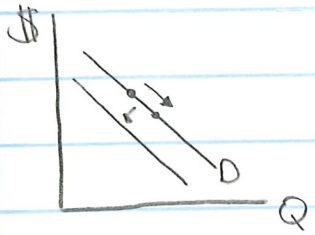
Review of PS1: #1, 2, 3

Section 1



- Parameter - variable we hold constant (i.e. income)
- when a variable changes it moves along the graph
- when the value of a parameter changes, the line shifts

- Demand - the consumers willingness to pay a price for a specific good
  - ↳ items that can make the demand curve change (price, income, complements, etc)
- when the slope is constantly changing use the derivative to find (1 variable)

Example: $Y = 4x^{\frac{1}{2}}$

$$\frac{dy}{dx} = 4 \cdot \frac{1}{2} \cdot x^{\frac{1}{2}-1} = 2x^{-\frac{1}{2}}$$

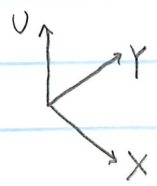
- Partial Derivatitive - still has a dependent but has two independent variables

Example: $U = 4x^{\frac{1}{2}}y^{\frac{1}{3}}$

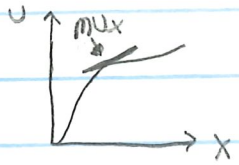
$$\frac{dU}{dx} = 4 \cdot \frac{1}{2} \cdot x^{\frac{1}{2}-1} \cdot y^{\frac{1}{3}} = 2x^{-\frac{1}{2}}y^{\frac{1}{3}}$$

Section 2

- Fundamental Model of Microeconomics - will be applied everywhere "climb hills"

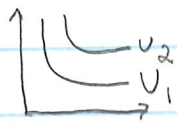


- topographic map - lines can not touch, indefinite density, more or less the top of a topo map (different altitudes)
- U = utility (hill), $U = f(X, Y)$



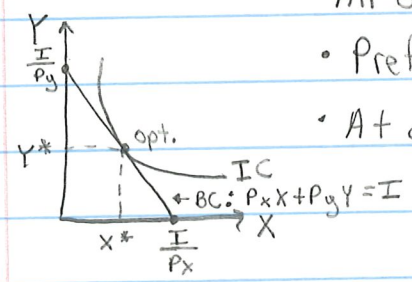
- MU_x - how one variable changes (dependent) b/c of a very small change in the other

- diminishing marginal utility - as you consume more of a good the extra utility you get starts to go down



← iso-utility graph

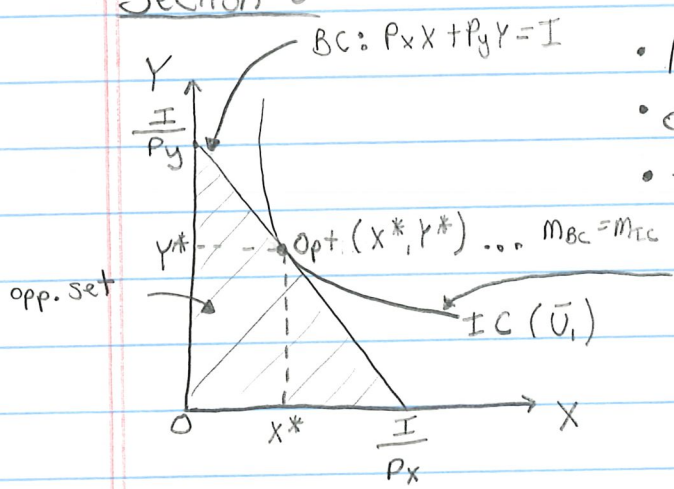
Section 2



- All of economics is constrained optimization
- Preferences are given by the utility function $U=f(X,Y)$
- At optimum, the BC is equal to the IC
  - slope of BC: $m_{BC} = -\frac{P_x}{P_y}$
  - slope of IC: $m_{IC} = -\frac{MU_x}{MU_Y}$

- At optimum: $m_{BC} = m_{IC}$ → $\boxed{\frac{P_x}{P_Y} = \frac{MU_x}{MU_Y}}$ ← optimal condition

Section 3



- Always calculate MU_x + MU_Y first
- opportunity set use an equal (=)
- feasible set uses ($\leq$)

$MU_x\,dx + MU_Y\,dy = 0$

$m = \frac{MU_x}{MU_Y}$

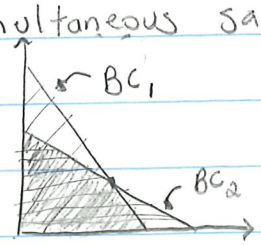
- Indifference Curve - every point at which the utility is the same (iso-utility)

equal slopes condition

$$\frac{MU_x}{P_x} = \frac{MU_Y}{P_Y}$$

- Marginal utility per dollar of every good in the consumption bundle must be the same

- If you have multiple constraints, can you satisfy all the constraints at the same time? Answer: No you cannot simultaneous satisfy all of them.



