commerce undergraduate society

COMMERCE MENTORSHIP PROGRAM

MIDTERM REVIEW SESSION

COMM 295

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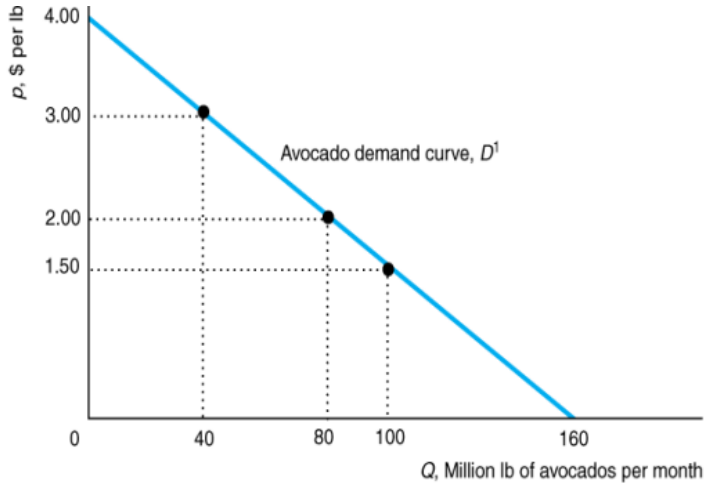
Supply & Demand

Law of Demand: Quantity demanded rises as prices fall, and vice versa. Demand curve is downward sloping.

$$Q = a + bP$$

Quantity = x-intercept + inverse slope x Price



Write an equation for this demand curve; i.e., what are the values for a and b assuming Q=a–bP?

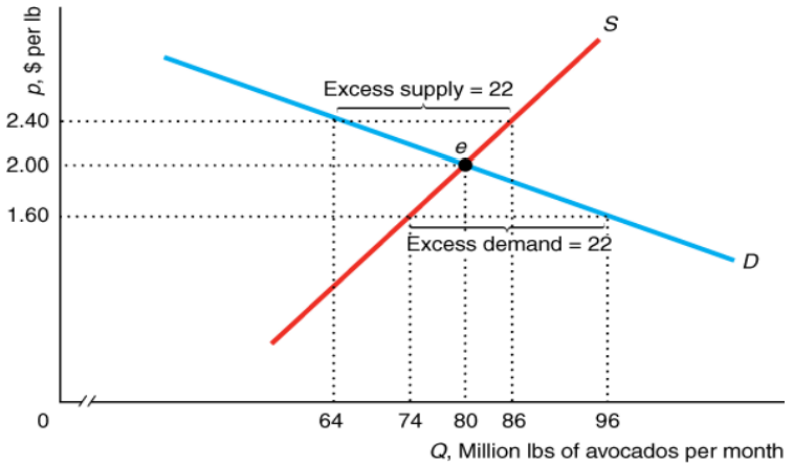
Q = 160 – 40p

What is the inverse demand?

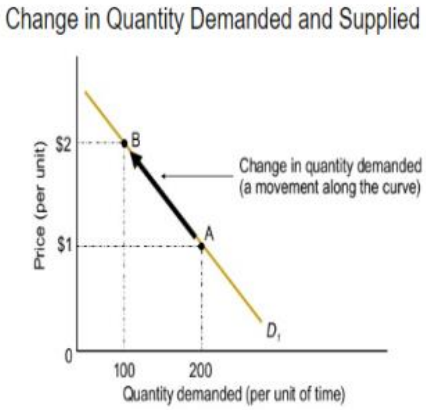
y = mx + b
p = -1/40x + 4 // p = 4 – 1/40x

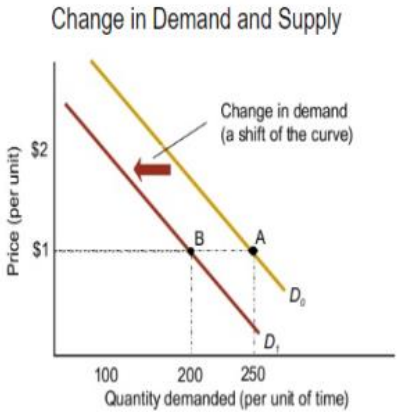
Law of Supply: Quantity supplied rises as prices rise, and vice versa. Supply curve is upward sloping.

Market Equilibrium: The intersection of the supply and demand curve, at the point e. If there is excess supply or demand, market forces drive the price back to equilibrium.



