
Final Exam - Solutions

You have until 10:00am to complete this exam. Be certain to put your name, id number and section on both the exam and your scantron sheet and fill in test form A on the scantron. Answer all multiple choice questions on your scantron sheet. Choose the single best answer for each question; if you fill in multiple answers for a question you will be marked wrong. Answer the long answer questions directly on the exam. You must show your work for full credit. Answers may be left as fractions. Please place a box around final answers when appropriate. Good luck!

Name:

ID Number:

Section:

SECTION I: MULTIPLE CHOICE (50 points)

1. A firm is currently producing at a level of output where the marginal cost of the last unit produced exceeded the marginal revenue of the last unit produced. This firm:
 - (a) May be maximizing profits and could be a competitive firm or a monopoly.
 - (b) May be maximizing profits but only if it is a monopolist.
 - (c) May be maximizing profits but only if it is a perfectly competitive firm.
 - (d) Is not maximizing profits.

(d) The firm lost money on the last unit that it produced (since the cost of that unit exceeded the revenue from that unit). So the firm could increase profits by reducing output by one unit.
2. If Adam's marginal utility from apples is positive and his marginal utility from oranges is negative, on a graph with apples on the horizontal axis and oranges on the vertical axis:
 - (a) Adam's indifference curves will have a positive slope.
 - (b) Adam's indifference curves will have a negative slope.
 - (c) Adam's indifference curves will be horizontal lines.
 - (d) Adam's indifference curves will be vertical lines.

(a) If we increase the number of apples consumed, Adam's utility will increase. To offset the increase in utility and keep Adam on the same indifference curve, we must increase the number of oranges to bring his utility back down.
3. Suppose that a firm uses capital and labor as its only two inputs. The firm's production technology exhibits a positive, diminishing marginal product of capital, a positive, diminishing marginal product of labor, and smooth convex isoquants. Currently the firm is minimizing costs by using 10 units of capital and 10 units of labor. If the price of labor increases relative to the price of capital, the firm will:
 - (a) Increase the amount of labor and increase the amount of capital they use if they want to continue producing the same amount and minimize costs.
 - (b) Increase the amount of labor and decrease the amount of capital they use if they want to continue producing the same amount and minimize costs.

- (c) Decrease the amount of labor and increase the amount of capital they use if they want to continue producing the same amount and minimize costs.
- (d) Decrease the amount of labor and decrease the amount of capital they use if they want to continue producing the same amount and minimize costs.
- (c) The increase in the price of labor relative to the price of capital will mean that the ratio of w to r is now greater than the ratio of MPL to MPK . So a dollar spent on capital produces more output than a dollar spent on labor. The firm can lower their costs by using more capital and less labor.
4. If the demand curve is downward sloping and the supply curve is upward sloping, increasing a quantity tax from \$1 to \$2 will definitely:
- (a) Increase tax revenue.
 (b) Decrease tax revenue.
 (c) Increase deadweight loss.
 (d) Decrease deadweight loss.
- (c) Tax revenue could either increase or decrease. Deadweight loss will definitely increase.
5. Suppose that the Engel curve for lobsters is upward sloping. We can say for certain that:
- (a) Lobsters are a normal good.
 (b) Lobsters are an ordinary good.
 (c) Both (a) and (b).
 (d) Neither (a) nor (b).
- (c) An upward sloping Engel curve indicates that demand for lobsters increases when income increases. This is the definition of a normal good. All Giffen goods are inferior, so lobsters cannot be a Giffen good and are therefore ordinary.
6. At a firm's current level of output, average costs exceed marginal costs. This means that the firm is:
- (a) Earning positive profits.
 (b) On a downward sloping portion of the average cost curve.
 (c) On an upward sloping portion of the average cost curve.
 (d) Not behaving optimally.
- (b) If marginal costs are below average costs, the next unit produced will increase costs by an amount smaller than the current average. This will bring down the average cost per unit, implying that the average cost curve is downward sloping at that point.
7. A firm with two factories is producing 10 units of output at one factory and 20 units of output at its other factory. Which of the following statements is definitely true if the firm is minimizing costs?
- (a) The average costs at the two factories are currently equal.
 (b) The factories have identical cost functions.
 (c) The marginal costs at the two factories are currently equal.

