Introductory Microeconomics

Section 1: Theory of Perfectly Competitive Markets

1.1 Main Concepts of Economics

What is economics?
- Economics is the study of economic activity – that is, situations involving resource allocation
- Scarcity of resources means that decisions about resource allocation matter for the well-being of individuals and society

What is the main methodology that economists use?
- Economists develop theories to understand and predict economic activity
- A theory consists of (a) A model (representation of essential features of the situation being studied); and (b) Hypotheses or predictions (what the model implies about economic activity).

What is microeconomics?
- Microeconomics is about:
- (a) The behavior of individual decision-makers: Buyers, Suppliers, and Government
- (b) The interaction of individual decision-makers in markets.

How do rational decision-makers make choices?
- The core assumption of economics is that decision-makers use the cost-benefit principle to make choices
- The cost-benefit principle is that a decision-maker should only take an action if the extra benefits from that action outweigh the extra costs.

What measure of costs does economics use?
- Economics uses opportunity cost as the measure of costs
- The opportunity cost of an action is the value of the resources used (not available for alternative use) when that action is taken, valued in their next best alternative use
- Sunk costs are resources that are used before a decision-maker chooses whether to take an action, and are not included as opportunity cost

How does a decision-maker apply the cost-benefit principle?
- The optimal level of an activity is assumed to maximize the net gain which equals benefit minus opportunity cost
- The optimal level is found by using marginal analysis – comparing the marginal cost and marginal benefit of doing an activity, or increasing the level of an activity
- Marginal benefit (MB) is the addition to total benefit by doing, or increasing by one unit, the level of an activity
- Marginal cost (MC) is the addition to total cost by doing, or increasing by one unit the level of an activity
- For discrete (yes/no) choices, a rational decision-maker should choose to do an activity if $MB > MC$; for continuous (for example, 0,1,2,3,4…) choices, a rational decision-maker should choose to do units of the activity for which $MB > MC$.

- When the MB and MC of different activities alter, then rational decision-makers may change their choices. This is what is called responding to incentives.

1.2 Theory of Competitive Markets

What are the main assumptions of the theory of competitive markets?
- In the model of a perfectly competitive market it is assumed that buyers and suppliers are 'price-takers', and trade an identical items.

When will trade occur between rational decision-makers?
- Suppose a buyer has valuation of an item, b; and a seller has an opportunity cost of supplying the item, s. Denote p as the price at which the seller trades the item to the buyer.
- That is, trade is rational for a buyer where $b > p$, and for a seller where $p > s$.

What is market demand?
- Market demand is the aggregation of demands of all individual buyers.
- Demand is assumed to depend on: (a) Price – Inverse relation; and (b) Other factors such as price of other goods, income, and expected future price

What is market supply?
- Market supply is the aggregation of supplies of all individual suppliers
- Supply is assumed to depend on: (a) Price – Positive relation; and (b) Other factors such as income, prices of substitutes and complements, tastes and future expectations

How are demand and supply represented graphically?
- In the graphical representation of the perfectly competitive market model, the demand curve shows the relation between price and quantity demanded
- The supply curve shows the relation between price and quantity supplied
- The effect of changes in price is represented as movements along the demand and supply curve
- The effect of changes in other factors other than the price is represented as shifts of the demand and/or supply curve

What is market equilibrium?
- Market equilibrium is the price (P*) and quantity traded (Q*) in a market at which quantity demanded equals quantity supplied.

What are excess demand and excess supply?
- Excess supply occurs where $P > P*$ so that quantity supplied exceeds quantity demanded
- Where excess supply exists we expect the price to decrease to the equilibrium price
- Excess demand occurs where $P < P*$ so that quantity demanded exceeds quantity supplied
- Where excess demand exists we expect the price to increase to the equilibrium price

What is comparative statics?
- To understand or predict how market outcomes can change, we study how changes in demand and supply affect the market equilibrium. This is known as comparative statics.
- For example, an increase in demand will cause an increase in equilibrium price and quantity traded

1.3 Elasticity of Demand and Supply

What is elasticity?
- Elasticity is a measure of the responsiveness of demand or supply to their determinants

What is own-price elasticity of demand?
- The own-price elasticity of demand is the % change in quantity demanded due to a 1% increase in price
- The own-price elasticity of supply is the % change in quantity supplied in response to a 1% increase in price