Change	Result
Change in Quantity Demanded/Supplied	Movement along the curve
Change in Demand/Supply	Shift in the Curve





Substitute vs Complement

Suppose demand for frat party tickets is $Q = 100 - 2P_F - 0.5P_A$, where P_F is the price of the frat party ticket and P_A is the price of alcohol. Are these substitutes or complements? Why?

Complements. As the price of alcohol rises, the demand for frat tickets decreases, and vice versa.

Elasticity

Price Elasticity of Demand: The percent change in quantity demanded divided by the percentage change in price.

e.g. If the price elasticity of demand is -3, a 1% decrease in price would cause quantity demanded to increase by 3%.

$$\varepsilon = \frac{\text{percentage change in quantity demanded}}{\text{percentage change in price}} = \frac{\Delta Q / Q}{\Delta P / P}$$

Arc Price Elasticity: Similar to above, but uses average price and quantity. Without using averages, the standard formula would produce different values depending on your start point.

$$\varepsilon = \frac{\Delta Q / \bar{Q}}{\Delta P / \bar{P}}$$

If price decreases from $18 to $10, and quantity demanded rises from 10 to 50, what is the arc elasticity of demand?
(40/30) / (-8/14) = -2.333

Point Elasticity: Calculated at a specific price-quantity combination.

$$\varepsilon = \frac{\Delta Q}{\Delta P}\frac{P}{Q} \quad \text{or} \quad \varepsilon = \frac{dQ}{dP}\frac{P}{Q}$$

= Derivative of demand equation, with respect to price
= Slope of demand curve multiplied by P/Q

Note: Must use regular form of demand curve (q= a + bP), not inverse demand!

Cross Price Elasticity: Percent change in the quantity demanded of one good resulting from a percent change in the price of another good.

Complements have negative cross-price elasticity; substitutes have positive cross-price elasticity.

$$\frac{(\Delta Q_X/Q_X)}{(\Delta P_Y/P_Y)}$$

Question: Would cars and gasoline most likely have positive or negative cross price elasticity?
Cars and gasoline are complements, so when the price of gas goes up, the demand for cars goes down. In other words, the numerator is positive but the denominator is positive – the cross-price elasticity is negative.

Income Elasticity: Percent change in the quantity demanded of one good resulting from a percent change in income.

Luxury goods tend to be income elastic, while necessities tend to be income inelastic.

$$\frac{\text{Percentage Change in Quantity Demanded } (\Delta Q)}{\text{Percentage Change in Consumers Real Income } (\Delta I)}$$

Question: Would medication, let's say COVID treatment, be regarded as income elastic or inelastic?
Inelastic; as consumer income decreases, their demand for treatment does not decrease at the same rate. Hence, numerator is smaller than denominator = elasticity < 1.

Production & Cost

Production Function: Quantity produced is a function of its inputs:

$$Q = f(L, M, K)$$
Where L=Labour, M=Materials, K=Capital

Returns to Scale: What happens to the output when we double all inputs?

Q more than doubles -> increasing returns to scale
Q exactly doubles -> constant returns to scale
Q less than doubles -> decreasing returns to scale

Question: Identify whether the following functions are increasing, decreasing, or constant RTS?

1) $Q = KL$
   Let's say K & L doubled from 1 to 2: Q increases from 1 to 4.
   Since Q more than doubles, this is increasing returns to scale.

2) $Q = K^{0.4} L^{0.2}$
   Let's say K & L doubled from 1 to 2: Q increases from 1 to 1.52.
   Since Q less than doubles, this is decreasing returns to scale.

3) $Q = K + L$
   Let's say K & L doubled from 1 to 2: Q increases from 2 to 4.
   Since Q exactly doubles, this is constant returns to scale.

Shortcut: For power functions, add the exponents. If greater than 1, there is increasing RTS.

Costs: Explicit costs are direct, out-of-pocket costs for labour, capital, materials, etc. Implicit costs reflect forgone opportunity, rather than explicit expenditure.

Accountants would not consider implicit costs, but economists must! Accountants would, by contrast, consider sunk costs, but an economist would not.