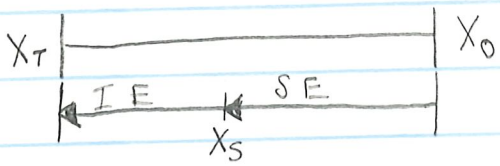
• Review of PS1: #3, 5, 6

Section 3

- When the price of a good changes the consumption of a good changes as well
- Why do we buy less of a good when the price goes up?

Answer: we feel poorer + other thing become cheaper (happen in conjunction)

Total Effect = Substitution Effect + Income Effect (TE = SE + IE)

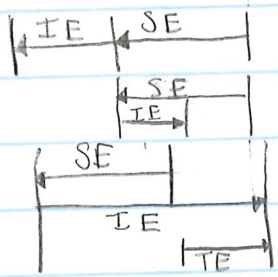


← Total Effect

← Broken down Total Effect

Substitution Effect - is always negative and we are keeping the income effect constant by holding the original utility the same

Income Effect - the change in consumption resulting in a change of real income.



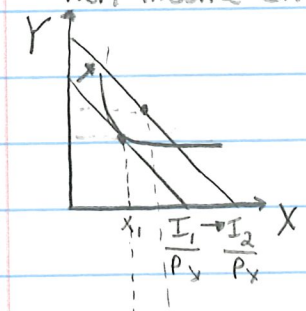
- Normal Good - price increases, a substitute option is cheaper
- Inferior Good - sometimes as price increases we feel richer
- Giffen Good - SE is still always negative but the income effect is so negative it becomes positive, making TE positive

- For most goods the income effect is negative (because we feel poorer)

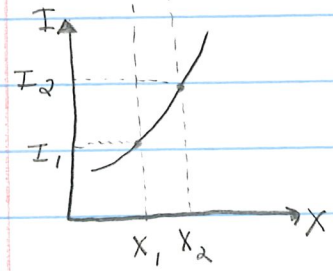
- Derived Curves -

Section 3

• when income changes the constraints shifts outward, nothing else changes



• Income Expansion Path - shows how different income affects consumption of two different products



• Engle Curve - helps us to capture if the good is inferior or not

• There is no difference in Graph I + Graph 2

• Start with the demand curve with all constraints: $P_x X + P_y Y = I$

• Locate the variables of interest (i.e. demand curve) $P_x X$ ← P_x - Price, X = Quantity

↳ $P_x X + P_y Y = I$; for an engle curve we are looking variables (X + I)

• Every good has to be normal for some part of the curve

• Not every good in your consumption bundle can be inferior

$\frac{3Y}{2X} = \frac{6}{7} \rightarrow 4X = 7Y$ • Use equal slope condition + solve for the optimun ratio

$6X + 7(4/7\, X) = I$ • use budget constraint and solve for X (plug in X value)

$10X = I$ ← Engle Curve

$MRS_{YX} = \frac{P_x}{7}$ • Use equal slopes condition + plug in P_x instead of the given original Price (solve for $Y = \frac{2}{21} P_x X$)

$P_x X + 7(\frac{2}{21} P_x X) = 250$ • Use original Budget Constraint + plug in $P_x X$ + Solve to get $P_x X = 150$

Section 3

• Budget Share of Elasticity - measures the

$10X = I \rightarrow \frac{X}{I} = \frac{1}{10}$ • use the engle curve for X + solve for $\frac{X}{I}$

$BS_x = \frac{P_x X}{I}$ • use budget formula + set equal to original price

$6 = \frac{1}{10} \rightarrow 3/5$ ← Budget Share of X

$\varepsilon_{IX} = \frac{dx}{dI} \times \frac{I}{X}$ • income elasticity of DD for X

$1 = \frac{1}{10} \times 10$

Income + Substitution (Example)

P_x: \$6 → \$9

$(X_0, Y_0) = (25, 14.29)$ ← original / initial consumption

$(X_T, Y_T) = (16.67, 14.29)$ ← final / new consumption

$X^*: X_0 \longrightarrow X_T$ • use original + final consumption bundles to find

$Y^*: Y_0 \longrightarrow Y_T$ TE. (falls, rises, no change)