When is demand price-elastic and price-inelastic?
- Demand (supply) is defined to be price-inelastic where a change in price causes a less than proportionate change in quantity demanded (supplied)
- Demand (supply) is defined to be price-elastic where a change in price causes a more than proportionate change in quantity demanded (supplied)
- Complements tend to have negative cross-price elasticity, as a rise in the price of a good will reduce the quantity demanded of that good, which will in turn tend to reduce the quantity demanded of complements for that good
- Alternatively, substitutes tend to have positive cross-price elasticity, as a rise in the price of a good will tend to induce consumers to switch to substitutes for that good, thus increasing the demand for aid substitutes

What is the relation between own-price elasticity of demand and total revenue?
- Knowing a product's own-price elasticity exactly identifies the effect of a change in price on total revenue from selling that product
- For example, an increase in price will cause an increase in total revenue when demand is own-price inelastic, and vice-versa

What is the income elasticity of demand?
- The income elasticity of demand is equal to the percentage change in quantity demand caused by a 1% increase in consumer income
- It measures how much changes in income affect the demand for a certain goods
- Luxuries tend to have high income elasticities, while necessities have lower income elasticities, and inferior goods have negative income elasticities

1.4 Government Intervention in Markets

What are the main types of government regulation?
- Government regulation can involve:
- Indirect taxation (a payment to government per unit traded) or subsidies (a payment from government per unit traded)
- Direct regulation may take the form of: a price floor (a minimum allowable price), a price ceiling (a maximum allowable price), or a quota (a maximum quantity traded)

How does taxation affect market outcomes?
- Taxes place a wedge between the price sellers receive and the price buyers pay. This wedge shifts the relative positions of the supply and demand curve, thus determining the share of the tax burden

- Tax burden is not, however, determined by whether taxes are actually imposed on sellers or buyers – in either case they effect price and quantity, and hence tax burden, in the same way
- The less elastic the demand and/or supply, the smaller will be the dead weight loss caused by a tax or subsidy, as less elastic demand/supply means a smaller change in quantity traded in response to a given change in price, and hence a smaller distortion caused by the regulation
- A tax increases the cost to buyers and reduces the profitability to sellers. In the cases where the difference between seller cost and consumer valuation of the good is greater than the tax, then that amount of income (or surplus) will simply be transferred from the buyers and sellers to the government
- In cases where the size of the tax exceeds the difference between cost and valuation, however, the tax makes the trade unprofitable for either party to enter into, and as such it does not take place. In this instance income/surplus utility is lost for no gain to the government

How does elasticity of demand/supply affect the outcome of regulations?
- The relative share of the tax burden will depend upon the relative elasticities of supply/demand
- Relatively inelastic demand means that consumers are willing to pay a much higher price so as to avoid buying fewer units – hence the quantity traded will not decline much, and the consumers will pay most of the tax
- Conversely, a relatively inelastic supply means that suppliers are willing to continue supplying a similar quantity even if they had to accept a significant reduction in unit price – hence the quantity traded will not decline much, and the producers will pay most of the tax
- Whichever party has a more inelastic curve has less bargaining power, and hence will pay more of the tax
- When a tax is levied and the demand is relatively inelastic, it means that producers will stop supplying a given quantity of goods in response to a much smaller reduction in price than it would take to induce consumers to stop consuming an amount of equal size, and hence to equalize quantity supplied with quantity demand, price paid by consumers will have to rise relatively more than the fall in price received by producers, and thus consumers will pay more of the tax. For inelastic supply, it is the other way around.
- In contrast, when a subsidy is paid and the demand is relatively inelastic, it means that consumers will have to be offered a much greater reduction in price to agree to consume a given additional quantity of the good than producers would have to be offered in order to sell it, and hence consumers will get most of the subsidy.

1.5 Welfare and Markets

How is well-being in a society measured?
- Well-being in a society is measured as the sum of net gains from trade for buyers and sellers.
- Net gain for buyers is measured as consumer surplus (CS), equal to the area under the demand curve (maps out willingness to pay) and above the market price
- Net gain for suppliers is measured as producer surplus (PS), equal to the area above the supply curve (maps out opportunity cost) and below the market price

When is resource allocation in an economy efficient?
- Resource allocation in an economy is efficient where total surplus is maximized
- Total surplus is equal to the sum of consumer surplus and producer surplus
- Efficiency means that society is achieving the greatest value for buyers for a given opportunity cost for suppliers

How does international trade affect well-being?

- Where a country is small relative to the size of the world market, international trade can be represented as the opportunity for that country's buyers or sellers to buy or sell any quantity at the world price
- Introducing the scope for international trade expands the opportunities for mutually beneficial trade since 'domestic' buyers and sellers can either trade between themselves, or trade on the world market
- Hence introducing the scope for international trade improves well-being

Why are perfectly competitive markets efficient?

