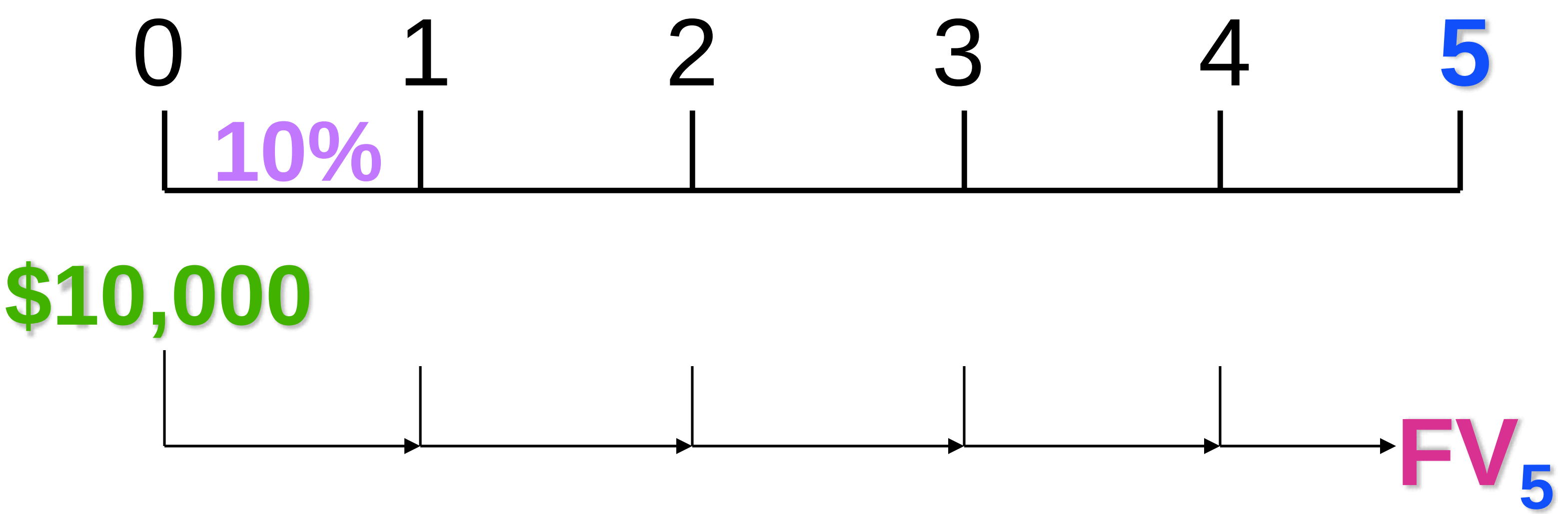
$= \$1{,}144.90$

How much a deposit of Rs 3000 will earn you in one year, two years and three years @10% rate of interest?

1. **Write down the values for 1st, 2nd and 3rd years respectively using compounding formula (Future value formula)**
2. **3,300**
3. **3,630**
4. **3,999**

Problem Example

Miller wants to know how large her deposit of $10,000 today will become at a compound annual interest rate of 10% for 5 years.



Problem Solution

- Calculation based on general formula:

$$FV_n = PV(1+i)^n$$

$$FV_5 = \$10,000\ (1+ 0.10)^5$$

- $= \$16,105.10$

Problem 2

Calculate the compounding value of Rs. 4000 if it is invested at 12% for two years.

Problem 3

Calculate the future sum of money if it is invested at 10% for four years of Rs. 25000

Problem 4

Arun deposits Rs. 10000 in a bank which pays 8% interest compounded annually for 8 years. Calculate the amount To be received after 8 years.

Answers

- 1) $4000(1 + 0.12)^2$

  = 5017.6

2) $25000(1 + 0.1)^4$

   = 36602.5

3) $10000(1 + 0.08)^8$

   = 18509.50

b) In case of multiple compounding

In this method if the compounding period varies, interest earned will also vary, viz., if the Interest Is compounded semi-annually, quarterly or monthly, such future value is calculated by using the Following formula

$$FV=PV\left(1+\frac{i}{m}\right)^{mn}$$

Where, FV=Future Value

PV=Present Value

i=Rate of Interest

m=number of times interest is compounded in a year

n=Number of years

m could be…..

Annual =1

Semi = 2

Quarterly = 4

Monthly = 12

Daily = 365

Calculate the future value of sum of Rs. 2000 if it is invested for a year with compounding period of semi annually at 10%.

Problem 1

Calculate the future value of sum of Rs. 2000 if it is invested for a year with compounding period of semi annually at 10%.

Solution

FV = ?

PV=2000

i=10% or 0.1

m=2

n=1

$$FV=2000\left(1+\frac{0.1}{2}\right)^{2 \text{ X } 1}$$

$$=2000(1+0.05)^2$$

$$=2000(1.05)^2$$

$$=2000(1.1025)$$

FV=2205

General Present Value Formula

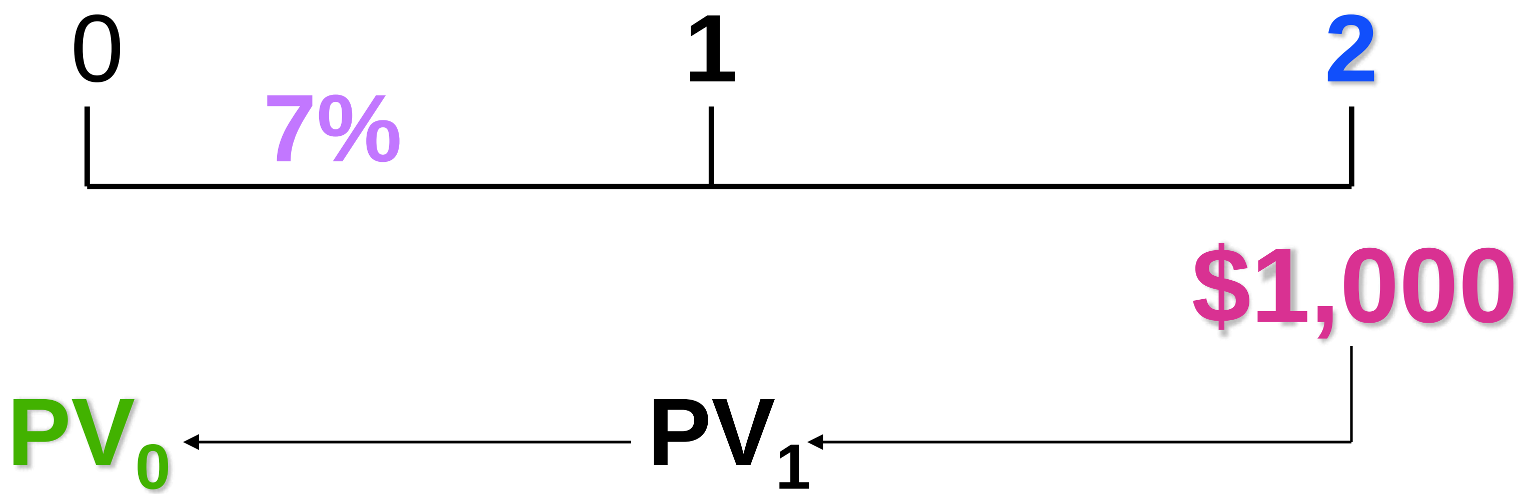
General Present Value Formula:

$$PV_0 = FV_n / (1+i)^n$$

$$= \textit{Cash Flow} / (1+i)^n$$

Present Value
Single Deposit (Graphic)

Assume that you need $1,000 in 2 years. Let's examine the process to determine how much the value today at a discount rate of 7% annually.



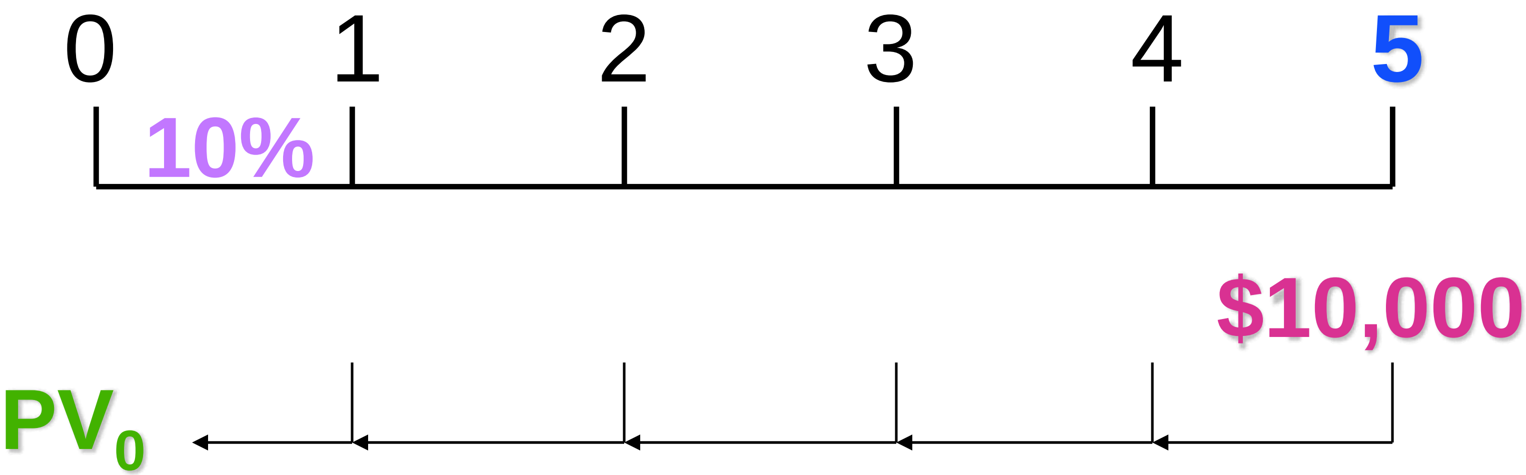
Present Value Single Deposit (Formula)

$$PV_0 = FV_2 / (1+i)^2 \qquad = \$1{,}000 / (1.07)^2$$

$$= FV_2 / (1+i)^2 \qquad = \$873.44$$

Problem Example

Miller wants to know how large of a deposit value today to make so that the money will grow to $10,000 in 5 years at a discount rate of 10%.



Story Problem Solution

- **Calculation based on general formula:**

$$PV_0 = FV_n / (1+i)^n$$

$$PV_0 = \$10{,}000 / (1+ 0.10)^5$$

$$= \$6{,}209.21$$

Annuity

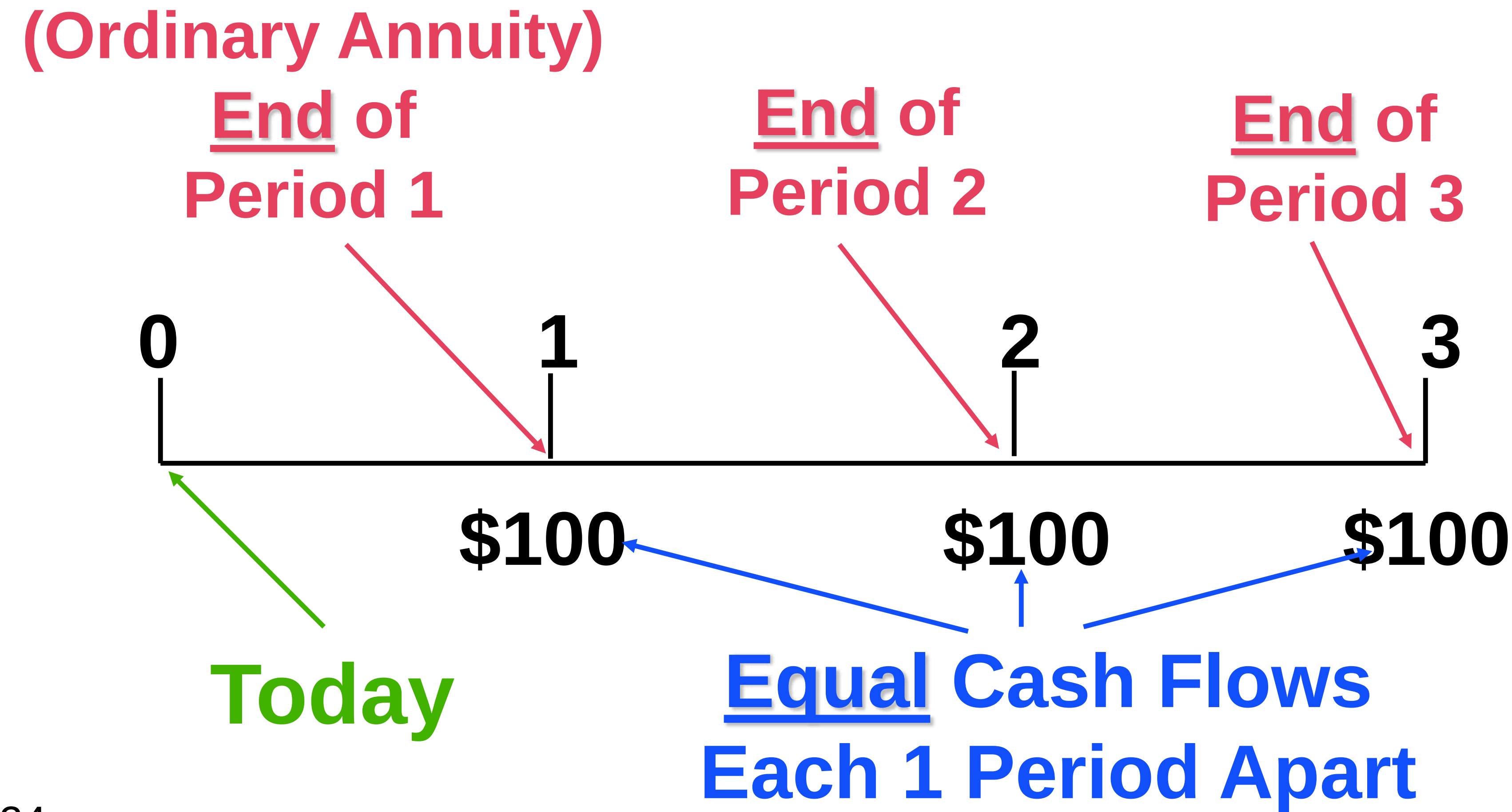
Annuity – a sequence of payments made at regular time intervals.

Ordinary Annuity – payments made at the end of each payment period.

Examples of Annuities

- Student Loan Payments
- Car Loan Payments
- Insurance Premiums
- Mortgage Payments
- Retirement Savings

Parts of an Annuity

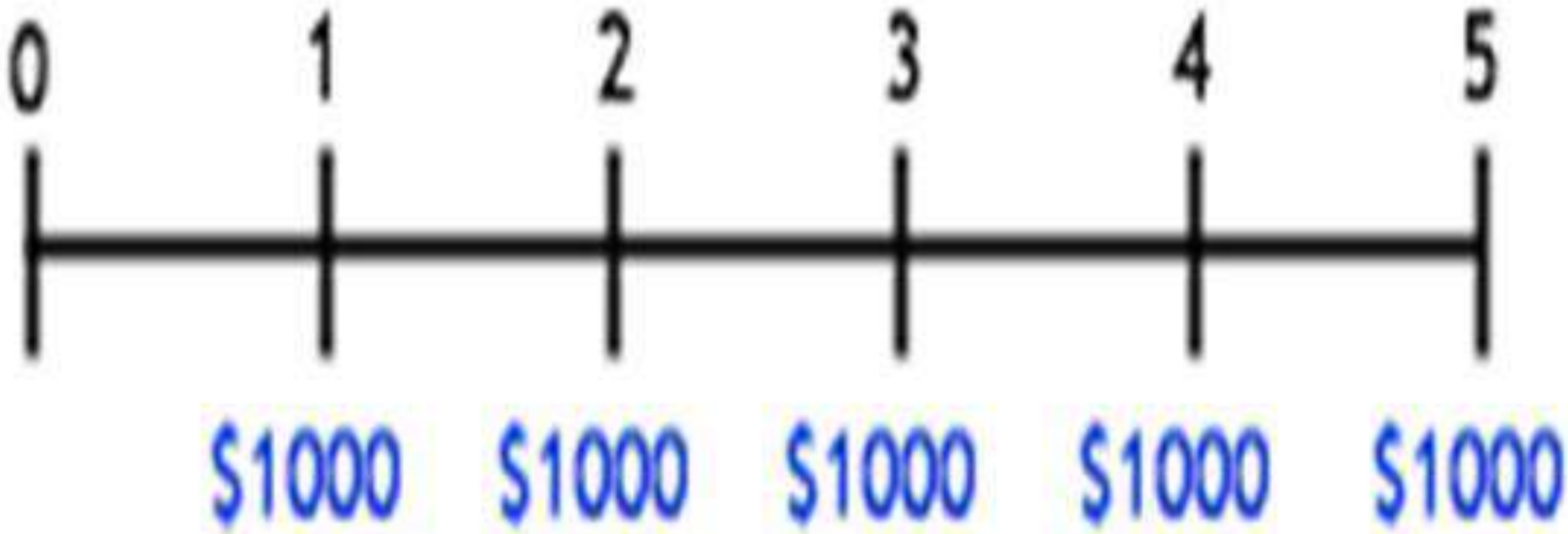


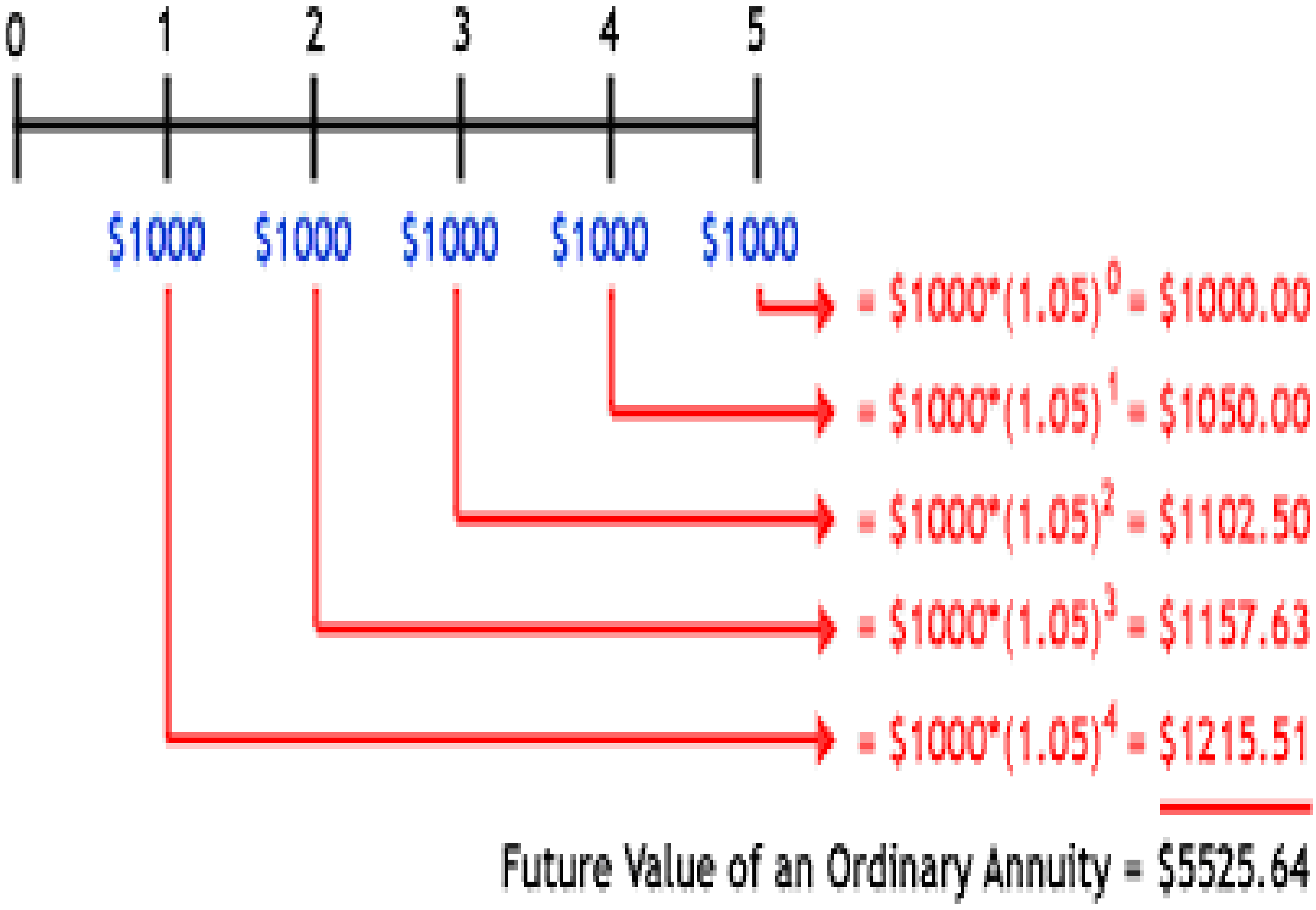
Steps to Solve Time Value of Money Problems

1. Read problem thoroughly
2. Create a time line
3. Put cash flows and arrows on time line
4. Determine if it is a PV or FV problem
5. Determine if solution involves a single CF, annuity stream(s), or mixed flow
6. Solve the problem
7. Check with financial calculator (optional)

- Let's assume that you are paying $1,000 every year for the next five years, and you invest each payment at 5% compounded interest.


0
1
2
3
4
5


0
1
2
3
4
5
$1000
$1000
$1000
$1000
$1000


0
1
2
3
4
5
$1000
$1000
$1000
$1000
$1000
= $1000*(1.05)^0 = $1000.00
= $1000*(1.05)^1 = $1050.00
= $1000*(1.05)^2 = $1102.50
= $1000*(1.05)^3 = $1157.63
= $1000*(1.05)^4 = $1215.51
Future Value of an Ordinary Annuity = $5525.64

- Rahul receiving Rs. 1000 every year end, what is the Future value of compounded rate of interest being 8 percent per annum for 5 years?

- Sumit receiving Rs. 900, 400, 300, 400, 500 every year end. what is the future value of compounded rate of interest rate being 10 percent per annum?

Mixed Flows Example

0	1	2	3	4	**5**
10%					
	$900	**$400**	**$300**	**$400**	**$500**

Overview of an Ordinary Annuity -- PVA

Cash flows occur at the end of the period

0 | 1 | 2 | . . . | n

i%

R | R | R

R = Periodic Cash Flow

- $FV/(1+i)^1$
- $FV/(1+i)^2$
- $FV/(1+i)^n$

PVA_n

$$PVA_n = FV/(1+i)^1 + FV/(1+i)^2 + \ldots + FV/(1+i)^n$$

Example of an Ordinary Annuity -- PVA

Cash flows occur at the end of the period

0 1 2 3 4

7%

$1,000 $1,000 $1,000

$934.58

$873.44

$816.30

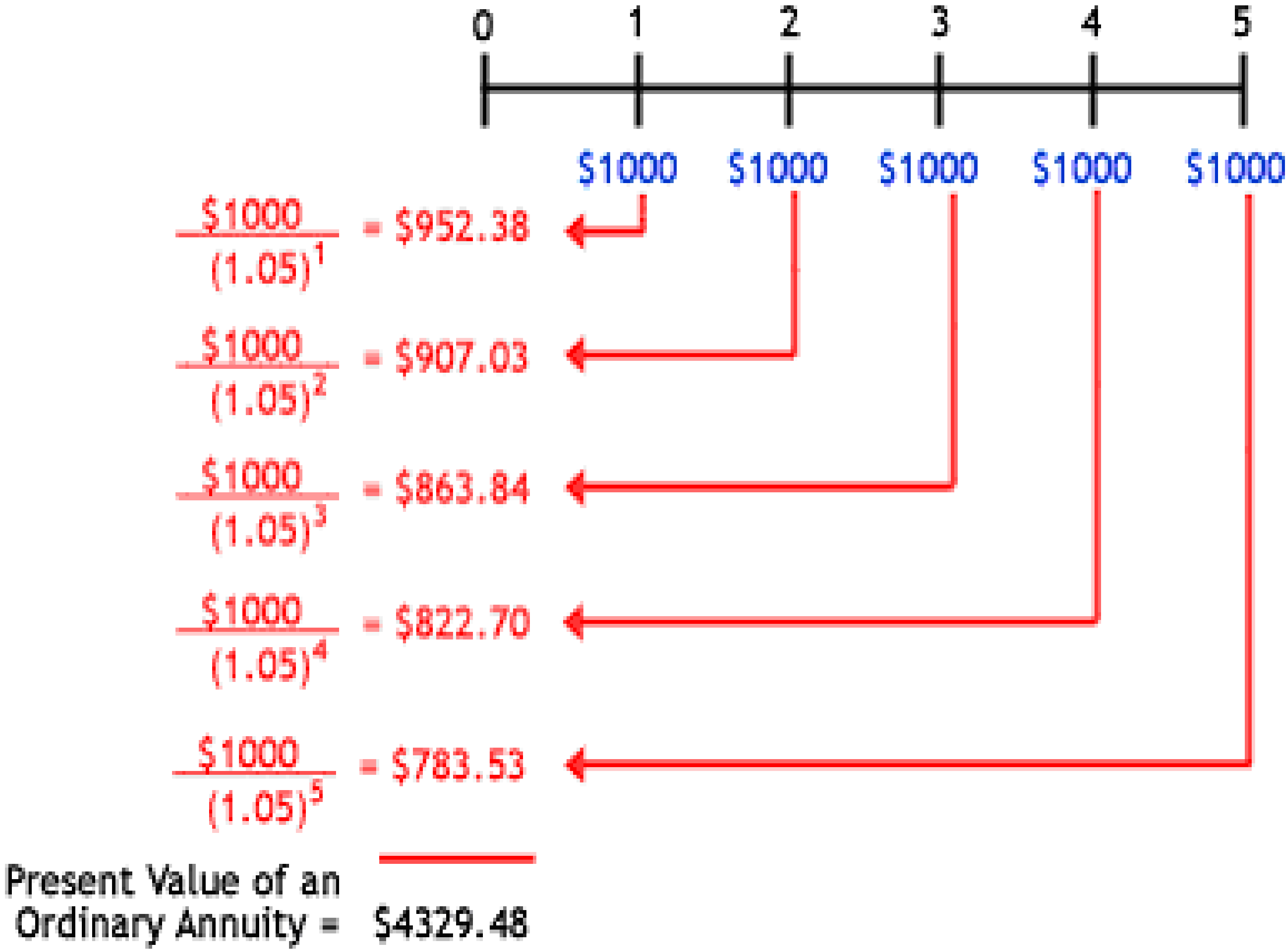
$2,624.32 = PVA_3

$$PVA_3 = \$1{,}000/(1.07)^1 + \$1{,}000/(1.07)^2 + \$1{,}000/(1.07)^3$$

$$= \$934.58 + \$873.44 + \$816.30$$

$$= \$2{,}624.32$$

- Let's assume that you are paying $1,000 every year for the next five years, and you invest each payment at 5% discounted interest.



0
1
2
3
4
5
$1000
$1000
$1000
$1000
$1000
$1000 / (1.05)^1 = $952.38
$1000 / (1.05)^2 = $907.03
$1000 / (1.05)^3 = $863.84
$1000 / (1.05)^4 = $822.70
$1000 / (1.05)^5 = $783.53
Present Value of an Ordinary Annuity = $4329.48

BEP

BREAK EVEN ANALYSIS (BEA)

The BEA helps in understanding the relationship between revenues and costs of a firm in relation to its volume of sales. It helps in determining the volume at which the firm's cost and revenue are in equilibrium.

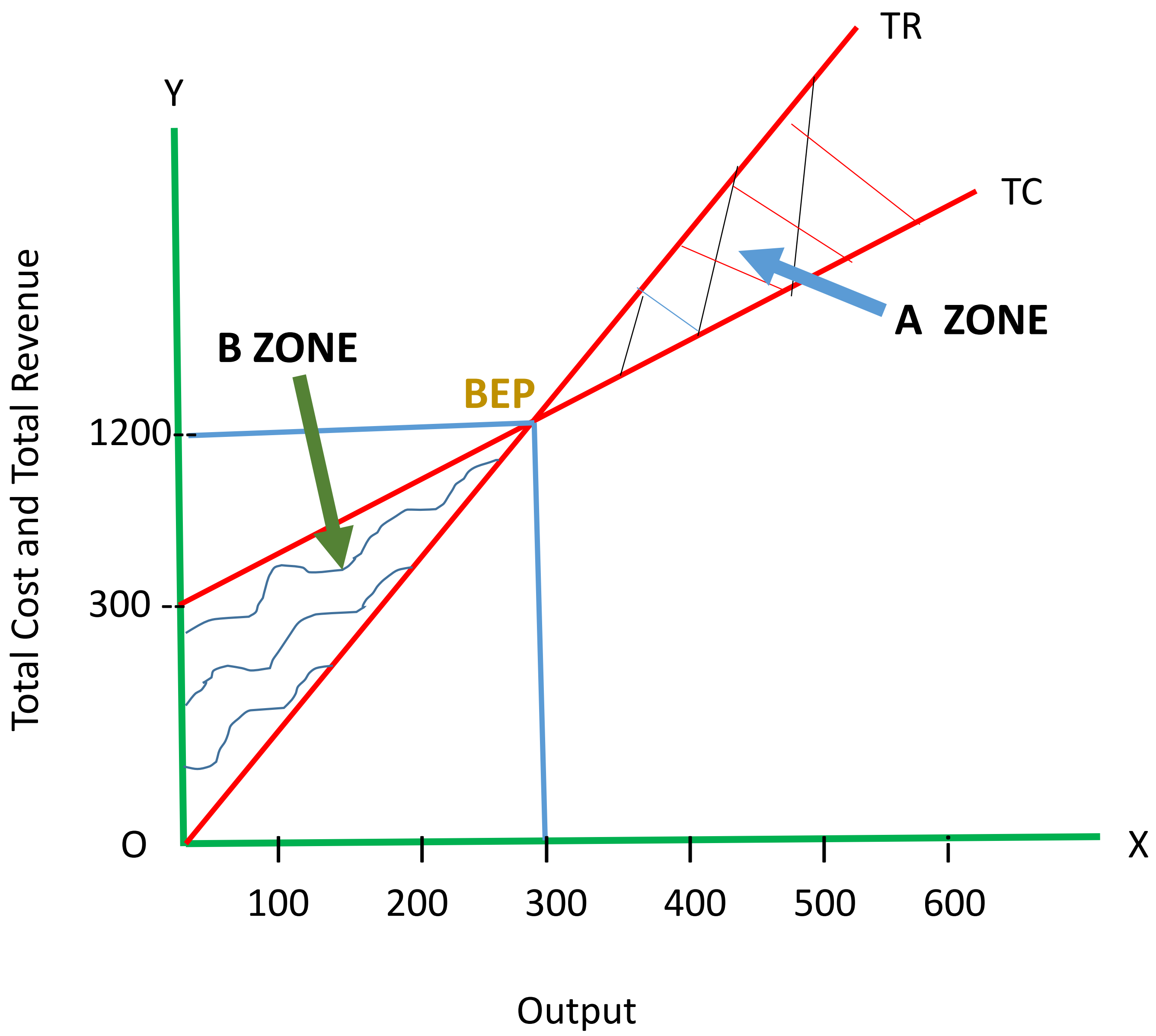
It is a technique which helps to analyze the effect of change in the level of production and total profit of a company. The BEA establishes the relationship between cost, volume and profits. Hence it is also known as "Cost-Volume-Profit analysis".
In BEA more prominence to identify the Break Even Point (BEP), BEP refers to that level of sales volume at which there is neither profit nor loss, Costs being equal to its sales value and the contribution is equal to fixed costs.

BEP is defined as "that level of sales at which the total revenue is equal to total costs and the net income is equal to zero.

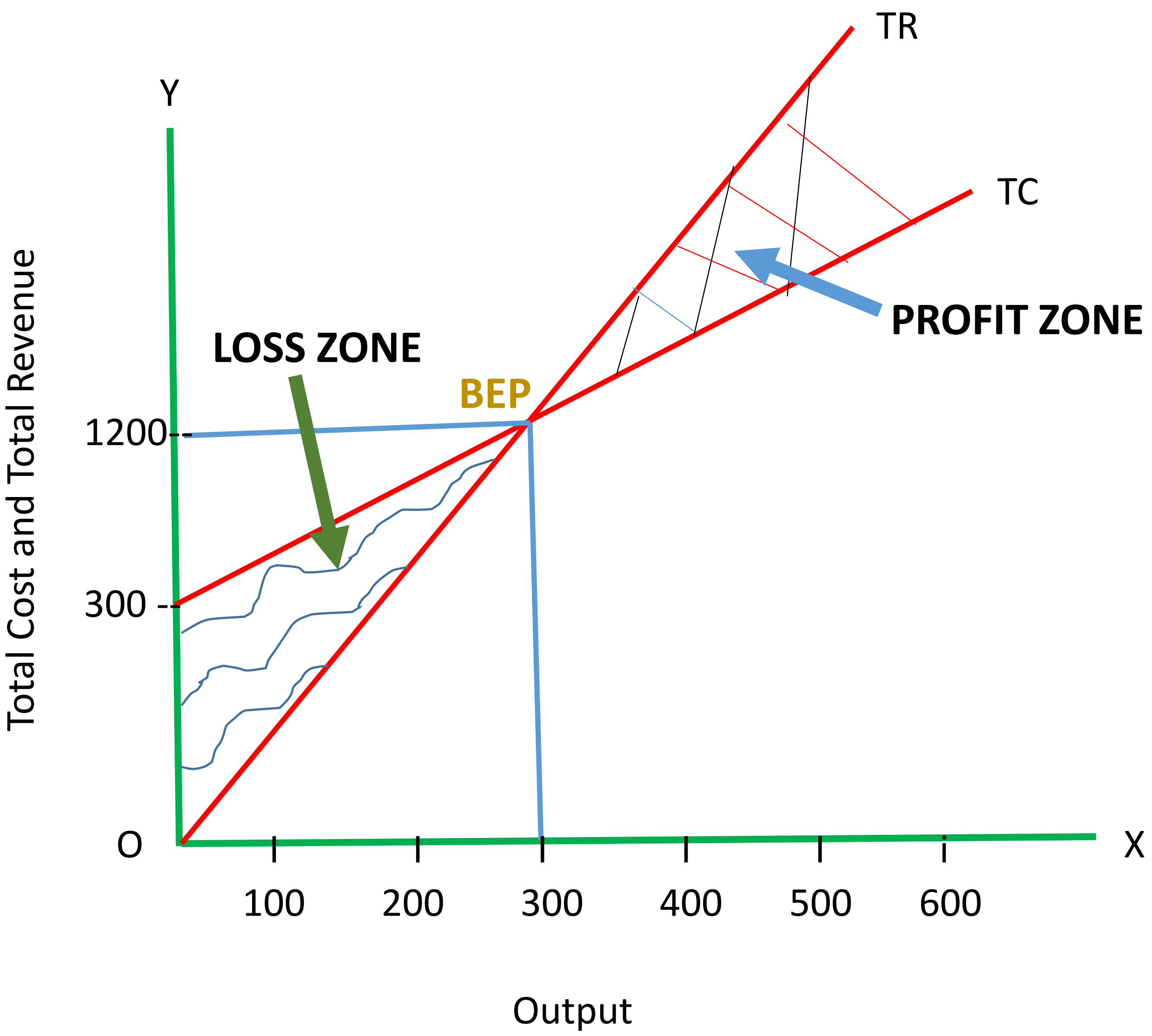
Break even chart and diagrammatic representation

Selling Price is Rs. 4 per unit

Output (Q)	Total Revenue (TR)		Total Cost (TC)
0	0		300
100	400 (100 x 4)		600
200	800 (200 x 4)		900
300	1200 (300 x 4)		1200
400	1600 (400 x 4)		1500
500	2000 (500 x 4)		1800
600	2400 (600 x 4)		2100



TR
TC
Y
A ZONE
B ZONE
BEP
1200
300
O
X
100
200
300
400
500
600
Output
Total Cost and Total Revenue



TR
Y
TC
PROFIT ZONE
LOSS ZONE
BEP
1200
300
Total Cost and Total Revenue
O
X
100
200
300
400
500
600
Output

Methods of calculation of BEP

1) BEP in terms of physical units
2) BEP in terms of sales value

CALCULATION OF BREAK EVEN POINT

Formula for calculating BEP in terms of physical units

$$\text{Now, BEP} = \frac{\text{TFC}}{\text{CM}}$$

CM= Selling Price (P) – Variable cost per unit.(VC)

CALCULATION OF BREAK EVEN POINT

Illustration for calculating BEP in terms of physical units

Selling Price Rs. 15 per engg component
Variable cost Rs. 10 per engg component
Total Fixed cost (TFC) Rs. 1,50,000

First step is to calculate Contribution Margin (CM)

CM= Selling Price (P) – Variable cost per unit.(VC)
Rs. 15 – Rs. 10 = Rs. 5 is the CM

$$\text{Now, BEP} = \frac{\text{TFC}}{\text{CM}} = \frac{\text{Rs. 1,50,000}}{\text{Rs. 5}} = \text{3,0000 Units}$$

Hence, the firm reaches BEP by producing 3,0000 units

Formula for calculating BEP in terms of sales value

$$\text{Now BEP} = \frac{\text{TFC}}{\text{CR}}$$

=

$$\textbf{CR} = \frac{\text{TR} - \text{TVC}}{\text{TR}}$$

Illustration for calculating BEP in terms of sales value

This method is useful for a firm producing multi products

Total Sales Value	Rs. 10,000	(TR)
Total Variable Costs	Rs. 6,000	(TVC)
Total Fixed Cost	Rs. 3,000	(TFC)

First step is to calculate Contribution Ratio (CR)

$$\textbf{CR} = \frac{TR - TVC}{TR} = \frac{\text{Rs. } 10{,}000 - \text{Rs. } 6{,}000}{\text{Rs. } 10{,}000} = 0.4\ (CR)$$

$$\text{Now BEP} = \frac{TFC}{CR} = \frac{\text{Rs. } 3{,}000}{0.4} = \text{Rs. } 7{,}500$$

Hence it is clear from this calculations that at sales value of Rs. 7500 (BEP)
There is no profit and no loss.

A firm incurs fixed cost of Rs. 4000 and variable cost of Rs. 10000 and its total sales receipts are Rs.15000. determine Break even point

A firm incurs fixed cost of Rs. 4000 and variable cost of Rs. 10000 and its total sales receipts are Rs.15000. determine Break even point

First step is to calculate Contribution Ratio (CR)

$$\textbf{CR=} \frac{\text{TR} - \text{TVC}}{\text{TR}} = \frac{\text{Rs. } 15000 - \text{Rs. } 10000}{\text{Rs. } 15{,}000} = 0.33 \text{ (CR)}$$

$$\text{Now BEP} = \frac{\text{TFC}}{\text{CR}} = \frac{\text{Rs. } 4000}{0.33} = \text{Rs. } 12121$$

Hence it is clear from this calculations that at sales value of Rs. 12121 (BEP) There is no profit and no loss.

- M/s. Gayatri Engineering furnishes the following information.. On the basis of the information
- Annual Sales 20,000 units
- Selling Price Rs. 8.00
- VC (per Unit) Rs. 6.00
- TFC   Rs. 60,000

a) Find BEP in physical units and in terms of sales value in rupees.
b) Show the amount of Total Variable Cost at BEP
c) Profit made by the company at 20,000 units when the selling price is increased by 25%.

i) Physical Units:

$$TFC/CM = 60000/2 = 30000 \text{ Units}$$

ii) Sales Value: $CR = \frac{TR - TVC}{TR} = \frac{160000-120000}{160000} \quad \frac{40000}{160000} = 0.25$

$$\frac{TFC}{CR} \quad \frac{60000}{0.25} = \text{Rs. } 240000$$

2) Units at BEP is 30000, VC (per Unit) Rs. 6.00

= 30000 X 6 = Rs. 180000 (Total Variable Cost at BEP)

3) When the selling price is increased by 25% (i.e.Rs.10(8+2)).

Profit= TR-TC

TR=200000(20000 X 10) *TR = P X Q*

TC= 180000 (60000 (TFC)+ 120000(TVC)) *TC = TFC+TVC*

Profit = 200000 – 180000

= 20000

Profit for new selling price (Rs.10) is Rs. 20000

SAMPLE PROBLEMS FOR CALCULATING BREAK EVEN POINT

ROBLEM 1

Premier Engineering Co. incurs a FC of Rs. 4000 and VC of Rs. 10000 and its total sales receipts

Are Rs.15000. Determining Break Even point

PROBLEM 2

ABC Enterprises with annual sales of small ball bearings 8000 units. It is selling at Rs. 9.50 per unit.

The TFC of the company is Rs. 18000 and VC per unit is Rs. 6.50. on the basis of above calculate:

a) BEP in physical units and sales value in rupees.

b) Show the amount of VC at BEP.

c) Profit made by the company at 8000 units.

i) Physical Units:

TFC/CM=18000/3 =6000 Units

ii) Sales Value: CR = $\frac{TR - TVC}{TR}$ = $\frac{76000-52000}{76000}$ $\frac{24000}{760000}$ = 0.31

$\frac{TFC}{CR}$ $\frac{18000}{0.31}$ = Rs. 58064

2) Units at BEP is 6000, VC (per Unit) Rs. 6.5

= 6000 X 6.5 = Rs. 39000 (Total Variable Cost at BEP)

3)

Profit= TR-TC

TR=76000(8000 X 9.5) *TR = P X Q*

TC= 700000 (18000 (TFC)+ 52000(TVC)) *TC = TFC+TVC*

Profit = 76000 – 70000

= 6000

Profit for new selling price (Rs.9.5) is Rs. 6000

SAMPLE PROBLEMS ON COST ANALYSIS

PROBLEM 1

Excel engineers have provided the following information:

Output (in units)	0	1	2	3	4	5	6	7	8
Total Cost (Rs.)	400	480	550	590	620	650	730	820	950

Calculate TVC, AFC, AVC, and MC

PROBLEM 2

XYZ Engineers provided the following information. Calculate TFC, TVC, AC and MC. Give a graphic illustration to explain the relationship between Output and TC.

Output (in units)	0	1	2	3	4	5	6
TC (Rs.)	150	200	240	270	260	400	510

PROBLEM 3

M/s. Instrumentation Engineers have provided the following cost data. Calculate TVC, AFC,AVC, AC and MC.

Output (in units)	0	1	2	3	4	5	6
TC (Rs.)	360	540	600	630	675	780	990

Solution for PROBLEM 1

Output	Total Cost	TFC	TVC	AFC	AVC	MC
0	400	400	0			
1	480	400	80	400.00	80	80
2	550	400	150	200.00	75	70
3	590	400	190	133.33	63.33	40
4	620	400	220	100.00	55	30
5	650	400	250	80.00	50	30
6	730	400	330	66.67	55	80
7	820	400	420	57.14	60	90
8	950	400	550	50.00	68.75	130

Solution for PROBLEM 2

Output	TC	FC	VC	AC	MC
0	150	150	0		
1	200	150	50	200	50
2	240	150	90	120	40
3	270	150	120	90	30
4	260	150	110	65	-10
5	400	150	250	80	140
6	510	150	360	85	110

Solution for PROBLEM 3

Output	TC	TFC	TVC	AFC	AVC	AC	MC
0	360	360	0				
1	540	360	180	360	180	540	180
2	600	360	240	180	120	300	60
3	630	360	270	120	90	210	30
4	675	360	315	90	78.75	168.75	45
5	780	360	420	72	84	156	105
6	990	360	630	60	105	165	210

MARKET EQUILIBRIUM

Market Equilibrium

- The operation of the market depends on the interaction between buyers and sellers.
- An ***equilibrium*** is the condition that exists when quantity supplied and quantity demanded are equal.
- At equilibrium, there is no tendency for the market price to change.

EQUILIBRIUM PRICE AND OUTPUT

Price	Quantity Demanded	Quantity Supplied	Market Condition
5	2	10	
4	4	8	
3	6	6	
2	8	4	
1	10	2	

MARKET EQUILIBRIUM

EQUILIBRIUM PRICE AND OUTPUT

Price	Quantity Demanded	Quantity Supplied	Market Condition	Market Prices
5	2	10	SURPLUS	
4	4	8	SURPLUS	
3	6	6	EQUILIBRIUM	Equilibrium
2	8	4	SHORTAGE	
1	10	2	SHORTAGE	

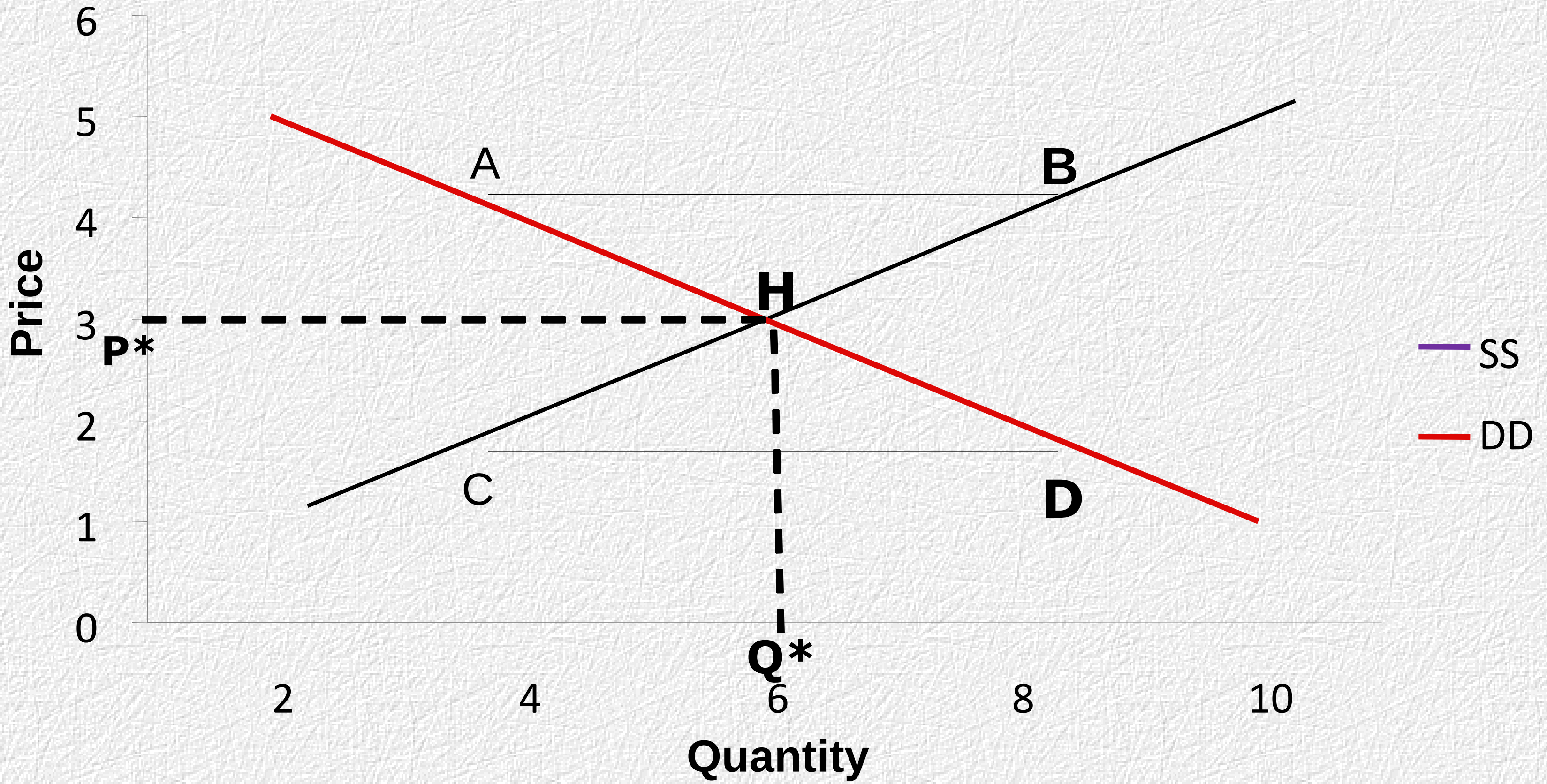
MARKET EQUILIBRIUM

EQUILIBRIUM PRICE AND OUTPUT

Price	Quantity Demanded	Quantity Supplied	Market Condition	Market Prices
5	2	10	SURPLUS	Falls
4	4	8	SURPLUS	Falls
3	6	6	EQUILIBRIUM	Equilibrium
2	8	4	SHORTAGE	Rises
1	10	2	SHORTAGE	Rises

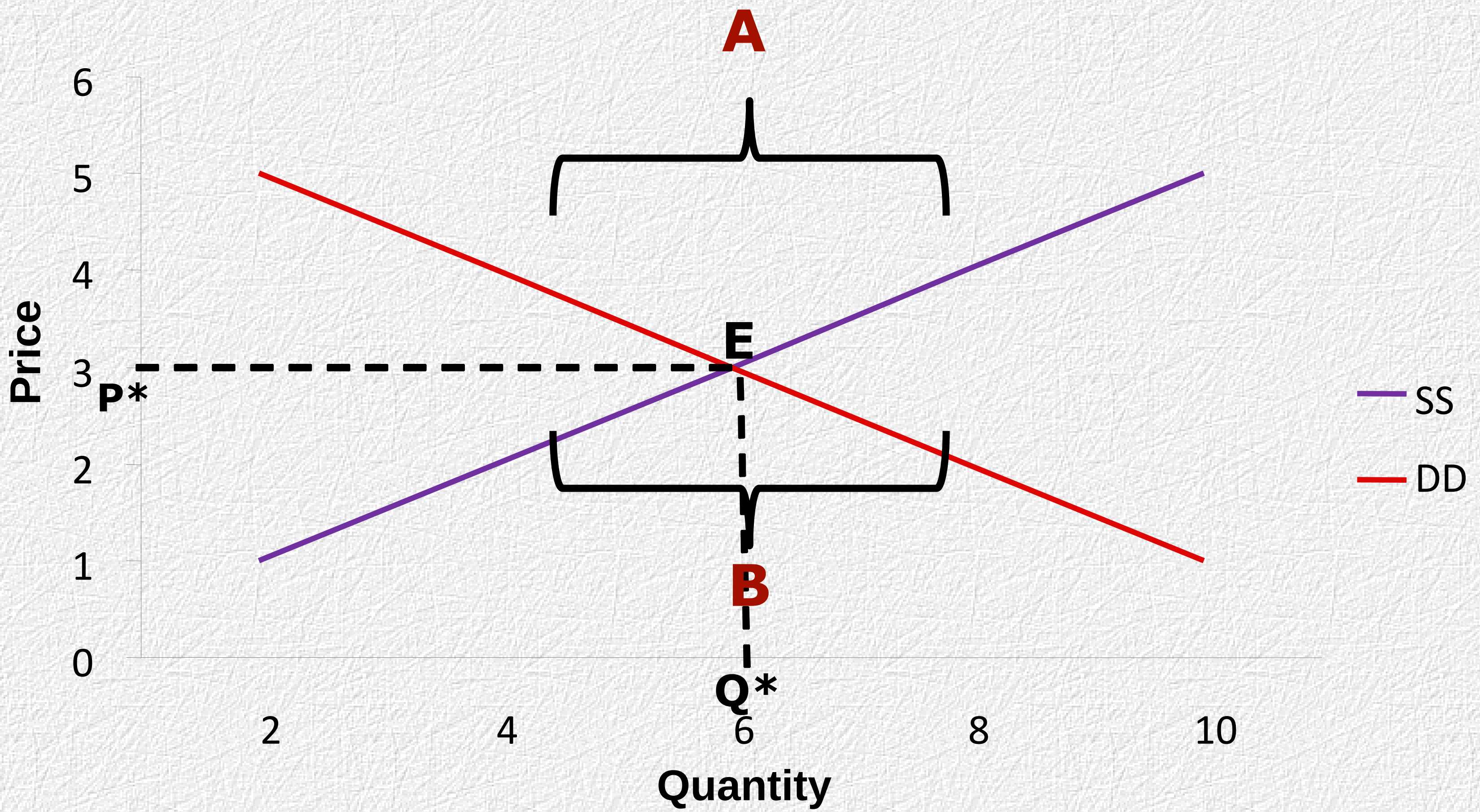
MARKET EQUILIBRIUM

EQUILIBRIUM PRICE AND OUTPUT



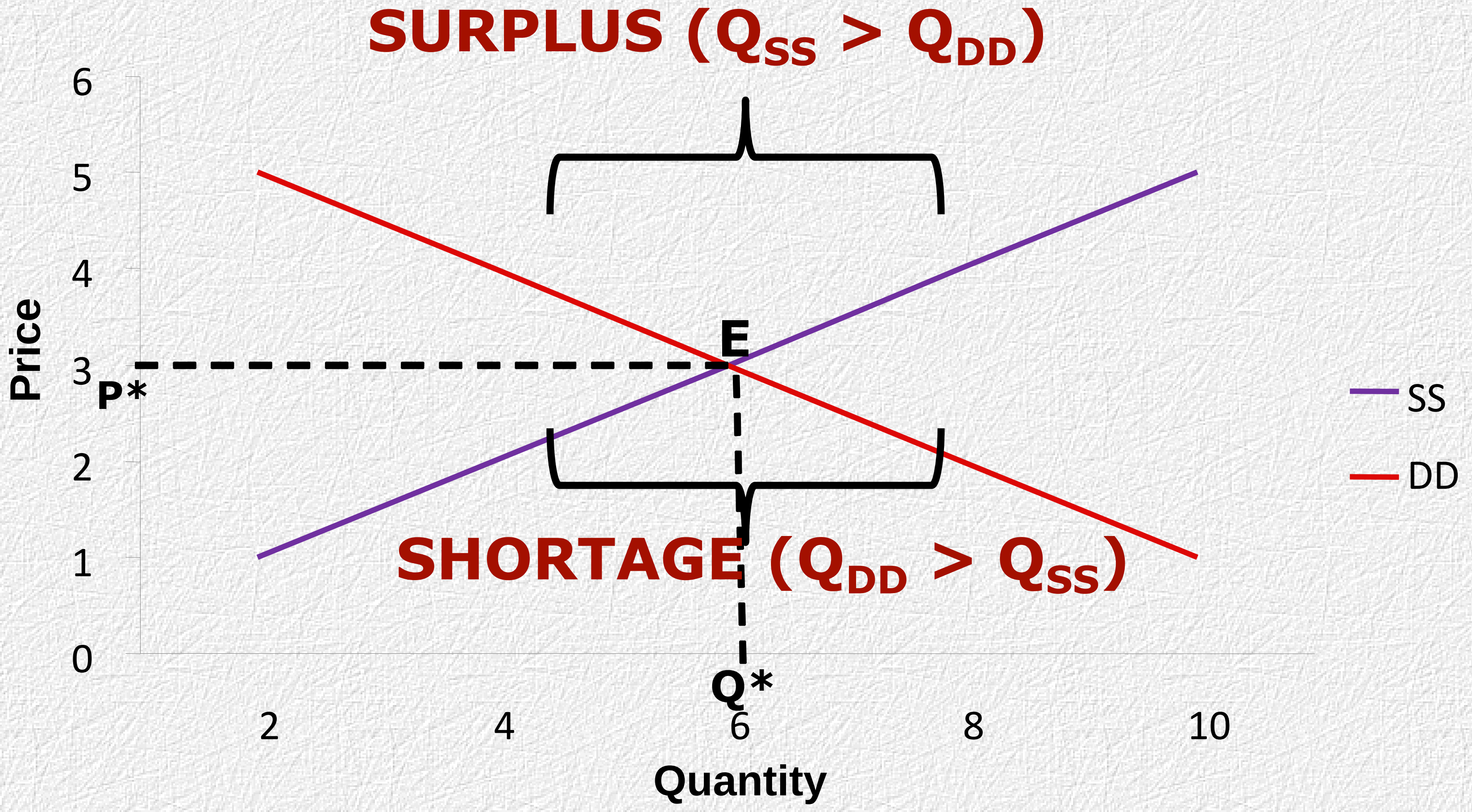
MARKET EQUILIBRIUM

EQUILIBRIUM PRICE AND OUTPUT



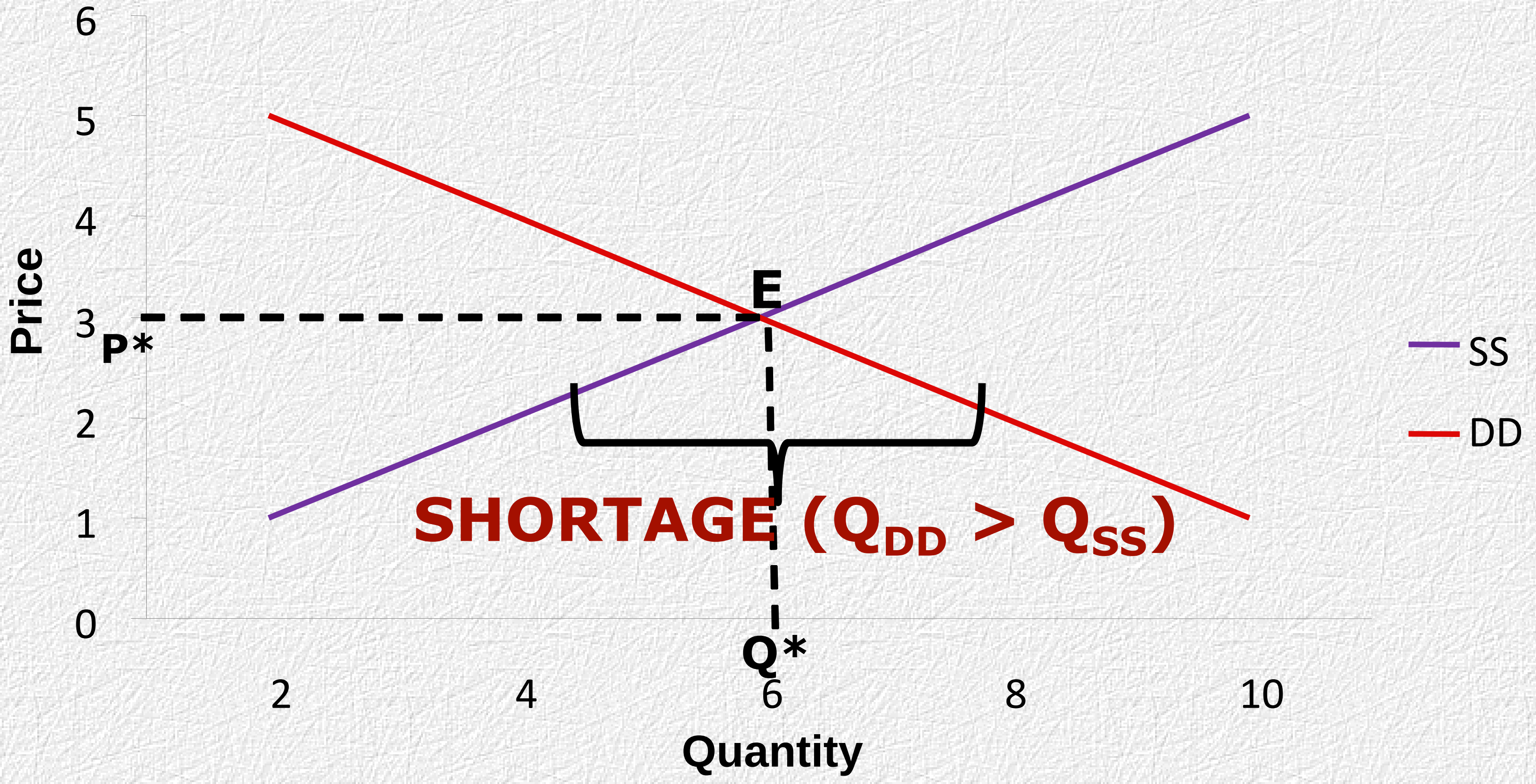
MARKET EQUILIBRIUM

EQUILIBRIUM PRICE AND OUTPUT



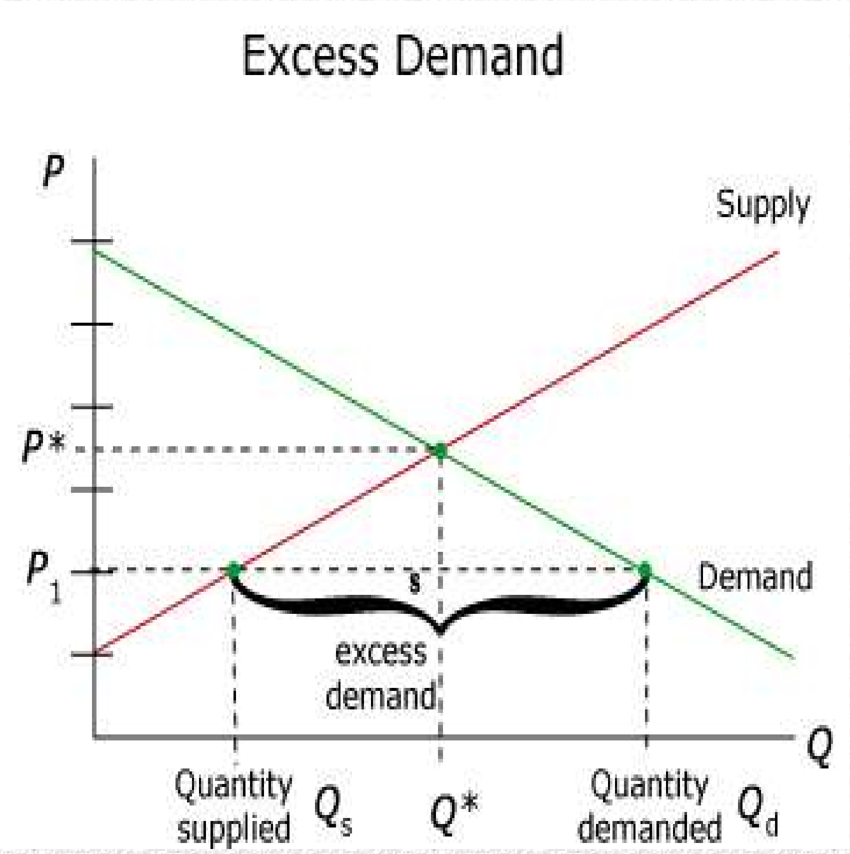
MARKET EQUILIBRIUM

SHORTAGE OR EXCESS DEMAND



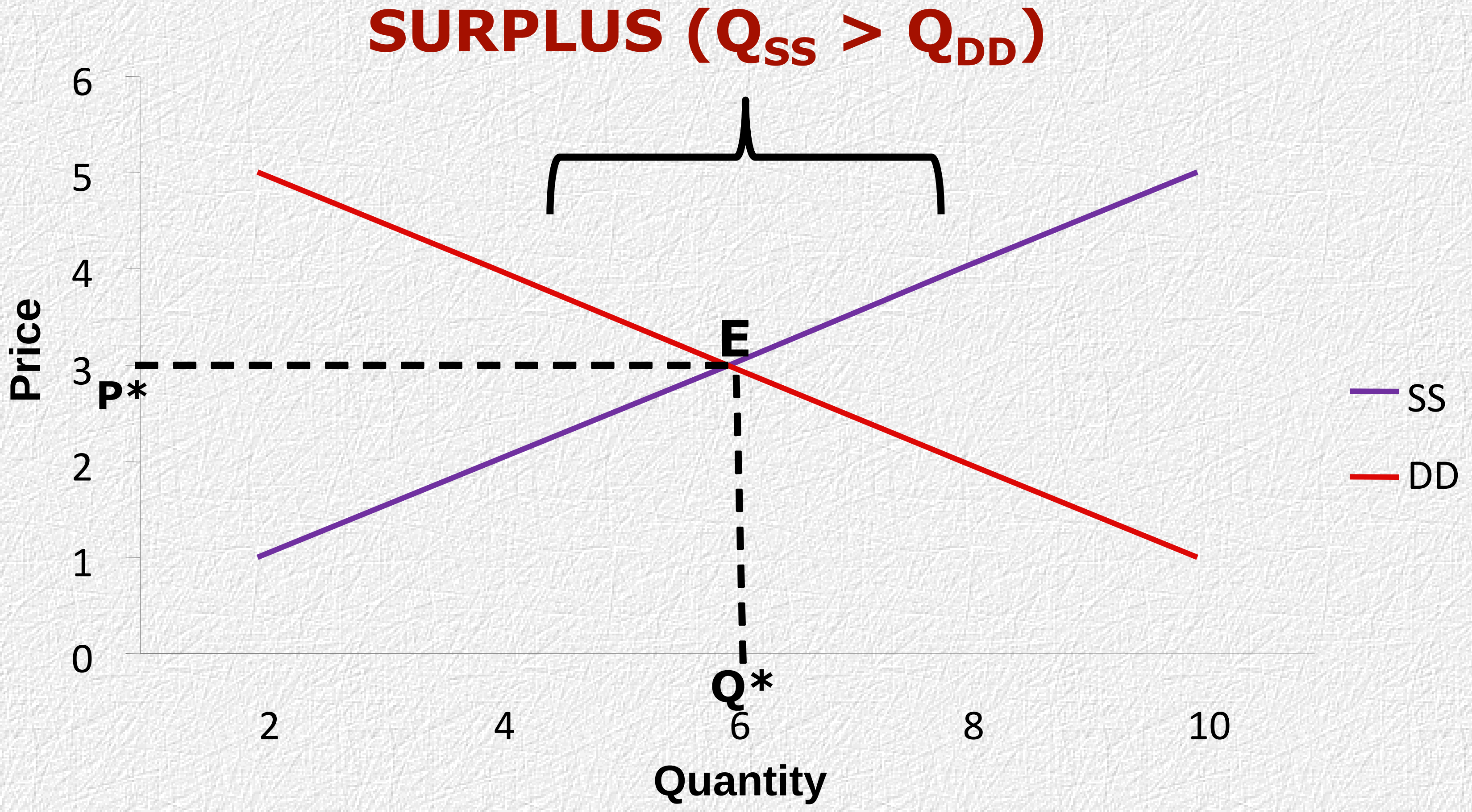
MARKET EQUILIBRIUM

SHORTAGE OR EXCESS DEMAND

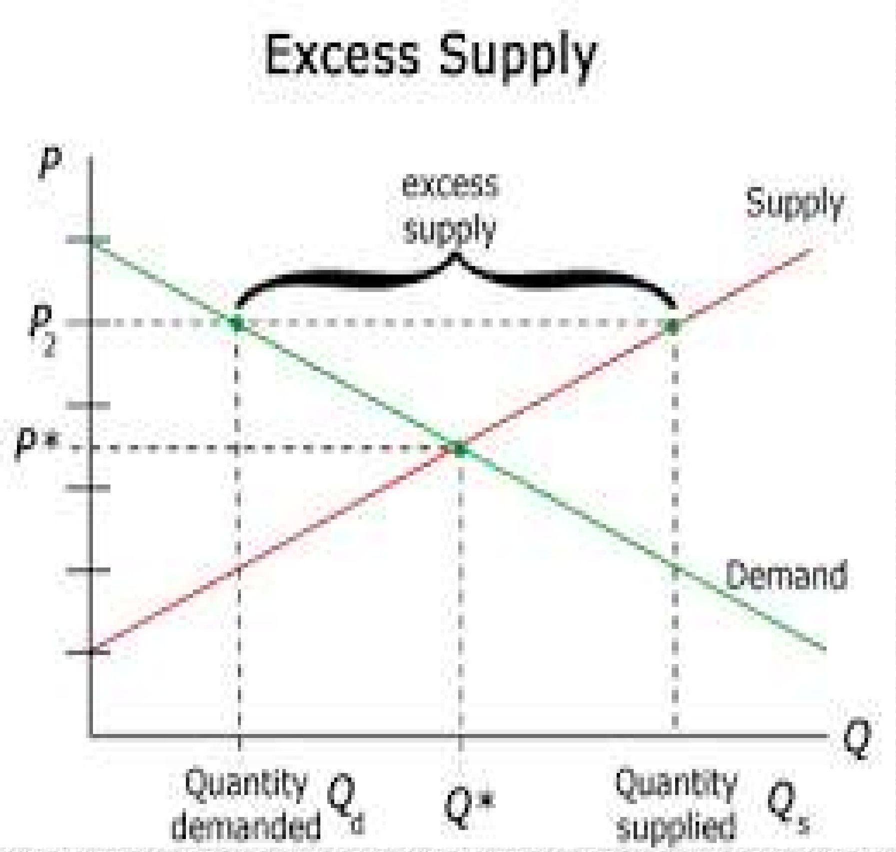


- ***Excess demand***, or shortage, is the condition that exists when quantity demanded exceeds quantity supplied at the current price.
- When quantity demanded exceeds quantity supplied, price tends to rise until equilibrium is restored.
- Price Increase to P*

SURPLUS OR EXCESS SUPPLY



SURPLUS OR EXCESS SUPPLY



- ***Excess supply***, or surplus, is the condition that exists when quantity supplied exceeds quantity demanded at the current price.
- When quantity supplied exceeds quantity demanded, price tends to fall until equilibrium is restored.
- Price Decrease to P*

SUPPLY

- Supply of a commodity means quantity of the commodity which is actually offered for sale at a given price during some particular time.