$U_0 = 4(X_0^*)^{\frac{1}{2}}(Y_0^*)^{\frac{1}{3}}$ • Plug in original consumption to the original utility function

$= 48.53$ ← Initial Utility Level

$U_S = 4(X_S^*)^{\frac{1}{2}}(Y_S^*)^{\frac{1}{3}}$ • Substitution Utility Level is the same thing (no calculation)

$U_S = 48.53$ ← substitution utility level

$\frac{3Y}{2X} = \frac{9}{7} \rightarrow 6X = 7Y$ • Use the final optimal condition, from price change (P_x = \$9)

$4(X_S^*)^{\frac{1}{2}}(Y_S^*)^{\frac{1}{3}} = 48.53$ • Plug into original utility function + set equal to U_S

$(21.26, 18.33)$ • Solve for (X_S^*, Y_S^*) ← substitution point

$X^*: X_0 \longrightarrow X_S$ • use original bundle + substitution points to find

$Y^*: Y_0 \longrightarrow Y_S$ SE. (falls, rises, no change)

$X^*: X_S \longrightarrow X_T$ • use substitution bundle + final bundle to get the

$Y^*: Y_S \longrightarrow Y_T$ IE. (falls, rises, no change)

Equivalent Variation - the measure of economic welfare associated with a change in price.

Income + Substitution (Example Continued) → Equivalent Variation

(X_T^*, Y_T^*) • Use the final consumption bundle

$U_T = 4(X_T^*)^{\frac{1}{2}}(Y_T^*)^{\frac{1}{3}}$ • Plug final bundle into original Utility Function

$= 39.69$ ← Final Utility Level

$U_R = 4(X_T^*)^{\frac{1}{2}}(Y_T^*)^{\frac{1}{3}}$ • Equivalent variation level is the same thing (no calculation)

$U_R = 39.69$ ← Equivalent variation level

$\frac{3Y}{2X} = \frac{6}{7} \rightarrow 4X = 7Y$ • Use the original optimum condition, before price change ($P_X = \$6$)

$4(X_R^*)^{\frac{1}{2}}(Y_R^*)^{\frac{1}{3}} = 39.69$ • Plug into original utility function + set equal to U_R

$(19.61, 11.20)$ • Solve for (X_R^*, Y_R^*) ← Equivalent Variation Point

$6X + 7Y = \$250$ • Use the original Budget Constraint + Plug in (X_R^*, Y_R^*)

$= \$196.06$ to solve for the final budget

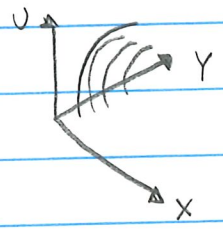
$250 - 196.06 = \$53.94$ • Take the original Budget Constraint and substract final budget to get the "pay to avoid increase"

• Review of PS2: # 2,4,5

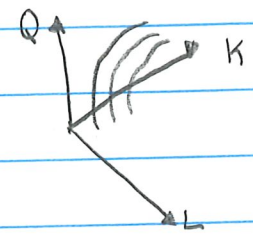
Section 4

• Similarity between TOC + TOF

TOC



TOF



Utility function: $U = f(X, Y)$ ← consumer preferences

Production function: $Q = f(L, K)$ ← technology

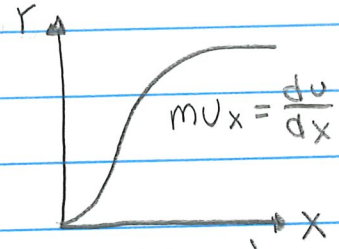
At optimum (TOC)

$m_{BC} = m_{IC} \rightarrow \frac{P_x}{P_y} = \frac{mU_x}{mU_y}$

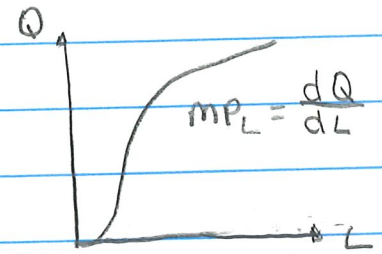
At optimum (TOF)

