
Midterm 2 - Solutions

You have until 11:50am 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 (60 points)

1. Suppose that pizza is an ordinary good for both Alex and Betsy. If Alex's demand for pizza is more inelastic than Betsy's, a one percent increase in the price of pizza:
 - (a) Will lead to a greater percentage decrease in pizza purchased for Alex than for Betsy.
 - (b) Will lead to a greater percentage decrease in pizza purchased for Betsy than for Alex.
 - (c) Will lead to an increase in pizza purchased for both Alex and Betsy.
 - (d) Will have the same affect on the pizza purchased by both Alex and Betsy.

(b) If Betsy has more elastic demand, then the quantity she purchases is more responsive to price. Her quantity will drop by more than Alex's does.
2. Suppose that the market for candy has a negatively sloped linear demand curve and a positively sloped linear supply curve. A quantity tax placed on consumers will:
 - (a) Generate a deadweight loss at least as large as the revenue generated from the tax.
 - (b) Generate a deadweight loss smaller than the revenue generated from the tax.
 - (c) Generate a deadweight loss equal to the revenue generated from the tax.
 - (d) Not enough information.

(d) At small levels of the tax, the deadweight loss will likely be smaller than the tax revenue. However, the deadweight loss will continue to increase as the tax goes up while the tax revenue will eventually start to fall. At some point, deadweight loss will be greater than the tax revenue.
3. Suppose that computers are made using machines and workers and the production technology is convex and monotonic. If 4 workers and 8 machines can produce 10 computers and 8 workers and 4 machines can also produce 10 computers, then 6 workers and 7 machines can produce:
 - (a) Exactly 10 computers.
 - (b) At least 10 computers.
 - (c) Less than 10 computers.
 - (d) Not enough information.

- (b) The fact that the production technology is convex tells us that 6 workers and 6 machines will produce at least 10 computers. Because the technology is also monotonic, increasing the number of machines from 6 to 7 will either leave output unchanged or increase it.
4. The demand for wheat bread is likely to be:
- (a) More elastic than the demand for bread in general.
 - (b) More inelastic than the demand for bread in general.
 - (c) Less elastic than the demand for bread in general.
 - (d) Just as elastic as the demand for bread in general.
- (a) There are more close substitutes for wheat bread than for bread in general. This will mean that demand for wheat bread will tend to be more elastic than demand for bread in general (if the price of wheat bread goes up, people will likely substitute a different type of bread).
5. If a firm using capital and labor as inputs has isoquants that are straight lines, then:
- (a) The firm's technology exhibits a diminishing technical rate of substitution.
 - (b) The marginal product of labor equals the marginal product of capital.
 - (c) The ratio of the marginal product of capital to the marginal product of labor is constant.
 - (d) Both (a) and (c).
- (c) If the isoquants are straight lines, then the technical rate of substitution is constant, implying that the ratio of MP_L to MP_K is constant.
6. A kink in the market demand curve typically occurs when:
- (a) The price drops below some consumer's maximum willingness to pay.
 - (b) An additional firm enters the market.
 - (c) A change in demand occurs on along the intensive margin.
 - (d) A firm leaves the market.
- (a) When the price drops below a consumer's maximum willingness to pay, that consumer will enter the market, changing the slope of the market demand curve.
7. Carl consumes only apples and oranges and apples are a normal good. If the magnitudes of the substitution and income effects for apples are equal when the price of oranges goes up, we can say that:
- (a) Apples and oranges are substitutes.
 - (b) Apples and oranges are complements.
 - (c) The quantity of apples consumed goes up when the price of oranges goes up.
 - (d) The quantity of apples consumed does not change when the price of oranges goes up.
- (d) Since apples are a normal good, the income effect will be negative when the price of oranges increases. Because apples became relatively cheaper, the substitution effect will be positive. If the income and substitution effects have the same magnitude but opposite signs, they will cancel each other out and the net change in the quantity of apples will be zero.

