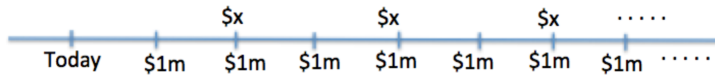


**Numeric Problems:**

1. (8 points) The city of San Francisco spends \$1million every year repainting the golden gate bridge. You have developed a paint that lasts twice as long. If the city were to switch to your new type of paint, how much would the city be willing to spend for each repainting? Assume the city uses a discount rate of  $i=4\%$ .



*Explanation:* This is a case of capital investment with unequal lives, with an unlimited usage time (project will run forever for all practical purposes). Per unit benefits are the same but costs are different. (Once the bridge is painted, there is no difference in the appearance, quality etc.) but the costs are different.

*Solution:*

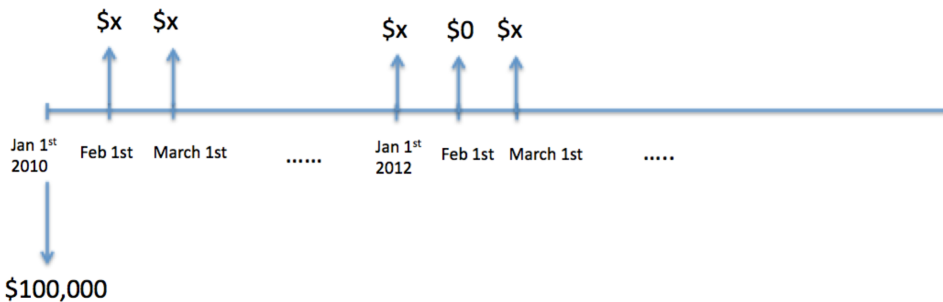
$$\$x = \$1 + \$1/(1.04) = \$1.96$$

*Further explanation:*

*Note that the following equation is not correct!*

$$\$x/(1.04)^2 = \$1/(1.04) + \$1/(1.04)^2 = \$2.04$$

2. (12 points) Mr. Anderson started a business and got a loan to pay his fixed costs for \$100,000 at APR 12% with monthly compounding on January 1<sup>st</sup> 2010. He agreed to make fixed payments of amount \$x each month beginning February 1<sup>st</sup> 2010 for a total of 60 months. With this plan, his loan will be paid completely at the end of 60 months.



Unfortunately, Mr. Anderson misses his 25<sup>th</sup> payment (Feb 1<sup>st</sup> 2012) but resumes his regular payments the following month. For how many months his loan period lengthens?

*Explanation:* First we need to find the monthly payment that would pay off the loan in 60 months. Monthly payments constitute a uniform series with a \$100,000 present value. When a payment is missed, the accumulated interest will be higher than it would have been. Hence additional monthly payments will be required. For how many more additional months? We can find the remaining balance as of January 1<sup>st</sup>, 2012, and then carry it one month further which will give us the remaining balance at the time of the

missed payment. Let's call this  $R$ . Then, the same monthly payments (uniform series) will be made with a present value of  $R$  for an unknown period,  $n$ .

Solution:

$$PV = \$100,000.$$

$$x = \$100,000[A/P, 1\%, 60] = \$100,000 * 0.0222 = \$2,220$$

Remaining balance on Jan 1<sup>st</sup> 2012:

$$100,000(1.01)^{24} - 2,220(F/A, 1\%, 24) = \$67,093$$

Remaining balance on Feb 1<sup>st</sup> 2012:

$$67,093 * (1.01) = \$67,764$$

$$67,764 = 2,220 (P/A, 1\%, n)$$

$$n = 36.6$$

Therefore, the loan lengthens by 1.6 months!

3. (12 points) You are considering getting a car for your business. You are planning on using the car for 8 years. You have two options: Hybrid version and non-hybrid version. The following table indicates the associated costs:

	Non-hybrid Car	Hybrid Car
Initial Cost	\$19,200	\$25,500
Initial Annual Maintenance (Increases by \$100 each year)	\$1,000	\$1,500
Initial Annual Gas and Oil (Increases 3% yearly)	\$2,500	\$1,200
Salvage Value (at year 8)	\$8,000	\$10,000

You will pay the initial cost today. Maintenance, gas, and oil costs will be paid a year from today and each year thereafter, a total of 8 times.

