ENG110   Midterm Exam-SOLUTIONS   Spring 2014   Meliha Bulu-Taciroglu

Numeric Problems:

1. (10 points) You have the following total cost function for a firm operating in a <u>monopolistically competitive</u> market :

TC = 980 + 5Q^2 + 30Q

Firm faces the following demand for its product:

P = -4Q+210

    a) What is the profit maximizing level of output?

Under Monopolistic Competition profit is maximized when MC=MR.
MC = 10Q+30
MR = -8Q+210
Q*=10

    b) What is the price? What is the profit?

P*=-4(10)+210 = 170
Π = TR-TC = 170x10-980-5x100-30x10 = -80

    c) If the firm advertises, the <u>new demand</u> will be P=-4Q+300. How much would the firm be willing to pay for this advertisement service if any?

With the advertisement, firm can produce Q*=15, (10Q+30=-8Q+300), and charge, P*=-4(15)+300=240. The new profit would be;
Π = TR-TC = 240x15-980-5x225-30x15 = 1,045
Then, the firm is ready to pay at most 1045+80=1,125 in the short run and at most 1,045 in the long run. (either 1,125 or 1,045 gets full points).

    2. (10 points) You bought a car today for $30,000. You are given two options to pay for this car:

    I.   Pay nothing now. Make 60 constant monthly payments at APR 12% <u>compounded monthly</u> beginning from a month from today.

    II.   Pay nothing now. Make 60 constant monthly payments at APR 11.8% <u>compounded weekly</u> (assume there are four weeks in a month).

    Which option would you prefer and why?

There are many ways to solve this problem, the most obvious being to compare the effective interest rates that are charged per month:

For OPTION I monthly rate is 1%, whereas, for OPTION II, it is (1+11.8%/4)^4-1=0.987%

Then, you would prefer, option II.

3. (12 points) You got a loan for $5,000 today at APR 10%. You will pay it in 5 installments in the coming 5 years. The first payment is due exactly a year from today. Each payment is <u>half as much as the previous payment</u>. If at the end of your fifth payment your balance is $0 (you paid the principal as well as all the accumulated interest), how much was your first payment?

The total present value of the payments you make is $5,000. Let's denote the first payment you make by x,

$5,000=x/1.1 + (x/2)/(1.1)^2 + (x/4)/(1.1)^3 + (x/8)/(1.1)^4 + (x/16)/(1.1)^5$

x=$3,059.36

4. (10 points) Assume that market APR is 10%. Total Cost (TC) of a producer operating in a <u>perfectly competitive</u> environment is given by the following equation:

$TC = 30,000 + 5Q + Q^2/100$

Your production/sales schedule is as follows. All of your costs are due at the first day of production. You can sell everything you produce at the market price of $110 and collect the money in a year's time.

a) (3 points) How many units would you produce?

This question demands taking into account the time value of money. The cost is paid now but the revenue is obtained in a year's time. Then, to be able to make a sensible profit maximization, either we need to calculate how much the cost would be in a year's time OR how much the present value of the revenue is now.

The present value of the revenue that would be obtained from a unit is the present value of the price: 110/1.1=$100

MC=MR, 5+Q/50=100, Q=4,750

If the solution does not take the time value of money into account and solves for 5+Q/50=110, then take off half the points.

b) (3 points) What is the present value of your profit at the first day of production?

$\Pi = TR\text{-}TC = 100x4,750\text{-}30,000\text{-}5x4,750\text{-}4,750^2/100 = $195,625$

c) (4 points) A customer offers you to pay $x per unit at the first day of production, if you reserve all of your production for him. What is the lowest $x you would accept?

$100.

5. (12 points) You started a company five years ago by taking a loan of $100,000. The APR on the loan is 12%. You agreed to make fixed payments every month for 10 years. Today, your 60th payment is due and you decided to make a double payment. (You paid twice what you were paying each month). You will continue to make single payments to pay the rest of the loan. By how many months your loan term shortened? (According to the contract you signed with the bank, you can make double payments, your APR stays the same, your fixed monthly payments do not change, therefore, your loan term shortens.)

Monthly payments: A=100,000 (A/P,1%,120) = 100,000 x 0.0143 = $1,430. (Due to rounding in the tables, the result maybe different if they calculated the value by directly applying the uniform series annuity formula)

Present Value of the Remainder of the debt right after you make your double payment is:

$P_{remainder}$ *= 1,430(P/A,1%,60)-1,430 = 1,430x44.955-1,430= $62,855.65*

Now the question becomes: How many months does it take to pay $62,855.65, by paying $1,430 per month at 12% APR?