- The definition of supply is complete when it has the following elements:
  (i) Quantity of a commodity offered for sale;
  (ii) Price of the commodity; and
  (iii) Time during which the quantity is offered.

LAW OF SUPPLY

*Law of supply states that the **higher the price** of a good, the **greater** is the **quantity supplied** for that good and the lower the price of a good, the lower is the quantity supplied, ceteris paribus.*

$P\uparrow \; Q_{SS}\uparrow$

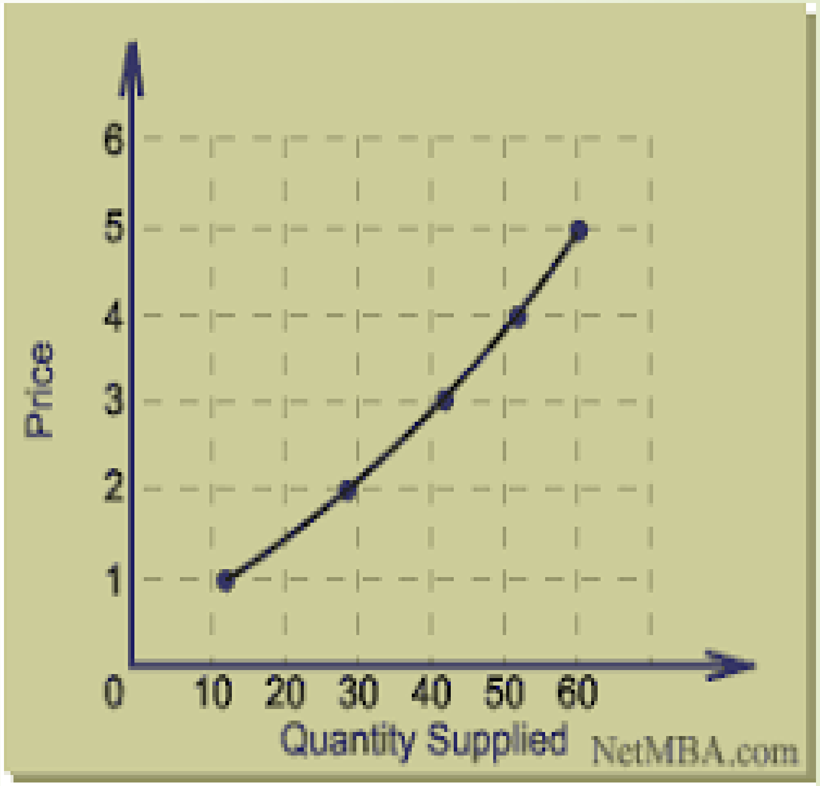
$P\downarrow \; Q_{SS}\downarrow$

POSITIVE RELATIONSHIP

SUPPLY SCHEDULE AND CURVE

Supply Schedule

Price	Quantity
5	60
4	50
3	40
2	30
1	10



INDIVIDUAL AND MARKET SUPPLY

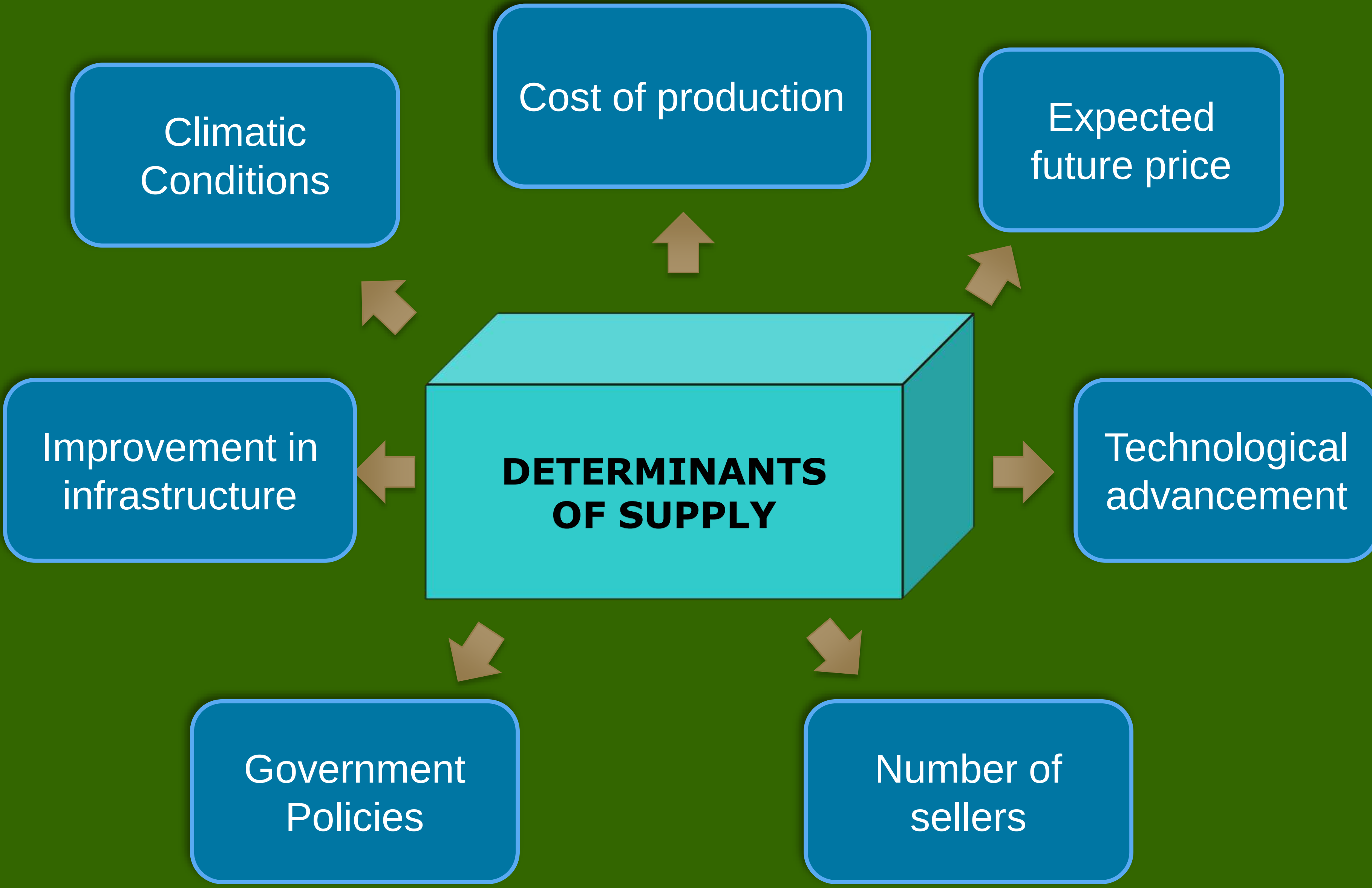
INDIVIDUAL SUPPLY

The relationship between the quantity of a product supplied by a ***single seller*** and its price.

MARKET SUPPLY

The relationship between the total quantity of a product supplied by adding all the quantities supplied by ***all sellers*** in the market and its price.

DETERMINANTS OF SUPPLY


Cost of production
Climatic Conditions
Expected future price
DETERMINANTS OF SUPPLY
Improvement in infrastructure
Technological advancement
Government Policies
Number of sellers

Price

- Price is perhaps the most obvious determinant of supply. As the price of a firm's output increases, it becomes more attractive to produce that output and firms will want to supply more.
- Economists refer to the phenomenon that quantity supplied increases as price increases as the law of supply.

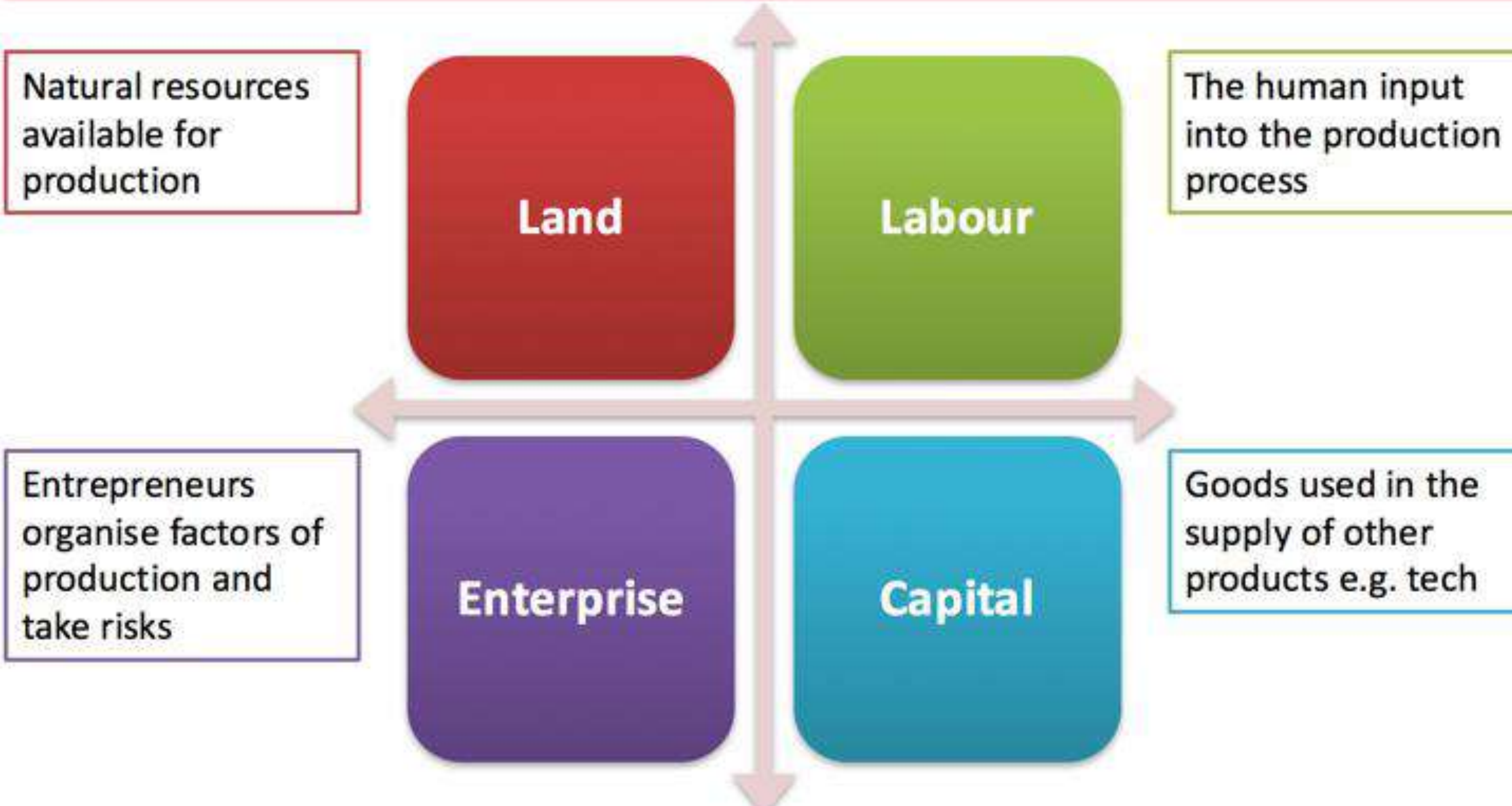
$$\text{Price } (P) \uparrow \rightarrow \text{quantity supplied } (q_S) \uparrow$$

$$P \downarrow \rightarrow q_S \downarrow$$

Factor Prices

Factors of Production (Factor Inputs)

Factors of production are the inputs available to supply goods and services in an economy.



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Input (Factors of Production) Prices

- Not surprisingly, firms consider the costs of their inputs to production as well as the price of their output when making production decisions.
- Inputs to production, or factors of production, are things like Land, labor and capital, Organization and all inputs to production come with their own prices.

$$Input\ Prices \uparrow \rightarrow quantity\ supplied\ (q_S) \downarrow$$

$$Input\ Prices \downarrow \rightarrow q_S \uparrow$$

- For example, a wage is a price of labor and an interest rate is a price of capital.
- When the prices of the inputs to production increase, it becomes less attractive to produce, and the quantity that firms are willing to supply decreases.
- In contrast, firms are willing to supply more output when the prices of the inputs to production decrease.

Technology

- Technology, in an economic sense, refers to the processes by which inputs are turned into outputs.
- Technology is said to increase when production gets more efficient.

Technology

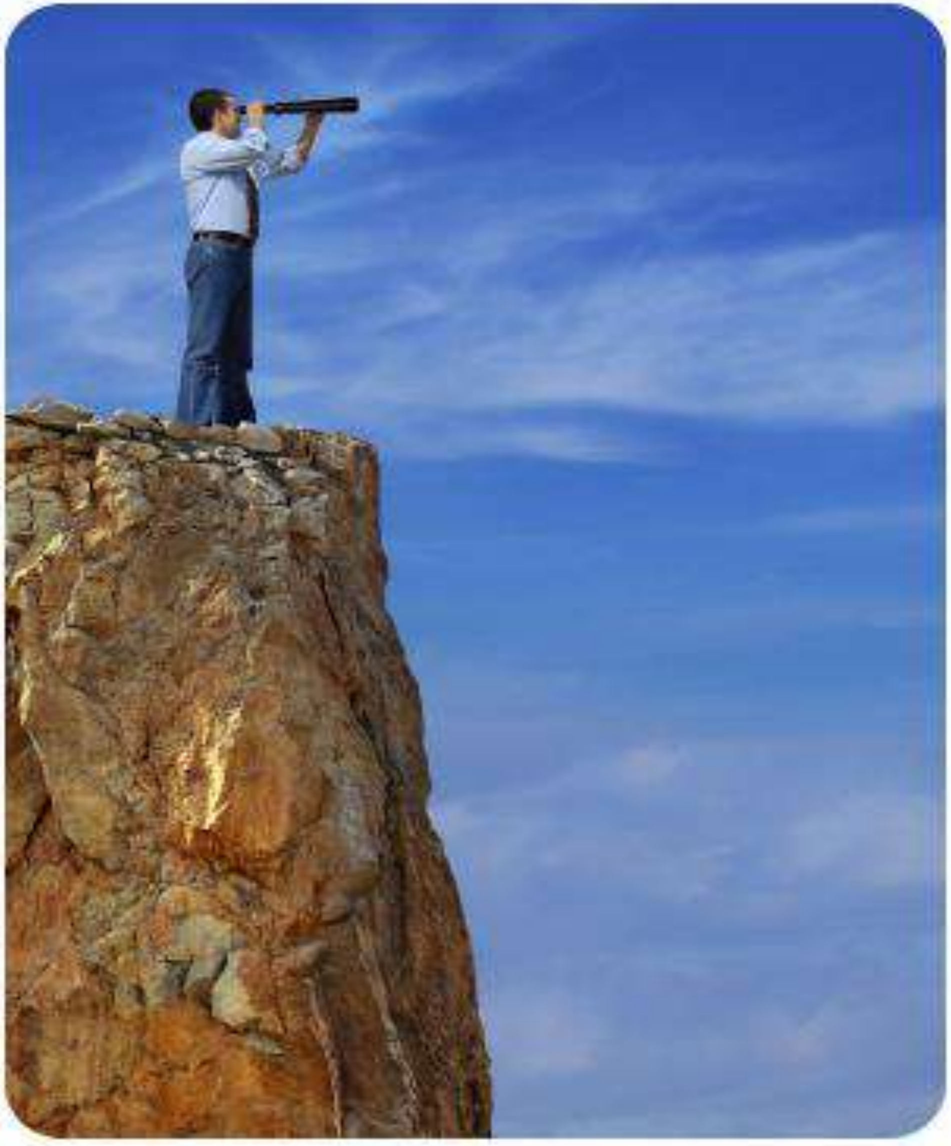
- Increases in technology make it more attractive to produce (since technology increases decrease per unit production costs), so increases in technology increase the quantity supplied of a product.
- On the other hand, decreases in technology make it less attractive to produce (since technology decreases increase per-unit costs), so decreases in technology decrease the quantity supplied of a product.

$$Tehnology \uparrow \rightarrow quantity\ supplied\ (q_S) \uparrow$$

$$Technology \downarrow \rightarrow q_S \downarrow$$

Future Expectations

- If producers expect future price to be higher, they will try to hold on to their inventories
- and offer the products to the buyers in the future, thus they can capture the higher price



Number of Sellers

- Although not a determinant of individual firm supply, the number of sellers in a market is clearly an important factor in calculating market supply
- Not surprisingly, market supply increases when the number of sellers increases, and market supply decreases when the number of sellers decreases.

Number of Sellers

- This may seem a bit counterintuitive, since it seems like firms might each produce less if they know that there are more firms in the market

$$\textit{Number of Sellers} \uparrow \rightarrow \textit{market quantity supplied}\ (Q_S) \uparrow$$

$$\textit{Number of Sellers} \downarrow \rightarrow Q_S \downarrow$$

Government policies

Taxes and Subsidies:

- Taxes reduces profits, therefore increase in taxes reduce supply whereas decrease in taxes increase supply.
- Subsidies reduce the burden of production costs on suppliers, thus increasing the profits. Therefore increase in subsidies increase supply and decrease in subsidies decrease supply

PRICE ELASTICITY OF SUPPLY

PRICE ELASTICITY OF SUPPLY

DEFINITION:

*Measures the **sensitivity/responsiveness** of the **quantity supplied** due to a change in the **price of a product or service**.*

PRICE ELASTICITY OF SUPPLY (cont.)

FORMULA:

$$\varepsilon_{ss} = \frac{\%\ \Delta\ \text{Quantity Supplied}}{\%\ \Delta\ \text{Price}}$$

$$\varepsilon_{SS} = \frac{Q_2 - Q_1}{Q_1} \times \frac{P_1}{P_2 - P_1}$$

Types of Price Elasticity of Supply

Price Elasticity of Supply

iTutor

- Law of supply tells us that producers will respond to a price drop by producing less, but it does not tell us how much less. The degree of sensitivity of producers to a change in price is measured by the concept of price elasticity of supply.

- *Price elasticity of supply is the percentage change in quantity supplied resulting from a percent change in price.*

- *It is a measure of how much the quantity supplied of a good responds to a change in the price of that good.*

- The elasticity of supply is the same basic formula as the demand elasticity, but looks at the percentage change in quantity supplied instead of percentage change in quantity demanded.

$$\text{Price Elasticity of Supply} = \frac{\text{Percentage Change in Quantity Supply}}{\text{Percentage Change in Price}}$$

Perfectly elastic

- When there is an infinite supply at a particular price
- Then the supply of such a commodity is said to be perfectly elastic.
- In such a case $E_s = \infty$
- the supply curve is a chorizontal straight line parallel to the X-axis

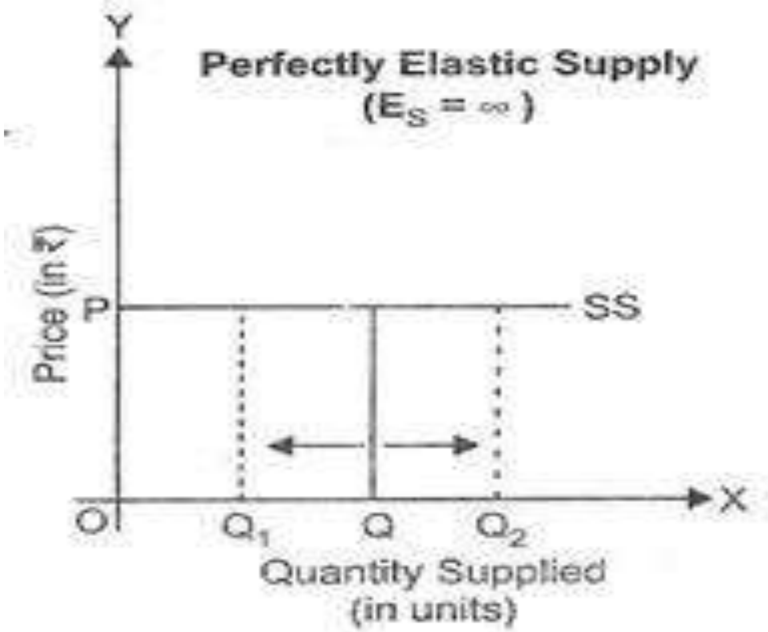


Fig. 9.23

Perfectly Inelastic Supply

- When the supply does not change with change in price, then supply for such a commodity is said to be perfectly inelastic.
- such a case, $E_s = 0$
- the supply curve (SS) is a vertical straight line parallel to the Y-axis

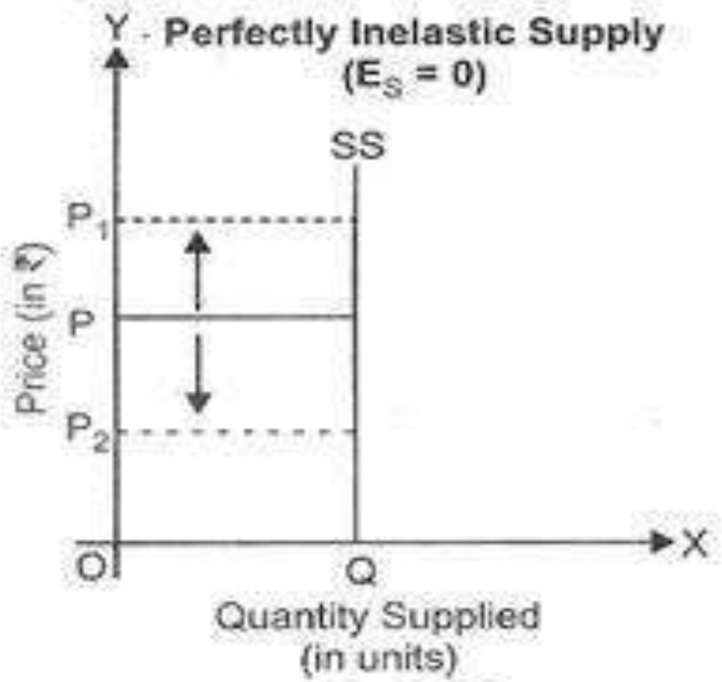


Fig. 9.24

Elastic Supply

- When percentage change in quantity supplied is more than the percentage change in price, then supply for such a commodity is said to be highly elastic.
- In such a case, $E_s > 1$
- The supply curve has an intercept on the Y-axis

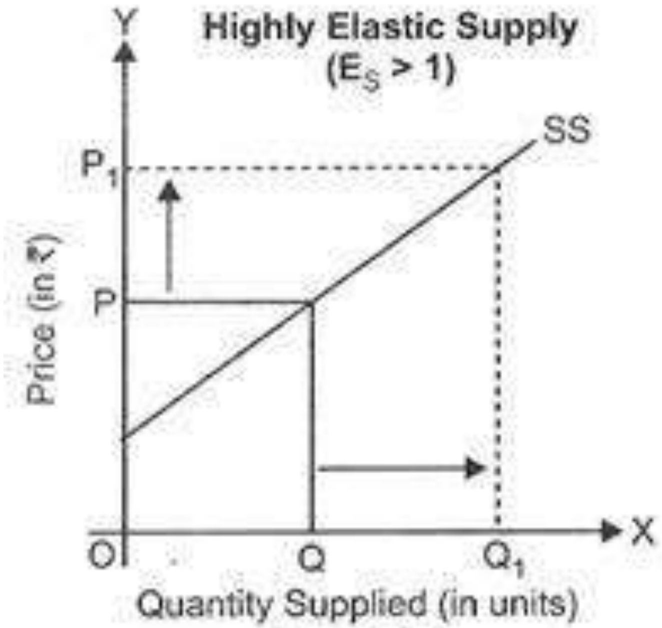


Fig. 9.25

Inelastic Supply

- When percentage change in quantity supplied is less than the percentage change in price, then supply for such a commodity is said to be less elastic.
- In such a case, $E_s < 1$
- The supply curve has an intercept on the X-axis

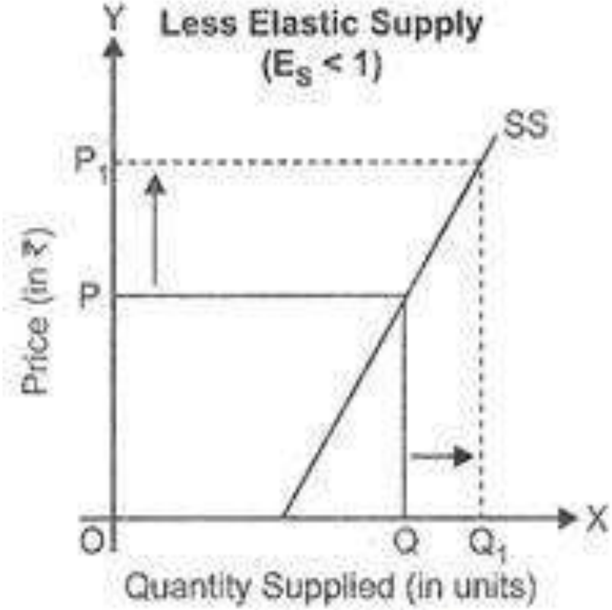


Fig. 9.26

Unitary Elastic Supply

- When percentage change in quantity supplied is equal to percentage change in price, then supply for such a commodity is said to the unitary elastic.
- In such a case, $E_s = 1$
- supply curve is a straight line passing through the origin

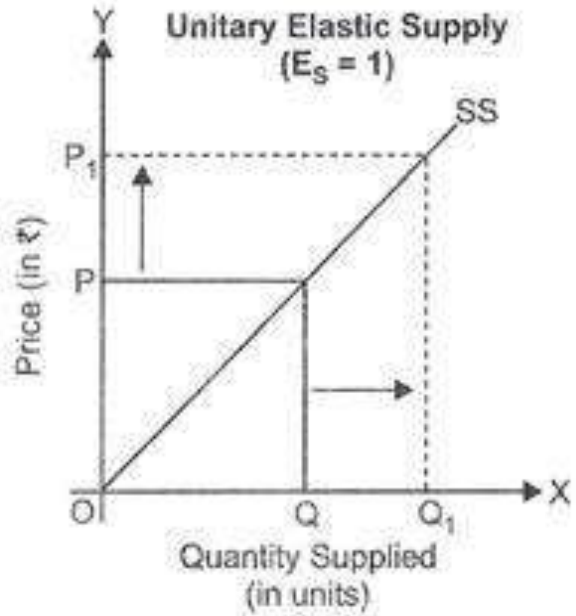


Fig. 9.27

MARKET EQUILIBRIUM

Market Equilibrium

- The operation of the market depends on the interaction between buyers and sellers.
- An ***equilibrium*** is the condition that exists when quantity supplied and quantity demanded are equal.
- At equilibrium, there is no tendency for the market price to change.

EQUILIBRIUM PRICE AND OUTPUT

Price	Quantity Demanded	Quantity Supplied	Market Condition
5	2	10	
4	4	8	
3	6	6	
2	8	4	
1	10	2	

MARKET EQUILIBRIUM

EQUILIBRIUM PRICE AND OUTPUT

Price	Quantity Demanded	Quantity Supplied	Market Condition	Market Prices
5	2	10	SURPLUS	
4	4	8	SURPLUS	
3	6	6	EQUILIBRIUM	Equilibrium
2	8	4	SHORTAGE	
1	10	2	SHORTAGE	

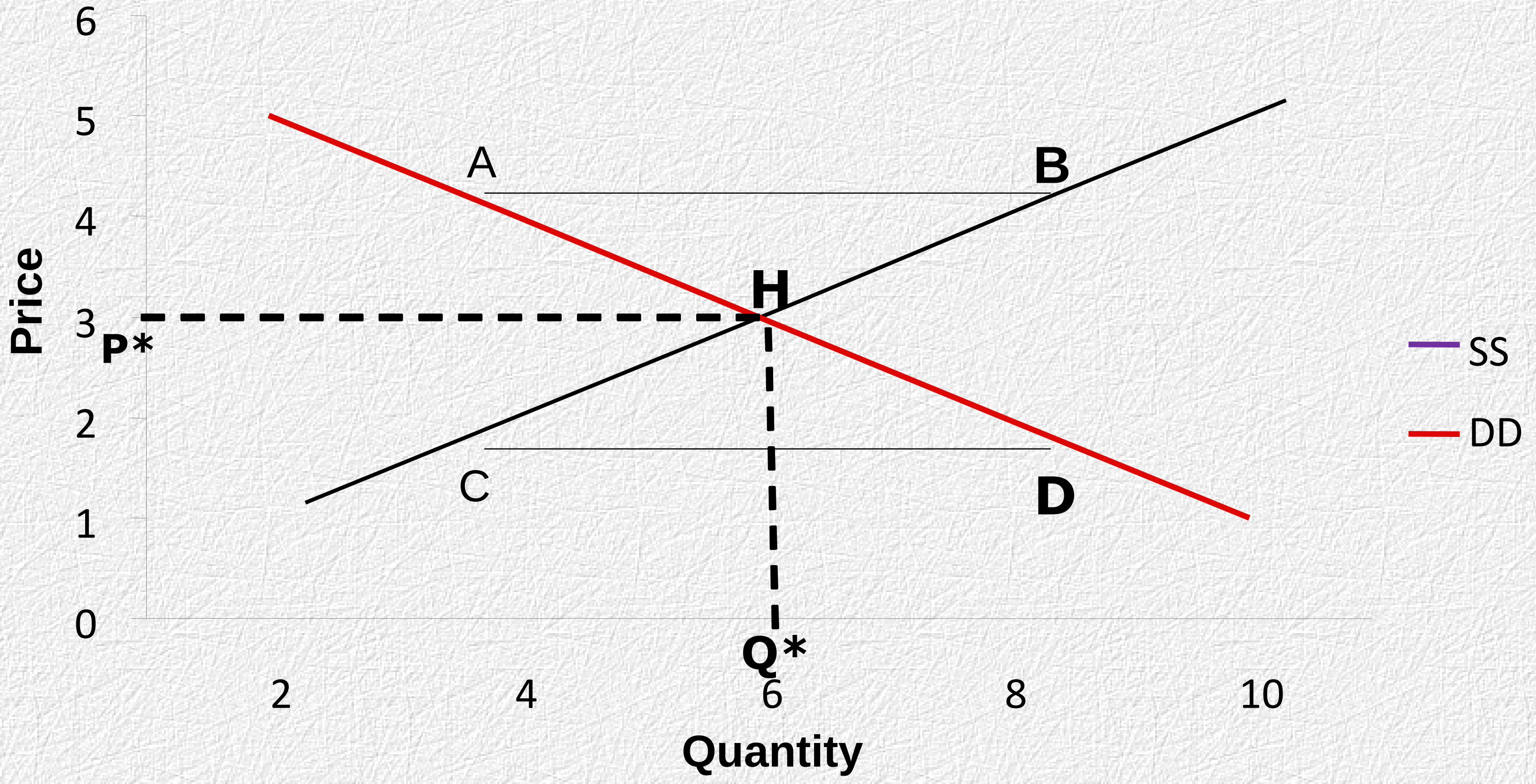
MARKET EQUILIBRIUM

EQUILIBRIUM PRICE AND OUTPUT

Price	Quantity Demanded	Quantity Supplied	Market Condition	Market Prices
5	2	10	SURPLUS	Falls
4	4	8	SURPLUS	Falls
3	6	6	EQUILIBRIUM	Equilibrium
2	8	4	SHORTAGE	Rises
1	10	2	SHORTAGE	Rises

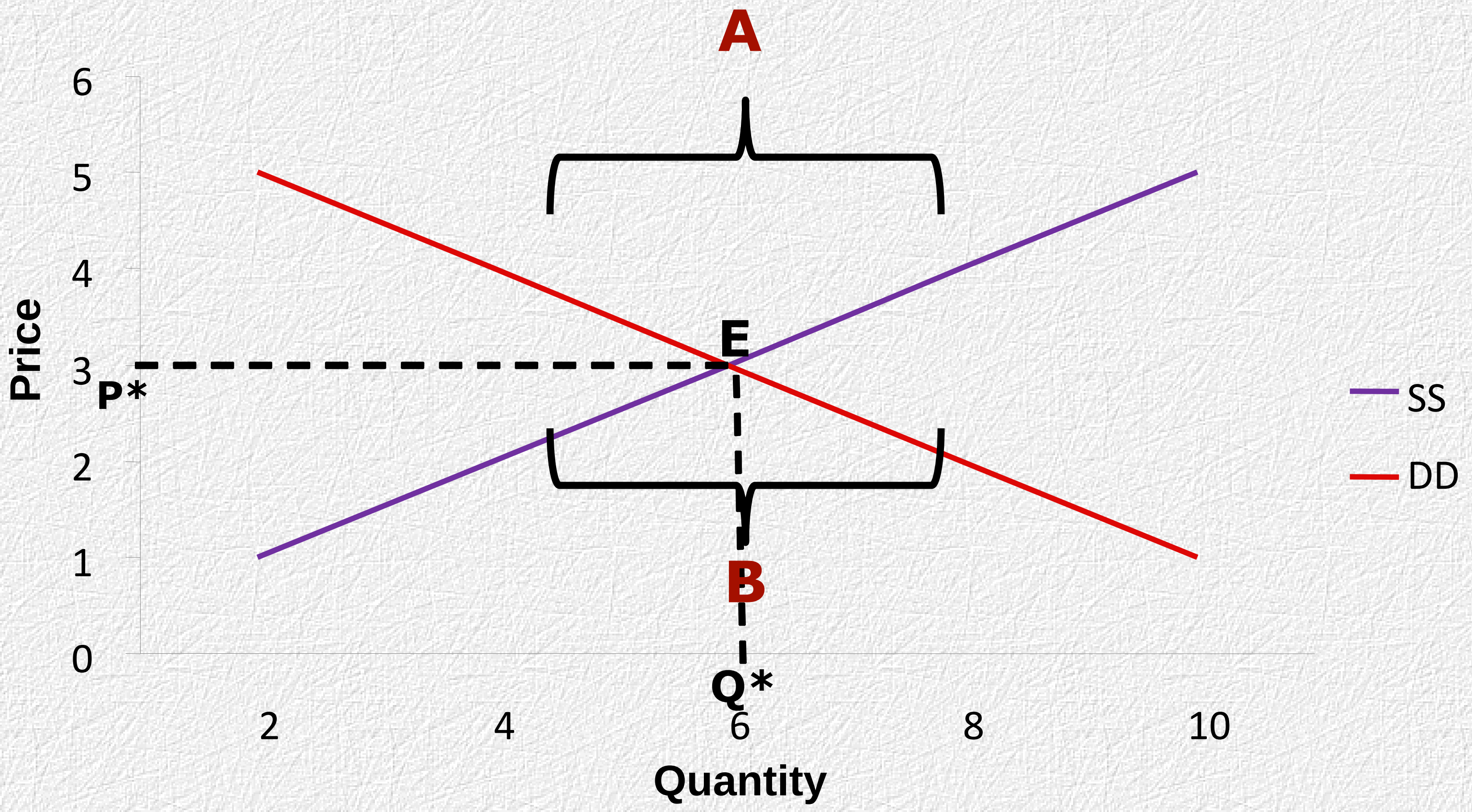
MARKET EQUILIBRIUM

EQUILIBRIUM PRICE AND OUTPUT



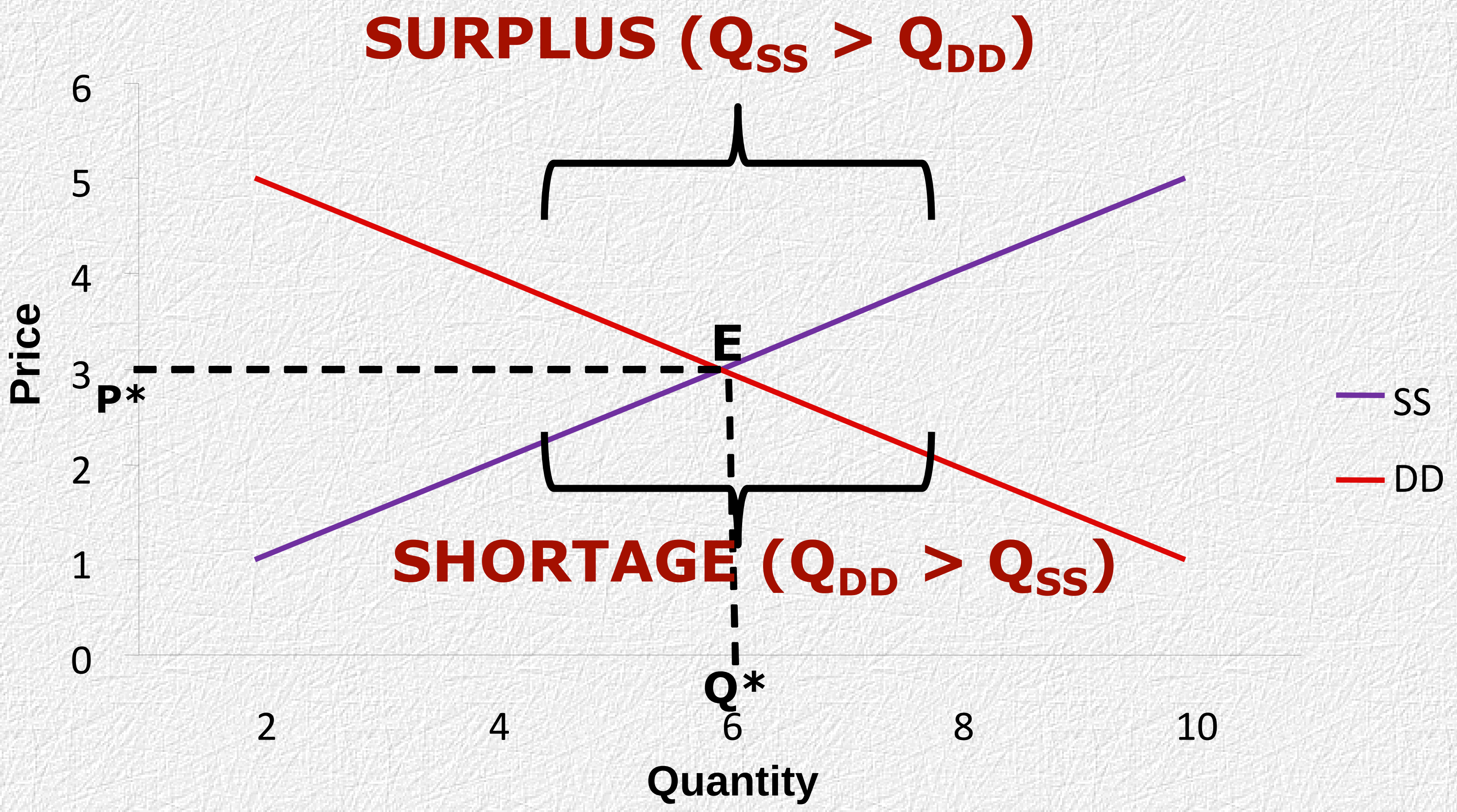
MARKET EQUILIBRIUM

EQUILIBRIUM PRICE AND OUTPUT



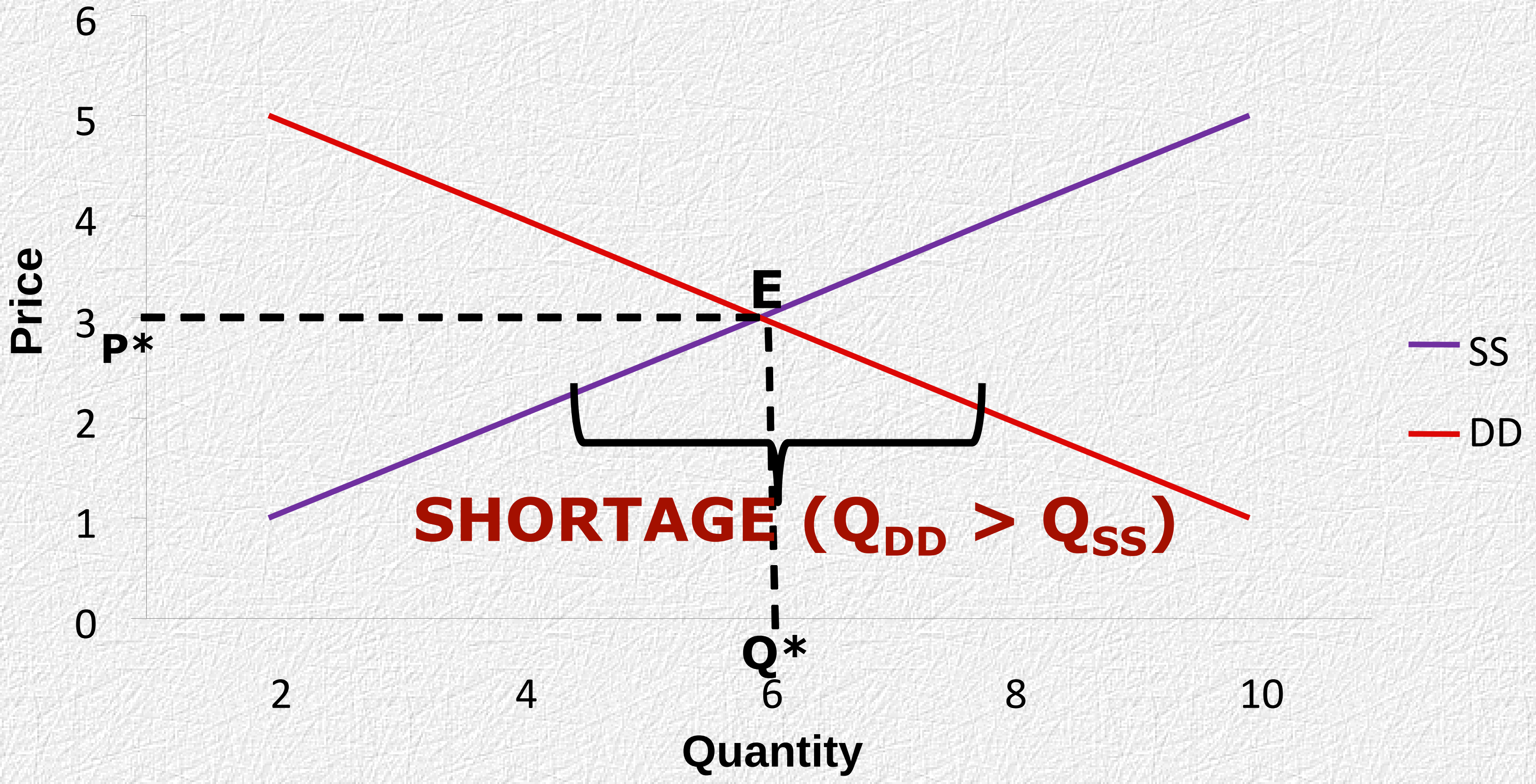
MARKET EQUILIBRIUM

EQUILIBRIUM PRICE AND OUTPUT



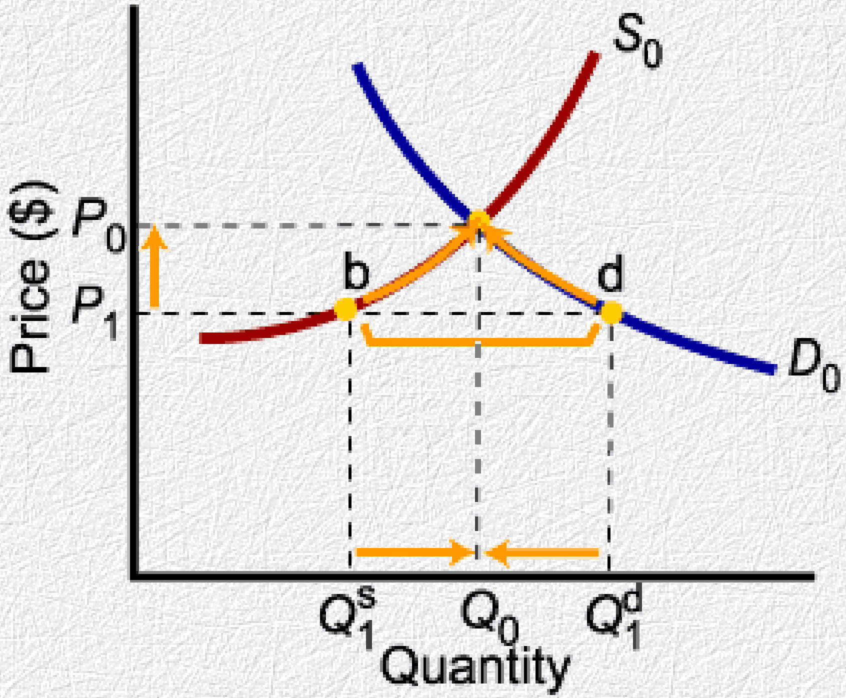
MARKET EQUILIBRIUM

EQUILIBRIUM PRICE AND OUTPUT



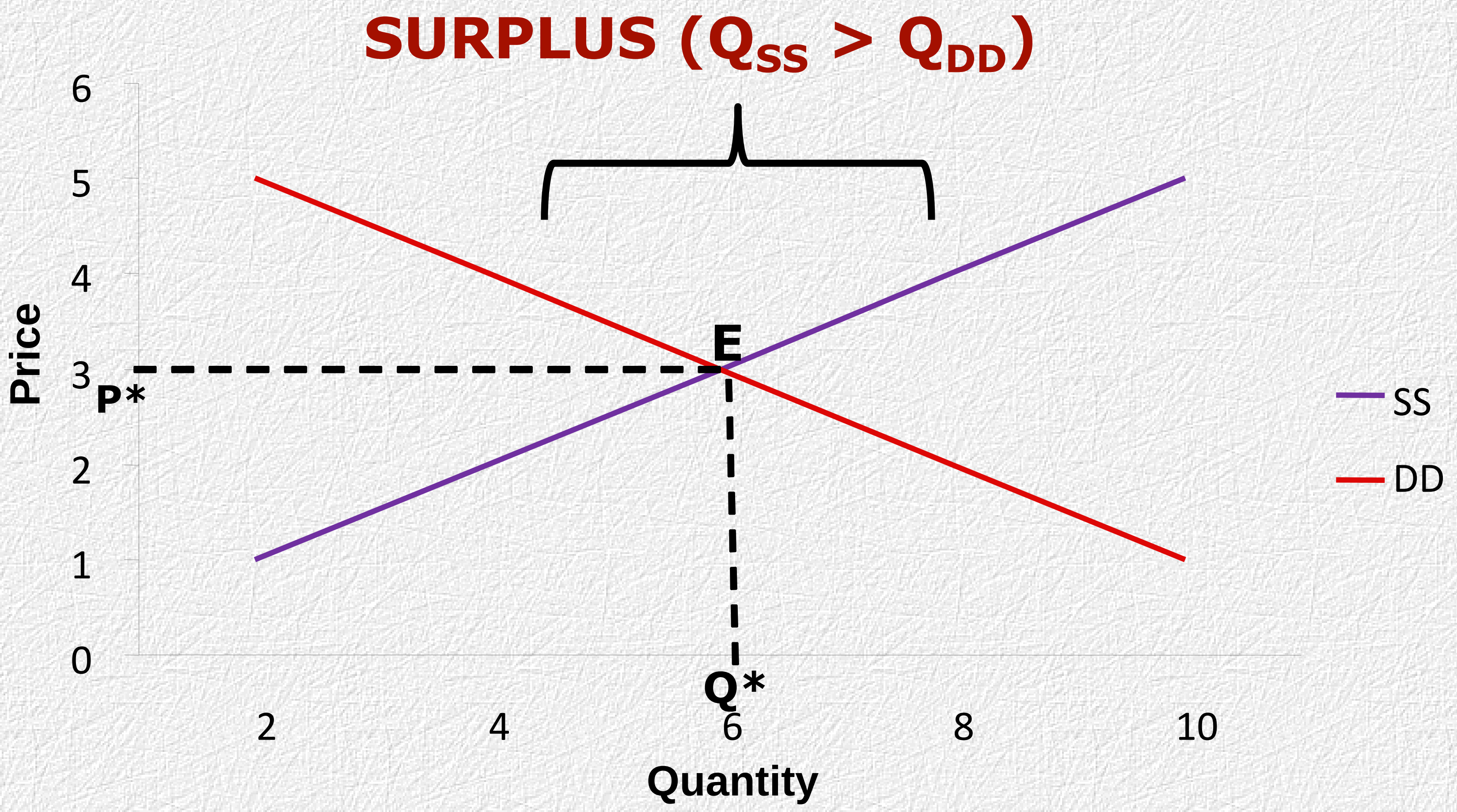
MARKET EQUILIBRIUM

Market Disequilibria



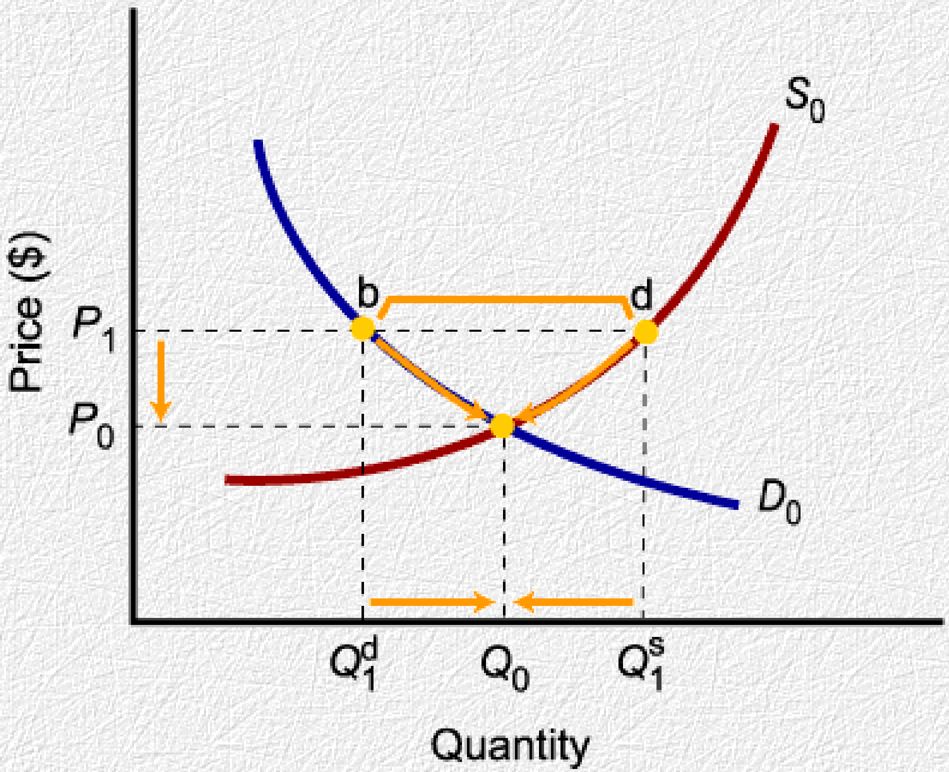
- ***Excess demand***, or shortage, is the condition that exists when quantity demanded exceeds quantity supplied at the current price.
- When quantity demanded exceeds quantity supplied, price tends to rise until equilibrium is restored.

EQUILIBRIUM PRICE AND OUTPUT



MARKET EQUILIBRIUM

Market Disequilibria



- ***Excess supply***, or surplus, is the condition that exists when quantity supplied exceeds quantity demanded at the current price.
- When quantity supplied exceeds quantity demanded, price tends to fall until equilibrium is restored.

CHAPTER

Theory of Costs

The Difference between Price and Cost

Price =Cost of Material + Labor + Overhead
+ General & Administrative Expenses
+ Selling Expense + Profit

Cost =Cost of Material + Labor + Overhead
+ General & Administrative Expenses
+ Sales Expense

EXAMPLE 1: Ram ’s Costs

- Farmer Ram must pay $1000 per month for the land, regardless of how much wheat he grows.
- The market wage for a farm worker is $2000 per month.
- So Farmer Ram’s costs are related to how much wheat he produces….

