Managerial Economics

Comm295 Midterm Review Package

October, 20 2014

Content:

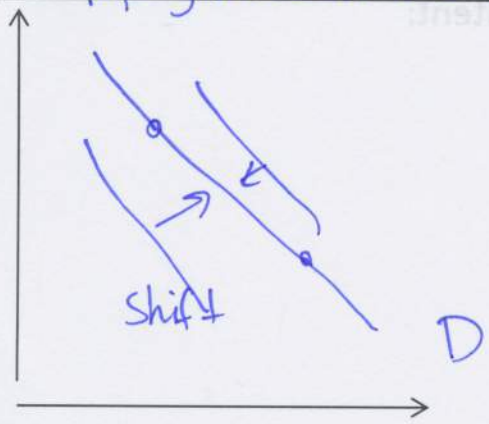
- Supply and Demand
- Elasticity
- Regression Analysis
- Consumer Choice
- Production
- Cost Concepts
- Profit Maximization
- Perfect Competition
- Monopoly
- Price Discrimination
- Oligopoly
- Game Theory

Supply and Demand

Slope of a demand curve is negative, meaning the higher the price, the lower the quantity.

Movement along the demand curve is caused by change in price

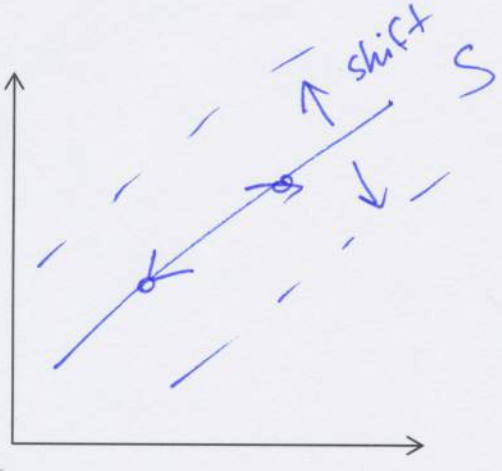
Shift of the demand curve is caused *by any* other relative factor except for price (change in ~~of~~ income, taste preferences, supply/demand of supplementary/comp. goods)



Slope of a supply curve is positive, meaning the higher the price, the higher the quantity.

Movement along the supply curve is caused by price

Shift of the supply curve is caused by any other relative factor except for price (change of input costs / technology)



Market Equilibrium:

Qs=Qd

Example1:

The demand function for muffins is given by Qd=185-30p. The supply function is given bt Qs=35+20p. What's the equilibrium price and quantity?

$185 - 30p = 35 + 20p$

$150 = 50p$

$p = 3$

$q = 185 - 30 \cdot 3 = 95$

Answer: p=3, q=95

Substitute goods – goods that are rival in consumption (Tea and coffee)

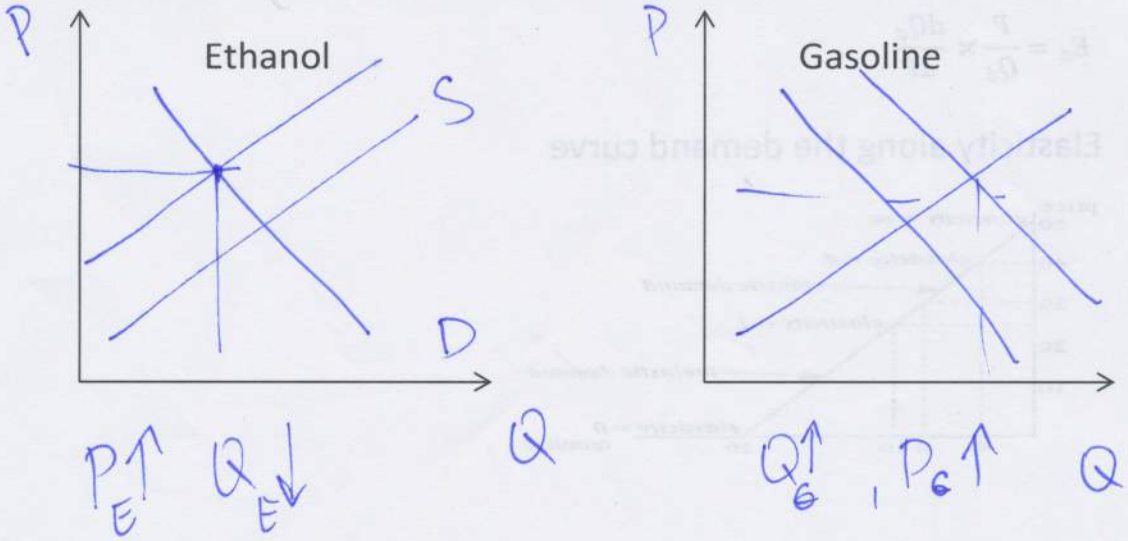
Complementary goods – goods that are consumed together (Pencils and erasers)

Normal goods – increase in income results in increase demand (Organic products)

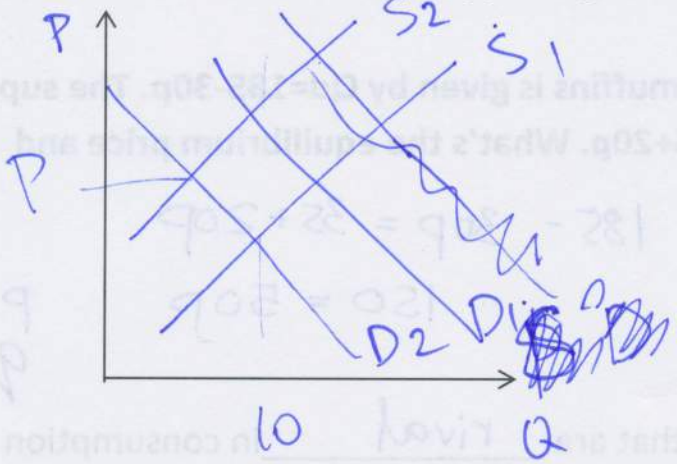
Inferior goods – increase in income results in decreased demand (Krafts Mac&Cheese)

Example2:

The cost of production of ethanol has gone up. Ethanol and Gasoline are substitutes. How does in affect consumption of Gasoline?



Example3: Tim-bits are considered an inferior good. The price of flour has gone up because of the recent drought, while wages in BC were raised by 10%. What's happening with consumption of tim-bits?



ΔP will depend
Q↓

Elasticity

Price elasticity of demand is the percentage change in Q demanded divided by the percentage change in P.

