

Economics 101
Spring 2001
Section 4 - Hallam
Problem Set 9

Due date: April 27,2001

1. Consider a monopolist with the following demand, cost, and marginal cost functions:

$$q = D(p) = 120 - p$$
$$C(q) = 900 + 0.5q^2$$
$$MC(q) = q$$

- a. What is the inverse demand function (What is the price as a function of output)?

- b. What is revenue as a function of output? Remember that revenue is price times quantity.

- c. Show that the competitive level (where marginal cost equals price) of output (q_c) is 60 units.

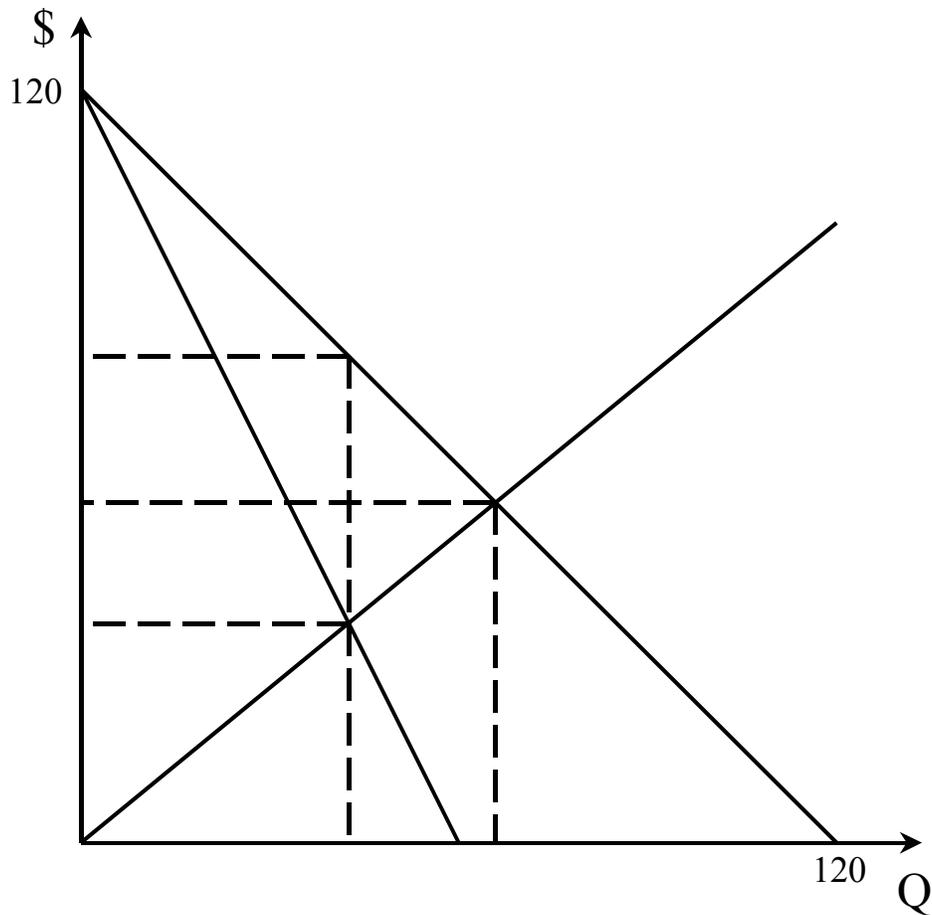
- d. What is the price p_c at this level of output?

- e. What is the firm's cost at this level of output?

- f. What is the firm's profit at this level of output?

- g. Would other firms like to enter the industry?
- h. Marginal revenue as a function of output is given by $120 - 2q$. Find the level of output q_m , that this firm will choose as a monopolist (where marginal cost equals marginal revenue).
- i. What is the price p_m at this level of output?
- j. What is marginal cost at this level of output?
- k. What is marginal revenue at this level of output?
- l. What is the firm's profit at this level of output?
- m. What is the firm's gain from monopoly (the difference between the answer to f and the answer to l)?

2. In the following graph use the answers to problem 1 to label demand (D), marginal cost (MC), marginal revenue (MR), the monopoly price (p_m), the competitive price (p_c), the competitive quantity (q_c), the monopoly quantity (q_m), marginal cost if the firm prices as a monopolist (c_m) at the equilibrium output, and marginal cost if the firm prices as a competitor (c_c) at the equilibrium output.



e. How much does each firm produce?

f. What is the profit for firm 1 and firm 2?