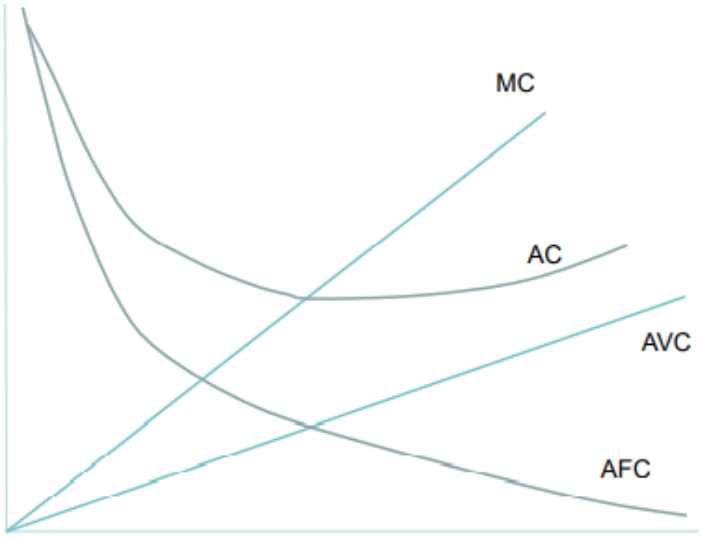
Total Cost (TC): Fixed cost (FC) + variable cost (VC)

Marginal Cost (MC): The cost of producing one more unit of Q. Slope or derivative of the total cost function.

Calculate the marginal cost of TC = $25Q^2 + 100$
MC = dC/dQ = 50Q

Average Cost (AC): Total cost divided by quantity – on average, how much does it cost to produce one unit?

Question: You produce knockoff AirPods with cost function TC = $25Q^2 + 100$
What is your the average cost (AC), average variable cost (AVC), and average fixed cost (AFC)?
AC = $25Q^2/Q + 100/Q = 25Q + 100/Q$
Remember that AC = AVC + AFC; realizing this, we know that:
AVC = 25Q , AFC = 100/Q
What would be your AFC after producing 15 knockoff AirPods?
AFC = 100/Q = 100/15 = 6.67



Notes on graph:
AVC + AFC = AC (add them up vertically on the graph)
Marginal cost (MC) always passes through average cost (AC) at its lowest point.

Estimation

Regression Analysis: Statistical process to estimate the relationship between a dependent variable and explanatory variable(s).

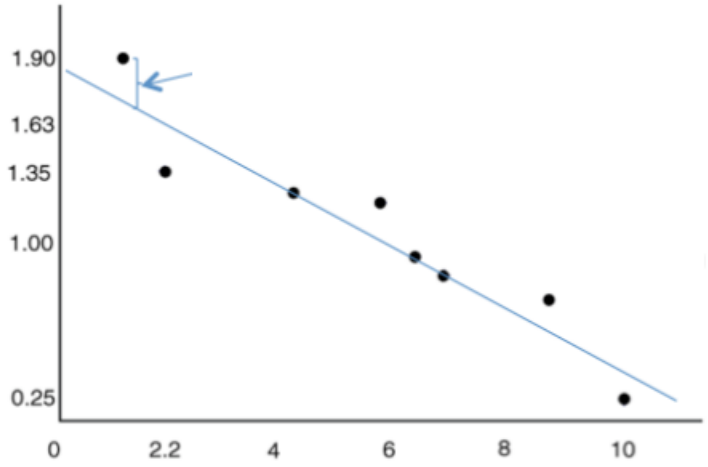
Take the example of a regression model to find the demand curve:

$$Q_d = a + bP$$

Explanatory variable: Price (P)
Dependent variable: Quantity demanded (Q_d)

Random Error: Difference between the observed and the predicted behavior of the dependent variable.

To account for random error, normal demand becomes Q = a + bP + e, where e represents the random error.

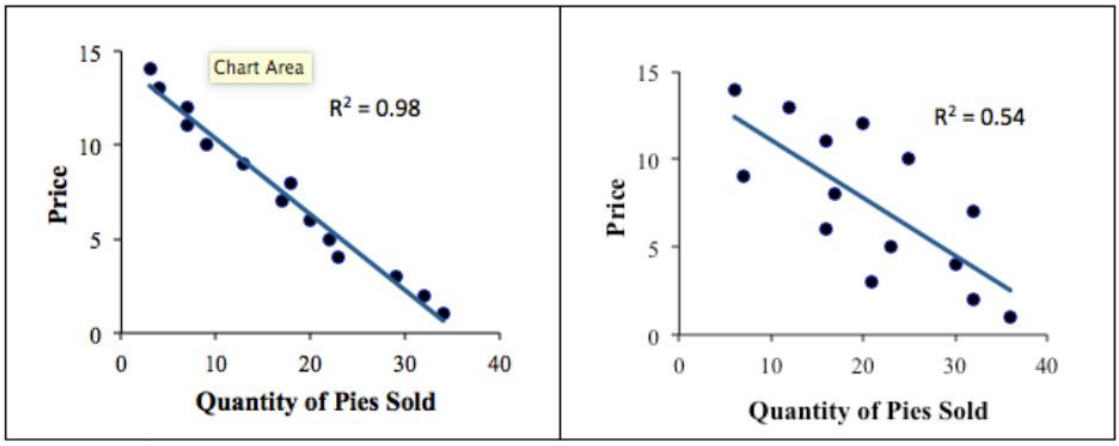


Ordinary Least Squares: Most effective way to fit a regression line (the demand curve) by minimizing the sum of the squared residuals.