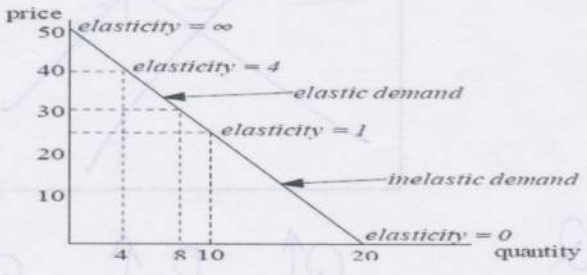
Arc elasticity – elasticity calculated using only two points

$$E=\frac{(Q2-Q1)/(Qavg)}{(P2-P1)/(Pavg)}$$

Point elasticity – elasticity evaluated at a single point

$$E_d = \frac{P}{Q_d} \times \frac{dQ_d}{dP}$$

Elasticity along the demand curve



Example4:

The demand function for apples is given by Qd=10-P and supply is Qs=4P. Calculate the point elasticity of demand at the equilibrium point. Is demand elastic or inelastic at this point?

$10 - P = 4P \Rightarrow 5P = 10 \quad P = 2$

$Q = 8$

$$\varepsilon = \frac{dQ}{dP} \cdot \frac{P}{Q} = -1 \cdot \frac{2}{8} = -\frac{1}{4}$$

$\left|\frac{dQd}{dP} = -1\right|$

inelastic

Income elasticity of demand

$$Ey = \frac{Percentage\ change\ in\ Qd}{Percentage\ change\ in\ income} = \frac{\Delta Q/q}{\Delta Y/y} = \frac{\Delta Q * y}{\Delta Y * q}$$

Good is normal when Ey is positive

Good in inferior when Ey is negative

Cross price elasticity

$$E = \frac{Percentage\ change\ in\ Qd}{Percentage\ change\ in\ price\ of\ another\ good} = \frac{\Delta Qa/Qa}{\Delta Pb/Pb} = \frac{\Delta Qa * Pb}{\Delta Pb * Qa}$$

Goods are complements if E is negative

Goods are substitutes if E is positive .

Regression Analysis

is used to estimate the mathematical relationship between a dependent variable Q and one or more explanatory variables price, income

Simple Linear Regression – one dependent variable depends on one explanatory variable (relationship is linear)

Random Error – effects on demand which can't be explained by explanatory variables

Qd=*a+bP+e*

Ordinary Least Squares Regression – minimizes the sum of squared residuals (the gap between predicted and actual value of the dependent variable).

Rsquared Statistic - how much of dependent variable is explained by the regression line. *0 <= R2<=1*

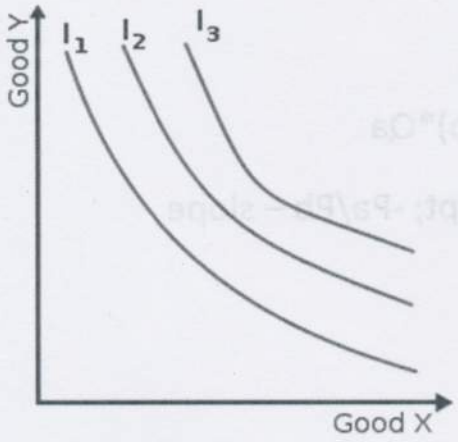
Consumer Choice

Utility – "happiness"

Law of diminishing marginal utility – as you increase consumption of Good A, utility from each additional unit decreasing.

Indifference curve – the set of all combinations of Goods A and B which provide the same utility

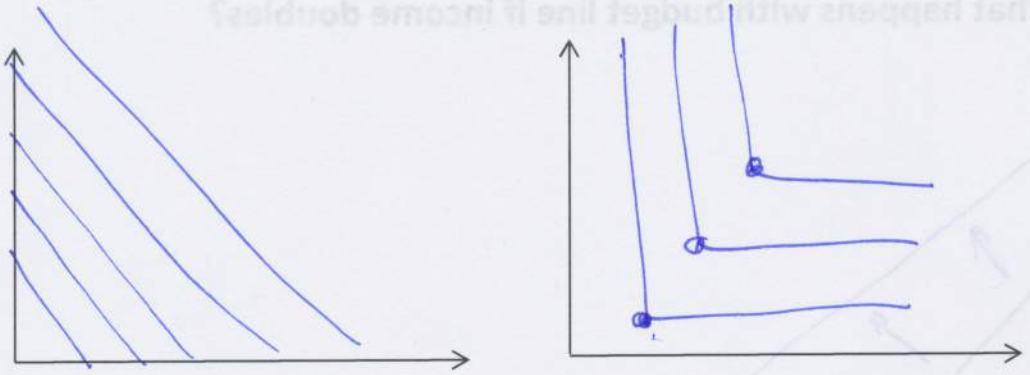
Indifference map – complete set of indifference curves



Example5:

perfect

How would indifference curve look like for a) substitutes b) complementary goods



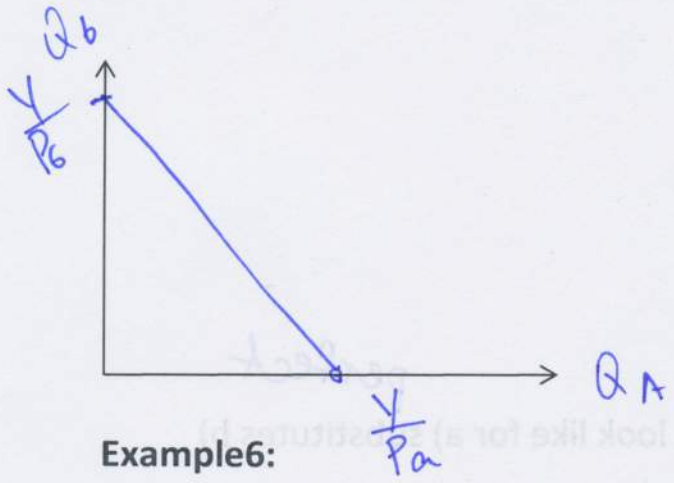
Marginal rate of Substitution – Slope of the Indifference Curve

MRS= $\frac{\Delta Qa}{\Delta Qb} = -\frac{MUb}{MUa}$

Budget Constraints:

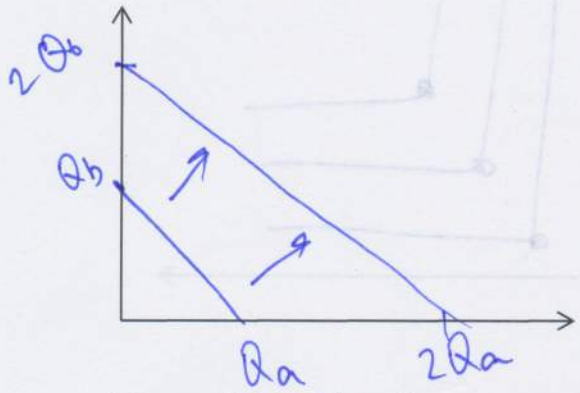
$Pb*Qb+Pa*Qa=Y$ $Qb=Y/Pb-(Pa/Pb)*Qa$

Y/Pb – y-intercept; $-Pa/Pb$ – slope

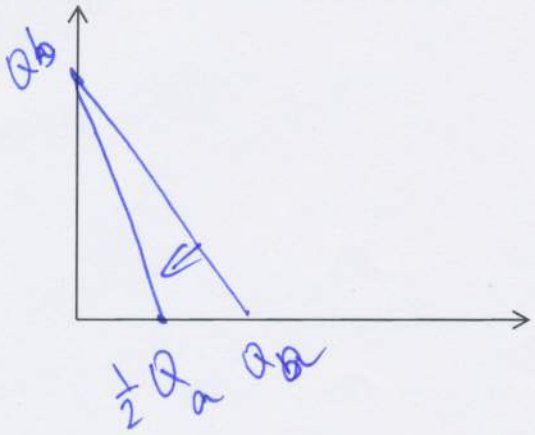


Example6:

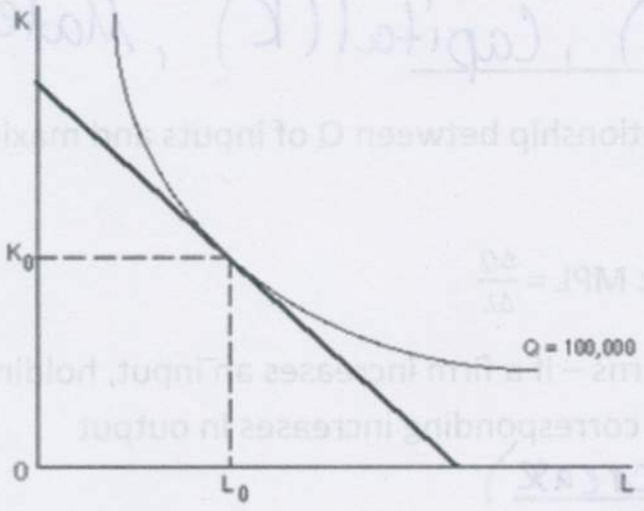
What happens with budget line if income doubles?



Example7: What happens with budget line if price of Good A doubles?



Consumer's optimal bundle (The last dollar rule)



Slope of the Indifference Curve = Slope of the Budget Line

+ MUa/MUb=Pa/Pb

or MUa/Pa=MUb/Pb

Example8: Alice consumes a combination of peanut-butter ice-cream and dark chocolate. However, recently she has noticed that MUi/Pi is less than MUc/Pc. What should Alice do?

$$\frac{MU_i}{P_i} < \frac{MU_c}{P_c}$$

$MU_i \uparrow$ if you decrease consumption of ice-cream

$MU_c \downarrow$ if you increase consumption of chocolate.

Alice should consume more chocolate until utility from chocolate (last dollar) equals MU_i from 1 dollar spent

Production

Inputs: Labour (L), Capital (K), Materials (M)

Production Function – relationship between Q of inputs and maximum Q of outputs. Q = f(L,K)

Marginal Product of Labor: MPL = $\frac{\Delta Q}{\Delta L}$

Diminishing Marginal Returns – if a firm increases an input, holding other inputs constant, the corresponding increases in output diminish (decrease)

Isoquant (similar to indifference curves) – combination of labor and capital that can produce the same output.

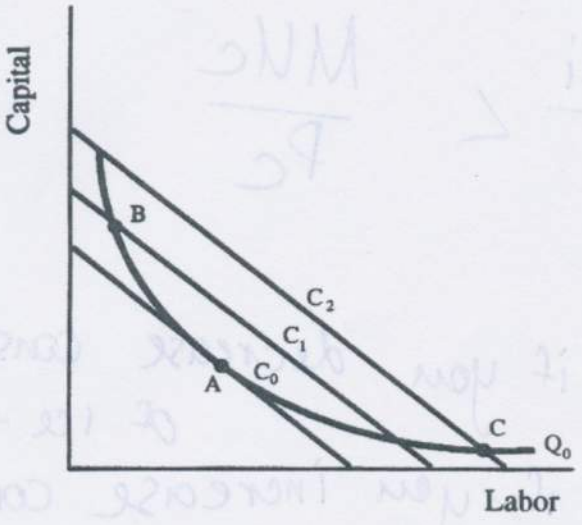
Production Optimal Bundle (Last dollar rule)

Slope of the Isoquant = Slope of the Isocost (similar to budget line)

MPL/MPk=w/r, where w – hourly wage, r – unit cost of capital

or MPL/w=MPk/r

Example9: What's the optimal point of production and why?



A

because produce the same output with a lower cost

Constant Returns to Scale: F(a*L, a*K) ___=___ a*F(L,K)=a*Q

Increasing Returns to Scale: F(a*L, a*K) ___>___ a*F(L,K)=a*Q

Decreasing Returns to Scale: F(a*L, a*K) ___<___ a*F(L,K)=a*Q

Example10: Bicycles are produced using labor (L) and capital (K). Q is the number of bicycles produced each day.

	L=1	L=2	L=3	L=4
K=2	Q=10	Q=14	Q=17	Q=19
K=4	Q=14	Q=20	Q=25	Q=28

What can we infer about marginal product of labor and returns to scale?

