

---

## Midterm 1 - Solutions

You have until 1:50pm 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. On a graph with good  $x$  on the horizontal axis and good  $y$  on the vertical axis, a consumer's indifference curves will be downward sloping when:
  - (a) Good  $x$  is a bad and good  $y$  is a good.
  - (b) Good  $y$  is a bad and good  $x$  is a good.
  - (c) Neither (a) nor (b) is true.
  - (d) Both (a) and (b) are true.

(c) To get downward sloping indifference curves, either both goods must be good or both goods must be bad. The scenarios in (a) and (b) would produce upward sloping indifference curves.
2. On a graph with apples on the horizontal axis and bananas on the vertical axis, an increase in the price of apples will:
  - (a) Make the budget line steeper.
  - (b) Make the budget line flatter.
  - (c) Shift the budget line away from the origin.
  - (d) Shift the budget line toward the origin.

(a) The slope of the budget line is  $-\frac{P_{apples}}{P_{bananas}}$ . If the price of apples goes up, the magnitude of the slope gets larger meaning the budget line gets steeper.
3. If salt and pepper are complements and both are normal, ordinary goods, an increase in the price of pepper will:
  - (a) Lead to an increase in the amount consumed of both pepper and salt.
  - (b) Lead to a decrease in the amount consumed of both pepper and salt.
  - (c) Lead to an increase in the amount of salt consumed and a decrease in the amount of pepper consumed.
  - (d) Lead to an increase in the amount of pepper consumed and a decrease in the amount of salt consumed.

(b) When the price of pepper rises less pepper is consumed because pepper is an ordinary good. Less salt is consumed because salt and pepper are complements.

4. Adam's preferences are transitive and the utility function  $U(x, y)$  represents his preferences. Suppose Adam prefers  $(x_a, y_a)$  to  $(x_b, y_b)$  and he prefers  $(x_a, y_a)$  to  $(x_c, y_c)$ . Which of the following statements is definitely true?
- $U(x_a, y_a) > U(x_c, y_c)$ .
  - $(x_b, y_b)$  is preferred to  $(x_c, y_c)$ .
  - $U(x_b, y_b) \leq U(x_c, y_c)$
  - (a) and (b).
- (a) If bundle A is preferred to bundle C, then the utility from bundle A must be larger than the utility from bundle B. We don't have enough information to say whether bundle B is preferred to bundle C.
5. If a consumer's preferences for goods  $x$  and  $y$  exhibit a diminishing marginal rate of substitution, then:
- $\frac{MU_x}{MU_y}$  gets smaller as  $x$  gets larger and  $y$  gets smaller.
  - $\frac{MU_x}{MU_y}$  gets larger as  $x$  gets larger and  $y$  gets smaller.
  - The consumer prefers extremes to averages.
  - The consumer's indifference curves will be concave.
- (a) With a diminishing marginal rate of substitution, an indifference curve gets flatter as we move down and to the right. Since  $\frac{MU_x}{MU_y}$  is the magnitude of the slope of the indifference curve, that means that this ratio is getting smaller as  $x$  gets larger and  $y$  gets smaller. Diminishing marginal rate of substitution produces convex indifference curves where averages are preferred to extremes.
6. If Bob spends all of his money on books and shoes and books are an inferior good, a decrease in income will lead Bob to (you can assume Bob is consuming positive quantities of both books and shoes):
- Buy fewer books and fewer shoes.
  - Buy more books and fewer shoes.
  - Buy fewer books and more shoes.
  - Buy more books and more shoes.
- (b) Since books are inferior, we know that Bob will buy more books when income goes down. If he buys more books that means he has less money left over to buy shoes so he must end up buying fewer shoes.
7. Hotdogs and buns are perfect complements and always consumed in a one to one ratio. The price of a hotdog is \$2 and the price of a bun is \$1. If a consumer has \$30, how many hotdogs will they consume?
- 15.
  - 10.
  - 5.
  - Not enough information.
- (b) or (d) were accepted. The possibility that both hotdogs and buns are bads means we don't have enough information (the question was supposed to state that

both were good). Assuming they are goods rather than bad, the answer would be (b). If hotdogs and buns are consumed in a one to one ratio, then the number of hotdogs and buns the consumer buys will be determined by total income divided by the price of a hotdog plus the price of a bun. In this case, that means the consumer can buy  $\frac{30}{1+2}$  hotdog/bun combos.

8. Debbie spends all of her money on coffee and magazines. Which of the following would not change her budget set?

- (a) A doubling of the price of magazines and a doubling of her income.
- (b) A doubling of the price of magazines and a doubling of the price of coffee.
- (c) The price of magazines, the price of coffee and income all doubling.
- (d) The price of magazines and the price of coffee doubling and income being cut in half.