$m_{IT} = m_{IQ} \rightarrow \frac{w}{r} = \frac{mP_L}{mP_K}$

View of Vertical Slice

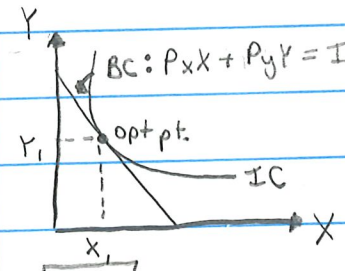


$U = f(X, \bar{Y})$ ← hold Y constant

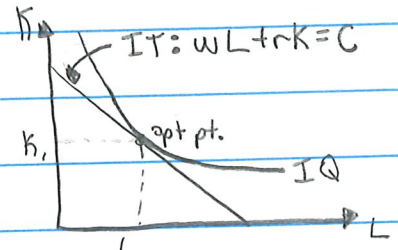


$Q = f(L, \bar{K})$ ← hold K constant

• We care more about the horizontal slice of the topo map



TOC



TOF

• Linear constraint

↳ $y = mx + c$ + $Ax + By = C$

• BC: $P_xX + P_yY = I$

$m_{BC} = -\frac{P_x}{P_y}$

$m_{IC} = -\frac{mU_x}{mU_Y}$

IT: $wL + rK = C$

$m_{IT} = \frac{w}{r}$

$m_{IQ} = -\frac{mP_K}{mP_L}$

Section 4

• There is one economic difference in TOC + TOF, theory of the Firm has an equation of three unknowns vs. theory of the consumer only has two.

TOC	TOF
• BC: $P_xX + P_yY = I$	• IT: $wL + rK = C$
• (3) Parameters → P_x, P_y, I	• (2) Parameters → w, r
• (2) variables (x + y)	• (2) variables (L + K)
• exogenous (given to us)	• endogenous to the model (need to find C)
• equation of two unknowns	• K + L can not be determined completely by model
• X + Y can be defined completely by the model	

• Think of two offices you are in the middle managing with a goal to maximize profit

• The back office + the front office are completely independent

Back	Front
Technology	Preferences
↓	↓
Production Function → $Q = f(L, K)$	$Q = f(P) \cdot Q$ ← Demand Curve
↓	↓
cost Function → $C = f(Q)$	$R = f(Q)$ ← Revenue is a function of Q
↓	↓
$MC \longrightarrow \boxed{\tilde{\pi}\text{-max}} \longleftarrow MR$	

At profit maximizing $MR = MC$. We set equal to 0 with the first order condition + solve.

• Review of PS2: #4,5,6

Section 5

• You should be paid how much you are worth to the company that you are producing at the marginal rate

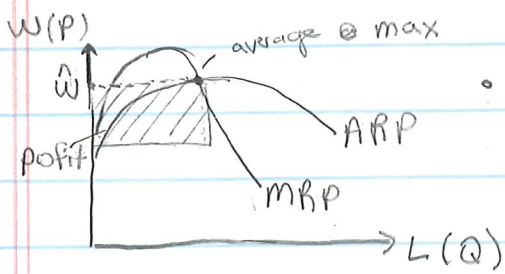
$MC = MR$ • First optimization principal in terms of output

$MFC = MFR$ • optimization principal in terms of input

$\downarrow \quad \downarrow$ • MFC, firm is paying for your labor (w)

MRP_L / VMP_L • MFR, what you produce (MP_L), + what you are selling the last unit of production for (MR)

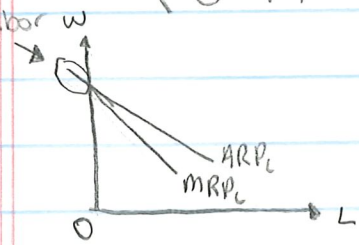
$w = MP_L \times MR$



• no demand for labor above $\hat{w}$ (wages are too high)

$$w = \begin{cases} MRP_L \text{ if } MRP_L \leq ARP_L, & w \leq \hat{w} \\ 0 \text{ if } >, & w > \hat{w} \end{cases}$$

negative labor



linear example →

• MRP_L has to be lower then ARP_L because you can not have negative labor

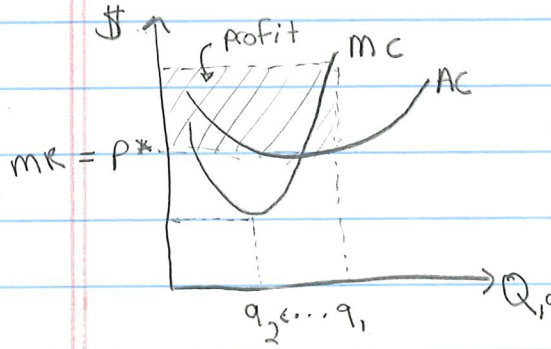
• Price is a fixed Marginal Revenue

• Short-run demand curve for labor, all above

• Review of PS2: # 4,5,6

Section 5 (Market Structure)

• The single thing that makes a firm perfectly competitive: no barriers to entry + free exit (only reason profits are $0)