- Resource allocation in a perfectly competitive market is efficient at the market equilibrium (in the absence of any source of market failure)
- This is because creating extra opportunities for mutually beneficial trade ($b > s$) will always improve well-being in society, and at the market equilibrium all mutually beneficial trades are realized
- Government regulation causes a different quantity traded to the market equilibrium (Q^*)
- This occurs both where government introduces a regulation on trade in the 'domestic economy' (such as indirect tax), or on international trade (such as tariff or quota).

What is market failure?

- Market failure occurs where the market equilibrium is not efficient
- One source of market failure is externality which occurs where a decision-maker's choice of action has costs or benefits for other members of society that are not borne or received by the decision-maker
- A negative externality exists where a decision-maker imposes costs on other members of society; and a positive externality exists where a decision-maker provides benefits to other members of society
- Another source of market failure is public goods, which is a good that is both non-rivalrous (consumption by one member of society does not diminish consumption possibilities for other members) and non-excludable (once the good is supplied for one member of society, it is available for all members)

What is an externality? Why is it a source of market failure?

- A market equilibrium reflects private marginal costs (PMC) and marginal benefits (PMB) of decision-makers, whereas an efficient outcome should reflect social marginal costs (SMC) and marginal benefits (SMB)
- The existence of an externality implies that a private decision-maker is not taking into account some costs or benefits to society of their choice of action
- Therefore where an externality exists the market equilibrium will always differ from the efficient outcome
- Where there is a negative externality then the level of an activity or amount of trade will be more than the efficient level; and when there is a positive externality then the level of an activity or amount of trade will be less than the efficient level.

What policy solutions might be applied to rectify externalities?

- 'Internalise the externality' through tax (negative externality) or subsidy (positive externality)
- Facilitate trade between the party causing the externality and the party affected by the externality by assigning property rights (Coase theorem)

- The Coase theorem states that private economic actors can solve externalities problems amongst themselves through payments to stop an activity from occurring, or to allow an activity to occur (e.g. pet owner pays neighbor to allow him to keep barking dog)
- Private solutions generally do not work when the transaction costs of arriving at and enforcing an agreement are large – often this is legal fees for lawyers to write contracts, or because the number of parties is so large that agreement is impossible
- These two solutions involve seeking to face a decision-maker with the social costs and benefits of their decisions
- Direct regulation of the level of the activity, or quantity of trade

What are the benefits of Pigovian taxes and tradable emissions permits?
- Pigovian taxes are a better idea than mandatory regulations, as they allocate the task of reducing the negative externality to those corporations, individuals or industries who can do so most effectively/cheaply.
- Also, pigovian taxes provide incentives to reduce the production of negative externalities as low as possible, whereas regulatory limits provide no incentive to reduce output below the legal limit
- Pigovian taxes generate revenue for the government without distorting market efficiency – in fact while actually improving market efficiency (i.e. no deadweight loss)
- Tradeable emissions limits achieve the same ends as an equivalent pigovian tax, except that instead of setting the price of pollution, they set the quantity to be emitted, and allow the relevant individuals or businesses to bid the price to the right level
- Because of this, tradeable emissions permits may be more effective than pigovian taxes, as the government does not have to worry about setting taxes at the right level – it can just auction off the number of permits corresponding to the desired pollution reduction

What is a public good? Why are public goods a source of market failure?
- In a market equilibrium the quantity of a public good traded will be too low relative to the efficient level.
- One reason is a 'positive externality effect' whereby each member of society ignores the benefit they provide to other members of society when they supply a public good (since public goods are non-rivalrous, it is only necessary to provide a public good once for all members of society to benefit)
- A second reason is a 'free-rider' effect whereby each member has an incentive to under-state their valuation of a public good in order to seek to have other members of society contribute a greater share to the costs of production (each member has an incentive to have other members pay for the public good, since it is non-excludable, and hence they can consume it after others have paid for it to be produced)

What policy solutions might be applied to rectify public goods?
- Government finances provision of the efficient quantity of public goods using taxation – e.g. Lindahl taxes tax all consumers in proportion to their share of total social benefits
- Patent or copyright systems to 'create' excludability so that the producer of a public good can charge other members of society for the right to consume the good, thereby increasing incentives for provision of public goods
- An advance commitment by market participants to purchase the public good at a pre-specified price once it is produced

1.5 The Value of Markets

Why are markets valuable?
- Markets can be used to facilitate mutually beneficial trade, to assist in solving market failure, to efficiently allocate resources, or to provide information that may be valuable
- Free markets allocate the supply of goods to buyers who value them most highly, as measured by their own willingness to pay
- They also allocate the demand for goods to the sellers who can produce them at the lowest cost
- Finally, markets produce the quantity of goods that maximises total surplus.