Which car should you pick if APR is 5%.

Explanation: This is a limited-usage, equal-lives factor of production choice problem. Hence we can calculate the NPV of each option and pick the one with the higher NPV.

Solution:

Non-hybrid:

$$NPV_{non-hybrid} = -19,200 - 1,000(P/A, 5\%, 8) - 100(P/G, 5\%, 8) - 2,500[(1 - (1.03)^8)(1.05)^{-8}]/(0.05 - 0.03) + 8,000/(1.05)^8$$

$$NPV_{non-hybrid} = -19,200 - 1,000 * 6.463 - 100 * 20.970 - 2,500 * 7.13 + 5,414.71 = -40,170.29$$

Hybrid:

$$NPV_{\text{hybrid}} = -25,500 - 1,500(P/A, 5\%, 8) - 100(P/G, 5\%, 8) + 1,200[(1 - (1.03)^8)(1.05)^8] / (0.05 - 0.03) + 10,000 / (1.05)^8$$

$$NPV_{\text{hybrid}} = -25,500 - 1,500 * 6.463 - 100 * 20.970 - 1,200 * 7.13 + 6,765.39 = -39,082.11$$

Choose Hybrid.

4. (10 points, equally divided) A monopoly has the following demand, marginal revenue and marginal cost:

$$\text{Demand: } P = (-Q/500) + 30$$

$$\text{MR: } (-Q/250) + 30$$

$$\text{MC: } (Q/500) + 10$$

a) What is the profit maximizing level of production? What is the monopoly price at this production level?

Explanation: Profit is maximized at the quantity where  $MC=MR$ . Price is found by solving the demand equation at this quantity.

Solution:

$$(-Q/250) + 30 = (Q/500) + 10, Q = 333.33$$

$$P = (-3,333.33/500) + 30, P = \$23.33$$

b) If this product was provided by a perfectly competitive market where the industry demand was the same as the monopoly demand and the total (horizontal summation) of each firm's marginal cost curve was the same as the monopoly's marginal cost, what would be the industry production level and the price?

Explanation: In a perfectly competitive environment, each firm accepts the market determined price as given. In the market, the total supply is determined by the addition of each firm's supply curve which is the same as each firm's MC curve above ATC. Hence, the market equilibrium price and quantity is determined by the intersection of demand and supply curves. (Note that the price under perfect competition is lower than the price under monopoly.)

Solution:

$$(-Q/500) + 30 = (Q/500) + 10$$

$$Q = 5,000$$

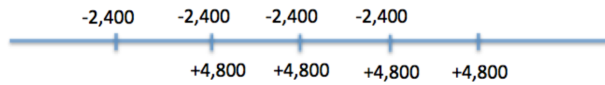
$$P = 20$$

5. (8 points) You are a small business owner and planning on producing 1,200 units per year for the coming 4 years. Per unit cost is \$2 and per unit price is \$4 and expected to stay the same over the coming 4 years. You will pay the total cost for each year at the beginning of the year and obtain the total revenue for each year at the end of the year.

It is the beginning of year 1 now. What is the maximum profit you can get at the end of 4<sup>th</sup> year if your borrowing rate is 10% annually and your lending rate (the rate at which you can invest) is 8% annually?

Explanation: Since the borrowing rate is higher than the rate at which you can invest, you would prefer to pay your debt as soon as you can to obtain the maximum profit at the end of four years.

Solution:



End of year 1 (beginning of year 2):

Debt:  $-2,400(1.1) - 2,400 = -5,040$

Revenue: 4,800

Net: -240

End of year 2:

Debt:  $-240(1.1) - 2,400 = -2,664$

Revenue: 4,800

Net: +2,136

End of year 3:

Debt: -2,400

Revenue:  $2,136(1.08) + 4,800 = +7,106.9$

Net: +4,706.9

End of year 4:

Debt: 0

Revenue:  $4,706.9(1.08) + 4,800 = +9,883.4$

Net Profit: +9,883.4

### **Discussion Questions (4 points each):**

1. According to the article titled "Airports and Economies of Scale", businesses are relocating their headquarters from some of the medium sized cities, like Cincinnati, since the high fixed costs are forcing airlines to charge higher prices for flights in and out of the city.