EXAMPLE 1: Farmer Ram's Costs

L (no. of workers)	***Q*** (wheat)	Cost of land	Cost of labor	Total Cost
0	0	$1,000	$0	$1,000
1	1000	$1,000	$2,000	$3,000
2	1800	$1,000	$4,000	$5,000
3	2400	$1,000	$6,000	$7,000
4	2800	$1,000	$8,000	$9,000
5	3000	$1,000	$10,000	$11,000

Marginal Cost

- **Marginal Cost** (*MC*)
  is the increase in Total Cost from producing one more unit:

$$MC = \frac{\Delta TC}{\Delta \boldsymbol{Q}}$$

EXAMPLE 1: Total and Marginal Cost

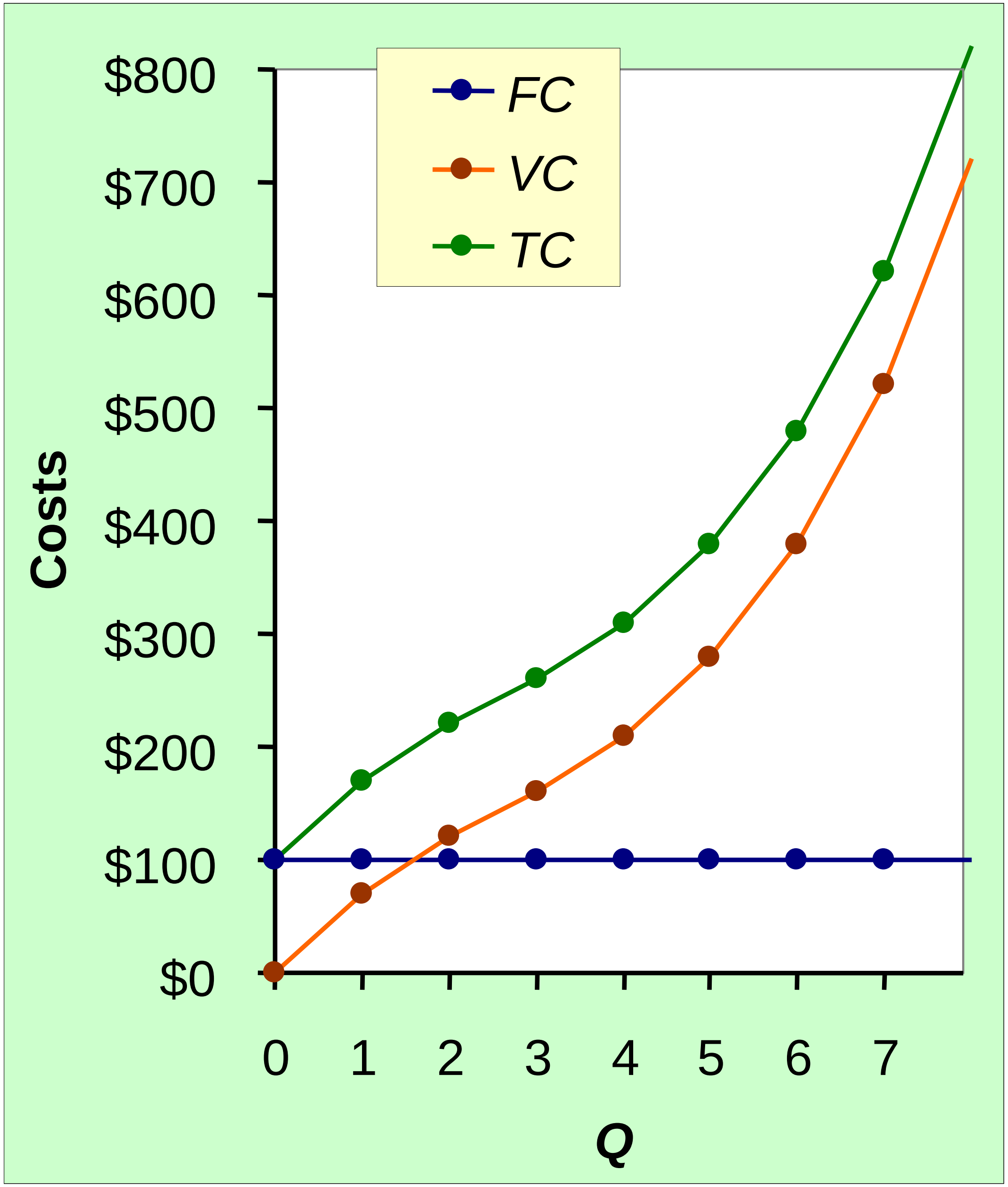
	Q (wheat)	Total Cost		Marginal Cost (*MC*)
	0	$1,000		
Δ***Q*** = 1000			Δ**TC** = $2000	$2.00
	1000	$3,000		
Δ***Q*** = 800			Δ**TC** = $2000	$2.50
	1800	$5,000		
Δ***Q*** = 600			Δ**TC** = $2000	$3.33
	2400	$7,000		
Δ***Q*** = 400			Δ**TC** = $2000	$5.00
	2800	$9,000		
Δ***Q*** = 200			Δ**TC** = $2000	$10.00
	3000	$11,000		

Fixed and Variable Costs

- **Fixed costs (*FC*)** do not vary with the quantity of output produced.
  - For Farmer Ram, *FC* = $1000 for his land
  - Other examples:
    cost of equipment, loan payments, rent
  - FC=TC-VC
- **Variable costs (*VC*)** vary with the quantity produced.
  - For Farmer Ram, *VC* = wages he pays workers
  - Other example: cost of materials
  - VC=TC-FC
- **Total cost (*TC*)** = *FC* + *VC*

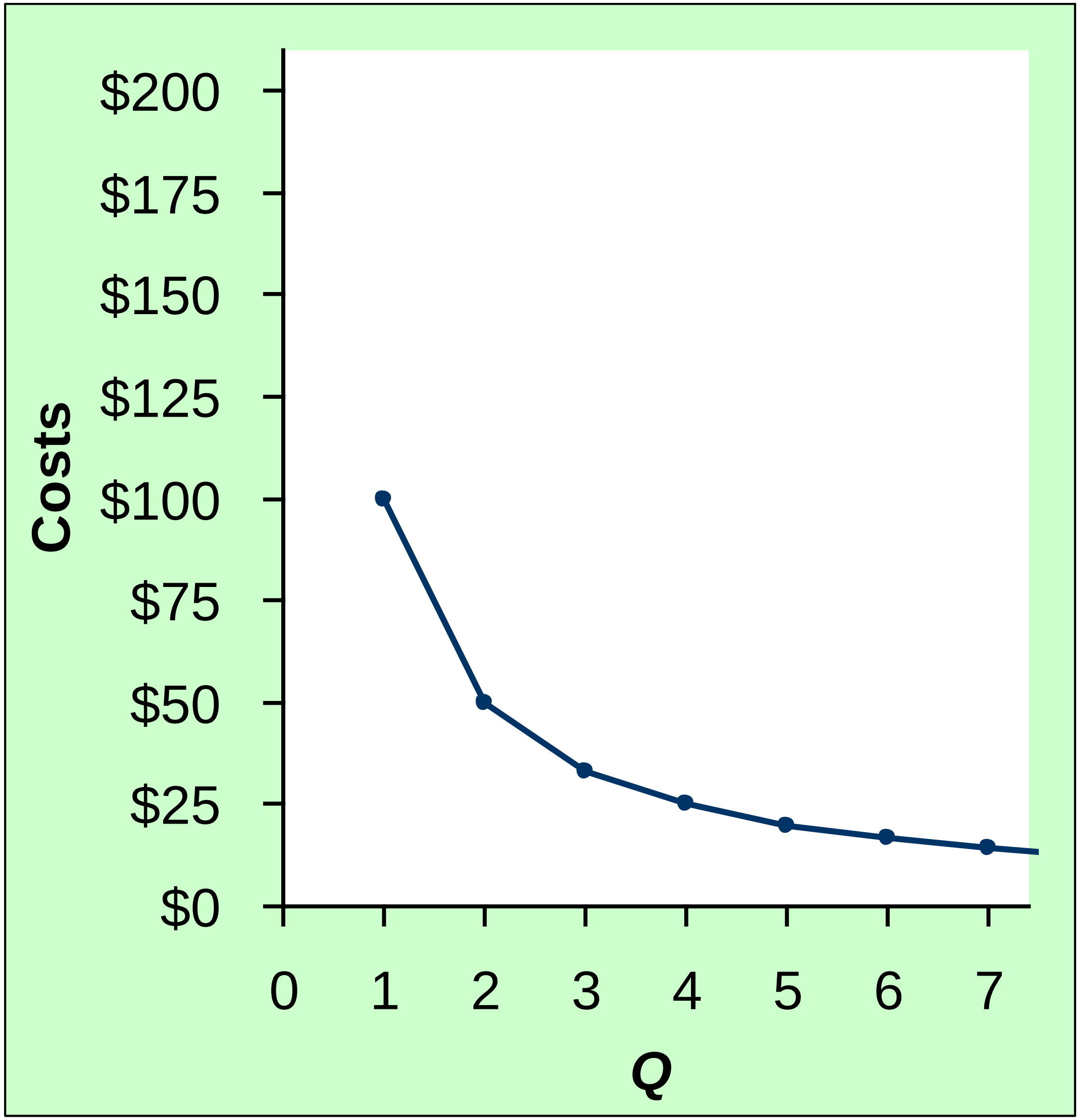
EXAMPLE 2: Costs

Q	*FC*	*VC*	*TC*
0	$100	$0	$100
1	100	70	170
2	100	120	220
3	100	160	260
4	100	210	310
5	100	280	380
6	100	380	480
7	100	520	620



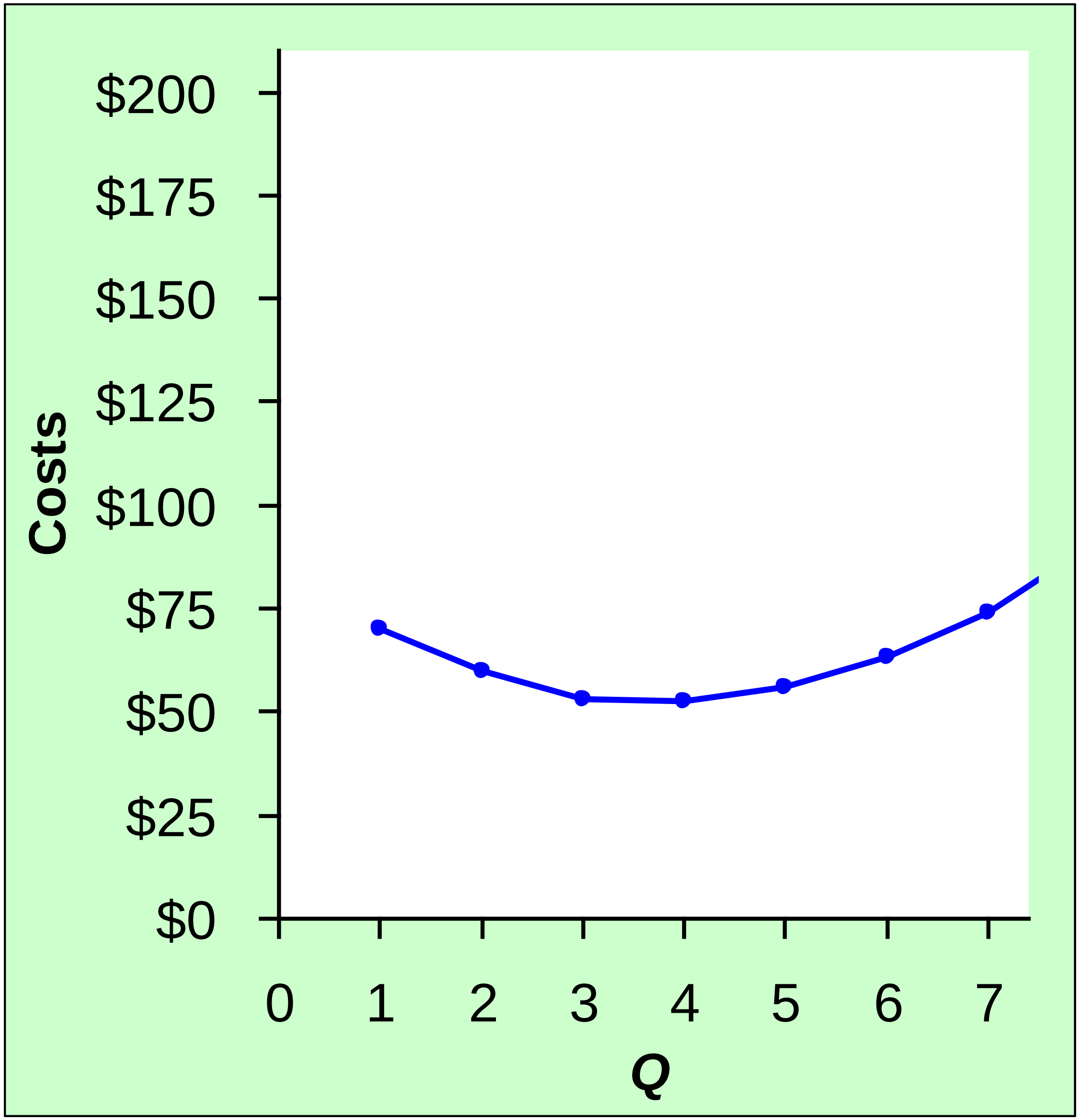
EXAMPLE 2: Average Fixed Cost

Q	*FC*	*AFC*
0	$100	n/a
1	100	$100
2	100	50
3	100	33.33
4	100	25
5	100	20
6	100	16.67
7	100	14.29



EXAMPLE 2: Average Variable Cost

Q	*VC*	*AVC*
0	$0	n/a
1	70	$70
2	120	60
3	160	53.33
4	210	52.50
5	280	56.00
6	380	63.33
7	520	74.29



Average Total Cost

Average total cost (*ATC*) equals total cost divided by the quantity of output:

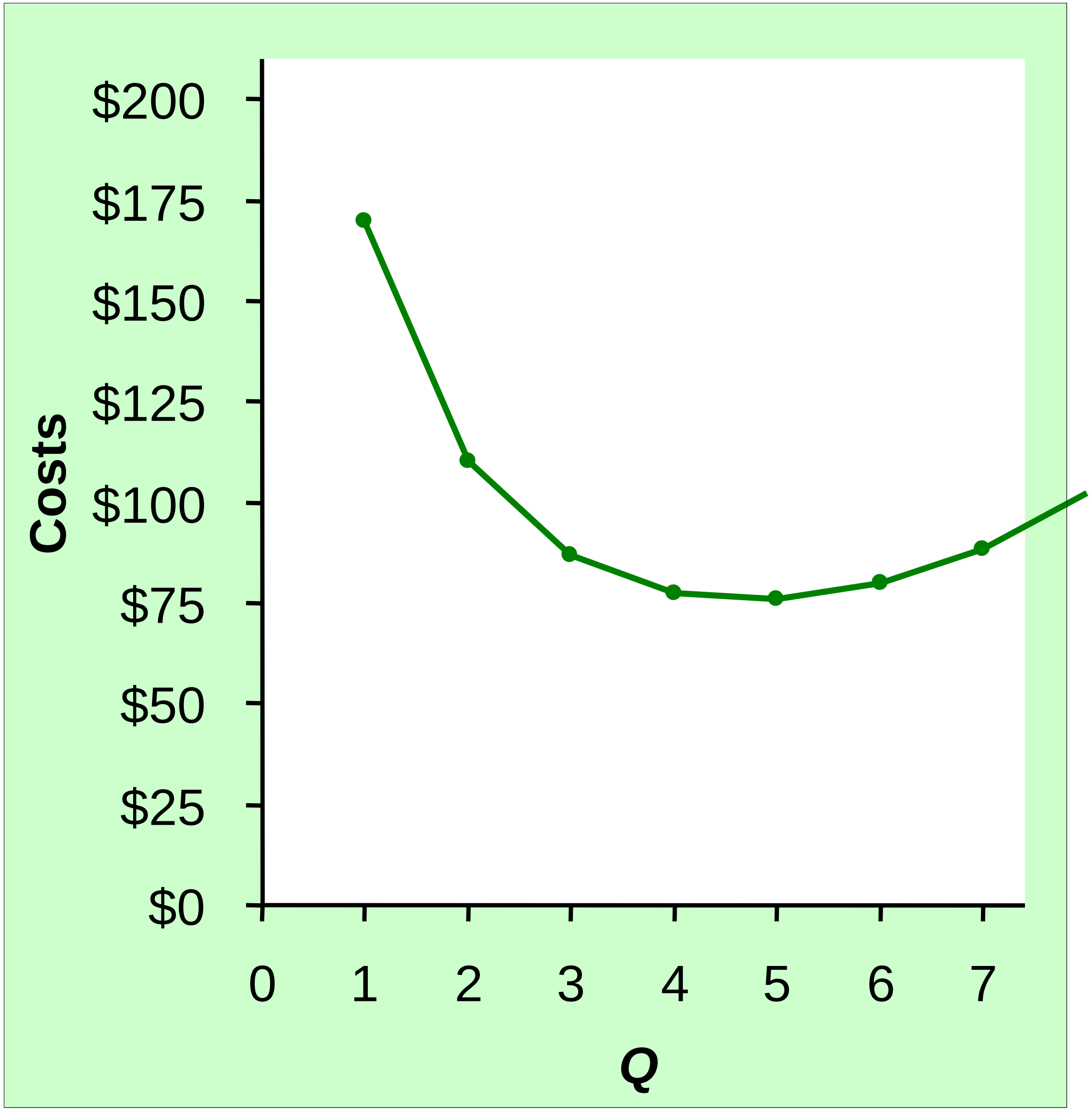
$$ATC = TC/\boldsymbol{Q}$$

Also,

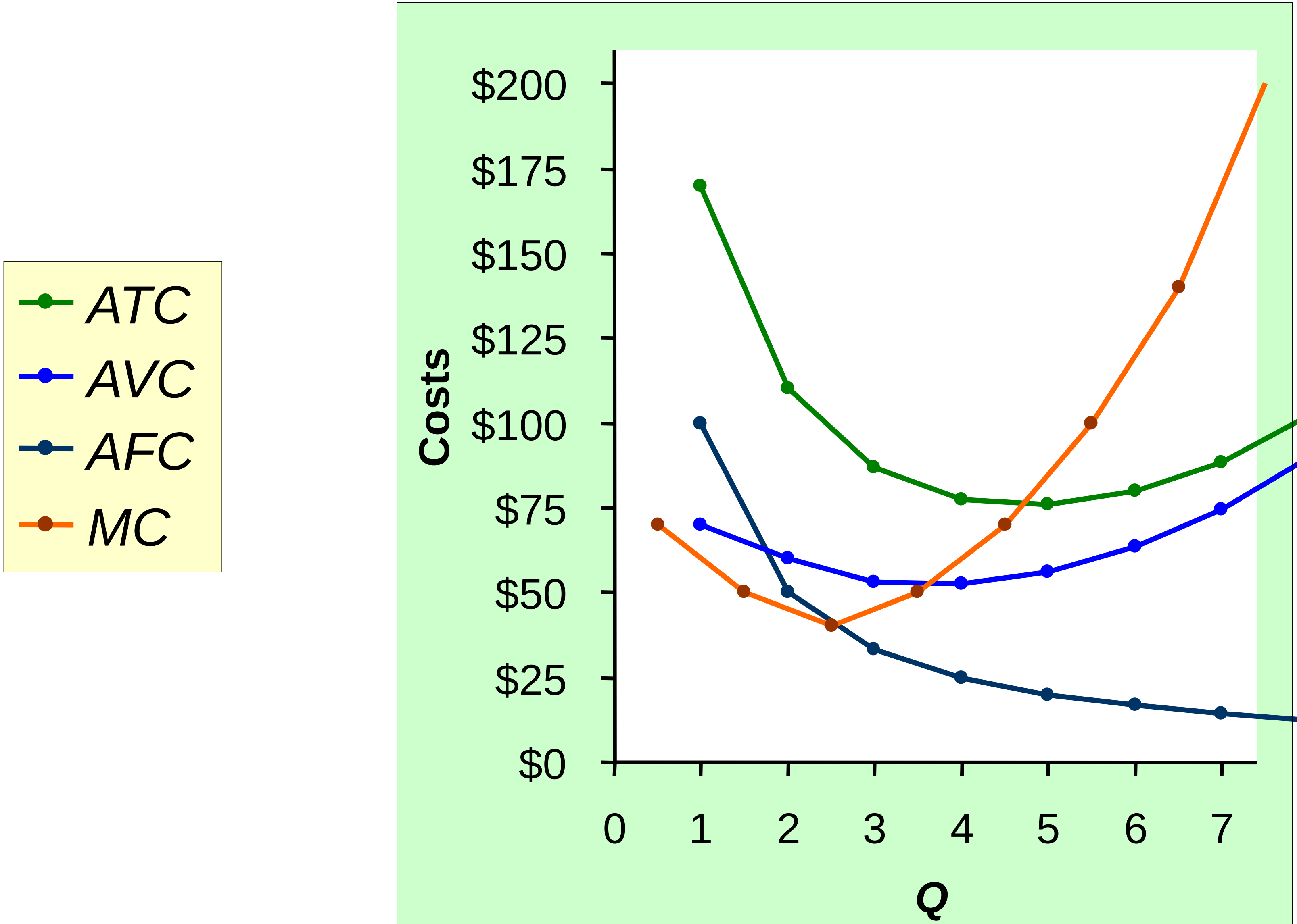
$$ATC = AFC + AVC$$

EXAMPLE 2: Average Total Cost

Q	*TC*	*ATC*
0	$100	n/a
1	170	$170
2	220	110
3	260	86.67
4	310	77.50
5	380	76
6	480	80
7	620	88.57



EXAMPLE 2: The Various Cost Curves Together



Very Important Points

- FC(Fixed Cost)always fixed, even when output (Q) is zero there will be FC.
- VC(Variable Cost)is depends on the Q, If Q $\uparrow$ then VC. $\uparrow$
- If Q is zero then VC also Zero
- TC = VC+FC
- FC = TC -VC
- VC = TC -FC
- ATC=TC/Q or AVC + AFC.
- AFC is Average Fixed Cost for one good (Q)= FC/Q
- AVC is Average Variable Cost for one good (Q)=VC/Q
- MC = Change in TC/Change in Q

Q	FC	VC	TC
0	10		
1		1	
2		3	13
3		6	16
4		10	
5			25
6		21	31

Q	FC	VC	TC
0	10	0	10
1	10	1	11
2	10	3	13
3	10	6	16
4	10	10	20
5	10	15	25
6	10	21	31

Q	TC	FC	VC	MC
0	50			
1	80			
2	130			
3	170			
4	190			
5	210			
6	250			
7	300			
8	330			
9	370			
10	420			

Q	TC	FC	VC	MC
0	50	50	0	
1	80	50	30	30
2	130	50	80	50
3	170	50	120	40
4	190	50	140	20
5	210	50	160	20
6	250	50	200	40
7	300	50	250	50
8	330	50	280	30
9	370	50	320	40
10	420	50	370	50

Q	TC	FC	VC	AFC	AVC	ATC (Ac)	MC
0	40						
1	70						
2	100						
3	140						
4	160						
5	190						
6	220						
7	280						
8	310						
9	350						
10	400						

Q	TC	FC	VC	AFC	AVC	ATC (Ac)	MC
0	40	40	0				
1	70	40	30	40.0	30.0	70.0	30
2	100	40	60	20.0	30.0	50.0	30
3	140	40	100	13.3	33.3	46.7	40
4	160	40	120	10.0	30.0	40.0	20
5	190	40	150	8.0	30.0	38.0	30
6	220	40	180	6.7	30.0	36.7	30
7	280	40	240	5.7	34.3	40.0	60
8	310	40	270	5.0	33.8	38.8	30
9	350	40	310	4.4	34.4	38.9	40
10	400	40	360	4.0	36.0	40.0	50

Q	TC	TFC/FC	TVC/VC	AFC	AVC	ATC	MC
0	25						
1	40						
2	70						
3	100						
4	130						
5	150						
6	170						
7	210						
8	240						

Q	TC	TFC/FC	TVC/VC	AFC	AVC	ATC	MC
0	25	25	0				
1	40	25	15	25	15.0	40	15
2	70	25	45	12.5	22.5	35	30
3	100	25	75	8.3	25.0	33.3	30
4	130	25	105	6.3	26.3	32.5	30
5	150	25	125	5.0	25.0	30.0	20
6	170	25	145	4.2	24.2	28.3	20
7	210	25	185	3.6	26.4	30.0	40
8	240	25	215	3.1	26.9	30.0	30

CHAPTER 3

THEORY OF PRODUCTION AND COST

DEFINITION OF PRODUCTION

Definition

- **Production** means the process of using the factor of production to produce goods and services.
- ***Production*** is the process of transforming inputs into outputs.

INPUTS

Inputs refers to the factors of production that a firm use in the production process.

→ **Processing** →

OUTPUTS

Refers to what we get at the end of the production process that is finished products.

LAND

LABOUR

CLASSIFICATION OF FACTORS OF PRODUCTION

CAPITAL

ENTREPRENEUR

LAND
All natural resources or gift of nature

LABOUR
Physical or mental activities of human beings

CLASSIFICATION OF FACTORS OF PRODUCTION

CAPITAL
Part of man-made wealth used for further production

ENTREPRENEUR
A person who combines the different factors of production, and initiates the process of production and also bears the risk

LAND

1) Land is the original and primary factor of production.

2) Without land the production process cannot exceed further.

3) In Economics all the natural resources that are available –

   a) on the surface of the earth

   b) below the surface of the earth

   c) above the surface of the earth

   and which are used in the production process is called LAND.

LABOU R

1) Labour is a human factor of production.

2) In economics labour is defined as- "Economic activity of man with HEAD and HAND."

3) LABOUR is human factor of any kind, manual or mental,skilled or unskilled, scientific or artistic undertaken with a view of creating or adding utility.

Capital

1) Capital is a man-made resource of production used to produce further wealth.
2) It refers to the stock of capital assets such as factories,machines, tools & equipments, raw material, transport vehicles etc...
3) Therefore capital is defined as "Produced means of production"

Entreprenuer

1) Entreprenuer is a person who brings in land, labour & capital in one place & uses it for the production process.

2) He is the person who decides-

a) What to produce?

b) How to produce?

c) Where to produce?

3) The person who takes these decisions along with the risk associated with them is known as 'Entreprenuer'.

Short run period

- the time frame in which at least one of the inputs (factors of production) is fixed but the other inputs are varied. The example of short-run is building, equipment, tools, and others.

Long-run period

- the time frame in which all inputs are variable.

Fixed input

- an input in which the quantity does not change according to output. For example, machinery, land, building, tools, equipment, etc.

Variable input

- an input in which the quantity changes according to output. For example, raw materials, transportation, communication, etc.

LONG RUN PRODUCTION FUNCTION

- A production function is a statement of the functional relationship between inputs and outputs, where it shows the maximum output that can be produced with given inputs.

$$Q = f(N, K, L, R, etc.)$$

- Where: Q = Output

  N = Land

  K = Capital

  L = Labour

  R = Raw Material

SHORT-RUN PRODUCTION FUNCTION

- In the short run, only variable factors will change.
- Therefore, in the short run the production function can be written as:

$$Q = f(L, R)$$

Where: Q = Output

L = Labor

R = Raw material

SHORT-RUN PRODUCTION FUNCTION (cont.)

TOTAL PRODUCT (TP)

The amount of output produced by utilizing all labor available to Producer

AVERAGE PRODUCT (AP)

Divide the total product by the amount of that input used in the production

$$\textbf{Average Product } (AP_L) = \frac{\textbf{Total Product}}{\textbf{Total Labour}}$$

$$AP_L = TP/L$$

SHORT-RUN PRODUCTION FUNCTION (cont.)

MARGINAL PRODUCT (MP)

It Change in the total product of that input corresponding to an addition unit change in its labour, assuming other factors that is capital fixed.

It is a Additional Product from additional Labor

$$\textbf{Marginal Product } (MP_L) = \frac{\textbf{Change in Total Product}}{\textbf{Change in Total Labour}}$$

$$MP_L = \Delta TP / \Delta L$$

EXAMPLE 1: Marginal Product (MP)

	L (Labour)	Total Product (TP)		Marginal Product (*MP*)
	0	1,000		
Δ***L*** = 1000			Δ**TP** = $2000	2.00
	1000	3,000		
Δ***L*** = 800			Δ**TP** = $2000	2.50
	1800	5,000		
Δ***L*** = 600			Δ**TP** = $2000	3.33
	2400	7,000		
Δ***L*** = 400			Δ**TP** = $2000	5.00
	2800	9,000		
Δ***L*** = 200			Δ**TP** = $2000	10.00
	3000	11,000		

	Labour (Variable input)	Total Product	Marginal Product	Average Product
	0	0		
	1	8		
	2	20		
	3	33		
	4	44		
	5	50		
	6	54		
	7	56		
	8	56		
	9	54		
	10	50		

	Labour (Variable input)	Total Product	Marginal Product	Average Product
	0	0	0	0
	1	8	8	8
	2	20	12	10
	3	33	13	11
	4	44	11	11
	5	50	6	10
	6	54	4	9
	7	56	2	8
	8	56	0	7
	9	54	-2	6
	10	50	-4	5

$$MP = \frac{54 - 56}{9 - 8} = -2$$

$$AP = \frac{56}{8} = 7$$

LAW OF DIMINISHING MARGINAL RETURNS

- *Also called* ***Law of Variable proportion***
-
- "Law of diminishing marginal returns states that as more of a variable input is used while other inputs and technology are fixed, the marginal product of the variable input will eventually decline".

Assumptions

(i) Constant Technology

(ii) One factor is variable while others are fixed

(iii) Labor is Homogeneous

(iv) Short-Run

	Labour (Variable input)	Total Product	Marginal Product	Average Product	Stages of Production
	0	0			STAGE I
	1	8			
	2	20			
	3	33			
	4	44			
	5	50			STAGE II
	6	54			
	7	56			
	8	56			
	9	54			STAGE III
	10	50			

	Labour (Variable input)	Total Product	Marginal Product	Average Product	Stages of Production
	0	0	0	0	
	1	8	8	8	
	2	20	12	10	STAGE I
	3	33	13	11	
	4	44	11	11	
	5	50	6	10	
	6	54	4	9	STAGE II
	7	56	2	8	
	8	56	0	7	
	9	54	-2	6	STAGE III
	10	50	-4	5	

$$MP = \frac{54 - 56}{9 - 8} = -2$$

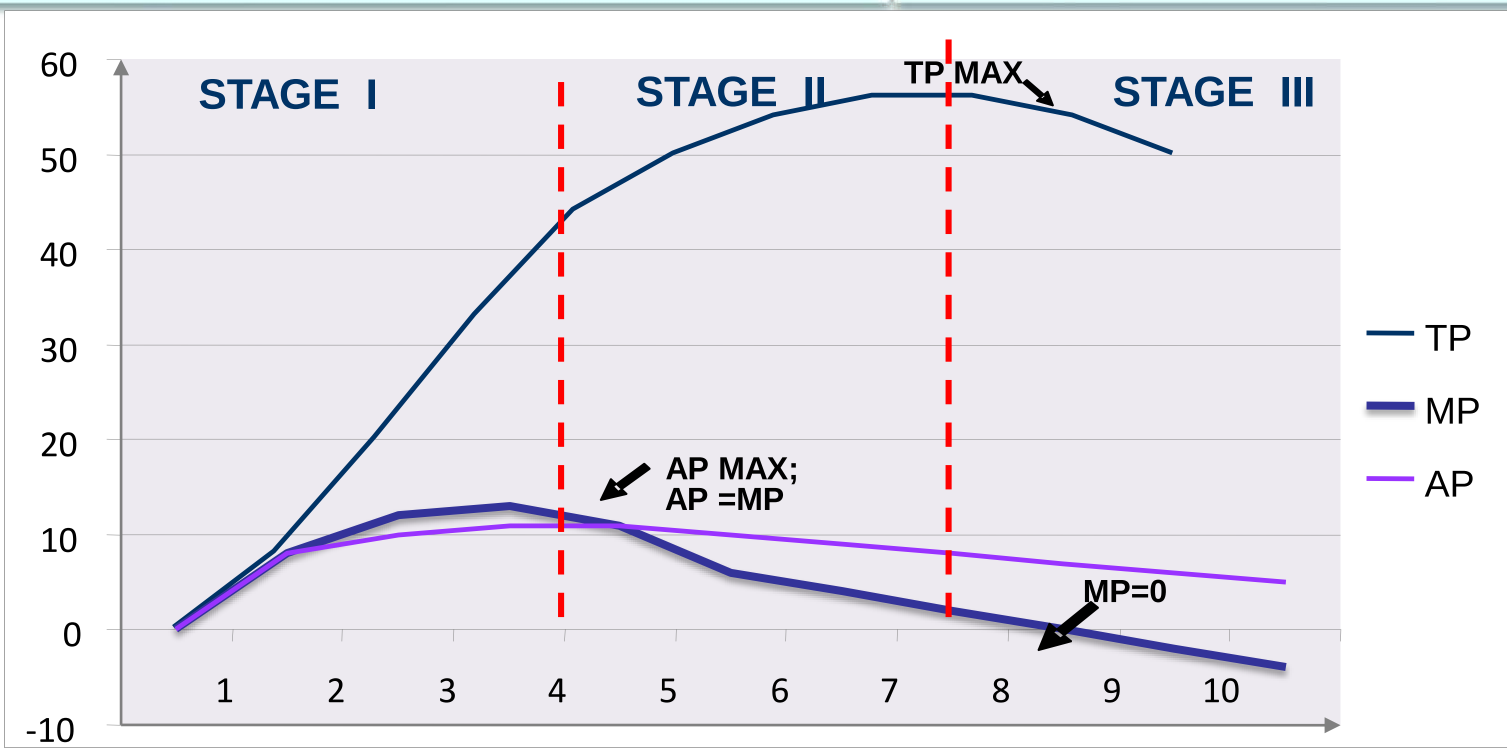
$$AP = \frac{56}{8} = 7$$

RELATIONSHIP BETWEEN TP AND MP

When ***MP*** is *increasing*, ***TP*** increase at an *increasing rate*.
When ***MP** is decreasing*, ***TP*** increase at a *decreasing rate*.
When ***MP** is zero*, ***TP*** at its *maximum*.
When ***MP** is negative*, ***TP*** *declines*.

RELATIONSHIP BETWEEN AP AND MP

When ***MP*** is above ***AP*** , ***AP*** is *increasing*
When ***MP*** is below ***AP***, ***AP*** is *decreasing.*
When ***MP*** equals to ***AP***, ***AP*** is at *maximum.*



THEORY OF PRODUCTION

Total Product	Marginal Product	Average Product
Stage I		
First increases at increasing rate then at diminishing rate.	Increases in the beginning then reaches a maximum and begins to decrease.	First increases, continues to increase and becomes maximum.
Stage II		
Continues to increase at diminishing rate and becomes maximum.	Continues to diminish and becomes equal to zero.	Becomes equal to MP and then begins to diminish.
Stage III		
Diminishes	Becomes negative.	Continues to diminish but will always be greater than zero.

Rational Decision

- Stage II becomes the relevant and important stage of production.
- Production will not take place in either of the other two stages.
- It means production will not take place in stage III and stage I.
- Thus, a rational producer will operate in stage II

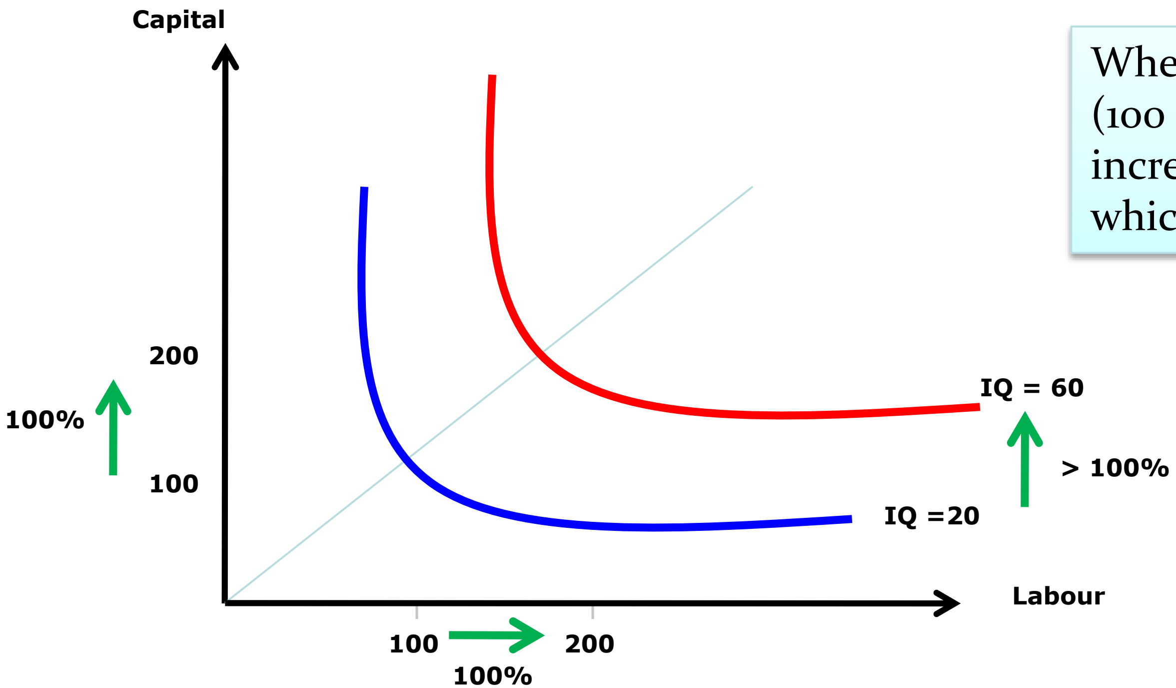
LAW OF RETURNS TO SCALE

- Based on long run
- "The term returns to scale refers to the changes in output as all factors change by the same proportion."
- Returns to scale are of the following three types:
- 1. Increasing Returns to scale (%I < %O)
- 2. Constant Returns to Scale (%I = % O)
- 3. Diminishing Returns to Scale (%I > % O)

LAW OF RETURNS TO SCALE

INCREASING RETURNS TO SCALE

All the factors of production are increased in a given proportion, output would increase by a greater proportion.



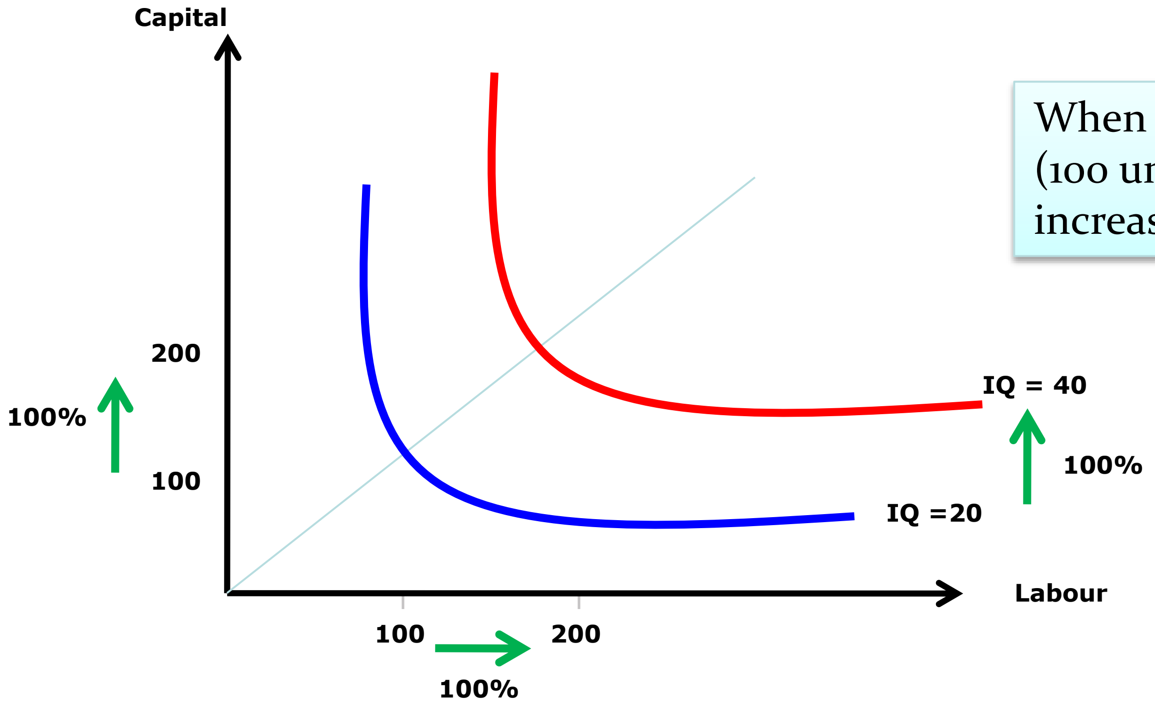
When labour and capital are doubled (100 units to 200 units), output increases from 20 units to 60 units, which is more than double.

The causes of increasing returns to scale are specialization, technical economies, managerial economies which are also known as **economies of scale**.

LAW OF RETURNS TO SCALE (cont.)

CONSTANT RETURNS TO SCALE

All the factors of production are increased in a given proportion, output would increase by same proportion.

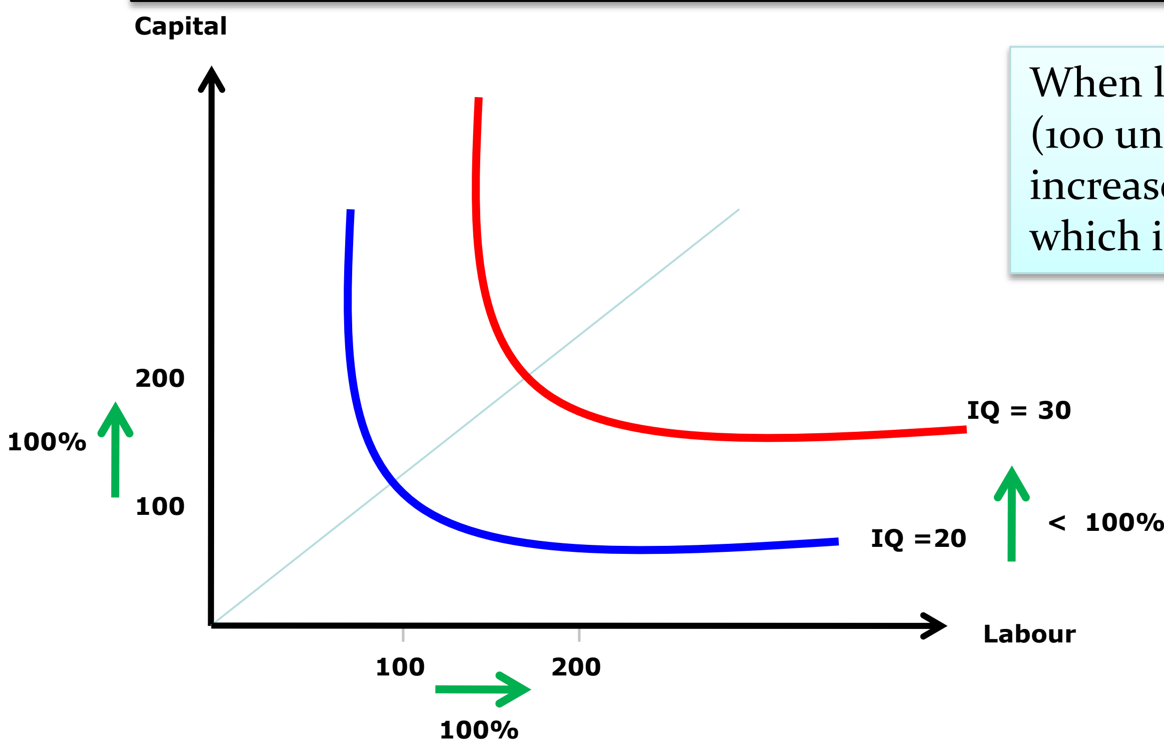


When labour and capital are doubled (100 units to 200 units), output increases from 20 units to 40 units.

LAW OF RETURNS TO SCALE (cont.)

DECREASING RETURNS TO SCALE

All the factors of production are increased in a given proportion, output would increase by a smaller proportion.



When labour and capital are doubled (100 units to 200 units), output increases from 20 units to 30 units, which is less than double.

The causes of decreasing returns to scale are internal and external diseconomies of scale.

Difference between law of variable proportion and returns to scale

Basis of difference	Law of variable proportions	Law of return to scale
Variable and fixed factors	Only variable factors are changed and fixed factors remain the same.	All the factors are increased simultaneously.
Stages	There are three stages: * Increasing returns * Diminishing returns * Negative returns	There are three stages: * Increasing returns * Constant returns * Decreasing returns
Time period	Applies in the short run.	Applies in the long run.

ISOQUANT ANALYSIS

- **ISOQUANT ANALYSIS**
  - An **isoquant** **or** **iso-product** represents all the possible combination of two factor inputs, which gives the same level of output (total product).
  - Represents all the possible combinations of variable inputs that used to generate the same level of output (total product).
  - LONG-RUN PRODUCTION

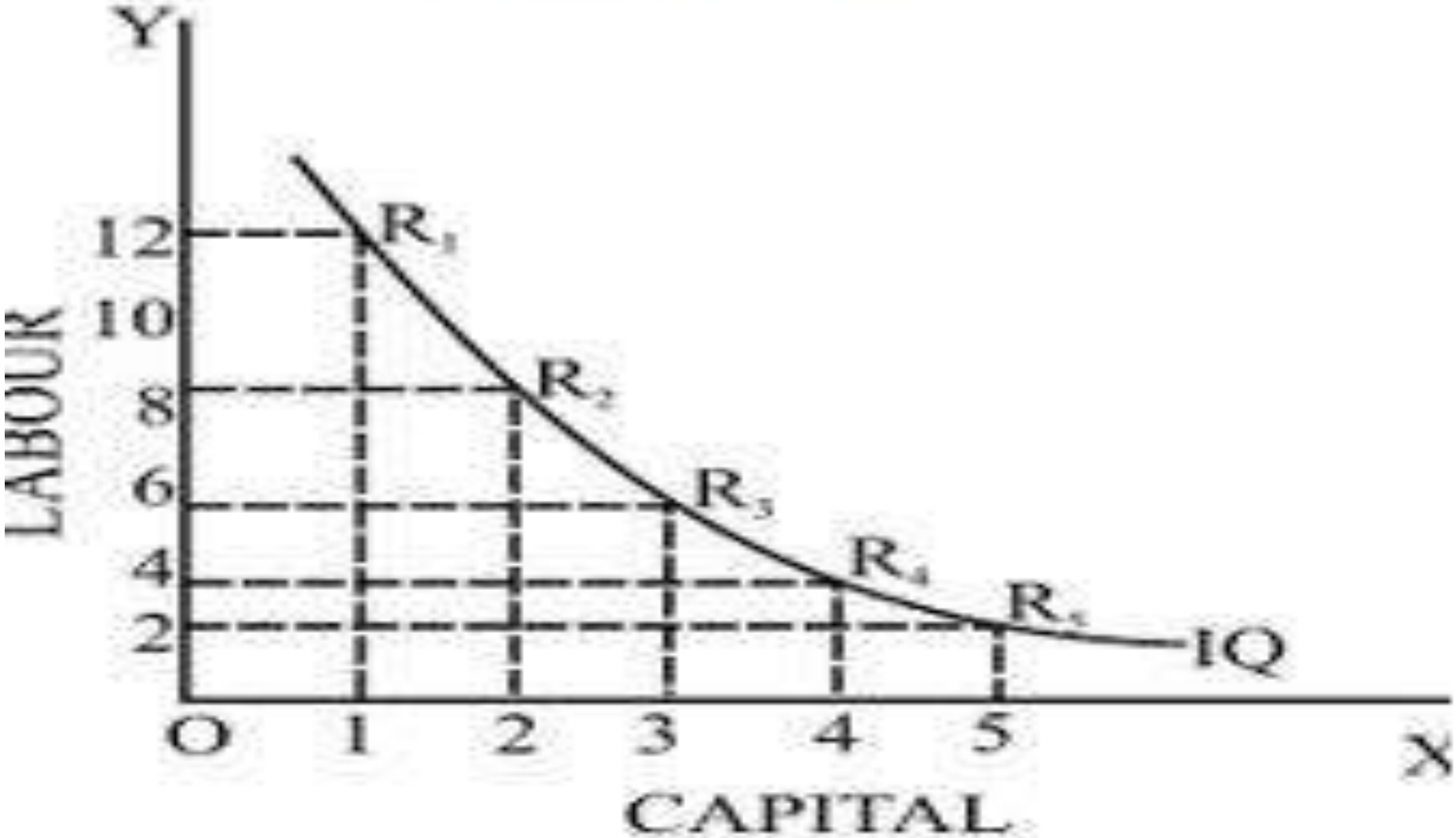
Assumptions

- Only two inputs (labor and capital) are employed to produce a good.
- There is technical possibility of substituting one input for another.
- Resources being constant
- State of technology is given and unchanged.

Table : Production with two variable inputs

Combination	Units of capital	Units of Labour	Output in units
A	1	12	1000
B	2	8	1000
C	3	5	1000
D	4	3	1000
E	5	2	1000

Isoquant Curve

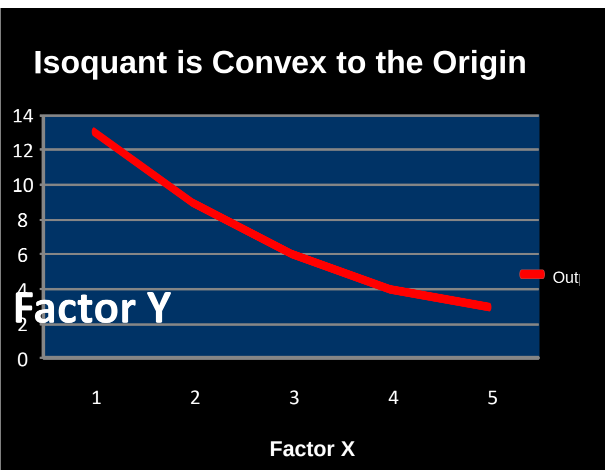


FIGURE

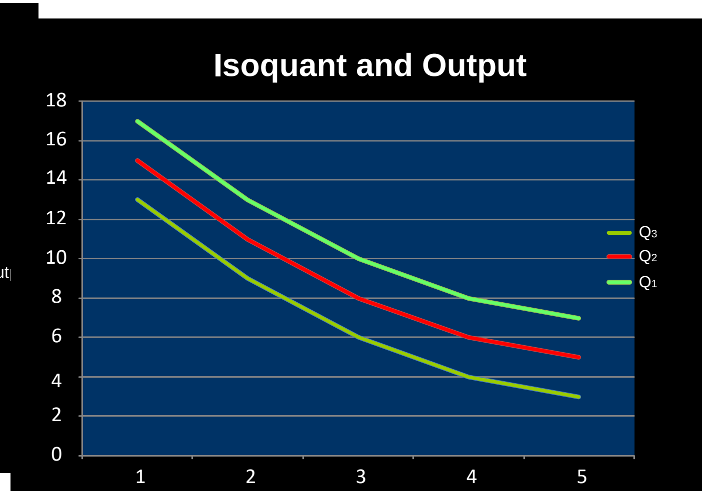
LONG-RUN PRODUCTION FUNCTION (cont.)

❑ Characteristics of Isoquant Curve

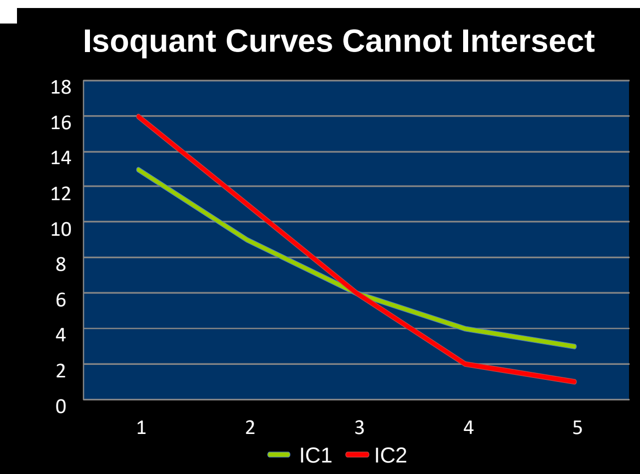
1. *Isoquant curve slope downward from left to right. (Figure A)*
2. *Isoquant curve are convex to the origin. (Figure A)*
3. *An isoquant lying to the right represents a larger output. (Figure B)*
4. *Isoquant curve never intersect each other. (Figure C)*



A



B



C

CHAPTER 3

Production and Costs

Part 1

Production Function – Variable proportions and Returns to Scale

SHORT-RUN AND LONG-RUN PRODUCTION FUNCTION

- **Two Types of Factor Inputs**
  - **Fixed Input**
    - An input which the quantity **does not change** according to the amount of **output**.
    - Example: Machinery, land, buildings, tools, equipment, etc.
  - **Variable Input**
    - An input which the quantity **changes** according to the amount of **output**.
    - Example: Raw materials, electricity, fuel, transportation, communication, etc.
- **Short-run and Long-run Periods**
  - ***Short run*** period is the time frame, which at least one of the inputs (factor of production) is ***fixed*** and other inputs can be varied.
  - ***Long run*** period is the time frame which all inputs are ***variable***.

SHORT-RUN PRODUCTION FUNCTION

- In the short run, we assume that at least one of the inputs is fixed that is capital.
- Therefore, in the short run the production function can be written as:

$$Q = f(L)$$

Where: Q = Output

L = Labor

SHORT-RUN PRODUCTION FUNCTION (cont.)

TOTAL PRODUCT (TP)

The amount of output produced when a given number of labor is used along with fixed inputs.

AVERAGE PRODUCT (AP)

Divide the total product by the amount of that input used in the production

$$\text{Average Product } (AP_L) = \frac{\text{Total Product}}{\text{Total Labour}}$$

$$AP_L = TP/L$$

SHORT-RUN PRODUCTION FUNCTION (cont.)

MARGINAL PRODUCT (MP)

Change in the total product of that input corresponding to an addition unit change in its labour, assuming other factors that is capital fixed.

$$\textbf{Marginal Product } (MP_L) = \frac{\textbf{Change in Total Product}}{\textbf{Change in Total Labour}}$$

$$MP_L = \Delta TP / \Delta L$$

LAW OF DIMINISHING MARGINAL RETURNS

- It states that if the quantities of certain factors (inputs) are increased while the quantities of one or more factors (inputs) are held constant, beyond a certain level of production, the rate of increase in output will decrease.

OR

- *"*Law of diminishing marginal returns states that as more of a variable input is used while other input and technology are fixed, the marginal product of the variable input will eventually decline".

Assumptions

(i) Constant Technology:

- The state of technology is assumed to be given and constant. If there is an improvement in technology the production function will move upward.

(ii) Factor Proportions are Variable:

- The law assumes that factor proportions are variable. If factors of production are to be combined in a fixed proportion, the law has no validity.

(iii) Homogeneous Factor Units:

- The units of variable factor are homogeneous. Each unit is identical in quality and amount with every other unit.

(iv) Short-Run:

- The law operates in the short-run when it is not possible to vary all factor inputs.

Capital (Fixed input)	Labour (Variable input)	Total Product	Marginal Product	Average Product	Stages of Production
10	0	0	0	0	STAGE I
10	1	8	8	8	
10	2	20	12	10	
10	3	33	13	11	
10	4	44	11	11	
10	5	50	6	10	STAGE II
10	6	54	4	9	
10	7	56	2	8	
10	8	56	0	7	
10	9	54	-2	6	STAGE III
10	10	50	-4	5	

$$MP = \frac{54 - 56}{9 - 8} = -2$$

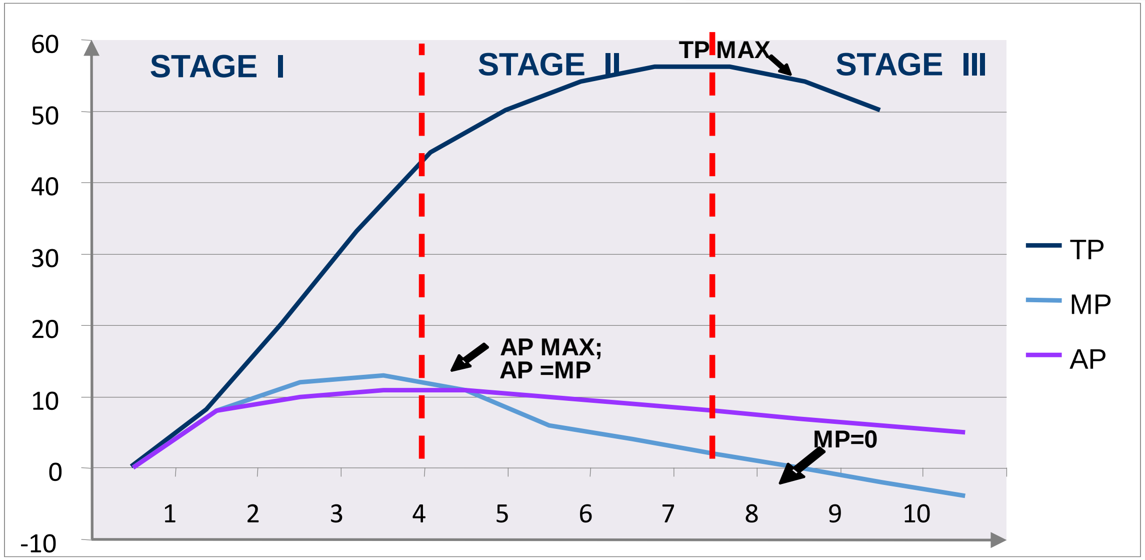
$$AP = \frac{56}{8} = 7$$

THEORY OF PRODUCTION

Properties and Relationships between TP, AP and MP

RELATIONSHIP BETWEEN TP AND MP
When ***MP*** is *increasing*, ***TP*** increase at an *increasing rate*.
When ***MP*** *is decreasing*, ***TP*** increase at a *decreasing rate*.
When ***MP*** *is zero*, ***TP*** at its *maximum*.
When ***MP*** *is negative*, ***TP*** *declines*.

RELATIONSHIP BETWEEN AP AND MP
When ***MP*** is above ***AP*** , ***AP*** is *increasing*
When ***MP*** is below ***AP***, ***AP*** is *decreasing.*
When ***MP*** equals to ***AP***, ***AP*** is at *maximum.*



THEORY OF PRODUCTION

Increasing returns

- It becomes cheaper to produce the additional output
- Thus, the producer will always expand through this stage

Causes

- Fixed factor is used more intensively and production increases rapidly.
- Division of labour and specialization
- The fixed factors are indivisible and which means they must be used in an fixed minimum size.

Diminishing returns

- This is the stage in which production is feasible and more profitable
- In this stage the marginal productivity of labour is positive though, it is diminishing but is non-negative

Causes

- The distribution in the combination of factors
- Control and supervision becomes difficult
- There may be shortage of trained labour or raw materials

Negative returns

- It clearly shows loss and no business would like to operate in this stage
- Stage II is the best because it utilizes the resources / inputs very well.

Total Product	Marginal Product	Average Product
Stage I		
First increases at increasing rate then at diminishing rate.	Increases in the beginning then reaches a maximum and begins to decrease.	First increases, continues to increase and becomes maximum.
Stage II		
Continues to increase at diminishing rate and becomes maximum.	Continues to diminish and becomes equal to zero.	Becomes equal to MP and then begins to diminish.
Stage III		
Diminishes	Becomes negative.	Continues to diminish but will always be greater than zero.

Rational Decision

- Stage II becomes the relevant and important stage of production.
- Mainstream production will not take place in either of the other two stages.
- Thus, a rational producer will operate in stage II

SHORT-RUN PRODUCTION FUNCTION (cont.)

Stage I

- Proportion of fixed factors are greater than variable factors
- Under utilization of fixed factor
- Operation involves a waste of resources

Stage II

- Called law of diminishing returns
- The most efficient stage of production because the combinations of inputs are fully utilized

STAGES OF PRODUCTION

Stage III

- Proportion of fixed factors is lower than variable factors
- Increase in variable factors decline the TP because of overcrowding
- A producer would not like to operate at this stage

THEORY OF PRODUCTION

LONG-RUN PRODUCTION FUNCTION

- **ISOQUANT ANALYSIS**
  - An isoquant or iso-product represents all the possible combination of two factor inputs, which gives the same level of output (total product).
  - Represents all the possible combinations of variable inputs that used to generate the same level of output (total product).

LONG-RUN PRODUCTION FUNCTION (cont.)

ISOQUANT SCHEDULE
Production with two variable inputs

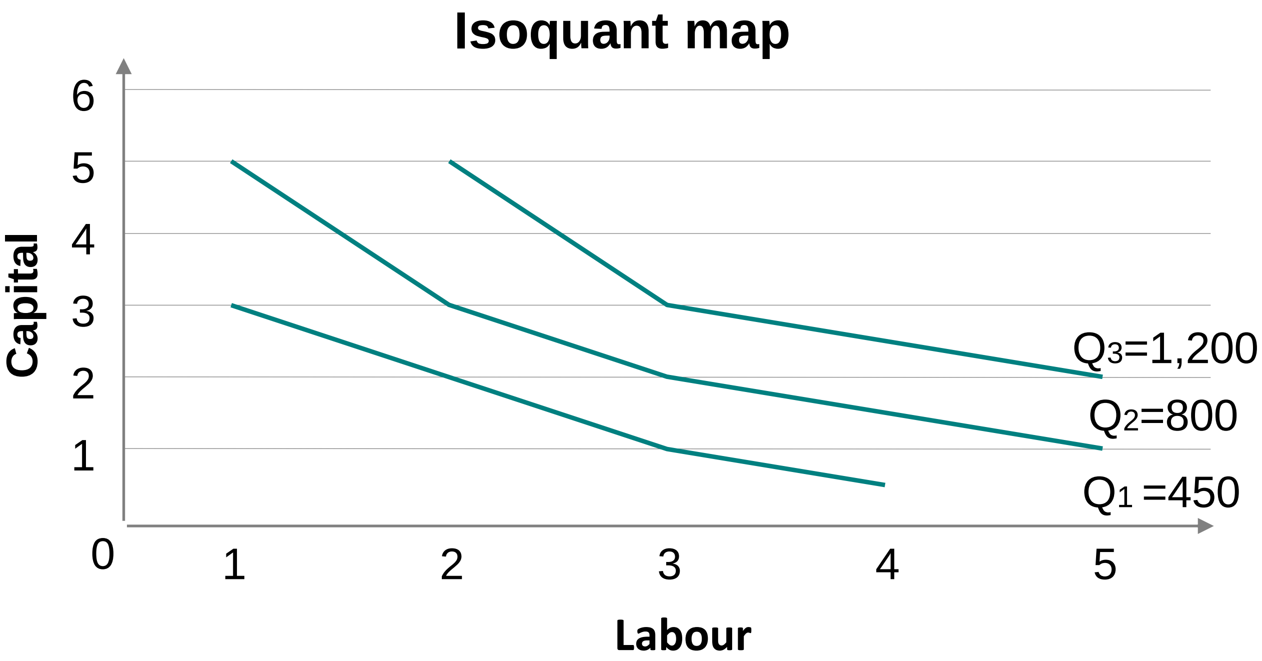
Capital	Labour				
	1	**2**	3	4	5
1	250	450	550	700	800
2	450	650	800	900	950
3	600	800	950	1050	1100
4	700	900	1050	1150	1200
5	800	950	1100	1200	1250

There are various combination of capital and labour. Using 2 units of capital and 2 units of labour, the total output would be 650 units. If a firm needs 900 units of output, there are a few combinations such as 2 labour and 4 capital or 4 labour with 2 capital.

LONG-RUN PRODUCTION FUNCTION (cont.)

- **Isoquant Map**
  - Refers to a number of isoquants that are combined in a single graph.
  - Can be used to estimate the maximum attainable output from different combinations of inputs.
  - higher isoquant curve represents a higher level of output.

LONG-RUN PRODUCTION FUNCTION (cont.)



LONG-RUN PRODUCTION FUNCTION (cont.)

Marginal Rate of Technical Substitution

- The technique to estimate the amount of capital input to be replaced by labour input without increasing or decreasing output.

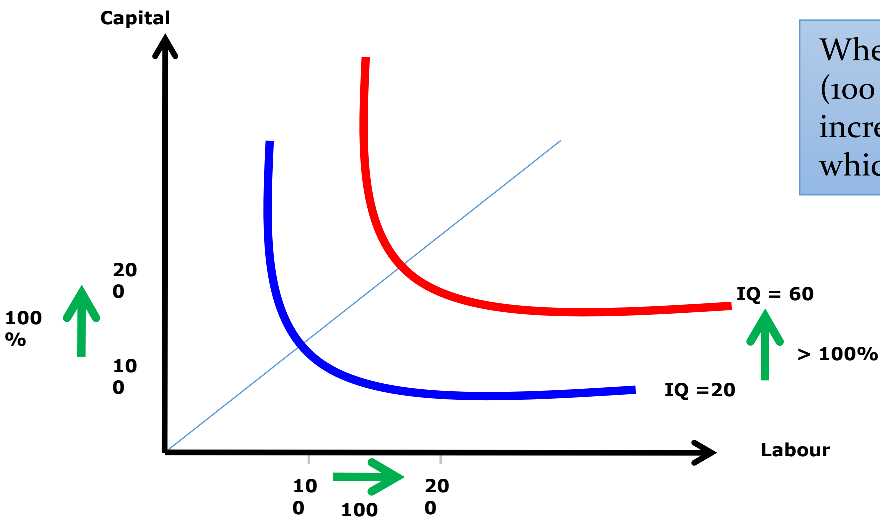
$$\text{MRTS} = - \frac{\text{Change in Capital}}{\text{Change in Labour}}$$

$$\text{MRTS} = - \Delta K / \Delta L$$

SCALE OF PRODUCTION

INCREASING RETURNS TO SCALE

- ***All the factors of production are increased in a given proportion, output would increase by a greater proportion.***



When labour and capital are doubled (100 units to 200 units), output increases from 20 units to 60 units, which is more than double.

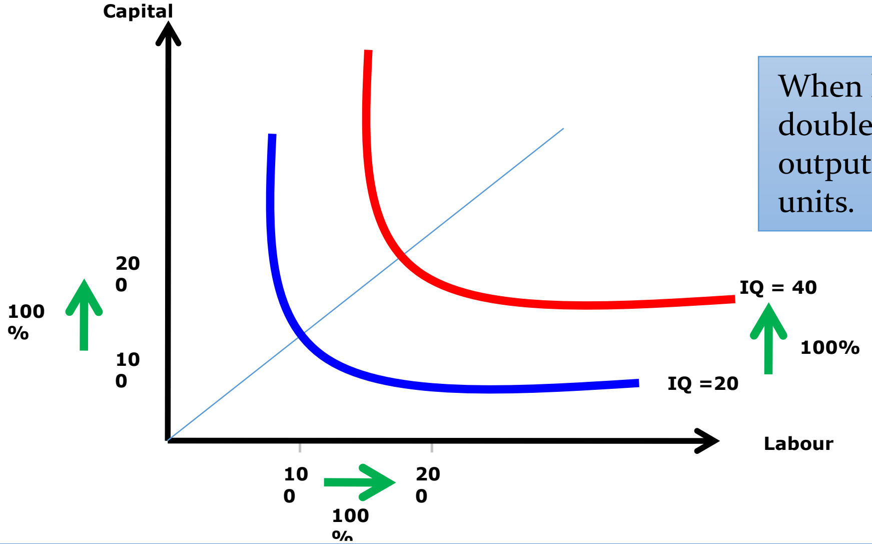
The causes of increasing returns to scale are specialization, technical economies, managerial economies which are also known as **economies of scale**.

THEORY OF PRODUCTION

SCALE OF PRODUCTION (cont.)

CONSTANT RETURNS TO SCALE

- ***All the factors of production are increased in a given proportion, output would increase by same proportion.***

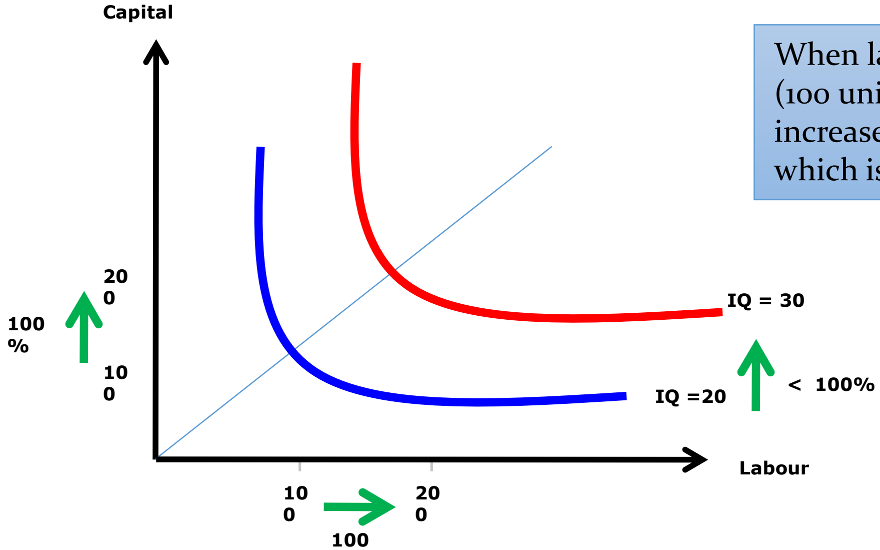


When labour and capital are doubled (100 units to 200 units), output increases from 20 units to 40 units.

SCALE OF PRODUCTION (cont.)

DECREASING RETURNS TO SCALE

- ***All the factors of production are increased in a given proportion, output would increase by a smaller proportion.***



When labour and capital are doubled (100 units to 200 units), output increases from 20 units to 30 units, which is less than double.

The causes of decreasing returns to scale are internal and external diseconomies of scale.

Economies of Scale

Economies of Scale

- As businesses grow – costs of production decrease
- Bigger businesses gain some advantages over smaller businesses through Economies of Scale
- There are two types of Economies of Scale:
  - Internal Economies
  - External Economies

Internal and External Economies

Internal Economies

- Those Specifically related to the business itself eg:-

1. Production
2. Purchasing
3. Marketing
4. Financial
5. Managerial

External Economies

- Benefits the whole industry and not specific firms

1. Skilled labour in the area
2. Better road and rail networks
3. Improves the reputation of the area
4. Attracts other businesses

Economies of Scale

- The advantages of large scale production that result in lower unit (average) costs (cost per unit)
- $AC = TC / Q$
- Economies of scale – spreads total costs over a greater range of output

Economies of Scale

- **Internal: Technical**
  - Specialisation – large organisations can employ specialised labour
  - Indivisibility of plant – machines can’t be broken down to do smaller jobs!
  - Principle of multiples – firms using more than one machine of different capacities - more efficient
  - Increased dimensions – bigger containers can reduce average cost

Economies of Scale

- **Indivisibility of Plant:**
- Not viable to produce products
  like oil, chemicals on small scale – need large amounts of capital
- Agriculture – machinery appropriate for large scale work – combines, etc.