Under what conditions do markets work best?
- There are a large number of buyers and suppliers so that the bargaining power of buyers and suppliers is relatively equal
- When market participants are experienced
- When market participants act independently, and have diverse beliefs
- When it is easy for buyers and sellers to find potential trading partners
- When market participants can trust that transactions will be completed/enforced

Section 2: Theory of the Firm

2.1 Introduction

What is a firm and what is the objective of a firm?
- A firm engages in production, which is the transformation of inputs to produce output that will be supplied to buyers (traded in markets)
- The objective of a firm is assumed to be profit maximization.

How are economic profits measured?
- Economic profits equal Total Revenue minus Total Opportunity Cost
- Since economic profits take into account the total opportunity cost of production (including, for example, earning a market rate of return on capital invested), therefore the level of zero economic profits is a state where a firm would be indifferent between being or not being a supplier in a market

What are the key decisions that a profit-maximizing firm must make?
- A firm that has as its objective to maximize profits can be thought of as having to make decisions on four key questions:
- What to produce?
- What price to set?
- What production method to choose?
- What price to pay for inputs?

2.2 Production and Costs

What are the short-run and long-run?
- Short-run: Time period over which the level of at least one input cannot be varied (Fixed input – Quantity cannot be varied; Variable input – Quantity can be varied);
- Long-run: Time period over which the level of all inputs can be varied.

Concepts of production and costs in short-run:
- Total product = How quantity of output varies depending on quantity of variable input
- Marginal product = Addition to total product when one extra unit of variable input is used
- SR Total Cost = How SRTC varies depending on quantity of output
- SR Marginal Cost = Addition to SRTC when one extra unit of output is supplied.

What are the different types of short-run costs?
- Fixed cost: Cost that does not vary with quantity of output
- Variable cost: Cost that varies with quantity of output
- Average Cost: AFC = FC/q; AVC = VC/q; SRATC = SRTC/q (q = firm's quantity of output)
- Diminishing MP of variable input => Increasing MC;
- Constant MP of variable input => Constant MC.
- There is a direct relation between production and average cost:
- Where FC and VC both account for relatively large shares of SRTC, and MC increases with the quantity of output => SRATC is U-shaped with quantity of output;
- Where FC is very large share of SRTC, or where MC is constant with output => SRATC always decreases with quantity of output.

What is the definition of LRATC? When do we say LRATC exhibits economies of scale?
- In the long-run a firm can choose any level/type of the fixed input
- Hence long-run ATC at each quantity of output is the minimum of all possible levels of SRATC (all possible choices of the fixed input) at that quantity
- Hence LRATC is often describe as an 'envelope' of SRATC
- Where LRATC decreases with output it is said that production displays economies of scale; and where it increases with output it is said that production displays diseconomies of scale

How can firms seek to minimize costs?
- Increasing the productivity of inputs (while keeping the same production method)
- Finding more efficient methods of production
- Reducing the price paid for inputs

What is the make-or-buy problem for a firm?
- The make-or-buy problem for a firm is whether to produce an input itself, or to buy it from an outside supplier
- This decision often involves a trade-off between cost of supply, and the quality of product provided

What are some benefits of outsourcing?
- Outside firms may have lower costs in producing an item if they specialize in producing that item and hence have a comparative advantage in its production (i.e. lower opportunity costs of production)
- By specializing in producing large quantities of the item, an outside firm may also be able to achieve economies of scale, and hence lower costs of production
- Greater competition from other firms in the market for the outsourced good may stimulate innovation and reduction of costs, which would not be enjoyed if the good was produced internally
- Outsourcing production of the good will also reduce organizational complexity and size

- The outsourcer will also benefit from converting some fixed costs into variable costs, hence reducing uncertainty about average costs

What are some problems with outsourcing?
- Sharing information with contractors introduces the risk of trade secrets or copyrights being breached, or other key information being lost
- In the case of a non-replaceable input, there exists the possibility of outside owners of key inputs 'holding up' production by refusing to supply
- It may be difficult to motivate contractors to maintain high quality production when quality is difficult to measure (e.g. prison services)
- Finally, there is a possibility that contracting out may lead to 'training up' future competitors

2.3 Revenue and Profit Maximization

What are the three major types of markets?
- Perfect competition: Many suppliers of an identical product, free entry and exit of suppliers to and from the market
- Monopolistic competition: Many suppliers of differentiated product, free entry and exist of suppliers to and from the market
- Monopoly: Single supplier of a product and barriers to entry prevent entry by new suppliers.

