cus commerce undergraduate society

COMM 295

MIDTERM REVIEW SESSION

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Introduction

An ***economic theory*** refers to the development and use of a model to test hypotheses and form explanations for some phenomenon

- Useful theories are testable
    - example: if the price of a good increases, the quantity demanded of that product falls
    - Human behavior depends on tastes, and tastes change randomly at random intervals → not a useful theory

Type of Statement	**Definition**
Positive (descriptive) statement	a **testable** assertion of fact; does not need to be true, only testable e.g. advertising on the internet will increase the amount of monthly sales at a car dealership
Normative (prescriptive) statement	A statement about whether something is **good or bad**; often a value judgment e.g. students *should* not skip class

Introduction

Question 1: Charging a luxury yacht tax is good for BC residents in the long run because the luxury yacht tax will provide a signal that disincentivizes the purchase of luxury yacht and help with fair income distribution.

This statement is _____ and therefore a _____ statement.

a. Non-testable, positive
b. Testable, positive
c. Non-testable normative
d. Testable normative

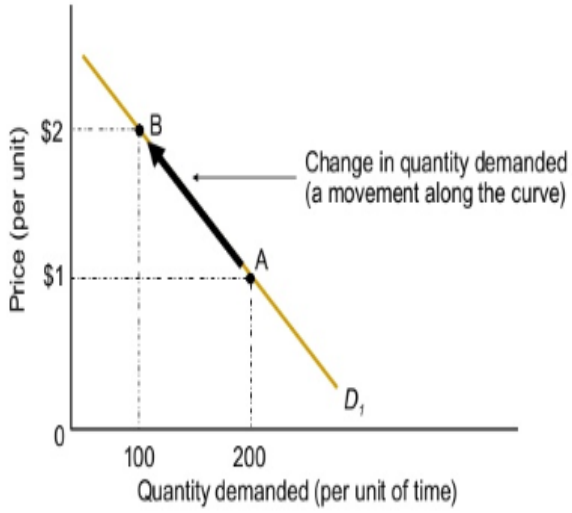
Supply and Demand

Law of Demand

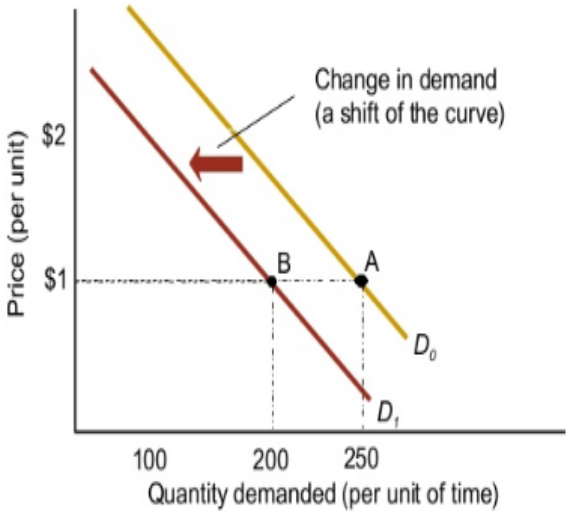
Quantity demanded **rises** when price falls: Demand curve slopes downward → empirical statement (lots of evidence supporting this law from observation of real markets)

Type of Change	Result
Change in Quantity Demanded and Supplied	***Movement along the curve*** from a change in price
Change in Demand and Supply	***Shift*** in the curve

Change in Quantity Demanded and Supplied



Change in Demand and Supply



Demand and Supply Determinants: changes in the following factors will cause a change in **demand or supply**.

Demand Determinants

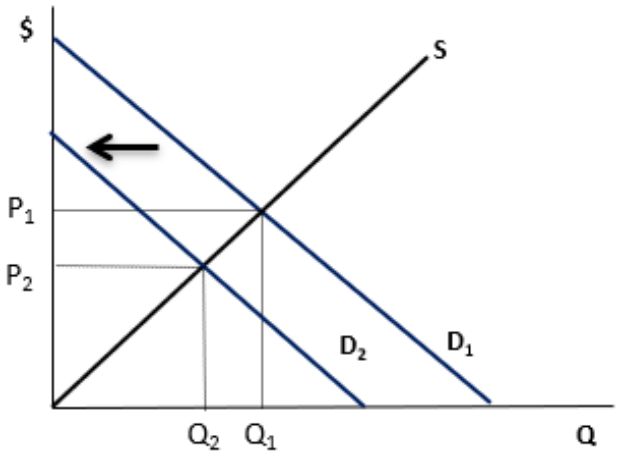
- Income
- Price of Related Goods
  - Substitutes/Complements
- Information
- Consumer Tastes
- Government Regulation
- Expectations

Supply Determinants

- Weather
- Input prices
- Number of producers
- Technology
- Expectations for future prices
- Government Regulation

Supply and Demand

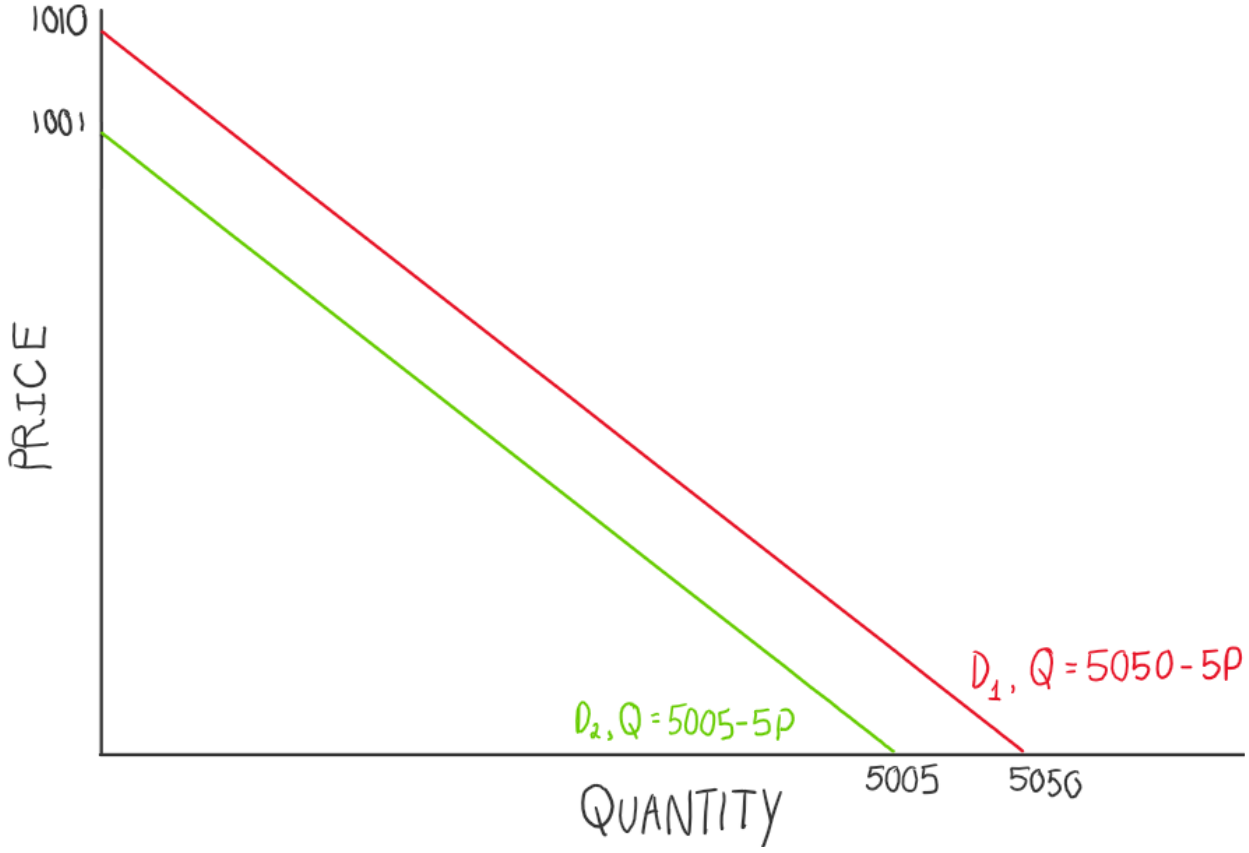
Question 2: Consider the market for red apples in Edmonton as shown below. Red apples are a normal good (demand increases when income increases). Which of the following events might have caused the demand curve for red apples to shift to the left (D1 to D2)?