5. Create a graph using the answers to problem 4 and label demand (D), marginal cost (MC), marginal revenue (MR), the monopoly price (p_m), the competitive price (p_c), the competitive quantity (q_c), the monopoly quantity (q_m), marginal cost if the firm prices as a monopolist (c_m) at the equilibrium output, and marginal cost if the firm prices as a competitor (c_c) at the equilibrium output. Use graph paper.
6. Consider a firm (or industry) with the following demand, cost, and marginal cost functions:

$$q = D(p) = 11 - \frac{1}{2}p$$

$$C(q) = 6q$$

$$MC(q) = 6$$

- a. What is the inverse demand function?
- b. What is marginal revenue function for this firm if it is a uniform pricing monopolist?
- c. How much output should the uniform pricing monopolist produce?
- d. How much output would be produced if this was a competitive industry?

e. If the firm in this market were a price discriminating monopolist, how much output would it produce?

f. What would be the profits of this price discriminating monopolist if it had to sell all units of output in integer values?

7. Consider the table on the next page for this question where y is output, TR is total revenue, MR is marginal revenue, LRTC is long run total cost, LRATC is long run average total cost, LRMC is long run marginal cost, SRAC is short run average total cost, SRMC is short run marginal cost, and the number after SRAC denotes plant size. Revenue, marginal revenue and profit amounts are only valid for a price of \$252.
- a. If the price was permanently \$252, what size plant should the firm build?
 - b. If the price was permanently \$375, what size plant should the firm build?
 - c. If the price was \$307, and the firm had a size 12 plant, how much output should the firm produce in the short run?
 - d. If the price was \$428, and the firm had a size 16 plant, how much output should the firm produce in the short run?
 - e. If the price was permanently \$428, how much output should the firm produce in the long run?
 - f. Is an industry price of \$428 sustainable with freedom of entry and exit? Why or why not?
 - g. If the price was permanently \$200, how much output should the firm produce in the long run?
 - h. Is an industry price of \$200 sustainable with freedom of entry and exit? Why or why not?
 - i. What will be the long run price and marginal cost in this industry if there is free entry and exit and all firms have the same cost structure?

Long Run															
y	Price	TR	MR	LRTC	LRATC	LRMC	Profit	SRAC 4	SRMC 4	SRAC 12	SRMC 12	SRAC 16	SRMC 16	SRAC 18	SRMC 18
0.00	252	0	252	0.00			0.00								
1.00	252	252	252	281.00	281.00	263.00	-29.00	371.00	203.00	1491.00	43.00	2531.00		3171.00	
2.00	252	504	252	528.00	264.00	232.00	-24.00	284.00	192.00	764.00	32.00	1244.00		1544.00	
3.00	252	756	252	747.00	249.00	207.00	9.00	252.33	187.00	519.00	27.00	812.33		999.00	
4.00	252	1008	252	944.00	236.00	188.00	64.00	236.00	188.00	396.00	28.00	596.00		726.00	
5.00	252	1260	252	1125.00	225.00	175.00	135.00	227.00	195.00	323.00	35.00	467.00		563.00	
6.00	252	1512	252	1296.00	216.00	168.00	216.00	222.67	208.00	276.00	48.00	382.67		456.00	
7.00	252	1764	252	1463.00	209.00	167.00	301.00	221.86	227.00	244.71	67.00	324.71		381.86	
8.00	252	2016	252	1632.00	204.00	172.00	384.00	224	252.00	224.00	92.00	284.00	12.00	329.00	
9.00	252	2268	252	1809.00	201.00	183.00	459.00	228.78	283.00	211.00	123.00	255.44	43.00	291.00	3.00
10.00	252	2520	252	2000.00	200.00	200.00	520.00	236.00	320.00	204.00	160.00	236.00	80.00	264.00	40.00
11.00	252	2772	252	2211.00	201.00	223.00	561.00	245.55	363.00	201.91	203.00	223.73	123.00	245.55	83.00
12.00	252	3024	252	2448.00	204.00	252.00	576.00	257.33	412.00	204.00	252.00	217.33	172.00	234.00	132.00
13.00	252	3276	252	2717.00	209.00	287.00	559.00	271.31	467.00	209.77	307.00	215.92	227.00	228.23	187.00
14.00	252	3528	252	3024.00	216.00	328.00	504.00	287.43	528.00	218.86	368.00	218.86	288.00	227.43	248.00
15.00	252	3780	252	3375.00	225.00	375.00	405.00	305.67	595.00	231.00	435.00	225.67	355.00	231.00	315.00
16.00	252	4032	252	3776.00	236.00	428.00	256.00	326.00	668.00	246.00	508.00	236.00	428.00	238.50	388.00
17.00	252	4284	252	4233.00	249.00	487.00	51.00	348.41	747.00	263.71	587.00	249.59	507.00	249.59	467.00
18.00	252	4536	252	4752.00	264.00	552.00	-216.00	372.89	832.00	284.00	672.00	266.22	592.00	264.00	552.00
19.00	252	4788	252	5339.00	281.00	623.00	-551.00	399.42	923.00	306.79	763.00	285.74	683.00	281.53	643.00
20.00	252	5040	252	6000.00	300.00	700.00	-960.00	428.00	1020.00	332.00	860.00	308.00	780.00	302.00	740.00
22.00	252	5544	252	7568.00	344.00	872.00	-2024.00	491.27	1232.00	389.45	1072.00	360.36	992.00	351.27	952.00
23.00	252	5796	252	8487.00	369.00	967.00	-2691.00	525.96	1347.00	421.61	1187.00	390.30	1107.00	379.87	1067.00
25.00	252	6300	252	10625.00	425.00	1175.00	-4325.00	601.40	1595.00	492.60	1435.00	457.40	1355.00	444.60	1315.00
26.00	252	6552	252	11856.00	456.00	1288.00	-5304.00	642.15	1728.00	531.38	1568.00	494.46	1488.00	480.62	1448.00
28.00	252	7056	252	14672.00	524.00	1532.00	-7616.00	729.71	2012.00	615.43	1852.00	575.43	1772.00	559.71	1732.00
30.00	252	7560	252	18000.00	600.00	1800.00	-10440.00	825.33	2320.00	708.00	2160.00	665.33	2080.00	648.00	2040.00