8. Suppose that capital and labor are the only inputs used by a firm and that capital is fixed in the short run. If each additional worker increases output by 10 units and the price of output is \$2 a unit, what is the highest wage the firm is willing to pay in the short run?

- (a) \$10.
- (b) \$20.
- (c) \$5.
- (d) \$2.

(b) The value of output generated by an additional worker will be \$20 (10 units of output times \$2 per unit). So the firm would be willing to pay up to \$20 to hire an additional worker.

9. Which of the following is not possible if a production technology using capital and labor as inputs is monotonic?

- (a) The marginal product of capital is diminishing.
- (b) The technical rate of substitution is negative.
- (c) The marginal product of labor is negative.
- (d) The marginal product of capital is increasing.

(c) If the production technology is monotonic, increasing one input while holding everything else constant should either increase output or leave it unchanged. A negative marginal product means that increasing an input actually decreases output.

10. Suppose that capital is our only variable input in the short run. To maximize profits, we should choose the level of capital where:

- (a) The price of a unit output is equal to the price of a unit of capital.
- (b) The marginal product of capital is equal to the price of a unit of capital.
- (c) The dollar value of the marginal product of capital is equal to the price of a unit of output.
- (d) The dollar value of the marginal product of capital is equal to the price of a unit of capital.

(d) The firm will use capital up to the point where the value of the output from an additional unit of capital ($p \cdot MP_K$) is just equal to the price of an additional unit of capital.

11. The market for ice cream has two consumers. The consumers have identical individual demand curves, each with a slope of -2. The slope of the market demand curve will be:

- (a) -4.
- (b) -2.
- (c) -1.
- (d) $-\frac{1}{2}$.

(c) You could figure this out by writing down two inverse demand curves, each with a slope of -1, and then converting them to demand curves and adding them together. Another way to see the answer is to think about what the slope is telling

us. A slope of -2 says that when the price drops by \$2, the consumer buys one additional unit. If there are two consumers, when the price drops by \$2, each will buy one more unit leading to a total change of 2 units. So the slope of the market demand curve would be $-\frac{2}{2}$.

12. When a \$3 quantity tax is placed on consumers, one third of the burden of the tax falls on consumers while two thirds falls on producers. If the tax is instead placed on producers, the portion of the tax burden falling on consumers will be:

- (a) \$1.
- (b) \$2.
- (c) \$3.
- (d) It depends on the original equilibrium price.

(a) The tax has the same effect regardless of whether it is placed on consumers or producers. So if consumers pay one third of the tax when it is placed on consumers, they will still pay one third of the tax when it is placed on producers.

13. When a record store raises the price of a record by 2 percent, revenues go down by 1 percent. This tells us that:

- (a) The demand for records is elastic.
- (b) The demand for records is inelastic.
- (c) The demand for records is perfectly elastic.
- (d) The demand for records is perfectly inelastic.

(a) If revenues fall when price is increased, demand is elastic. The large change in quantity lowers revenues by more than the increase in price on the units still sold raises revenues.

14. Suppose that capital is a fixed input in the short run and labor is a variable input. A decrease in the price of capital will:

- (a) Increase the short-run profit-maximizing level of labor.
- (b) Decrease the short-run profit-maximizing level of labor.
- (c) Increase the level of short-run profits.
- (d) Decrease the level of short-run profits.

(c) The price of capital will not affect the short run level of labor. However, it will affect profits. A lower price of capital means that money spent on the fixed amount of capital will be lower. Everything else in the profit function is staying the same, so profits will be larger than before the price change.