What is market power?
- Market power is the capacity of a firm to set price above the level that would exist in a competitive market without losing all its customers.

What are the main determinants of market power?
- A firm's market power depends on the elasticity of demand of their product, on the number of competing suppliers in the market, and on the degree of substitutability of their product
- The number of competing suppliers will depend on the extent of barriers to entry, while the degree of substitutability will depend on the extent of product differentiation
- Market power:
    - → elasticity of demand → degree of substitutability → product differentiation
    - → number of competitors → barriers to entry

How does market power differ between market types?
- Firms in a perfectly competitive market have zero market power since if a firm seeks to increase the price above the market equilibrium price (P*) it will lose all its customers
- Firms in monopoly and monopolistically competitive markets have market power since a firm that increases it price would be expected to lose some (but not all) of its customers
- For monopoly this is due to barriers to entry that prevent new firms competing with the monopolist, and in a monopolistically competitive market it is due to product differentiation that implies firms do not supply products that are exact substitutes

2.4 Price Setting

What is total revenue?
- Total revenue equals quantity supplied multiplied by average revenue per unit of output.

What is marginal revenue?
- Marginal revenue is the additional revenue that a firm obtains by supplying one extra unit of output

How should the profit-maximizing price/quantity be chosen?
- Where a firm must set the same price for each unit of output, the profit-maximizing price/quantity can be chosen using the MR/MC rule
- This rule is that a firm should supply a unit of output that has MR greater than or equal to MC, but should not supply a unit of output for which MC exceeds MR
- The MR/MC rule applies for profit maximization regardless of a firm's market power
- However, the character of MR varies between a firm that has or does not have market power

What demand curve does a firm in a perfectly competitive market face?
- Competitive markets have many buyers and sellers, homogenous goods sold by all suppliers, and the freedom of firms to enter and exit the market at will
- Because many other firms are offering the same product, a single firm in a competitive market has little or no market power (the power to influence prices)
- Firms in competitive markets have no motivation to sell for less than the market price, and if they try to sell for more, buyer will go to the many other available sellers
- Competitive firms are price takers, and hence the price at which they sell their goods is independent of how much they sell. Thus, price will always equal marginal revenue.

What demand curve does a firm in a monopolistically competitive market face?
- A monopolist's marginal revenue is always lower than the price, whereas for competitive firms it is always the same as price
- This means that for a monopoly firm, price will always be greater than marginal cost
- This occurs because when raising output, the monopolist faces both the quantity effect (i.e. more goods sold means higher income), but also the price effect (more goods sold means a lower price per good). Competitive firms do not face the price effect.
- Because a monopolists marginal revenue curve slopes downwards more quickly than the demand curve, the profit-maximising output that it chooses will result in a higher price and lower quantity supplied than is consistent with the optimum level

How should a firm decide on the quantity it is willing to supply?
- A firm's decision about supply will involve two key decisions
- Firstly, a choice of a profit-maximizing price/quantity, which should be made using the MR/MC rule
- Secondly, a decision about whether to operate; a firm should only be willing to operate where the total revenue it earns is at least as great as opportunity cost of production
- In the short run opportunity cost will equal variable cost, and in the long run opportunity cost will equal total cost

What is price discrimination?
- Price discrimination is where a firm sells the same product to different customers at different prices (for reasons not related to the cost of production)
- Price discrimination can allow a firm to increase its profits compared to charging a single price for all units of output
- This happens by allowing a firm to target the price for each consumer (or group of consumers) at the willingness to pay of that consumer (or group)

- At the same time, price discrimination is also likely to be associated with an increase in quantity traded
- This reduces the extent of market failure associated with imperfect competition in a market

What is needed for a firm to be able to price discriminate?
- To implement price discrimination a firm must:
- Have market power, as otherwise costumers having to pay more would buy elsewhere
- Have information on the willingness to pay of individual buyers (or groups of buyers)
- Be able to prevent resale between buyers

What are the main types of price discrimination?
- First degree: Charge a price equal to each buyer's willingness to pay
- Second degree: Variety of types of 'non-linear' pricing such as selling two different versions of essentially the same good (e.g. business and economy classes) and bundling (selling two or more goods together)
- Third degree: Charge a different price to groups of buyers on the basis of observable characteristics