(c) If all prices and income double, the budget equation remains the same (there is just an extra 2 in front of every term which would cancel out) so the set of affordable bundles stays the same. In (a), the budget line would both rotate and shift. In (b), the budget line would have the same slope as before but shift toward the origin. In (d), the budget line would shift in by even more than in part (b).

9. Which of the following utility functions does not exhibit a diminishing marginal rate of substitution?

- (a)  $U(x, y) = x^2y^2$ .
- (b)  $U(x, y) = x^{\frac{1}{3}} + y^{\frac{1}{3}}$ .
- (c)  $U(x, y) = x^{\frac{1}{2}}y^{\frac{1}{2}}$ .
- (d)  $U(x, y) = \frac{1}{2}x + \frac{1}{2}y$ .

(d) For this utility function, the MRS is constant (it is equal to  $-1$ ). The MRS for (a) is  $-\frac{y}{x}$ , the MRS for (b) is  $-\left(\frac{y}{x}\right)^{\frac{2}{3}}$  and the MRS for (c) is  $-\frac{y}{x}$ , all of which get smaller as  $x$  gets bigger and  $y$  gets smaller.

10. If two bundles of goods lie on the same indifference curve, we can say for certain that:

- (a) The two bundles give the same level of utility.
- (b) The two bundles contain equal quantities of the goods.
- (c) The two bundles cost the same amount.
- (d) (a) and (c).

(a) If they are on the same indifference curve, then the consumer is indifferent between the two bundles implying that they give the consumer the same level of utility. This does not imply that the bundles cost the same amount or contain the same quantities of goods.

11. Eddie's consumption bundles contain only two goods,  $x$  and  $y$ . In what situation would Eddie not want to spend his entire income:

- (a) When one of the two goods is a bad.
- (b) When both goods are bads.
- (c) When the prices of the two goods are extremely high.
- (d) None of the above.

- (b) If both goods are bad, Eddie will maximize his utility by buying nothing. If either of the goods is good, Eddie can increase his utility by spending more money on that good, leading him to spend all of his money.
12. If the price of white bread goes up and Fiona buys less of it, which of the following is not possible?
- White bread is a normal good.
  - White bread is an inferior good.
  - White bread is an ordinary good.
  - White bread is a Giffen good.
- (d) This tells us for certain that white bread is an ordinary good, not a Giffen good. We cannot say for certain whether it is normal or inferior.
13. Suppose ice cream and candy are normal, ordinary goods. George is currently spending all of his income on a consumption bundle where  $\frac{MU_{icecream}}{MU_{candy}}$  is greater than  $\frac{P_{icecream}}{P_{candy}}$ . George can increase his utility by:
- Spending more money on ice cream and less money on candy.
  - Spending less money on ice cream and more money on candy.
  - Sending less money on ice cream and less money on candy.
  - George can't increase his utility since he is already on his budget line.
- (a) At his current bundle, the indifference curve is steeper than the budget line (on a graph with ice cream on the horizontal axis and candy on the vertical axis). This means that there are bundles down and to the right along the budget line that lie above the current indifference curve and would give George greater utility. So George should buy more ice cream and less candy.
14. For which of the following utility functions is the marginal utility of  $x$  diminishing as  $x$  gets larger?
- $U(x, y) = -2x + y$ .
  - $U(x, y) = x^2y^{\frac{1}{2}}$ .
  - $U(x, y) = x^{\frac{1}{3}}y^2$ .
  - $U(x, y) = x^3 + 2y$ .
- (c) The marginal utility of  $x$  for this function is  $\frac{1}{3}x^{-\frac{2}{3}}y^{\frac{1}{2}}$  which gets smaller as  $x$  gets larger. The marginal utility of  $x$  is constant for (a) and increasing for (b) and (d).
15. Suppose that peanut butter and jelly are normal, ordinary goods and are complements. If the price of jelly goes down, on a graph with jelly on the vertical axis and peanut butter on the horizontal axis the new optimal bundle will be:
- Above to the right of the original optimal bundle.
  - Below and to the left of the original optimal bundle.
  - Above and to the left of the original optimal bundle.
  - Below and to the right of the original optimal bundle.

(a) When the price of jelly drops, the amount of jelly consumed increases because jelly is ordinary and the amount of peanut butter increases because it is a complement. This means the new bundle will be above and to the right of the old bundle.

16. For perfect substitutes:

- (a) A consumer will always spend all of his or her money on the good with the higher marginal utility.
- (b) A consumer will always buy positive quantities of both goods.
- (c) A consumer will always spend all of his or her money on just one of the goods.
- (d) None of the above.

(d) When the ratio of the marginal utilities is exactly equal to the ratio of the prices, the consumer is indifferent between all bundles on the budget line and can end up consuming positive quantities of both goods. Otherwise, the consumer will spend all of his money on the bundle with the larger ratio of marginal utility to price.