Table will not be helpful here, we need to apply the formula directly:

$$P = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right] = A(P/A, i, n)$$

$62,855.65=1,430[(1.01)^n-1/0.01(1.01)^n]$

$1.01^n=1.7843,$ n=58.19

That is, loan period shortens for about two months.

Discussion/Short Answer Questions (4 points each):

1. The diagram below represents a monopolistically competitive firm's cost structure as well as its marginal revenue (MR).

You know that at the optimal level of production, this firm is making a loss such that it makes sense to produce in the short run but not in the long run. Given this information, where should the demand be located on the following graph? (Draw the demand on the following graph.)
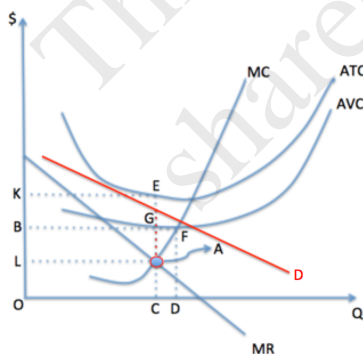
                              The red line is the DEMAND. It has to be downward sloping and passing through between E and G.

2. Suppose that there are two firms, A and B, each introducing a new product to the market. They will simultaneously decide on whether to charge a high(H), medium(M), or low(L) price for this new product, without knowing what the other will charge. The information summarized in the following table is common knowledge:

		Firm B		
		H	M	L
Firm A	H	16, 40	40, 28	36,20
	M	18, 10	38, 50	20,20
	L	10,10	10,30	38,60

For example, if A charges a high price and B charges a medium price , A gets 40 and B gets 28.

Given the above payoffs, under which outcome none of the firms has any incentive to deviate?

(L,L) where both firms charge a low price is the outcome with no incentives to deviate.

3. Do you agree with the following statement? Why or why not? Explain in a few sentences:

"For any product, firms operating in a perfectly competitive environment produce the best price and quality combination for consumers."

NO, as discussed extensively in class there are two basic reasons why a monopoly may be preferred over perfect competition: 1. Some products require a high fixed cost which prevents a small firm from reaching a low point of ATC. 2. Perfect competition drives down the economic profit of each firm which makes it hard for them to venture into new areas, investigate risky innovations and invest money on R&D. Monopoly maybe in a better position to take risks (case in point: Google venturing into different areas, driverless cars etc.)

4. Market APR is 12%. We are trying to decide on building a runway in an airport. We have two options:

Option I has a $5 million initial cost, a $20,000 annual cost and lasts (wears out in) 6 years.

Option II has an $8 million initial cost, a $12,000 annual cost and lasts 10 years.

If the runway will be replaced whenever it wears out, which option should we pick?

We have two ways to go about solving this problem:

1. *Find the common multiples (30 years) and evaluate each project for a 30 year period, calculate the NPV for each and compare them:*
   $NPV_I = \$5M + \$20K\ (P/A, 12\%, 6) + \$5M + \$20K\ (P/A, 12\%, 6)(1/(1.12)^6) + \$5M + \$20K\ (P/A, 12\%, 6)(1/(1.12)^{12}) + \$5M + \$20K\ (P/A, 12\%, 6)(1/(1.12)^{18}) + \$5M + \$20K\ (P/A, 12\%, 6)(1/(1.12)^{24})$

$NPV_{II} = \$8M + \$12K (P/A, 12\%, 10) + \$8M + \$12K (P/A, 12\%, 10) (1/(1.12)^{10}) + \$8M + \$12K$
$(P/A, 12\%, 10) (1/(1.12)^{20})$

2. *Find the Equivalent Uniform Annual Cost (EUAC) of each option and pick the lower one.*

$EUAC_I = 20{,}000 + 5M (A/P, 12\%, 6) = \$1{,}236{,}000$
$EUAC_{II} = 12{,}000 + 8M (A/P, 12\%, 10) = \$1{,}428{,}000$
Pick the first option.

Multiple Choice Questions (3 points each):

1. Your company is using a plant of size 10,000 sq. ft. that was constructed in 2006 for $300,000. The cost indices that correspond to this size of a plant for 2006 and 2014 are 145 and 184 respectively. If the power-sizing exponent is 0.55, how much would it cost to build a 40,000 sq. ft. warehouse in 2014?