2.5 The Effect of Competition

What happens if firms earn positive economic profits in a PC market?
- Equilibrium in the long-run in a PC market will involve a market price (P*), market quantity traded (Q*), and quantity supplied per firm (q*)
- Equilibrium will be such that Market demand = Market supply; each firm chooses q* to maximize profits (P*=MC); and each firm chooses q* such that it earns zero profits (P*=ATC)
- In the long-run firms should earn zero profits, since if this was not the case then there would be entry or exit occurring in the market.
- Where positive economic profits are being earned, then this will induce new firms to enter the market, which increases supply and reduces the market price and hence lowers profits (and entry should continue till economic profits are zero)
- Where negative economic profits are being earned, then this will induce some firms to exit the market, which decreases supply and increases the market price and profits (and exit should continue till economic profits are zero)
- The long-run market supply curve will be horizontal at the minimum average total cost, as any price above this would generate profits, thus attracting more firms and lowering price
- In actuality the long-term supply curve might slope upwards if new firms are less productive than the old ones, or if production requires resources that are only available in limited amounts

What happens if a monopoly earns positive economic profits?
- Equilibrium in the long-run in a monopoly market will involve a market price and quantity traded, P_M and Q_M, such that the firm maximizes profits (MR = MC)
- It is possible that a firm in a monopoly market will earn positive economic profits in the LR

Why are firms in a PC and monopoly market likely to earn different levels of profits?
- A comparison between the market outcome and dynamics in perfect competition and monopoly illustrates the effects of the relative balance of bargaining power between buyers and suppliers and of barriers to entry

- In monopoly the firm has greater bargaining power than in perfect competition, and it uses its market power to increase the price above the level that would exist in a perfectly competitive market in order to earn higher profits
- A monopolist can earn positive profits in LR equilibrium whereas a firm in a PC market cannot
- This is because (by assumption) in a monopoly it is not possible for new firms to enter the market to 'compete away' the profits of the monopolist supplier, whereas the scope for entry of new firms will always erode profits of suppliers in a PC market

What are the consequences of having a market with a monopoly supplier?
- The quantity traded in a market will be lower when there is a monopoly supplier than where the market is perfectly competitive
- Since the perfectly competitive outcome is efficient, therefore in a market with a monopoly supplier the quantity traded is less than the efficient quantity. In other words, monopoly constitutes a source of market failure.
- This is why governments are generally concerned to regulate monopoly or the degree of competition in a market
- For example, in Australia the Australian Competition and Consumer Commission has responsibility for administering the Trade Practices Act which has as its main objective to ensure markets are sufficiently competitive

What is product differentiation?
- In a monopolistically competitive market in the short-run a firm may earn positive economic profits on the basis of market power due to product differentiation
- Product differentiation describes the way in which a product supplied by one firm in a market differs from the product supplied by another firm in that market – for example, quality, design, location or brand-name
- However, in the long-run, it would be expected that entry by new firms to the market would change demand for the firm initially earning positive profits - by reducing the level and increasing elasticity of demand - so that its profits would decrease
- This process would continue until all firms were earning zero economic profits
- The model of a monopolistically competitive market can be applied to understand why firms supplying in the same market would set different prices – for example, where firms face the same costs, the profit-maximizing price will be higher for a firm that has a higher level and lower elasticity of demand for its product

What is meant by the process of 'imitation and innovation'?
- A comparison of market dynamics between perfectly competitive and monopolistically competitive markets illustrates the effect of the scope for product differentiation on market outcomes and firms' profits
- This can be characterized as a process of imitation and innovation
- In a monopolistically competitive market firms that are earning positive economic profits will attract imitators (in the same way as in a perfectly competitive market)
- But there is also scope for firms to engage in innovation – the development of new sources of product differentiation – that can allow them to preserve market power and hence positive economic profits (in a way that is not possible in a perfectly competitive market)

What is the 'characteristics' approach to product differentiation?
- One way in which it is possible to think formally about the process of product differentiation is using the 'characteristics' approach

- In this approach a product is thought of as a bundle of characteristics. For example, a holiday might be represented in terms of the amount of 'relaxation' and amount of 'new experiences' that it provides
- Product differentiation will provide a firm with the greatest degree of market power where a firm chooses a product that matches the preferences of the largest number of consumers, and which is an 'optimal' distance from the bundles of characteristics in products supplied by other firms in the market

Section 3: Game Theory

3.1 Introduction

What is game theory? What is a strategic situation?
- Game theory is the study of strategic situations
- A strategic situation is a situation where there is an inter-dependency between decision-makers
- That is, each decision-makers need to anticipate the decisions of other parties or how those parties will react to their decisions, prior to knowing how to best behave themselves
- Game theory becomes relevant when all parties in an interaction are significant, either because there were few players to start with, or because subsequent commitments or private information make each player significant in its own right

What are some examples of strategic situations?
- Strategic situations are ubiquitous in society
- The way firms compete in some markets (oligopoly)
- Auctions and bargaining
- Warfare and international relations
- Sports and some TV game shows.