Economies of Scale

- **Principle of Multiples:**
- Some production processes need more than one machine
- Different capacities
- May need more than one machine to be fully efficient

Economies of Scale

- **Commercial**
- Large firms can negotiate favourable prices as a result of buying in bulk
- Large firms may have advantages in keeping prices higher because of their market power

Economies of Scale

- **Financial**
- Large firms able to negotiate cheaper finance deals
- Large firms able to be more flexible about finance – share options, rights issues, etc.
- Large firms able to utilise skills of merchant banks to arrange finance

Economies of Scale

- **Managerial**
  - Use of specialists – accountants, marketing, lawyers, production, human resources, etc.

Economies of Scale

- **Risk Bearing**
  - Diversification
  - Markets across regions/countries
  - Product ranges
  - R&D

Diseconomies of Scale

- **The disadvantages of large scale production that can lead to increasing average costs**
  - Problems of management
  - Maintaining effective communication
  - Co-ordinating activities – often across the globe!
  - De-motivation and alienation of staff
  - Divorce of ownership and control

Part 2

Concepts of Costs, Short-run and Long-run

In this part, look for the answers to these questions:

- What are the various costs, and how are they related to each other and to output?
- How are costs different in the short run vs. the long run?
- What are “economies of scale”?

Total Revenue, Total Cost, Profit

- We assume that <u>the firm's goal is to maximize profit</u>.

Profit = Total revenue – Total cost

Total revenue: the amount a firm receives from the sale of its output

Total cost: the market value of the inputs a firm uses in production

Costs: Explicit vs. Implicit

- **Explicit costs** require an outlay of money, *e.g.*, paying wages to workers.
- **Implicit costs** do not require a cash outlay, *e.g.*, the opportunity cost of the owner's time.
- One of the Ten Principles:

  The cost of something is
  what you give up to get it.
- This is true whether the costs are implicit or explicit. Both matter for firms' decisions.

Explicit vs. Implicit Costs: An Example

You need $100,000 to start your business.
The interest rate is 5%.

- Case 1: borrow $100,000
  - explicit cost = $5000 interest on loan
- Case 2: use $40,000 of your savings, borrow the other $60,000
  - explicit cost = $3000 (5%) interest on the loan
  - implicit cost = $2000 (5%) *foregone* interest you could have earned on your $40,000.

In both cases, total (exp + imp) costs are $5000.

Economic Profit vs. Accounting Profit

- **Accounting profit**
  = total revenue minus total explicit costs
- **Economic profit**
  = total revenue minus total costs (including explicit and implicit costs)
- Accounting profit ignores implicit costs, so it's higher than economic profit.

ACTIVE LEARNING 2

Economic profit vs. accounting profit

The equilibrium rent on office space has just increased by $500/month.

Compare the effects on accounting profit and economic profit if

- **a.** you rent your office space
- **b.** you own your office space

ACTIVE LEARNING 2
Answers

The rent on office space increases $500/month.

a. You rent your office space.
Explicit costs increase $500/month.
Accounting profit & economic profit each fall $500/month.

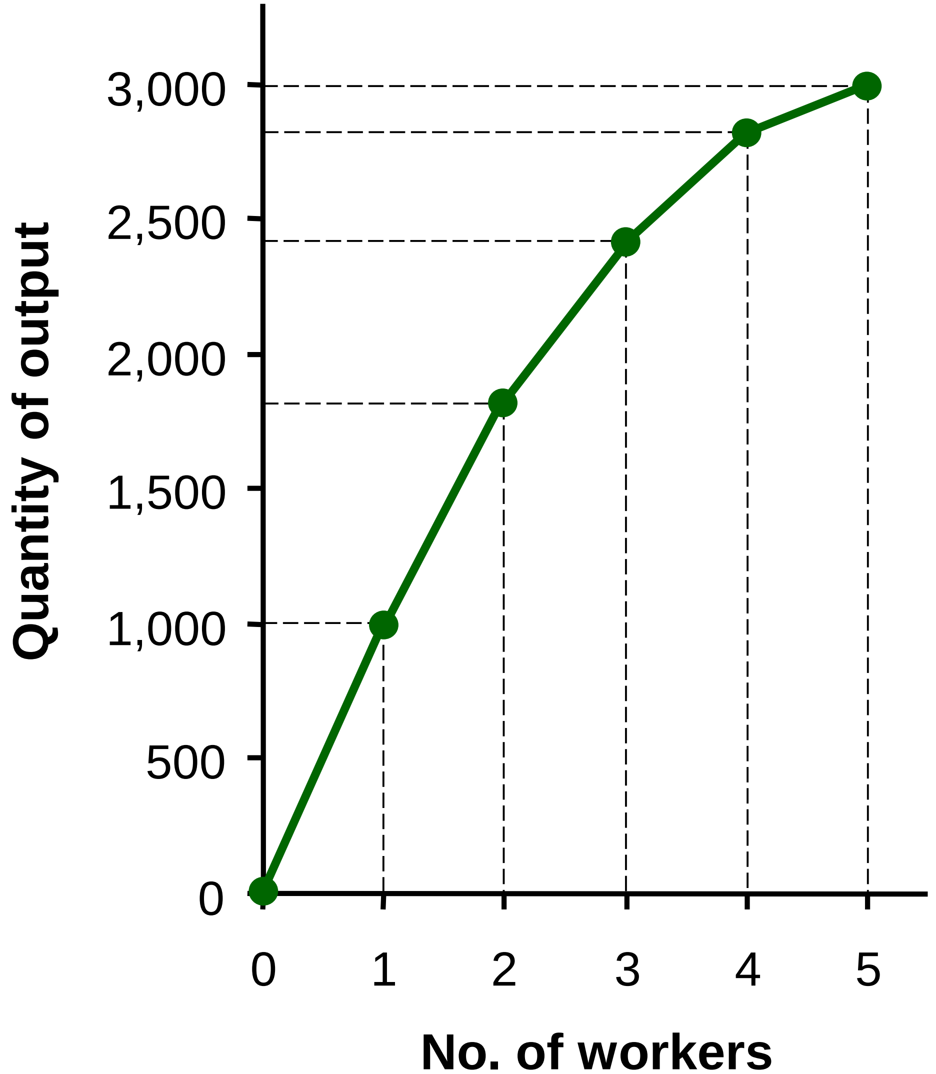
b. You own your office space.
Explicit costs do not change,
so accounting profit does not change.
Implicit costs increase $500/month (opp. cost of using your space instead of renting it),
so economic profit falls by $500/month.

The Production Function

- A **production function** shows the relationship between the quantity of inputs used to produce a good and the quantity of output of that good.
- It can be represented by a table, equation, or graph.
- Example 1:
  - Farmer Jack grows wheat.
  - He has 5 acres of land.
  - He can hire as many workers as he wants.

Example 1: Farmer Jack's Production Function

L (no. of workers)	***Q*** (bushels of wheat)
0	0
1	1000
2	1800
3	2400
4	2800
5	3000



Marginal Product

- If Jack hires one more worker, his output rises by the *marginal product of labor*.
- The **marginal product** of any input is the increase in output arising from an additional unit of that input, holding all other inputs constant.
- Notation:
  Δ (delta) = "change in…"

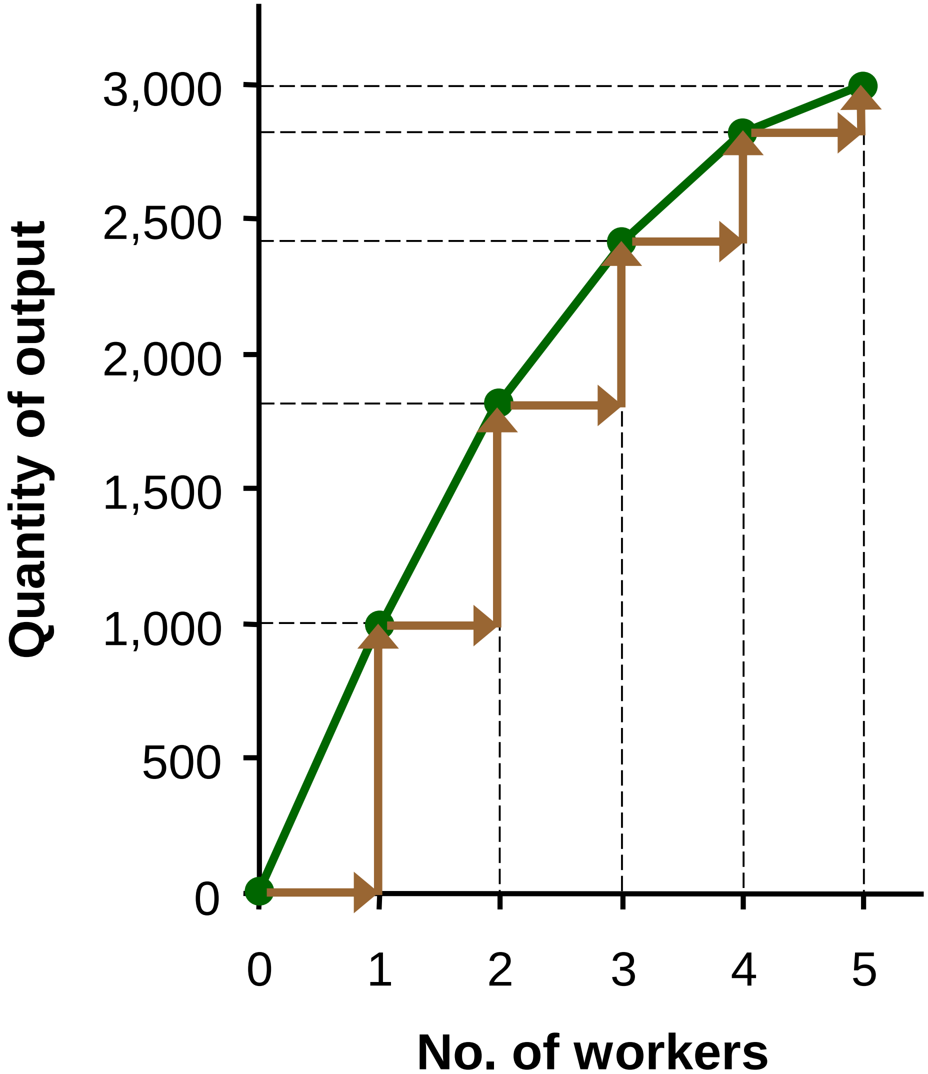
  Examples:
  $\Delta \boldsymbol{Q}$ = change in output, $\Delta \boldsymbol{L}$ = change in labor
- Marginal product of labor (*MPL*) = $\dfrac{\Delta \boldsymbol{Q}}{\Delta \boldsymbol{L}}$

EXAMPLE 1: Total & Marginal Product

	L (no. of workers)	***Q*** (bushels of wheat)		*MPL*
	0	0		
Δ***L*** = 1			Δ***Q*** = 1000	1000
	1	1000		
Δ***L*** = 1			Δ***Q*** = 800	800
	2	1800		
Δ***L*** = 1			Δ***Q*** = 600	600
	3	2400		
Δ***L*** = 1			Δ***Q*** = 400	400
	4	2800		
Δ***L*** = 1			Δ***Q*** = 200	200
	5	3000		

EXAMPLE 1: MPL = Slope of Prod Function

L (no. of workers)	***Q*** (bushels of wheat)	*MPL*
0	0	
		1000
1	1000	
		800
2	1800	
		600
3	2400	
		400
4	2800	
		200
5	3000	



EXAMPLE 1: Farmer Jack's Costs

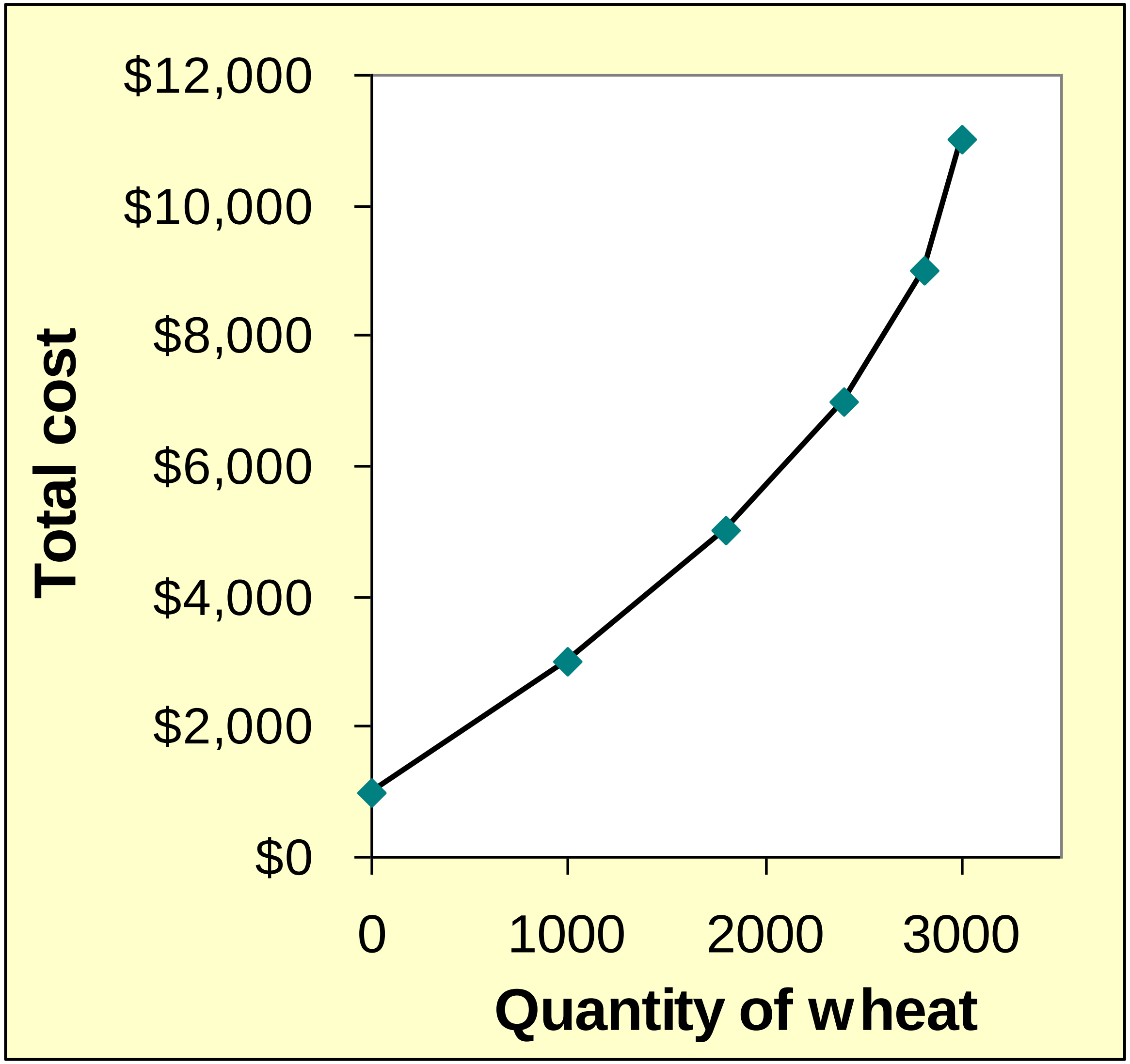
- Farmer Jack must pay $1000 per month for the land, regardless of how much wheat he grows.
- The market wage for a farm worker is $2000 per month.
- So Farmer Jack's costs are related to how much wheat he produces….

EXAMPLE 1: Farmer Jack's Costs

L (no. of workers)	***Q*** (bushels of wheat)	Cost of land	Cost of labor	Total Cost
0	0	$1,000	$0	$1,000
1	1000	$1,000	$2,000	$3,000
2	1800	$1,000	$4,000	$5,000
3	2400	$1,000	$6,000	$7,000
4	2800	$1,000	$8,000	$9,000
5	3000	$1,000	$10,000	$11,000

EXAMPLE 1: Farmer Jack's Total Cost Curve

Q (bushels of wheat)	Total Cost
0	$1,000
1000	$3,000
1800	$5,000
2400	$7,000
2800	$9,000
3000	$11,000



Marginal Cost

- **Marginal Cost** (*MC*)
  is the increase in Total Cost from producing one more unit:

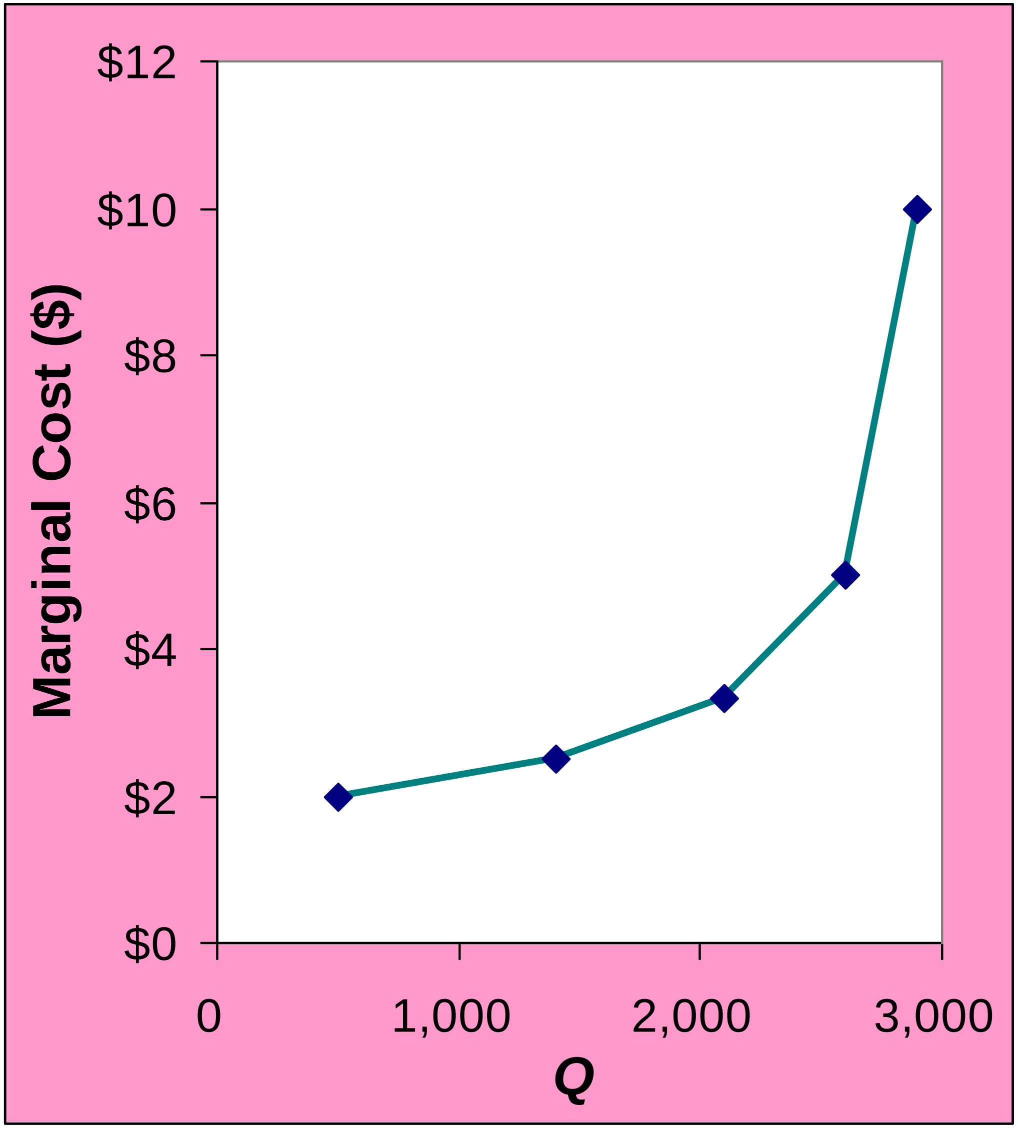
$$MC = \frac{\Delta TC}{\Delta Q}$$

EXAMPLE 1: Total and Marginal Cost

	Q (bushels of wheat)	Total Cost		Marginal Cost (*MC*)
	0	$1,000		
Δ***Q*** = 1000			Δ**TC** = $2000	$2.00
	1000	$3,000		
Δ***Q*** = 800			Δ**TC** = $2000	$2.50
	1800	$5,000		
Δ***Q*** = 600			Δ**TC** = $2000	$3.33
	2400	$7,000		
Δ***Q*** = 400			Δ**TC** = $2000	$5.00
	2800	$9,000		
Δ***Q*** = 200			Δ**TC** = $2000	$10.00
	3000	$11,000		

EXAMPLE 1: The Marginal Cost Curve

Q (bushels of wheat)	*TC*	*MC*
0	$1,000	
		$2.00
1000	$3,000	
		$2.50
1800	$5,000	
		$3.33
2400	$7,000	
		$5.00
2800	$9,000	
		$10.00
3000	$11,000	



Fixed and Variable Costs

- **Fixed costs (*FC*)** do not vary with the quantity of output produced.
  - For Farmer Jack, *FC* = $1000 for his land
  - Other examples:
    cost of equipment, loan payments, rent
- **Variable costs (*VC*)** vary with the quantity produced.
  - For Farmer Jack, *VC* = wages he pays workers
  - Other example: cost of materials
- **Total cost (*TC*)** = *FC* + *VC*

Importance of Various Costs

- Costs are a critical variable to consider when plotting business strategy. After all, if you can't recover the expenses required to create your product through revenue and profit, then the business just isn't viable.

- Yet costs change as a company grows.

- In most cases, expenses fall, relatively speaking, as volume rises. That's a key reason why businesses aim to ramp up their production as quickly as possible so they can achieve economies of scale. But that trend can't continue forever.

- That's where the concept of marginal cost comes into play. Simply put, marginal cost is the cost of producing one additional unit of your product. And depending on where you are on the cost curve, the marginal cost can be falling, rising, or horizontal.

What is marginal cost?

Let's first define marginal cost by using an example. If one is producing a physical item, say a ceiling fan, then there are a host of costs that go into this. These include things like parts, labor, and machining expenses.

Let's say a production line is currently generating 100 of these fans, for a total cost of $1,000 (or $10 per fan). If the production pace is increased to 101 fans, and the total cost rises to $1,009, then my marginal cost is $9.00, and average cost falls to $9.99 per fan. In other words, it cost $9.00 to produce one additional fan.

The marginal-cost curve

- The scenario describes a situation where marginal cost is falling (the average cost of producing X items is higher than the average cost of producing X + 1 items).

- This is a happy environment for most businesses, and usually occurs while the company is in a period of growth. Production lines are getting more efficient, fixed costs are being spread out over greater sales volumes, and variable costs are dropping as a company gains pricing power with its raw material purchases.

- In this situation, the marginal cost curve is *sloping downwards*, and the company has a strong incentive to increase production.

- By contrast, you can imagine a time when marginal costs are rising (the average cost of producing X items is lower than the average cost of producing X + 1 items).
- For example, a motorcycle factory is running at its 10,000-unit capacity, and will require an entirely new production line to get to unit number 10,001.
- Or let's assume that we've purchased all the cheap raw materials we can to satisfy our current level of production, and buying more will increase our average cost.
- In these scenarios, the marginal-cost curve is *sloping upwards*, and the company is pressured to lower production volume or keep it steady.

When the marginal cost is horizontal

- Finally, we have the situation where the marginal cost curve *is flat* (the average cost of producing X items is equal to the average cost of producing X + 1 items). This is a special case because it can describe an equilibrium that's persistent. A company can't hope to have declining marginal costs forever, but it can organize itself in such a way that average costs don't rise, even as production ramps up.

- Think of a business that sells software, like **Microsoft**. The firm has every incentive to deliver as many copies of its flagship Windows operating system that it can, since the cost of producing one more CD is negligible compared to the development expenses that went into creating the underlying code.

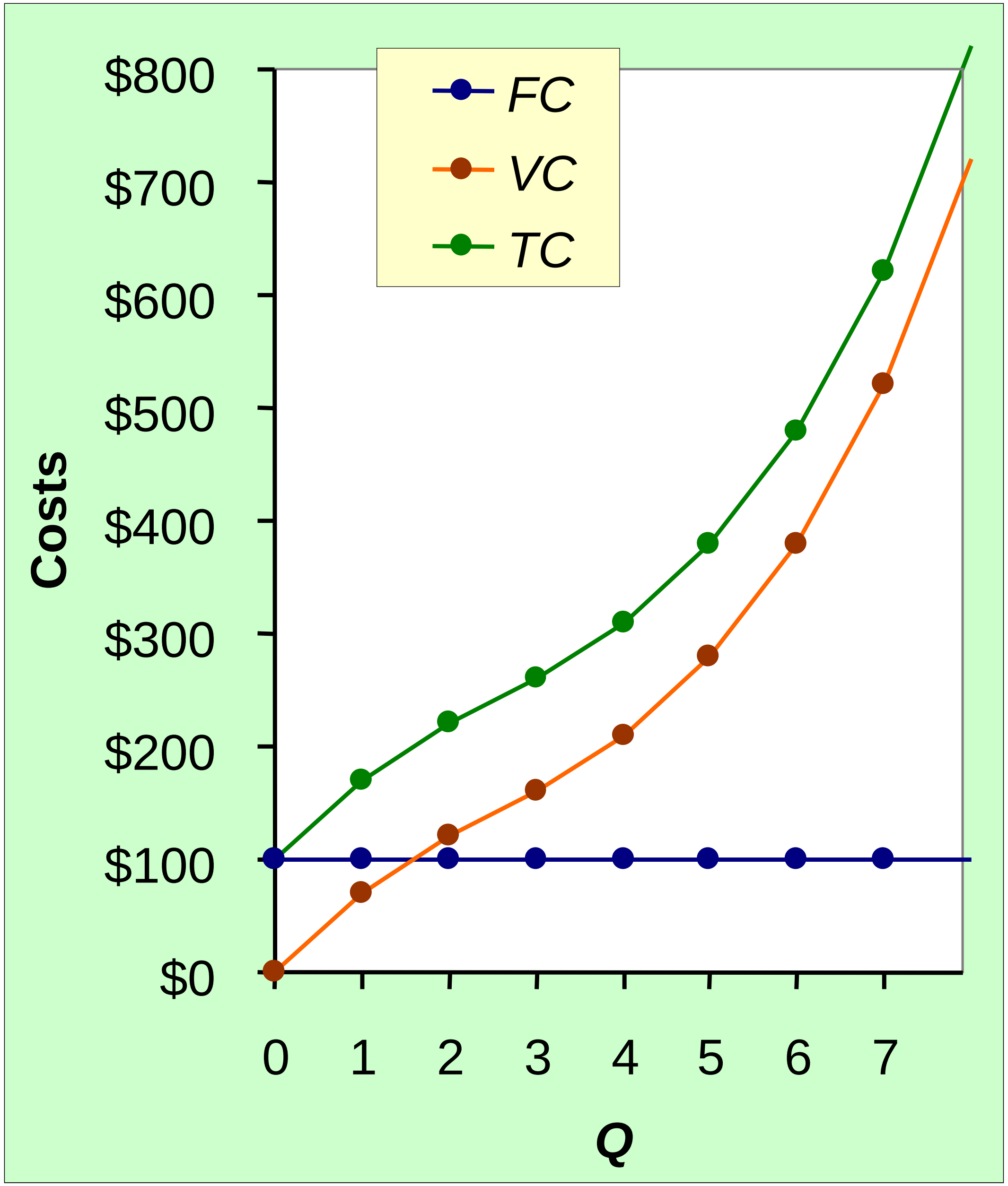
- Or consider the example of **Netflix**, which provides a streaming-video service. The marginal cost of delivering content to one more subscriber is insignificant compared to its fixed costs for securing rights to that content. In this situation, Netflix would seek to sign up as many members as it can convince to join its service, because marginal costs effectively don't matter.

EXAMPLE 2

- Our second example is more general,
  applies to any type of firm
  producing any good with any types of inputs.

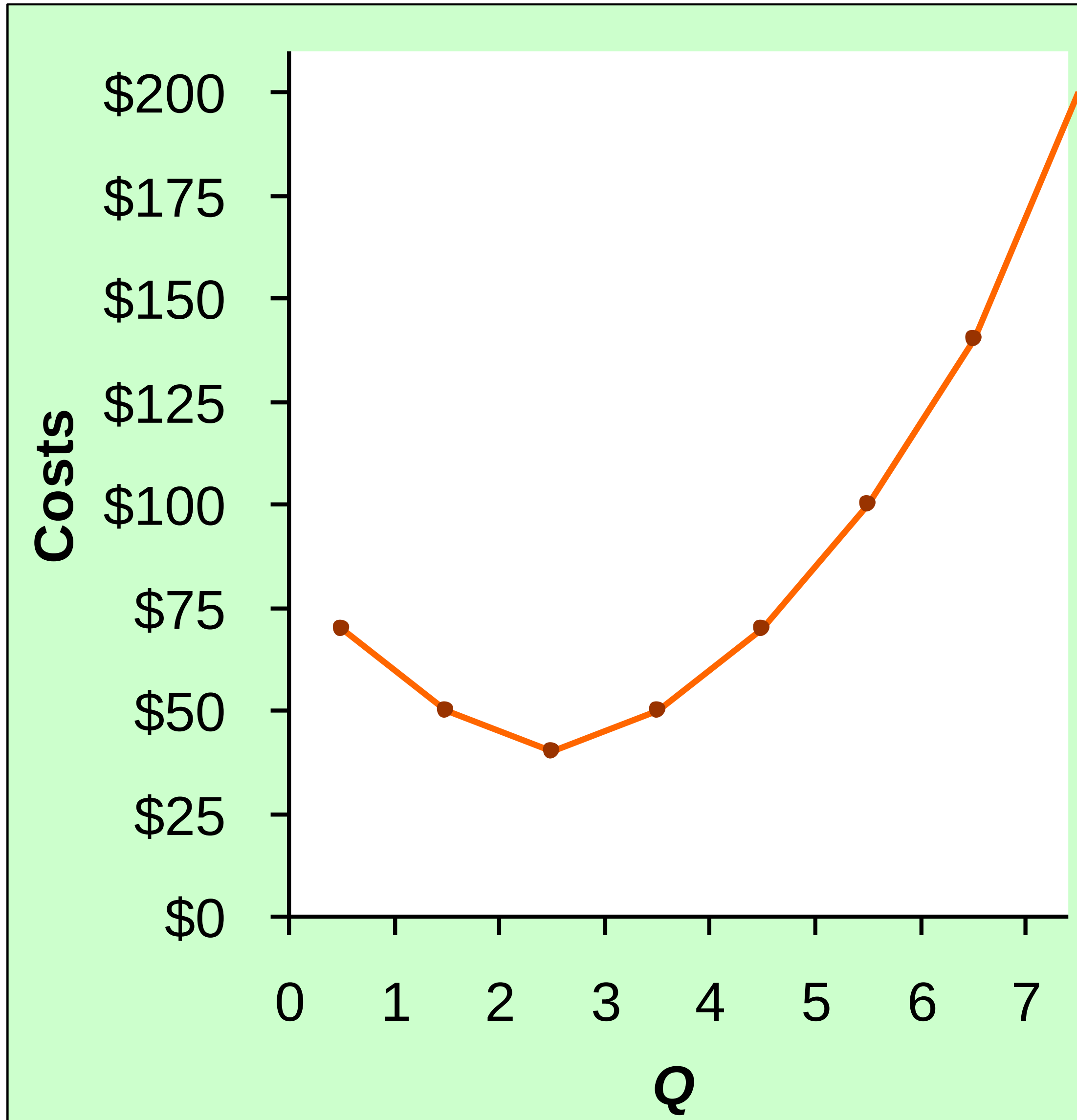
EXAMPLE 2: Costs

Q	*FC*	*VC*	*TC*
0	$100	$0	$100
1	100	70	170
2	100	120	220
3	100	160	260
4	100	210	310
5	100	280	380
6	100	380	480
7	100	520	620



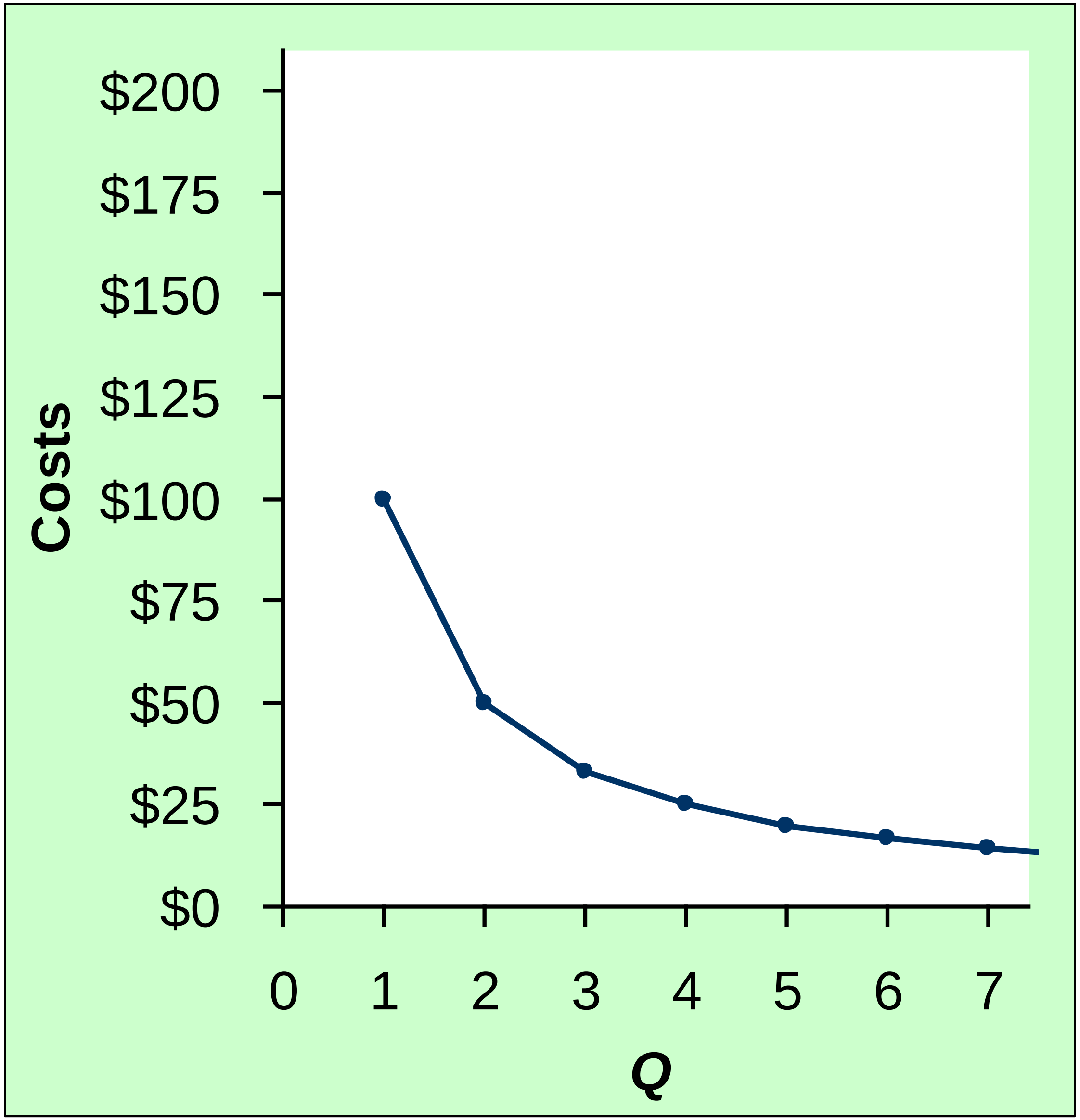
EXAMPLE 2: Marginal Cost

Q	*TC*	*MC*
0	$100	
		$70
1	170	
		50
2	220	
		40
3	260	
		50
4	310	
		70
5	380	
		100
6	480	
		140
7	620	



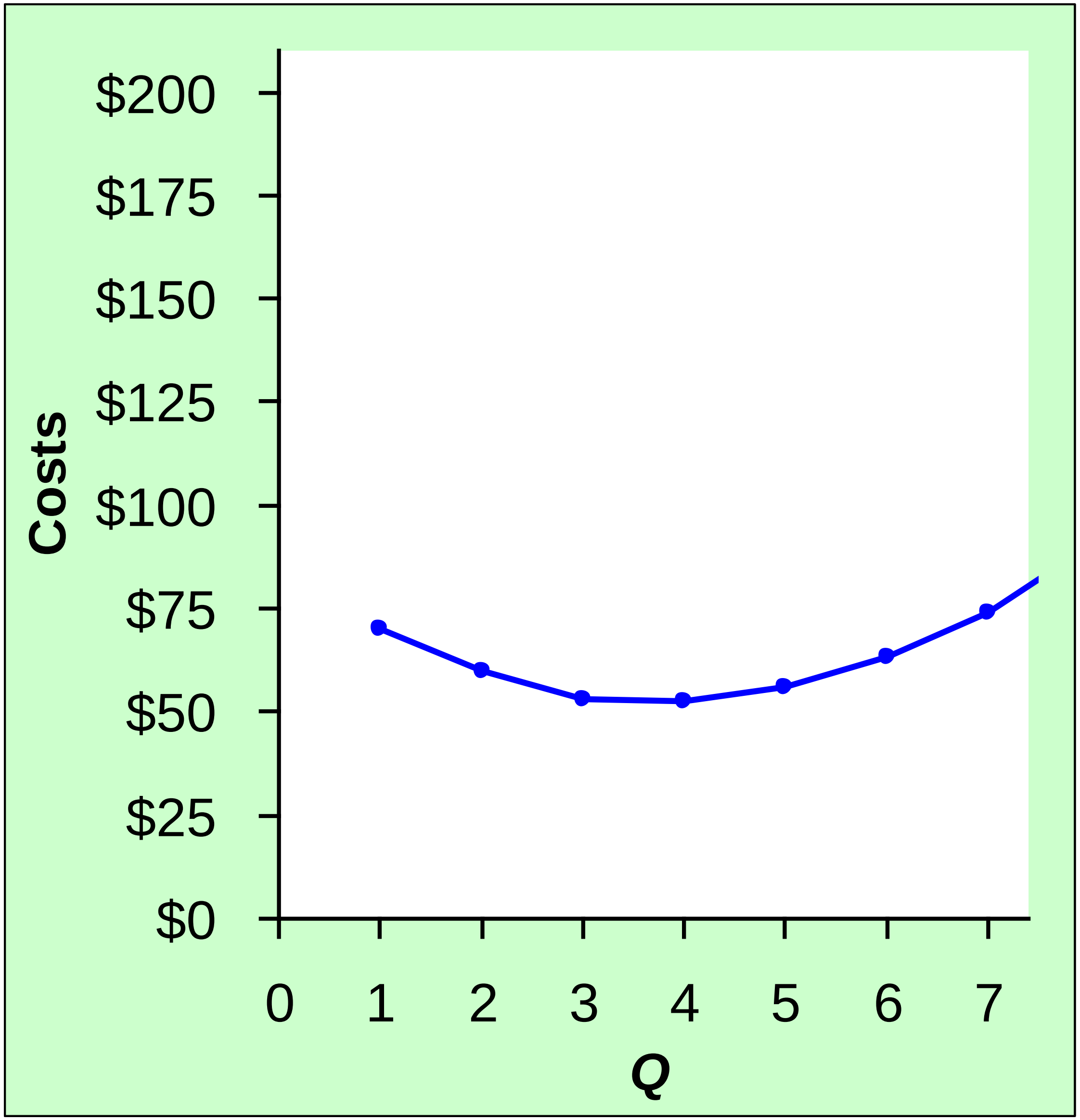
EXAMPLE 2: Average Fixed Cost

Q	*FC*	*AFC*
0	$100	n/a
1	100	$100
2	100	50
3	100	33.33
4	100	25
5	100	20
6	100	16.67
7	100	14.29



EXAMPLE 2: Average Variable Cost

Q	*VC*	*AVC*
0	$0	n/a
1	70	$70
2	120	60
3	160	53.33
4	210	52.50
5	280	56.00
6	380	63.33
7	520	74.29



EXAMPLE 2: Average Total Cost

Q	*TC*	*ATC*	*AFC*	*AVC*
0	$100			
1	170	$170	$100	$70
2	220	110	50	60
3	260	86.67	33.33	53.33
4	310	77.50	25	52.50
5	380	76	20	56.00
6	480	80	16.67	63.33
7	620	88.57	14.29	74.29

Average total cost (*ATC*) equals total cost divided by the quantity of output:

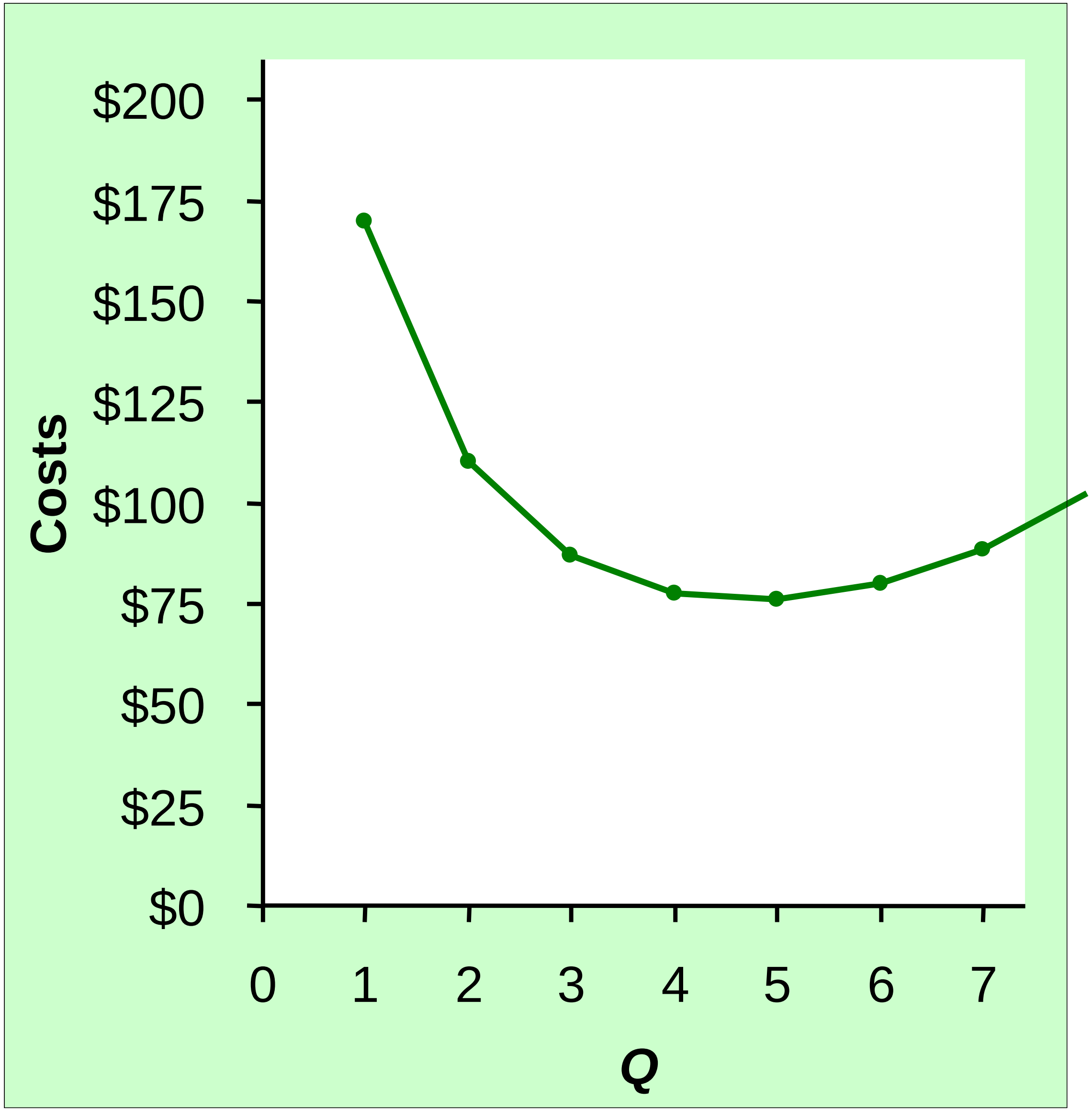
$$ATC = TC/\boldsymbol{Q}$$

Also,

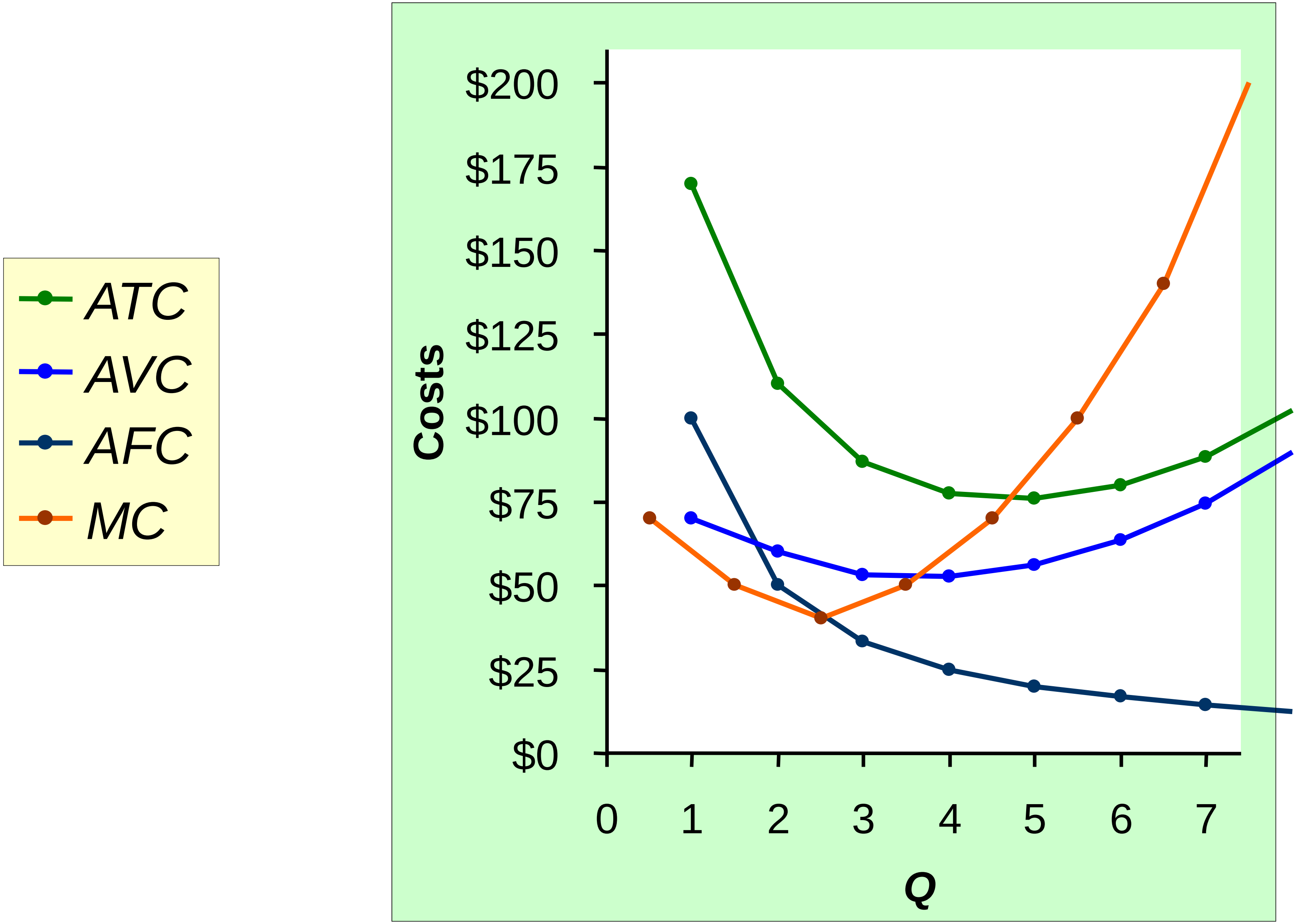
$$ATC = AFC + AVC$$

EXAMPLE 2: Average Total Cost

Q	*TC*	*ATC*
0	$100	n/a
1	170	$170
2	220	110
3	260	86.67
4	310	77.50
5	380	76
6	480	80
7	620	88.57



EXAMPLE 2: The Various Cost Curves Together

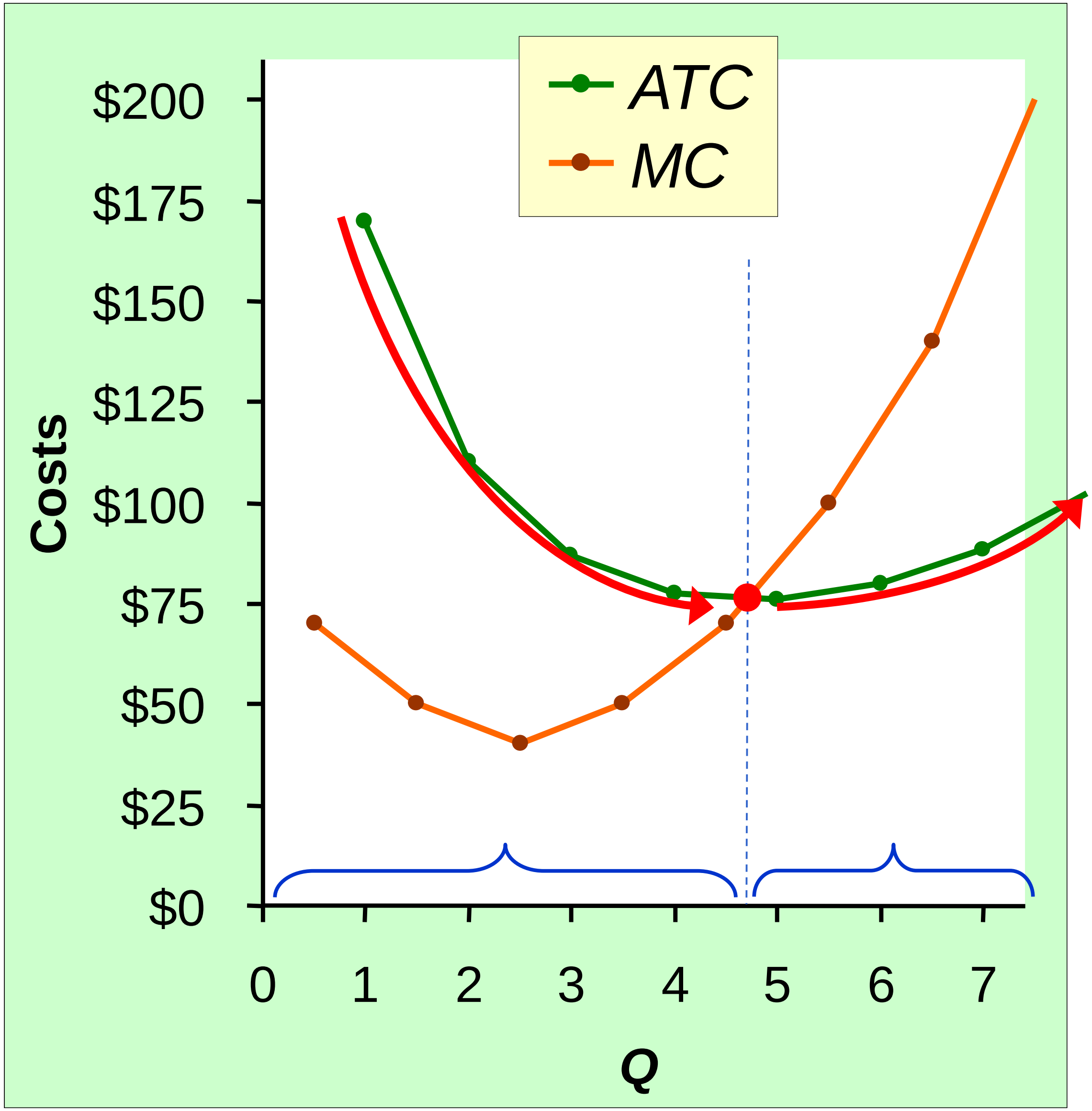


EXAMPLE 2: ATC and MC

When *MC* < *ATC*, *ATC* is falling.

When *MC* > *ATC*, *ATC* is rising.

The *MC* curve crosses the *ATC* curve at the *ATC* curve's minimum.



Costs in the Short Run & Long Run

- Short run:
  Some inputs are fixed (*e.g.,* factories, land).
  The costs of these inputs are *FC*.

- Long run:
  All inputs are variable
  (*e.g.,* firms can build more factories,
  or sell existing ones).

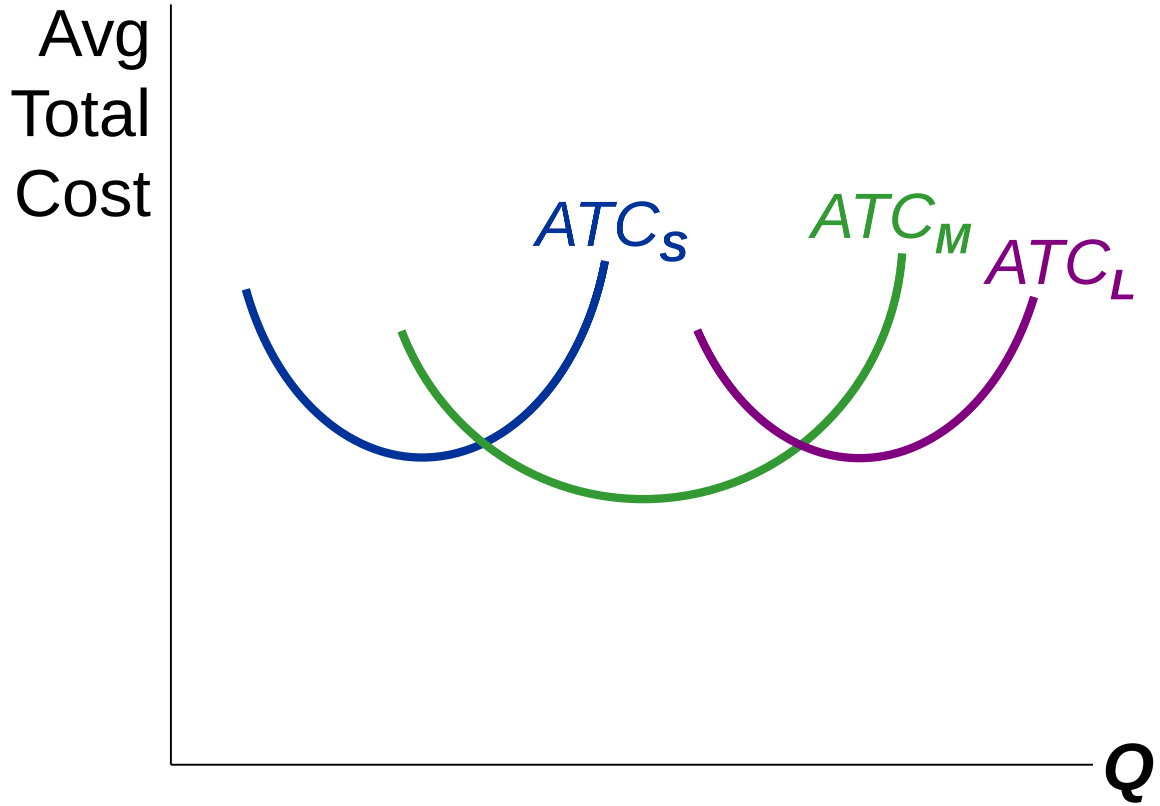
- In the long run, *ATC* at any ***Q*** is cost per unit using the most efficient mix of inputs for that ***Q*** (*e.g*., the factory size with the lowest *ATC*).

EXAMPLE 3: LRATC with 3 factory Sizes

Firm can choose from 3 factory sizes: **S**, **M**, **L**.

Each size has its own *SRATC* curve.

The firm can change to a different factory size in the long run, but not in the short run.

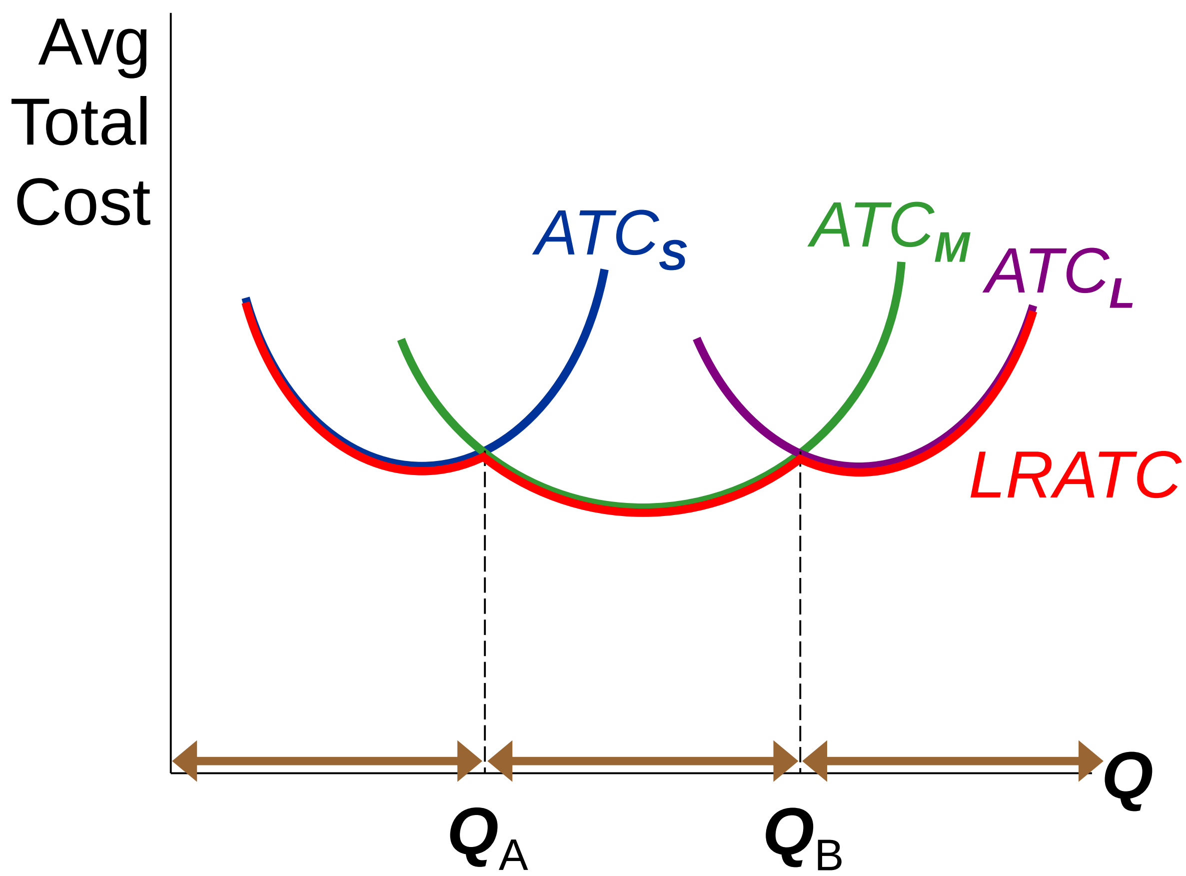


EXAMPLE 3: LRATC with 3 factory Sizes

To produce less than Q_A, firm will choose size **S** in the long run.

To produce between Q_A and Q_B, firm will choose size **M** in the long run.

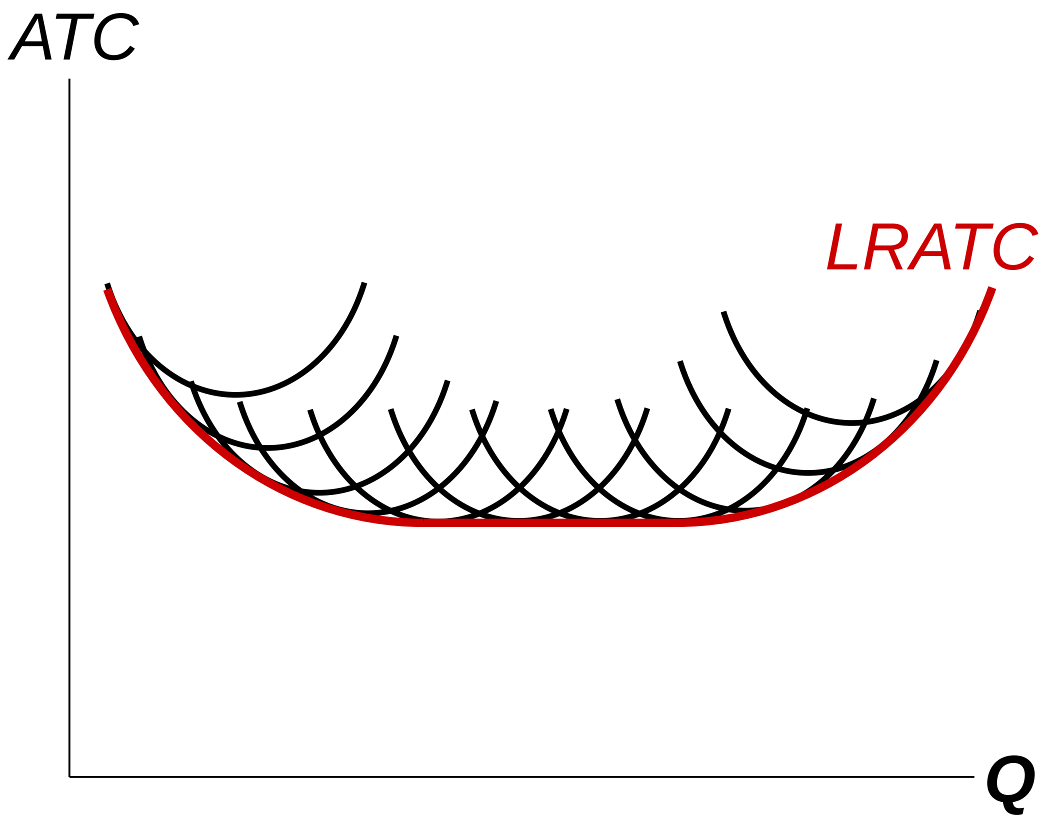
To produce more than Q_B, firm will choose size **L** in the long run.



A Typical LRATC Curve

In the real world, factories come in many sizes, each with its own *SRATC* curve.

So a typical *LRATC* curve looks like this:

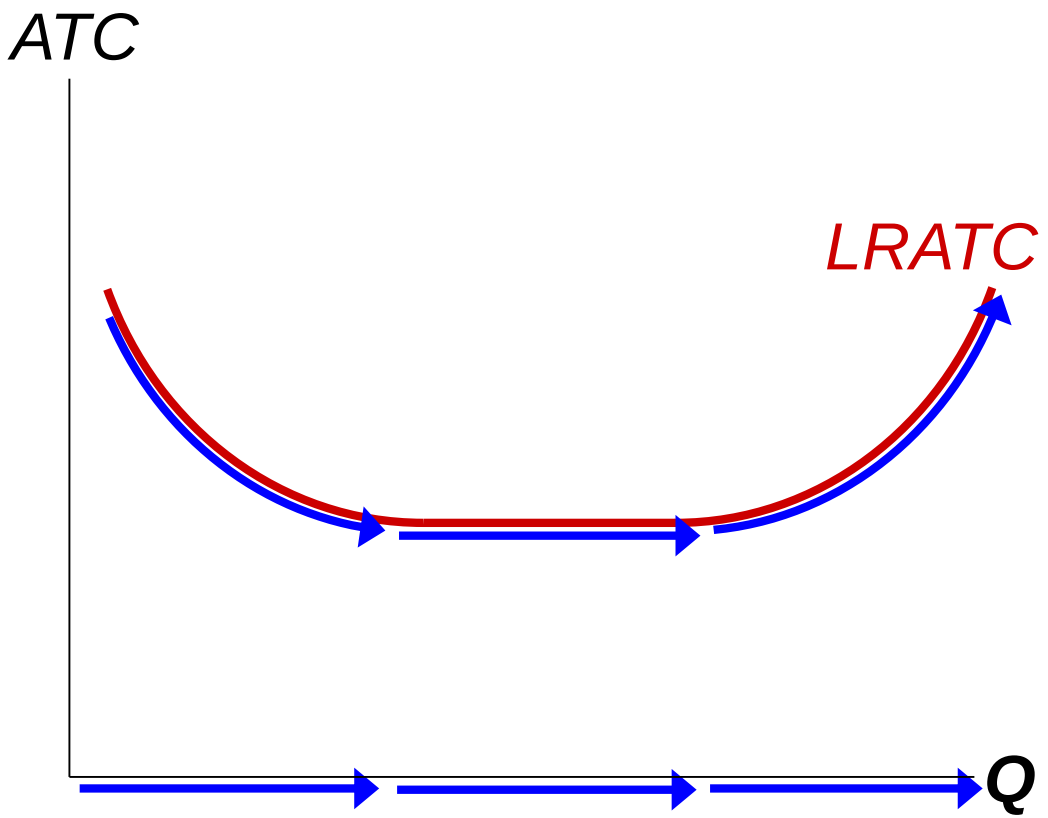


How ATC Changes as the Scale of Production Changes

Economies of scale: *ATC* falls as ***Q*** increases.