The trend line tool in Microsoft Excel uses ordinary least squares to fit a regression.

R^2 Goodness of Fit: Measure of how well the regression line fits the scatter plot.

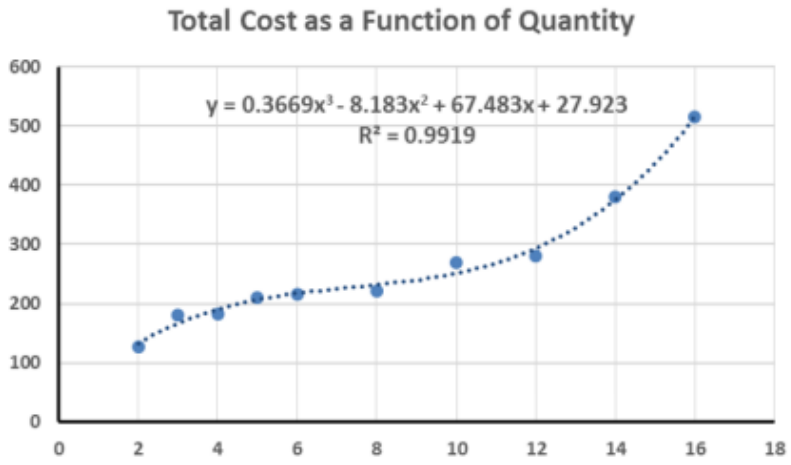
R^2 values range from 0 to 1, with 0 meaning the explanatory and dependent variables are independent



Standard Error: The extent which an estimate would vary from sample to sample. The smaller the standard error, the less variation across samples and the higher level of confidence in our estimate.

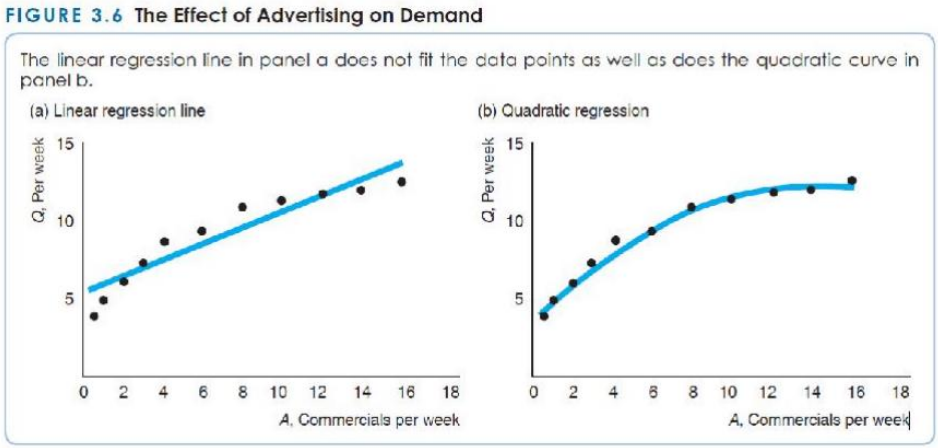
Confidence Interval: The range of likely values for our estimate to lie in. A 95% confidence interval approximately is calculated as mean +/- 2 x standard error.

Question:



a) The average cost is curve is U-shaped
b) Marginal cost is well-approximated by a quadratic function
c) In the underlying data, factors other than quantity have little effect on cost
d) All of the above

Answer: D



a) The R2 statistic is smaller for the quadratic regression, indicating a better fit to the data.
b) We would expect that the coefficient on A^2 in the quadratic regression is statistically significant
c) The linear regression line illustrates the saturation effect of advertising
d) All of the above

Answer: B

Perfect Competition

Perfectly Competitive Markets:

Price-Taking: Each firm produces a very small share of the market quantity and has no influence on the market price – they sell at the market price.

Product Homogeneity: Products of all firms are perfect substitutes.

Freedom of Entry/Exit: Firms can enter or exit the industry without difficulty

Competitive Markets: In the real world, many markets are close to being perfectly competitive, albeit some assumptions do not hold. We refer to these, in practice, as competitive industries.