   A. $816,026
   B. $920,000
   C. $643,064
   D. $380,690
   E. $422,026

2. The most distinguishing feature of Monopolistic Competition is

   A. The number of firms in the industry
   B. The ease of entry into the industry
   C. Differentiated products
   D. Control over the price
   E. A steep demand curve

3. A Monopoly:

   A. does not have control over the price
   B. engages in activities to keep the competitors out
   C. produces a homogenous product as the rest of the industry
   D. may not hold any patents
   E. cannot legally exist

4. Which of the following is NOT correct about a pure public good?
   A pure public good:
   A. is non-rival
   B. is non-exclusive
   C. creates positive externalities
   D. can be used by free riders
   E. gets to be produced by free market without intervention from the government.

5. Which of the following is least likely to be a reason for firms to get bigger (remember the class discussion on "corporate giants"):

A. managers want to control bigger firms
B. economies of scale
C. firms want to make use of state funds
D. eliminate competition and increase revenue
E. to balance the average variable and average fixed cost

6. Which of the following is <u>NOT</u> a reason for imposing a positive tax?

   A. Collecting revenue for the government
   B. Creating disincentives for un-favored activity
   C. Correcting market failure caused by positive externalities
   D. Correcting market failure caused by negative externalities
   E. Collecting funds for the provision of public goods

7. Price Discrimination:

   A. is done to capture more of the consumer surplus
   B. is a way of decreasing the fixed cost
   C. is a way of increasing the consumer's willingness to pay
   D. is the difference between consumer's willingness to pay and the average total cost
   E. makes the demand less price sensitive

8. Which of the following is <u>NOT</u> an activity that allows a firm to become and/or stay as a monopoly

   A. buying up a key resource
   B. holding a patent
   C. acquiring competitors
   D. money burning
   E. having a price sensitive demand curve

9. Determine the labor cost of the $10,000^{th}$ item if the first item requires 3 hours to produce, the learning curve percentage is 80%, and labor cost per hour is $20.

   A. $1.12
   B. $2.42
   C. $42.8
   D. $3.09
   E. $30.09

10. Which of the following is <u>NOT</u> correct concerning short run/long run?

   A. A perfectly competitive firm earns zero economic profit in the long run.
   B. A monopolistically competitive firm may earn positive economic profit in the short run.

C. A firm can change its scale in the long run.

D. The duration of short run does not change from business to business.

E. The portion of the total cost that does not depend on quantity cannot be changed in the short run.

I. Cost Structure and Estimation: $TC = TVC + TFC$, $ATC = TC/Q$, $MC = \Delta TC / \Delta Q$

$$\frac{Cost_A}{Cost_B} = \frac{Index_A}{Index_B} \qquad Cost_A = Cost_B \left(\frac{Size_A}{Size_B} \right)^x$$

$T_N = T_{initial} \times N^b$, **where** $b = \log(\text{learning curve rate})/\log 2$

II. Single Payment:

$$F = P(1+i)^n \qquad F = P(F/P, i, n) \qquad P = F(1+i)^{-n} \qquad P = F(P/F, i, n)$$

III. Effective Rate: $i_a = (1 + \frac{r}{m})^m - 1$

IV. Uniform Series:

$$F = A \left[\frac{(1+i)^n - 1}{i} \right] = A(F/A, i, n) \qquad A = F \left[\frac{i}{(1+i)^n - 1} \right] = A(A/F, i, n)$$

$$A = P \left[\frac{i(1+i)^n}{(1+i)^n - 1} \right] = P(A/P, i, n) \qquad P = A \left[\frac{(1+i)^n - 1}{i(1+i)^n} \right] = A(P/A, i, n)$$

Arithmetic Gradient Present Worth Factor:

$$P = G \left[\frac{(1+i)^n - i \cdot n - 1}{i^2 (1+i)^n} \right] = G(P/G, i, n)$$

Arithmetic Gradient Uniform Series Factor

$$A = G \left[\frac{(1+i)^n - i \cdot n - 1}{i(1+i)^n - i} \right]$$
$$= G \left[\frac{1}{i} - \frac{n}{(1+i)^n - 1} \right] = G(A/G, i, n)$$

Geometric Gradient Present Worth Factor:

$$P = A_1 \left[\frac{1 - (1+g)^n (1+i)^{-n}}{i - g} \right] \quad \text{where} \quad i \neq g \qquad\qquad P = \frac{n \cdot A_1}{(1+i)} \quad \text{where} \quad i = g$$

Capitalized Cost: $A = Pi$