• when MC = AC, profit is, $0

• P is fixed MR because the point of average cost is at a minimum

• AC curve is fixed if the price is fixed
↳ bottom of the cost curve is fixed

• we are to find $P^*, q^*, Q^*, n, \tilde{\pi}$

① AC = MC

② ACmin

③ TR = TC, $\tilde{\pi} = 0$

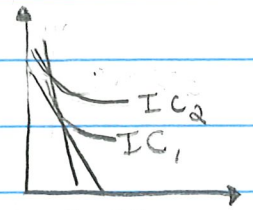
Long-run$_1$ → find $P^*, Q^*, q^*, n^*, \tilde{\pi}$

Short-run → n^* does not change, MC function does not change

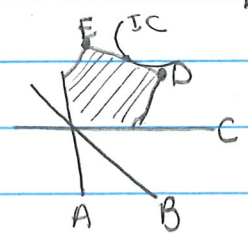
Long-run$_2$ → MC + AC do not change, $q^*, P^*, \tilde{\pi}^*$ are the same. n^* + Q^* change

Section 6 (Midterm Review)

- Review the ETC Section
- PS1: #2



- It does not matter which way the curve swings, as soon as you have a higher line you are on a higher indifference curve (higher utility)



- We are only concerned with the highest constraint which will be the furthest away from the origin

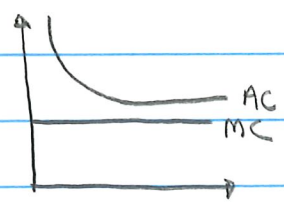
PS1: #3 - Why is bread not a Giffen Good?

↳ we are looking at the reaction when purchasing that good when the price of the good changes. (1 good, 1 constraint, 1 price)

PS1: #4 - Price expansion path

↳ we are looking if the goods are in lock step (both goods working together; normal or inferior) * No good can be inferior over the entire price range

PS2: #1



- If you have a marginal cost curve & the MC is constant, if there are fixed costs the average cost falls

PS2: #2 - In the short-run, K is fixed

PS2: #3 - Remember the caviot, you will not higher labor above a certain price

- Work Leisure - find the equation for the constraint & you are given the utility functi

Section 6 (Midterm Review)

- Profit maximizing is better than Revenue Maximizing, because in real life you want to make profits

- PS2: #6 - Perfect Competition
- If the production function does not change, the cost does not change
- The front office (demand) starts with consumer preferences
- So in the short-run, cost does not change (PS2: #6B) & the number of firms does not change

- TOF does not assume Perfect Competition

Graduate Review

- Answer the Lagrainger in the correct format → GPS #1
- Standard Cobb Douglas function → GPS #2 (be able to follow the steps)
- Elasticity is very important & you have to nail it (Part C)

*

if $Q = AK^{\alpha}L^{\beta}$

then $C = wL^{*} + rK^{*}$

$C = Bw^{x}r^{y}Q^{z}$

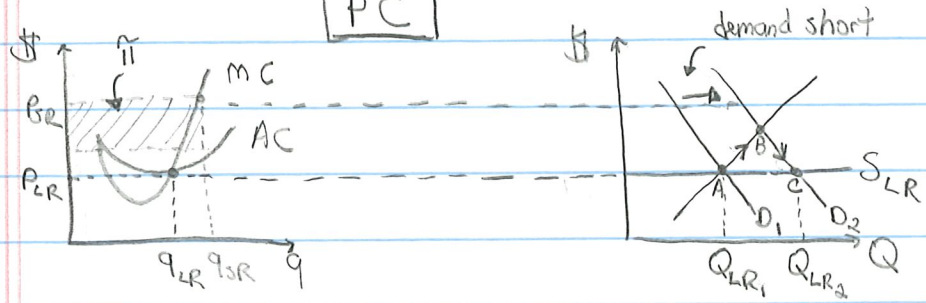
*must know boxed section in italic after question #1

- PS1, PS2, Section Questions

Section 7

PC

Plant / firm →



← industry

- AC min is also the minimum efficient scale (MES)
- MES is when we are looking at this graph as a plant
- MES is the most efficent point even if you can produces at different levels
- Example of a demand short; no more firms can enter the industry
- End up in the short-run → firms flood in due to PC (free entry + exit) because you can make a profit → brings back down π = $0. A → B → C
- Supply long run in PC is always a straight line

- Monolopies can be categorized in two different ways:

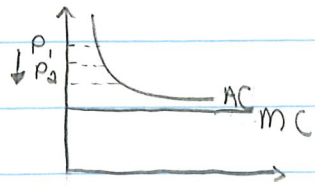
① How they are formed (i.e. what causes them to become a monolopy)

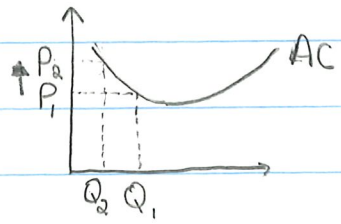
① Structural (i.e. natural) - monolopy destined to happen
  - sometimes it makes more sense for one firm to produce it than many

② Strategic - a company strategize to corner the market
  - ex: De Beers

③ Legal (i.e. license) - government gives one firm the right to produce
  - offer of a specific product or service at regulated prices

iconic natural → monolopy case



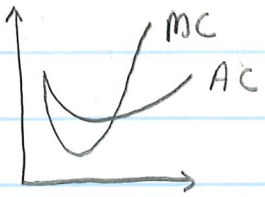


← example of another natural monolopy

- as you produce more .. price falls

- if another firm comes in same business model, split production → price goes ↑

Section 7



← standard cost curve

- plant
- firm
- industry

PS3 → 1D

- What do cost curves mean? Who's cost curve is this?
- Cost curves are coming from technology, → technology is given to us by the production function
- cost curve for a factory / plant
- cost curves for the firm → we assume the firm has 1 plant but there can be multi-plant firms
- cost curve for an industry - can have 1 or more firms

- monolopies can be categorized in two different ways:

② Price Discrimination - power to discrimination, 3 different ways

- In PC, the firm cannot control price ← price taker (must accept prices given)
- If you are not in PC, your firm can affect price ← price maker / setter

① First-degree or perfect price discrimination

→ discriminate + set a different price for every individual product or service I sell

② Second-degree price discrimination

→ bulk discounts

③ Third-degree price discrimination

(Kink Curves) → multi-plant monolopy, multi-market monolopy

- Arbitrage - buying a security in one market + selling in another for higher
  - ↳ ex: medication purchases in Canada are cheaper than in US because arbitrage is not possible
- Segregation - this can stop arbitrage (due to the internet this became easier)

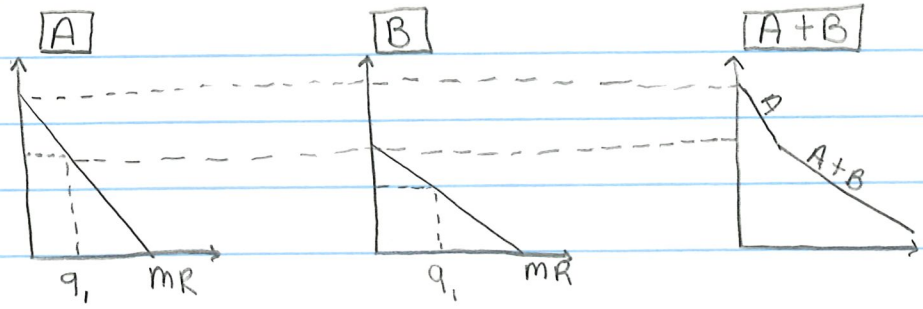
• Review of PS3: #2 + #3

* Key is to find point of intersection

Section 8

markets →

* MR comes from Demand revenue →



• we care about A+B Market b/c firm is looking to maximize π

• Here we are looking at situations where there can be different markets one is selling in

• 3rd Degree - discriminating on the basis of multiple markets + these markets arise because of segregation + we have arbitrage

• If MR is linear, the demand curve has the same intercept + is ½ the slope of MR vice versa MR is twice the demand curve slope

• we decide what markets to sell in based off total profits (π)

• If we are going to sell q_1 or anything between 0 + q_1, which market do you sell in? Answer: Sell in market A, because the MR is higher.

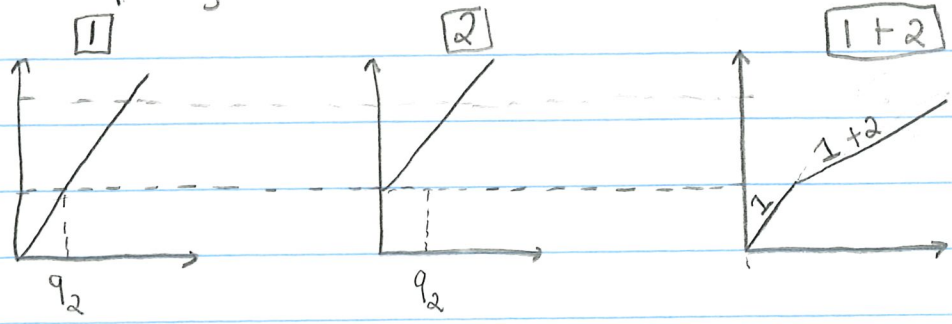
• If we are selling anything beyond q_1, we sell in both markets

↳ Answer: b/c you get some revenue from A + some from B.