A. An increase in consumer incomes
B. A decrease in consumer incomes
C. A decrease in the price of green apples
D. An increase in the price of red apples
E. B and C

Question 3: Suppose the market demand for coats is denoted by $Q=5000-5P+5P_R$, where Q and P denote quantity demanded and price of coats and P_R is the price of a related good R, and market supply for calculators is $Q=300+5P$

(a) What is the relationship between coats and R?

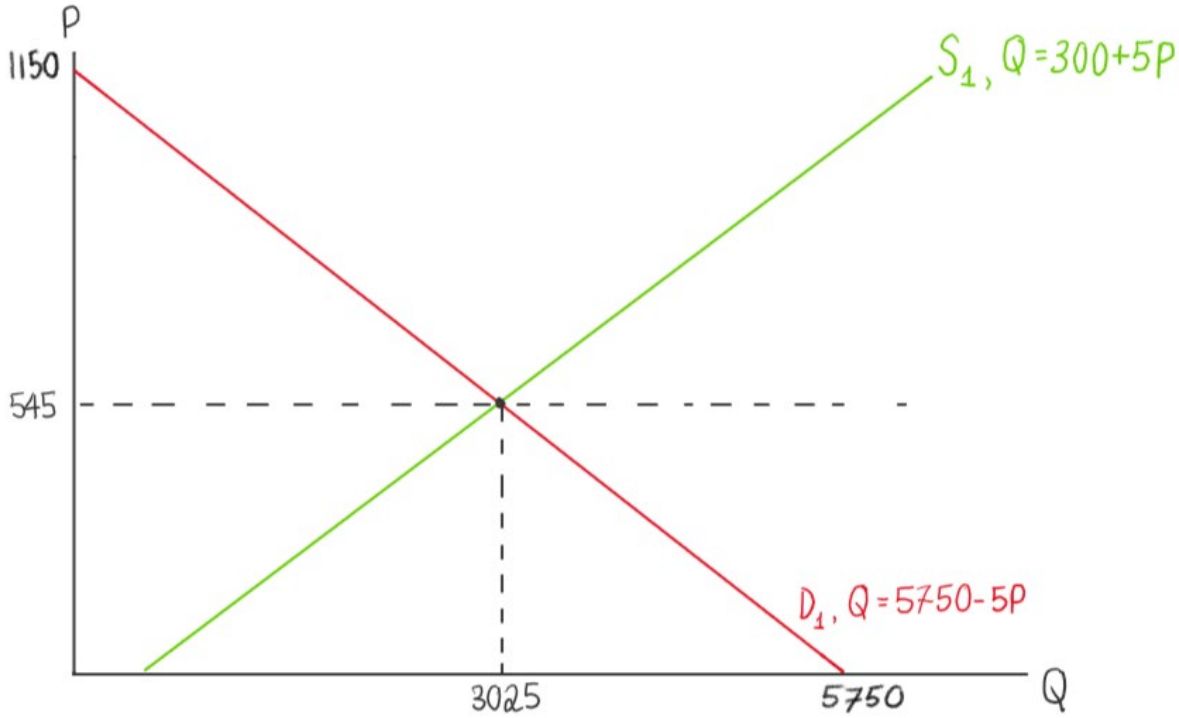


Q=5000-5P+5(1) = 5005-5P
Q=5000-5P+5(10) = 5050-5P
Price of related good increases from $1 to $10

The market demand curve for calculators shifts right when the price of the related good increases

They are substitutes

(b) Suppose P_R = 150 initially. Calculate the equilibrium price and quantity for coats. Show this outcome in a clearly labeled diagram.



① $Q = 5000 - 5P + 5(150) \Rightarrow 5750 - 5P$

② $5750 - 5P = 300 + 5P$

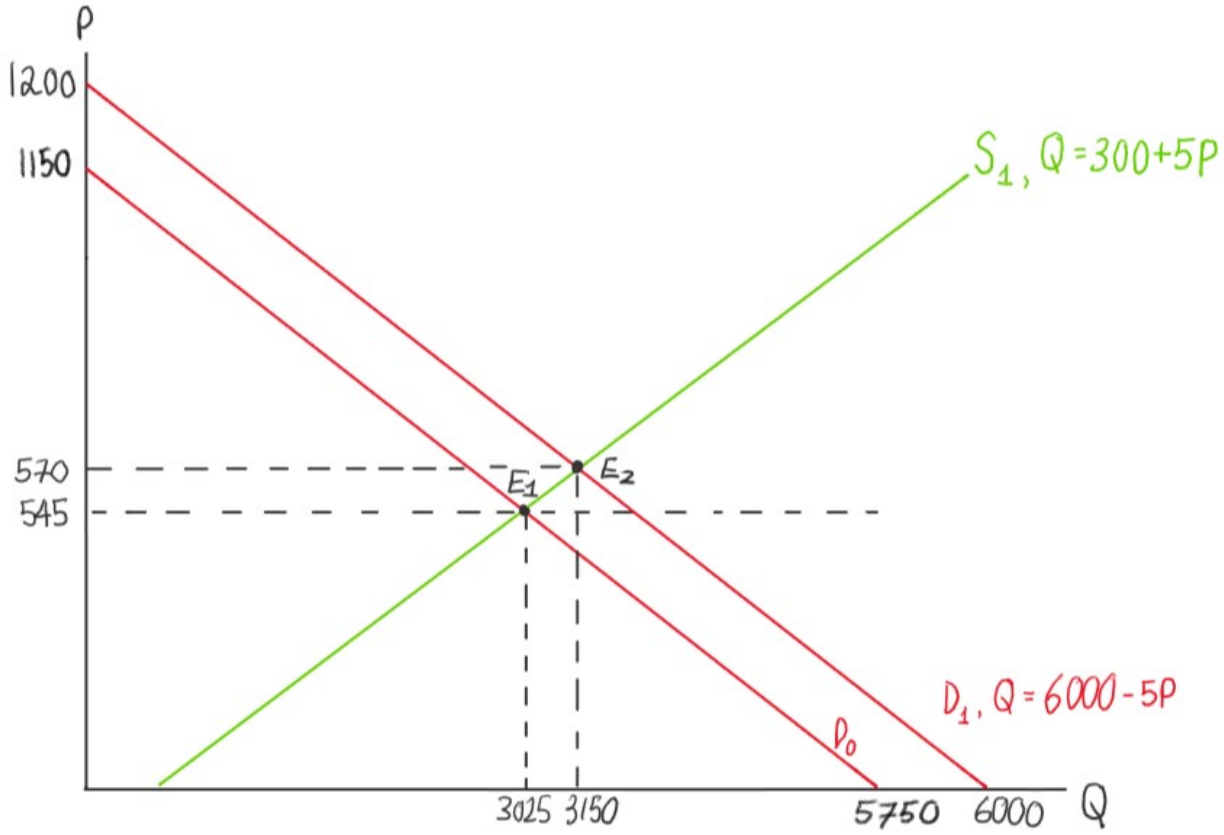
$P = 545$

③ $5750 - 5(545) = Q$

$3025 = Q$

$P = 545,\ Q = 3025$

(c) Suppose the price of R increases to $P_R = 200$. Show this change in the diagram you drew for part (b), and calculate the resulting equilibrium price and quantity for coats.