A solution for this problem can be to introduce more competition and have the flight prices to go down, thereby preventing Cincinnati from losing business offices.

Do you agree? Is the problem lack of competition? Why or why not?

Answer:

*The high fixed costs of flying airplanes in and out of Cincinnati combined with the size of the city, which, in turn, determines the demand for these flights, make this situation resemble mostly to a natural monopoly.*

*Then, the problem is not “not having enough competition”. The city does not have a market to support a profitable airline operation. Hence, introducing more competition is not a solution as long as the fixed costs are relatively the same for all airlines.*

2. Starbucks has recently reduced the price of its bags of coffee sold in grocery stores. What was the reason for this reduction? (Remember that at the same time, Starbucks is raising its regular in-store coffee prices) What type of strategic interaction is at play?

Answer: *This is a typical case of market segmentation and price discrimination. At the high-end, Starbucks is charging a high price to capture as much of the consumer surplus as it can. At the low-end, Starbucks is charging a lower price.*

*Also, at the low-end market, a strategic interaction is at play. In the long-run, Starbucks wants to have a high market share. To achieve this, it is undercutting the competition price. The economies of scale is allowing Starbucks to afford this kind of price cut even if it means a loss in the short run. Due to its huge warehouses, Starbucks can buy coffee at bulk when beans are cheap and hedge against coffee bean price fluctuations.*

3. Comcast, the largest cable operator in US, shows the properties of a natural monopoly by having very high fixed costs and very low marginal costs. Its pricing practice of charging an introductory low price only to increase it later is criticized. Many suggest that, government should step in and have Comcast charge a low flat price to everyone that would make the company cover its costs and make a small/reasonable profit.

How would the consumer suffer from imposing such a policy?

Answer: *Every firm in every industry is in operation to create value and make money. Comcast is no different. If Comcast is forced into charging a fixed low price by the government, determined by letting Comcast make a “small, reasonable profit”, the company will have no incentive in improving its services, making innovation etc. Because, Comcast will know that the moment it innovates and reduces costs, it will not rip off benefits due to government intervention. Hence the consumer will suffer in the form of poor service, and an outdated product.*

*Note: If the price cut comes from the pressure of competition rather than the government, the implications for consumer would be different. Comcast would have an incentive to innovate and better its services. Doing so would allow Comcast to collect the benefits.*

4. Like any other company, Staples Inc. is trying to differentiate the customers who have high willingness to pay versus those who don't. Using the zip codes of customers who shop on staples.com as signals for different willingness to pay, the same commodity sold at a different price to different customers.

What profile of a customer gets to be charged a higher price and what is the reasoning behind it?

*Answer: In this particular case of "online price discrimination" Staples is charging a higher price to those customers who reside in an area where there is no nearby competing store, Office Depot etc. and it is charging a lower price to those zipcodes where competing stores exist.*

*Ironically, the rural areas, where median consumer income is lower, are charged a higher price and, urban areas are charged a lower price.*

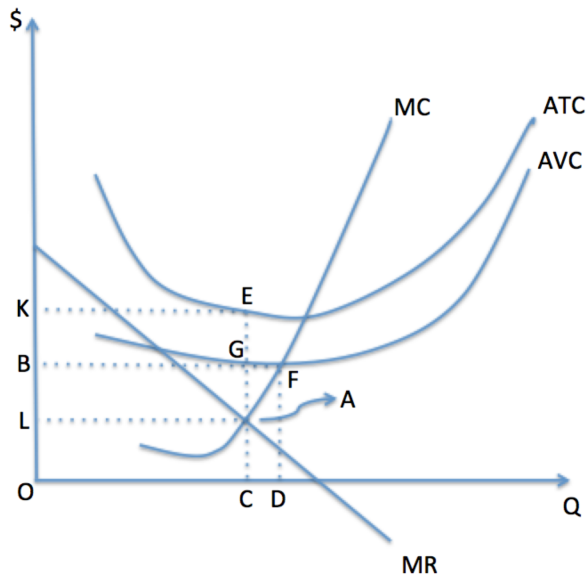
5. "There may be cases where a monopoly better serves consumers interests than a perfectly competitive market." Do you agree? Why or why not?

