

Practice Problems for Quiz #2

Questions 1 & 2 are based on the following policy scenario:

A number of proposals have been made to institute a “fuel-stamp” program of some kind to reduce the impact of high heating oil prices on low-income homeowners who are dependent on oil for heat. You have been asked by the governor to analyze two such proposals.

Plan 1 would give each family 100 free gallons per month during the heating season.

Plan 2 would pay one-third of the cost of all heating oil purchased by eligible families and would place no limit on the amount of subsidized oil families could buy.

(Strict controls would prevent families from reselling the oil to others. Although implementation of such controls would be an additional cost of the Plans in practice, they are not a part of this homework!)

The governor wants you to do the analysis for a “typical” low-income family, which has an income of \$500 per month. Currently, that is, without any government assistance, this typical family purchases 200 gallons of oil each winter month at \$0.50 per gallon.

1. Assume that there are only two goods: fuel (F) and everything else (E), where the price of the latter (E) is exactly \$1.00.
 - a) Sketch the budget line for the typical low-income homeowner without either of the plans. Draw one indifference curve that is tangent to the budget constraint at 200 gallons of oil.
 - b) Briefly explain why this point of tangency maximizes the household's satisfaction.
 - c) On a separate diagram, reproduce the budget line from part a. and add the budget lines with Plan 1 and with Plan 2. Label each budget line.
2. After some careful analysis (not presented here), you discover that the typical low-income family would purchase exactly 300 gallons of oil under Plan 2. Given this finding, answer the following questions (on a separate page):
 - a) Redraw and label the three budget lines from question 3 part c. Show where the typical low-income family ends up under Plan 2.
 - b) Which plan costs the government more? (Hint: the budget lines for Plan 1 and Plan 2 intersect at 300 gallons of oil.)
 - c) Draw an additional indifference curve showing (approximately) where families will choose to be under Plan 1. Explain intuitively why Plan 1 will lead to a higher level of satisfaction for recipient households than Plan 2.
 - d) Explain why Plan 2 leads to a greater consumption of oil by recipient households than Plan 1.

3. The country of Pangaea currently subsidizes gasoline. Concerned over both the environmental impact and the cost of these subsidies, the government is considering eliminating the subsidy. You have been asked to analyze the effect of eliminating the subsidy on both consumers and the government's budget. To begin, consider the following facts for a typical family in Pangaea.

- With the subsidy, gasoline costs \$1.50 per gallon. The typical family purchases 100 gallons of gasoline at this price.
- The cost of gasoline without any subsidy would be \$2.50 per gallon.
- The typical family has \$750 of disposable income to spend on gasoline or other consumption goods.

- a) Using an indifference curve and budget constraint, sketch the initial condition with the subsidy. Place other consumption on the y-axis and gallons of gasoline on the x-axis. Be sure to show the endpoints of the budget constraint, as well as the levels of gasoline and other consumption chosen by this family.
- b) Reproduce your diagram from part (a). Now, consider what happens when the subsidy is removed and gasoline prices increase to \$2.50 per gallon. Add the new budget constraint to the diagram, along with a new indifference curve showing approximately how much gasoline the family will consume when prices are higher.
- c) Reproduce your answer to (b). To compensate families for higher prices, the government uses the money saved from eliminating the gasoline subsidy to lower income taxes. Suppose that the amount of extra income each family gets is just enough to return their utility to what it was when gasoline was subsidized. Add a budget constraint representing this policy to your diagram.

After taxes are reduced, will families choose to purchase 100 gallons of gasoline, as they did under the subsidy? Explain briefly.

- d) Finally, consider the effects of lowering taxes on government revenue. Compared to what they spent subsidizing gasoline, will the income tax cut cost the government more, less, or exactly the same amount? How do you know this?

4. The Philadelphia Police Department has 500 police officers to allocate between West Philadelphia and Center City. The average product, total product, and marginal product in each of these two areas is given below, where output is measured as the number of arrests made. Currently, the police department allocates 200 police officers to Center City and 300 to West Philadelphia. If police can be redeployed only in groups of 100, how, if at all, should the police department reallocate its officers to achieve the maximum number of arrests?