① 5000 - 5P + 5(200) = Q

6000 - 5P = Q

6000 - 5P = 300 + 5P

570 = P

↳ 300 + 5(570) = 3150

P = 570

Q = 3150

Elasticity

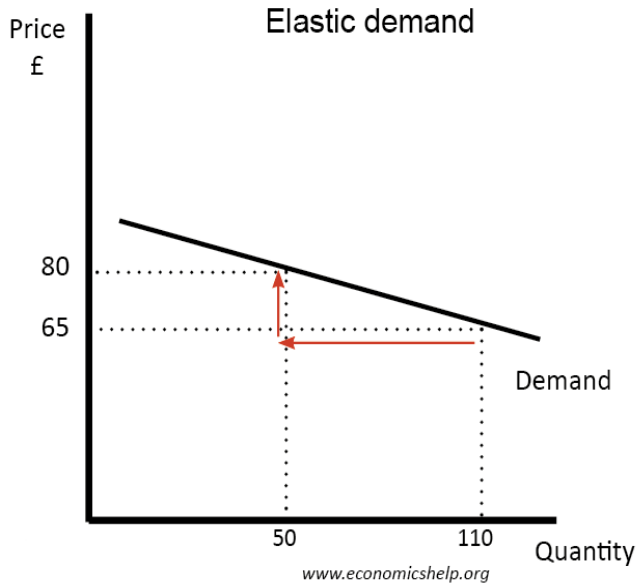
Price Elasticity of Demand

Textbook definition: measures the **percentage change** in the quantity demanded resulting from a percentage change in price.

- In most cases, it is a negative number
  - As price increases, quantity demanded decreases
  - As price decreases, quantity demanded increases
- Another way of thinking: it is the ***responsiveness*** *of* quantity demanded to a change in price

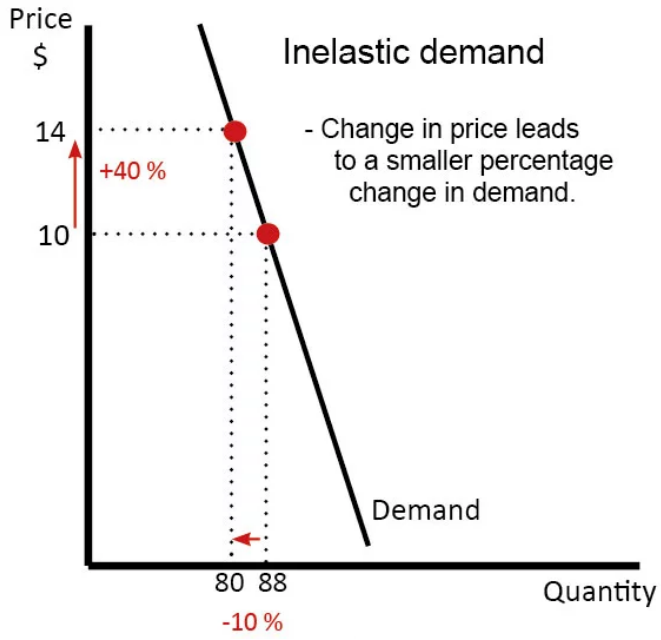
Elastic Demand: demand for which a percentage change in a product's price causes a larger percentage change in quantity demanded.

- Shown with a flatter curve
- When $|\varepsilon| > 1$, it is price ***elastic***
- When demand is elastic, total revenue and the change in price have an ***inverse relationship*** → total revenue changes in the opposite direction to the change in price.

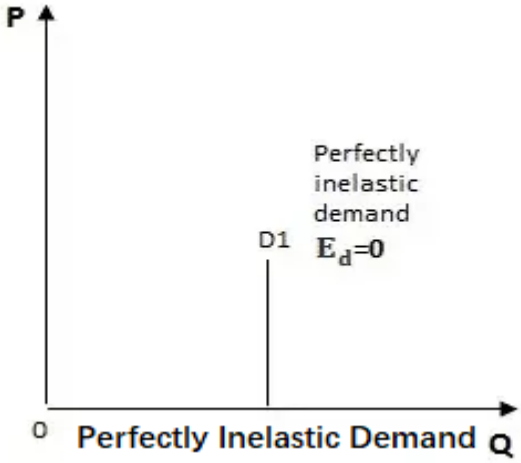


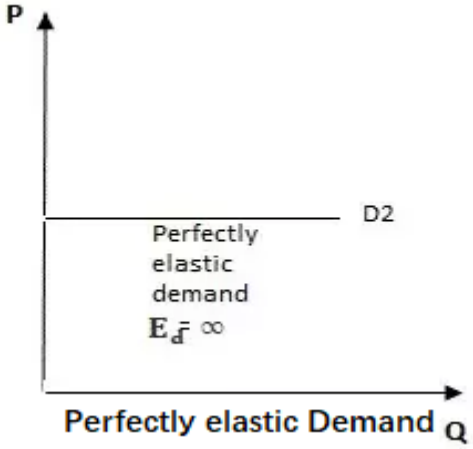
Inelastic Demand: demand for which a percentage change in a product's price causes a smaller percentage change in quantity demanded.

- Shown with a steeper curve
- When $0 < |\varepsilon| < 1$, it is price ***inelastic***
- When the demand is inelastic, the price and total revenue have a ***direct relationship*** → total revenue changes in the same direction as the change in price.



Perfectly Elastic and Perfectly Inelastic





Arc Elasticity

$$|E_d| = \frac{\frac{Q_2 - Q_1}{\left(\frac{Q_2 + Q_1}{2}\right)}}{\frac{P_2 - P_1}{\left(\frac{P_2 + P_1}{2}\right)}} = \frac{\%\Delta Q}{\%\Delta P}$$

Point Elasticity

$$E_p^D = \frac{\%\Delta Q}{\%\Delta P} = \frac{\frac{dQ}{Q}}{\frac{dP}{P}} = \frac{P}{Q} \cdot \frac{dQ}{dP}$$

- Even with a linear demand curve, the price elasticity of demand is NOT the same at all points along the curve because it is calculated using % change.

Income Elasticity of Demand

• Goods consumers regard as "necessities" tend to be income inelastic.
e.g. medicine

• Goods consumed regard as "luxuries" tend to be income elastic.
e.g. Luxury brands and expensive restaurants

Cross-Price Elasticity of Demand

• Measures the percentage change in the quantity demanded of one good that resulted from a percent change in the price of another good.

Substitutes

• Cross-price elasticity of demand is positive for substitute goods.
e.g. when the price of butter increases, quantity demanded of margarine rises.

Complements

• Cross-price elasticity of demand is negative for complementary goods.
e.g. when the price of cars increases, quantity demanded of tires decrease.

Elasticity

Question 4: Here is a table showing the percentage changes in price and quantity

Change in Quantity	Change in Price	Elasticity
-7%	7%	**-1**
-5%	3%	**-5/3**
20%	10%	**2**

What are the elasticities?

$$|E_d| = \frac{\%\Delta Q}{\%\Delta P}$$

When does the law of demand hold?

Law of Demand: quantity demanded rises when price falls

10% increase in price causes a 20% increase in quantity → law of demand does not hold

Production and Cost

Measures of Productivity
- Average Product of Labor: APL = Q/L
- Average Product of Capital: APK = Q/K
- Marginal Product of Labor: MPL = dQ/dL (assuming K is constant)
- Marginal Product of Capital: MPK = dQ/dK (assuming L is constant)

Returns to Scale
- Original function Q = F(K,L)
- Increase both inputs by a factor of c (where c >1)
- New function Q' = F(cK,cL)
- If Q' > cF(K,L) then there is increasing returns to scale.
- If Q' < cF(K,L) then there is decreasing returns to scale.
- If Q' = cF(K,L) then there is constant returns to scale.