* important concept

• There is no limit to the number of markets you can sell in, but depending on where the MC crosses the kink, determines which markets to sell in

cost →



• MC curves - producing something in two different plants

• If you are producing q_2 or anything between 0 + q_2, which market do you produce in? Answer: 1, because it is cheaper to produce

• Review of PS3: #2 + 3

* Key is to find the point of intersection

Section 8

• Quanity is a function of Price or you can rewrite as Price is a function of Quanity

$P_A(q_A) \rightarrow MR_A(q_A)$

• Price as a function of quanity + you can directly calculate MR as a function of quanity (multiply q by 2)

$q_A(MR_A) + q_B(MR_B)$

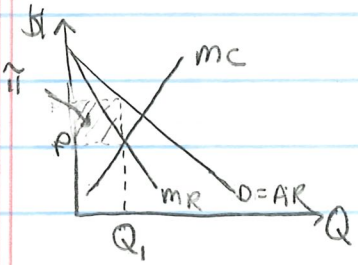
• we are solving for the quanity + then combining them (MR's are now the same quanity)

$Q = q_A + q_B$

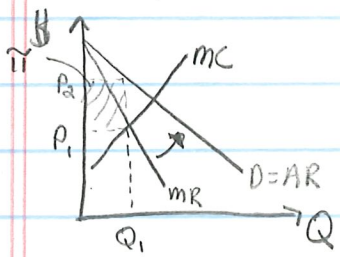
• Now we have $MR = MR_A = MR_B$ + can solve

• 1st degree price discrimination

typical situation →



first degree situation →



• In a typical situation Demand = Avg. Revenue Curve, MR falls at twice the speed of the Avg. Revenue Curve

• Demand curve is a schedule of different price + quanity combos

• Demand is a schedule of reservation prices

↳ there is always someone who is willing to buy at a higher or lower price → you can charge everyone at the price they are willing to buy (1st Degree)

• MR swings up - now we have the demand curve (Avg. Rev Curve) + MR are identical

• This cause the firm to be able to make as much profit they can from an individual

• Pareto Efficency → see next page

- Review of PS3: #2 + 3
- Key is to find where the points intersect

Section 8

- Economic (or Pareto) Efficency - is achieved when the allocation of inputs (factors) + output (goods) is such that there is no other feasible allocation that would make some agent better off without making another worse off. The conditions for Pareto Effiency are:

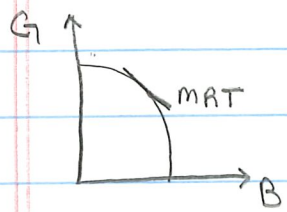
$MRS_X = MRS_Y$ → ① Exchange Efficiency: Same MRS for any two goods X + Y for all consumers.

$MRTS_A = MRTS_B$ → ② Input Efficiency: Same $MRTS_{BA}$ for any two inputs A + B for all producers

$MRS_{YX} = MRT_{YX}$ → ③ Output Efficiency: $MRS_{YX} = MRT_{YX}$ for the same two goods X + Y.

* If all all three situations are met we have Pareto Efficency

Marginal Rate of Transformation (MRT) - slope of the Production Possibilities Frontier + is the ratio of the MC of the goods X + Y: $MRT_{YX} = MC_X / MC_Y$



- G = Guns, B = Butter
- This is P.P.F graph which is important because it looks at the rate an economy can move productive ability (i.e. producing guns to producing butter)

• Review of PS3: # 4, 5, 6

Section 9

- Duopoly is fundamentally different than the other market structures because it deals with <u>strategy</u> + <u>reaction</u>
- In PC, we do not care about the other firms b/c they are doing the same thing
- In monolopy, we do not care about other firms b/c there is only one
- In duopoly, the name of the game is what the other firm is doing
- There are 3 kinds of Duolopy ← memorize!

continous case → ① Bertrand → compete on price

continous + discrete → ② Cournot → compete on quanity - simultaneous entry (same time)

continous case → ③ Stackelberg → compete on quanity - sequential entry (leader + follower)

- If two firms are competing they can compete on the basis of Price + Quanity

- Nash Equilibrium Matrix: PS3, page 7
- Payoffs + Strategies → π is my payoff
- Payoffs are what we get by following a strategy
- Strategy is more importants than payoffs