8. Consider the table on the next page for this question where y is output, TR is total revenue, MR is marginal revenue, LRTC is long run total cost, LRATC is long run average total cost, LRMC is long run marginal cost, SRAC is short run average total cost, SRMC is short run marginal cost, and the number after SRAC denotes plant size. Revenue, marginal revenue and profit amounts are only valid for a price of \$332.
- a. If the price was permanently \$332, what size plant should the firm build?
 - b. If the price was \$332, and the firm had a size 6 plant, how much output should the firm produce in the short run?
 - c. If the price was permanently \$266, what size plant should the firm build?
 - d. If the price was permanently \$500, what size plant should the firm build?
 - e. If the price is \$246 and the current plant is size 14, how much output should the firm produce?
 - f. If the price was \$716, and the firm had a size 18 plant, how much output should the firm produce in the short run?
 - g. If the price was permanently \$716, how much output should the firm produce in the long run?
 - h. If the price was permanently \$212, how much output should the firm produce in the long run?
 - i. Is an industry price of \$212 sustainable with freedom of entry and exit? Why or why not?
 - j. What will be the long run price and marginal cost in this industry if there is free entry and exit and all firms have the same cost structure?

y	Price	TR	MR	LRTC	LRATC	LRMC	Long Run		6	6	10	10	14	14	18	18
							Profit	SRAC 6								
0	332	0	332	0.00			0.00									
1	332	332	332	454.00	454.00	410.00	-122.00	704.00	310.00	1264.00	230.00	2144.00		3344.00		
2	332	664	332	824.00	412.00	332.00	-160.00	492.00	252.00	732.00	172.00	1132.00		1692.00		
3	332	996	332	1122.00	374.00	266.00	-126.00	404.00	206.00	537.33	126.00	777.33		1124.00		
4	332	1328	332	1360.00	340.00	212.00	-32.00	350.00	172.00	430.00	92.00	590.00		830.00		
5	332	1660	332	1550.00	310.00	170.00	110.00	312.00	150.00	360.00	70.00	472.00		648.00		
6	332	1992	332	1704.00	284.00	140.00	288.00	284.00	140.00	310.67	60.00	390.67		524.00		
7	332	2324	332	1834.00	262.00	122.00	490.00	263.43	142.00	274.86	62.00	332.00		434.86		
8	332	2656	332	1952.00	244.00	116.00	704.00	249	156.00	249.00	76.00	289.00		369.00		
9	332	2988	332	2070.00	230.00	122.00	918.00	240.00	182.00	231.11	102.00	257.78	22.00	320.00		
10	332	3320	332	2200.00	220.00	140.00	1120.00	236.00	220.00	220.00	140.00	236.00	60.00	284.00		
11	332	3652	332	2354.00	214.00	170.00	1298.00	236.73	270.00	214.91	190.00	222.18	110.00	258.55	30.00	
12	332	3984	332	2544.00	212.00	212.00	1440.00	242.00	332.00	215.33	252.00	215.33	172.00	242.00	92.00	
13	332	4316	332	2782.00	214.00	266.00	1534.00	251.69	406.00	220.92	326.00	214.77	246.00	233.23	166.00	
14	332	4648	332	3080.00	220.00	332.00	1568.00	265.71	492.00	231.43	412.00	220.00	332.00	231.43	252.00	
15	332	4980	332	3450.00	230.00	410.00	1530.00	284.00	590.00	246.67	510.00	230.67	430.00	236.00	350.00	