Cost
Marginal Cost (MC): the cost of producing one more unit of Q

$$MC = \frac{dTC}{dQ}$$

Total Cost (TC) = Fixed Cost (FC) + Variable Cost (VC)
Average Cost (AC) = FC/Q + VC/Q = AFC + AVC

- The MC curve always crosses the ATC curve at the minimum ATC.

The Law of Diminishing Marginal Returns (Thomas Malthus)

If a firm keeps **increasing** an input, holding all other inputs and technology constant, the corresponding increases in output will eventually become **smaller** e.g. growing wheat requires suitable land, seeds, labor, capital in the form of machines, fertilizer, and possibly other chemical inputs. Increasing the amount of land, while holding all other inputs fixed, will eventually reach a point where additional land produces little additional output

Economies of Scale

- *Economies of scale* mean that the average cost falls as output rises.
- *Constant costs* means average cost is constant as output rises.
- *Diseconomies of scale* means average cost rises as output rises.

- Economies of scale are normally caused by increasing returns to scale.
- Economies of scale is a ***cost concept***; increasing returns to scale is a production concept. They are related but not the same thing.

Production and Cost

Question 5: Here are two production functions. K is fixed (and positive).

1. q = 10K + 5L
2. q = 10KL^0.5

A. Both production functions satisfy the LDMR.
B. Only production function 1 satisfies the LDMR.
C. **Only production function 2 satisfies the LDMR**.
D. Neither production function satisfies the LDMR.
E. Not enough information is given to answer the question.

LDMR: if a firm keeps increasing an input, holding all other inputs and technology constant, the corresponding increases in output will eventually become smaller

1. q = 10K+5L → constant returns to scale
2. q = 10KL^0.5 → decreasing returns to scale

FIND MPL

① $\frac{dq}{dL} = 5$ ② $\frac{dq}{dL} = 0.5\left(\frac{10K}{\sqrt{L}}\right)$

$= \frac{5K}{\sqrt{L}}$

Question 6: The average variable cost of producing metal sunglasses is given by AVC = 3 + 0.03q. The total cost of producing 100 metal sunglasses is 1375. Find the:

- Marginal cost
- Fixed cost
- Total cost of producing 80 pairs of metal sunglasses

Step 1:

AVC= VC / Q ----> VC = (AVC)(Q)

$(3+0.03Q)(Q) = VC \rightarrow 3Q+0.03Q^2$

Step 2:

TC= FC + VC

$1375 = FC + 3(100) + 0.03(100)^2$

775= FC

$TC=775+3Q+0.03Q^2$

MC=3+0.06Q

Marginal Cost:

MC = 3+0.06Q

MC = 3+0.06(100) = 9

Total cost of producing 80 lime green pens

$TC = 775+3(80)+0.03(80)^2 = 1207$

Question 7: If the production function of Pitt Meadows Bakery is Q = K^0.5L^0.8, assuming K is constant, what kind of returns of scale does Pitt Meadows Bakery have?

$$Q = \sqrt{K} \cdot L^{0.8}$$

$$MPL = \frac{dQ}{dL} = \frac{0.8\sqrt{K}}{L^{0.2}}$$

$$0.8\sqrt{K} > \frac{0.8\sqrt{K}}{1.15}$$

L=1 L=2

If L=1, MPL = $0.8\sqrt{K}$

If L=2, MPL = $\frac{0.8\sqrt{K}}{1.1487}$

MPL is therefore decreasing as L increases.
Pitt Meadows Bakery is experiencing decreasing returns to scale.

Question 8: The table below shows the number of hockey sticks that Sher-Wood Hockey Inc. produces each day using various combinations of capital (K) and labour (L). The underlying production function has both:

	K=1	K=1.5	K=2
L=1	4	8	13
L=1.5	8	15	20
L=2	15	21	28

A. Diminishing marginal returns to labour and increasing returns to scale.
B. Constant marginal returns to labour and increasing returns to scale.
C. Diminishing marginal returns to labour and decreasing returns to scale.
D. Constant marginal returns to labour and decreasing returns to scale.

Increasing returns to scale: output increases by a multiple that is more than the increase in input (look at how much your input increases by, then compare with how much your output increases by)
Diminishing marginal returns: each successive increase in input, holding K constant, will return less and less output

When L goes from 1 to 1.5 (input increasing by a factor 1.5)
The output increases from 4 to 8 (output increases by a factor of 2)

When L goes from 1.5 to 2 (input increasing by a factor 1.33~)
The output increases from 8 to 15 (output increases by a factor of 1.875)

2>1.875 → diminishing marginal returns
1.875>1.33 → increasing returns to scale

Estimation and Regression Analysis

Regression analysis: statistical technique used to estimate the mathematical relationship between a dependent variable and one or more explanatory variable

When estimating a demand curve, the points do not lie on the line precisely due to random error.

- The ***residual*** is the vertical distance between the estimated demand curve and the actual data points.

When we use Excel, the method of ***"ordinary least squares"*** is used

- This method makes the sum of squared residuals as small as possible to form an estimated regression line.

The degree to which a regression line is a "good fit" for the data can be measured by the ***R2value***.

- ***R2value***: measures how well the estimated regression line fits the data; the proportion of total variance (of the response variable) that is explained by the model (the explanatory variable)
    - When R2is 1.0, 100% of the variation in the response variable is explained by the explanatory variable

Standard error: how much the estimated coefficient would vary in repeated samples

- Small standard errors indicates precise estimates
    - Various estimated coefficients are tightly bunched around the true coefficient

T-statistic: equals the coefficient divided by the standard error

- Larger t-statistics indicate greater confidence that the true coefficient differs from zero
- When the absolute value of the t-statistic is greater than 2, it is considered important or "statistically significant"

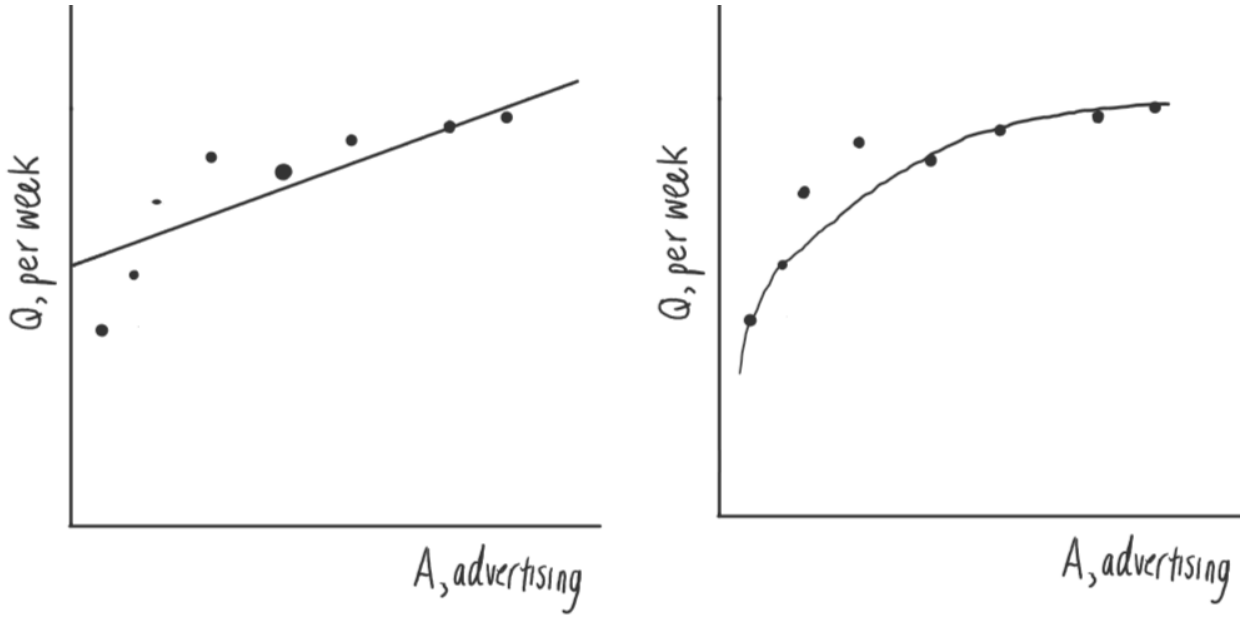
$$estimated\ coefficient \div standard\ error\ =\ t-statistic\ value$$

Estimation and Regression Analysis

Question 9: Consider the following scatterplot outlining the salaries of executives.