K=2 $\Delta Q_{21}=4$ $\Delta Q_{32}=3$ $\Delta Q_{43}=2$ => diminishing marginal product of labour

$Q(1,2)=10$ $Q(2,4)=20$ => constant returns to scale

Cost Concepts

Opportunity Cost – the value of best next alternative

Sunk Cost – a past expenditure which can't be recovered (not relevant)

Fixed Cost (FC) – doesn't vary with level of output

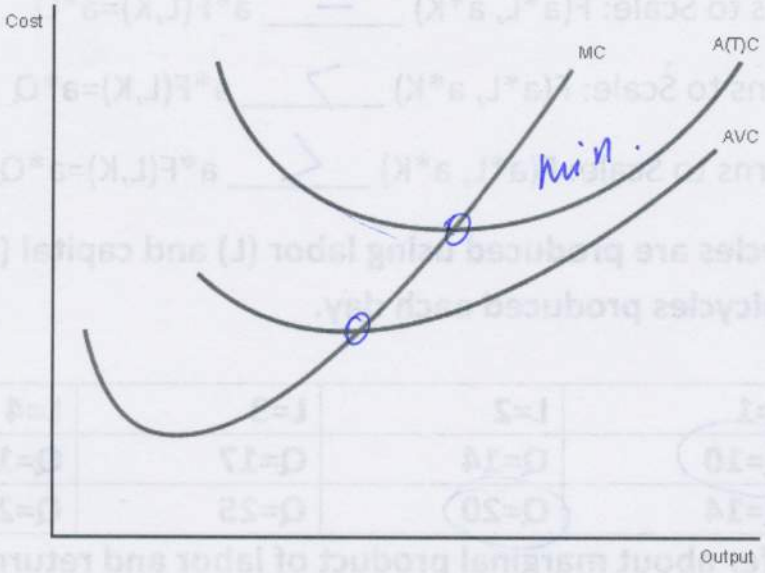
Variable Cost (VC) – varies with level of output

Average Fixed Cost: AFC=FC/Q (As Q increases, AFC ↓)

Average Variable Cost: AVC=VC/Q

Average Cost: AC=AVC+AFC

Marginal Cost: $MC = \frac{\Delta C}{\Delta Q} = \frac{\Delta VC}{\Delta Q} = \frac{dVC}{dq}$



Marginal Cost intercepts ATC and AVC at their minimum.

$ATC = AVC + AFC$

Economies of Scale	Constant Costs	Diseconomies of Scale
ATC ↓ as Q increases	ATC is constant as Q increases	ATC ↑ as Q increases

Example 11: True or False?

If MC is greater than ATC then MC must be rising T

If MC is positive then AC must be strictly greater than AVC F AC > AVC when a Fixed cost there is

If MC is rising then AC must be also rising F

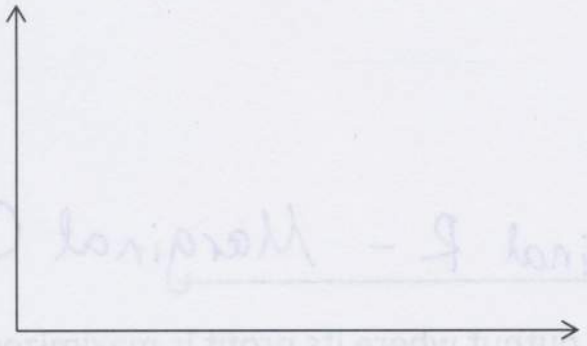
Example 12:

The TC for the firm is C=100+10q+q^2. Derive the MC and AC curves. When is AC minimized?

$MC = 0 + 10 \cdot 1 + 2q = 10 + 2q$

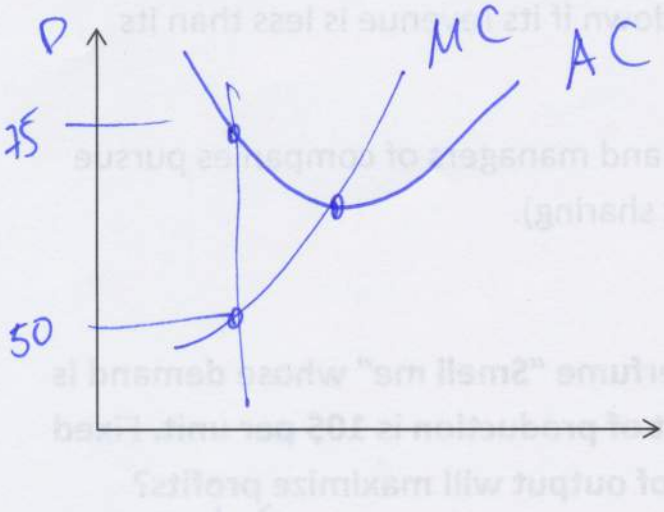
$AC = \frac{C}{q} = \frac{100 + 10q + q^2}{q} = \frac{100}{q} + 10 + q = MC$

$10 + 2q = \frac{100}{q} + 10 + q$ $\quad 100 = q^2$ $\quad q = 10$.



Example 13:

If a firm is currently operating at an output level where MC=$50 and AC=$75, what can we say about economies of scale at this level?



economies of scale because AC ↓ as Q ↑

Example 14: True or False?

Expecting the price of apples to rise, Johnny purchased a 10 year supply at 2$ per pound. Due to favorable economic conditions, apples sell at 1.5$ per pound.

- Johnny's opportunity cost for pound of apples is 2$ F
- Sunk costs are not relevant; therefore Johnny has no sunk costs F
- Johnny's opportunity cost for consuming a pound of apple is the difference between the price he paid (2$) and the current market price (1.5$) F

opp. cost = $1.5 / pound.

Profit Maximization

Profits=Revenue-Cost

Marginal Profits = Marginal R - Marginal C

Output rule: The firm sets its output where its profit is maximized.

Profits are maximized when (1) Marginal Profits = 0 or

(2) Marginal Revenue = Marginal Cost

Shutdown rule: The firm shuts down if its revenue is less than its avoidable cost

Agency problem: when owners and managers of companies pursue different goals (solution – profit sharing).

Example 15:

"The Irresistible" produces a perfume "Smell me" whose demand is given by Qd=1000-2*P. The cost of production is 10$ per unit. Fixed costs are 10,000$. Which level of output will maximize profits?

~~R=(1000-2P)P~~ $P = (1000 - Q)/2 = 500 - Q/2$

$R = q \cdot P = (500 - q/2)q$ $TC = 10q + 10000$

$MR_q = 500 - \frac{2q}{2} = 500 - q$ $MC = 10$

$500 - q = 10$ $q = 490$

$P = 500 - \frac{490}{2} = 255\$$

Example 16:

The owner of a company delegates the production decision of Q to the manager. Which of the following compensation packages will eliminate agency problem?