16	332	5312	332	3904.00	244.00	500.00	1408.00	306.50	700.00	266.50	620.00	246.50	540.00	246.50	460.00	
17	332	5644	332	4454.00	262.00	602.00	1190.00	333.18	822.00	290.82	742.00	267.29	662.00	262.59	582.00	
18	332	5976	332	5112.00	284.00	716.00	864.00	364.00	956.00	319.56	876.00	292.89	796.00	284.00	716.00	
19	332	6308	332	5890.00	310.00	842.00	418.00	398.95	1102.00	352.63	1022.00	323.16	942.00	310.53	862.00	
20	332	6640	332	6800.00	340.00	980.00	-160.00	438.00	1260.00	390.00	1180.00	358.00	1100.00	342.00	1020.00	
22	332	7304	332	9064.00	412.00	1292.00	-1760.00	528.36	1612.00	477.45	1532.00	441.09	1452.00	419.27	1372.00	
23	332	7636	332	10442.00	454.00	1466.00	-2806.00	579.65	1806.00	527.48	1726.00	489.22	1646.00	464.87	1566.00	
25	332	8300	332	13750.00	550.00	1850.00	-5450.00	694.40	2230.00	640.00	2150.00	598.40	2070.00	569.60	1990.00	
26	332	8632	332	15704.00	604.00	2060.00	-7072.00	757.85	2460.00	702.46	2380.00	659.38	2300.00	628.62	2220.00	
28	332	9296	332	20272.00	724.00	2516.00	-10976.00	896.86	2956.00	839.71	2876.00	794.00	2796.00	759.71	2716.00	
30	332	9960	332	25800.00	860.00	3020.00	-15840.00	1052.00	3500.00	993.33	3420.00	945.33	3340.00	908.00	3260.00	

9. Consider an industry with two firms each producing output q_i . The industry demand function is given by

$$Q = 6 - \frac{1}{20}p$$

The two firms in the industry produce with constant average and marginal costs. Costs per unit for the first firm are \$20.00 while costs per unit for the second firm are \$40.00.

- a. What is the industry inverse demand function?
- b. We can assume that $q_1 + q_2 = Q$. Write the inverse demand function so that it depends on both q_1 and q_2 .
- c. Consider now the first firm. Given that it makes a conjecture about the output of the second firm, it will take the quantity produced by the second firm as a constant. Explain why conjectural marginal revenue for the first firm is given by

$$MR_1(q_1, q_2) = [120 - 20q_2] - 40q_1$$

- d. The first firm will maximize conjectural profit by setting marginal revenue equal to marginal cost. Find the best response function for the first firm. This will give the optimal level of q_1 given the conjectured level of q_2 . (Hint: The answer is $q_1 = 2.5 - \frac{1}{2}q_2$.)
- e. What is conjectural marginal revenue for the second firm?

f. The second firm will maximize conjectural profit by setting marginal revenue equal to marginal cost. Find the best response function for the second firm. This will give the optimal level of q_2 given the conjectured level of q_1 . (Hint: The answer is $q_2 = 2 - \frac{1}{2}q_1$.)

g. A Nash equilibrium in this market occurs when the pair of quantities (q_1, q_2) satisfies the best response functions for both firms. Using the best response functions obtained in parts d and f, what are the Nash equilibrium levels of q_1 and q_2 . (Hint: The answers are $q_1 = 2$ and $q_2 = 1$).

h. What is the market price that prevails in this market? (Hint: The answer is $p = 60$.)

i. What are the profits of each of the firms?