<i>West Philadelphia</i>				<i>Center City</i>			
# Police	AP	TP	MP	# Police	AP	TP	MP
0	0	0	--	0	0	0	--
100	40	40	40	100	45	45	45
200	40	80	40	200	40	80	35
300	40	120	40	300	35	105	25
400	40	160	40	400	30	120	15
500	40	200	40	500	25	125	5

5. Coldwell Banker is employing 10 acres of land and 50 tons of cement to produce 1,000 parking spaces. Land costs \$100 per acre and cement costs \$12 per ton. For the input quantities employed, $MP_L = 50$ and $MP_C = 4$.
- Is Coldwell Banker producing parking spaces as cheaply as possible? If so, how do you know this? If not, say what Coldwell Banker could do to improve the situation.
 - Illustrate the above scenario using a diagram with an isoquant for 1,000 parking spaces and the appropriate isocost curve.
6. Explain why a firm's costs in the long-run will always be less than or equal to its costs in the short-run.
7. A rural electricity district owns two power plants – a hydroelectric plant that can generate power at $2\text{¢}/\text{kWh}$, and a natural gas plant that can generate power at a cost of $4\text{¢}/\text{kWh}$. Currently, the district generates two-thirds of its power using the hydro plant, and the remaining one-third using the natural gas plant. As a result, the natural gas plant is only operated at one-half of its capacity, while the hydroelectric plant is used at its full capacity. The mayor of Smallville, whose town is served by these power plants, argues that the natural gas plant should be used more, rather than the hydro plant. Because of the gas plant's large size, operating the plant at full capacity would allow the fixed costs of building the natural gas plant to be spread over a larger amount of generated electricity, thus lowering prices for consumers in the district. How would you respond to the mayor's argument?

8. Smarter Kids is an international NGO that provides schooling in underserved areas of low-income countries. Depending on the location, they can either send teachers to teach in classrooms in local buildings or deliver services on-line. Smarter Kids measures the effectiveness of their services based on observed increases in the test scores of local children on standardized tests. You are given the following information on the costs and effectiveness of each type of service provision:

On-line instruction: On-line instruction is less expensive, costing just \$500 per student per year. However, on-line instruction is not as effective as services provided in person. Research shows that a year of on-line instruction raises test scores by just 5 points.

In-person instruction: Providing teachers to teach in local classrooms is more effective, as teachers are able to pay more attention to individual children. However, both the cost and effectiveness of doing so varies by location, depending on both the number of student in a classroom and the quality of the facilities available. On the next page are data on in-person services for four local communities:

Community	Cost per student per year	Test score increase
Apple Hill	\$2,000	10 points
Baskerville	\$5,000	60 points
Canterbury	\$3,000	45 points
Denali	\$6,000	50 points

Smarter Kids has sufficient funding to provide services in each of these four cities. However, they need to decide whether it is more effective to provide services in-person or on-line. Based on the data given above, in which communities should Smarter Kids provide services in-person, rather than on-line? Why?

9. To maximize profits, the firm produces at an output level at which total revenue exceeds total costs by the greatest possible amount. At the same time, profits are maximized at the output level at which marginal cost equals marginal revenue. Can you reconcile these two statements?

10. Consider the following cost data for a perfectly competitive firm:

Q	AVC	MC
6	8.5	8
7	8.571	9
8	8.75	10
9	9	11
10	9.3	12

This company also has fixed costs of \$10.

- Graph this company's average variable cost, average total cost, and marginal cost.
- For the following market prices, find the equilibrium quantity and profits. Be sure to explain how you arrived at your answers:
i) \$12, ii) \$10, iii) \$9, iv) \$8.
- What will be the long-run equilibrium price for this product? Why?

11. Suppose that the market for artificial Christmas trees is initially in a long run equilibrium.

- Draw a supply and demand curve showing the equilibrium price and quantity for artificial Christmas trees. On a second graph, depict a typical tree firm's average and marginal cost curves and depict their profits. Explain why you have drawn this as you did.
- Because of bad weather conditions this year, many pine trees were killed. As a result, fewer natural Christmas trees are available. How will this affect the equilibrium price and quantity for artificial Christmas trees this year? How will this affect profits in the artificial Christmas tree industry? Redraw the diagram of the firm from part a and illustrate the changes you have just described.
- Assuming that the Christmas tree shortage is permanent, what will happen to the artificial tree industry over the next several years? What will the long-run price and quantity of artificial trees be? Redraw your diagrams from parts a and b and depict the changes that occur in the long run.