What are the three steps in doing game theory?
1. Develop a model of the strategic situation that describes:
   a. Who are the players?
   b. What strategies are available to each player?
   c. What is the payoff to each player from each possible combination of strategies?
   d. [It is assumed that all players know the description of the game and know that other players know the description. Payoffs summarize the total effect of an outcome on the well-being of a player.]
2. Predict the outcome using an equilibrium concept. In game theory there are different ways of predicting the outcome depending on the type of game. Any method of predicting the outcome will always involve the idea that players are choosing strategies that are optimal for them.
3. Use the analysis of game to develop guides or rules for behavior in strategic situations.

What are the two main types of games?
- A simultaneous game can involve both players taking moves at exactly the same time, or when moves are made at different times, both without knowledge of the decision of the other player
- Sequential games involve a set order of moves, in which each players knows the action taken by the previous player before they make their move
- Thus, each player must consider the response of other players before making their moves

What are the two major time periods of games?
- One-shot games are played only once, and therefore players tend to be more sneaky and brutal, with no reputations to punishments to worry about, and little information about the other player
- In contrast, repeated games involve more information about either side, as time is available for reputations to form. Players also have better opportunities to negotiate and enforce agreements

What are the important concepts of game theory?
- A strategy is a complete plan of action of what one player will do in every possible circumstance
- The payoff is the average expected benefit to be obtained from each possible outcome of the game. The payoff must incorporate information about all aspects of the game that the player cares about
- In game theory, it is assumed that each player has complete knowledge of their own objectives, and can precisely calculate the strategy which best serves their interests
- Equilibrium occurs when each player is pursuing the strategy that is the best response to the strategies of the other players – it does not mean that it is the best outcome for all players, nor does it mean that nothing changes

3.2 Simultaneous games

How are simultaneous games represented?
- Simultaneous games can be represented using a game table
- In a two player game there is a 'row' player and a 'column' player, and for example, strategies for the row player are represented as different rows on the table
- Payoffs are written within sections of the table corresponding to each combination of strategies, with the convention being to write the payoff to the 'row' player first, and to the 'column' player second.

What is a strict dominant strategy equilibrium? How can it be used to predict the outcome?
- One method of predicting the outcome in a simultaneous game is to use the concept of strict dominant strategy equilibrium
- A strategy is dominant if it yields a payoff at least equal to all, and greater than at least one, of the payoffs available from adopting any other strategy, regardless of which strategy is chosen by the other player
- If the payoff from the dominant strategy is higher than all other strategies, it is said to be strictly dominant. If it is only equal to some of the payoffs, is it said to be weakly dominant.
- Where a player has a strict dominant strategy then it immediately follows that a rational player would choose that strategy
- Hence, where all players in a game have strict dominant strategies we should expect them to choose those strategies – This is what is described as a strict dominant strategy equilibrium

What is a weak dominant strategy equilibrium? How can it be used to predict the outcome?
- Another method of predicting the outcome in a simultaneous game is to use the concept of weak dominant strategy equilibrium

- A player has a weak dominant strategy where there is a strategy that, regardless of the strategy choices of other players, always gives at least as high a payoff as any other strategy available, and sometimes gives a strictly higher payoff
- Hence, where all players in a game have weak dominant strategies we should expect them to choose those strategies – This is what is described as a weak dominant strategy equilibrium

How can the outcome be predicted where only one player has a strict dominant strategy?
- Where only one player in a two-player game has a strict dominant strategy, this may still be the basis for predicting the outcome in that game
- The player with the strict dominant strategy would be expected to choose that strategy
- The other player – by putting themselves in the shoes of the player with the strict dominant strategy – can work out that the player has this strategy
- By restricting their consideration to just that part of the game table that involves the player with the strict dominant strategy choosing that strategy, the other player may then have a unique strategy that maximizes their payoff. This would then be the predicted outcome in the game.

When is a game dominance solvable?
- In games where no player has a strict dominant strategy it may be possible to predict the outcome of a game using the concept of iterated dominant strategy equilibrium
- A strategy for player is strictly dominated strategy where, regardless of the strategies of other players, there is another strategy that always gives a player a strictly higher
- Where a player has a strictly dominated strategy then it immediately follows that a rational player would never choose that strategy
- Where it is possible to arrive at a unique outcome in a game by successively eliminating strictly dominated strategies, then the game is said to be dominance solvable, and that outcome would be the predicted outcome
- Once a dominated strategy has been eliminated, a dominant strategy for one or more players may become apparent, and the game will be solved.