Profit Maximization: Profit is maximized when MR = MC

Note that the fixed P = MR in perfectly competitive markets since firms are price-takers; hence, MR = MC reduces to P = MC

Question: A price taking firm has cost C(q) = 6 + 1.5q2 . To maximize profit the firm chooses q = 2. The price that this firm is facing is equal to

a) P = 1
b) P = 2
c) P = 6
d) P = 8

Answer: C – take derivative of cost function and plug in q=2

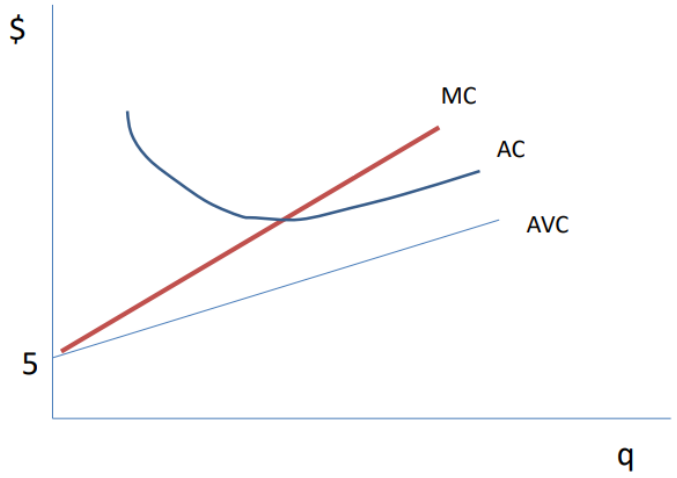
Shut Down Decision: In the short run, firms should produce as long as P > AVC. If P < AVC, firms should shut down because the firm is losing money with each unit produced.

In the long run, all costs are avoidable and so the shut-down point is P < ATC. If the price is less than the average total cost to produce it, the firm is losing money and should shut down.

Question: A coffee shop at Sauder has the cost function $C(q) = 8 + 5q + 0.25q^2$

Derive short run supply
MC = 5 + 0.5q
Remember, in perfect competition MC = P, therefore P = 5 + 0.5q
Now, inverse the equation to get a supply curve
0.5q = -5 + P
Q = -10 + 2P

Should you shut down in the short run if the market's price of coffee is $4?
Intuitively, if P = 4, the demand curve will output Q = -2, so yes you should shut down
Alternatively, look at AVC = 5 + 0.25q
Only produce when P > AVC, therefore the minimum of AVC is 5. You would only produce is the price was at least 5.

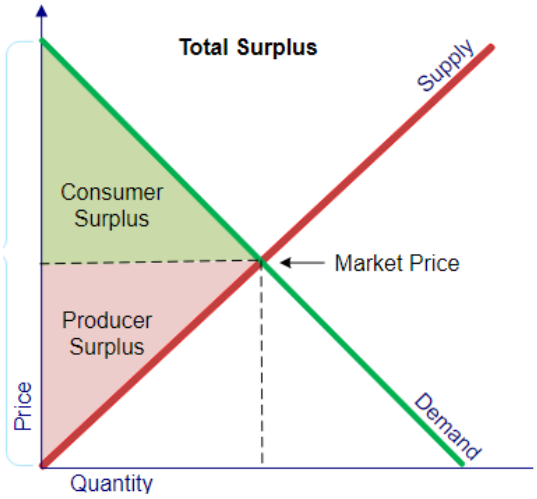


Long Run Supply: In perfect competition, where entry/exit can freely occur, the price will adjust until economic profit π = 0, which occurs at the minimum of AC.

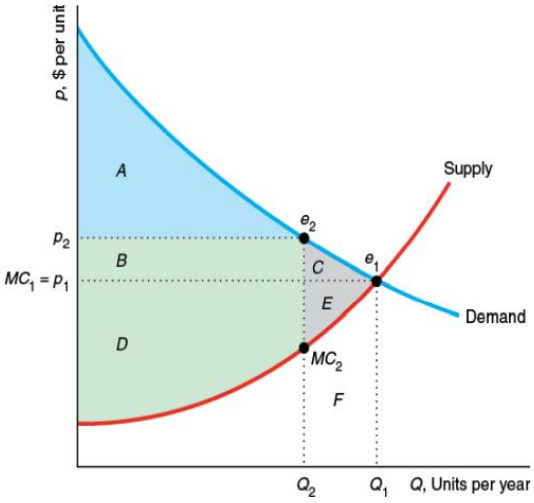
If profits are positive in the short run, more firms will enter the market. Hence, the new entrants shifts the industry supply curve to the right, causing the price to decrease until the long run price level where π = 0.