12. The owner of a small retail store does her own accounting work. How would you measure the opportunity cost of her work?

- 13.** In the village of Pleasantville, residents either work as salaried employees at local offices or are proprietors of stores on Main Street. Salaried employees earn \$30,000 per year. All of the stores are rented to the proprietors by one of several real estate companies who own the buildings. Business is brisk at these stores, so currently the typical store brings in \$70,000 of revenue per year. The typical variable costs needed to run a store in Pleasantville (paying workers, buying material) are \$20,000 year.
- a) What is the opportunity cost of running a store? Explain how you know this.
 - b) Given this opportunity cost, what rent will the real estate companies charge? Why?
 - c) Suppose that a new highway brings more visitors to town, so that a new store now brings in \$100,000 of revenue per year. What will happen to rents after the increase in revenues? Who will benefit – shop owners or the real estate companies?
- 14.** Through the miracles of 19th century medicine, Earnest's Extraordinary Elixir has discovered the cure for the common cold. As Earnest is the only one that knows the formula, Earnest has a monopoly on the cold medicine market. The demand for cold medicine is $P=100 - 5Q$. The marginal costs of production are equal to \$10. There are no fixed costs.
- a) What is Earnest's profit-maximizing output and price?
 - b) What is the producer surplus that corresponds with your answer to part (a)? What is the consumer surplus?
 - c) Suppose that, over time, others learn the secret to Earnest's Elixir, and the market becomes perfectly competitive. What will the new price and quantity be? Explain how this problem differs from the monopoly problem in part (a).
 - d) Find the new consumer surplus and producer surplus in perfect competition. How does the sum of consumer surplus and producer surplus in the monopoly case [part (b)] compare to consumer surplus with perfect competition? Explain any differences between the two.

15. The city of Danville has just built a new public transportation system, designed as a roller coaster that travels throughout the Tri-State area. They need to decide how much to charge riders of the roller coaster transport system. Because of your background in economics, you have been asked by the city to help set the price. The fixed costs of operating the system are \$64,000. In addition, the marginal costs of operation are \$8 per rider. Having researched the demand for the roller coaster transport system in Danville, the city has come up with the following table with price, quantity, marginal revenue, and various costs filled in:

P	Q	MR	AC	MC
48	0	48		
44	1000	40	72.00	8
40	2000	32	40.00	8
36	3000	24	29.33	8
32	4000	16	24.00	8
28	5000	8	20.80	8
24	6000	0	18.67	8
20	7000	-8	17.14	8
16	8000	-16	16.00	8
12	9000	-24	15.11	8
8	10000	-32	14.40	8
4	11000	-40	13.82	8
0	12000	-48	13.33	8

- Phineas, a member of the city council, has taken some economics, and wants to ensure that there is no inefficiency, and thus no deadweight loss, from the pricing scheme. What price will achieve this goal? How many riders will use the roller coaster? How much revenue will these riders generate? What will be the total costs of serving this many riders? Will Danville make money, lose money, or break even on the roller coaster transport system at this price?
- Dr. Doofenshmirtz, a second council member, prefers that Danville take advantage of its market power whenever it can. He asks you to determine the price at which the city, which has a monopoly as the only provider of roller coaster transportation, would maximize its profit from roller coaster riders. What price would that be? How many riders use the roller coaster at that price? Please calculate the total revenue and total costs, as well as the profit for these sales.
- A third member of the council, Perry, is concerned about consumers, and does not want the city to maximize its profits. However, it is important to Perry that the city covers its costs, so that Danville does not lose money on its roller coaster venture. Based on the numbers above, what price should the city set to meet Perry's goal? How do you know this?

At this price, how many riders will use the roller coaster? How much revenue will these riders generate? What will be the total costs of serving these riders? What profit, if any, does Danville make from these riders?