Constant returns to scale: *ATC* stays the same as ***Q*** increases.

Diseconomies of scale: *ATC* rises as ***Q*** increases.



How ATC Changes as the Scale of Production Changes

- Economies of scale occur when increasing production allows greater specialization: workers more efficient when focusing on a narrow task.
  - More common when ***Q*** is low.
- Diseconomies of scale are due to coordination problems in large organizations.
  E.g., management becomes stretched, can't control costs.
  - More common when ***Q*** is high.

BREAK EVEN ANALYSIS (BEA)

The BEA helps in understanding the relationship between revenues and costs of a firm in relation to its volume of sales.

It helps in determining the volume at which the firm's cost and revenue are in equilibrium.

It is a technique which helps to analyse the effect of change in the level of production and total profit of a company.

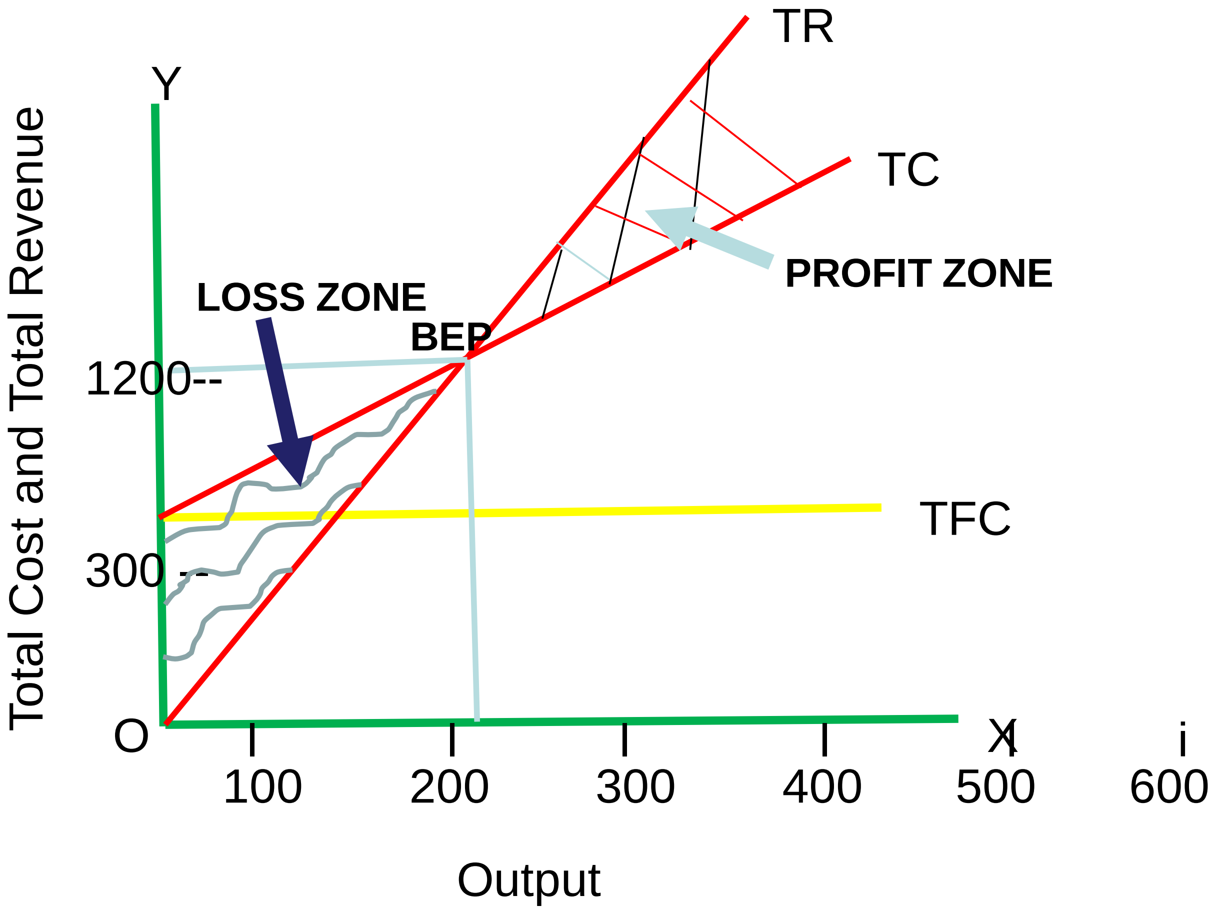
The BEA establishes the relationship between cost, volume and profits. Hence it is also known as "Cost-Volume-Profit analysis".

In BEA more prominence to identify the Break Even Point (BEP).
BEP refers to that level of sales volume at which there is neither profit nor loss,
Costs being equal to its sales value and the contribution is equal to fixed costs.
BEP is defined as "that level of sales at which the total revenue is equal to total costs and the net income is equal to zero.

Break even chart and diagrammatic representation

Selling Price is Rs. 4 per unit

Output (Q)	Total Revenue (TR)	Fixed Cost (TFC)	Variable Cost (TVC)	Total Cost (TC)
0	0	300	0	300
100	400 (100 x 4)	300	300	600
200	800 (200 x 4)	300	600	900
300	1200 (300 x 4)	300	900	1200
400	1600 (400 x 4)	300	1200	1500
500	2000 (500 x 4)	300	1500	1800
600	2400 (600 x 4)	300	1800	2100



TR
Y
TC
LOSS ZONE
PROFIT ZONE
BEP
1200--
TFC
300 --
Total Cost and Total Revenue
O
X
100
200
300
400
500
600
Output

CALCULATION OF BREAK EVEN POINT

The two methods of calculation of BEP are 1) BEP in terms of physical units 2) BEP in terms of sales value

BEP in terms of physical units is suitable for a firm producing a single product.

BEP in terms of sales value is suitable for a firm producing multi products.

Illustration for calculating BEP in terms of physical units

Selling Price Rs. 15 per engg component

Variable cost Rs. 10 per engg component

Fixed cost (FC) Rs. 1,50,000

First step is to calculate Contribution Margin (CM)

Selling Price – Variable cost per unit.

Rs. 15 – Rs. 10 = Rs. 5 is the CM

$$\text{Now, BEP} = \frac{\text{TFC}}{\text{CM}} = \frac{\text{Rs. } 1{,}50{,}000}{\text{Rs. } 5} = 30{,}000 \text{ Units}$$

Hence, the firm reaches BEP by producing 30,000 units

Illustration for calculating BEP in terms of sales value
This method is useful for a firm producing multi products

Total Sales Value Rs. 10,000 (TR)
Variable Costs Rs. 6,000 (TVC)
Fixed Cost Rs. 3,000 (TFC)

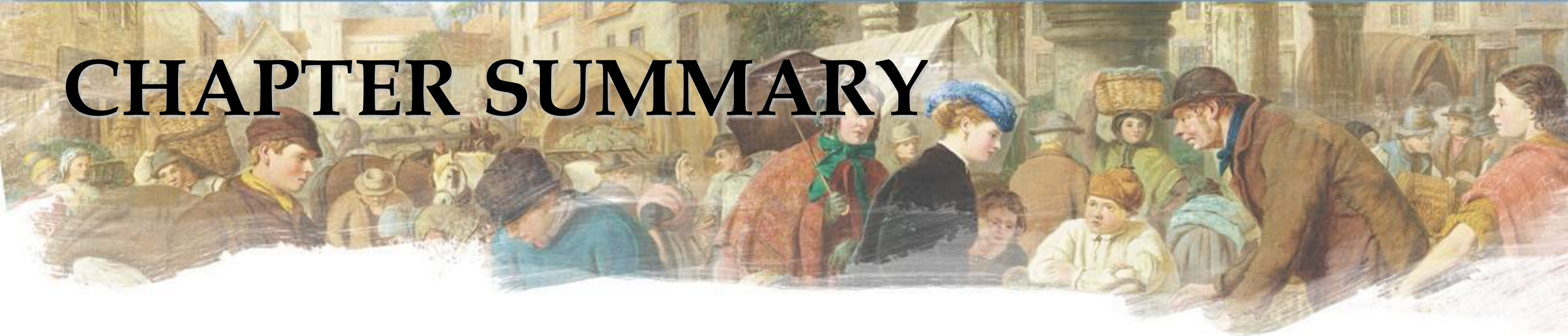
First step is to calculate Contribution Ratio

$$\frac{TR - VC}{TR} = \frac{\text{Rs. } 10{,}000 - \text{Rs. } 6{,}000}{\text{Rs. } 10{,}000} = 0.4 \text{ (CR)}$$

It implies that for every one rupee sales value the FC is 0.40 paise

$$\text{Now BEP} = \frac{FC}{CR} = \frac{\text{Rs. } 3{,}000}{0.4} = \text{Rs. } 7{,}500$$

Hence it is clear from this calculations that at sales value of Rs. 7500 (BEP)
There is no profit and no loss.



CHAPTER SUMMARY

- Implicit costs do not involve a cash outlay, yet are just as important as explicit costs to firms' decisions.
- Accounting profit is revenue minus explicit costs. Economic profit is revenue minus total (explicit + implicit) costs.
- The production function shows the relationship between output and inputs.

CHAPTER SUMMARY

- The marginal product of labor is the increase in output from a one-unit increase in labor, holding other inputs constant. The marginal products of other inputs are defined similarly.
- Marginal product usually diminishes as the input increases. Thus, as output rises, the production function becomes flatter, and the total cost curve becomes steeper.
- Variable costs vary with output; fixed costs do not.

CHAPTER SUMMARY

- Marginal cost is the increase in total cost from an extra unit of production. The MC curve is usually upward-sloping.
- Average variable cost is variable cost divided by output.
- Average fixed cost is fixed cost divided by output. AFC always falls as output increases.
- Average total cost (sometimes called “cost per unit”) is total cost divided by the quantity of output. The ATC curve is usually U-shaped.

CHAPTER SUMMARY

- The MC curve intersects the ATC curve at minimum average total cost.
  When MC < ATC, ATC falls as ***Q*** rises.
  When MC > ATC, ATC rises as ***Q*** rises.
- In the long run, all costs are variable.
- Economies of scale: ATC falls as ***Q*** rises.
  Diseconomies of scale: ATC rises as ***Q*** rises.
  Constant returns to scale: ATC remains constant as ***Q*** rises.

Unit 1 Summary

- Basic concepts
- Rational decisions / assumptions
- Production possibility diagram/curve
- Circular flow diagram
- Principles of engineering economics

Unit 2

Theory of Demand and Supply

Demand, Supply and concepts of elasticity

Learning Outcomes

- Develop the concepts of demand and its determinants.
- Discuss the factors that lead to shifts and movement along the demand curves.
- Explain price elasticity and its calculations, income and cross elasticity.

Markets

- A market is any institutional structure, or mechanism, that brings together buyers and sellers of particular goods and services

- Markets exists in many forms

- They determine the price and quantity of a good or service transacted

Markets

Demand

- The various amounts of a product that consumers are willing and able to purchase at various prices during some specific period
- Demonstrated by demand schedule and demand curve

Law of Demand

- The inverse relationship between the price and the quantity demanded of a good or service during some period of time

Law of Demand (cont.)

Based on:

1. Income
2. Substitution
3. Diminishing marginal utility

Income Effect

- At a lower price, consumers can buy more of a product without giving up other goods

- A decline in price increases the purchasing power of money/real income

Substitution Effect

- At a lower price, consumers have the incentive to substitute the cheaper good for similar goods that are now relatively more expensive

Diminishing Marginal Utility

- States that successive units of a given product yield less and less extra satisfaction

- Therefore, consumers will only buy more of a good if its price is reduced

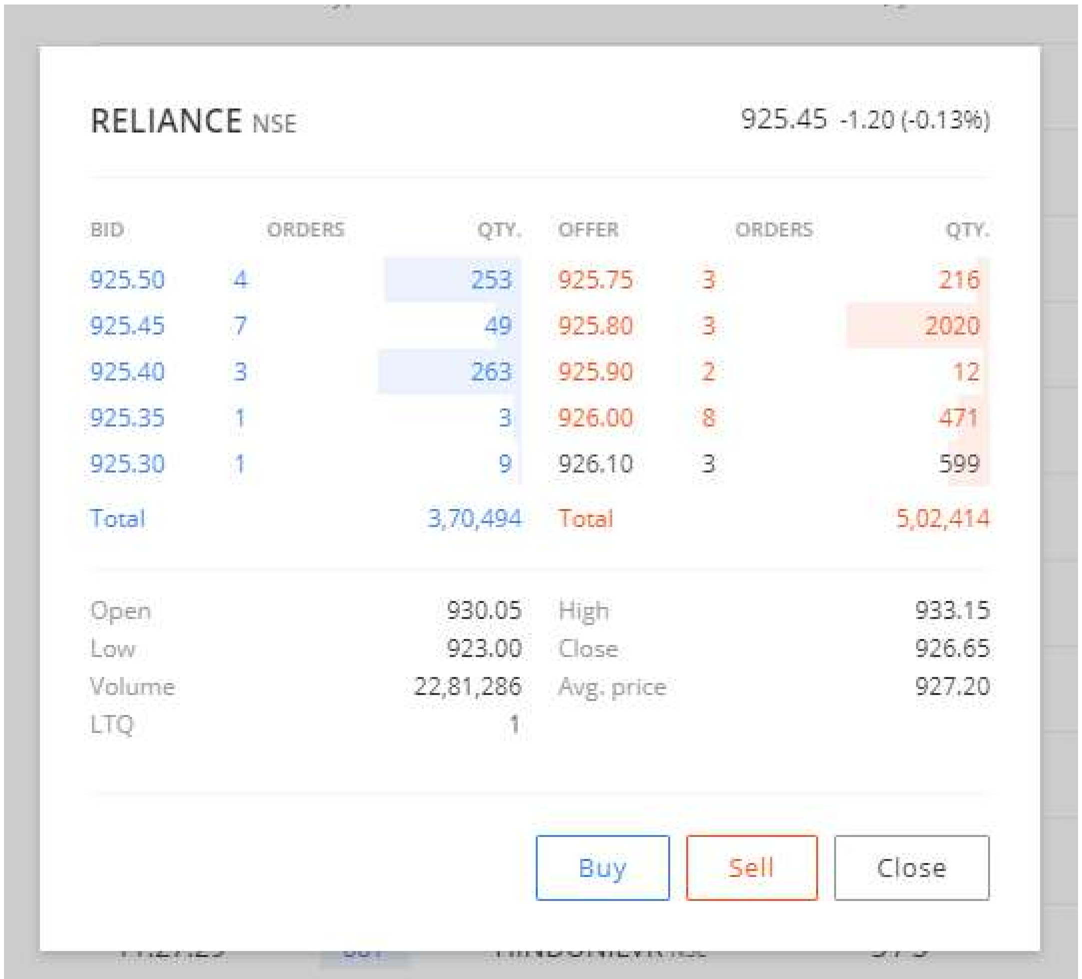
Consumer Demand: guidelines

- Free market economy: customer directs production through purchases:
  - 1) We buy what satisfies us!
  - 2) However, more and more = less satisfaction.

- Example: First piece of pizza (great), 5th piece (not as great), i.e. you have **less** satisfaction.

  -satisfaction level maintained by ordering a salad, bread, vs. one pizza.

Demand and Supply factors at the Stock Exchange



RELIANCE NSE 925.45 -1.20 (-0.13%)

BID	ORDERS	QTY.	OFFER	ORDERS	QTY.
925.50	4	253	925.75	3	216
925.45	7	49	925.80	3	2020
925.40	3	263	925.90	2	12
925.35	1	3	926.00	8	471
925.30	1	9	926.10	3	599
Total		3,70,494	Total		5,02,414

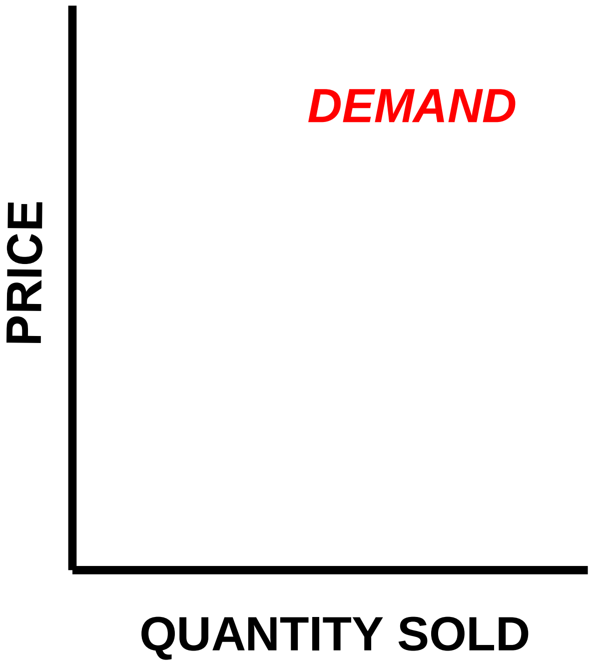
Open	930.05	High	933.15
Low	923.00	Close	926.65
Volume	22,81,286	Avg. price	927.20
LTQ	1		

Demand Curve

- Shows the inverse relationship between price and quantity demanded for a good or service
- Derived from a demand schedule showing the quantity demanded at various prices

Demand Schedule

- Higher price = fewer sold
- Negative relationship
- ***Law of demand***: consumers buy less as the price rises, more as it drops



Role of Price in Demand

- Even the richest people (companies) have budgets (guidelines)
- But, they are still after greatest satisfaction for least cash...
- Price helps consumers/producers maximize finite resources.
- Further, a producer's demand for inputs is related to the consumer's demand for products
- This applies to firms linked together in the system (i.e., they are all linked together by demand)

Factors Influencing Consumer Demand (changers)

1) **Own price (price to own):** the price of the item consumed

2) **Substitute price:** item that could be substituted as price of original increases (tea and coffee; MacBook vs Dell)

3) **Complement price:** item that is often sold or used in conjunction with original (batteries for flashlight; cartridge and printer)

4) **Income:** people tend to trade-up for better goods
5) **Change in population:** increase = greater demand
6) **Tastes and preferences:** varies constantly
7) **Seasonality:** demand influenced by time of year (e.g., umbrella, ice cream)

Demand Shifters

- **Demand *"shifters"*** factors which cause an increase/decrease in demand, but are not really price-related

- A ***"change"*** in demand occurs when the demand changes as a result of price

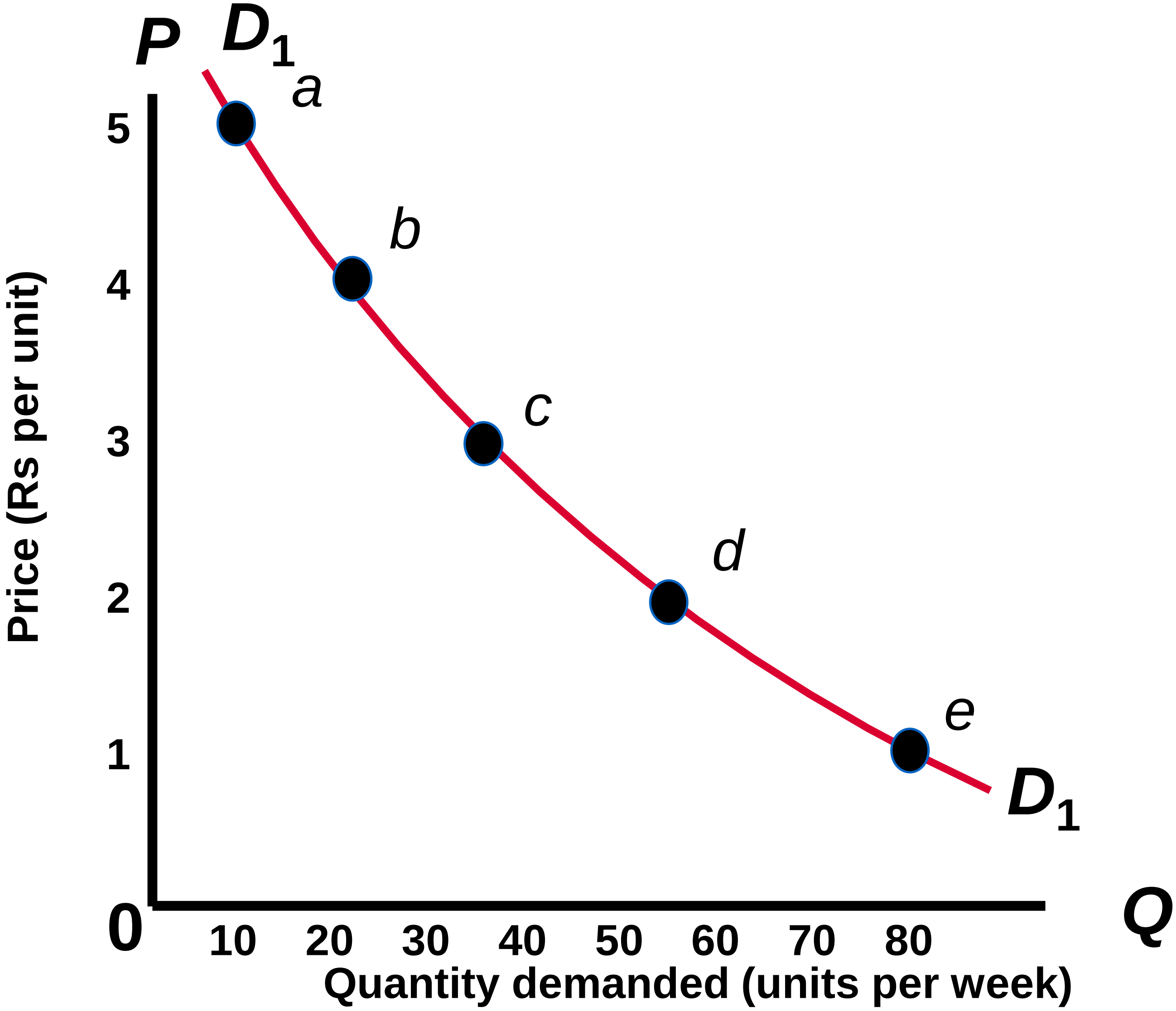
- If the own price increases and the amount of product sold decreases, the change in sales is a result of the law of demand

- If product sold simply increases without a change in price, it is a shift—can work both ways (up or down)

Demand schedule

	Price per unit	Quantity demanded per week
a	5	10
b	4	20
c	3	35
d	2	55
e	1	80

Graphing Demand



Changes in Demand

- Caused by changes in one or other of the determinants of demand
- Represented as a shift of the demand curve either to the right or left
- Represents a change in the quantity demand at every price, so cannot be related to a change in price

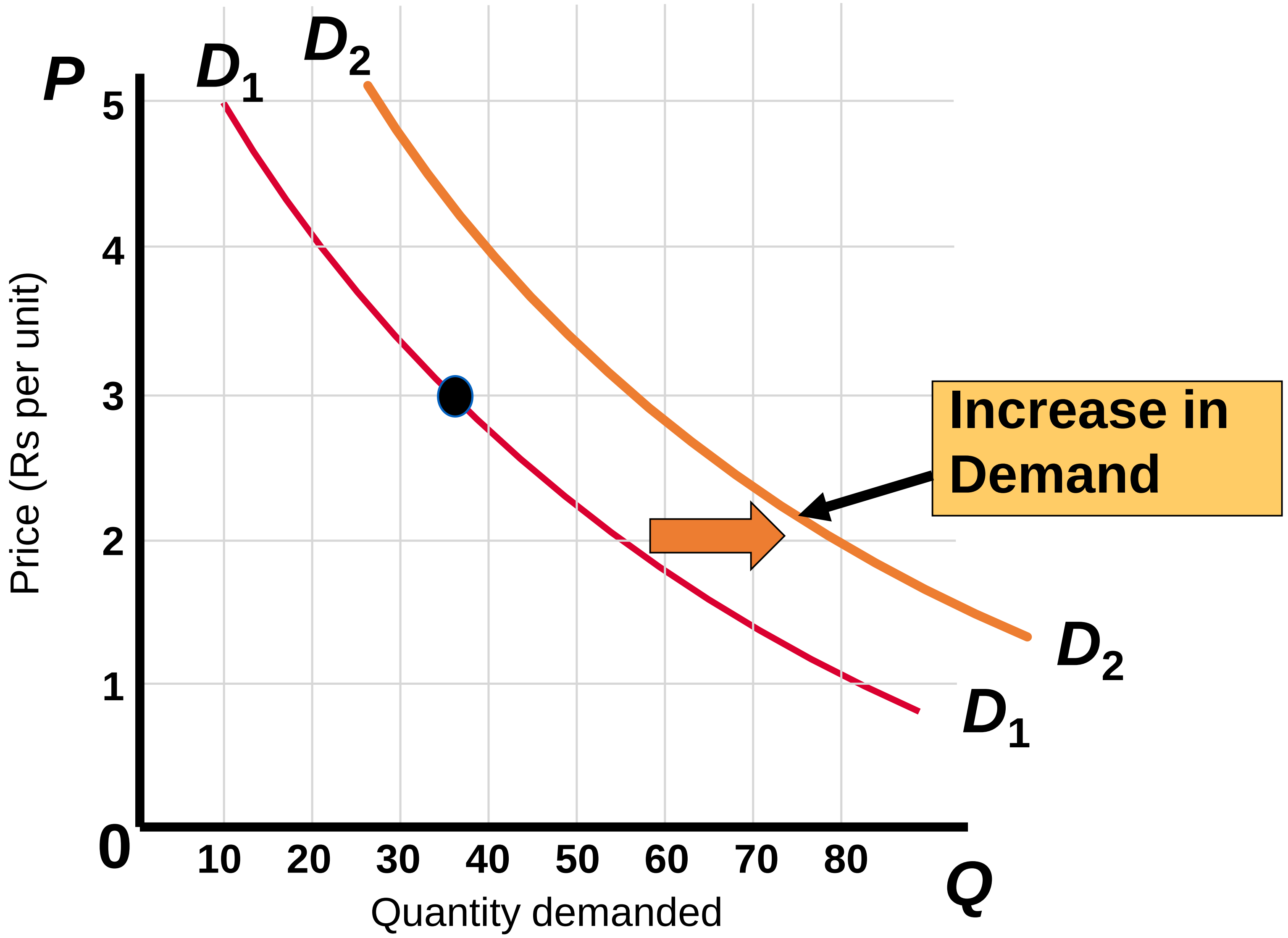
Changes in Demand

- Tastes or preferences
- Number of buyers
- Income
  - Normal or superior goods—demand varies directly with income
  - Inferior goods—demand varies inversely with income

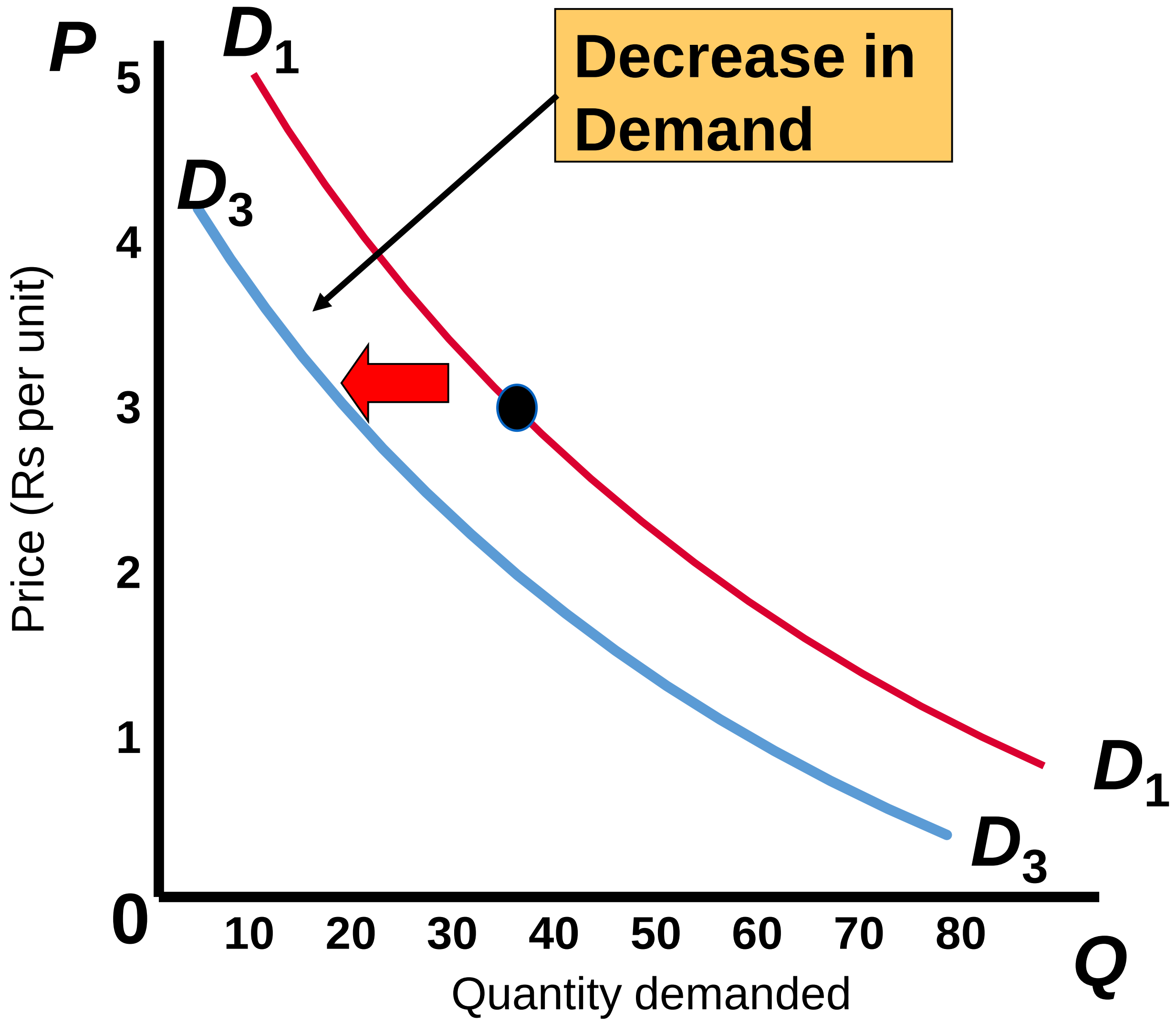
Changes in Demand (cont.)

- Prices of related goods
  - Substitute goods
  - Complementary goods
- Expectations
- Seasons/weather

Increase in Demand



Decrease in Demand



Changes in Quantity Demanded

- caused by changes in price only
- represented as movement along a demand curve
- other factors determining demand are held constant

Movement along a Curve

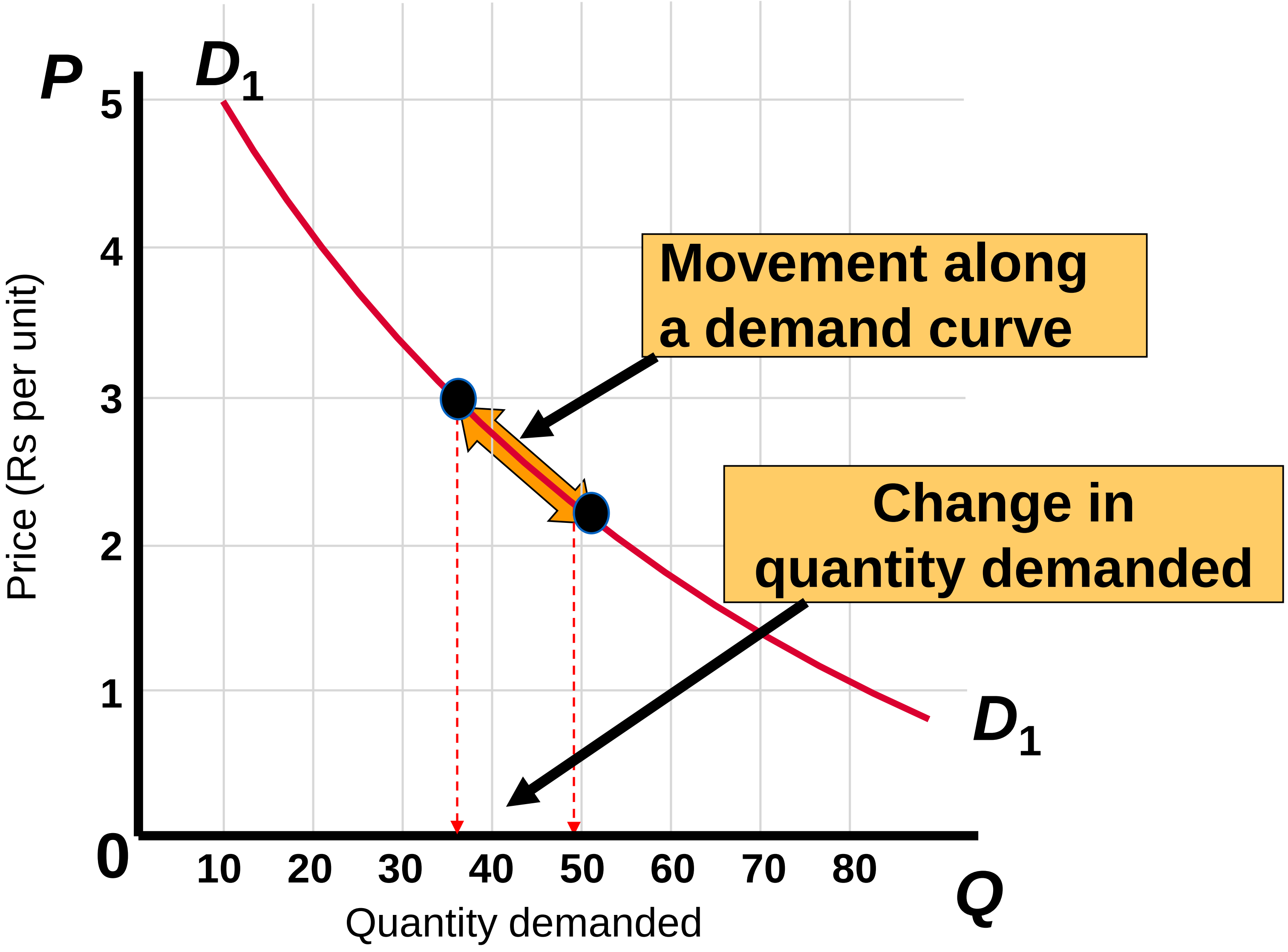
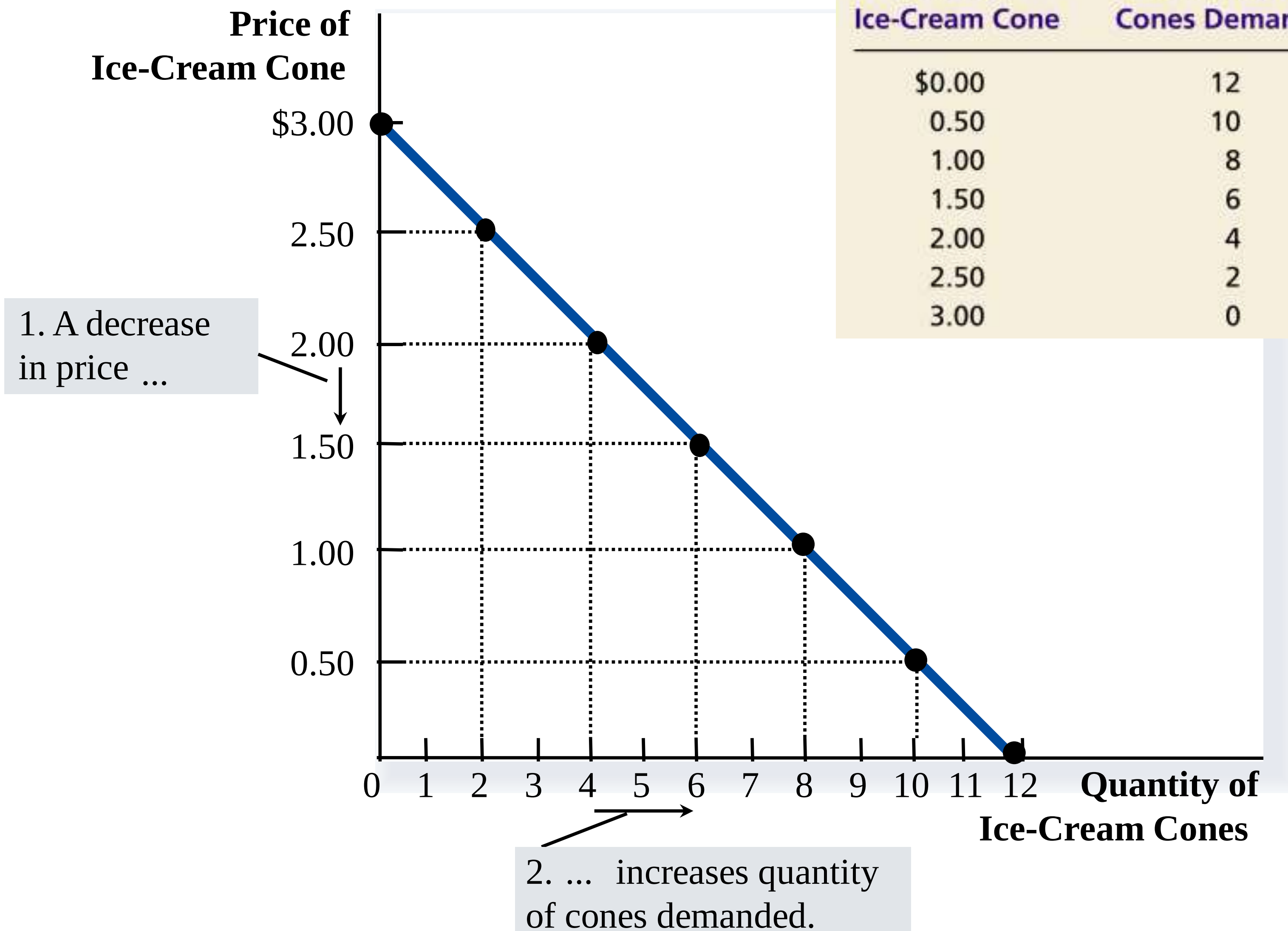


Figure 1 Catherine's Demand Schedule and Demand Curve

Price of Ice-Cream Cone	Quantity of Cones Demanded
$0.00	12
0.50	10
1.00	8
1.50	6
2.00	4
2.50	2
3.00	0



Market Demand versus Individual Demand

- Market demand refers to the sum of all individual demands for a particular good or service.
- Graphically, individual demand curves are summed horizontally to obtain the market demand curve.

The Market Demand Curve

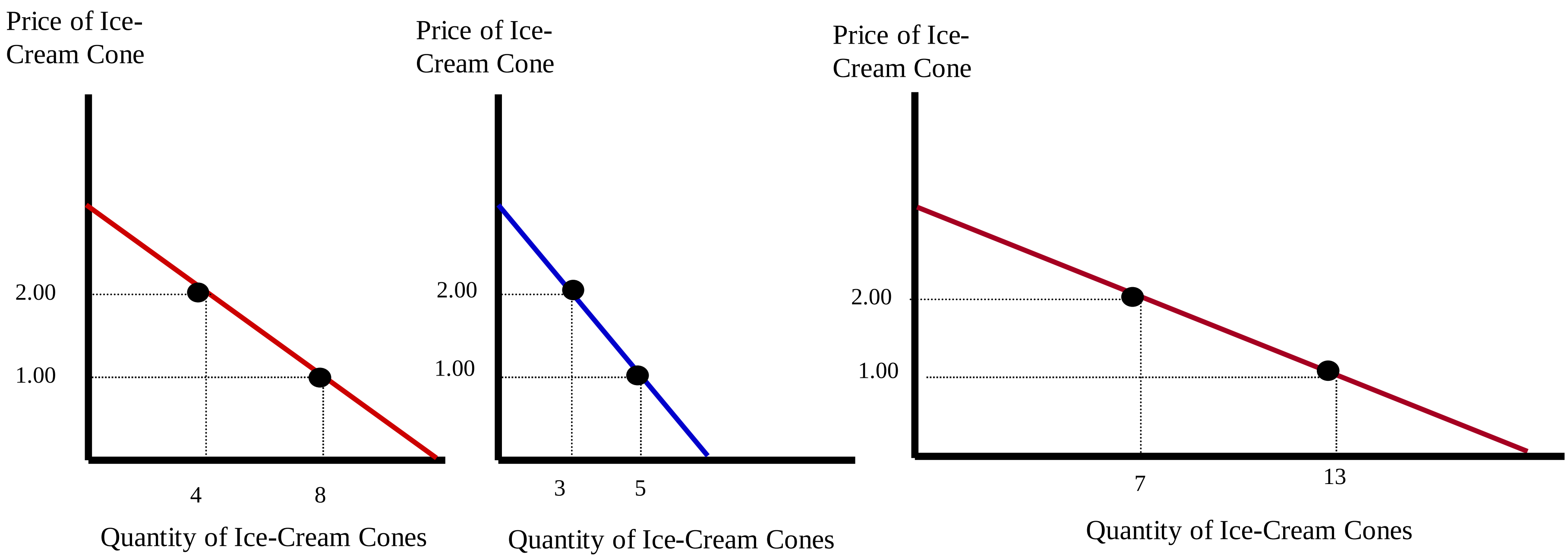
When the price is $2.
Catherine will deman
cream cones.

When the price is $2.00,
Nicholas will demand 3 ice-
cream cones.

The market demand at $2.00
will be 7 ice-cream cones.

The market demand curve is the horizontal sum of the individual demand curves!

Catherine's Demand + Nicholas's Demand = Market Demand



When the price is $1.00,
Catherine will demand 8 ice
cream cones.

When the price is $1.00,
Nicholas will demand 5 ice-
cream cones.

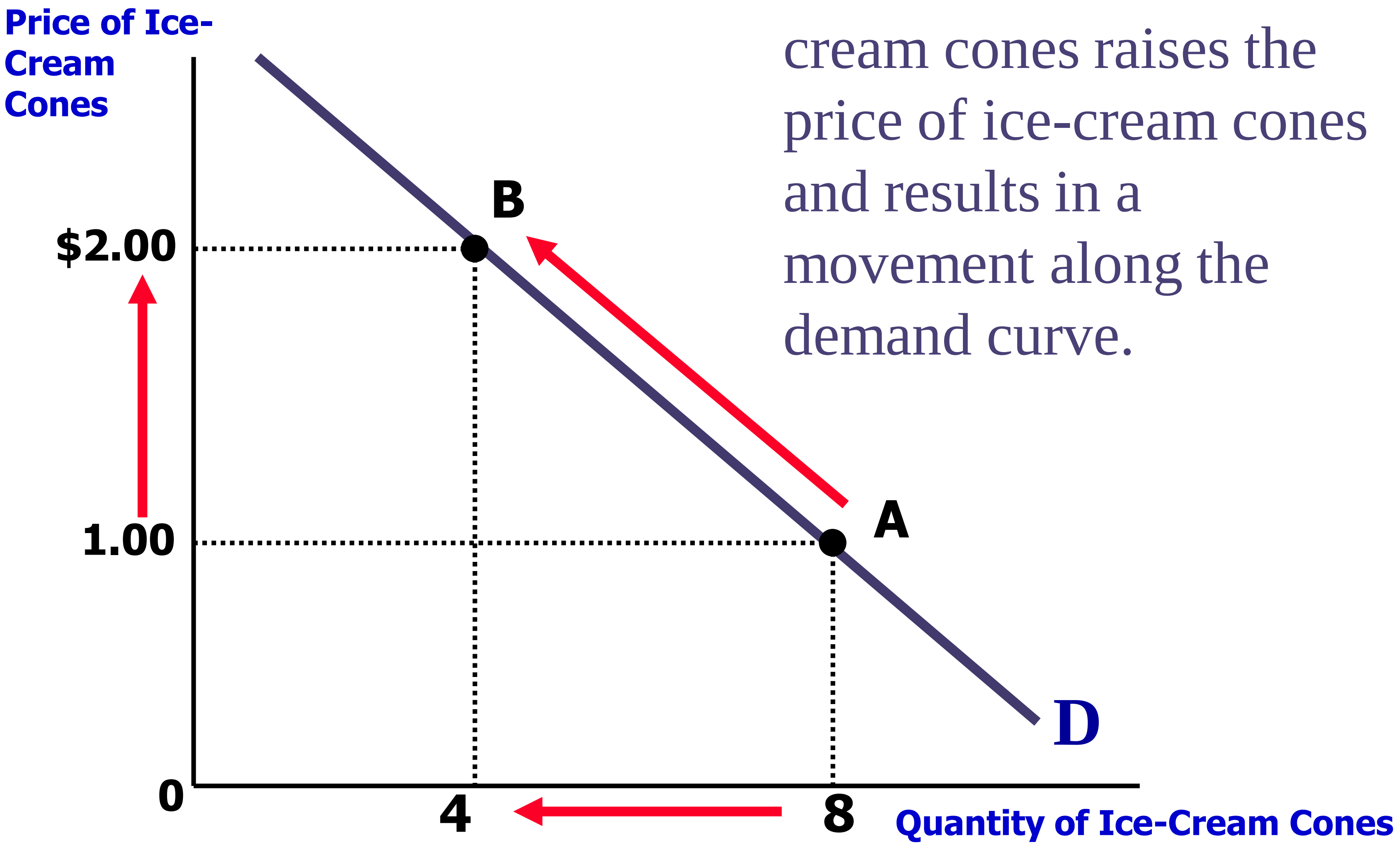
The market demand at $1.00,
will be 13 ice-cream cones.

Shifts in the Demand Curve

- Change in Quantity Demanded
  - Movement along the demand curve.
  - Caused by a change in the price of the product.

Changes in Quantity Demanded

A tax on sellers of ice-cream cones raises the price of ice-cream cones and results in a movement along the demand curve.



Individual and Market Demand

- Market demand is derived by horizontally summing individual demand curves

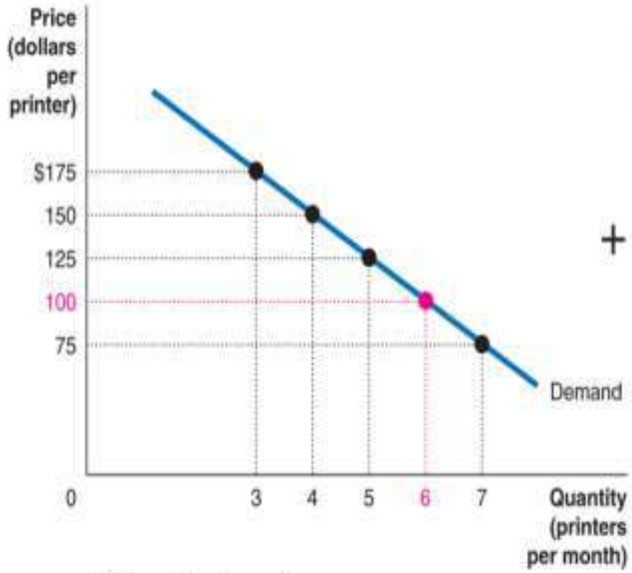
- Market demand is derived by adding all the quantities demanded in a demand schedule which correspond to their prices

Market Demand Table

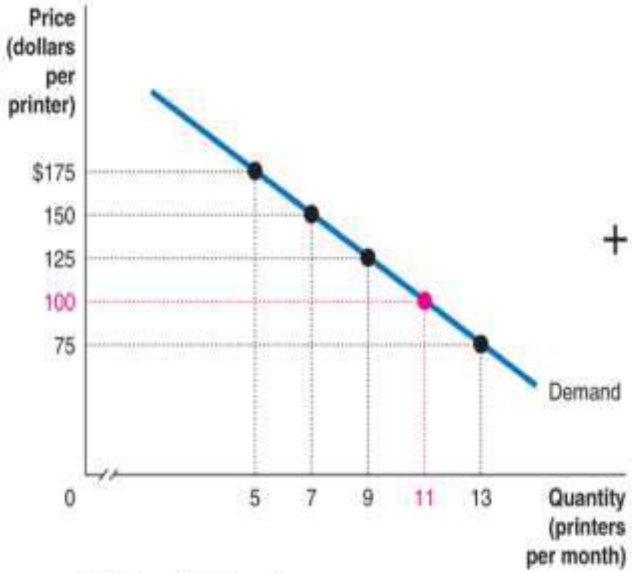
Price	Demand of individual 'A'	Demand of individual 'B'	Demand of individual 'C'	Market Demand
5	20	30	50	100
4	40	60	100	200
3	60	90	150	300
2	80	120	200	400

Deriving the market demand curve from individual curves: Figure 3.3

Quantity (printers per month)				
Price (dollars per printer)	Group A	Group B	Group C	Market
$175	3	5	6	14
150	4	7	7	18
125	5	9	8	22
100	6	11	9	26
75	7	13	10	30

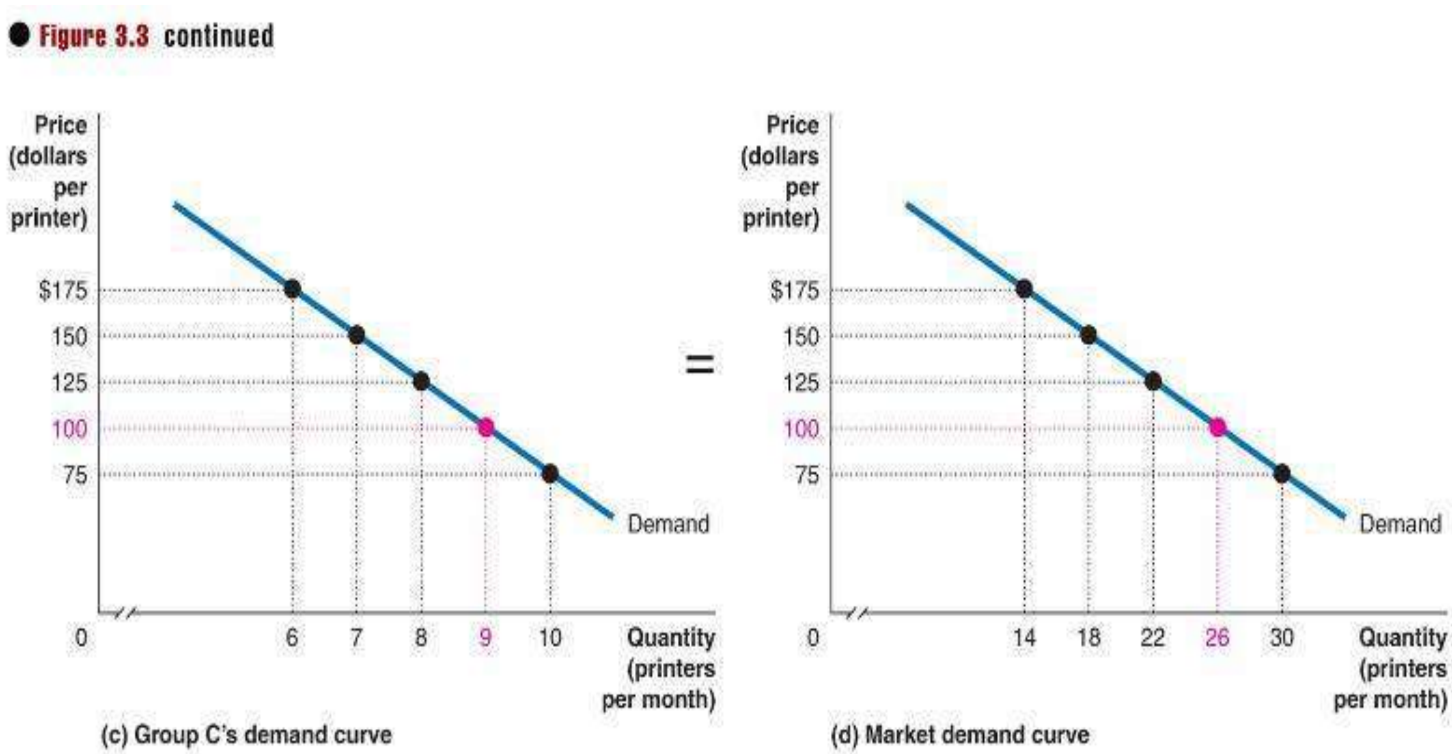


(a) Group A's demand curve



(b) Group B's demand curve

Deriving the market demand curve from individual curves: Figure 3.3, continued



Elasticity

- Basic idea:
  Elasticity measures how much one variable responds to changes in another variable.
  - One type of elasticity measures how much demand for products will fall if the price is raised.
- Definition:
  Elasticity is a numerical measure of the responsiveness of Q^d or Q^s to one of its determinants.

Price Elasticity of Demand

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in } \boldsymbol{Q^d}}{\text{Percentage change in } \boldsymbol{P}}$$

- **Price elasticity of demand** measures how much Q^d responds to a change in P.
- Loosely speaking, it measures the price-sensitivity of buyers' demand.

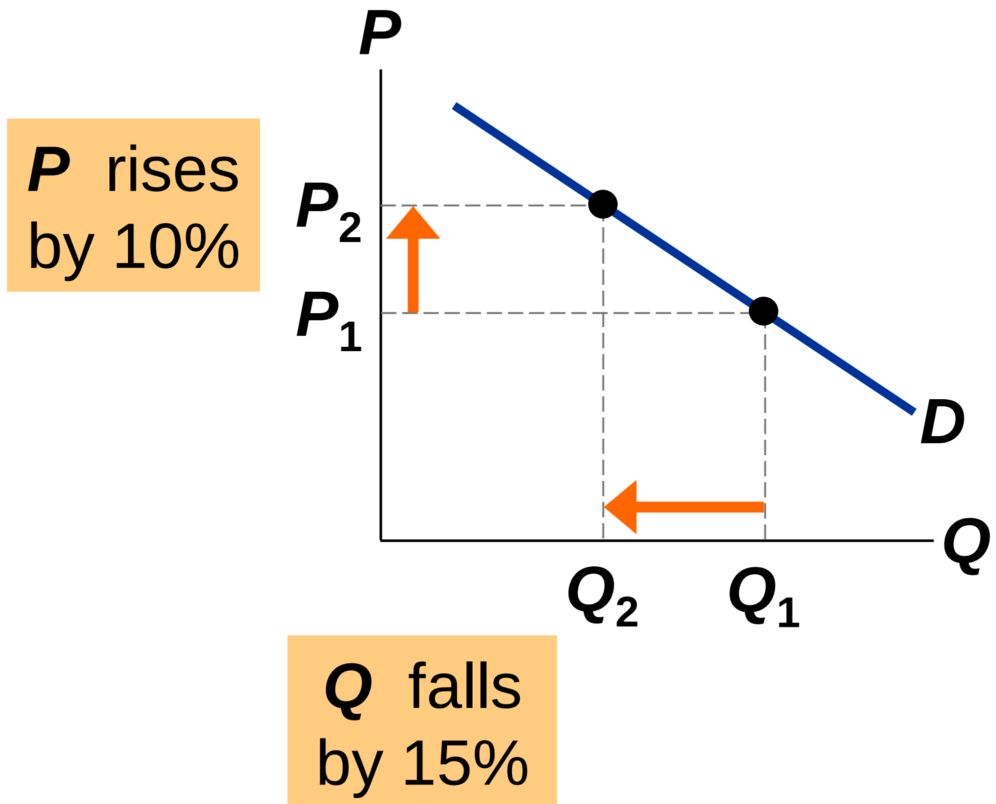
Price Elasticity of Demand

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in } \boldsymbol{Q^d}}{\text{Percentage change in } \boldsymbol{P}}$$

<u>Example:</u>

Price elasticity of demand equals

$$\frac{15\%}{10\%} = 1.5$$

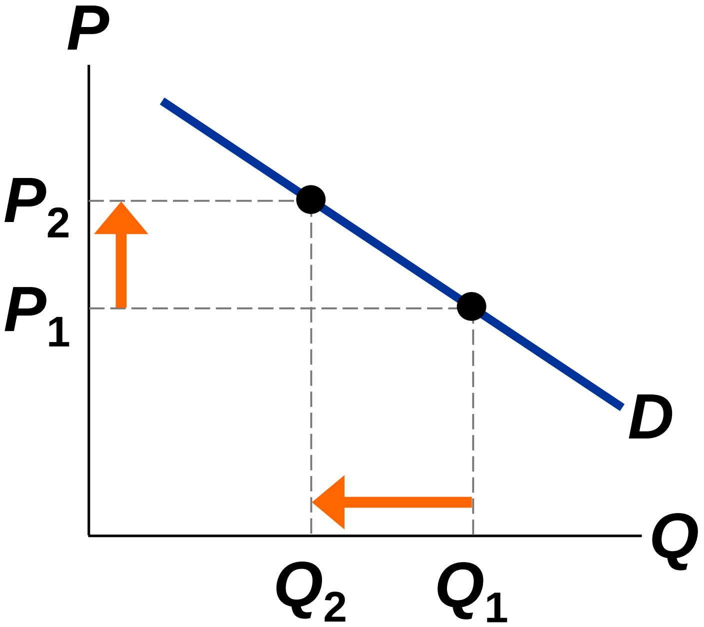


Price Elasticity of Demand

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in } \boldsymbol{Q^d}}{\text{Percentage change in } \boldsymbol{P}}$$

Along a ***D*** curve, ***P*** and ***Q*** move in opposite directions, which would make price elasticity negative.

We will drop the minus sign and report all price elasticities as positive numbers.

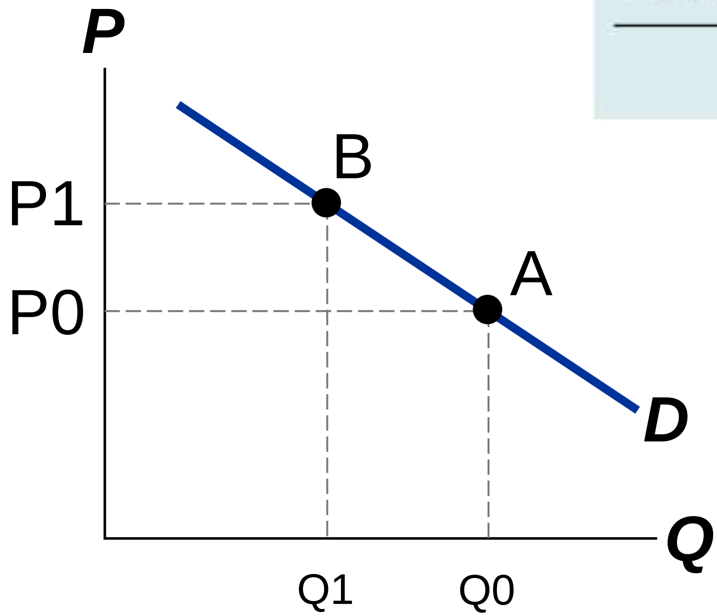


Market Demand Table

Price	Demand of individual 'A'	Demand of individual 'B'	Demand of individual 'C'	Market Demand
5	20	30	50	100
4	40	60	100	200
3	60	90	150	300
2	80	120	200	400

Calculating Percentage Changes

Standard method (Point elasticity)
of computing the percentage (%) change:



$$\frac{\text{end value} - \text{start value}}{\text{start value}} \times 100\%$$

Calculating Percentage Changes

Problem:

The standard method gives different answers depending on where you start.

Point elasticity calculation **(Point method)** gives rise to different values of elasticity based on where you start and end,

But elasticity calculation based on average values between the points **(ARC method)** where the average is chosen as denominator, avoids this problem

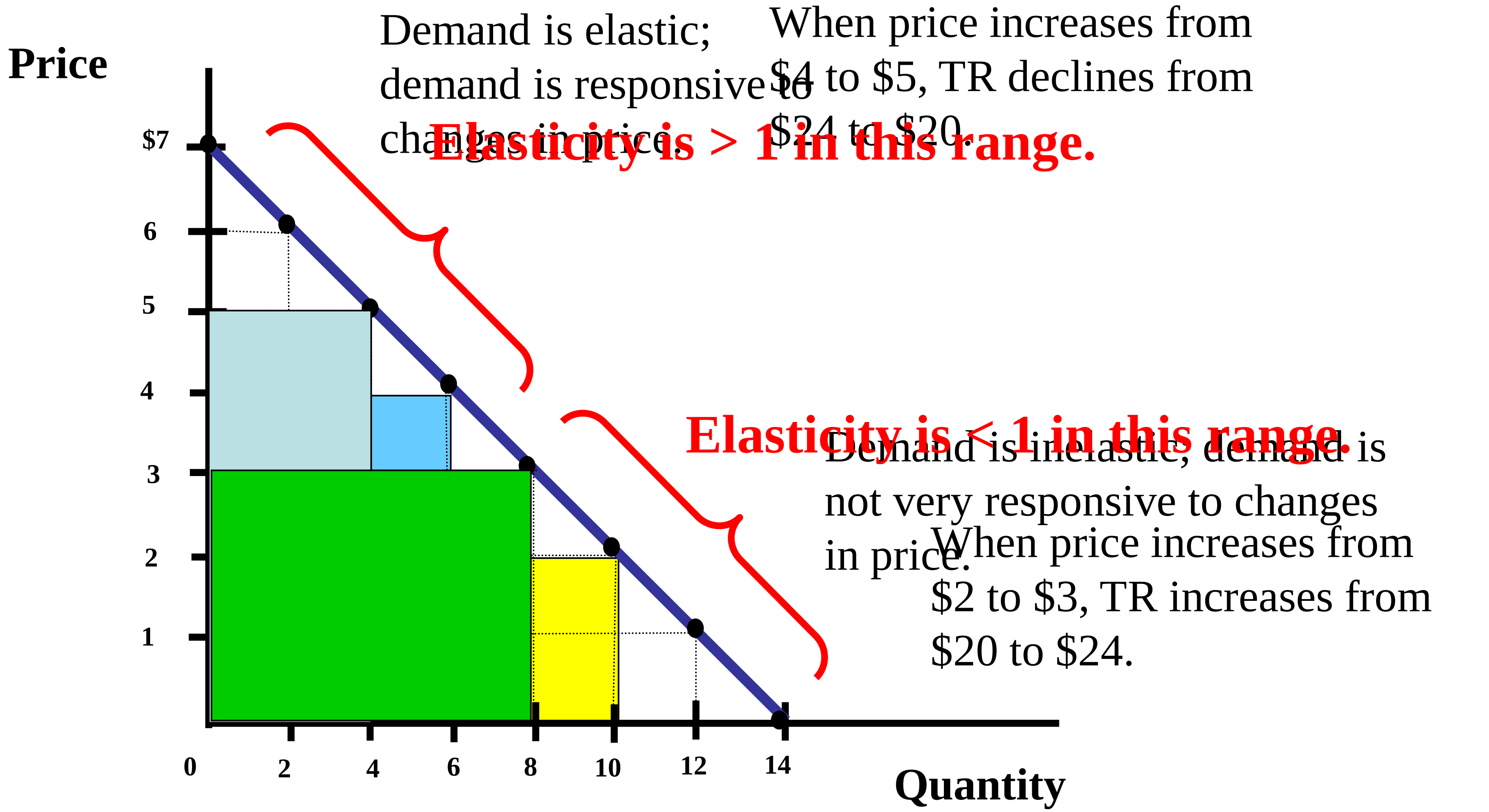
Calculating Percentage Changes

- So, we instead use the **midpoint method (ARC elasticity)**:

$$\frac{\text{end value} - \text{start value}}{\text{midpoint}} \text{ x } 100\%$$

- The midpoint is the number halfway between the start & end values, the average of those values.
- It doesn't matter which value you use as the "start" and which as the "end" – you get the same answer either way!

Elasticity of a Linear Demand Curve



What determines price elasticity?