A) The linear OLS regression under-estimates the salary of younger executives.
B) The linear OLS estimation is likely to show that marginal returns to age is diminishing.
C) The ***R2*** value with linear OLS regression is likely to be higher than that with quadratic estimation.
D) The quadratic OLS estimation shows that executive's salary increases with age at an increasing rate.

Question 10. Use the two regressions that illustrate the effect of advertising expenditure on quantity demanded below to choose the correct statement(s).



A. The quadratic regression fits the data better and has a smaller ***R^2*** statistic value.

B. The coefficient for *A^2* in the quadratic regression should be statistically significant.

C. The quadratic regression curve underestimates the effect of A because the level of advertisement when A=4 actually generates a demand Q above what is predicted by the regression curve

D. All of the above.

- R^2 value should be relatively high
- “Statistically significant” when the |t-stat| > 2

- Estimated coefficient / standard error = t-statistic value
- We know this because the standard error is quite small for each point T-stat should be greater than 2
- A single point that is above the regression curve would not mean that the entire quadratic regression curve underestimates the effect of A

Question 11: Karen is selling strawberries outside of The Nest. She is curious about how the quantity of strawberries sold (Qs) is affected by the temperature of the day (T) and the price he sets. After collecting information about Q, P, and T in a single day, she runs a regression of Q on P and T. The results from the regression are shown in the table below, with R-squared statistic being 0.91. Answer the following questions about this regression.

	Coefficients	Standard Errors
Intercept	-38.23	5.19
Price	-13.93	2.38
Temperature	8.38	8.23

1. The dependent variable is ***quantity of strawberries sold (Q_s)*** → ***or response variable***

2. The estimated demand function is ***-38.23 - 13.93P + 8.38T***

3. The t-stat for the coefficient of temperature (T) is ***1.018*** and the t-stat for the coefficient of price (P) is ***-5.853***.

Price: -13.93/2.38 = -5.853

Temperature: 8.38/8.23 = 1.018

4. State whether the coefficients on temperature (T) and price (P) are statistically significant at the 5% significance level and explain how you know that.

The temperature is not statistically significant because the absolute value of its t-stat is less than 2. Only the price coefficient is statistically significant.

5. After trying another regression specification by not including temperature (T) in the regression, the R-squared statistic changes to 0.73. Is this new specification <u>better</u> or <u>worse</u> than the original one?

- *Less variation in the response variable (Q_s) is explained by the explanatory variables*

Perfectly Competitive Markets

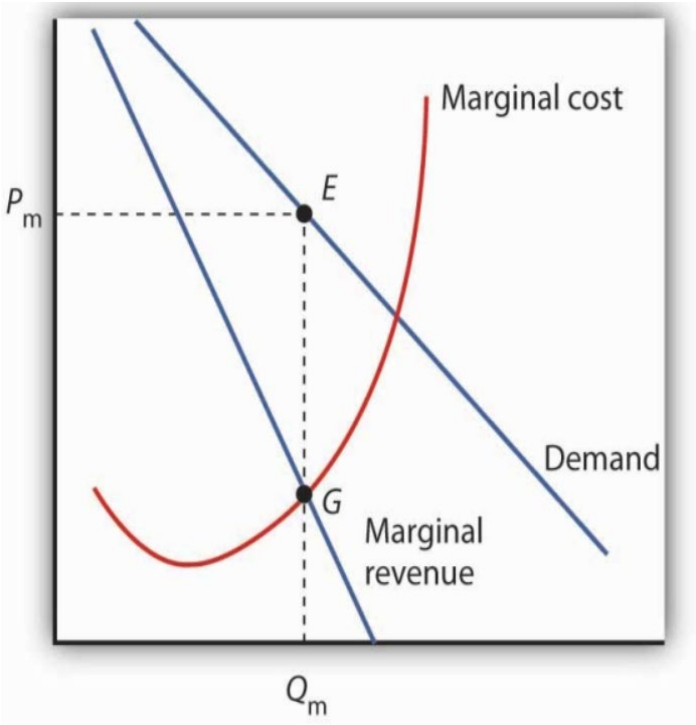
Characteristics of Perfectly Competitive Firms:

1. *Price-Taking*: The individual firm produces a very small share of the total market output and, therefore, cannot influence the market price.
2. *Product Homogeneity*: The products of all firms are perfect substitutes.
3. *Freedom of Entry and Exit*: There are no costs that make it difficult for a firm to enter or stay in the industry.
4. *Perfect Information*: Buyers and sellers have perfect information.
5. *Low Transaction Costs*: There are low transaction costs of buying and selling.

Profit for Competitive Firms: $\pi(q) = R(q) - C(q)$

Output Decision:

- The profit of competitive firms is maximized when **P=MR=MC**
  - For competitive firms, the *marginal revenue* is equal to *price*
  - MR=MC is the level of output where marginal profits are zero (or when there is no further room for increasing profits by producing more).



- When $Q < Q_m$, marginal revenue is greater than marginal cost, meaning that for each additional unit produced, revenue will be higher than the cost.

→ firms will produce more

- When $Q > Q_m$, marginal revenue is less than marginal cost, meaning that for each extra unit produced, the cost will be higher than revenue.

→ firms will produce less

- $Q = Q_m$ (MR=MC) is the sweet spot in between that allows a firm to maximize profit.

Short Run Shutdown Decision:

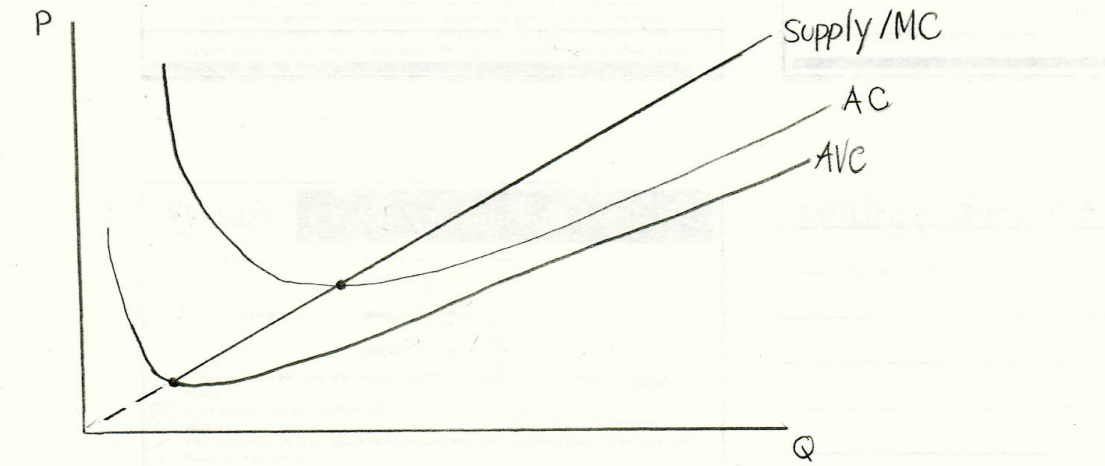
- <u>If P > AVC, a firm will still produce even if it is experiencing a loss</u>
  - This is because firms can reduce their losses by producing more when P > AVC
  - Revenue can cover all of VC and a portion of FC. As a result, by producing, the firm's loss < FC
  - In the short run, firms can avoid variable costs (VC) such as labor costs by shutting down, but not the (sunk) fixed costs (such as rent)
- <u>If P < AVC, the firm will shut down</u>
  - In this case, the firm cannot cover even its VC. By producing, the loss becomes greater than FC.
  - If it shuts down, then the firm's loss is limited to its FC

Long Run Shutdown Decision:

- In the long run, all costs (FC and VC) are avoidable
- If P < ATC, then the firm will shut down
- If P > ATC, then the firm will continue to produce

The Short Run Supply Curve

- The short run supply curve is the MC above the minimum AVC
  - Firms won't supply when MC < AVC for the same reason why firms shut down when P < AVC; producing below the minimum of AVC increases firm's losses.