How is the concept of Nash Equilibrium useful in predicting the outcome?
- In games where players do not have strictly dominant or strictly dominated strategies, it is usual to seek to predict the outcome using the concept of Nash equilibrium
- A nash equilibrium occurs in a Noncooperative game when each player is playing their optimum strategy, and would have no desire to change their strategy even after having seen what the other player has chosen
- The justification for using Nash equilibrium as the predicted outcome of a game is that it is a 'stable' outcome
- Even though players in a simultaneous game do not observe the choices of strategies of other players prior to making their own choices, if it was then revealed what each player was chosen and they were given the opportunity to change, if the strategies they had chosen were a Nash equilibrium, then no player would want to switch

How can Nash equilibrium strategy combinations in a game be found?
- Nash equilibrium strategy combinations in a game can be found using the 'cell-by-cell' inspection method
- This involves asking for each strategy combination for each player – Given the choices of other players, can this player obtain a strictly higher payoff by switching to another strategy?
- If the answer is 'no' for all players, then the strategy combination is a Nash equilibrium

- If the answer is 'yes' for any player, then the strategy combination is not a Nash equilibrium
- Only a cell with no crossings out (for which neither player would want to change their decision) can be a nash equilibrium outcome.

What is the relation between strict dominant strategy equilibrium and Nash equilibrium?
- Any strict dominant strategy equilibrium is a Nash equilibrium (but not vice-versa)
- It is possible to have more than one Nash equilibrium in a game
- Without extra information, it is not possible to make a unique prediction of the outcome

What are the main lessons for behavior in a simultaneous game?
- Always choose a strictly dominant strategy
- Never choose a strictly dominated strategy
- Where you do not have a strictly dominant or dominated strategy (considering the whole game), it may be possible to work out your optimal strategy by putting yourself in the shoes of the other player (or players)
- If that player (or players) have a strictly dominant or dominated strategy, this may provide a way of 'reducing' the game that then allows you to decide on an optimal strategy.

3.3 Sequential games

How can sequential games be represented?
- Sequential games can be represented using a game tree
- A game tree consists of decision nodes (points in the tree at which a player must make a choice of action), branches (which show the choices of action available to a player), and terminal nodes (points at the end of the game tree)
- Each terminal node corresponds to a possible outcome in the game, and payoffs associated with each possible outcome are written at the terminal nodes (with the convention of writing the payoff to the first moving player first, second moving player second, etc).

How is the outcome in a sequential game predicted?
- The outcome in a sequential game is predicted using the concept of roll-back equilibrium
- A roll-back equilibrium is a choice of strategy for each player that involves making an optimal choice of action at each decision node given that all other players will choose optimal actions at all subsequent decision nodes in the game tree
- The roll-back equilibrium is found using the principle of 'backward induction'.

What is the rationale for using this method of predicting the outcome?
- Backward induction requires starting at the final decision nodes in the game tree and working out optimal actions at those nodes
- Then information on payoffs from optimal choices of actions is rolled back in the tree as payoffs for choices of actions at decision nodes at the previous stage in the game
- This is repeated until all choices of actions in the tree have been predicted
- The rationale for using roll-back equilibrium as a way of predicting outcomes in sequential games is that this is the outcome that would be expected if all players in the game are rational and believe that other players are rational

What is first-mover advantage?

- A first-mover advantage can exist in a sequential game where by moving first a player can force another player to change their choice of strategy (compared to in a simultaneous game) in a way that advantages the player moving first

What is second-mover advantage?
- A second-mover advantage can exist in a sequential game where by moving second a player can adjust strategy using information on the strategy of the other player in a way that achieves a higher payoff than in the simultaneous game

What are the main lessons for behavior in a sequential game?
- Make decisions by 'looking forward and reasoning backwards'
- Order of choosing strategy can matter

3.4 Oligopoly

What is an oligopoly?
- An oligopoly is a market with a few sellers that interact strategically
- The quantity traded in an oligopoly will be between a monopoly and a PCM

How does competition occur in oligopoly?
- Competition in oligopoly can occur by firms strategically choosing quantities or prices
- Outcomes for each type of competition can be predicted (in a simultaneous game) using the concept of Nash equilibrium
- Predicted market outcomes can differ between the different types of competition in an oligopoly

How can the outcome from each type of competition be analysed?
- Firms in an oligopolistic market may seek to retain market power by preventing the entry of potential new suppliers
- Attempts to deter entry can be studied using a sequential game, and using roll-back equilibrium to predict the outcome
- Such analysis establishes that it is important that entry deterrence behaviour by incumbent firms in an oligopoly must be credible