- (d) The fixed costs at the first factory are higher than the fixed costs at the second factory.
- (c) If the marginal costs were not equal, the firm could lower costs by decreasing output at the factory with high marginal costs and increasing output at the factory with low marginal costs.
8. Suppose that a firm has constant average costs of \$4 per unit. Which of the following statements is definitely true:
- (a) Fixed costs are zero.
(b) Marginal costs are increasing.
(c) Marginal costs are decreasing.
(d) Not enough information.
- (a) Total costs are just average costs times output, so $C(y) = AC(y) \cdot y = 4y$. From this total cost function, it is clear that fixed costs are equal to zero and that marginal costs are constant.
9. All firms in the paperclip industry have identical cost functions. The paperclip industry is perfectly competitive and there are currently 500 firms in the short run equilibrium. The number of paperclip firms in the long run will be:
- (a) Greater than 500.
(b) Equal to 500.
(c) Less than 500.
(d) Not enough information.
- (d) The answer depends on the current level of profits for firms. If profits are positive, the number of firms will increase in the long run. If profits are negative, the number of firms will decrease. If profits are zero, the number of firms will remain constant.
10. A person who prefers averages to extremes will have:
- (a) Linear indifference curves.
(b) Convex indifference curves.
(c) Concave indifference curves.
(d) Convex budget lines.
- (b) For convex indifference curves, if two extreme bundles lie on the same indifference curve, an average of those two bundles will lie above the indifference curve.
11. A perfectly competitive firm should shut down in the short run if:
- (a) Profits would be negative if they stayed open.
(b) Producer surplus would be negative if they stayed open.
(c) Output would be below the efficient quantity if they produced.
(d) Output would be above the efficient quantity if they produced.
- (b) The firm can always choose to shut down and earn zero producer surplus. Therefore, they should never choose to operate when producer surplus is negative. It will make sense for the firm to stay in operation if profits are negative as long as they are covering all of their variable costs.

12. For a monopolist facing a downward-sloping, linear demand curve, marginal revenue is:
- (a) Constant.
 - (b) Greater at the profit-maximizing level of output than the socially efficient level of output.
 - (c) Smaller at the profit-maximizing level of output than the socially efficient level of output.
 - (d) (a) or (b) could be true.
- (b) If the demand curve is a downward sloping line, the marginal revenue curve will be a downward sloping line. This means that marginal revenue is lower at larger quantities. The efficient level of output is larger than the profit-maximizing level of output for a monopoly so the marginal revenue at the efficient level of output will be smaller than the marginal revenue at the profit-maximizing level.
13. The price elasticity of demand for a good with no close substitutes will tend to:
- (a) Be equal in magnitude to the price elasticity of demand for a good with many close substitutes.
 - (b) Be larger in magnitude than the price elasticity of demand for a good with many close substitutes.
 - (c) Be smaller in magnitude than the price elasticity of demand for a good with many close substitutes.
 - (d) Have the opposite sign of the price elasticity of demand for a good with many close substitutes.
- (c) Demand for a good will be more elastic if there are more close substitutes for it (since people will be more likely to switch to these other goods when price increases).
14. Coffee and donuts are complements. When the price of coffee increases, the substitution effect for donuts:
- (a) Will be larger in magnitude than the income effect for donuts.
 - (b) Will be smaller in magnitude than the income effect for donuts.
 - (c) Will be equal in magnitude than the income effect for donuts.
 - (d) Not enough information.
- (b) If coffee gets more expensive, there will be a positive substitution effect for donuts. However, the net effect for donuts will be negative since donuts are a complement. This implies that the income effect for donuts must be negative and larger in magnitude than the substitution effect.
15. If a monopolist uses a two-part tariff:
- (a) Consumer surplus will be maximized.
 - (b) Total surplus will be maximized.
 - (c) Output will be less than the efficient level.
 - (d) Output will be greater than the efficient level.
- (b) Since the monopolist can charge a fee equal to the consumer surplus, it will try to maximize total surplus (they get their producer surplus and manage to transfer all consumer surplus to producer surplus). This will lead to the monopolist producing the efficient quantity and capturing all of the surplus.