Short Run Market Supply Curve

- Horizontal sum of the supply curves of all individual firms
  - The maximum number of firms in a market is fixed in the SR
- Market supply curve at any price is *n* times the supply of an individual firm
- The larger the *n*, the flatter (more elastic) the SR market supply curve is at each price
  - More firms → more responsive to changes in price → more elastic

Perfectly Competitive Markets

Question 12: Which of the following is true for a perfectly competitive industry with identical profit-maximizing firms in a long-run equilibrium?

A. Firms produce where P = MC.
B. Firms produce where P = AC.
C. Each firm produces at the minimum of its long run average cost curve.
D. a and b.
E. All of the above.

Question 13: Assume that the golden retriever adoption industry is perfectly competitive. There are n identical firms (n is limited). Each firm has the following total cost function in the short run and the long run: $C(q) = 25 + 5q + q^2$ where q represents the number of golden retrievers. The fixed cost is unavoidable in the short run but avoidable in the long run.

1. What is the marginal cost function for each firm? **MC = 2Q+5**

2. What is the equation for the firm's supply function?
Q = 0.5P+2.5 → Q as a function of P

3. What is the average variable cost function for each firm? At what price should the firm shut down?

AVC = Q+5

MC= 2Q+5

SR Shut Down Price is given where MC=AVC:

2Q+5 = Q+5
Q = 0

Plug Q=0 into MC or AVC

2(0)+5= 5
Shut down when P<5

4. What is the average cost function for each firm? At what price will firms exit the industry in the long run?

AC = 25/Q + 5 + Q

MC = 2Q + 5

LR Shut Down Price is given where MC=ATC:

2Q+5 = 25/Q + 5 + Q
Q = 5

Plug Q=0 into MC or AVC

2(5)+5= 15
Shut down when P<15

5. Suppose that market demand is given by Q = 200 – 2P. The long run industry equilibrium price is **15** and the industry output quantity is **170**.

Long run equilibrium price was solved in the Question 4
Quantity: 200 - 2(15) = 170

The long run equilibrium price of the industry is the shutdown price of a firm because firms make normal profits in the long run.

6. In the long run equilibrium, there will be **34** firms and each firm produces quantity **5**.

The long run quantity produced in the industry is 170

Each firm produces 5 units in the long run.

# of firms = market output / individual output

170/5 = 34 firms

Monopoly and Pricing with Market Power

Monopoly: a sole supplier of a good for which there is no close substitute.

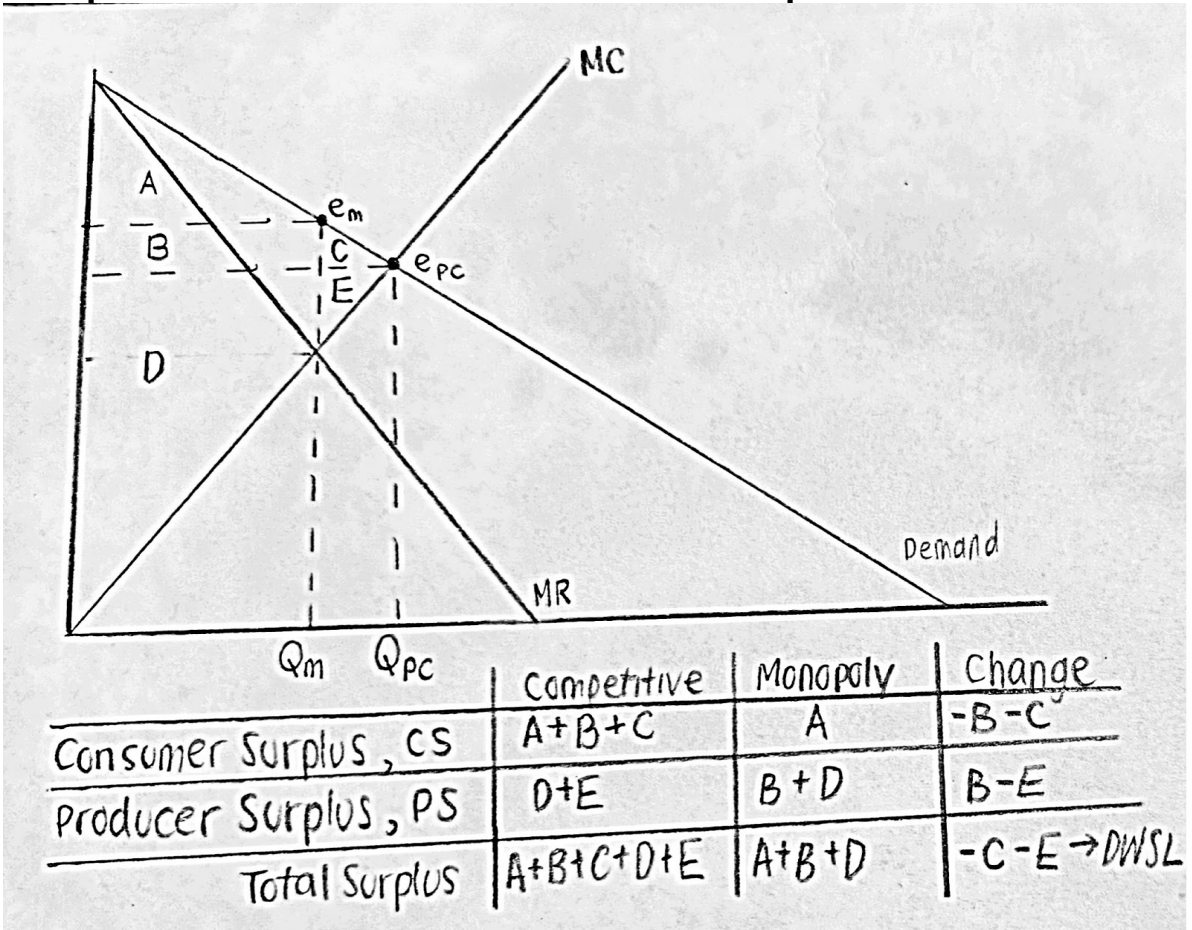
- As a single supplier, a monopolist faces the entire (downward sloping) market demand.
- A monopoly's output is the market output

- Profit Maximization: MR=MC

Profit-maximizing managers set their quantity according to this formula:

$$MR = p\left(1 + \frac{1}{\varepsilon}\right) = MC.$$

Comparison of Consumer and Producer Surplus



	Competitive	Monopoly	Change
Consumer Surplus, CS	A+B+C	A	-B-C
Producer Surplus, PS	D+E	B+D	B-E
Total Surplus	A+B+C+D+E	A+B+D	-C-E → DWSL

Pricing with Market Power

Perfect price discrimination: Monopolist charges the **maximum** price that each consumer is willing to pay.
Multi-group price discrimination: Splitting consumers into two or more groups based on their demand curve and charging different prices to each group.
Non-linear price discrimination: Charging different prices based on the quantity
Two-Part Pricing: Charging an entry fee and a usage fee

Bundling: selling products together in sets

- Pure bundling: works when there is a negative correlation between the demands of consumers.
    - Changes lower price, but increases the number of consumers.
- Mixed bundling: allow the customer to buy the pure bundle or any of the bundle's components separately

Peak Load Pricing: charging higher prices during periods of peak demand in other periods

- used when there is a capacity constraint
- increases profits and spreads demand during off-peak time

Monopoly and Pricing with Market Power

Question 15: A monopoly faces a market demand curve given by P = 15-0.25Q. Its cost function is C=15+5Q.

a. Calculate the profit maximizing output and price for the monopolist (under uniform pricing strategy).