17. Hannah's marginal utility from pencils ( $P$ ) is independent of the number of pencils she has and her marginal utility from erasers ( $E$ ) is decreasing as the number of erasers gets larger. Which of the following utility functions could represent Hannah's preferences?

- (a)  $U(P, E) = P + E$ .
- (b)  $U(P, E) = PE$ .
- (c)  $U(P, E) = P^{\frac{1}{2}}E$ .
- (d)  $U(P, E) = PE^{\frac{1}{2}}$ .

(d) The problem tells us that  $MU_P$  is constant and  $MU_E$  is decreasing. The only utility function with those features is (d), where  $MU_P = E^{\frac{1}{2}}$  (which doesn't change when  $P$  changes) and  $MU_E = \frac{1}{2}PE^{-\frac{1}{2}}$  (which gets smaller as  $E$  gets larger).

18. Suppose that Ivan's consumption bundles consist of crackers and cookies and Ivan always chooses the optimal bundle. If the price of cookies goes up, which of the following could be true?

- (a) Ivan's utility will increase.
- (b) Ivan's utility will decrease.
- (c) Ivan's utility will stay the same.
- (d) (b) or (c) could be true.

(d) Typically, Ivan's utility will go down since it is likely that his old optimal bundle is no longer affordable. However, if Ivan was consuming zero cookies before the price change, the higher price of cookies will not affect his utility.

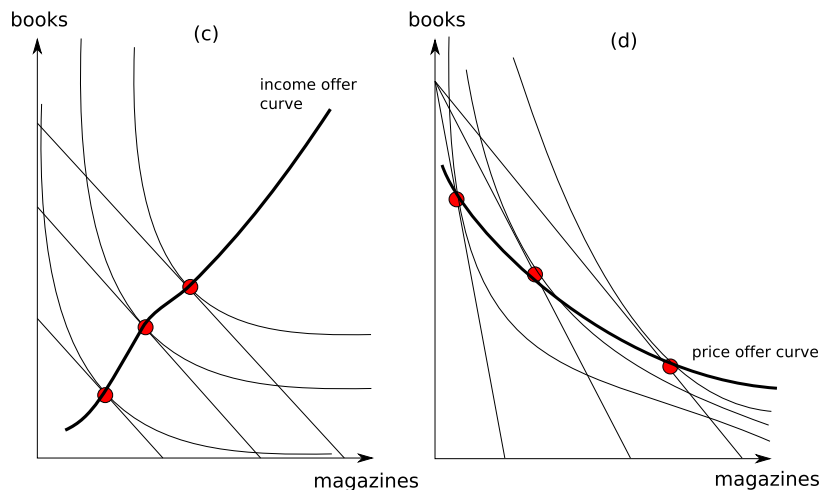
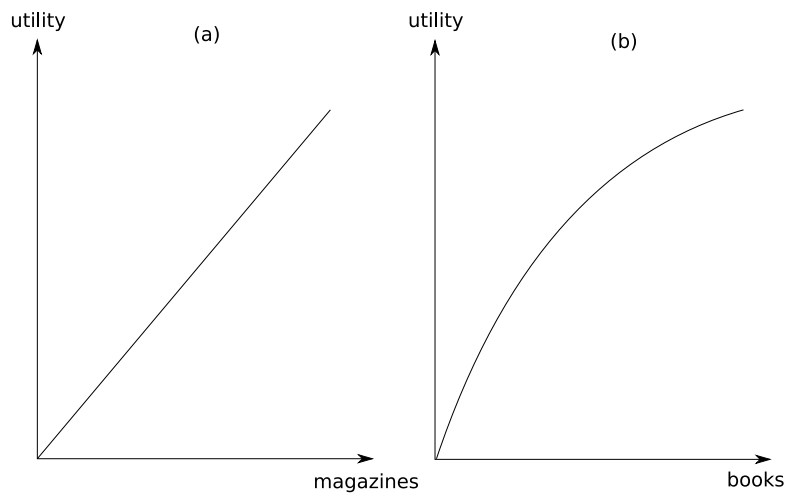
19. On a graph with eggs on the horizontal axis and pancakes on the vertical axis, the steeper a consumer's indifference curve is:

- (a) The more pancakes the consumer is willing to give up for an additional egg.
- (b) The more eggs the consumer is willing to give up for an additional pancake.
- (c) The more expensive pancakes are relative to eggs.

- (d) The more expensive eggs are relative to pancakes.
- (a) A steeper indifference curve implies a larger marginal utility for eggs relative to pancakes which means the consumer would be willing to trade more pancakes for an extra egg compared to somebody with flatter indifference curves.
20. If goods  $x$  and  $y$  are both normal goods, the income offer curve will be:
- (a) Upward sloping.  
(b) Downward sloping.  
(c) A horizontal line.  
(d) A vertical line.
- (a) If both are normal goods, an increase in income will move the optimal bundle up and to the right (the consumer buys more of both goods), giving us an upward sloping income offer curve.