- Profit sharing: 10% of the profits to the manager T
- Revenue sharing: 15% of the total revenues to the manager F
- Cost sharing: 3% of total costs will be subtracted from manager's base salary F
- Profit sharing: 1% of the profits to the manager? T

Example 17:

A firm's inverse demand curve is given by p=70-Q. Total cost is given by C=1000+10Q. Assuming that the fixed cost of 1000$ is avoidable in the long run, what should company do to maximize profits?

$R = pq = q \cdot (70-q) = 70q - q^2$ $MR = 70 - 2q$

$C = 1000 + 10Q$ $MC = 10$ $MR = MC$

$70 - 2Q = 10$, $2Q = 60$ $Q = 30$

$P = \$40$

$R = \$1200 > \$1000$, still produce.

Perfect Competition

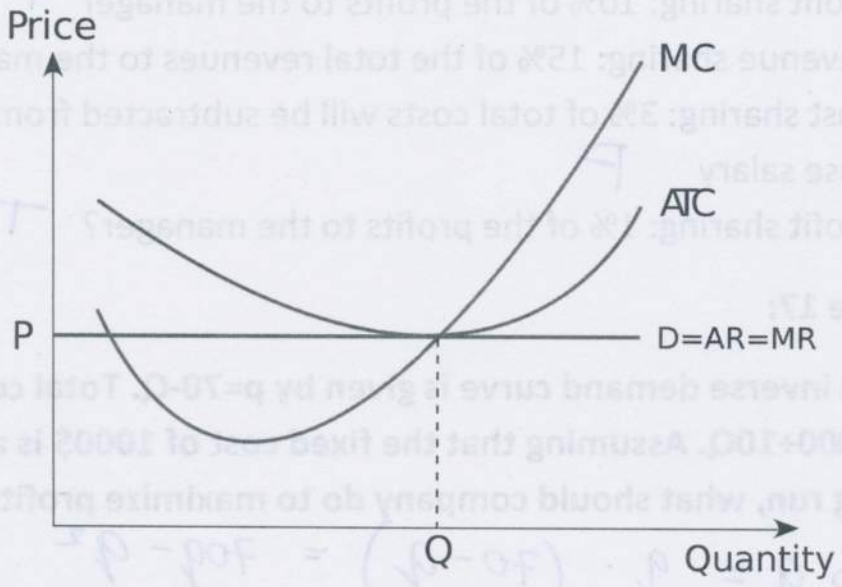
- Large number of Buyers and Sellers
- Identical Products
- Free Entry and Exit

Demand curve = P = MR

Supply Curve (individual firm) = MC

Supply Curve (market) = MC1+MC2+MC3+.....+MCn => slope=0 flat

No deadweight loss – social surplus is maximized!



Profits are maximized when MC=Price

Example 18:

Firm has a cost function C=400+Q^2 (fixed cost is not avoidable). Current market price is 50$. What should be firm's output to maximize profits? What happens to optimal quantity if price drops to 32$?

$MC = 2Q = 50\$$

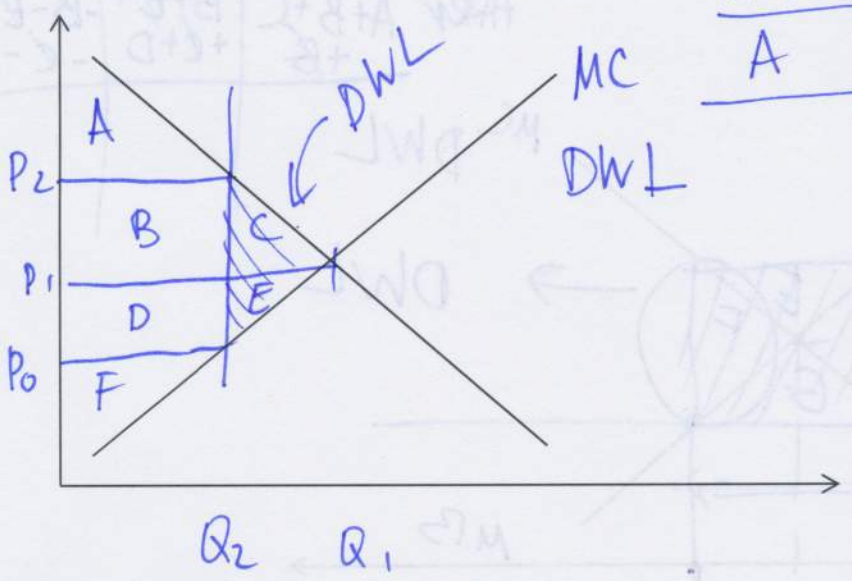
$Q = 25$

$2Q = 32\$$

$Q = 16$

Example 19:

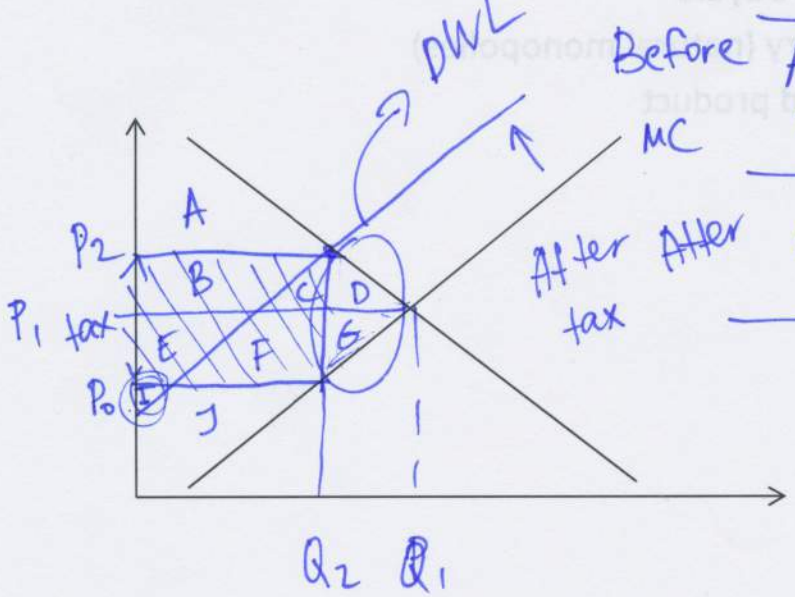
A government has imposed quota on a competitive market that reduced output from Q1 to Q2. What's the DWL? What are the new CS and PS?



	CS	PS	SS
Before	A+B+C	D+E+F	A+B+C+D+E+F
	A	B+D+F	A+B+D+F
			(-E-C)

Example 20:

A government has imposed tax on competitive market. What's the dwl?