$MR = MC$

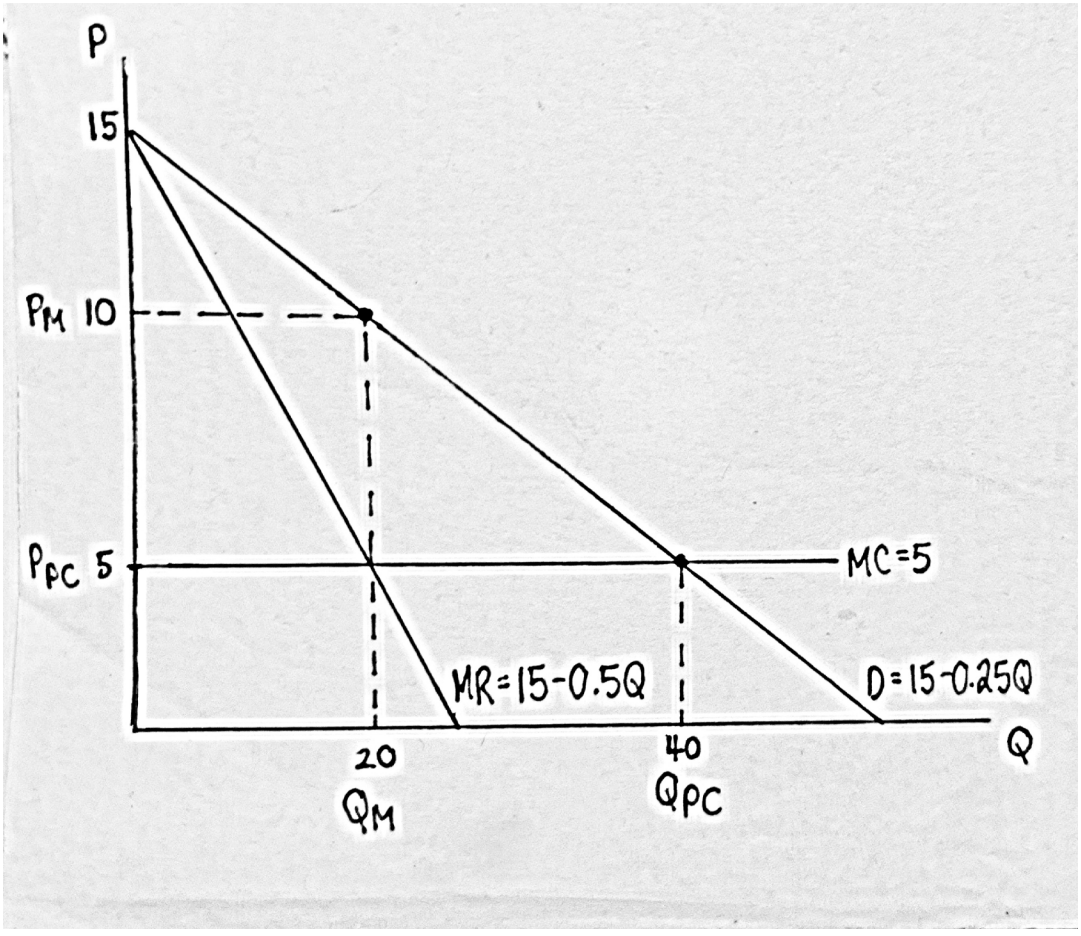
$15 - 0.50Q = 5$

$Q = 20$

$15-0.25(20) = P$

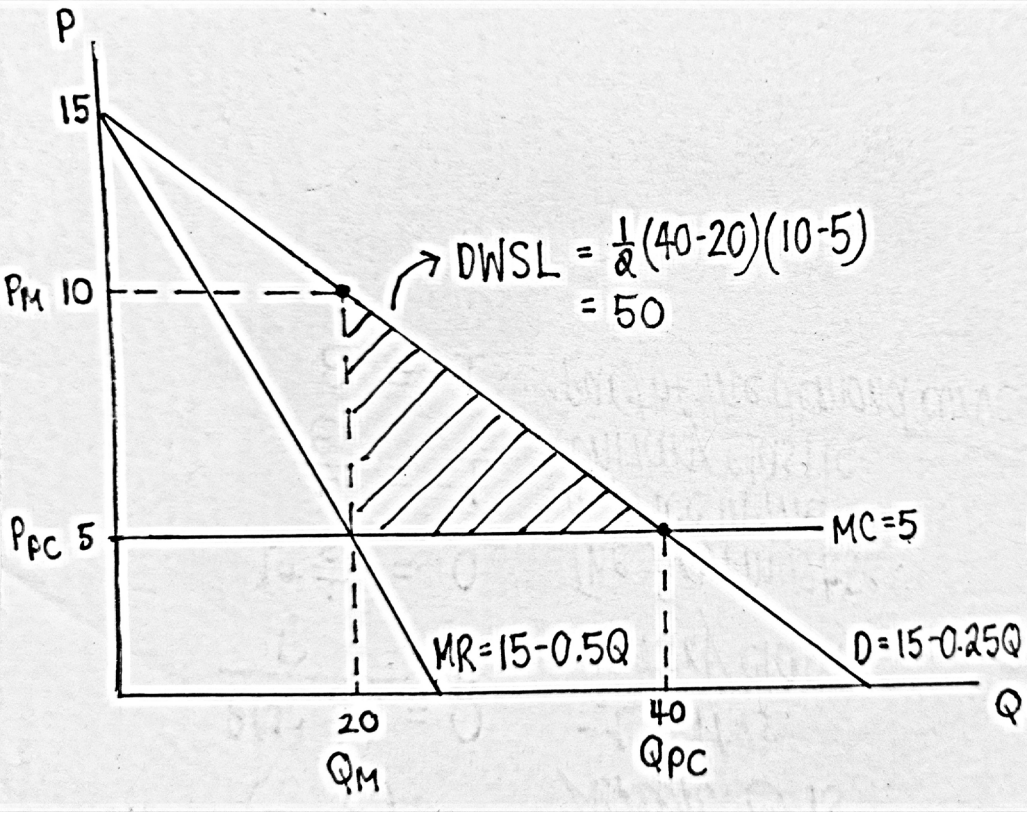
$10 = P$

b. On a diagram, draw the demand curve, marginal revenue curve, and marginal cost curve. Clearly label the axes.



c. The deadweight loss under this uniform pricing strategy is 50.

If the monopoly can carry out first-degree price discrimination, the deadweight loss in that case would be 0.



Question 16:

The table provides the reservation prices for three consumers who are deciding what to do during winter break. The consumers could travel to France or Germany. For this question, we will assume that these are the only consumers and the marginal cost is 0 for both choices. A travel agency is considering whether to use stand-alone pricing or pure bundling pricing strategy.

	France	Germany	Bundle
Jorge	110	100	210
Travis	105	125	230
José	100	150	250

a. Fill in the willingness to pay for the bundles in the above table.

b. With stand-alone pricing, France should be priced at **100** and Germany should be priced at **100**. The profit from both products is **600**.

3 x 100 + 3 x 100 = 600

c. With pure bundling, the profit-maximizing price for the bundle is **210**, and the profit is **630**.

210 x 3 = 630

Oligopoly

Oligopolies are characterized by few sellers, limited entry, homogeneous or differentiated products, and firm's awareness of strategic interdependence between each other.

Cartels: formed when oligopolistic firms collude in setting prices or quantities to raise their profits

- Each member agrees to reduce its output from the level of output if it acted independently → market price rises and firms earn higher profits
- Cartels tend to produce the output analogous to monopolies → helps achieve the highest possible collective profit

Cournot Duopoly: two firms compete in choosing quantity (more realistic)
Bertrand Duopoly: two firms compete in choosing price.