16. A firm is currently at a point on their isoquant where the isoquant is steeper than the isocost curve. If the firm moves up and left along its current isoquant:
- (a) Output will stay the same and costs will decrease.
 - (b) Output will stay the same and costs will increase.
 - (c) Costs will stay the same and output will increase.
 - (d) Costs will stay the same and output will decrease.
- (b) Since the firm is moving along an isoquant, output will stay the same. If the isoquant is steeper than the isocost curve, moving up and left along the isoquant will move the firm above the isocost line implying an increase in costs.
17. A company that manufactures bikes uses a constant returns to scale technology and has no fixed costs. Suppose that the company decides to double the level of inputs it uses. Which of the following will definitely be true?
- (a) Costs and revenues will both double.
 - (b) Costs will double but revenues will less than double.
 - (c) Costs will double but revenues will more than double.
 - (d) Not enough information.
- (a) Since the company uses a constant returns to scale technology, a doubling of inputs will double output which will double revenue. Doubling inputs will also double the money spent on inputs. Since there are no fixed costs, this means that total costs will double.
18. Which of the following would shift the budget line while leaving the slope unchanged?
- (a) Increasing income and holding prices constant.
 - (b) Holding income constant and doubling the prices of both goods.
 - (c) Both (a) and (b).
 - (d) Neither (a) nor (b).
- (c) A change in income shifts the budget line. If we double the price of both goods, the relative prices don't change but our income is effectively cut in half, shifting the budget line in.
19. Bob and Chris are the only two consumers for hamburgers and both have downward-sloping, linear demand curves. Bob never buys hamburgers when the price goes above \$5 and Chris never buys hamburgers when the price goes above \$10. The market demand curve:
- (a) Will have a kink at \$5 and will be flatter to the right of the kink than to the left of the kink.
 - (b) Will have a kink at \$5 and will be flatter to the left of the kink than to the right of the kink.
 - (c) Will have a kink at \$15 and will be flatter to the right of the kink than to the left of the kink.
 - (d) Will have a kink at \$15 and will be flatter to the left of the kink than to the right of the kink.

- (a) The kink at \$5 occurs because this is the price at which Bob enters the market. Adding an additional consumer's demand curve will make the market demand curve flatter.
20. Suppose that a competitive firm is currently producing at a point where market price equals the firm's marginal cost and the marginal cost curve is downward sloping. The firm could increase profits by:
- (a) Increasing the quantity they produce.
 - (b) Decreasing the quantity they produce.
 - (c) Increasing the price they charge.
 - (d) None of the above.
- (a) If the firm produces one more unit, revenues will go up by the market price, costs will go up by some amount less than the market price (since the marginal cost curve is downward sloping at the current quantity). So the firm would earn a positive profit on the next unit, increasing total profits.

SECTION II: SHORT ANSWER (50 points)

1. (12 points) A deli specializes in making grilled cheese sandwiches. Each sandwich requires two slices of bread and one slice of cheese. While the deli can make fractions of sandwiches, it must always follow this fixed proportion of bread to cheese. For example, the deli could make half a grilled cheese sandwich by using one slice of bread and half a slice of cheese.