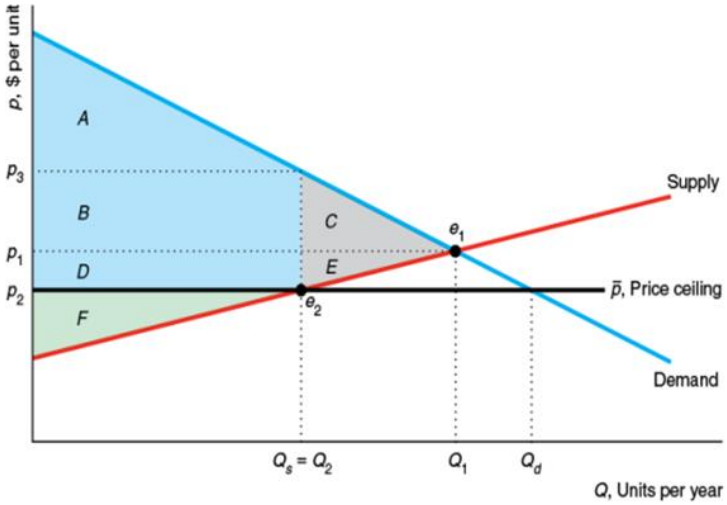
Total Surplus: Perfect competition maximizes total surplus (TS) = consumer surplus (CS) + producer surplus (PS).

Under perfect competition, any type of government intervention reduces TS. The graphs below demonstrates the loss in surplus when quantity is restricted (left) and when a price ceiling is instituted (right).



Question: Under the following scenarios, what is the DWL?





Monopoly

Monopolist: A sole supplier of a good for which there are no close substitutes. A monopolist has market power and has access to the entire market demand curve. A monopolist sets the price and supplies the quantity demanded by the market at that price.

Profit Maximization: Firms maximize profit when MR = MC.

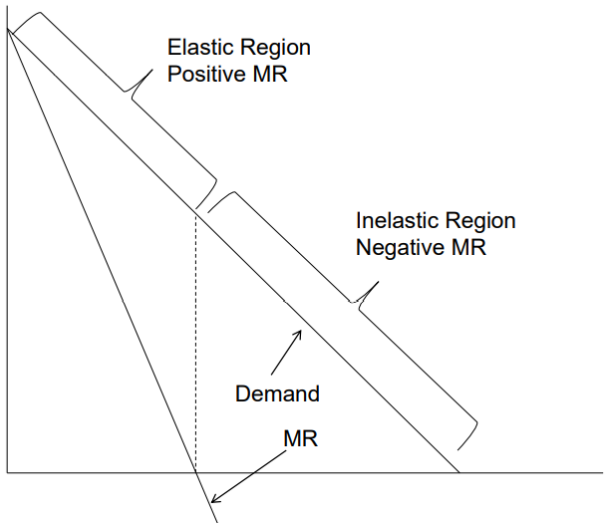
> Shortcut: The MR curve is the same as a linear inverse demand curve (p as a function of q), but with double the slope.

Question: Demand is represented by Q = 100 – 2P. The monopolist has MC constant at 10. What will the monopolist do to maximize profit?

> MR = MC
> Inverse demand = P = 50-0.5Q
> MR = 50-Q ; MC = 10
> 50-Q = 10
> Q = 40
> Solve for P using demand curve (NOT MR curve) = P = 30

Elasticity: What would happen to revenue if the monopolist lowers the price? If demand is elastic, q rises more than the decrease in price, hence MR is positive. If demand is inelastic, q rises proportionately less than the decrease in P, hence MR is negative.

If demand is inelastic, lowering the price would not be profitable; raising the price would be profitable.



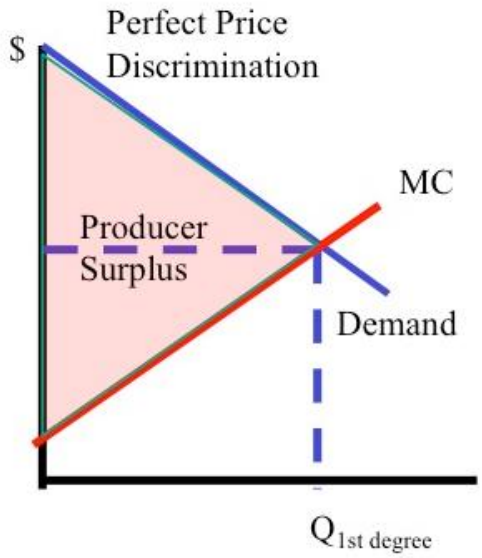
Question: You are in charge of the TransLink monopoly. For a certain service, your optimal price is P=6, and your MC=4. What is the elasticity of demand facing TransLink?