To learn the determinants of price elasticity,
we look at a series of examples.
Each compares two common goods.

In each example:

- Suppose the prices of both goods rise by 20%.
- The good for which Q^d falls the most (in percent) has the highest price elasticity of demand. Which good is it? Why?
- What lesson does the example teach us about the determinants of the price elasticity of demand?

The concept of elasticity

- Has the London congestion charge reduced traffic flows and congestion?

- Will most people still fly if there is a new aviation fuel tax?

Price elasticity of demand

- Why is elasticity of demand important for Stelios?

Elasticity of Demand

- Why do hotels hike room-rates at weekends and why do car rental firms charge higher prices at weekend?

Elasticity Questions…are these products Price Elastic or Inelastic?

Dell cuts the price of their desktop PCs by 10%	
A fall in the price of I-max tickets	
An increase in the price of the EconomicTimes	
A taxi home from a night-club on a Friday night	
A rise in average car insurance premiums	
Petrol prices rise by 5% after the budget	
Vodafone cuts their mobile phone charges	
Aviation surcharge rises by 20% due to a rise in world oil prices	
A local leisure club decreases monthly charges by 15% in a bid to increase the number of members	

- In early 2011, Netflix consumers paid about $10 a month for a package consisting of streaming video and DVD rentals. In July 2011, the company announced a packaging change. Customers wishing to retain both streaming video and DVD rental would be charged $15.98 per month – a price increase of about 60%. In 2014, Netflix also raised its streaming video subscription price from $7.99 to $8.99 per month for new U.S. customers. The company also changed its policy of 4K streaming content from $9.00 to $12.00 per month that year.

- How do the customers react?

EXAMPLE 1:
Breakfast cereal vs. Sunscreen

- The prices of both of these goods rise by 20%. For which good does Q^d drop the most? Why?
  - Breakfast cereal has close substitutes (*e.g.*, pancakes, Eggo waffles, etc.), so buyers can easily switch if the price rises.
  - Sunscreen has no close substitutes, so consumers would probably not buy much less if its price rises.
- Lesson: ***Price elasticity is higher when close substitutes are available.***

EXAMPLE 2:
"Blue Jeans" vs. "Clothing"

- The prices of both goods rise by 20%.
  For which good does Q^d drop the most? Why?
  - For a narrowly defined good such as blue jeans, there are many substitutes (khakis, shorts, Speedos).
  - There are fewer substitutes available for broadly defined goods.
    (There aren't too many substitutes for clothing)
- Lesson: ***Price elasticity is higher for narrowly defined goods than broadly defined ones.***

EXAMPLE 3:
Insulin vs. Luxury Caribbean Cruises

- The prices of both of these goods rise by 20%. For which good does $\boldsymbol{Q}^{\mathbf{d}}$ drop the most? Why?
  - To millions of diabetics, insulin is a necessity. A rise in its price would cause little or no decrease in demand.
  - A cruise is a luxury. If the price rises, some people will forego it.
- Lesson: ***Price elasticity is higher for luxuries than for necessities.***

EXAMPLE 4:

Petrol in the Short Run vs. petrol in the Long Run

- The price of petrol rises 20%. Does Q^d drop more in the short run or the long run? Why?
  - There's not much people can do in the short run, other than ride the bus or carpool.
  - In the long run, people can buy smaller cars or live closer to where they work or alternate fuel systems may develop.
- Lesson: ***Price elasticity is higher in the long run than the short run.***

The Determinants of Price Elasticity: A Summary

The price elasticity of demand depends on:

- the extent to which close substitutes are available
- whether the good is a necessity or a luxury
- how broadly or narrowly the good is defined
- the time horizon – elasticity is higher in the long run than the short run

The Variety of Demand Curves

- The price elasticity of demand is closely related to the slope of the demand curve.
- Rule of thumb:
  The flatter the curve, the bigger the elasticity.
  The steeper the curve, the smaller the elasticity.
- Five different classifications of ***D*** curves.…

"Perfectly inelastic demand" (one extreme case)

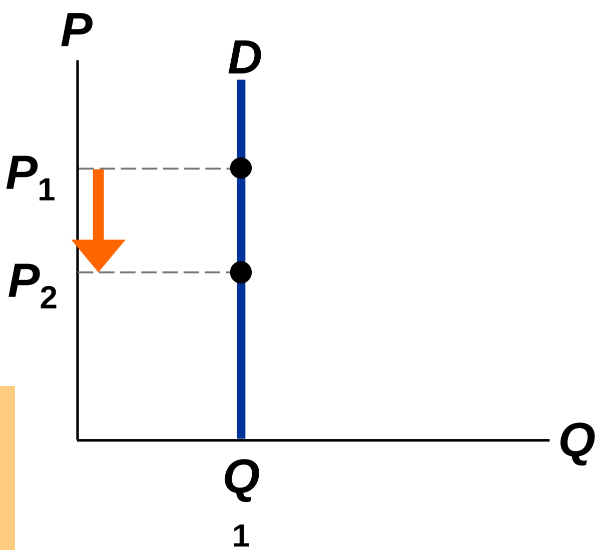
$$\text{Price elasticity of demand} = \frac{\%\text{ change in } \boldsymbol{Q}}{\%\text{ change in } \boldsymbol{P}} = \frac{0\%}{10\%} = 0$$

D curve:
vertical

Consumers' price sensitivity:
none

Elasticity: 0

P falls by 10%



Q changes by 0%

"Inelastic demand"

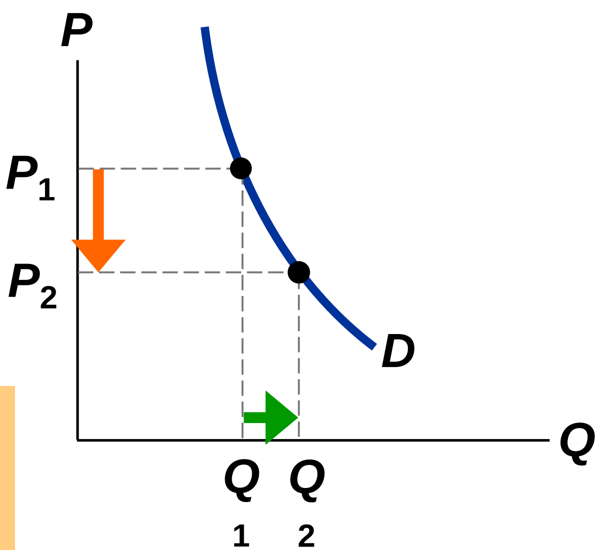
$$\text{Price elasticity of demand} = \frac{\text{\% change in } \boldsymbol{Q}}{\text{\% change in } \boldsymbol{P}} = \frac{< 10\%}{10\%} < 1$$

D curve:
relatively steep

Consumers' price sensitivity:
relatively low

Elasticity: < 1

P falls by 10%



Q rises less than 10%

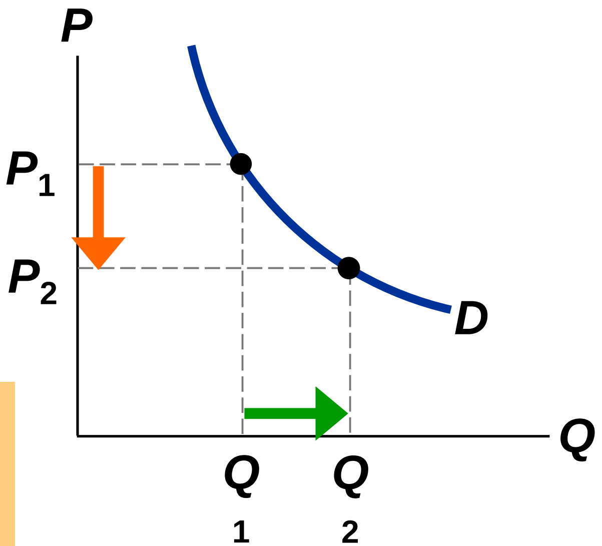
"Unit elastic demand"

$$\text{Price elasticity of demand} = \frac{\%\text{ change in } \boldsymbol{Q}}{\%\text{ change in } \boldsymbol{P}} = \frac{10\%}{10\%} = 1$$

D curve:
intermediate slope

Consumers' price sensitivity:
intermediate

Elasticity: 1



P falls by 10%

Q rises by 10%

"Elastic demand"

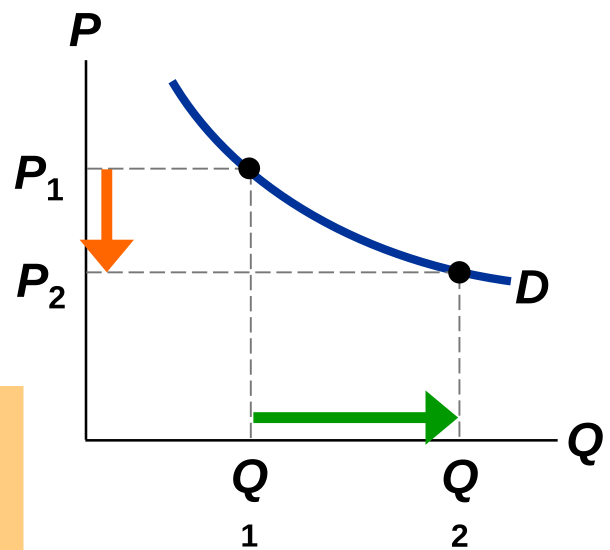
Price elasticity of demand $= \dfrac{\%\text{ change in } \boldsymbol{Q}}{\%\text{ change in } \boldsymbol{P}} = \dfrac{> 10\%}{10\%}$ > 1

D curve:
relatively flat

Consumers' price sensitivity:
relatively high

Elasticity: > 1

P falls by 10%



Q rises more than 10%

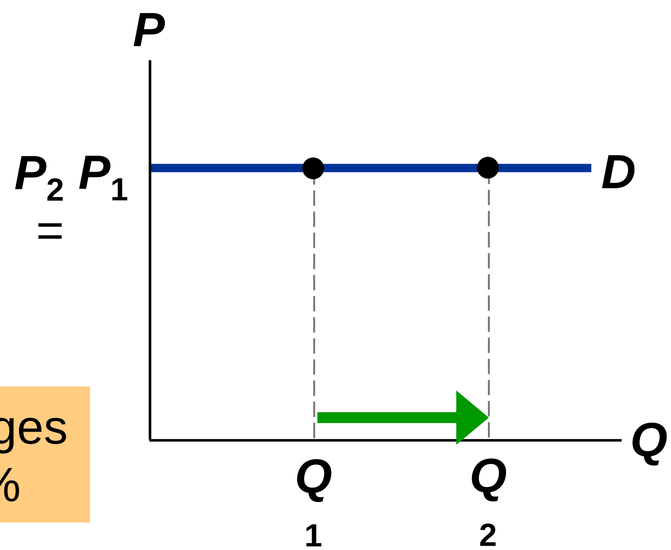
“Perfectly elastic demand” (the other extreme)

$$\text{Price elasticity of demand} = \frac{\text{\% change in } \boldsymbol{Q}}{\text{\% change in } \boldsymbol{P}} = \frac{\text{any \%}}{0\%} = \text{infinity}$$

D curve:
horizontal

Consumers’ price sensitivity:
extreme

Elasticity: infinity



P changes by 0%

Q changes by any %

Price Elasticity and Total Revenue

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in } \boldsymbol{Q}}{\text{Percentage change in } \boldsymbol{P}}$$

Revenue = ***P*** x ***Q***

- If demand is inelastic, then

  price elast. of demand < 1

  % change in ***Q*** < % change in ***P***

- The fall in revenue from lower ***Q*** is smaller than the increase in revenue from higher ***P***, so revenue rises.

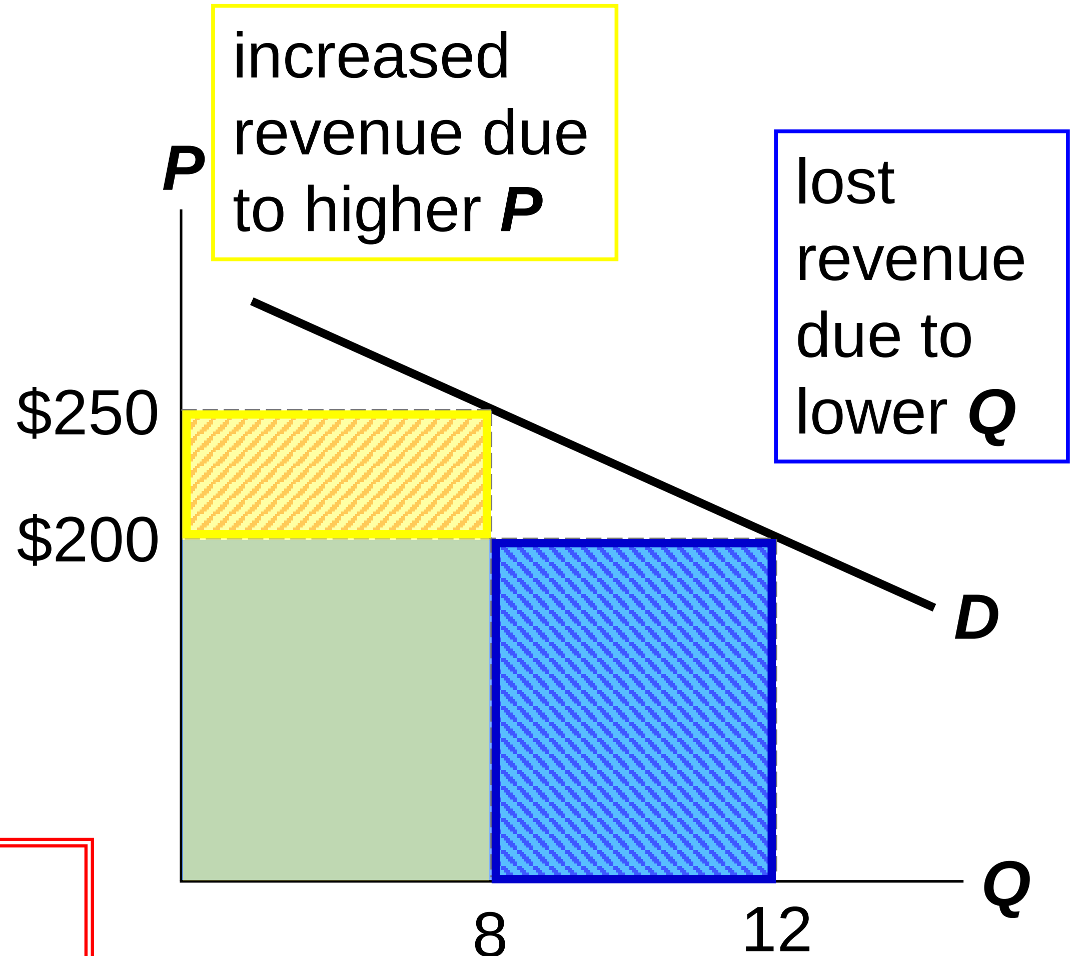
Price Elasticity and Total Revenue

Elastic demand
(elasticity = 1.8)

If ***P*** = $200,
Q = 12 and
revenue = $2400.

If ***P*** = $250,
Q = 8 and
revenue = $2000.

When ***D*** is elastic,
a price increase
causes revenue to fall.



Price Elasticity and Total Revenue

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in } \boldsymbol{Q}}{\text{Percentage change in } \boldsymbol{P}}$$

Revenue = ***P*** x ***Q***

- If demand is inelastic, then

  price elast. of demand < 1

  % change in ***Q*** < % change in ***P***

- The fall in revenue from lower ***Q*** is smaller than the increase in revenue from higher ***P***, so revenue rises.

- In our example, suppose that ***Q*** only falls to 10 (instead of 8) when you raise your price to $250.

Price Elasticity and Total Revenue

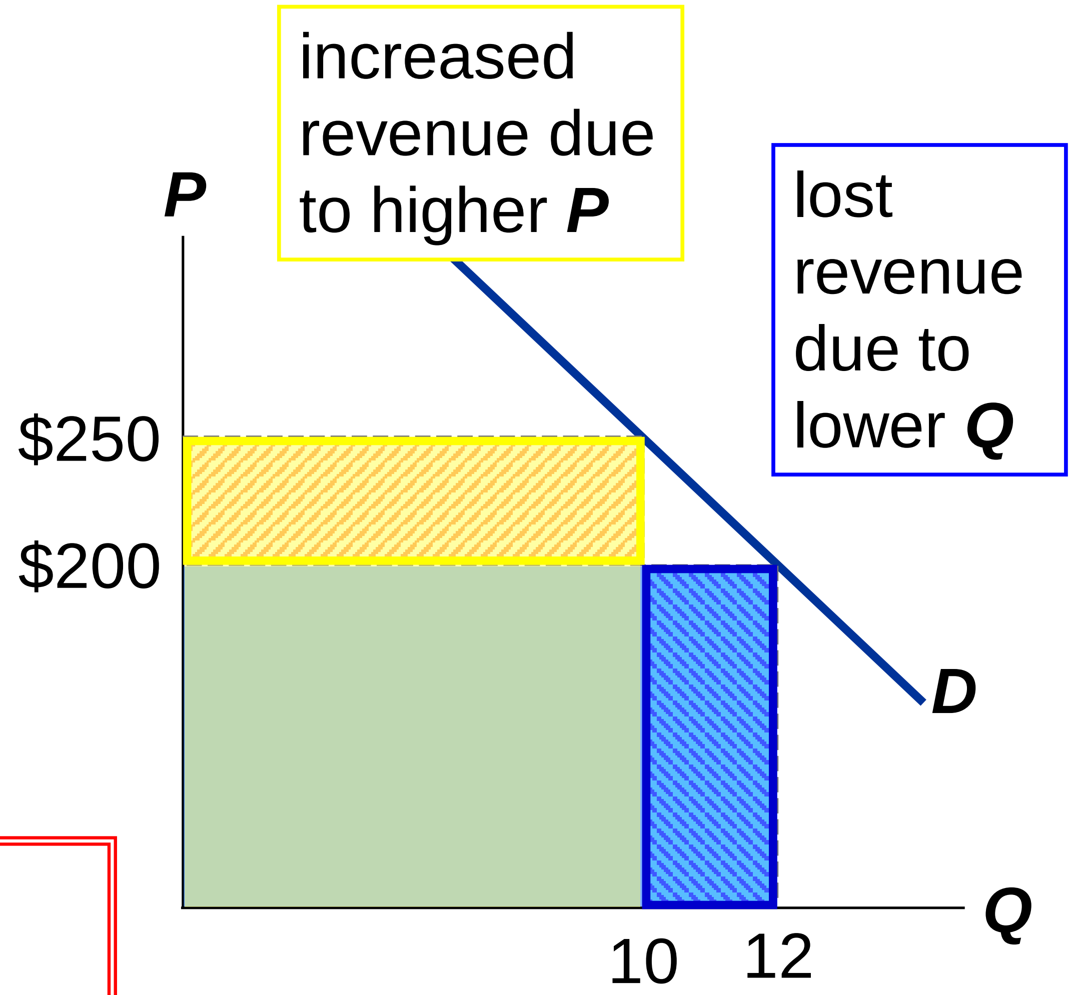
Now, demand is inelastic:

elasticity = 0.82

If ***P*** = \$200,
Q = 12 and
revenue = \$2400.

If ***P*** = \$250,
Q = 10 and
revenue = \$2500.

When ***D*** is inelastic,
a price increase
causes revenue to rise.



Computing the Price Elasticity of Demand

Example: If the price of an ice cream cone increases from \$2.00 to \$2.20 and the amount you buy falls from 10 to 8 cones then your elasticity of demand would be calculated as:

$$\frac{8-10}{10} X \frac{2}{2.20-2} = 2$$

Table-2: Demand Schedule	
Price per unit (₹)	Quantity Demanded(units)
60	100
70	90

Elasticity =

Example-1: The demand schedule for coffee is shown in Table-1:

Table-1: Demand Schedule for Coffee	
Price of Coffee (₹)	**Quantity Demanded(Kg)**
20	10
22	9

Elasticity =

Other Elasticities

- **Income elasticity of demand**: measures the response of $\boldsymbol{Q^d}$ to a change in consumer income

$$\text{Income elasticity of demand} = \frac{\text{Percent change in } \boldsymbol{Q^d}}{\text{Percent change in income}}$$

- An increase in income causes an increase in demand for *luxury* and *normal* goods.
- Income elasticity is >1 for luxury products.
- For normal goods, income elasticity > 0 but <1.
- For *inferior* goods, income elasticity < 0.

Other Elasticities

- **Cross-price elasticity of demand**:
  measures the response of demand for one good to changes in the price of another good

$$\text{Cross-price elast. of demand} = \frac{\%\text{ change in } \boldsymbol{Q^d} \text{ for good 1}}{\%\text{ change in price of good 2}}$$

- For substitutes, cross-price elasticity > 0
  (e.*g*., an increase in price of beef causes an increase in demand for chicken)
- For complements, cross-price elasticity < 0
  (*e.g*., an increase in price of computers causes decrease in demand for software)

Cross-Price Elasticities in the News

"As Fuel Costs Soar, Buyers Flock to Small Cars"

-*New York Times*, 5/2/2008

"Fuel Prices Drive Students to Online Courses"

-*Chronicle of Higher Education*, 7/8/2008

"Fuel prices knock bicycle sales, repairs into higher gear"

-*Associated Press*, 5/11/2008

"Camel demand soars in India"
(as a substitute for "fuel-guzzling tractors")

-*Financial Times*, 5/2/2008

"High fuel prices drive farmer to switch to mules"

-*Associated Press*, 5/21/2008

CHAPTER

Income Elasticity of Demand

Income Elasticity of Demand

- The income is the other factor that influences the demand for a product.

- Hence, the degree of responsiveness of a change in demand for a product due to the change in the income is known as income elasticity of demand.

INCOME ELASTICITY OF DEMAND (cont.)

FORMULA:

$$\varepsilon_Y = \frac{\%\ \Delta\ \text{Quantity Demanded}}{\%\ \Delta\ \text{Income}}$$

$$\varepsilon_Y = \frac{Q_2 - Q_1}{Q_1} \times \frac{Y_1}{Y_2 - Y_1}$$

Income Elasticity of Demand

- Income elasticity (in absolute sense) can be:

  1) Greater than 1 (normal good, income elastic)

  - **luxury goods** - ocean cruises, jewelry

  2) Between zero and 1 (normal good, income inelastic)

  - **necessities** - food, clothing

  3) Less than zero (inferior good)

  - potatoes, rice

Calculate the income elasticity of demand for X when the income of consumers increases from 200 to 400. then demand increases from 100 to 150 ,What type of product is X

Calculate the income elasticity of demand for Z when the income of consumers decreases from 200 to 100. then demand increases from 100 to 120 ,What type of product is Z

CHAPTER

Cross Elasticity of Demand

Cross Elasticity of Demand

- The cross elasticity of demand refers to the change in quantity demanded for one commodity as a result of the change in the price of another commodity.
- This type of elasticity usually arises in the case of the interrelated goods such as substitutes and complementary goods.

Cross Elasticity of Demand

- Elasticity measure that looks at the impact a change in the price of one good has on the demand of another good.
- % change in demand Q1/% change in price of Q2.
- Positive-Substitutes
- Negative-Complements.

Substitute Goods

- When the cross elasticity of demand for product A relative to a change in price of product B is positive, it means that in response to an increase (decrease) in price of product B, the quantity demanded of product A has increased (decreased). Since A, say Coke, and B, say Sprite, are substitutes, an increase in price of product B means that more people will consume A instead of B, and this will increase the quantity demanded of product A. Increase in quantity demanded of product A relative to increase in price of product B gives us a positive cross elasticity of demand.

Complementary Goods

- When the cross elasticity of demand for product A relative to change in price of product B is negative, it means that the quantity demanded of A has decreased (increased) relative to an increase (decrease) in price of product B. As A, say car, and B, say fuel, are complimentary goods, and an increase in price of B will reduce the quantity demanded of A. This is because people consume both A and B as a bundle and an increase in price reduces their purchasing power and decreases quantity demanded.

CROSS ELASTICITY OF DEMAND

FORMULA:

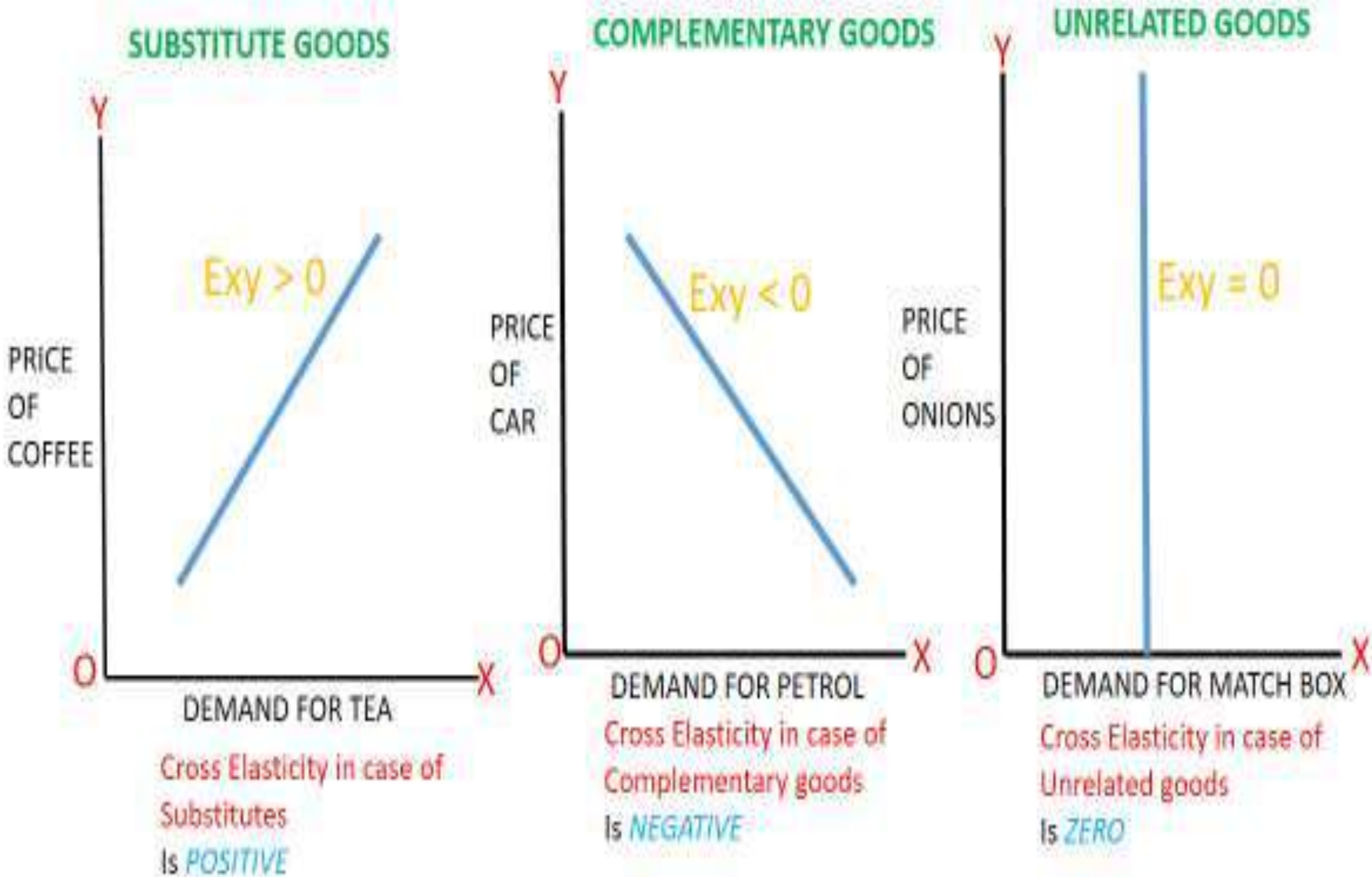
$$\varepsilon_X = \frac{\%\ \Delta\ \text{Quantity Demanded of good X}}{\%\ \Delta\ \text{Price of good Y}}$$

$$\varepsilon_X = \frac{Q_{X2} - Q_{X1}}{Q_{X1}} \times \frac{P_{Y1}}{P_{Y2} - P_{Y1}}$$

Understanding the Coefficient of Cross Price Elasticity

The stronger the relationship between two products, the higher is the co-efficient of cross-price elasticity of demand

- **Substitutes:**
  - **Close substitutes** have a strongly **positive** cross price elasticity of demand i.e. a small change in relative price causes a big switch in consumer demand
- **Complements:**
  - When there is a strong complementary relationship, the cross elasticity will be highly **negative**.
  - An example might be games consoles and software games
- **Unrelated products:**
  - Unrelated products have **zero** cross elasticity e.g. the effect of changes in taxi fares on the market demand for cheese!



SUBSTITUTE GOODS
Y
Exy > 0
PRICE
OF
COFFEE
O
X
DEMAND FOR TEA
Cross Elasticity in case of
Substitutes
Is POSITIVE
COMPLEMENTARY GOODS
Y
Exy < 0
PRICE
OF
CAR
O
X
DEMAND FOR PETROL
Cross Elasticity in case of
Complementary goods
Is NEGATIVE
UNRELATED GOODS
Y
Exy = 0
PRICE
OF
ONIONS
O
X
DEMAND FOR MATCH BOX
Cross Elasticity in case of
Unrelated goods
Is ZERO

Price of X	Demand for X	Demand for Y	Income
25	10	5	100
20	20	10	200
15	30	15	300
10	40	20	400

- Calculate the price elasticity of demand for X, if the price of X increase from Rs10 to Rs 20, and indicate whether the demand is elastic or inelastic.
- Calculate the income elasticity of demand for X when the income of consumers increases from 200 to 400.What type of product is X.
- Calculate the cross elasticity of demand for Y when the price of X decrease from 25 to 15. Are X and Y complements or substitute.

$$\frac{20-40}{40} X \frac{10}{20-10}$$

Ep = 20/40 X 10/10

Ep = 0.5

Inelastic demand

$$\frac{Q2-Q1}{Q1} X \frac{Y1}{Y2-Y1}$$

$$\frac{40-20}{20} X \frac{200}{400-200}$$

- Ep = 20 / 20 X 200 / 200
- Ep = 1
- Since its equal to 1 and positive , so A is Normal good

$$\frac{Qy2 - Qy1}{Qy1} X \frac{Px1}{Px2 - Px1}$$

$$\frac{15 - 5}{5} X \frac{25}{15 - 25}$$

Ep = 10/5 X 25/-10

Ep = 2 X -2.5

Ep = - 5 (Complementary Goods)

Income Elasticity of Demand

- Income elasticity of demand measures how much the quantity demanded of a good responds to a change in consumers' income.
- It is computed as the percentage change in the quantity demanded divided by the percentage change in income.

Computing Income Elasticity

$$\text{Income Elasticity of Demand} = \frac{\text{Percentage Change in Quantity Demanded}}{\text{Percentage Change in Income}}$$

- Income increases from Rs 100 to Rs 110, and quantity demanded also increases from 50 to 55. then income elasticity of demand will be -

Income Elasticity
- Types of Goods -

Normal Goods

Income Elasticity is positive.

Inferior Goods

Income Elasticity is negative.

Higher income *raises* the quantity demanded for normal goods but *lowers* the quantity demanded for inferior goods.

Elasticity

- **Cross Elasticity:**
- The responsiveness of demand of one good to changes in the price of a related good – either a substitute or a complement

$$Xed = \frac{\%\ \Delta\ Qd\ \text{of good t}}{\%\ \Delta\ \text{Price of good y}}$$

- If quantity demanded of X increases by 5 % when the price of Y increases by 20 % the cross price elasticity would be – Qx/Py

- If quantity demanded of A increases by 10 % when the price of B declines by 20 %, the cross price elasticity of demand between A and B would be – QA/PB

Supply

- The various amounts of a product that producers are willing and able to supply at various prices during some specific period
- Demonstrated by the supply schedule and supply curve

Law of Supply and illustrations

- Corn crops are very plentiful over the course of the year and there is more corn than people would normally buy. To get rid of the excess supply, producers need to lower the price of corn and thus the price is driven down for everyone.

- There is a drought and very few strawberries are available. More people want the strawberries than there are berries available. The price of strawberries increases dramatically.

- A huge wave of new, unskilled workers come to a city and all of the workers are willing to take jobs at low wages. Because there are more workers than there are available jobs, the excess supply of workers drives wages downward.

On the other side

- A popular artist dies and, thus, he obviously will be producing no more art. Demand for his art increases substantially as people want to purchase the few pieces that exist.

- A new restaurant opens up in town and gets great reviews. There are only 12 tables in the restaurant but everyone wants to get a reservation. Demand for the reservations goes up.

Law of Supply

- Direct relationship between the price and quantity supplied
- Increased price causes increased quantity supplied
- Decreased price causes decreased quantity supplied

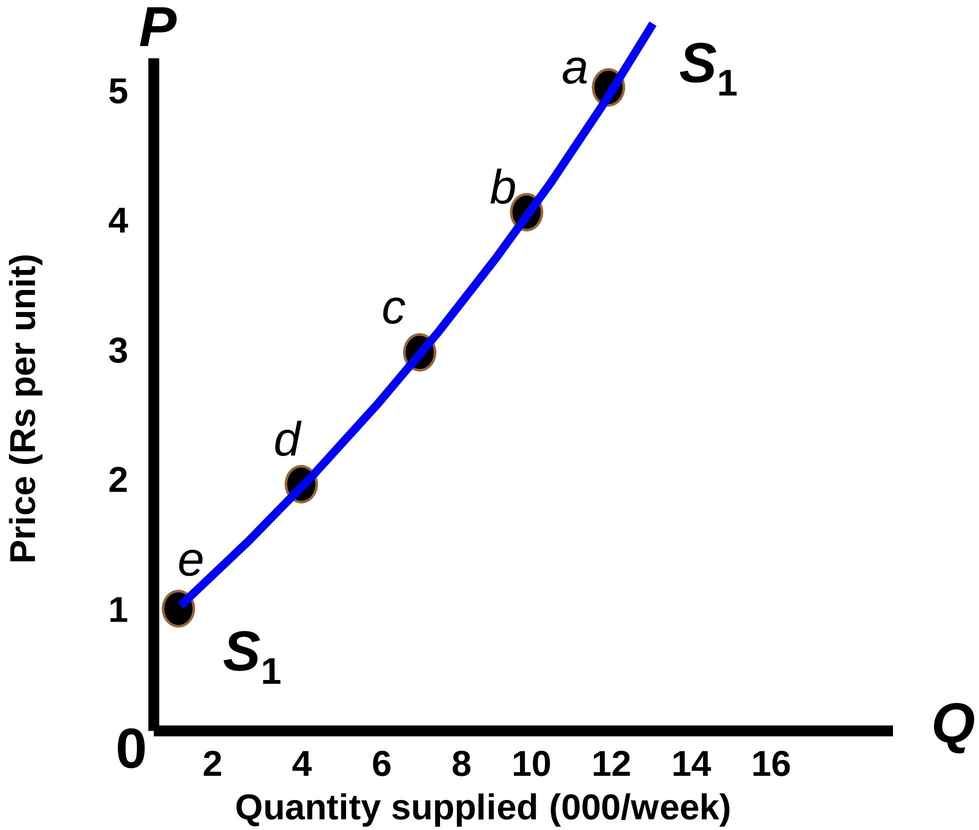
Market Supply

	Price per unit (Rs)	Quantity supplied per week
a	5	12 000
b	4	10 000
c	3	7 000
d	2	4 000
e	1	

1

000

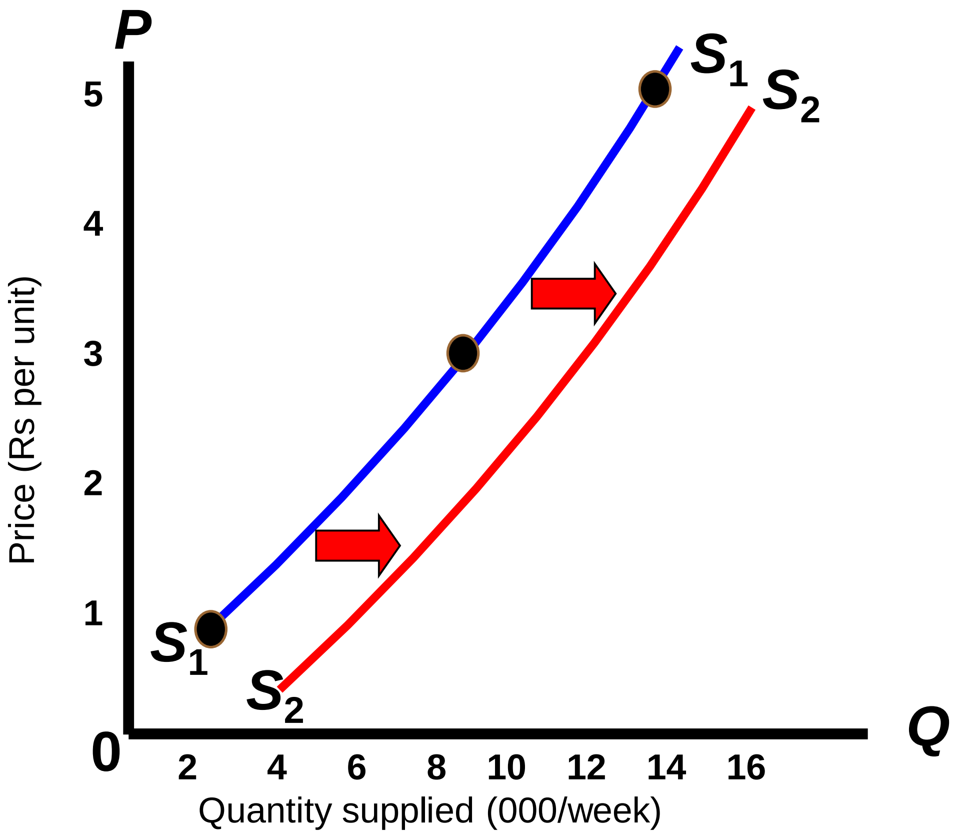
Supply Curve



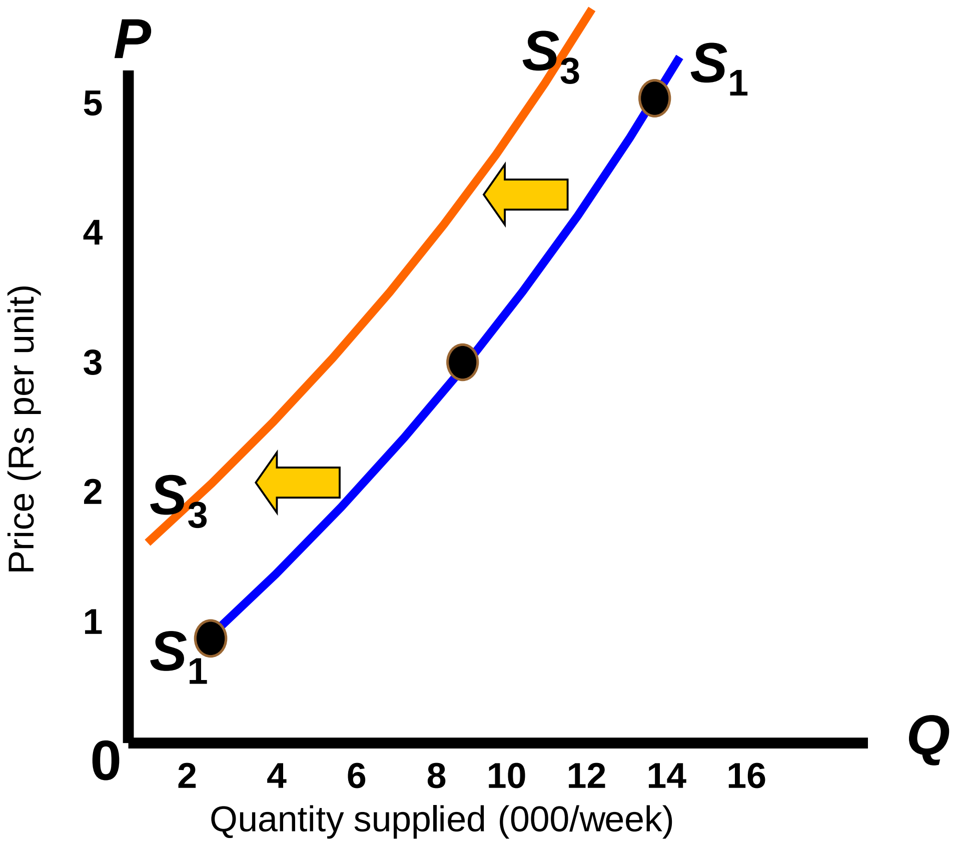
Change in Supply

- represented as a shift of the supply curve
- caused by changes in determinants of supply other than price

Increase in Supply



Decrease in Supply



Non-price determinants of Supply

- Resource price
- Technology
- Prices of other goods
- Expectations
- Number of sellers
- [Note mostly related to changing costs of production reflecting marginal cost curve]

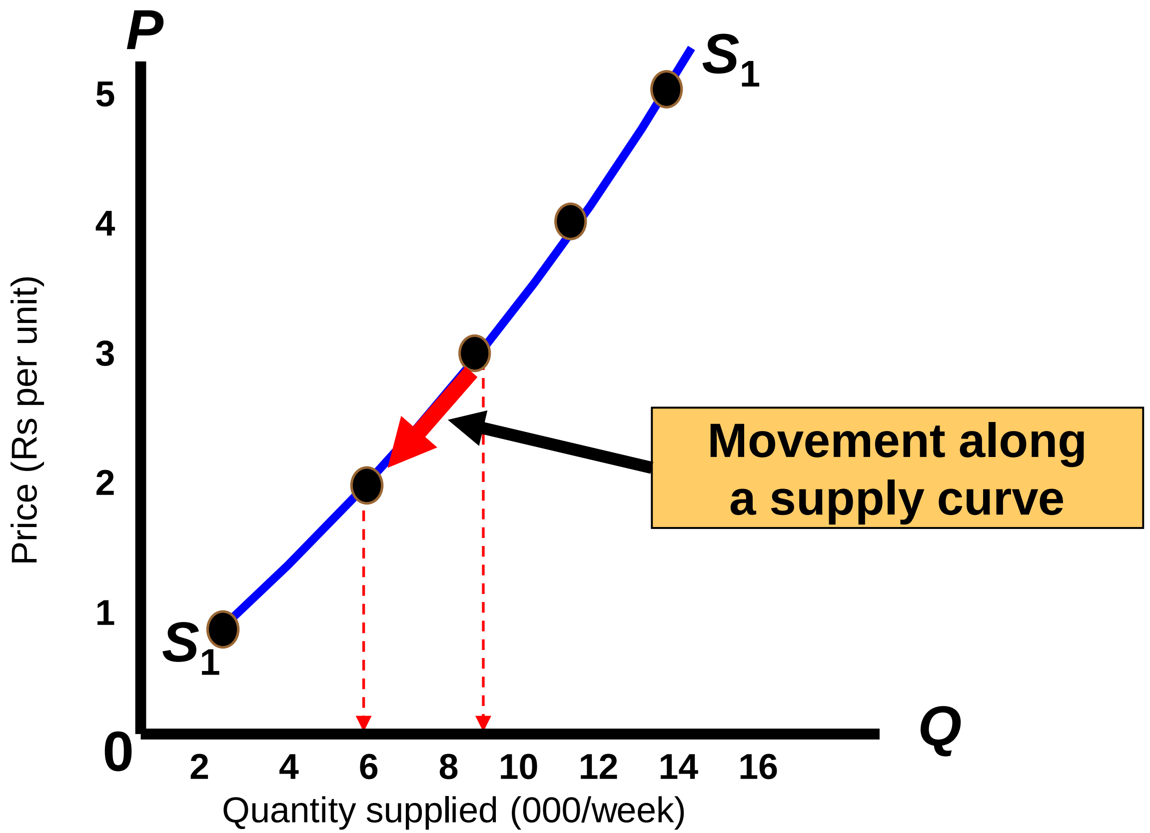
Variables that Influence Sellers

Variable	A change in this variable…
Price	…causes a movement along the ***S*** curve
Input Prices	…shifts the ***S*** curve
Technology	…shifts the ***S*** curve
# of Sellers	…shifts the ***S*** curve
Expectations	…shifts the ***S*** curve

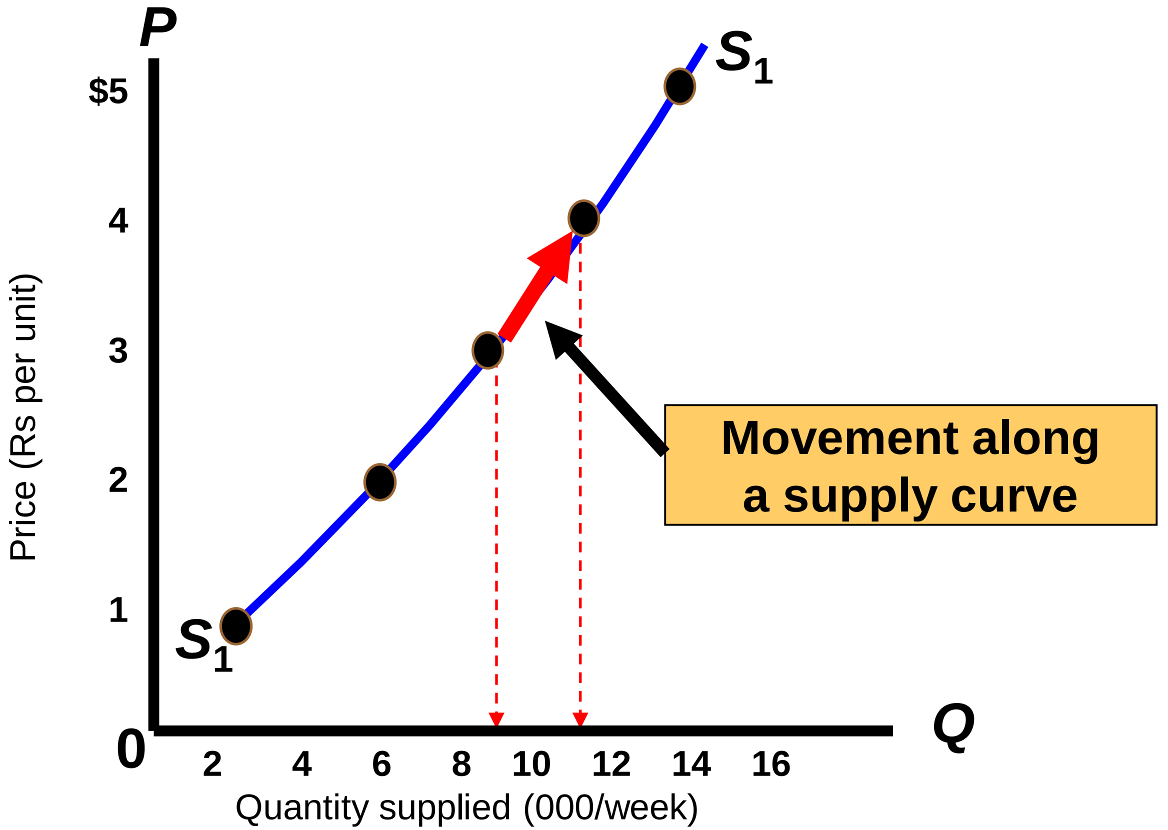
Changes in Quantity Supplied

- Caused by changes in price only
- Represented as a movement along a supply curve

Movement along a Supply Curve

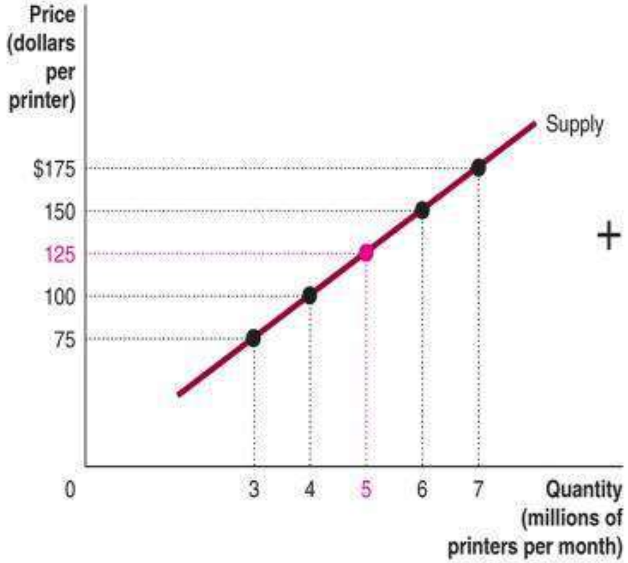


Movement along a Supply Curve



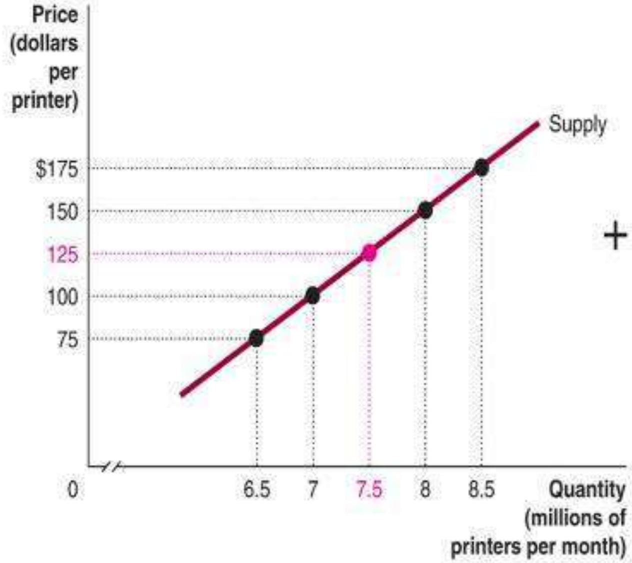
Deriving the market supply curve from individual curves

Price (dollars per printer)	Quantity (millions of printers per month) Epson	Lexmark	Hewlett-Packard	Market
$175	7	8.5	10	25.5
150	6	8	9.5	23.5
125	5	7.5	9	21.5
100	4	7	8.5	19.5
75	3	6.5	8	17.5



(a) Epson's supply curve

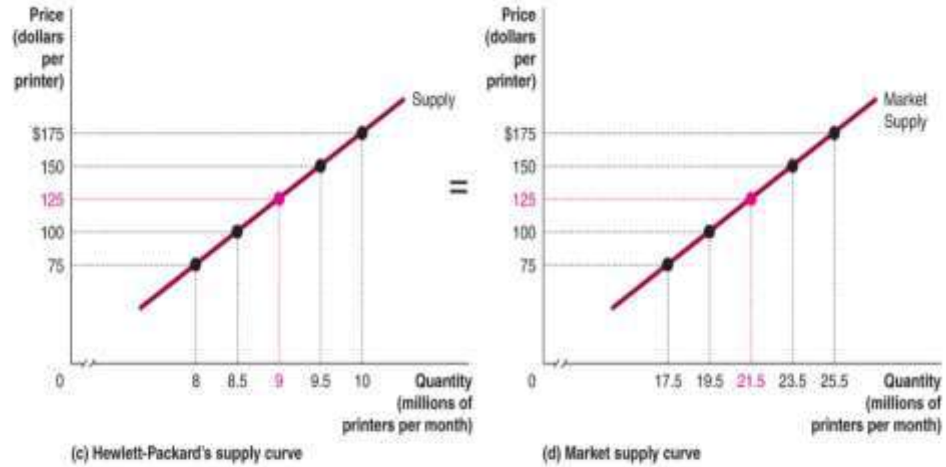
+



(b) Lexmark's supply curve

+

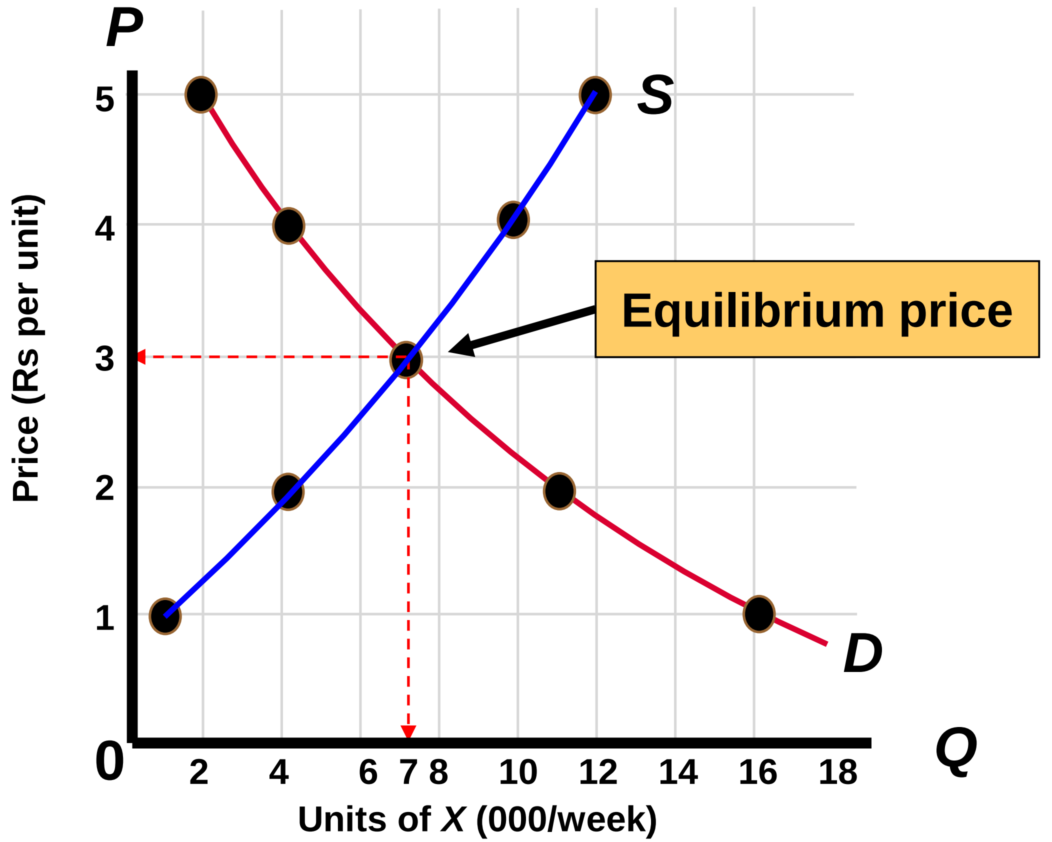
Deriving the market supply curve from individual curves



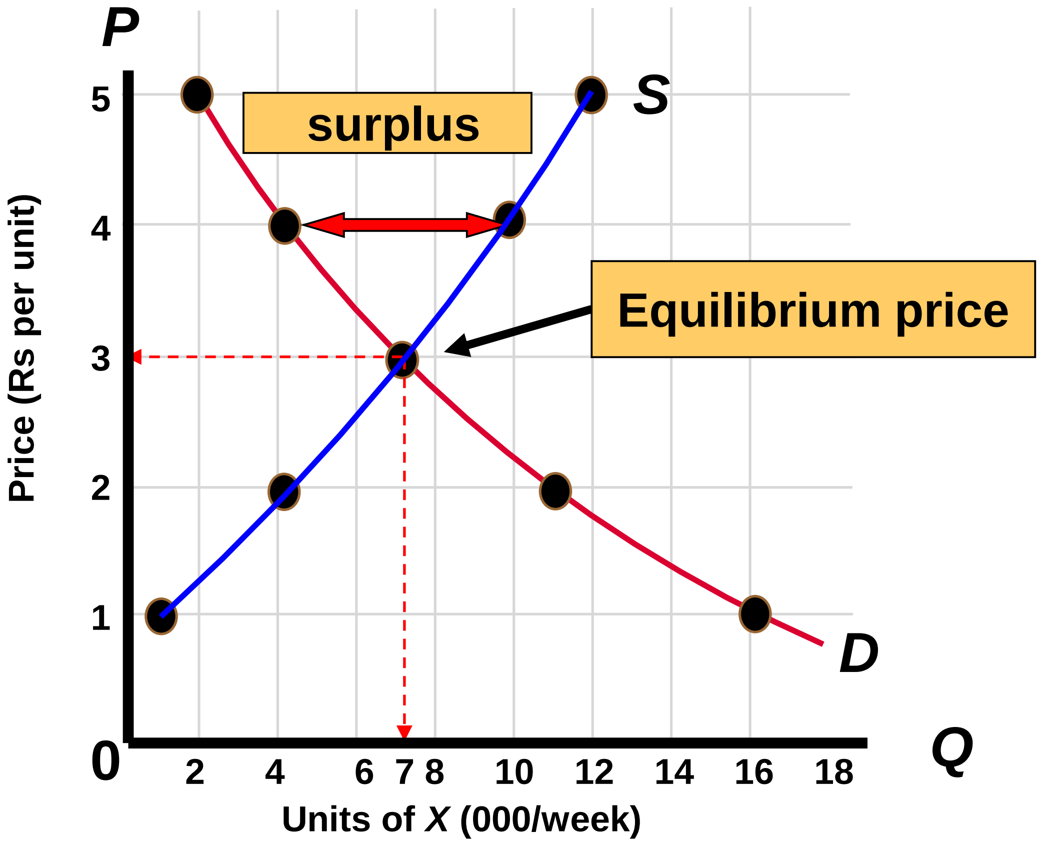
Market Equilibrium

- Occurs when the buying decisions of households and the selling decisions of producers are equated
- Determines the equilibrium price and equilibrium quantity bought and sold in the market

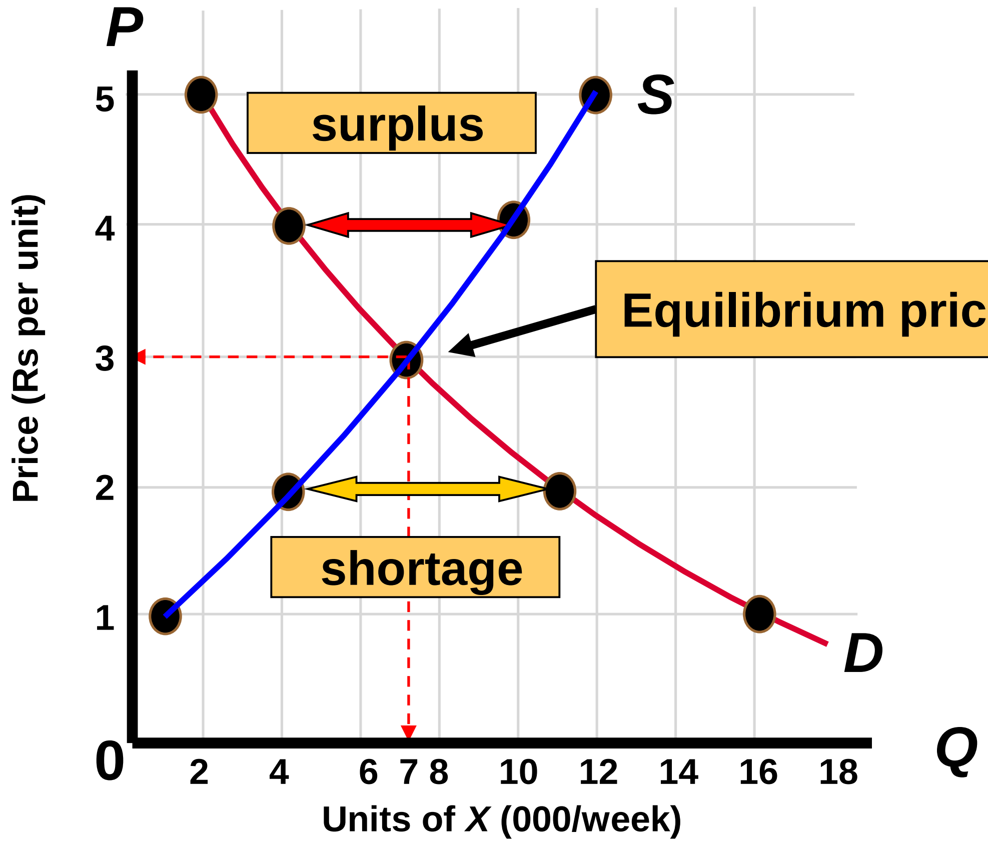
Market Equilibrium (cont.)



Market Equilibrium (cont.)



Market Equilibrium (cont.)



How the Law of Supply and Demand Works

- A company sets the price of its product at Rs 10.00. No one wants the product, so the price is lowered to Rs 9.00. Demand for the product increases at the new lower price point and the company begins to make money and a profit.

- The company could lower the price to Rs 5.00 to increase demand even more, but the increase in the number of people buying the product would not make up money lost when the price point was lowered from Rs 9.00 to Rs 5.00. The company leaves the price set at Rs 9.00 because that is the point at which supply and demand are in equilibrium. Raising the price would reduce demand and make the company less profitable, while lowering the price would not increase demand by enough to make up the money lost.