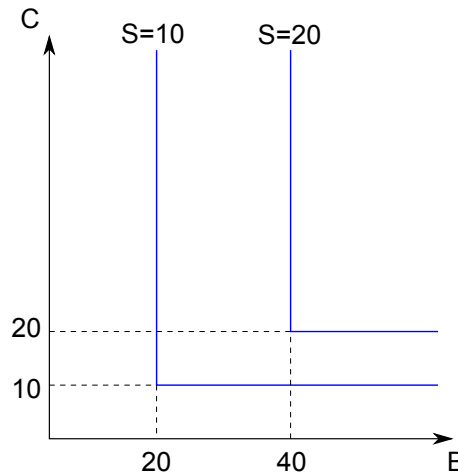
- (a) Write down the deli's production function for sandwiches as a function of the number of slices of bread (B) and the number of slices of cheese (C) used.

This is a fixed proportions technology. The number of sandwiches that can be made is limited by whichever is smaller, the number of slices of cheese or one half the number of slices of bread. This can be captured with a min function:

$$f(B, C) = \min\left(\frac{1}{2}B, C\right)$$

Notice that the absolute magnitudes of the coefficients, not just their relative magnitudes, are important here since we want output to be expressed in sandwiches. So if I plug in four slices of bread and two slices of cheese, my function should tell me that two sandwiches are produced.

- (b) Sketch the isoquants corresponding to 10 sandwiches and 20 sandwiches on a graph with B on the horizontal axis and C on the vertical axis.



- (c) Derive an expression for costs as a function the number of sandwiches produced (S) assuming that the firm chooses its input levels to minimize total costs.

Notice that it never makes sense to produce anywhere along an isoquant other than on the vertex. Producing at a point other than the vertex still produces the same output but uses more inputs and therefore costs more. So we know that the cost minimizing firm will be at the vertex of the isoquant corresponding to the desired level of output S . The vertex is where the two arguments in the min function are equal. This tells us that:

$$\frac{1}{2}B = C = S$$

So now we can write the cost-minimizing levels of each input in terms of output:

$$B(S) = 2S$$

$$C(S) = S$$

Plugging these expressions into the cost function will give us costs as a function of S :

$$Costs(S) = p_B B(S) + p_C C(S)$$

$$Costs(S) = p_B 2S + p_C S$$

$$Costs(S) = (2p_B + p_C)S$$

2. (12 points) The California State Fair is deciding how much to charge for their rides. The California State Fair is a monopolist (there are no other state fairs in California). The fair has no fixed costs and has to spend \$1 in electricity costs every time a person goes on a ride. Assume there are no other costs for the fair. Demand for rides when the price of a ride is p is given by:

$$D(p) = 100 - \frac{1}{5}p \quad (1)$$

- (a) Suppose that the fair decides to make admission to the fair free and charge people per ride. Assume that the fair must charge everyone the same price per ride no matter who the person is or how many rides they go on. What price will the fair charge per ride, how many rides will people take and what will the fair's profits be?

The fair will produce at the quantity where marginal revenues equal marginal costs. To find this quantity, we first need to derive the marginal revenue and marginal cost functions:

$$\begin{aligned} R(y) &= p(y) \cdot y \\ R(y) &= (500 - 5y)y \\ R(y) &= 500y - 5y^2 \\ MR(y) &= \frac{dR(y)}{dy} = 500 - 10y \end{aligned}$$

The marginal cost function is simply constant and equal to 1 (since each additional ride increases the fair's costs by one dollar). Setting marginal revenue equal to marginal cost will give us the monopoly quantity:

$$\begin{aligned} MR(y) &= MC(y) \\ 500 - 10y &= 1 \\ 10y &= 499 \\ y &= 49.9 \end{aligned}$$

To find the price, we can plug this quantity back into the inverse demand function:

$$\begin{aligned} p(y) &= 500 - 5y \\ p &= 500 - 5 \cdot 49.9 \\ p &= 250.5 \end{aligned}$$

So the fair will charge \$250.5 per ride and people will take 49.9 rides. The fair's profits will be:

$$\begin{aligned} \pi &= p \cdot y - C(y) \\ \pi &= 250.5 \cdot 49.9 - 1 \cdot 49.9 \\ \pi &= 12,450.05 \end{aligned}$$

- (b) What is the socially efficient quantity of rides? What is the deadweight loss generated by the fair acting as a monopolist?