Best Response Functions: shows the firm's best output as a function of the other firm's output and depends on the firm's marginal cost.

Nash-Cournot Equilibrium: the set of quantities chosen by firms where no firm can obtain higher profits by choosing a different quantity (holding the quantities of all other firms constant) → intersection of best-response curves

Solving Cournot Model and Deriving Best Response Functions:

Step 1: Find the residual demand function

Step 2: Use the residual demand function to find the MR equation of each firm

Step 3: Set MR = MC for both firms

Step 4: Solve for Q_A and Q_B

Step 5: Use Q to find the price

Explanations of Steps:

Step 1: For *Cournot oligopolies*, where there are only two firms that are identical in marginal cost and their demand curves (this is also called a duopoly), we look for their residual demand curves so we can solve for the best-response functions.

- Because the two firms compete with one another, they consider each other's behavior when choosing profit-maximizing output.
    - The firms are concerned with the residual demand curve, which shows the market demand that is not met by other sellers at any given price.

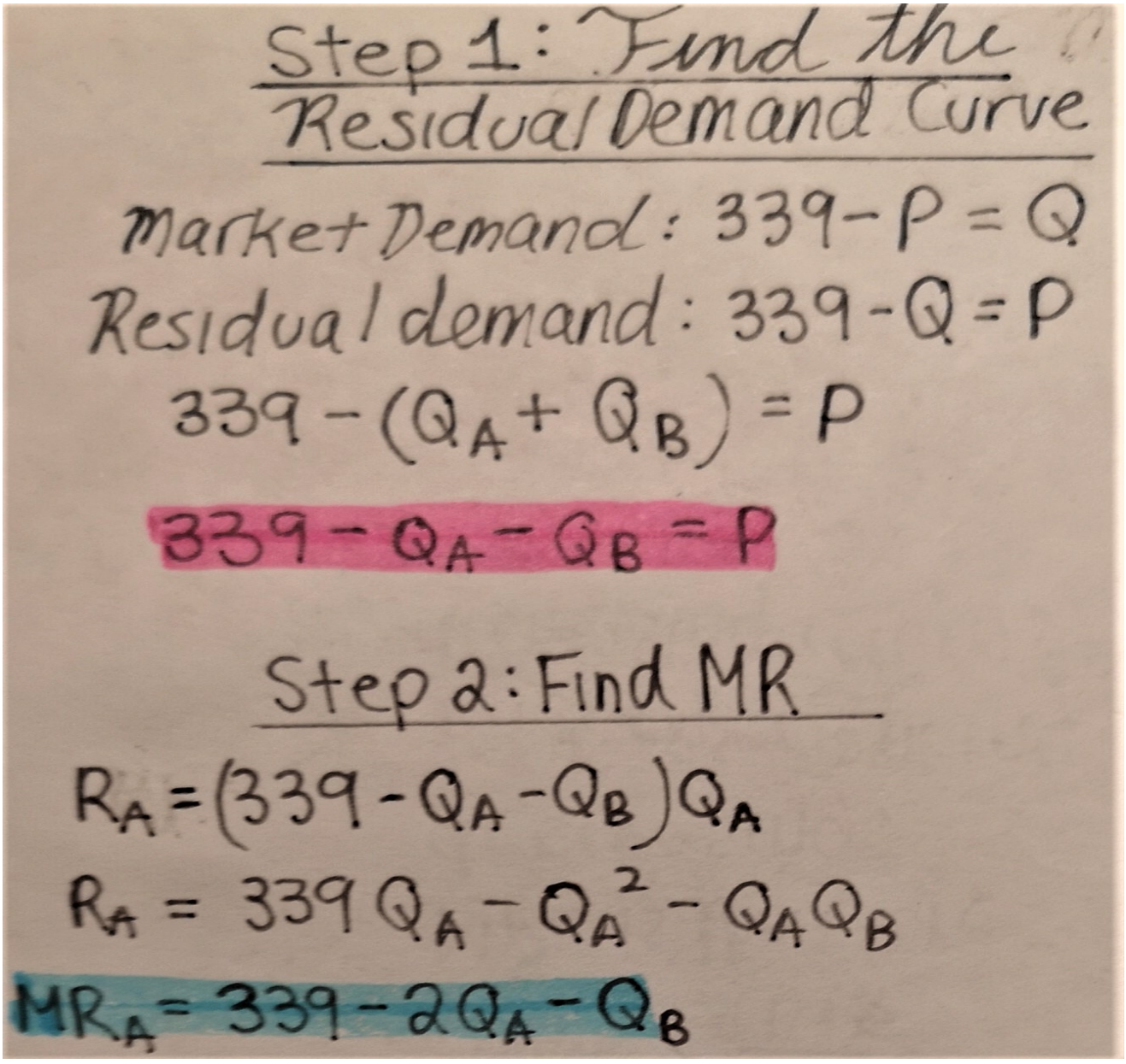
Step 2: Once we know the residual demand function, we want to find the MR equation so we can set the profit maximizing condition that a firm should follow to maximize its profit given the behavior of the other firm

- The firm's best response - its profit maximizing output given the output of the other firm - is the output that equates its marginal revenue and its marginal cost
- Because the two firms have the same marginal cost and demand curves, their best-response functions will be identical

Step 4: To solve for Q_A and Q_B, we take the best response functions of one firm and plug it into another. This will give us the quantity a firm should produce in response of another.

Oligopoly

There are two firms in a Cournot duopoly. The market demand function is Q = 339 – P and the cost function is C = 147Q. Find the equilibrium price, the quantity produced by each firm, and the profit of each firm.



Step 3: Set MR=MC

$MC = 147$

$147 = 339 - 2Q_A - Q_B$

$2Q_A + Q_B = 192$

$Q_A = 96 - \frac{1}{2}Q_B$

$Q_B = 96 - \frac{1}{2}Q_A$

] by symmetry

Step 4: Solve for Q_A / Q_B

$96 - \frac{1}{2}(96 - \frac{1}{2}Q_A) = Q_A$

$96 - 48 + \frac{1}{4}Q_A = Q_A$

$64 = Q_A$

$64 = Q_B$

$128 = Q$

Step 5: Find Price

$P = 339 - 128$

$= \$211$

Game Theory

Game Theory: tries to determine the optimal strategy for each player
A game consists of:

1. Players (i.e. firms)
2. Rules (simultaneous, sequential)
3. Strategies (price and quantity decisions, given the other's move)
4. Payoffs (what each player receives for the combination of strategies)

Static game: each player acts once and at the same time
Dynamic Game: arises when players move sequentially or repeatedly

Dominant Strategy: the strategy that is best no matter what one's rival does
Nash Equilibrium: the set of strategies such that each player is doing the best it can, GIVEN the strategy of the rival player(s)

Prisoner's Dilemma Game:

1. There is a dominant strategy solution
2. An alternative outcome exists that provides higher payoffs for all players

- In a prisoner's dilemma game, the Nash Equilibrium can be worse than a possible outcome in the game
    - There can be another possible outcome that can give better payoffs than the Nash Equilibrium, but is not achieved

		Player B: Confess	Player B: Don't Confess
Player A	Confess	-2, -2	0,-3
	Don't Confess	-3,0	-1,-1

Game Theory

The following diagram below shows the payoff matrix for the decisions of you and your professor.

		Professor		
		Test	Quiz	Cancel Class
You	Eat	0,0	8,3	18,6
	Study	3,8	18,18	23,12
	Sleep	6,18	12,23	21,21

What is the Nash Equilibrium?

Nash Equilibrium: the set of strategies such that each player is doing the best it can, GIVEN the strategy of the rival player(s)

You: ***Study***

Professor: ***Quiz***

Is this a Prisoner's Dilemma Game?

No, there is no dominant strategy solution