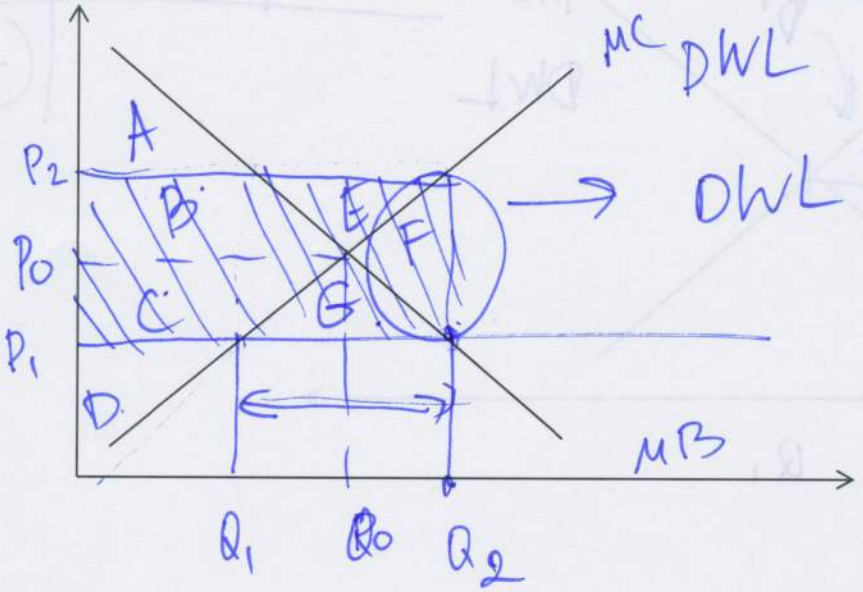
	CS	PS	Govt	SS
Before	A+B+C+D	E+F+G+J+I	0	A+B+C+D+E+F+G+J+I
After	A	I+J	B+C+E+F	A+I+J+B+C+E+F
After tax				-D-G

Example 21:

A government has imposed a price ceiling on a competitive market.

Govt can subsidize the shortage.

	CS	PS	Govt	SS
Before	A+B	C+D	0	A+B+C+D
After	A+B+C+~~B~~	~~B+E~~+C+D	-B-E-~~F~~-C-~~G~~	A+B+C+D-F
				-F

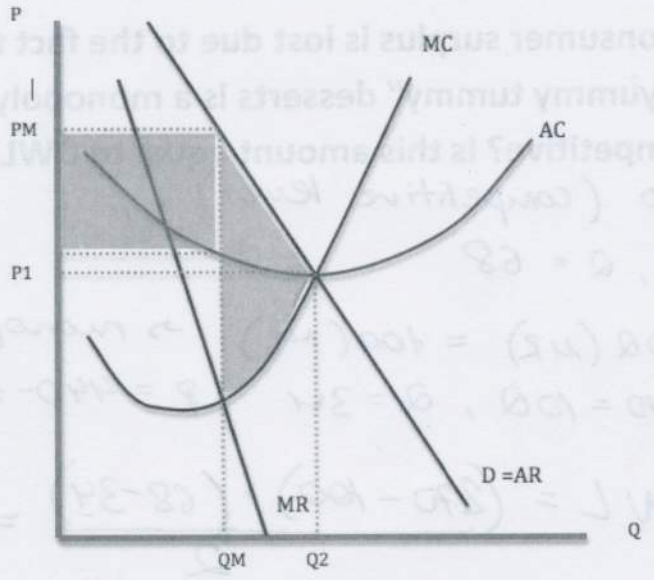


MC DWL

→ DWL

Monopoly

- One seller, multiple buyers
- High barriers to entry (natural monopolies)
- Highly differentiated product
- Market power



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Demand – downward sloping = AR
Supply = MC
Profits are maximized when MC=MR (Producing at Qm)

Example22: (SKIP).

Shrek has invented a new dessert called "yummy tummy" which has a constant marginal cost of $100 and no fixed costs. With the help of the donkey Shrek has estimated the demand function to be P=440-5Q. Shrek has proprietary rights on his dessert.

a) **Donkey has read in his Econ101 book that revenue will be maximized when elasticity is equal to -1. Is Donkey correct?**

$\mathcal{E} = \frac{dQ}{dP} \cdot \frac{P}{Q}$ $\quad P = 440 - 5Q, \quad Q = 88 - P/5$

$\frac{dQ}{dP} = -1/5$

$\mathcal{E} = -\frac{1}{5} \cdot \frac{P}{(88 - P/5)} = -1 \Rightarrow P = 5(88 - P/5) = 440 - P$

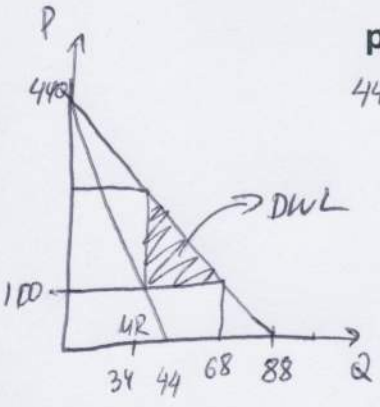
$2P = 440, \quad P = 220, \quad Q = 88 - \frac{220}{5} = 44$

Rev. is max. when $MR = 0$ $\quad MR = (440 - 5Q)Q)' =$

$= 440 - 10Q = 0 \Rightarrow$

$Q = 44$ got the same result, Donkey is correct!

b) How much consumer surplus is lost due to the fact that the market for "yummy tummy" desserts is a monopoly and not perfectly competitive? Is this amount equal to DWL?



$440 - 5Q = 100$ (competitive level)

$340 = 5Q$, $Q = 68$

$440 - 10Q\,(MR) = 100\,(MC)$ → monopoly

$340 = 10Q$, $Q = 34$, $P = 440 - 5 \cdot 34 = 270$

170

$$DWL = \frac{(270-100)\cdot(68-34)}{2} = \$2890$$

Example23: True or False

A monopolist with a constant MC of production equal to 10$ maximizes its profit by choosing to produce where elasticity of its demand is equal to -3/2. Remember that relationship between MR and price is given by MR=p*(1+1/E).