The socially efficient quantity will be where marginal cost intersects the demand curve:

$$p(y) = MC(y)$$

$$500 - 5y = 1$$

$$499 = 5y$$

$$y = 99.8$$

The deadweight loss will be the area between the monopoly quantity and the efficient quantity and between the demand curve and the marginal cost curve:

$$DWL = \frac{1}{2}(y_{eff} - y_m)(p(y_m) - p(y_{eff}))$$

$$DWL = \frac{1}{2}(99.8 - 49.9)(250.5 - 1)$$

$$DWL = 6,225.025$$

- (c) Suppose that the fair decides to have an admission fee in addition to a price per ride. What admission fee will the fair charge and what price will they charge per ride? What are the fair's profits now? (To simplify things, you can think of the demand as coming entirely from a single consumer.)

In this case, the fair should operate at the efficient quantity. They can capture any consumer surplus through the admission fee, so it makes sense to produce at y_{eff} . So the price they will charge per ride is simply their marginal cost of \$1. The admission fee will be equal to the entire consumer surplus when price is \$1 and consumers take 499 rides. This is the area below the demand curve above the price between the quantities of 0 and 499:

$$fee = \frac{1}{2}(p(0) - p(y_{eff}))(y_{eff} - 0)$$

$$fee = \frac{1}{2}(500 - 1)(499 - 0)$$

$$fee = 124,500.5$$

Note that the price per ride exactly covers the fair's average costs per ride. This means that the fair's profits will simply be equal to the admission fee, making profits \$124,500.50, a substantially larger number than the profits without price discrimination.

3. (16 points) There are 50 identical firms in the car rental industry. Each firm has the following total cost function:

$$C(R) = 10 + 5R + 25R^2 \quad (2)$$

where R is the number of cars they rent. Demand for car rentals when the price of a rental is p is given by:

$$D(p) = 495 - 9p \quad (3)$$

- (a) Derive expressions for an individual firms average cost, average variable cost and marginal cost functions.

$$AC(R) = \frac{C(R)}{R} = \frac{10}{R} + 5 + 25R$$

$$AVC(R) = \frac{VC(R)}{R} = \frac{5R + 25R^2}{R} = 5 + 25R$$

$$MC(R) = \frac{dC(R)}{dR} = 5 + 50R$$

- (b) What is the shutdown price for the firms?

The firm will stop producing when they would be operating at a point below their average variable cost curve. This is where the marginal cost curve is below the average variable cost curve. Finding where the marginal cost curve intersects the average variable cost curve will therefore tell us the point at which the firm begins producing:

$$MC(R) = AVC(R)$$

$$5 + 50R = 5 + 25R$$

$$50R = 25R$$

$$2R = R$$

The only value for R that solves this equation is zero. This means that at the shutdown price, quantity is zero. Plugging zero in for quantity into the marginal cost function will give us the shutdown price:

$$p_{sd} = MC(0)$$

$$p_{sd} = 5 + 50 \cdot 0$$

$$p_{sd} = 5$$

- (c) Derive an expression for the industry supply curve.

First we need to find the individual firm supply curve. The firm's supply curve is simply its marginal cost curve above the shutdown price:

$$p(R) = MC(R)$$

$$p(R) = 5 + 50R$$

This is the inverse supply curve. We'll need the regular supply curve to get to industry supply. We get this by simply rearranging the inverse supply curve:

$$50R = p - 5$$

$$R = \frac{p}{50} - \frac{1}{10}$$

This is the supply of a single firm. There are 50 identical firms, so industry supply will be 50 times the firm supply:

$$S(p) = \sum_{i=1}^{50} R_i(p)$$

$$S(p) = 50R_i(p)$$

$$S(p) = 50 \cdot \left(\frac{p}{50} - \frac{1}{10} \right)$$

$$S(p) = p - 5$$

This is the industry supply for all prices above \$5. For prices below \$5, industry supply is zero.