Hint: Use optimal pricing formula $\frac{p}{MC} = \frac{1}{1+(1/\varepsilon)}$

6/4 = 1/(1+(1/e))
e = -3 – demand is elastic

Pricing:

Perfect Price Discrimination: Also called first-degree discrimination, monopolist charges the maximum price that each consumer is willing to pay Quantity is the same as perfect competition; all surplus is producer surplus – eliminates deadweight loss.



Group Price Discrimination: Also called third-degree discrimination, this method involves splitting consumers into two or more groups depending on their demand curve and then charging different prices to the different groups.

Non-Linear Price Discrimination: Also called second-degree discrimination, this involves charging different prices based on quantity. The objective is to expand sales through a lower price only for additional sales – not reducing the price on all existing sales. Firm converts some CS and DWL into PS.

Two-Part Pricing: Charging an entry fee and then a specified price per unit. Commonly used where the market is well defined and membership benefits are present. Price is set to marginal cost and the firm extracts profit from the access fee.

Bundling: Selling multiple goods or services at a single price. Exploits willingness to pay by consumers. Can be either:

Pure bundling – items sold individually OR in a bundle;
Mixed bundling – items sold individually AND in the bundle.

If customers have negatively correlated preferences, bundling is usually preferable to individual pricing – price is set so that both consumers would buy the bundle. If preferences are positively correlated, the advantage of the bundle is eliminated.

Question: You are in charge of the Triple O's beside the Sauder building. You sell to four types of customers, each with different reserve prices.

	Burger	Fries	Bundle
A	$ 5.00	$ 1.50	$ 6.50
B	$ 4.50	$ 4.00	$ 8.50
C	$ 4.00	$ 4.50	$ 8.50
D	$ 1.50	$ 5.00	$ 6.50

Your MC is $1 per burger and $0.50 for fries. What price would you charge if you were setting individual prices? What about if you gave an option to buy a combo? What if you were only selling combos? How would profits compare?
Individual: $4 burger & $4 fries -> Profit = Rev – Cost = 3(4-1) + 3(4-0.5) = $19.50
Pure Bundle = Set price to $6.50 -> Profit = 4 * 6.50 = $20
Mixed Bundle = Set burger, fries price to $5; set bundle to $8.50 -> Profit = $22.50

Peak Load Pricing: Volume of demand is different during different time slots; firms set higher price during periods of peak demand. Frequently used when the firm has a capacity constraint.

Question: Due to COVID restrictions, Triple O's only has capacity for 72 customers. The MC per meal is $20 and inverse demand is P = 60-0.25Q. What is the optimal price? What would the optimal price be without the capacity restriction?
Without restriction, MR = MC -> 60-0.5Q = 20 -> Q=80; P=$40
Since optimal Q is above capacity, set price at capacity Q
P = 60-0.25(72) = $42

Question: What pricing strategy is likely employed in each example?

a) Costco Membership – Two-part pricing
b) International tuition – Group price discrimination
c) Haggling at a night market – Perfect price discrimination
d) BOGO deals – Non-linear price discrimination
e) McDonalds Happy Meals – Bundling
f) TransLink concession Compass card – Group price discrimination
g) Uber surge pricing – Peak load pricing

Oligopoly

Oligopolist: One of few sellers in a market with high barriers to entry. Firms do have market power and will strategically interact with each other.

There are many examples of oligopolies in real life: natural gas suppliers, Canadian telecom, banks, aircraft manufacturers, big pharma, even food companies.

Cartel: A case of an oligopoly that cooperates (colludes), unlike the standard case where oligopolies tend to be non-cooperative. Cooperating can be in the form of restricting production (OPEC), price fixing, agreeing not to bid vs each other on contracts. Cartels tend to act as a single profit maximizing monopolist.

Cournot Duopoly: Two firms compete by choosing their quantity. Applicable when products are homogeneous.