10. Two fellow criminals are caught by police and interrogated in separate rooms. Each has two choices: collaborate with the police to get a good plea bargain, or stay mum and remain loyal to his friend. Thus, each has the strategy set: {collaborate with police, stay mum} . If both stay mum, then they will each be convicted of a minor offense, and will each stay in jail for a year. If one refuses to collaborate, but the other does collaborate, then the collaborator will get off with probation, but the other will go to jail for 10 years. If both collaborate, then each will get 4 years. We can express this game as follows:

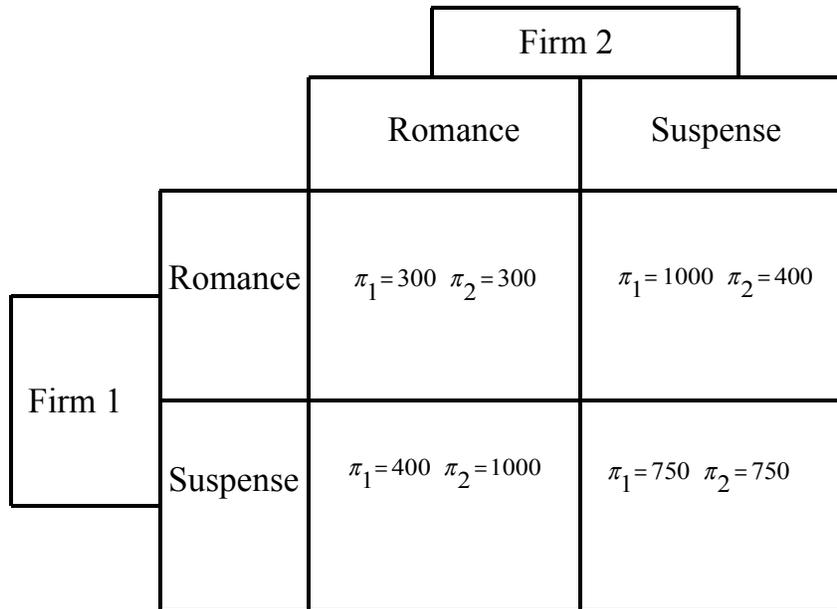
		Criminal 2	
		Collaborate	Stay Mum
Criminal 1	Collaborate	-4, -4	0, -10
	Stay Mum	-10, 0	-1, -1

- a. Which strategy is always best for the first criminal?
- b. Why is it best (dominant)?
- c. Which strategy is always best for the second criminal?
- d. Why is it best (dominant)?
- e. What is the equilibrium of this game? (What are the strategies chosen?)
- f. What are the equilibrium payoffs to each individual?
- g. There is another strategy combination that makes both players better off. Which is it?
- h. Explain why that combination won't happen?

11. Firm 1 and Firm 2 are movie producers. Each has the option of producing a blockbuster romance or a blockbuster suspense film. The payoff matrix displaying the payoffs for each of the four possible strategy combinations (in thousands of dollars) is shown in the following table. Each firm must make its choice without knowing the choice of its rival.

		Firm 2			
		Romance		Suspense	
Firm 1	Romance	$\Pi_1 = 300$	$\Pi_2 = 300$	$\Pi_1 = 1000$	$\Pi_2 = 400$
	Suspense	$\Pi_1 = 400$	$\Pi_2 = 1,000$	$\Pi_1 = 750$	$\Pi_2 = 750$

Identify the Nash equilibrium or equilibria for this problem. Explain your answer. The diagram below will be useful.



12. Use a series of two to three diagrams (your choice) to show how and why a long run industry supply curve can be upward sloping. Explain each curve you draw carefully. Explain why the supply curve may be upward sloping.
13. Use a series of two to three diagrams (your choice) to show how and why a long run industry supply curve can be downward sloping. Explain each curve you draw carefully. Explain why the supply curve may be downward sloping.
14. Work question 3 from Skills and Tools in Chapter 9.
15. Work question 4 from Skills and Tools in Chapter 9.
16. Work question 5 from Skills and Tools in Chapter 9.
17. Work question 6 from Skills and Tools in Chapter 9.
18. Work question 3 from Skills and Tools in Chapter 10.
19. Work question 4 from Skills and Tools in Chapter 10.