- Revenues for the monopolist will increase if price is increased by a small amount — F
- The price set by the monopolist is equal to 30 — ✓ T
- Price and marginal revenue are both greater than MC — F

$\varepsilon = -3/2$ constant · $MC = \$10$ ·

$$\varepsilon = \frac{dQ}{dP}\cdot\frac{P\uparrow}{Q\downarrow} = -\frac{3}{2}.$$

Rev is Max when $\varepsilon = -1$

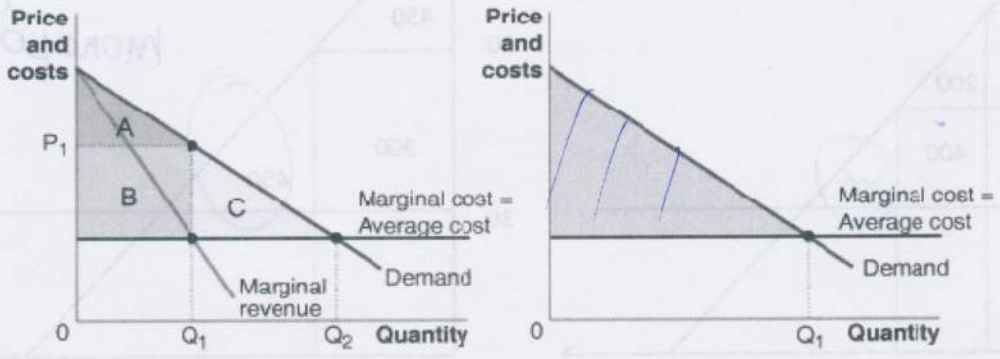
To incr. Rev. $\downarrow P \Rightarrow \uparrow Q$

$MR = p\,(1 + 1/E) = MC = 10$

$$P = \frac{10}{1+1/E} = \frac{10}{1-\frac{2}{3}} = \frac{10}{1/3} = \$30$$

Price discrimination:

Perfect price discrimination – consumers pay their reservation price.



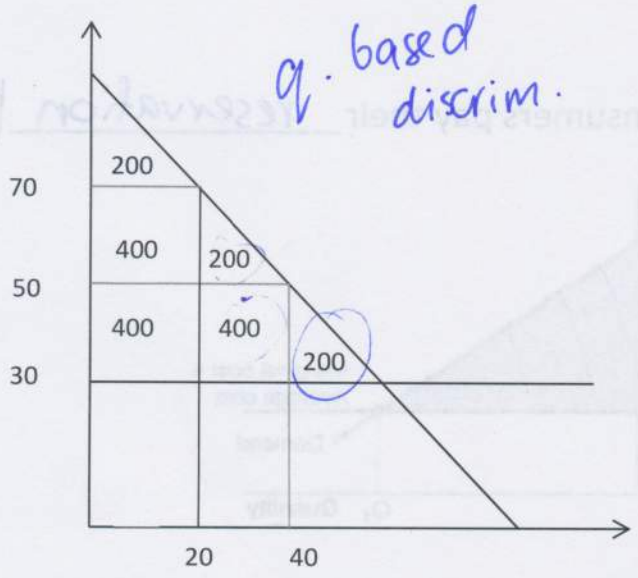
Example24: Consider a monopoly that serves a large number of different consumers. Assume the monopoly can prevent sale. Relative to standard uniform monopoly pricing, perfect price discrimination:

- Increases profits T
- Raises the sum of consumer surplus F
- Increases the quantity sold T
- Causes some consumers to pay higher prices T

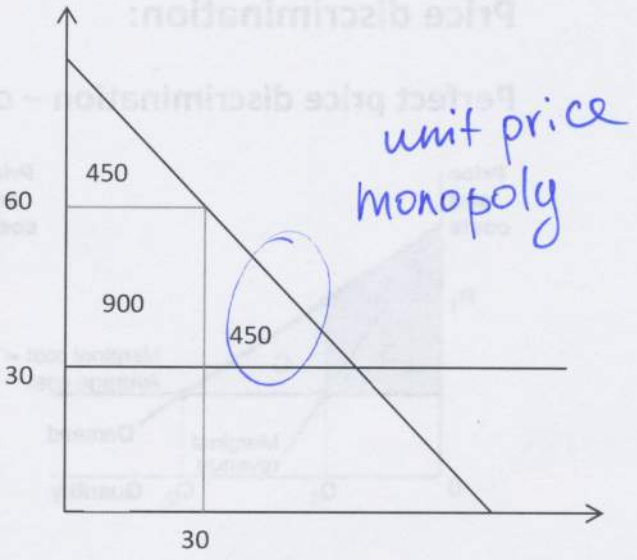
Quantity-based price discrimination – price the customer pays varies with order size.

Example25: True or False

A consumer has a demand curve given by p=90-q. Panel (a) shows the consequences of quantity discrimination if the firm charges 70$ each for the first 20 units and 50$ each for any additional units. Panel (b) illustrates profit-maximizing uniform monopoly pricing.



q. based discrim.



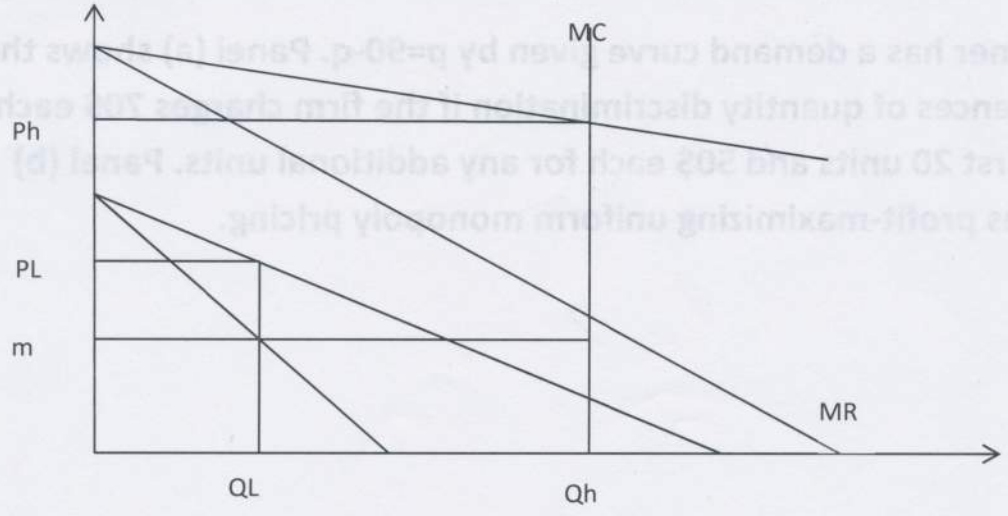
unit price monopoly

- Quantity discrimination is better for consumers that uniform monopoly pricing 450 > 400 → F
- Profits are higher under monopoly than with quantity discrimination F 1200 vs 900
- DWL is higher under uniform monopoly pricing than under quantity discrimination 450 > 200 T

Peak-Load Pricing – charging higher prices during periods of peak demand than in other periods

Example 26: True or False SKIP

Consider a hotel that has high demand in the summer and low demand in the winter. The hotel's maximizing peak load pricing strategy is illustrated below.