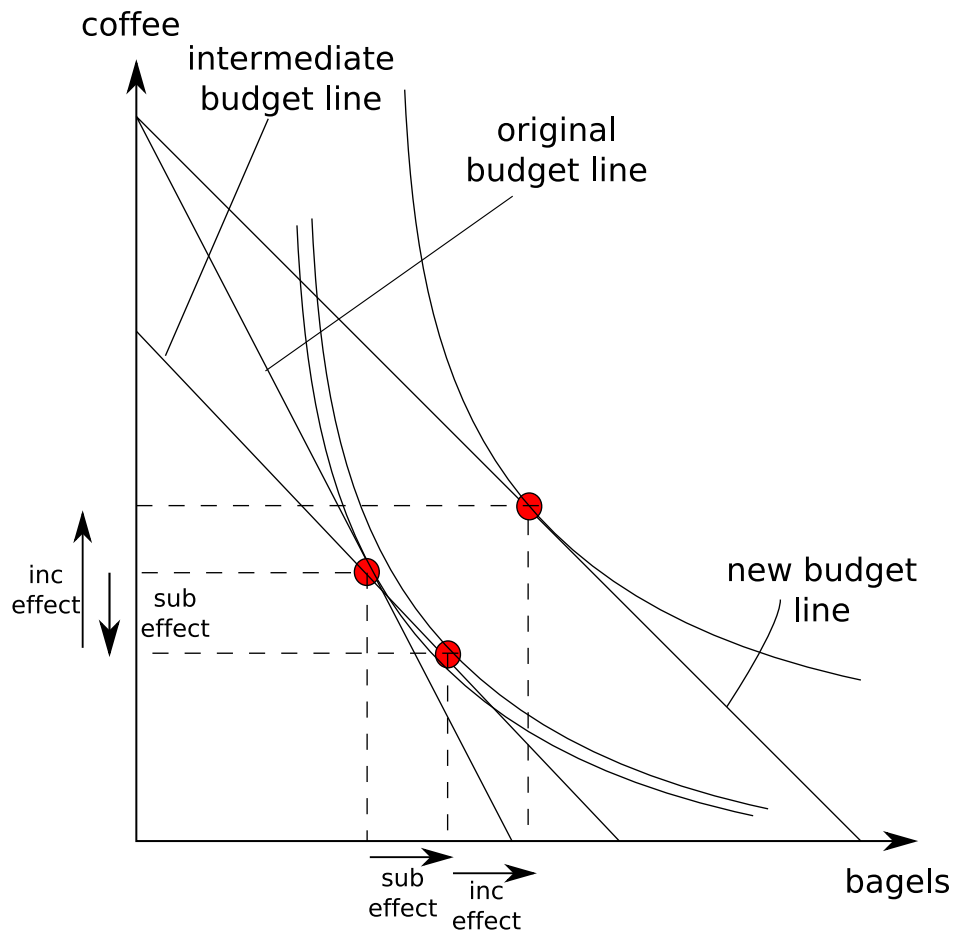
15. If sweaters are a normal good, we can say for certain that:

- (a) The income elasticity for sweaters is greater than 1.
- (b) The income elasticity for sweaters is less than 1.
- (c) The income elasticity for sweaters is less than -1.
- (d) None of the above.

(d) Knowing that sweaters are a normal good only tells us that the income elasticity is positive. If we knew whether or not sweaters were a luxury good, we would be able to say whether the income elasticity is greater than or less than one.

SECTION II: SHORT ANSWER (40 points)

1. (14 points) Dennis consumes only coffee and bagels, both of which are normal, ordinary goods. Coffee and bagels are complements. Dennis has standard, convex indifference curves. Draw a graph that shows the income and substitution effects for both coffee and bagels when the price of bagels decreases. Your graph should have bagels on the horizontal axis and coffee on the vertical axis. Be certain to label your graph clearly (including all relevant budget lines and bundles) and to show both the magnitude and direction of the effects.



The decrease in the price of bagels will rotate the budget line out. Because bagels are ordinary and coffee and bagels are complements the quantity of bagels and the quantity of coffee will both increase as a result of the price change. So the new bundle is above and to the right of the original bundle. The intermediate budget line has the same slope as the new budget line but passes through the old bundle. Because coffee has gotten relatively more expensive and bagels have gotten relatively cheaper, the intermediate bundle should be below and to the right of the original bundle. Because both coffee and bagels are normal goods, the intermediate bundle should be below and to the left of the final bundle.