Shortage (Excess Demand)

- Occurs when the quantity demanded exceeds the quantity supplied at the current price
- Competition amongst buyers eventually bids up the price until equilibrium is reached

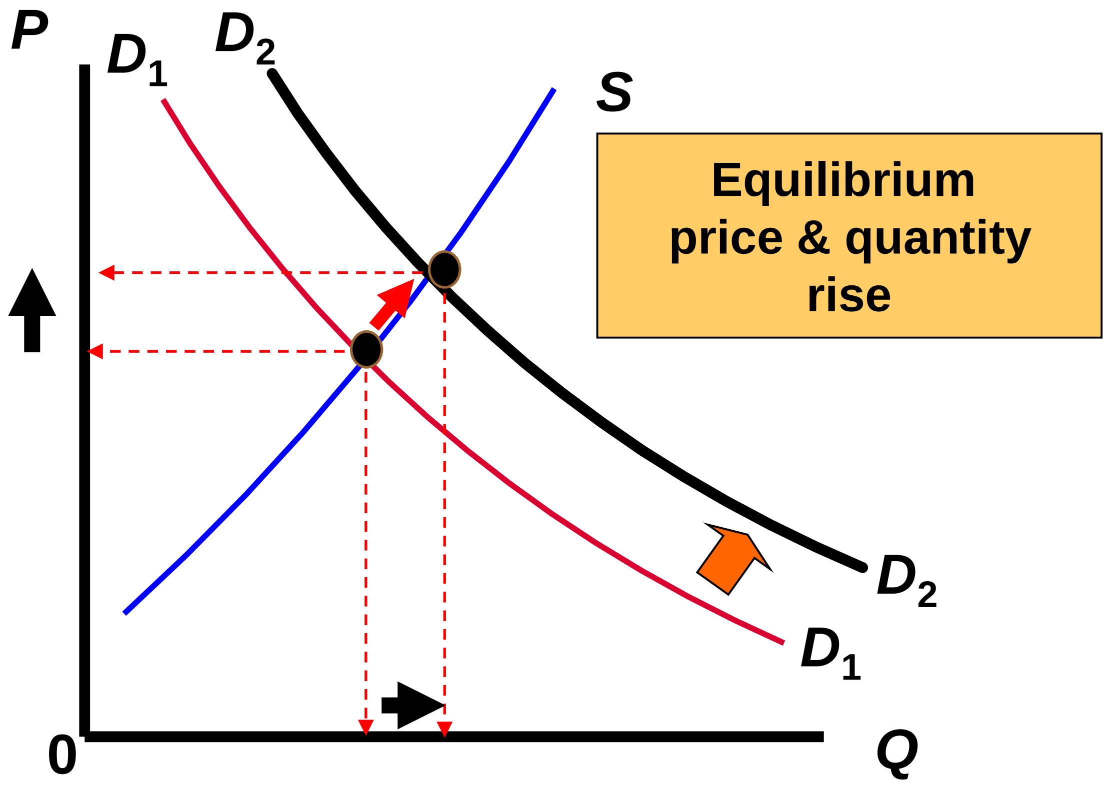
Surplus (Excess Supply)

- Occurs when the quantity supplied exceeds the quantity demanded at the current price
- Competition amongst producers eventually causes the price to decline until equilibrium is reached

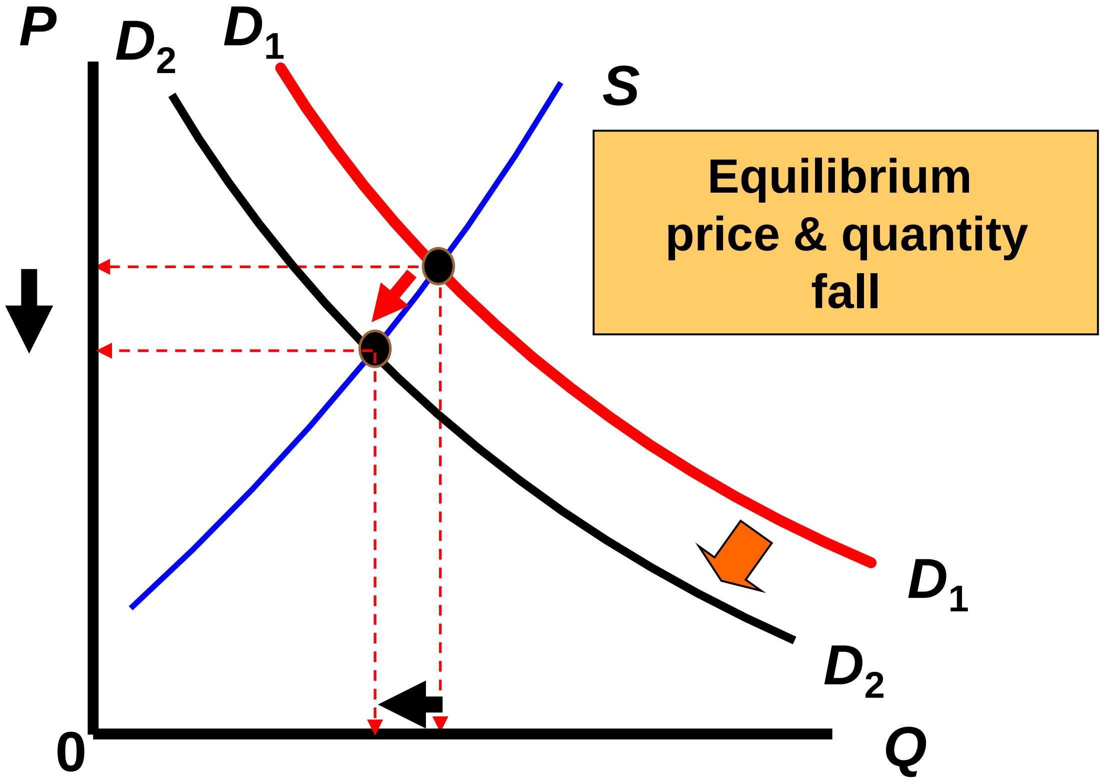
Changes in Demand and Supply

- Changes or shifts will disrupt the equilibrium
- The market will adjust until once again an equilibrium is reached
- The equilibrium price and quantity traded will change

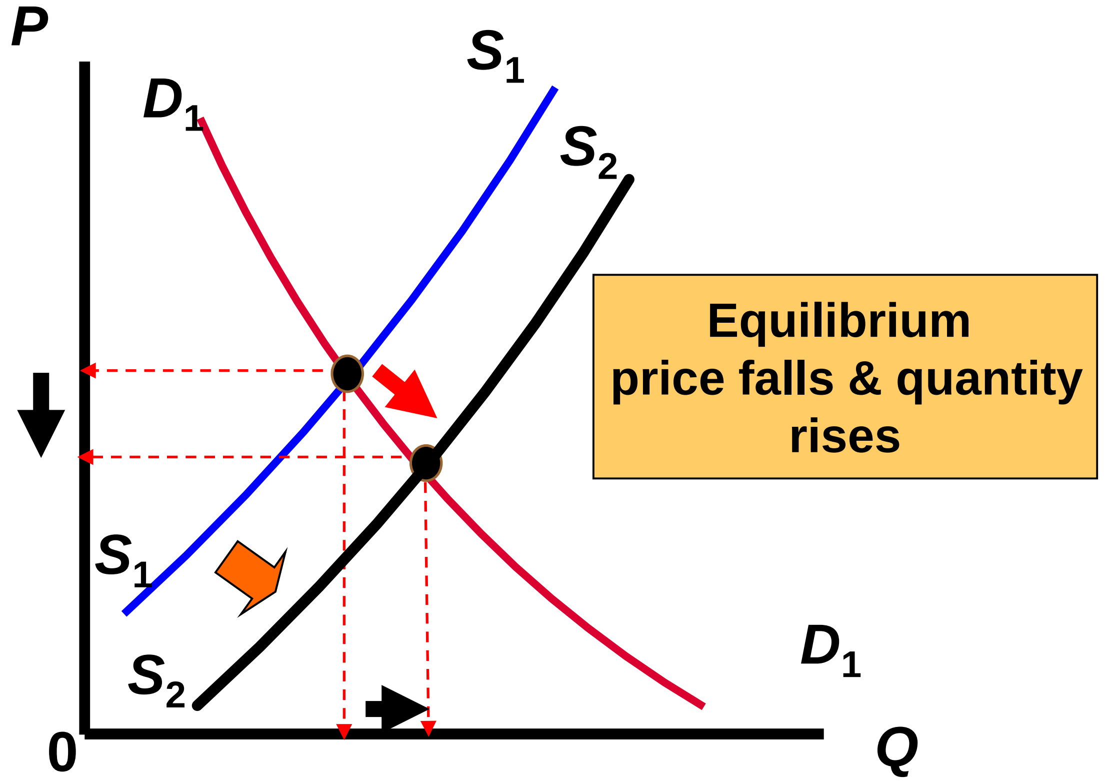
Increase in Demand



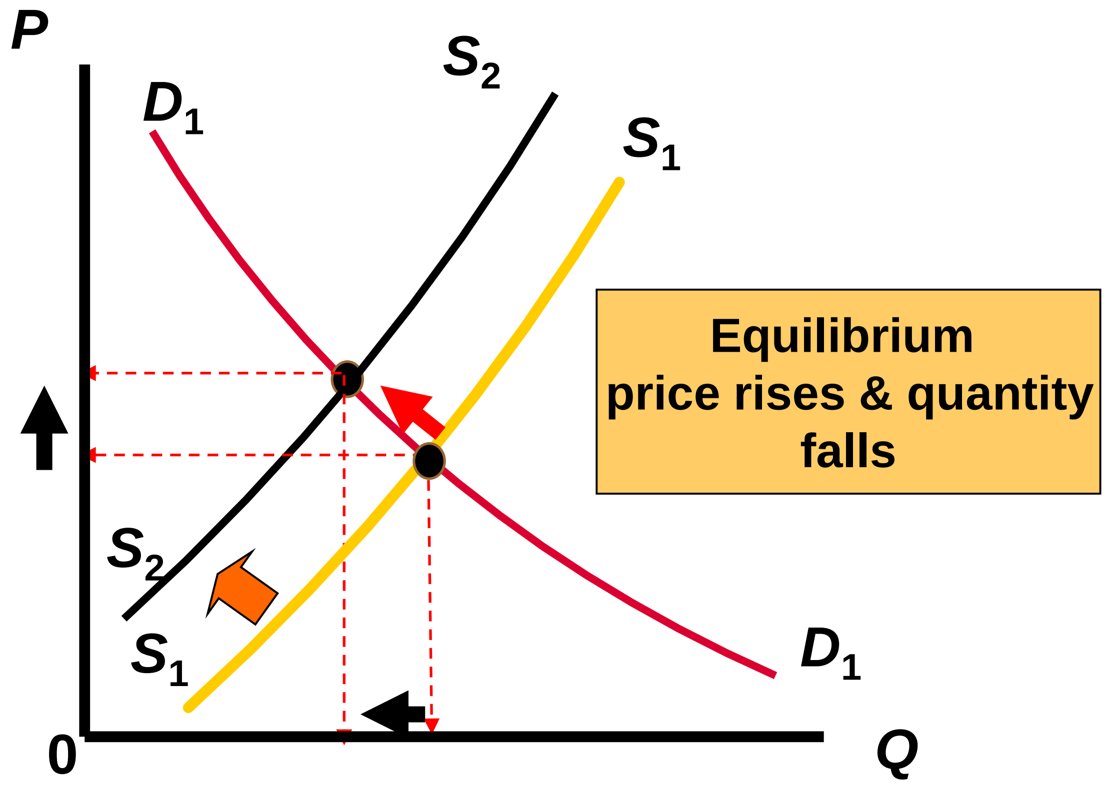
Decrease in Demand



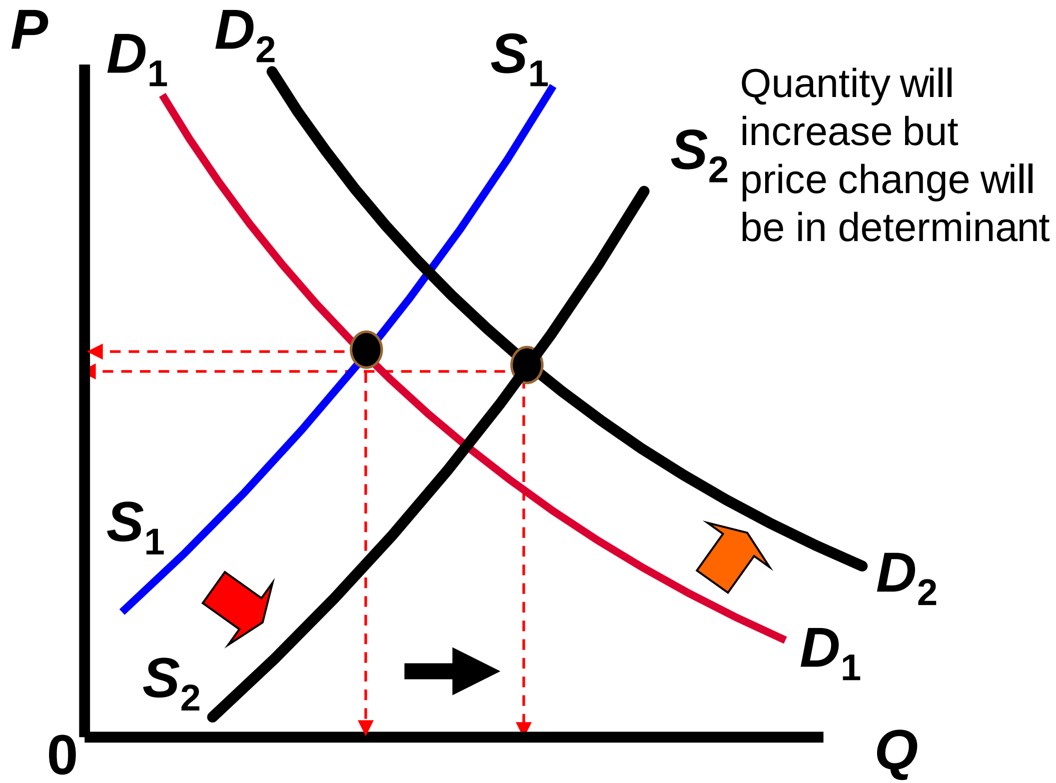
Increase in Supply



Decrease in Supply



Both Demand & Supply Increase



Demand or Supply change

- Increase in D: P increases; Q decreases
- Decrease in D: P decreases; Q increases
- Increase in S: P decreases; Q increases
- Decrease in S: P increases; Q decreases

Both Demand & Supply change

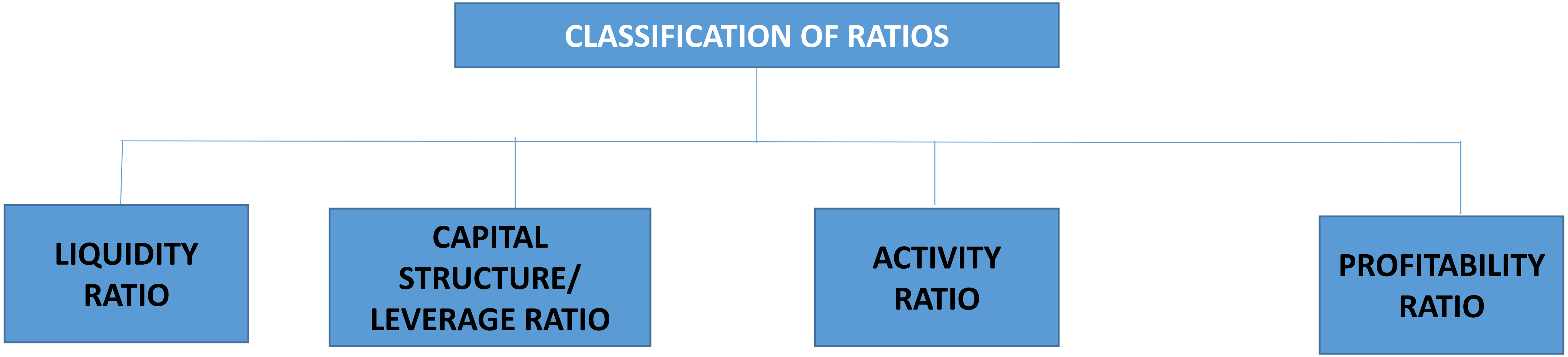
- Demand increases and supply increases; Q must rise but P??
- Demand increases and supply decreases; P must rise but Q??
- Demand decreases and supply increases; P must fall but Q??
- Demand decreases and supply decreases; Q must fall but P??

Both Demand & Supply change

- The overall change in the indeterminate side of the market, i.e. P or Q depends on the relative shifts in DD and SS.

RATIO ANALYSIS

A ratio is an expression of relationship between two numerical values. Ratio analysis is used as a benchmark for evaluating the financial position and performance of a business firm.



Liquidity Ratios refer to the ratios which measure the short term solvency of a business enterprise. These ratios indicate the ability of a business enterprise in meeting its short term liabilities.

Next Slide shows the types of liquidity ratios.

The subdivisions of Liquidity Ratio, Capital Structure Ratio, Activity/Turnover Ratio and Profitability Ratios

LIQUIDITY RATIO	CAPITAL STRUCTURE/ LEVERAGE RATI	ACTIVITY RATIO	PROFITABILITY RATIO
CURRENT RATIO	PROPRIETORY RATIO	TOTAL ASSETS TURNOVER RATIO	RETURN ON INVESTMENT
QUICK RATIO/ACID RATIO	DEBT-EQUITY RATIO	FIXED ASSETS TURNOVER RATIO	RETURN ON EQUITY
LIQUIDITY RATIO	CAPITAL GEARING RATIO	CURRENT ASSETS TURNOVER RATIO	NET PROFIT RATIO
CASH RATIO	FINANCIAL LEVERAGE	WORKING CAPITAL RATIO	PROFIT VOLUME RATIO
BASIC DEFENCE INTERVAL	DEBT SERVICE COVERAGE RATIO	CAPITAL TURNOVER RATIO	OPERATING PROFIT RATIO
INVENTORY TO WORKING CAPITAL RATIO		INVENTORY TURNOVER RATIO	EARNING PER SHARE
			YIELD RATIO

Types of Liquidity Ratio

Types of Liquidity Ratio	Meaning & interpretation	formula	inclusions
CURRENT RATIO	It refers to the ratio between current assets and current liabilities. It shows the extent of current assets available for 'each rupee of current liabilities'.	$\frac{\text{Current Assets}}{\text{Current Liabilities}}$	***Current Asset*** include inventories, receivables, cash and bank balances, marketable securities. ***Current Liabilities*** include creditors, short term loans, bank overdraft, outstanding expenses, incomes received in advance.
QUICK RATIO/ ACID TEST RATIO	It refers to ratio between Liquid Assets and Liquid Liabilities. It indicates the extent of 'immediately realizable assets' available for payment of current liabilities which may be 'instantly demanded'	$\frac{\text{Quick Assets}}{\text{Quick Liabilities}}$	Quick Asset includes all current assets - inventory and prepaid expenses. Quick Liabilities include all current liabilities - bank overdraft and income received in advance.

Types of Liquidity Ratio (Continuation)

Ratio	Meaning & intrepretation	formula	inclusions
INVENTORY TO WORKING CAPITAL RATIO	It indicates the extent of working capital blocked in inventory, which cannot be immediately realized.	$\frac{\text{Inventory}}{\text{Net Working Capital}}$	***Working Capital=*** Current Asset – Current Liabilities

Capital Structure Ratios refers to ratios which indicate the capital structure of the company, the risk associated with the capital structure and long term solvency position of the company.

Types of capital structure ratio

Types of Capital Structure Ratio	Meaning & intrepretation	formula	inclusions
PROPRIETORY RATIO	It indicates the extent to which the assets are funded out of owner's funds. Higher percentage indicates low risk and vece versa.	$\frac{\textbf{Total Assets}}{\textbf{Shareholders' funds}}$	***Shareholders' funds* =** Share Capital = Other Equity – Miscellaneous Expenses and Losses
DEBT EQUITY RATIO	It indicates the proportion of debt to equity. Higher number indicates high risk for the company	$\frac{\textbf{Debt}}{\textbf{Equity}}$	Debt = Secured Loans + Unsecured Loans Equity = Share Capital + Other Equity – Miscellaneous Expenses and losses.

Unit 4

Time Value of Money and Depreciation

Lots of Questions: Project/$ driven

- Why do this at all?
  - Is there a need for the project?
- Why do it now?
  - Can it be delayed? Can we afford it now?
- Why do it this way?
  - Is this the best alternative? Is this the optimal solution?
- Will the project pay?
  - Will we run a loss or make a profit?

Sample Engineering Project

Hydro vs. Thermal power

- **Hydro:**
  - expensive initially
  - far away from load centres (high transmission cost)
  - no fuel required
  - longer life
  - no pollution
- **Thermal**
  - less expensive initially
  - can be near load centres
  - require fuel
  - shorter life
  - can cause pollution

Other examples

- **Buy** vs. **rent** (car, house, equipment)
- **Good quality (expensive) but longer life vs. poor quality (cheap) but shorter life**
  - **car, shoes, computers**
- **Investments decisions - GIC, Bonds, Stocks and Shares**

Steps in Engineering Economics Study

- **Define alternatives in physical terms**
- **Cost and revenue estimates**
- **All money estimates placed on a comparable basis**
  - **appropriate interest rate used**
  - **time horizon (economic life)**
- **Recommend choice among alternatives**

The Time Value of Money

- The Interest Rate
- Simple Interest
- Compound Interest
- Discount Rate

The Terminology of Time Value

- **Present Value - An amount of money today, or the current value of a future cash flow**
- **Future Value - An amount of money at some future time period**
- **Period - A length of time (often a year, but can be a month, week, day, hour, etc.)**
- **Interest Rate - The compensation paid to a lender (or saver) for the use of funds expressed as a percentage for a period (normally expressed as an annual rate)**

The Interest Rate

Which would you prefer -- $10,000 today or $10,000 in 5 years?

Obviously, $10,000 today.

You already recognize that there is *TIME VALUE TO MONEY*!!

Why TIME?

Why is TIME such an important element in your decision?

TIME allows you the *opportunity* to postpone consumption and earn INTEREST.

Types of Interest

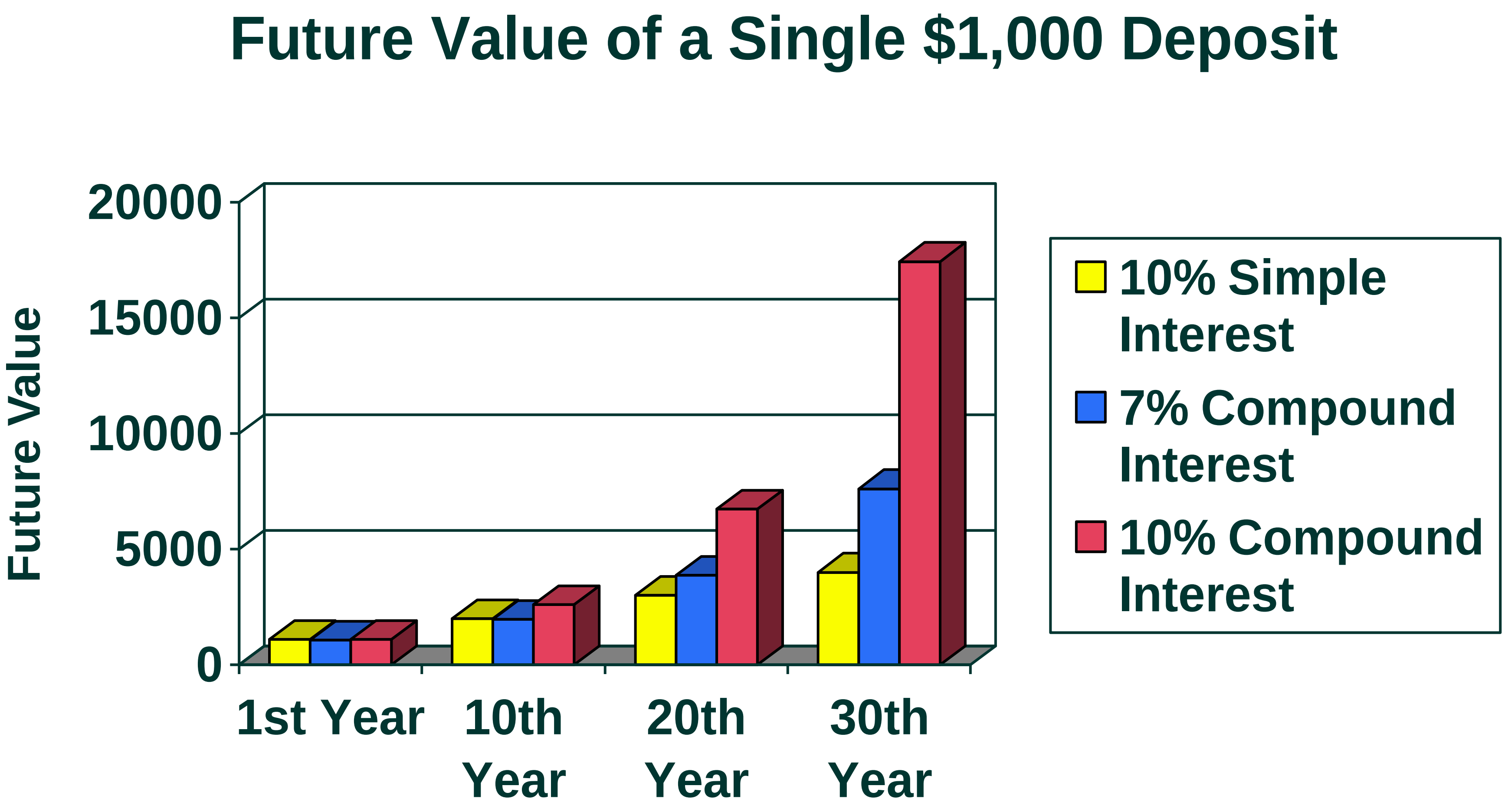
- **Simple Interest**

  Interest paid (earned) on only the original amount, or principal, borrowed (lent).

- **Compound Interest**

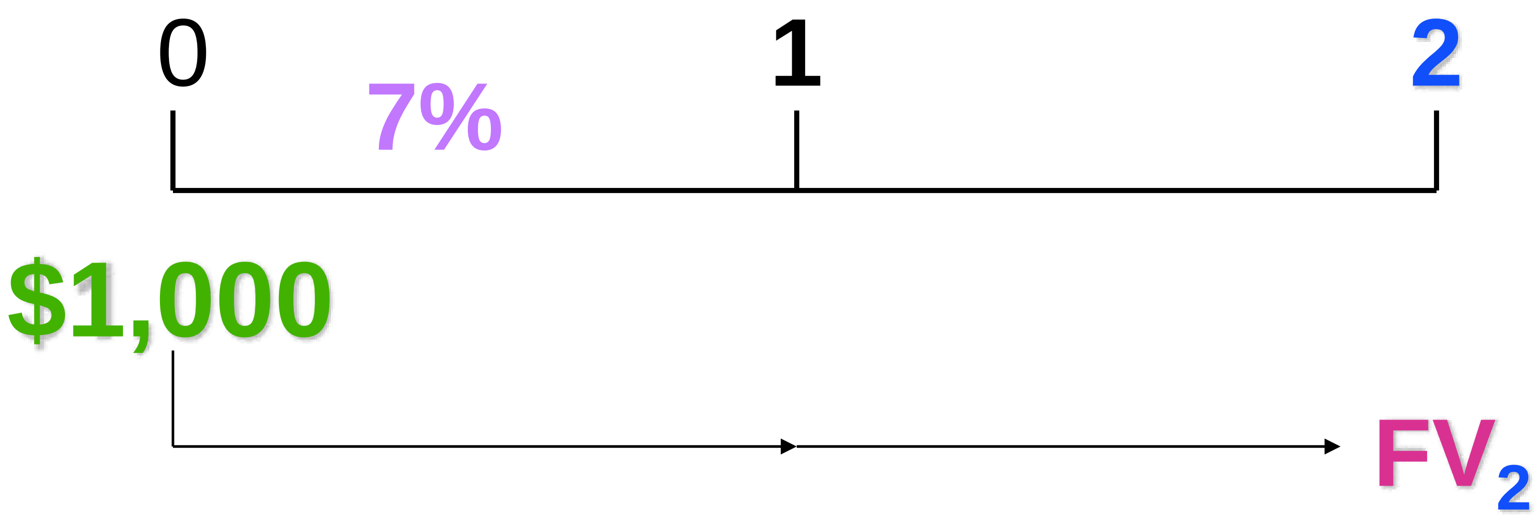
  Interest paid (earned) on any previous interest earned, as well as on the principal borrowed (lent).

Why Compound Interest?



Future Value Single Deposit (Graphic)

Assume that you deposit $1,000 at a compound interest rate of 7% for 2 years.



Future Value Single Deposit (Formula)

$FV_1 = P_0 (1+i)^1 \quad = \$1,000\ (1.07)$

$= \$1,070$

Compound Interest

You earned $70 interest on your $1,000 deposit over the first year.

This is the same amount of interest you would earn under simple interest.

Future Value Single Deposit (Formula)

$FV_1 = P_0 (1+i)^1 = \$1{,}000\ (1.07) = \$1{,}070$

$$FV_2 = FV_1 (1+i)^1 = P_0 (1+i)(1+i) = \$1{,}000(1.07)(1.07)$$
$$= P_0 (1+i)^2 = \$1{,}000(1.07)^2 = \$1{,}144.90$$

You earned an *EXTRA* *$4.90* in Year 2 with compound over simple interest.

General Future Value Formula

$$FV_1 = P_0(1+i)^1$$

$$FV_2 = P_0(1+i)^2$$

etc.

General Future Value Formula:

$$FV_n = P_0 (1+i)^n$$

How much a deposit of Rs 3000 will earn you in one year, two years and three years @10% rate of interest?

1. **Write down the values for 1st, 2nd and 3rd years respectively using compounding formula (Future value formula)**

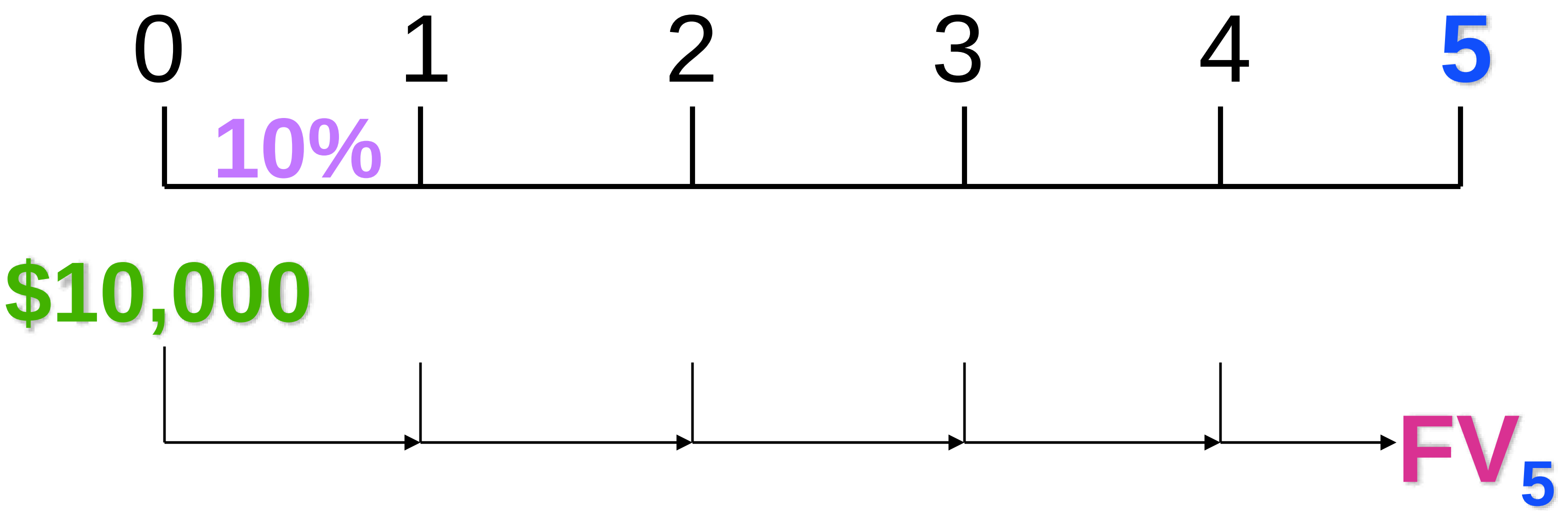
How much a promised sum of Rs 100 after one year, two years and three years will be worth today?

- **Find a discount rate (clue – based on the rate of interest)**
- **Calculate using present value formula**

Numerical Example 3

Miller wants to know how large her deposit of $10,000 today will become at a compound annual interest rate of 10% for 5 years.

Problem Example



Problem Solution

- Calculation based on general formula:

$$FV_n = P_0\,(1+i)^n$$
$$FV_5 = \$10{,}000\,(1+0.10)^5$$
$$= \$16{,}105.10$$

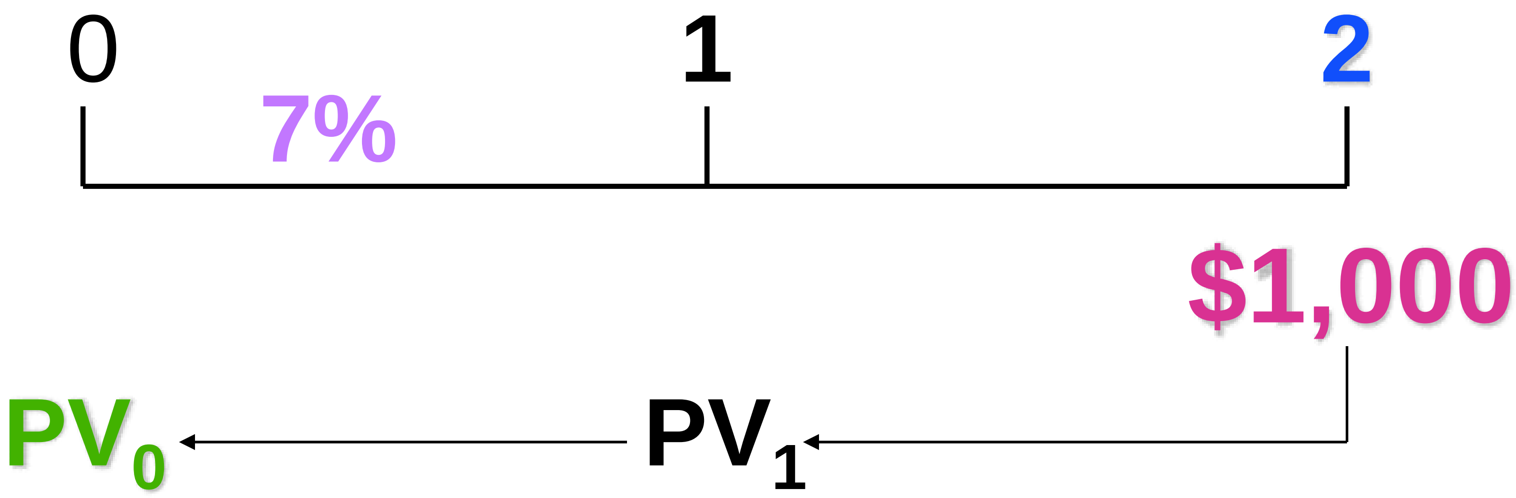
- Calculation based on Table I:

$$FV_5 = \$10{,}000\,(FVIF_{10\%,\,5})$$
$$= \$10{,}000\,(1.611)$$
$$= \$16{,}110$$ [*Due to Rounding*]

Numerical Example 4

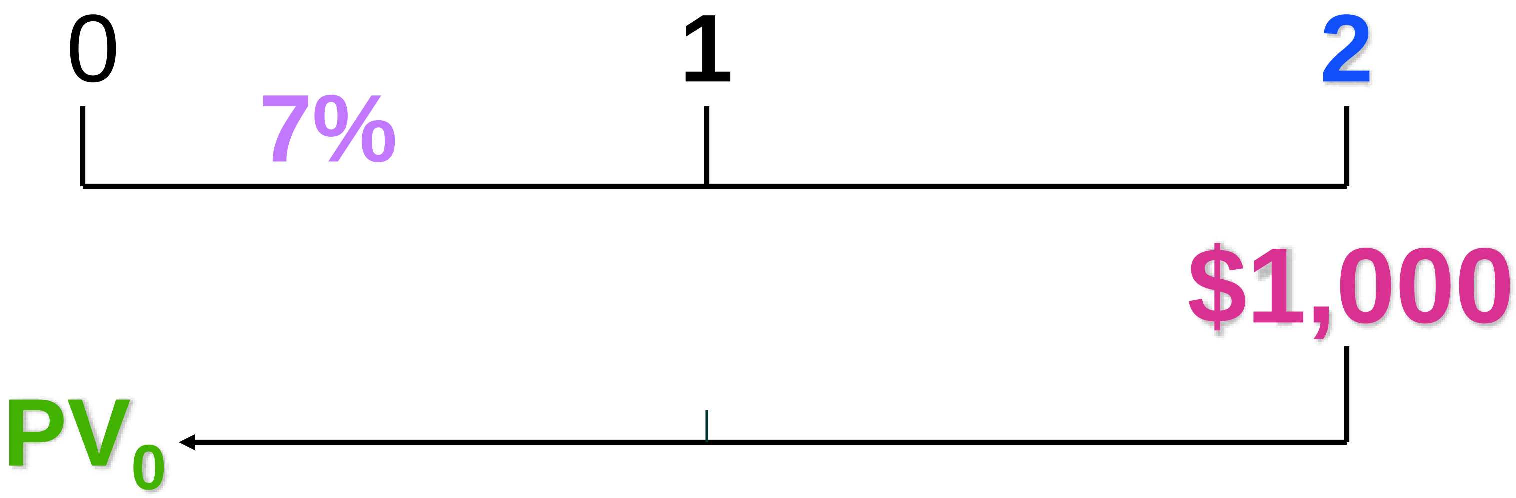
Assume that you need $1,000 in 2 years. Let's examine the process to determine how much you need to deposit today at a discount rate of 7% compounded annually.

Present Value
Single Deposit (Graphic)



Present Value Single Deposit (Formula)

$$PV_0 = FV_2 / (1+i)^2 \qquad = \$1{,}000 / (1.07)^2$$
$$= FV_2 / (1+i)^2 \qquad = \$873.44$$



General Present Value Formula

$$PV_0 = FV_1 / (1+i)^1$$

$$PV_0 = FV_2 / (1+i)^2$$

etc.

General Present Value Formula:

$$PV_0 = FV_n / (1+i)^n$$

or $PV_0 = FV_n (PVIF_{i,n})$ -- ***See Table II***

Future Value Table

Future Value of 1 Table (FV of 1 Table)
FV Factors for a Single Amount of 1.000
(rounded to three decimal places).

Note: This table begins with row n = 0, which is different from most future value of 1 tables.

	i=1%	i=2%	i=3%	i=4%	i=5%	i=6%	i=8%	i=10%	i=12%
n = 0 →	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
n = 1 →	1.010	1.020	1.030	1.040	1.050	1.060	1.080	1.100	1.120
n = 2 →	1.020	1.040	1.061	1.082	1.103	1.124	1.166	1.210	1.254
n = 3 →	1.030	1.061	1.093	1.125	1.158	1.191	1.260	1.331	1.405
n = 4 →	1.041	1.082	1.126	1.170	1.216	1.262	1.360	1.464	1.574
n = 5 →	1.051	1.104	1.159	1.217	1.276	1.338	1.469	1.611	1.762
n = 6 →	1.062	1.126	1.194	1.265	1.340	1.419	1.587	1.772	1.974
n = 7 →	1.072	1.149	1.230	1.316	1.407	1.504	1.714	1.949	2.211
n = 8 →	1.083	**1.172**	1.267	1.369	1.477	1.594	1.851	2.144	2.476
n = 9 →	1.094	1.195	1.305	1.423	1.551	1.689	1.999	2.358	2.773
n = 10 →	1.105	1.219	1.344	1.480	1.629	1.791	2.159	2.594	3.106
n = 11 →	1.116	1.243	1.384	1.539	1.710	1.898	2.332	2.853	3.479
n = 12 →	1.127	1.268	1.426	1.601	1.796	2.012	2.518	3.138	3.896

n = the number of time periods in which the interest is compounded
i = the interest rate per period with the interest added and compounded at the end of each period

Present Value Tables

Present Value Tables

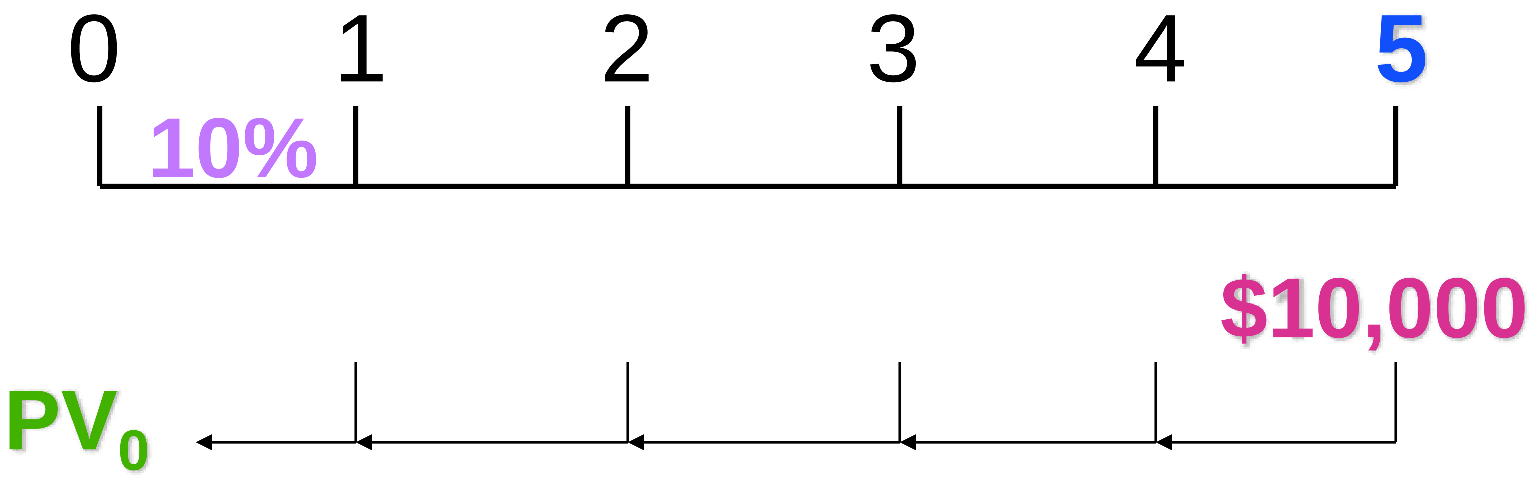
PV Factors

Periods	1%	2%	3%	4%	5%	6%	7%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346
2	0.9803	0.9612	0.9426	0.9246	0.907	0.89	0.8734
3	0.9707	0.9423	0.9151	0.889	0.8638	0.8396	0.8163
4	0.961	0.9238	0.8885	0.8548	0.8227	0.7921	0.7629
5	0.9515	0.9057	0.8626	0.8219	0.7835	0.7473	0.713
6	0.942	0.888	0.8375	0.7903	0.7462	0.705	0.6663
7	0.9327	0.8706	0.8131	0.7599	0.7107	0.6651	0.6228
8	0.9235	0.8535	0.7894	0.7307	0.6768	0.6274	0.582
9	0.9143	0.8368	0.7664	0.7026	0.6446	0.5919	0.5439
10	0.9053	0.8203	0.7441	0.6756	0.6139	0.5584	0.5083
11	0.8963	0.8043	0.7224	0.6496	0.5847	0.5268	0.4751
12	0.8874	0.7885	0.7014	0.6246	0.5568	0.497	0.444
13	0.8787	0.773	0.681	0.6006	0.5303	0.4688	0.415
14	0.87	0.7579	0.6611	0.5775	0.5051	0.4423	0.3878
15	0.8613	0.743	0.6419	0.5553	0.481	0.4173	0.3624

Numerical Exercise 5

Miller wants to know how large of a deposit to make so that the money will grow to $10,000 in 5 years at a discount rate of 10%.

Problem Example



Story Problem Solution

- **Calculation based on general formula:**

$$PV_0 = FV_n / (1+i)^n$$
$$PV_0 = \$10{,}000 / (1+ 0.10)^5$$
$$= \$6{,}209.21$$

- **Calculation based on Table I:**

$$PV_0 = \$10{,}000\ (PVIF_{10\%,\ 5})$$
$$= \$10{,}000\ (.621)$$
$$= \$6{,}210.00$$ **[*Due to Rounding*]**

Future Value of an Annuity

The *future value S* of an annuity of n payments of R rupees each, paid at the end of each investment period into an account that earns interest at the rate of i per period is

$$S = R\left[\frac{(1+i)^n - 1}{i}\right]$$

Examples of Annuities

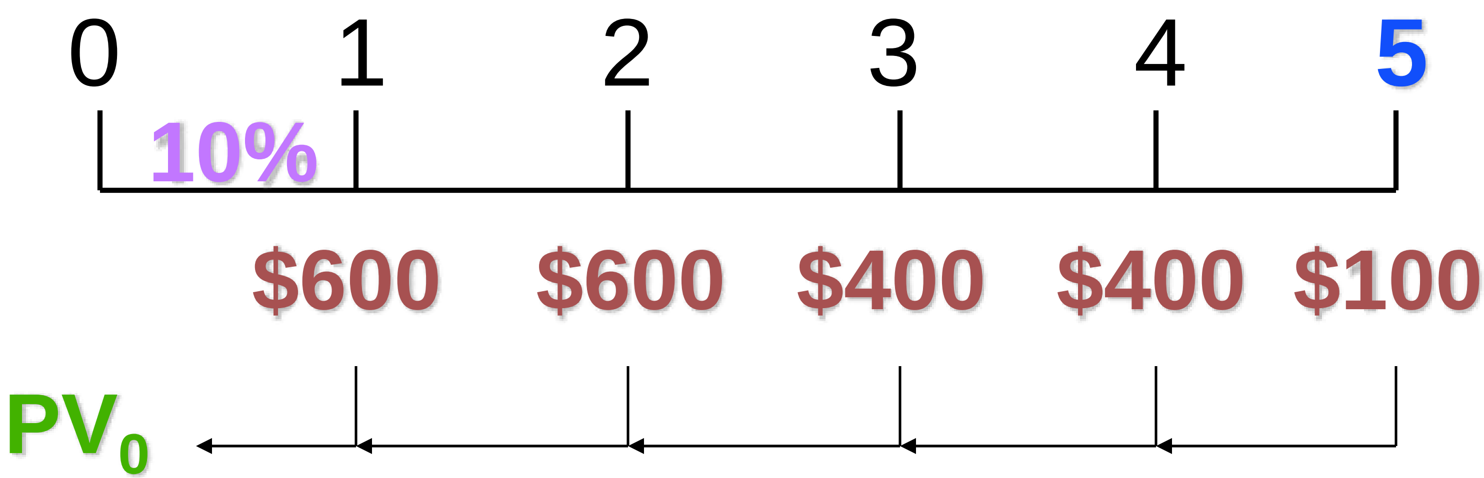
- Student Loan Payments
- Car Loan Payments
- Insurance Premiums
- Mortgage Payments
- Retirement Savings

Steps to Solve Time Value of Money Problems

1. Read problem thoroughly
2. Create a time line
3. Put cash flows and arrows on time line
4. Determine if it is a PV or FV problem
5. Determine if solution involves a single CF, annuity stream(s), or mixed flow
6. Solve the problem
7. Check with financial calculator (optional)

Mixed Flows Example

Miller will receive the set of cash flows below. What is the Present Value at a discount rate of 10%.



How to Solve?

1. **Solve a "*piece-at-a-time*" by discounting each *piece* back to t=0.**
2. **Solve a "*group-at-a-time*" by first breaking problem into groups of annuity streams and any single cash flow groups. Then discount each *group* back to t=0.**

"Piece-At-A-Time"

0 1 2 3 4 **5**

10%

$600 $600 $400 $400 $100

$545.45
$495.87
$300.53
$273.21
$ 62.09

$1677.15 = PV_0 of the Mixed Flow

"Group-At-A-Time" (#1)

0	1	2	3	4	5
10%	$600	$600	$400	$400	$100

$1,041.60
$ 573.57
$ 62.10

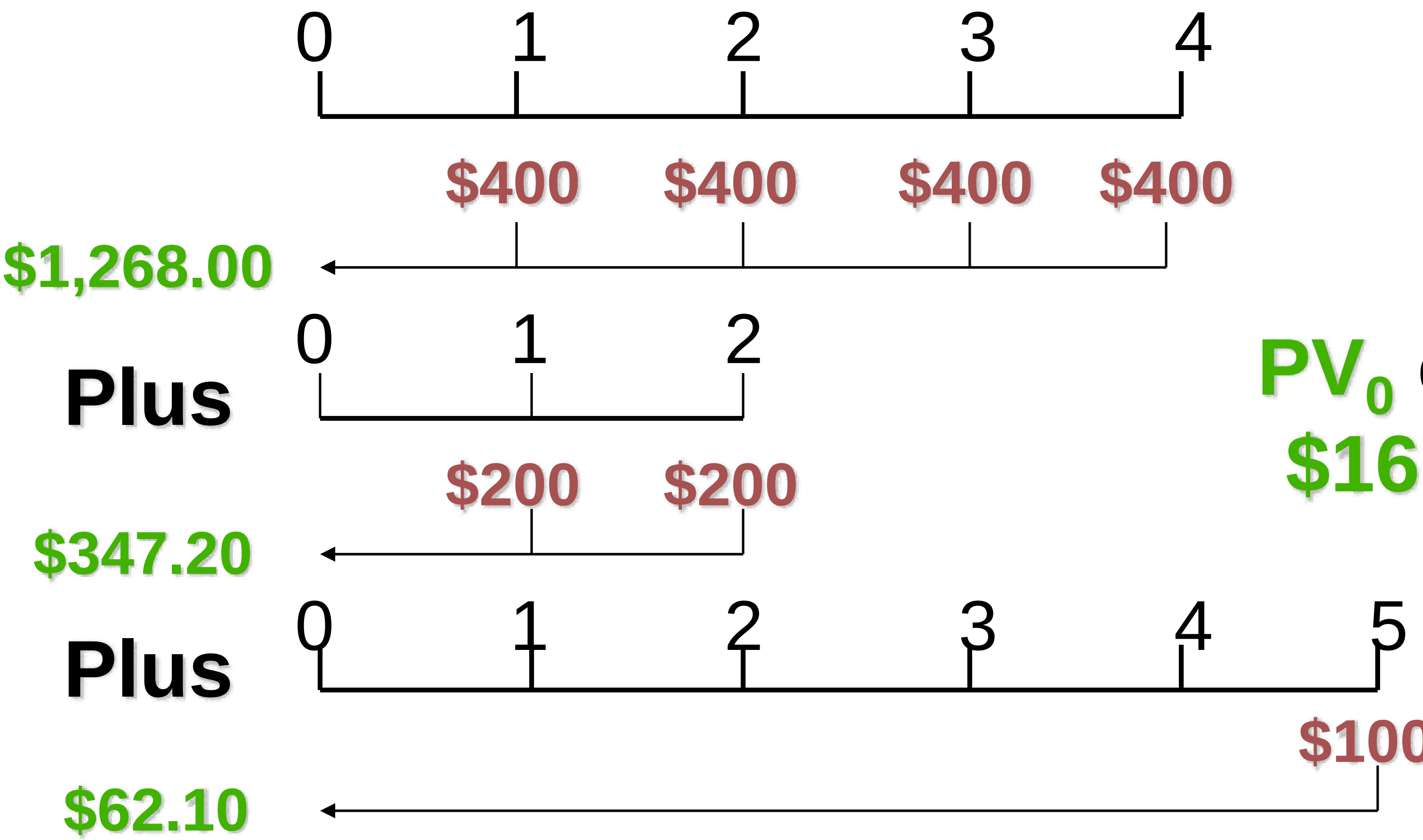
$1,677.27 = PV_0 of Mixed Flow [Using Tables]

$\$600(PVIFA_{10\%,2}) = \$600(1.736) = \$1,041.60$

$\$400(PVIFA_{10\%,2})(PVIF_{10\%,2}) = \$400(1.736)(0.826) = \$573.57$

$\$100\,(PVIF_{10\%,5}) = \$100\,(0.621) = \$62.10$

"Group-At-A-Time" (#2)



PV_0 equals $1677.30.

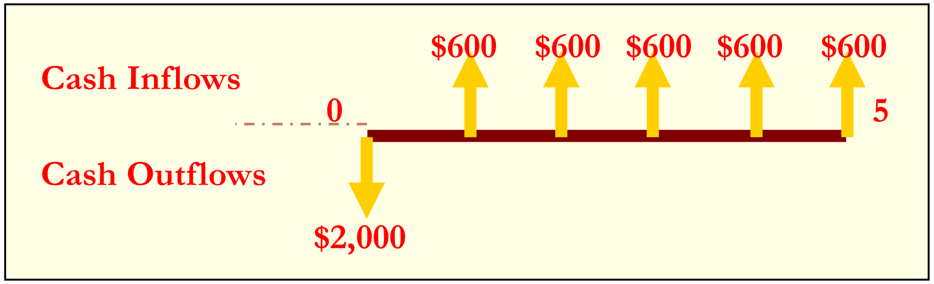
Elements of CBA

- Cash flow
- Present value (PV)
- Measures of Profitability
  - Payback Period
  - Net Present Value (NPV)
  - Internal Rate of Return (IRR)
  - Depreciation

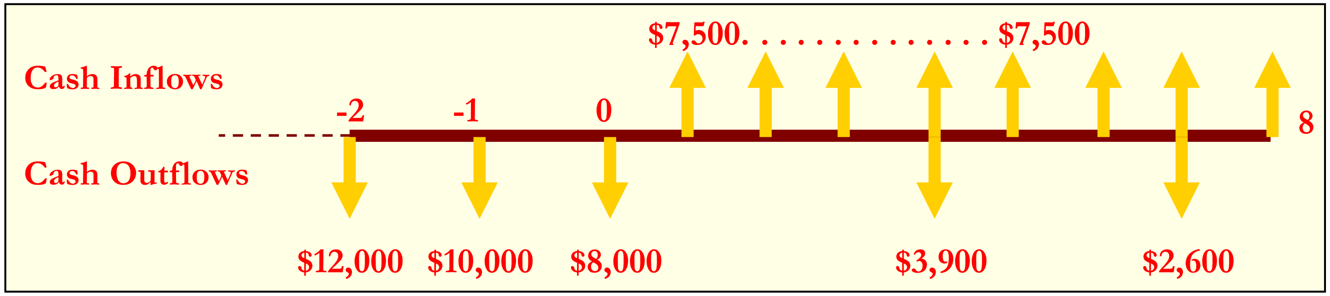
Cash Flow

A Cash Flow is meant to illustrate incomes ("cash inflows") and expenses ("cash outflows"). They may be **conventional** and **non-conventional.** Each arrow represents the time period of a year in this case.

Conventional Cash Flow



Non-Conventional Cash Flow



Present Value (PV)

- PV is a way of comparing the value of money now with the value of money in the future. A rupee today is worth less than a rupee in the future, because inflation erodes the buying power of the future money, while money available today can be invested to grow.

- Calculation of the PV requires the use of “interest rate”. Interest rate is typically a percentage used to calculate the PV. It reflects the time value of money. Generally, this interest rate is taken as equal to the prevailing bank interest rate.

Assuming an interest rate of 10%, the PV of $100 three years from now is approximately $133.

Payback Period

- As the name suggests, the Payback Period is the length of time required to recover the cost of an investment.

- It is calculated with the formula below:

$$\text{Payback period} = \frac{\$\ \text{Invested}}{\$\ \text{Return per year}}$$

- **Drawbacks -**

- The payback period ignores the time value of money
- The payback period ignores cash flows after the initial investment has been recouped

Payback Period

If the initial cost of the investment or $ invested = $ 20,000 and the net savings or $ return per year = $ 2,200; then

Payback period = 20,000 / 2,200 = 9.09 years

(say 9.1 years)

Discounted Payback Period

- This improves upon the payback period by taking into account the time value of money.

- A project's **discounted payback period** is the number of years it takes for the net cash flows' present values to pay back the net investment. Again, shorter paybacks are better than longer paybacks.

Discounted Payback Period

- We will compute the discounted payback period (DPP) using the same example. We will need a required rate of return for the computation. Let's use 10%.

- The following table is used to compute the project's DPP.

Total investment or outlay is Rs.35 Calculate the discounted payback @8%.

Year	**X**	**Y**
1	10	10
2	20	15
3	10	5
4	40	10
5	10	30

What is the Discounted Payback Period

- A discounted payback period gives the number of years it takes to break even from undertaking the initial expenditure, by discounting future cash flows and recognizing the time value of money.

What is the payback period for M & N Initial is Rs.50 outlay, What is the discounted payback period for M & N if cost of capital is 12%?

Year	Project M ₹ millions	Project N ₹ millions
1	11	38
2	19	22
3	32	18
4	37	10

- What is the payback period for M & N
- Initial is Rs.50 outlay, What is the discounted payback period for M & N if cost of capital is 12%?

What is the payback period for M & N Initial is Rs.50 outlay, What is the discounted payback period for M & N if cost of capital is 12%?

Year	Project M ₹ millions	Present Value of M	Project N ₹ millions	Present Value of N
1	11		38	
2	19		22	
3	32		18	
4	37		10	

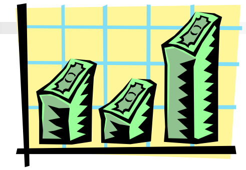
What is the payback period for M & N
Initial is Rs.50 outlay, What is the discounted payback period for M & N if cost of capital is 12%?

Year	Project M ₹ millions	PV-M	Project N ₹ millions	PV-N
1	11	9.82	38	33.93
2	19	15.15	22	17.54
3	32	22.78	18	12.81
4	37	23.51	10	6.36

Discounted Payback Period

- The DPP is an improvement upon the payback period in 2 ways:
  - The DPP takes into account the time value of money.
  - There is an objective criterion for an acceptable DPP if a project has normal cash flows. Under these circumstances a project is acceptable if the DPP is less than the economic life of the project.

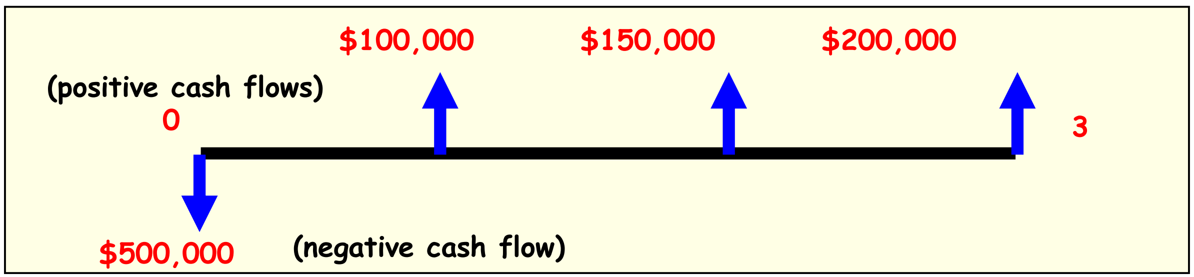
Net Present Value (NPV)



- NPV may be defined as the difference between the total present value of the cash inflows and the total present value of the cash outflows.
- NPV compares the value of the amount today versus the value of that same amount in the future, after taking inflation and returns into account.
- If the NPV of a prospective project is positive then it should be accepted (i.e. NPV > 0)
- However, if the NPV of a prospective project is negative, then the project should be rejected because cash flows are negative (i.e. NPV < 0)
- If the NPV of a prospective project is zero then it should probably be rejected as it generates exactly the return that is expected (i.e. NPV = 0)

Net Present Value (NPV) -134861

Let us calculate the NPV from a series of cash flows. The formula is given below.



$$NPV = -CF_o + \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \frac{CF_3}{(1+r)^3} + \frac{CF_n}{(1+r)^n}$$

where CF_X = cash flow in year x, n = number of periods (n=3), r = interest rate (say, 10%)

$$NPV = -500{,}000 + \frac{100{,}000}{(1+0.1)^1} + \frac{150{,}000}{(1+0.1)^2} + \frac{200{,}000}{(1+0.1)^3} = ?$$

- VirginiaTech invested in a four-year project. Virginia's discount rate is 10%. The cash inflows from this project are:

  Year 1 = 4000

  Year 2 = 4400

  Year 3 = 4800

  Year 4 = 5200

- Assuming a positive net present value of $1,000, the amount of the original investment was closest to _____.

Huggins Co. has identified an investment project with the following cash flows:

1. If the discount rate is 10 percent, cash inflow is $3500 what is the present value of these cash flows?
2. What is the present value at 16 percent?
3. What is the present value at 25 percent?

Year	Cash Flow
1	$820
2	$1,130
3	$1,390
4	$1,525

Internal Rate of Return (IRR)

- The IRR method of analyzing a project or option allows one to find the interest rate that is equivalent to the rupee returns expected from the project or option.

- Once you know the IRR, you can compare it to the rates you could earn by investing your money in other projects or options.

- If the IRR is less than the cost of borrowing used to fund the project, the project will clearly be a money-loser.

- However, usually a business owner will insist that in order to be acceptable, a project must be expected to earn an IRR that is at least several percentage points ***higher*** than the cost of borrowing, to compensate the company for its risk, time, and trouble associated with the project.

Internal Rate of Return (IRR)

- As an example of how IRR works, let us say you are looking at a project costing $7,500 that is expected to return $2,000 per year for five years, or $10,000 in total.

- The IRR calculated for the project would be 10 percent.

- If your cost of borrowing for the project is less than 10 percent, the project may be worthwhile.

- If the cost of borrowing is 10 percent or greater, it will not make sense to do the project (at least from a financial perspective) because, at best, you will be breaking even.

Internal Rate of Return (IRR)

- The formula used for calculating the IRR is very similar to the formula used for calculating the NPV.

- The main difference is that in the IRR formula, you must solve for the interest rate “r”.

- $$0 = -CF_o + \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \frac{CF_3}{(1+r)^3} + \frac{CF_n}{(1+r)^n}$$

where CF_X = cash flow in year x, n = number of periods, r = interest rate (to be solved for)

Depreciation and methods of calculation

- In accounting terms, **depreciation** is defined as the reduction of recorded cost of a fixed asset in a systematic manner until the value of the asset becomes zero or negligible. An example of fixed assets are buildings, furniture, office equipment, machinery, etc.

- A land is the only exception which cannot be depreciated as the value of land appreciates with time.

- **Salvage value**, also called scrap value, is the value of an asset after it has come to the end of its useful life.

- For example, let's assume you buy a car for 800,000. You believe that the car could last for 15 years. After that, the car is probably "run into the ground" and its next stop is the junkyard. The salvage value of the car is the price a junkyard or recycler might pay you for the old, nonworking car.
- In the business world, salvage values are very important because they help companies calculate depreciation. For example, let's assume Company XYZ purchases a piece of machinery for $1 million, and that piece of machinery is expected to last for 10 years. After that, the machinery is estimated to be worth, say, $10,000. Thus, Company XYZ would record a depreciation expense equal to $990,000 over 10 years (there are a variety of ways to do that).
- Salvage values are important in business because they affect the size of a company's depreciation expense (and thus they affect net income). It is important to note, however, that salvage values are merely estimates. Nobody knows what an asset will be worth 10 years in advance.

What Are the Main Types of Depreciation Methods?

There are several types of depreciation expense and different formulas for determining the book value of an asset. The most common depreciation methods include:

Straight-line

Double declining balance

Units of production

Sum of years digits

- Depreciation expense is used in accounting to allocate the cost of a tangible asset over its useful life. In other words, it is the reduction of value in an asset over time due to usage, wear and tear, or obsolescence.

1 Straight-Line Depreciation Method

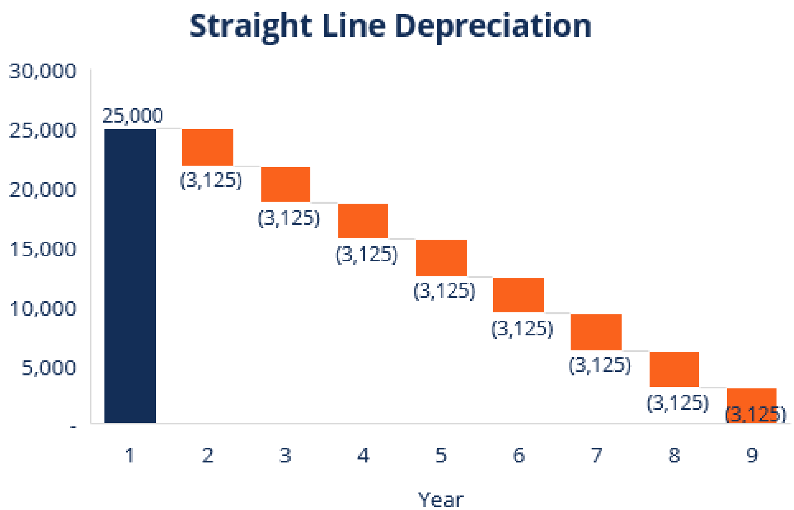
Straight-line depreciation is a very common and simple method of calculating the expense. In straight-line depreciation, the expense amount is the same every year over the useful life of the asset.

Depreciation Formula for the Straight Line Method:
Depreciation Expense = (Cost – Salvage value) / Useful life

Example

Consider a piece of equipment that costs ₹ 25,000 with an estimated useful life of 8 years and a ₹0 salvage value. The depreciation expense per year for this equipment would be as follows:

Year #		1	2	3	4	5	6	7	8
Straight Line									
Opening Book Value		25,000	21,875	18,750	15,625	12,500	9,375	6,250	3,125
Depreciation	8	3,125	3,125	3,125	3,125	3,125	3,125	3,125	3,125
Ending Book Value	25,000	21,875	18,750	15,625	12,500	9,375	6,250	3,125	-



Depreciation Expense = (₹25,000 – ₹0) / 8 = ₹3,125 per year

A company purchases a machine for its manufacturing facility for 90,000 in January and as of December has recorded only 11 months of depreciation. The machinery is estimated to have a useful life of 5 years. What is the proper entry to record the year-end adjustment for depreciation, assuming the straight-line method is used?

- Debit depreciation expense–machinery 1,500 and credit accumulated depreciation–machinery 1,500
- Annual depreciation is calculated as the cost of an asset divided by its useful life. In this case, the machinery was purchased for $90,000 and has a useful life of 5 years. Thus, the annual amount of depreciation should be 90,000 (purchase price of the machine) divided by 5 years, or 18,000 per year. In this example, the company already recorded 11 months of depreciation and needs to record only one more month. So, you need to find the monthly depreciation, which you calculate by dividing the annual depreciation of 18,000 by 12 months, or 1,500 per month. The adjusting entry should be recorded as a debit to depreciation expense and a credit to accumulated depreciation for 1,500, or one month's worth of depreciation.

2 Double Declining Balance Depreciation Method

- Compared to other depreciation methods, double-declining-balance results in larger expense in the earlier years as opposed to the later years of an asset's useful life. The method reflects the fact that assets are more productive in its early years than in its later years. With the double-declining-balance method, the depreciation factor is 2x that of a straight line expense method.