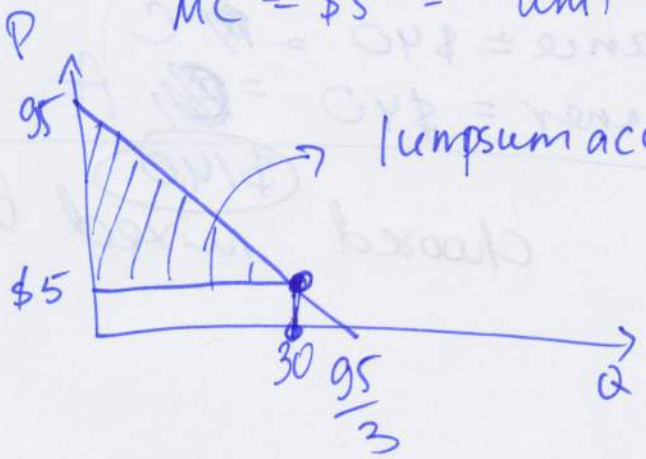


- The firm sets prices such that MR>m in the summer and MR=m in the winter T
- The firm has excess capacity in both periods F
- We cannot tell which season has higher price F

Two-part pricing – a firm charges each consumer a lump-sum access fee and per unit price.

Example 27: Joanna has moved to a small town with one tennis club. Her inverse demand function per year is given by p=95-3q. The marginal cost to the club of one session is 5$. What two part-pricing strategy would maximize profit obtained from Joanna?

MC = $5 = unit fee



lumpsum access fee

$\frac{90 \times 30}{2} = \frac{2700}{2}$

= $1350

$5 = 95 - 3q$

$q = \frac{90}{3} = 30$

Bundling – selling multiple goods or services for a single price

Example28: Cactus Club is trying to decide whether to have a bundle price for a buffet dinner and dancing combined or whether to charge stand-alone prices for dinner and dancing. There are three types of customers with an equal number of each type. The table below shows the willingness to pay of the three different consumer types. Assume the marginal costs of zero.

Consumer type	Dinner	Dancing	Bundle
A	40	5	45
B	30	30	60
C	5	40	45

Determine the maximum profit under stand-alone pricing, pure bundling and mixed bundling. What's the best approach?

stand alone pricing: Dinner $p=40 \quad R=40$
$p=30 \quad R=2\cdot 30=60$
$p=5 \quad R=3.5=15$

Dancing: $p=5 \quad R=15$
$p=30 \quad R=60$
$p=40 \quad R=40$

$60+60=120\$$

Pure bundling: $p=\$45 \quad R=\$45\times 3=\$135$
$p=\$60 \quad R=\$60$

Mixed bundling: price bunde $=\$60 = B$
dance $=\$40 = C$
dinner $=\$40 = A$
$\$140$

choosed mixed bundling

Oligopoly

- A few sellers
- Limited entry

Cartels – oligopolies which collude over prices and quantities so as to increase their profits (illegal in USA/Canada, likely to cheat and fall apart).

Cournot Oligopoly

- Firms set Q independently and simultaneously
- Firms have identical costs
- Firms sell identical products
- There are two firms and no one else can enter the market

Example29:

AMD and Intel are the only 2 firms that produce CPUs. The inverse demand for CPUs is given by P=520-Q. Each firm has MC=40 and fixed costs are equal to zero. Output of AMD is Qa, output of Intel is Qi. Derive the Cournot best response functions for AMD and Intel. Solve for the Cournot Equilibrium price and quantities.

$P = 520 - Q = 520 - (Qa + Qi)$

$R_A = Qa \cdot (520 - Qa - Qi) = Qa \cdot 520 - Qa^2 - Qi \cdot Qa$

$MR_A = 520 - 2Qa - Qi = MC = 40$

$520 - 2Qa - Qi = 40$

$Qa = \frac{480 - Qi}{2} = \frac{480 - \frac{480 - Qa}{2}}{2}$

$Qi = \frac{480 - Qa}{2}$

$2Qa = 480 - 240 + \frac{Qa}{2}$

$1{,}5Qa = 240$

$Qa = 160 = Qi$

$P = 520 - (160 + 160) =$

$= 200$

Game Theory:

Static game – each player acts individually and the players act simultaneously

Dominant strategy – strategy that produces a higher payoff that any other strategy the player can use no matter what its rivals do.

Prisoner's dilemma – all players have dominant strategies that lead to a inferior payoff to what they could achieve if they cooperated.

Best response – a strategy that maximizes player's payoff given its beliefs about rivals' strategies.

Nash equilibrium – no player can obtain a higher payoff by choosing a different strategy.

Pure strategy – each player chooses a particular strategy with certainty

Pareto criterion – selecting a solution that it is better for all ~~other~~ parties.

Example 30: The market for milk chocolate is dominated by two firms (Milka and Hershey). Their payoffs from advertising or not advertising can be shown in the following table. This is a static game. Number on the left is the payoff for Hershey.

		Milka	
		Do Not Advertise	**Advertise**
Hershey	**Do Not Advertise**	**10, 11** ✳	**8, 10**
	Advertise	**12, 4** ✳	**11, 11** ✳ ✳

Does either firm have a dominant strategy? Is there a Nash Equilibrium? Is this prisoners' dilemma?

Hershey does ⇒ Advertise

Milka doesn't

Yes → Adv, Adv. → N.E.

No, it's not:

- Milka doesn't have a dom. str.
- final payoff is superior to all other choices

Example31:

Two friends are deciding what to do for the day. They have to make simultaneous and independent decisions. If they choose the same activity, they will meet and do it together. Otherwise they will each be alone.

		Michael	
		Movie	Biking
Sarah	Movie	6,6	3,2
	Biking	2,3	8,7

Find any dominant strategies and any Nash equilibrium in this game. Could pre-play or Pareto criterion have any relevance here?

None of them have a domin. Str.

There are 2 NE (Movie/M ; B/B)

yes because they will end doing something together.