2. (12 points) The market demand for paintings is given by:

$$D(p) = 100 - p \quad (1)$$

The market supply for paintings is perfectly inelastic: 50 paintings are supplied no matter what the price of a painting is.

- (a) Find the equilibrium price of and quantity of paintings. Be certain to show your work.

Notice that our supply function is just:

$$S(p) = 50$$

To get the equilibrium price and quantity we just need to set this supply function equal to the demand function:

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

$$100 - p = 50$$

$$p = 50$$

$$D(50) = 100 - 50 = 50$$

So the equilibrium price will be \$50. The equilibrium quantity will be 50 paintings.

- (b) Suppose that a \$10 quantity tax is placed on consumers. Find the new equilibrium quantity, the new equilibrium price paid by consumers and the new equilibrium price received by painters.

The new equilibrium will be where the quantity demanded by consumers at the price with the tax included is equal to the quantity supplied by producers at the price net of the tax:

$$D(p + t) = S(p)$$

$$100 - (p + t) = 50$$

$$90 - p = 50$$

$$p = 40$$

So the new equilibrium price received by producers will be \$40. The equilibrium price paid by consumers will be \$40 plus the \$10 tax, or \$50. The equilibrium quantity is still 50 paintings.

- (c) What was the change in consumer surplus resulting from the tax? How much tax revenue was generated?

Notice that consumers pay the same price and purchase the same quantity after the tax as they did before the tax. Therefore from the consumer's perspective nothing has changed. The change in consumer surplus will be zero. Tax revenue will be equal to the after-tax equilibrium quantity times the tax:

$$TR = t \cdot q = 10 \cdot 50 = 500$$

So tax revenue is \$500.

3. (14 points) Suppose that a firm makes cars using metal (M) and fiberglass (F). The firm's production function is given by:

$$f(M, F) = M^{\frac{1}{2}} + F^{\frac{1}{2}} \quad (2)$$

In the short run, the firm's metal is fixed at 100 units but fiberglass is a variable input. The price of a car is \$2,000 and the price of a unit of fiberglass is \$100.

- (a) Derive expressions for the marginal product of metal and the marginal product of fiberglass.

$$MP_M = \frac{df(M, F)}{dM} = \frac{1}{2}M^{-\frac{1}{2}}$$

$$MP_F = \frac{df(M, F)}{dF} = \frac{1}{2}F^{-\frac{1}{2}}$$

- (b) How many units of fiberglass will the firm use in the short run?

In the short run, fiberglass is the only variable input. So the firm will maximize profits by setting the value of the marginal product of fiberglass equal to the price of a unit of fiberglass (w_F):

$$pMP_F = w_F$$

$$p \cdot \frac{1}{2}F^{-\frac{1}{2}} = w_F$$

$$\frac{1}{2} \frac{p}{w_F} = F^{\frac{1}{2}}$$

$$F = \frac{1}{4} \frac{p^2}{w_F^2}$$

Plugging in our price of cars and our price of a unit of fiberglass gives us:

$$F = \frac{1}{4} \frac{2000^2}{100^2} = \frac{1}{4} 40^2 = 100$$

- (c) How many cars will the firm produce in the short run?

To find the number of cars produced we just need to plug our fixed level of metal and our profit-maximizing level of fiberglass into the production function:

$$f(100, 100) = 100^{\frac{1}{2}} + 100^{\frac{1}{2}} = 10 + 10 = 20$$

- (d) Derive an expression for the short run demand for fiberglass as a function of the price of fiberglass (w_F).

We have already done all of the work for this in part (b) where we found:

$$F = \frac{1}{4} \frac{p^2}{w_F^2}$$

Plugging in the value for p and simplifying gives us:

$$F = \frac{1}{4} \frac{2000^2}{w_F^2}$$

$$F = \frac{1000000}{w_F^2}$$