*Answer: It may not be always the case, but it is possible that monopoly better serves consumers than a perfect competition in two respects:*

- 1. Due to economies of scale, monopoly may be able to obtain a lower ATC (average total cost) per unit than a perfectly competitive market by running a high volume operation.*
- 2. Monopoly is likely to have accumulated funds to invest on research and development and can afford to put money on a wide variety of promising research (example: the pharmaceutical industry.)*

**Multiple Choice Questions (3 points each):**

1. Economists make a distinction between the short and the long run. The difference is that in the long run, as opposed to the short run,
  - A. all factors of production are fixed
  - B. all factors of production are variable
  - C. only constant returns to scale are possible
  - D. labor productivity is maximized
  - E. the law of diminishing returns takes effect
  
2. The demand curve for Kellogg's Raisin Bran,
  - A. would be horizontal if Kellogg was a monopoly
  - B. would be horizontal if Kellogg was operating in oligopoly
  - C. is expected to be less price sensitive than the demand curve for the entire cereal market
  - D. is expected to be more price sensitive than the demand curve for the entire cereal market
  - E. is expected to be steeper as more cereal brands are introduced into the market
  
3. Without knowing the specifics about the costs associated with airline travel, it is safe to assume that when American Airlines adds a last-minute passenger to its Chicago-San Francisco flight, all of the following is true except
  - A. average fixed cost falls
  - B. average variable cost falls
  - C. average total cost falls
  - D. marginal cost is greater than average total cost
  - E. marginal cost is less than the average variable cost
  
4. If a firm reduces its size by a half and its total costs are reduced by more than a half, then
  - A. firm is experiencing economies of scale
  - B. firm is experiencing constant returns to scale
  - C. firm is experiencing diseconomies of scale
  - D. firm is expected to go out of business
  - E. firm would be better off increasing rather than decreasing its scale
  
5. If the average variable cost and the average total cost converge but never become equal as more and more units are produced, then all of the following may be true except
  - A. marginal cost is increasing
  - B. marginal cost is constant
  - C. fixed cost is zero
  - D. average variable cost is u-shaped
  - E. average variable cost is flat (horizontal)
  
6. If the firm pictured below is a monopoly, then
  - A. total profit is given by the area ALOC
  - B. total profit is given by the area BGAL
  - C. total profit is given by the area KBGE
  - D. total profit is given by the area BFDO
  - E. none of the above



7. At the profit maximizing level of production, the firm pictured in the previous question

- A. has total cost of BGCO
- B. has total variable cost of LACO
- C. has total variable cost of KECO
- D. has total fixed cost of KEGB
- E. none of the above

8. Your company is using a plant of size 10,000 sq. ft. that was constructed 5 years ago for \$420,000. If the prices in the construction sector were increasing by 2% per year and the relevant power-sizing exponent is 0.69, how much would it cost to build a 40,000 sq. ft. warehouse today?

- A. \$463,714
- B. \$500,000
- C. 1,463,714
- D. 1,206,901
- E. 1,500,000

$$10,000 \text{ sq. ft. cost now} = 420,000 * (1.02)^5 = \$463,714$$

$$\text{Cost A} = \text{Cost B} (\text{Size A}/\text{Size B})^{(0.69)}$$

$$\text{Cost A} = 1,206,901$$

9. Determine the labor cost of the 2000<sup>th</sup> item if the first item requires 180 minutes to produce and the learning curve percentage is 92% and labor cost per hours is \$12.

- A. \$12.43
- B. \$11.12
- C. \$13.50
- D. \$14.42
- E. \$17.70

$$T_{2000} = 180 (2000^{\log(.92)/\log(2)}) = 72.14,$$

$$\text{Labor cost} = (12/60) * 72.14 = \$14.42$$



10. All of the following are correct about oligopoly and monopolistic competition except
- A. market entry is possible for each
  - B. there is more than one firm in each
  - C. product is differentiated
  - D. there is strategic interaction among firms
  - E. advertising may increase market share

**Bonus (2 points):**

Tobacco usage creates negative externalities as second-hand smoking costs. Hence, the production costs do not include all of what the society gives up.

On April 22, UCLA became the first UC campus to go tobacco-free. This is an example of solving the externality problem by market methods. Do you agree?

*Answer: No. By banning something we do not let the people who demand clean air and supply clean air (by refraining from smoking) get together and determine an optimal production level.*