↳ Ex: Job 1 + Job 2 (Strategy) - compare the sets of payoff + choose a strategy

* Always think in terms of payoffs but always answer in terms of strategy

Firm ②

q_1 ↘ / q_2 →	0	1	2	3
0	0,0	0,12	0,20	0,24
1	13,0	11,10	9,16	7,18
2	22,0	18,8	14,12	10,12
3	27,0	21,6	15,8	9,6

Firm ①

π_1 π_2

- inside the matrix are pairs of payoffs
- q_1 + q_2 are the strategies
- we are looking for best response
- Nash eqoilb - both firms payoff are in the same cell
- Dominant - all circles or diamonds are in the same row or collumn
- Dominated - strategy you never take

• Review PS4: # 1, 2, 3

Section 10

Game Theory - mathmatical study of strategy

Strategic Situation - minimum of two players, do not have to be sapient but cannot be nature

Prisoners Dilema - 2 x 2 game → each player has 2 strategies + 2 options

	C	D ②
C	R, R	S, T
D	T, S	P, P

①

• C = cooperate, D = Deflect

• Social dilema games payoffs

• R = Reward, P = Punishment, T = Temptation, S = Sucker

• R does not need to be equal; just stands for the payoffs

• There are 4 social semetric dilema games + that depends on how we rank the payoffs

$T > R > P > S$ ← Prisoners Dilema

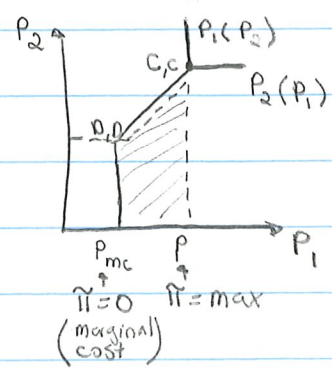
• Nash Equilibrum of Prisoners Dilema is D, D → NE = {(D, D)}

• Two reasons prisoners Dilema is a Dilema:

① RR is better than PP, C,C dominates D,D but given any change individually you would choose deflection so as a group you choose mutual deflection

② Rule: If a game has 0 or 2 Pure-Nash Equilibrum, there is always 1 mixed Nash Equilibrum

Bertrand Duopoly →



• T = Temptation = π monolopy

• R = $\pi/2$, P = 0, S = ∅

• At (C, C) you are colluding having mutual cooperation + the idea is to set π @ max + split profits evenly

• From C, C, to D, D this is immediate (cooperation to deflect)

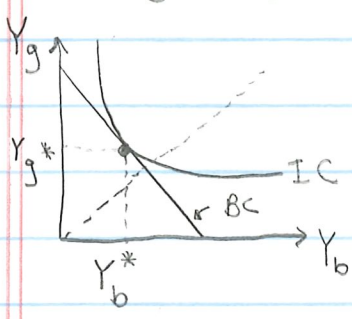
Ex: A charges \$100, B decides to charge \$99 (temptation), A comes back to charge \$98, etc.

* reaction Function on the basis of price, two firms reacting to price ☒

• Review of PS4: # 1, 2, 3

Section 10

- Insurance - we purchase because we want to be risk advese
- Risk advesion - reduce the volatility - we do not like the there is a possibility we will lose all of it, not just some of it
- Willing to give up something today so we feel more secure



- to solve we first need the equal slopes condition (slope of BC + IC)
- equation of the constraint
- we are always comparing π (profit probability) + γ (gamma - premium per dollar) of insurance
- if these are equal we call them actual fair situation

π - chance of loss

γ - premium per dollar of insurance

$\pi > \gamma$ • chances of a loss > insurance (over insure, lose is better off)

$\gamma > \pi$ • insurance > chance of loss (pay more for the chance of loss, under insure)

$\gamma = \pi$ • actual fair situation

slope → $m_{BC} = -\dfrac{\gamma}{1-\gamma}$

• $U = \ln(Y)$ ← natural log Y ← equation how insurance is given ← only 2 unknowns

• Utility if a function of all Income (Y)

$$m_{IC} = \frac{\pi \, MU_{Y_b}}{(1-\pi)\, MU_g} \rightarrow \frac{\pi\left(\frac{1}{Y}\right)}{(1-\pi)\, MU_g}$$

$$y = mx + c$$

y ↑ y_g; m ↑ m_{BC}; x ↑ y_b; c ↑ initial endowment (constant)

(Y_B^*, Y_g^*) ← ANSWER Format