- **Depreciation formula for the double declining balance method:**

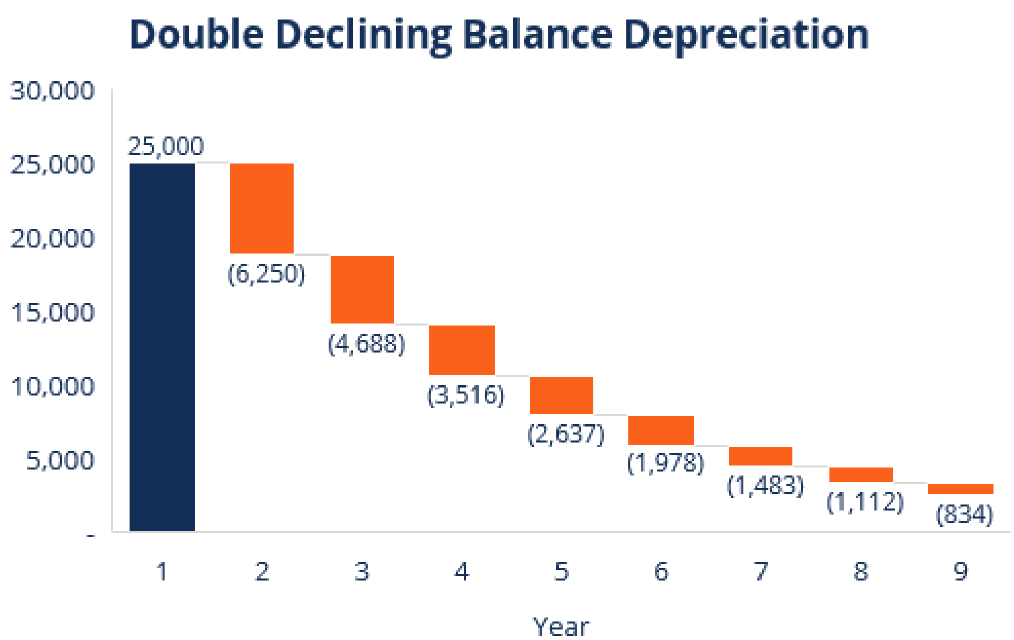
  Periodic Depreciation Expense = Beginning book value x Rate of depreciation

- Consider a piece of equipment that costs ₹25,000 with an estimated useful life of 8 years and a ₹2,500 salvage value. To calculate the double declining balance depreciation, set up a schedule:

Year #			1	2	3	4	5	6	7	8
DDB										
Opening Book Value			25,000	18,750	14,063	10,547	7,910	5,933	4,449	3,337
Depreciation	25%		6,250	4,688	3,516	2,637	1,978	1,483	1,112	834
Ending Book Value		25,000	18,750	14,063	10,547	7,910	5,933	4,449	3,337	2,503

Year #		1	2	3	4	5	6	7	8
DDB									
Opening Book Value		25,000	18,750	14,063	10,547	7,910	5,933	4,449	3,337
Depreciation	25%	6,250	4,688	3,516	2,637	1,978	1,483	1,112	834
Ending Book Value	25,000	18,750	14,063	10,547	7,910	5,933	4,449	3,337	2,503

- The information on the schedule is explained below:
- The beginning book value of the asset is filled in at the beginning of year 1 and the salvage value is filled in at the end of year 8.
- The rate of depreciation (Rate) is calculated as follows:
- **Expense = (100% / Useful life of asset) x 2**
- **Expense = (100% / 8) x 2 = 25%**
- Note: Since this is a double declining method**,** we multiply the rate of depreciation by 2.
- 3. Multiply the rate of depreciation by the beginning book value to determine the expense for that year. For example, ₹25,000 x 25% = ₹6,250 depreciation expense.
- 4. Subtract the expense from the beginning book value to arrive at the ending book value. For example, ₹25,000 – ₹6,250 = ₹18,750 ending book value.
- 5. The ending book value for that year is the beginning book value for the following year. For example, the year 1 ending book value of ₹18,750 would be the year 2 beginning book value. Repeat this until the last year of useful life.


Double Declining Balance Depreciation
30,000
25,000
20,000
15,000
10,000
5,000
-
25,000
(6,250)
(4,688)
(3,516)
(2,637)
(1,978)
(1,483)
(1,112)
(834)
1
2
3
4
5
6
7
8
9
Year

ELASTICITY OF DEMAND

LAW OF DEMAND

- *Law of demand* states that if price of commodity increases quantity demanded will falls and if price of commodity falls quantity will increases.

- *Law of demand* indicates only direction of change in quantity demanded in response to change in price but *ELASTICITY OF DEMAND* states with how much or to what extent the quantity demanded will change in response to change in price.

Elasticity – the concept

- If price rises by 10% - what happens to demand?
- We know demand will fall
- By more than 10%?
- By less than 10%?
- **Elasticity measures the <u>extent</u> to which demand will change**

The Law of Demand simply explains the inverse relationship between Price and Demand. In other words it tells us the ***direction of change in Price and Quantity demanded***.

In order to understand the ***quantitative changes in Price and Demand***, we need to study the concept of Elasticity of Demand.

Elasticity is an index of reaction.

There are 3 types of Elasticity of Demand

1. Price Elasticity of Demand
2. Income Elasticity of Demand
3. Cross Elasticity of Demand

Price Elasticity of Demand

It is generally defined as the responsiveness of demand to a given change in price of a commodity. Price Elasticity of Demand is a ratio of two pure numbers, the numerator is the percentage in quantity demanded and the denominator is the percentage change in price of the commodity

PRICE ELASTICITY OF DEMAND

DEFINITION:

The **Elasticity of Demand** measures the percentage change in quantity demanded for a percentage change in the price.

PRICE ELASTICITY OF DEMAND (cont.)

FORMULA:

$$\varepsilon_d = \frac{\%\ \Delta \text{ Quantity Demanded}}{\%\ \Delta \text{ Price}}$$

$$\varepsilon_d = \frac{Q_2 - Q_1}{Q_1} \times \frac{P_1}{P_2 - P_1}$$

Q1= Original or Old Demand
Q2= New Demand
P1= Old Price
P2= New Price

Examples

- Assume
  - The price of X falls by 2% and the quantity demanded increases by 6%
    - Then the price elasticity of demand for X is

$$\frac{6}{-2} = -3$$

Computing the Price Elasticity of Demand

Example: If the price of an ice cream cone increases from $2.00 to $2.20 and the amount you buy falls from 10 to 8 cones then your elasticity of demand would be calculated as:

$$\frac{8-10}{10} X \frac{2}{2.20-2} = 2$$

Computing the Price Elasticity of Demand

If the price of LUX Soap decreases from Rs.40.00 to Rs.25.00 and the amount you buy rises from 10 to 20 soaps then your elasticity of demand would be calculated as:

$$\frac{20-10}{10} X \frac{40}{25-40} = 2.6$$

Computing the Price Elasticity of Demand

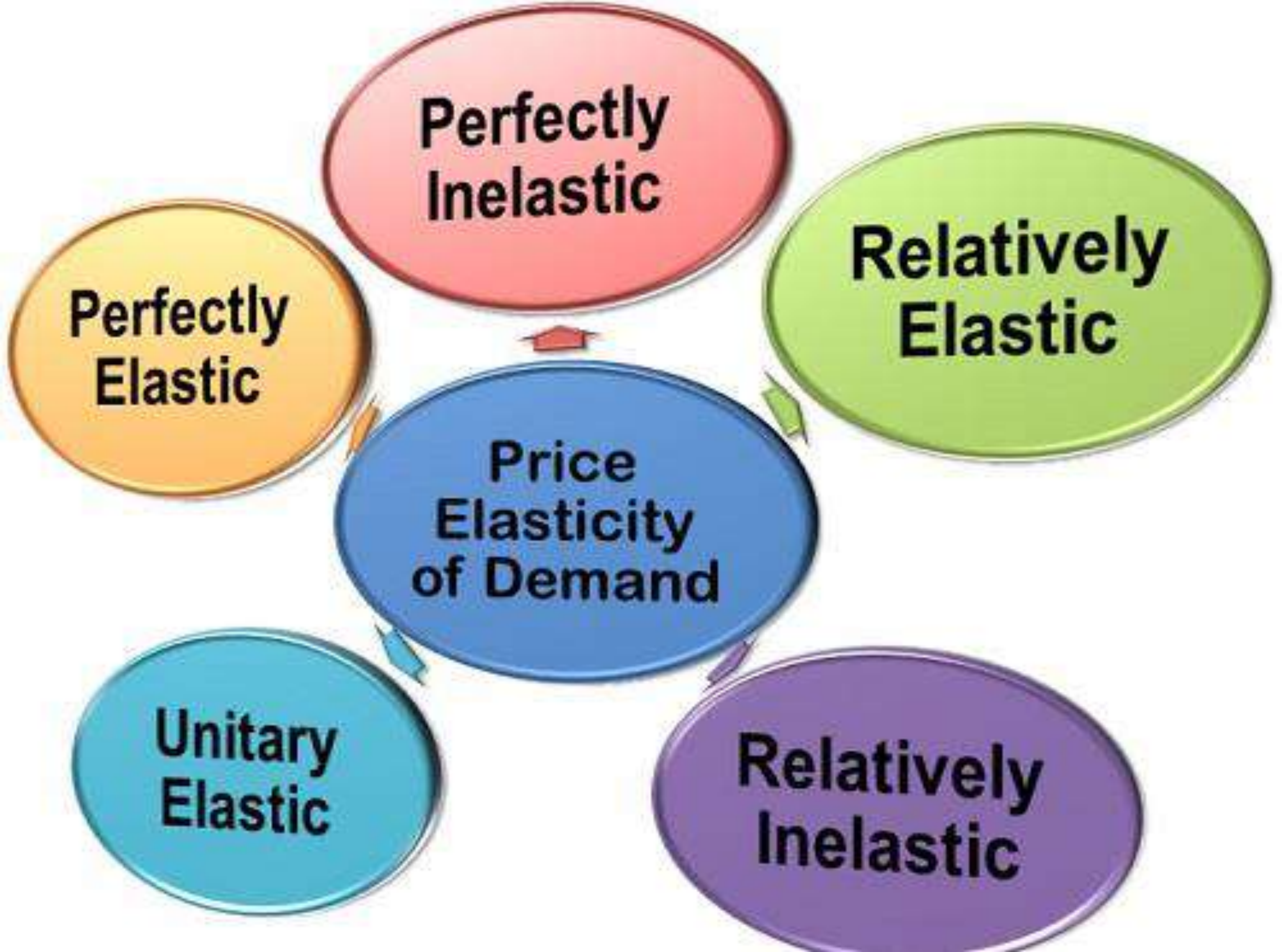
If the price of Movie ticket decreases from Rs.100.00 to Rs.80.00 and the amount you buy rises from 2 to 4 tickets then your elasticity of demand would be calculated as:

$$\frac{4 \ -2}{2} X \frac{100}{80-100} = 5$$

Table-2: Demand Schedule	
Price per unit (₹)	Quantity Demanded(units)
60	100
70	90

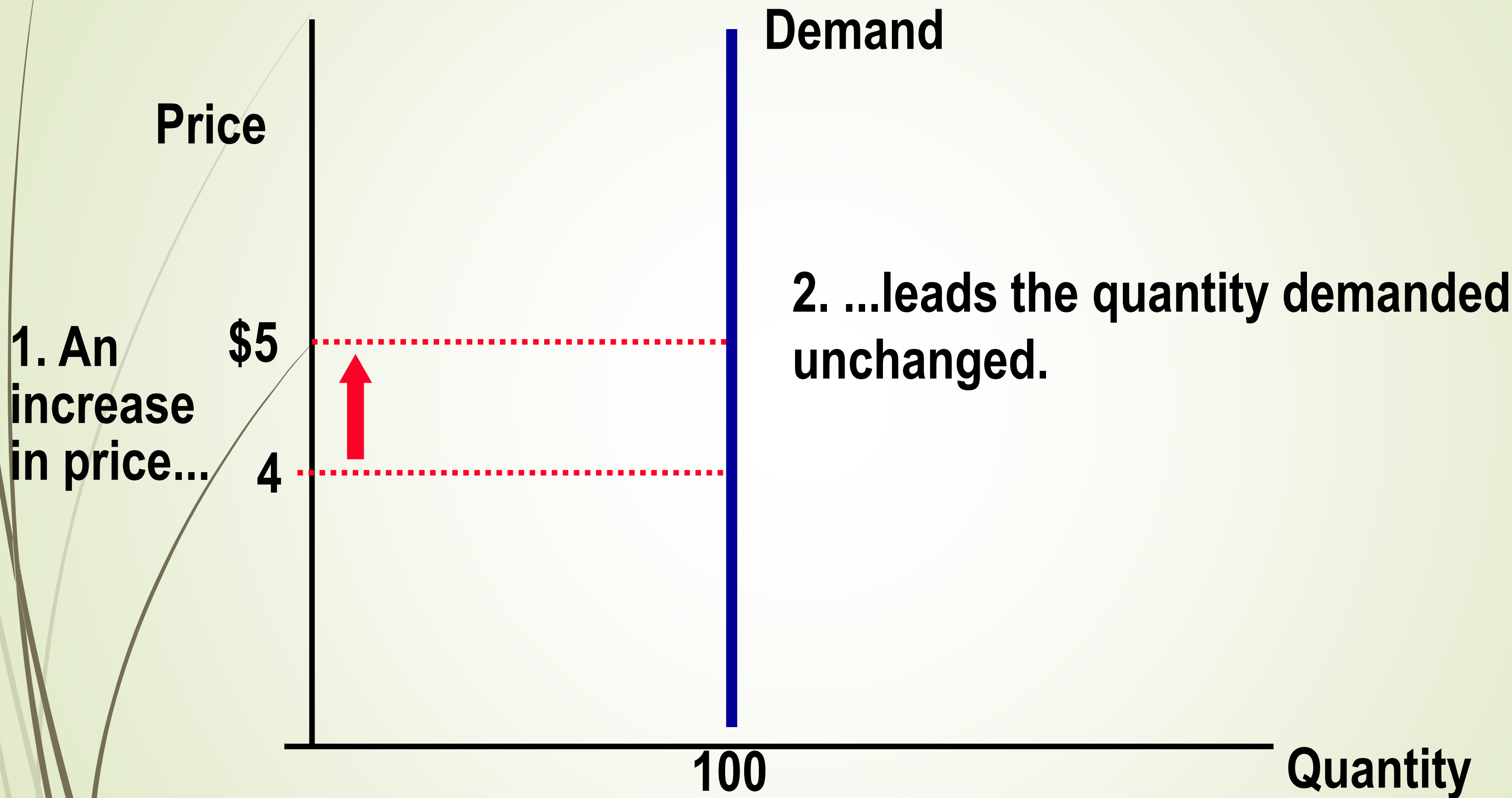
Ed=

Types of price elasticity of demand


Perfectly Inelastic
Perfectly Elastic
Relatively Elastic
Price Elasticity of Demand
Unitary Elastic
Relatively Inelastic

- A perfectly inelastic demand is one when there is **no change in the demand of a product with whatever changes in its price.**
- Ed= 0

Perfectly Inelastic Demand - Elasticity equals 0

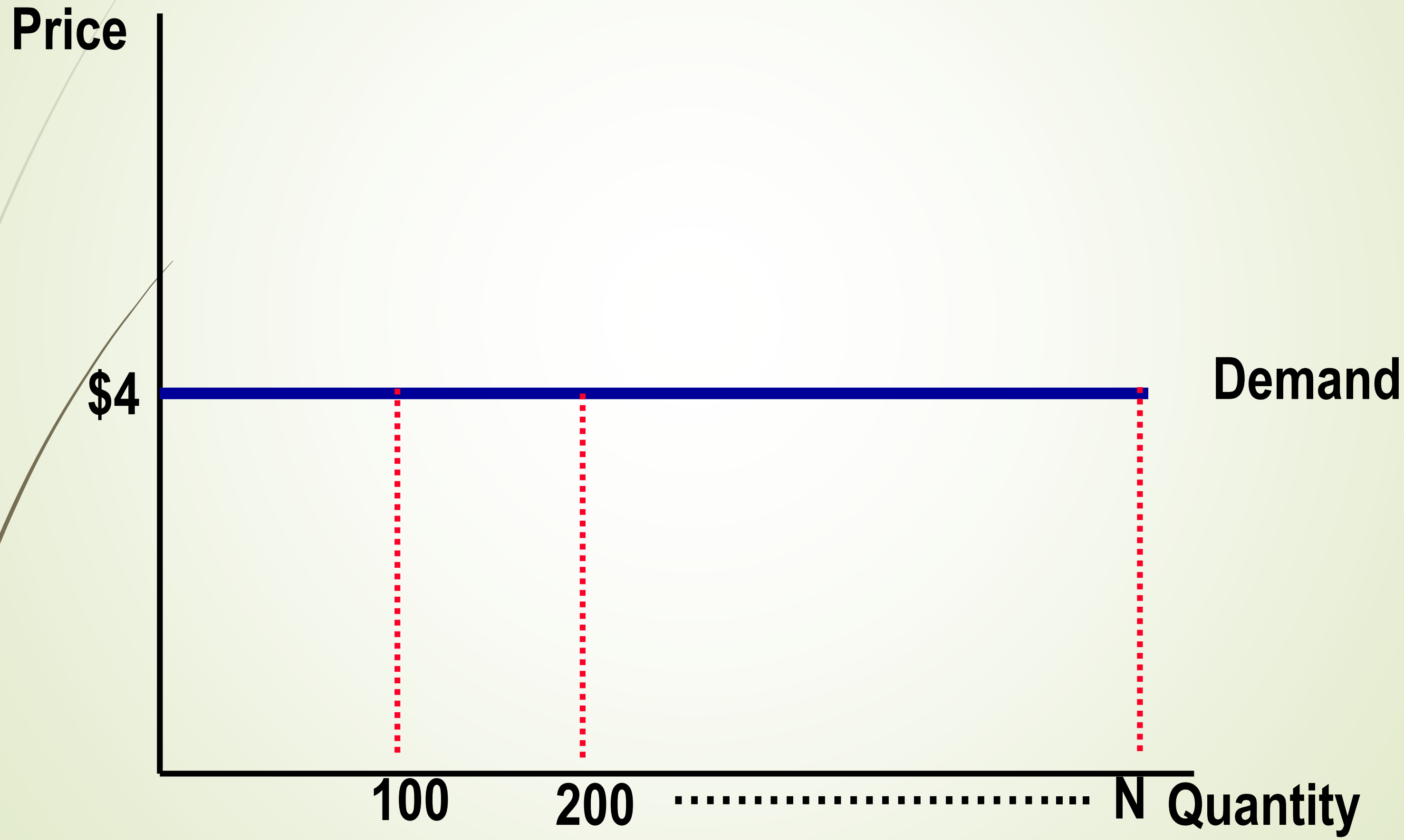


Perfectly elastic demand

When there is no change in price of a product causes a **infinite change** in its demand, it is said to be perfectly elastic demand.

Ed= Infinity

Perfectly Elastic Demand

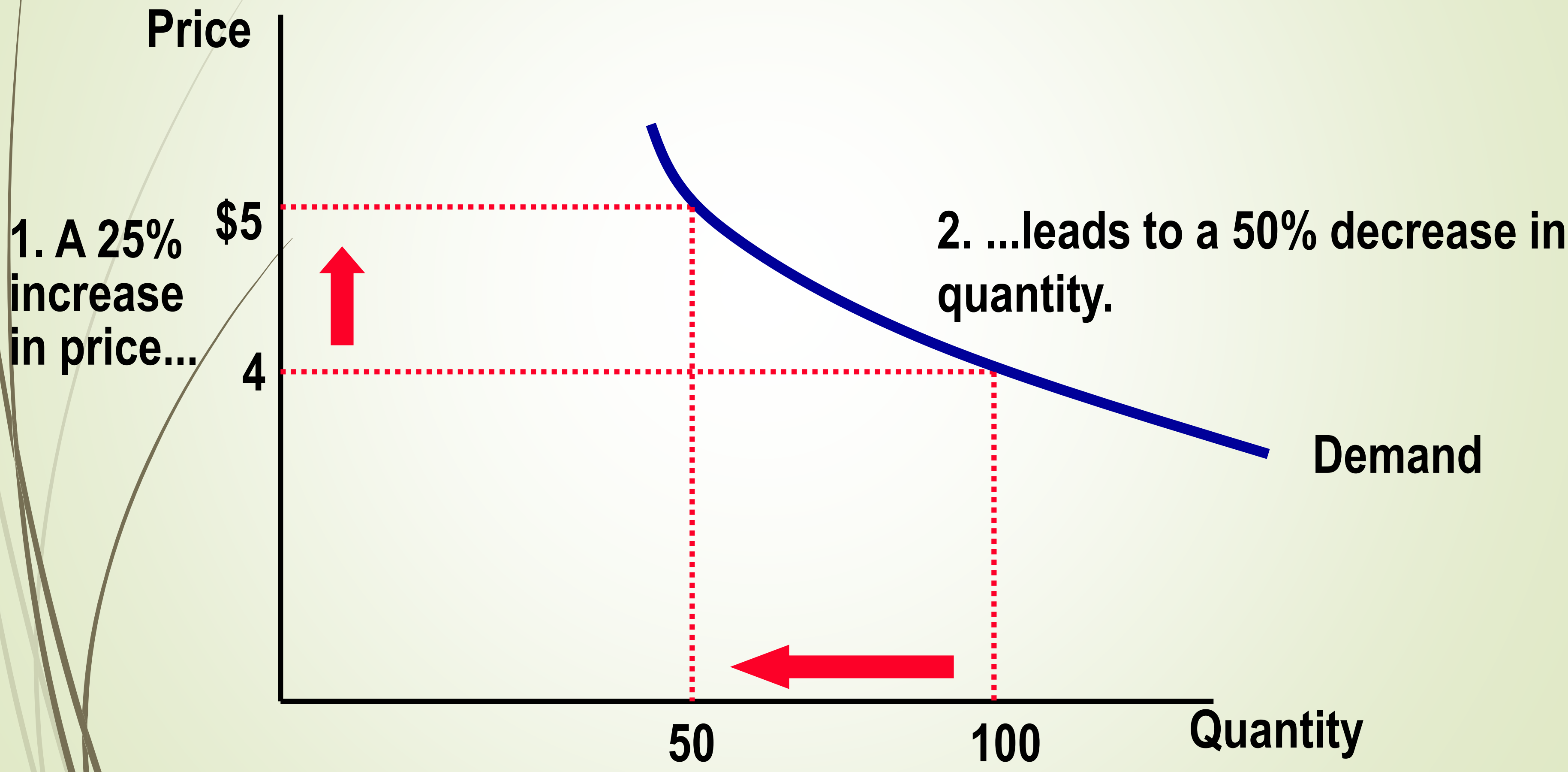


Relatively elastic demand

Relatively elastic demand refers to the demand when the proportionate change in demand is **greater than** the proportionate change in price of a product

Ed >1

Elastic Demand

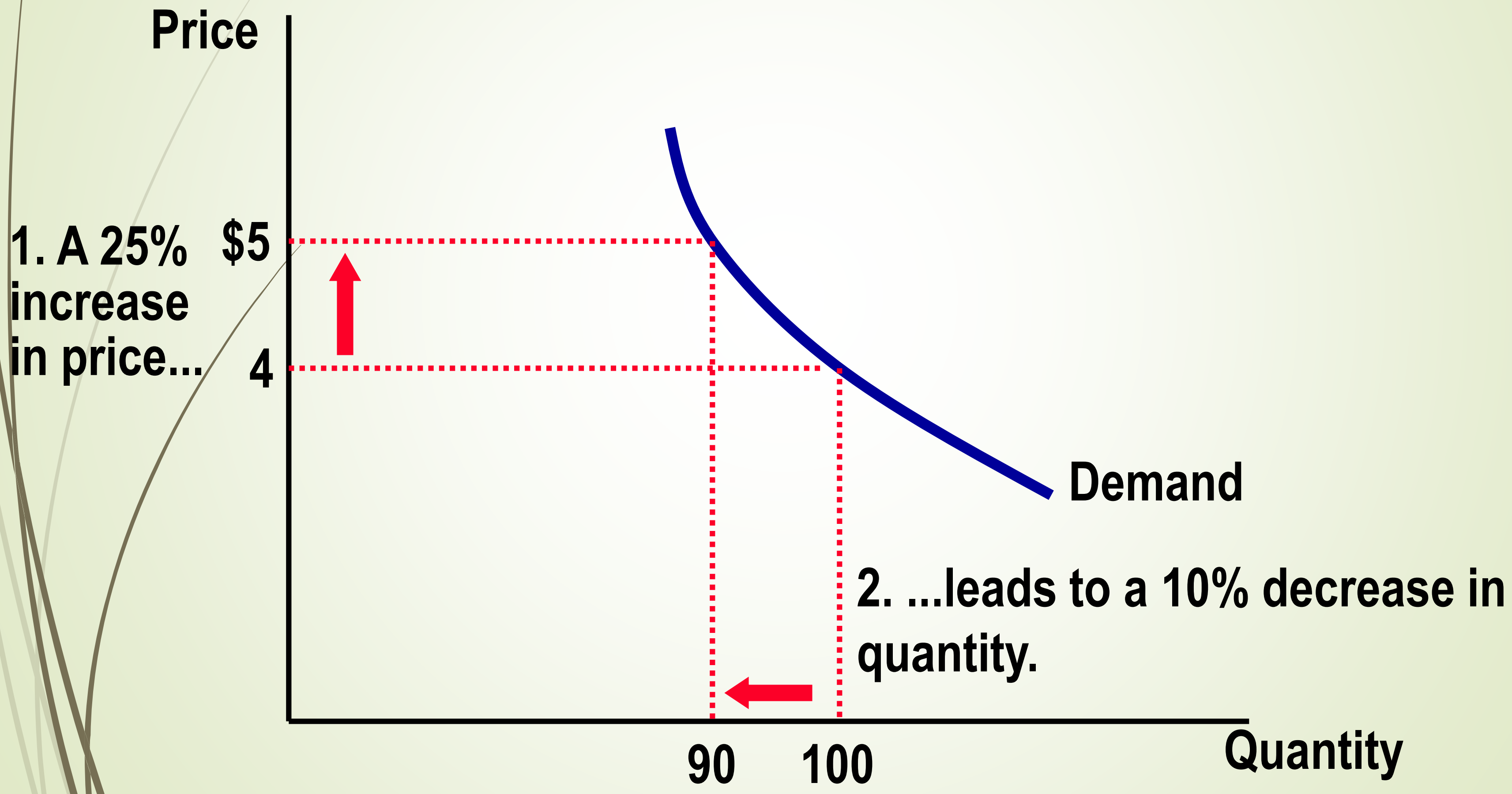


Relatively inelastic demand

Relatively inelastic demand is one when the percentage change in demand is less than the percentage change in the price of a product.

Ed<1

Relatively Inelastic Demand

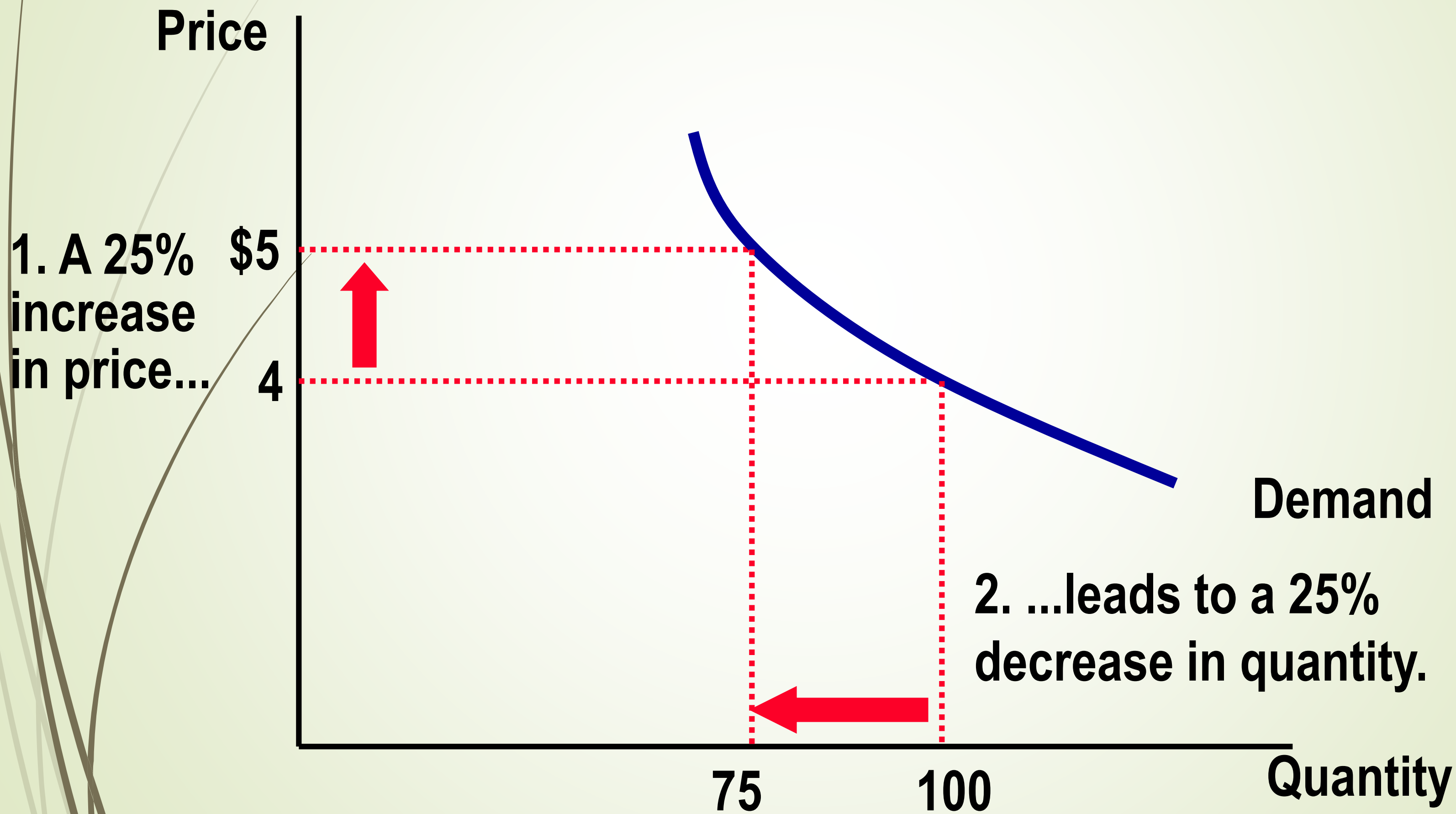


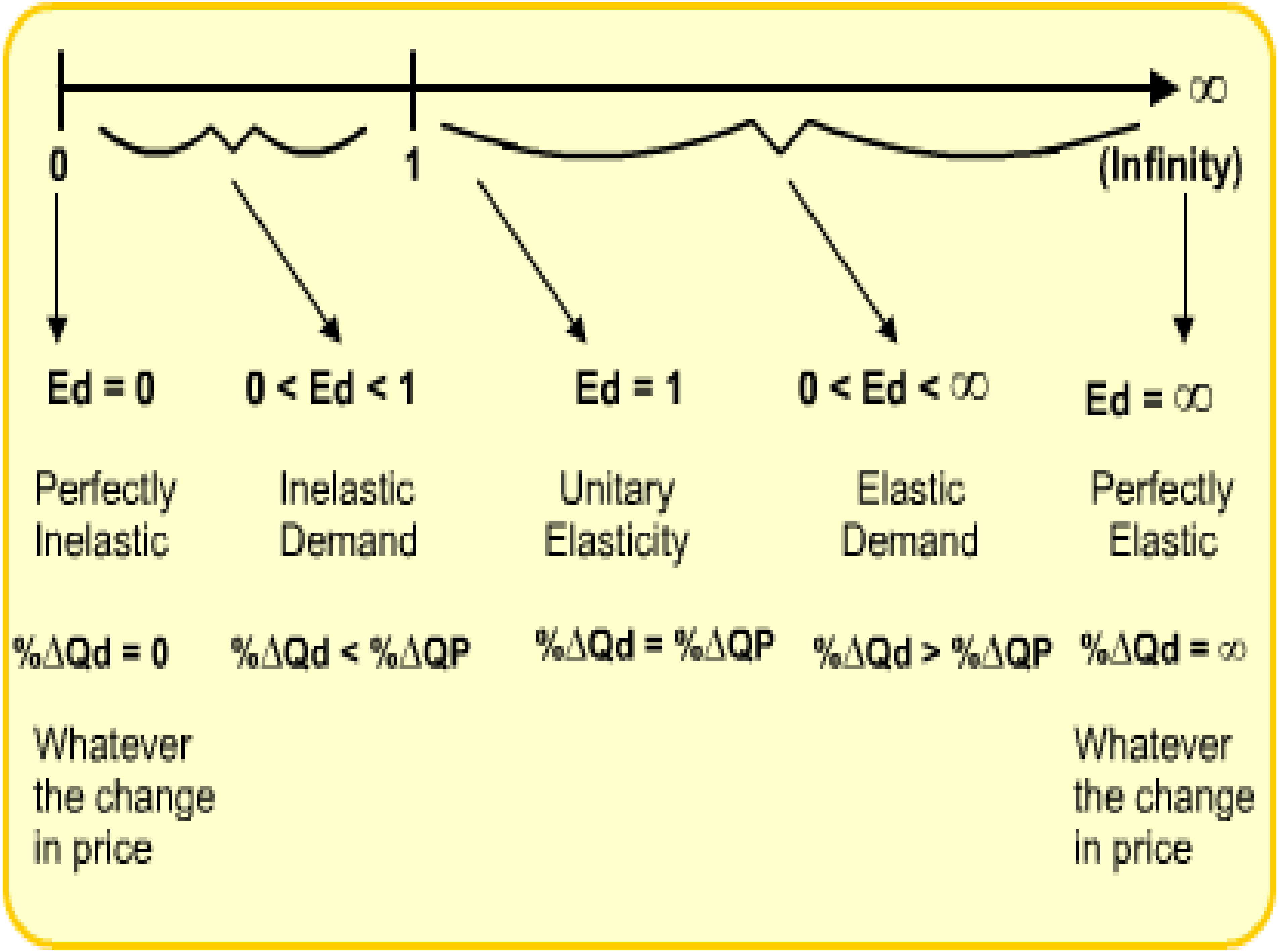
Unitary elastic demand

When the proportionate change in demand is **equal** to change in the price of the product

Ed=1

Unit Elastic Demand
- Elasticity equals 1




∞
0
1
(Infinity)
Ed = 0
0 < Ed < 1
Ed = 1
0 < Ed < ∞
Ed = ∞
Perfectly Inelastic
Inelastic Demand
Unitary Elasticity
Elastic Demand
Perfectly Elastic
%ΔQd = 0
%ΔQd < %ΔQP
%ΔQd = %ΔQP
%ΔQd > %ΔQP
%ΔQd = ∞
Whatever the change in price
Whatever the change in price

Example

- Price of pens decreases from Rs. 2 to Rs.1 then the demand for pens increase from 40 pens to 50 pens.
- **Ans: 0.5**
- **It means Relatively inelastic**

Income Elasticity of Demand

Income Elasticity of Demand

- The income is the other factor that influences the demand for a product.
- Hence, the degree of responsiveness of a change in demand for a product due to the change in the income is known as income elasticity of demand.

INCOME ELASTICITY OF DEMAND (cont.)

FORMULA:

$$\varepsilon_Y = \frac{\%\ \Delta\ \text{Quantity Demanded}}{\%\ \Delta\ \text{Income}}$$

$$\varepsilon_Y = \frac{Q_2 - Q_1}{Q_1} \times \frac{Y_1}{Y_2 - Y_1}$$

Q1= Original or Old Demand
Q2= New Demand
Y1= Original or Old Income
Y2= New Income

Income Elasticity of Demand

- Income elasticity (in absolute sense) can be:
  1) Greater than 1 (normal good, income elastic)
     - **luxury goods** - ocean cruises, jewelry

  2) Between zero and 1 (normal good, income inelastic)
     - **necessities** - food, clothing

  3) Less than zero (inferior good)
     - potatoes, rice

- Let's say the economy is booming and everyone's income rises by 400%. Because people have extra money, the quantity of Ferraris demanded increases by 15%.

- **Income Elasticity = 15% / 400% = 0.0375**

Calculate the income elasticity of demand for X when the income of consumers increases from 200 to 400. then demand increases from 100 to 150 ,What type of product is X

$$\frac{150 - 100}{100} \quad X \quad \frac{200}{400 - 200}$$

$$= 0.5$$

Calculate the income elasticity of demand for X when the income of consumers decreases from 500 to 400. then demand increases from 100 to 120 ,What type of product is Z

$$\frac{120 - 100}{100} \quad X \quad \frac{500}{400 - 500}$$

$$= -1$$

Cross Elasticity of Demand

Cross Elasticity of Demand

- The cross elasticity of demand refers to the change in quantity demanded for one commodity as a result of the change in the price of another commodity.
- This type of elasticity usually arises in the case of the interrelated goods such as substitutes and complementary goods.

CROSS ELASTICITY OF DEMAND

FORMULA:

$$\varepsilon_X = \frac{\%\ \Delta\ \text{Quantity Demanded of good X}}{\%\ \Delta\ \text{Price of good Y}}$$

$$\varepsilon_X = \frac{Q_{X2} - Q_{X1}}{Q_{X1}} \times \frac{P_{Y1}}{P_{Y2} - P_{Y1}}$$

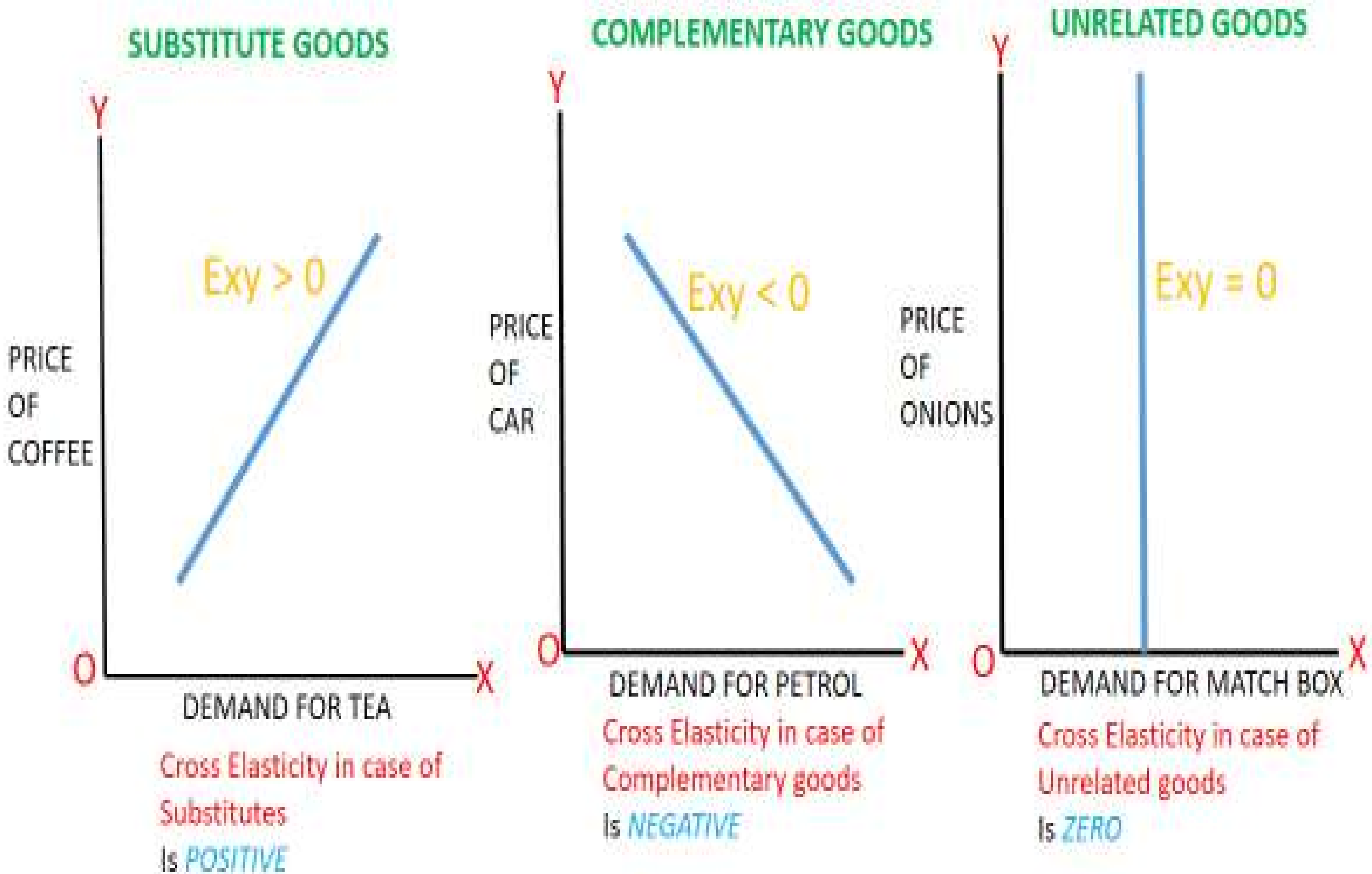
Qx1= Old Demand of X good
Qx2= New Demand of X good
Py1= Old Price of Y good
Py2= New Price of Y good

Understanding the Coefficient of Cross Price Elasticity

The stronger the relationship between two products, the higher is the co-efficient of cross-price elasticity of demand

- **Substitutes:**
  - **Close substitutes** have a strongly **positive** cross price elasticity of demand i.e. a small change in relative price causes a big switch in consumer demand
- **Complements:**
  - When there is a strong complementary relationship, the cross elasticity will be highly **negative**.
  - An example might be games consoles and software games
- **Unrelated products:**
  - Unrelated products have **zero** cross elasticity e.g. the effect of changes in taxi fares on the market demand for cheese!

tutor2u


SUBSTITUTE GOODS
Y
Exy > 0
PRICE
OF
COFFEE
O
X
DEMAND FOR TEA
Cross Elasticity in case of
Substitutes
Is POSITIVE
COMPLEMENTARY GOODS
Y
Exy < 0
PRICE
OF
CAR
O
X
DEMAND FOR PETROL
Cross Elasticity in case of
Complementary goods
Is NEGATIVE
UNRELATED GOODS
Y
Exy = 0
PRICE
OF
ONIONS
O
X
DEMAND FOR MATCH BOX
Cross Elasticity in case of
Unrelated goods
Is ZERO

Computing the Cross Elasticity of Demand

Example: If the price of X cone increases from Rs. 10 to 50 and the amount demand of Y falls from 10 to 8 then what is your cross elasticity of demand, what is the nature of X and Y :

$$\frac{8 - 10}{10} X \frac{10}{50 - 10} = -0.05$$

Computing the Price Elasticity of Demand

If the price of Z decreases from Rs. 100 to Rs.80 and the amount of demand of P falls from 25 to 10 units then what is your cross elasticity of demand, what is the nature of Z and P :

$$\frac{10-25}{25} \; X \; \frac{100}{80-100} = 3$$

Price of Computer	Quantity Demanded
40000	8
48000	6
50000	5
54000	4
60000	2

1) Calculate the elasticity, when price of computer increases from 48000 to 54000

2)Calculate the elasticity, when price of computer decreases from 60000 to 50000

$$\frac{4-6}{6} X \frac{480000}{54000-48000} = 2.6$$

$$\frac{5-2}{2} X \frac{60000}{54000-48000} = 9$$

- Consider change in demand of a commodity as 20% when price changes by 40%. Calculate elasticity.

FORMULA:

$$\varepsilon_Y = \frac{\%\ \Delta\ \text{Quantity Demanded}}{\%\ \Delta\ \text{Price}}$$

- 20/40
- 0.5

- The price of a small engineering component decreases from Rs.6 to Rs. 4 and quantity demanded increases from 10 units to 15 units. Calculate elasticity.

$$\varepsilon_d = \frac{Q_2 - Q_1}{Q_1} \times \frac{P_1}{P_2 - P_1}$$

$$\frac{15-10}{10} X \frac{6}{4 - 6}$$

$$=1.5$$

- When income of a consumer increases by 30% demand also increases by 30%. What is the elasticity of demand?

FORMULA:

$$\varepsilon_Y = \frac{\%\ \Delta\ \text{Quantity Demanded}}{\%\ \Delta\ \text{Income}}$$

- 30/30
- = 1

- Quantity demanded of an engineering component X increases from 800 to 1200 units, due to increase in price of another Component Y in the market increases from Rs.2300 to Rs.2700. calculate elasticity.

$$\frac{Qx2 - Qx1}{Qx1} X \frac{Py1}{Py2 - Py1}$$

$$\frac{1200 - 800}{800} X \frac{2300}{2700 - 2300}$$

$$=2.87$$

commodity	Original Price (Rs.)	New Price (Rs.)	Original demand (Kg)	New demand (Kg)
A	10	11	50	45
B	2	1.2	10	18
C	90	92	40	35
D	5	6	25	22

- Find elasticity of demand for each commodity.
- Show that each commodity obeys the law of demand.
- Which commodity has the greatest elasticity, and which the least?

For A

$$\varepsilon_d = \frac{Q_2 - Q_1}{Q_1} \times \frac{P_1}{P_2 - P_1}$$

$$\frac{45 - 50}{50} \; X \; \frac{10}{11 - 10}$$

$$=1$$

For B

$$\varepsilon_d = \frac{Q_2 - Q_1}{Q_1} \times \frac{P_1}{P_2 - P_1}$$

$$\frac{18-10}{10} X \frac{2}{1.2-2}$$

$$=2$$

For C

$$\varepsilon_d = \frac{Q_2 - Q_1}{Q_1} \times \frac{P_1}{P_2 - P_1}$$

$$\frac{35-40}{40} X \frac{90}{92-90}$$

$$=5.6$$

For D

$$\varepsilon_d = \frac{Q_2 - Q_1}{Q_1} \times \frac{P_1}{P_2 - P_1}$$

$$\frac{22 - 25}{25} X \frac{5}{6 - 5}$$

$$= 0.6$$

Price of X	Demand for X	Demand for Y	Income
25	10	5	100
20	20	10	200
15	30	15	300
10	40	20	400

- Calculate the price elasticity of demand for X, if the price of X increase from Rs10 to Rs 20, and indicate whether the demand is elastic or inelastic
- Calculate the cross elasticity of demand for Y when the price of X decrease from 25 to 15 .Are X and Y complements or substitute
- Calculate the income elasticity of demand for X when the income of consumers increases from 200 to 400.What type of product is X.

$$\frac{20-40}{40} X \frac{10}{20-10}$$

$Ep = 20/40 \times 10/10$

$Ep = 0.5$

Inelastic demand

$$\frac{Qy2 - Qy1}{Qy1} X \frac{Px1}{Px2 - Px1}$$

$$\frac{15-5}{5} X \frac{25}{15-25}$$

Ep = 10/5 X 25/-10

Ep = 2 X -2.5

Ep = - 5 (Complementary Goods)

$$\frac{Q2 - Q1}{Q1} X \frac{Y1}{Y2 - Y1}$$

$$\frac{40 - 20}{20} X \frac{200}{400 - 200}$$

- Ep = 20 / 20 X 200 / 200
- Ep = 1
- Since its equal to 1 and positive , so A is Normal good

PAY BACK PERIOD

The Pay Back Period is a capital budgeting technique based on establishing how long It takes to recover the initial investment from the cumulative cash flows.

Pay Back Period can be calculated in two ways

1) Non Discounted Pay Back
2)Discounted Pay Back

Problem1 on Non Discounted Pay Back

A project requires Rs.20000 initial investment. It generates cash flows of Rs. 8000, 7000, 4000, and 3000 during 4 years. Calculate payback period.

$$\text{Formula} = \text{Years before full recovery} + \frac{\text{Uncovered amount}}{\text{Next year cash flow}}$$

Solution

First step: prepare cumulative cash flow

Year	cash flow	cumulative cash flow
1	8000	8000
2	7000	15000
3	4000	19000
4	3000	22000

In the cumulative total it can be noted that 3years + requires for payback period

Hence 3 years + $\frac{\text{Uncovered amount (20000-19000=1000)}}{\text{3000 (cash flow of next year)}}$ $= 3 + \frac{1000}{3000}$

= 0.33

Hence the payback period is 3.33 years

= 0.33 X12 = 3.9 (3 months)

= 0.9 X 30 = 27 Days.

That means 3 Years 3 Months 27 Days

Problem 2

Calculate pay back period for two machines. Each machine requires an investment of Rs.50000

MACHINE X			MACHINE Y	
YEAR	CASH FLOWS		CASH FLOWS	
1	25000		15000	
2	30000		25000	
3	35000		30000	
4	25000		40000	
5	20000		30000	

Problem 2

Calculate pay back period for two machines. Each machine requires an investment of Rs.50000

MACHINE X			MACHINE Y	
YEAR	CASH FLOWS		CASH FLOWS	
1	25000		15000	
2	30000		25000	
3	35000		30000	
4	25000		40000	
5	20000		30000	

ANSWER = MACHINE X 1.83 YEARS
MACHINE Y 2.33 YEARS

DISCOUNTED PAY BACK PERIOD

DISCOUNTED PAY BACK PERIOD CALCULATION

In this method of calculation we consider Time Value of Money (TMV). The calculation is Done after considering TMV and discounting the future cash flows.

Problem 1

A project with an investment of Rs.1000 and has the cash flows as follows. If cost of capital is 10%, calculate Pay back period.

Solution is in red colour

YEAR	CASH FLOWS		PRESENT VALUE OF CASH INFLOWS Cash Flow/(1+i)n	CUMULATIVE DISCOUNTED CASH INFLOWS
1	500		454.5	454.5
2	400		330.4	784.9
3	300		225.3	1010.20
4	100		68.3	1078.2

$$\text{Years before full recovery} + \frac{\text{uncovered cost}}{\text{Next year cash flow}}$$

$$2 \text{ years} + \frac{215.10}{225.3} = 2+0.95$$

$$= 2.95 \text{ Years}$$

Problem 2

Project M with an initial investment of Rs. 50 has the following cash flows. Calculate pay back if the discounting Rate is 12%

Year	Cash flows
1	11
2	19
3	32
4	37

Answer: 3.09 Years

Problem 3

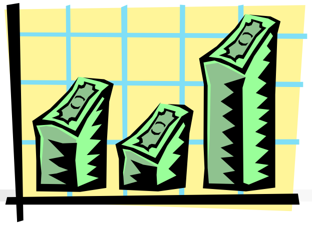
The investment of a project is Rs. 200000 and the cash flows are as follows. Calculate payback if the discount rate is 10%

Year	Cash flows
1	1,66,667
2	1,66,667
3	76,667

Answer: 1.84 Years

Net Present Value (NPV)

Net Present Value (NPV)



- NPV may be defined as the **difference** between the total present value of the cash inflows and the total present value of the cash outflows.

- NPV compares the value of the amount today versus the value of that same amount in the future, **after taking inflation and returns into account.**

- If the NPV of a prospective project is positive then it should be accepted (i.e. NPV > 0)

- However, if the NPV of a prospective project is negative, then the project should be rejected because cash flows are negative (i.e. NPV < 0)

- If the NPV of a prospective project is zero then it should probably be rejected as it generates exactly the return that is expected (i.e. NPV = 0)

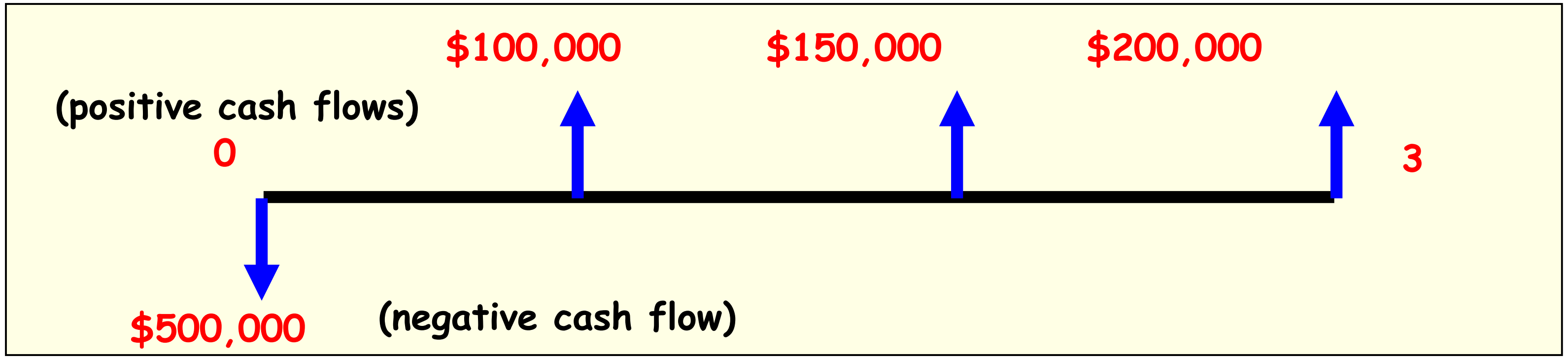
$$NPV = \frac{Cash\ Flow}{(1+i)^t} - initial\ investment$$

i = Required return or discount rate

t = Number of time periods

Net Present Value (NPV) -134861

Let us calculate the NPV from a series of cash flows. The formula is given below.



$$NPV = \frac{CF_1}{(1+i)^1} + \frac{CF_2}{(1+i)^2} + \frac{CF_3}{(1+i)^3} - \text{Investment}$$

$$NPV = \frac{100{,}000}{(1+0.1)^1} + \frac{150{,}000}{(1+0.1)^2} + \frac{200{,}000}{(1+0.1)^3} - 500{,}000 = ?$$

$$= 90909 + 123966 + 150262 - 500000 = -134860$$

Since we got negative value it is better to Reject the Project

Many projects generate revenue at varying rates over time. In this case, the formula for NPV can be broken out for each cash flow individually. For example, imagine a project that costs $1,000 and will provide 3 cash flows of $500, $300, and $800 over the next three years. Assume that there is no salvage value at the end of the project and the required rate of return is 8%. The NPV of the project is calculated as follows:

$$NPV\ (\$355.23) = \left(\frac{\$500}{(1+8\%)^1}\right) + \left(\frac{\$300}{(1+8\%)^2}\right) + \left(\frac{\$800}{(1+8\%)^3}\right) - \$1{,}000$$

NET PRESENT VALUE (NPV)

NPV is a classic economic method of evaluating the investment proposals.

Problem 1

The initial outlay/investment is Rs. 200000 and the cash flows are as follows. If the discounted rate is 10%, calculated NPV

YEAR	CASH INFLOW
1	130000
2	130000
3	130000
4	80000

NET PRESENT VALUE (NPV)

NPV is a classic economic method of evaluating the investment proposals.

Problem 1

The initial outlay/investment is Rs. 200000 and the cash flows are as follows. If the discounted rate is 10%, calculated NPV

Solution in Red Colour

YEAR	CASH INFLOW		PRESENT VALUE OF CASH INFLOW
1	130000		118170
2	130000		107380
3	130000		97630
4	80000		54640
	TOTAL		**377820**

First step – calculate discount factor for each year.
Second step – Multiply cash inflow with discounting factor
Third step – Total all present value of cash inflow

Formula is NPV=Cash inflow – Cash outflow(investment)

377820 – 200000 = 177820

If the answer is positive then such projects can be accepted.
If the answer is negative then such projects cannot be accepted.

In this problem the answer is 177820 which is a positive Number. It can be accepted.

Problem 2

Project X cost Rs. 2500 and cash flows are as follows. If the discounted rate is 10%, calculate NPV.

YEAR	CASH INFLOW
1	900
2	800
3	700
4	600
5	500

Problem 3 :

A project costs Rs. 16000 and expected cash inflows are as follows: Calculate NPV @ 20%

YEAR	CASH INFLOW
1	8000
2	7000
3	6000

IRR (INTERNAL RATE OF RETURN)

WHAT IS INTERNAL RATE OF RETURN (IRR)?

- Internal Rate of Return is the **interest rate that makes the Net Present Value zero**
- Internal rate of return is used to evaluate the attractiveness of a project or investment.
- If the IRR of a new project exceeds a company’s required rate of return, that project is desirable.
- If IRR falls below the required rate of return, the project should be rejected.

INTERNAL RATE OF RETURN (IRR)

The IRR method is another discounted cash flow technique which takes account of the magnitude and timing of cash flows.

IRR is the rate that equates the investment outlay with the present value of cash flow. This implies that the rate of return is the discount rate at which makes NPV=0.

The IRR is also known as Break even discount rate. In other words, the present value of cash inflows equals the present value of cash outflows.

Importance of IRR

We know that as borrowing cost raises the NPV declines. Hence, IRR is the limit of cost of capital for a project.

If borrowing cost exceeds IRR, the NPV turns negative and the project would be rejected.

IRR is related NPV in the sense that a project with a positive NPV will have cost of capital less that IRR.

$$LDR + \frac{\text{Original PV – Investment}}{\text{Original PV – New PV}} \quad X\ HDR - LDR$$

LDR = Lower Discount Rate
HDR = Higher Discount Rate

Problem 1

Calculate IRR @ 40% and 50% on the basis of following information. The investment is Rs. 50000. Show the exact IRR with proof.

Year	Cash flow
1	25000
2	30000
3	35000
4	25000
5	20000

Problem 1

Calculate IRR @ 40% and 50% on the basis of following information. The investment is Rs. 50000. Show the exact IRR with proof.

Year	Cash flow		Present Vlaue @ 40%		Present Value @ 50%
1	25000		17850		16650
2	30000		15300		13320
3	35000		12740		10360
4	25000		6500		4925
5	20000		3700		2620
		TOTAL	**56090**		**47875**

It can be observed that Total PV @ 40% is 56090 which more than cash outflow(investment) i.e. Rs. 50000. Hence we can understand that IRR lie between 40% and %50. Now let us increase PVF to 50% and verify. When we increase to 50% PV is 47875 which is less than cash outflow (investment) i.e. Rs. 50000.

Hence let us calculate, using the formula

$$\text{LDR} + \frac{\text{Original PV} – \text{Investment}}{\text{Original PV} – \text{New PV}} \text{ X HDR - LDR}$$

LDR = Lower Discount Rate

HDR = Higher Discount Rate

$$40 + \frac{56090 – 50000}{56090 - 47875} \text{ X } 50 – 40$$

$$40 + \frac{6090}{8215} \text{ X } 10$$

40 + 0.741 X 10

= 47.41% is the IRR

Problem 2

Calculate IRR between 40% and 42% on the basis of the following information. The investment is Rs. 50000. Show the exact IRR.

Year	Cash inflows
1	15000
2	25000
3	30000
4	40000
5	30000

Problem 1

Calculate IRR @ 40% and 42% on the basis of following information. The investment is Rs. 50000. Show the exact IRR with proof.

Year	Cash flow		Present Vlaue @ 40%		Present Value @ 42%
1	15000		10714		10563
2	25000		12755		12398
3	30000		10932		10477
4	40000		10412		9837
5	30000		5578		5196
		TOTAL	**50391**		**48472**

$$LDR + \frac{\text{Original PV} - \text{Investment}}{\text{Original PV} - \text{New PV}} \text{ X HDR - LDR}$$

LDR = Lower Discount Rate

HDR = Higher Discount Rate

$$40 + \frac{50391 - 50000}{50391 - 48472} \text{ X } (42 - 40)$$

$$40 + \frac{6090}{8215} \text{ X } 2$$

40 + 0.20 X 2

= 40.04% is the IRR

20 Marks Calculation

1. The cash flows of the two projects of Galantac company is given below. The company is faced with the situation of choosing between the two.

YEAR	PROJECT 'AIRBUS'	PROJECT 'BOEING'
0	-240000	-240000
1	120000	70000
2	100000	70000
3	70000	70000
4	20000	70000
5	10000	70000

1) Find out the payback period and Discounted payback period for AIRBUS
2) Find out the Net Present Value (NPV) of these projects at 8% discount Rate and indicate which project is preferred.
3) Also calculate Internal Rate of Return (IRR) for project Boeing(discount range from 13% to 15%.)

Solution for 20 Marks Calculation

1) Payback Period for AIRBUS:

YEAR	PROJECT 'AIRBUS'	Cumulative of Cash inflow
1	120000	120000
2	100000	220000
3	70000	290000
4	20000	310000
5	10000	320000

$$\text{Years before full recovery} + \frac{\text{Uncovered amount}}{\text{Cash flow of next year}}$$

$$= 2 + \frac{20000}{70000}$$

$$= 2 + 0.28$$

Hence the payback period is 2.28 years

1) Discounted Payback Period for AIRBUS:

YEAR	PROJECT 'AIRBUS'	PV for AIRBUS	Cumulative of PV of Cash Inflows
1	120000	111111	111111
2	100000	85733	196844
3	70000	55568	252412
4	20000	14700	267112
5	10000	6805	273917

$$\text{Years before full recovery} + \frac{\text{uncovered cost}}{\text{Next year cash flow}}$$

$$2 + \frac{43156}{55568}$$

$$= 2 + 0.77$$

$$= 2.77 \text{ Years}$$

2) NPV:

YEAR	PROJECT 'AIRBUS'	PV for AIRBUS	PROJECT 'BOEING'	PV for BOEING
1	120000	111111	70000	64814
2	100000	85733	70000	60013
3	70000	55568	70000	55568
4	20000	14700	70000	51452
5	10000	6805	70000	47640
	Total	273917	Total	279487

NPV For Project AIRBUS:

Formula is NPV=Cash inflow – Cash outflow (investment)

273917 – 240000 = 33917

NPV For Project BOEING:

Formula is NPV=Cash inflow – Cash outflow (investment)

279487 – 240000 = 39487

In this problem the NPV for AIRBUS is 33917 and NPV for BOEING is 39487.

Since BOEING having more NPV, so its profitable to accept BOEING project

3) IRR:

YEAR	PROJECT 'BOEING'	PV for BOEING(13%)	PROJECT 'BOEING'	PV for BOEING(15%)
1	70000	61946	70000	60869
2	70000	54820	70000	52930
3	70000	48513	70000	46026
4	70000	42932	70000	40022
5	70000	37993	70000	34802
	Total	**246204**	**Total**	**234649**

$$LDR + \frac{\text{Original PV} - \text{Investment}}{\text{Original PV} - \text{New PV}} \quad X\ (HDR - LDR)$$

LDR = Lower Discount Rate
HDR = Higher Discount Rate

$$13 + \frac{246204 - 240000}{246204 - 234649} \ X\ (15 - 13)$$

$$13 + \frac{6204}{11555} X\ 2$$

$$13 + 0.5369\ X\ 2$$

= 14.07 % is the IRR

DEPRECIATION

DEPRECIATION

Depreciation is a measure of the wearing out, consumption or other loss of value of a depreciable asset arising from use, obsolescene through technology and market changes. Straight line method of calculating depreciation.

Formula is Depreciation = $\frac{\text{Original cost – estimated scrap value}}{\text{Estimated useful life in years}}$

Problem 1

Cost of machine is Rs. 7800000 and estimated useful life is 5 years at the end of life the salvage value is expected of Rs. 390000. calculate depreciation using straight line method.

Solution : Original cost Rs. 7800000

Estimated scrap value Rs.390000

Estimated useful life 5 years

$$\frac{\text{Rs. 7800000 – Rs. 390000}}{\text{5 Years}}$$

= Rs. 14,82,000 per annum

Problem 2

A machine cost is Rs. 1000000 and expected life of machine is 6 years at the end of life the salvage value is Expected of Rs. 100000. calculate depreciation using straight line method.

Answer Rs. 150000 per annum

Problem 3 *(if salvage value is not given in the problem)*

A co. considering to purchase a machine costing Rs.250000. The machine has a life of 5 years. Calculate Depreciation using straight line method.

Solution

= Rs. 50000 per annum

Problem 3

Suresh & co. is considering to purchase a machine to manufacture chocolates which is costing Rs. 500000. The Machine has a life of 5 years. Calculate depreciation using straight line method.

Answer Rs. 100000 per annum