(d) What is the short-run equilibrium price and quantity?

We can get the short-run equilibrium price and quantity by simply setting demand equal to industry supply:

$$D(p) = S(p)$$

$$495 - 9p = p - 5$$

$$500 = 10p$$

$$p = 50$$

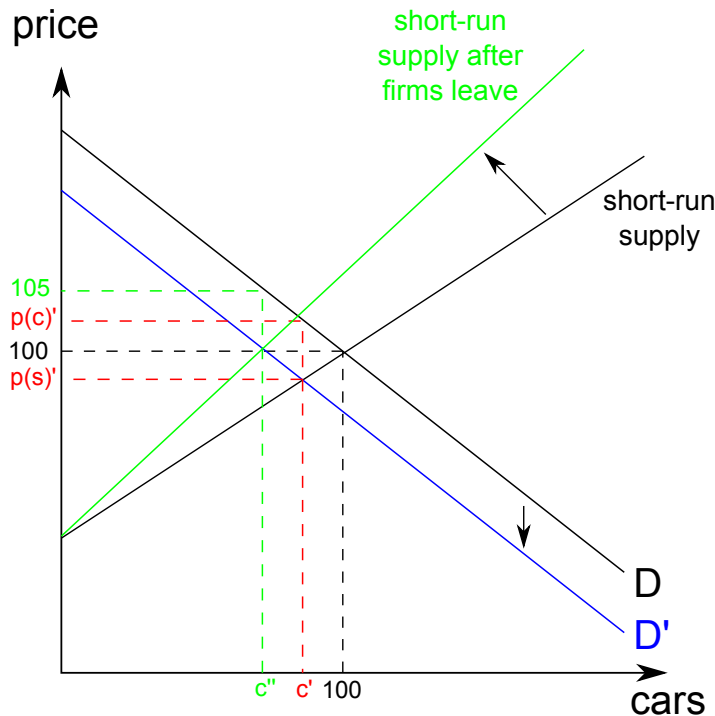
So the equilibrium price is \$50. Plugging this back into the demand (or supply) equation gives us the equilibrium quantity:

$$D(50) = 495 - 9 \cdot 50$$

$$D(50) = 45$$

So the equilibrium quantity is 45.

4. (10 points) The graph below shows the current short run equilibrium in the market for cars. The market is perfectly competitive and all firms are currently earning zero profits. Suppose that we introduce a \$5 quantity tax on consumers. Show the following effects of this quantity tax on the graph (note that you will be able to give exact numbers for some but not all of the quantities below):
- Any relevant shifts in the supply and demand curves in the short run and long run.
 - The new price paid by consumers and the new price received by producers in the short run.
 - The new number of cars sold in the short run.
 - The new price paid by consumers and the new price received by producers in the long run.
 - The new number of cars sold in the long run.



- The tax shifts the demand curve down by \$5 (to the blue demand curve on the graph).
- In the short run, this leads to a movement along the short run supply curve leading to a lower quantity sold, a higher price paid by consumers and a lower price received by producers. These new short run outcomes are shown in red on the graph. Note that the tax burden is shared in the short run, so the price paid by consumers is greater than \$100 and less than \$105 and the price received by producers is greater than \$95 and less than \$100.
- In the long run, the number of firms will adjust until the price received by firms is back at the break-even price. This will lead to firms exiting the industry, rotating the short run supply curve up (the green supply curve on the graph).

- Once the number of firms has adjusted, the price received by firms will be back to the original \$100. This implies that the consumers are now paying \$105. The new long-run equilibrium quantity is shown in green on the graph. Note that this quantity is lower than the new short-run quantity which is lower than the pre-tax quantity.