> **Question:** You are in charge of determining production for Boeing. The other oligopolist in the market is Airbus. The market demand for an airplane is $P = 280 – (Q_1 + Q_2)$ and your MC is constant at 40, in millions of dollars. What level of Q should your company produce and what will the market price be?
>
> Profit = Price * Quantity – Cost * Quantity
> $= [280 – (Q_1 + Q_2)] Q_1 – 40Q_1$
> $= 280Q_1 - Q_1^2 + Q_1Q_2 – 40Q_1$
> Once you have the profit function, take the derivative, with respect to Q_1. Set equation equal to zero because we want to find where the profit function is maximized (i.e., slope = 0).
> $0 = 280 – 2Q_1 – Q_2 – 40$
> $Q_1 = 120 – 0.5Q_2$ -> THIS IS THE BEST RESPONE CURVE
>
> Since the MC is the same for both firms, Airbus also has the same best response curve. If Airbus had a different MC, you would need to redo the steps above to find their BR function.
>
> Finally, substitute Airbus' best response into yours – now you can solve for Q_1
> $Q_1 = 120 – 0.5 (120 – 0.5Q_1)$
> $Q_1 = 120 – 60 + 0.25Q_1$
> $0.75Q_1 = 60$
> $Q_1 = 80$ – note that since response curves are symmetrical, $Q_2 = 80$
>
> Boeing should produce Q = 80; market price will be 280-160 = 120
> This is also referred to as the Nash-Cournot equilibrium

Bertrand Duopoly: Two firms compete by choosing their price. Generally, firms avoid price competition because they are unprofitable in the long run.

If products are homogenous (identical): Best response of Firm A is to slightly undercut Firm B (set price to $9.99 instead of $10.00). In response, Firm B will slightly undercut Firm A at $9.98, etc. until price is bid down to MC. The MC Is the unique Nash-Bertrand equilibrium for both firms.

If products are slightly differentiated: Solve with best response curves & calculus – yay!

> **Question:** You've quit your previous job at Boeing and now are in charge of pricing at Facebook. Both Facebook and Google are releasing a similar differentiated product. Since it's digital, the MC = 0. The demand for your product is given by the following: $Q_1 = 72 - 3P_1 + 2P_2$ (note that P_1 is your price and P_2 is Google's price).
>
> What price should you set for the digital product?

Profit = $P_1 \times Q_1 - [C_1 \times Q_1]$ – this represents costs, but in this problem there are no costs
Profit = $P_1 \times (72 - 3P_1 + 2P_2)$
Profit = $72P_1 - 3P_1^2 + 2P_1P_2$

Take derivative and set to 0
$0 = 72 - 6P_1 + 2P_2$
$6P_1 = 72 + 2P_2$
$P_1 = 12 + 1/3P_2$ – This is the best response curve

Apple's best response curve will be nearly identical, since their demand function and MC is the same
$P_2 = 12 + 1/3P_1$

Substitute Apple's BR curve into yours (Facebook's)
$P_1 = 12 + 1/3\ (12 + 1/3P_1)$
$P_1 = 12 + 4 + 1/9P_1$
$8/9\ P_1 = 16$
$P_1 = 18$ – You should charge $18 for the product
The quantity you will sell is $Q_1 = 72 - 3(18) + 2(18) = 54$
Your total revenue and your profit will be $972

Game Theory

What is Game Theory: A set of tools used to analyze decision making in situations of strategic interdependence. Basically, anytime there is strategic interaction between two or more parties. In other words, game theory is everywhere! In this course, we primarily focus on how game theory works in oligopolies.

Static Game: Each player acts once and at the same time – best of 1 rock paper scissors.

Dynamic Game: Players move sequentially or repeatedly – chess.

Dominant Strategy: The strategy that is the best regardless what the other player does.

Nash Equilibrium: Each player is doing the best the can, given the other player's strategy. This is the equilibrium because there is no incentive to deviate from the strategy.

Prisoner's Dilemma: Each party has a dominant strategy. The payoffs in the dominant strategy equilibrium are lower for both parties than the payoff in opposite diagonal.

> **Question:** The COMM 295 midterm is coming up. You are a super bright Sauder snake and realize that, because the course is scaled, if nobody studies for the exam, you will all get fine marks and save lots of time. Otherwise, if everyone studies for the exam, your marks will be the same as if you didn't study, and you will have wasted all that time that could've better been spent at the frat house. You propose in a big group chat that nobody studies – and everyone agrees with you. What will actually happen?

Other Students

You		*Study*	*Don't Study*
	Study	**-5, -5**	**5**, -10
	Don't Study	-10, **5**	0,0

Each party follows dominant strategy of studying. Equilibrium is everyone studies. In other words, your group chat (including yourself) all lied!