SECTION II: SHORT ANSWER (40 points)

1. (14 points) Suppose that magazines and books are normal, ordinary goods and are substitutes. For each extra magazine James reads, his utility goes up by a constant amount. The additional utility he gets from reading an extra book gets smaller as the number of books he already has gets larger.
  - (a) On graph (a), draw a curve showing utility as a function of the number of magazines holding the number of books constant.
  - (b) On graph (b), draw a curve showing utility as a function of the number of books holding the number of magazines constant.
  - (c) On graph (c), use three sets of indifference curves and budget lines to show three points on the income offer curve.
  - (d) On graph (d), use three sets of indifference curves and budget lines to show three points on the price offer curve when the price of magazines is varied.



Both utility graphs should have a positive slope. The graph for magazines should be a straight line since marginal utility is constant. The graph for books should be getting flatter as the number of books increases since marginal utility is decreasing. The income offer curve should be positively sloped since both goods are normal. The price offer curve will have a negative slope because magazines are ordinary (leading to more magazines when the price of magazines goes down) and magazines and books are substitutes (leading to fewer books when the price of magazines goes down).



2. (12 points) Suppose that your total income is \$200. Cans of soda ( $C$ ) cost \$1. Bottles of soda ( $B$ ) cost \$2. Suppose that you are always will to trade 3 cans of soda for 2 bottles of soda.
- (a) Write down a utility function,  $U(C, B)$ , that represents these preferences.

$$U(C, B) = 2C + 3B$$

There are many utility functions you could choose. The key thing is that the function should give a marginal rate of substitution that is constant and equal to  $-\frac{3}{2}$ .

- (b) Given the current prices, how many cans of soda and how many bottles of soda will you purchase?

Notice that  $\frac{MU_C}{p_C} = \frac{2}{1}$  is greater than  $\frac{MU_B}{p_B} = \frac{3}{2}$ . So a dollar spent on cans increases utility by more than a dollar spent on bottles. This will lead the consumer to spend all of his or her income on cans. \$200 spent on cans that cost \$1 will buy 200 cans. So the consumer buys 200 cans and 0 bottles.

- (c) Assume the price of cans is fixed at \$1. Over what range of prices for bottles will you purchase a positive number of bottles?

The consumer will buy a positive number of bottles only when  $\frac{MU_B}{MU_C} \geq \frac{p_B}{p_C}$ . Plugging in the values for the marginal utilities and the price of cans gives us:

$$\frac{MU_B}{MU_C} \geq \frac{p_B}{p_C}$$

$$\frac{3}{2} \geq \frac{p_B}{1}$$

So the consumer will buy bottles when the price of a bottle is less than or equal to \$1.50.

3. (14 points) Kimberly's utility from movie tickets ( $M$ ) and concert tickets ( $C$ ) is given by:

$$U(M, C) = 20M^{\frac{1}{2}}C^{\frac{1}{2}}$$

- (a) Derive expressions for  $MU_M$ ,  $MU_C$  and the marginal rate of substitution.

$$MU_M = \frac{dU(M, C)}{dM} = 20 \cdot \frac{1}{2} M^{-\frac{1}{2}} C^{\frac{1}{2}} = 10 \left(\frac{C}{M}\right)^{\frac{1}{2}}$$

$$MU_C = \frac{dU(M, C)}{dC} = 20 \cdot \frac{1}{2} M^{\frac{1}{2}} C^{-\frac{1}{2}} = 10 \left(\frac{M}{C}\right)^{\frac{1}{2}}$$

$$MRS = -\frac{MU_M}{MU_C} = -\frac{10\left(\frac{C}{M}\right)^{\frac{1}{2}}}{10\left(\frac{M}{C}\right)^{\frac{1}{2}}} = -\frac{C}{M}$$

- (b) Derive an expression for demand for movie tickets in terms of income ( $I$ ), the price of a movie ticket ( $p_M$ ) and the price of a concert ticket ( $p_C$ ). In other words, derive the function  $M(p_M, p_C, I)$  that gives the optimal number of movie tickets for any set of prices and income.

We begin by setting up our tangency condition and solving for one of the two goods:

$$-\frac{p_M}{p_C} = MRS$$

$$-\frac{p_M}{p_C} = -\frac{C}{M}$$

$$C = \frac{p_M}{p_C} M$$

Now we can plug this expression into the budget constraint and solve for  $M$  in terms of prices and income:

$$p_M M + p_C C = I$$

$$p_M M + p_C \frac{p_M}{p_C} M = I$$

$$M(p_M + p_M) = I$$

$$M = \frac{I}{2p_M}$$

This final expression is our demand equation for the optimal number of movie tickets.

- (c) Based on your expression in part (b), determine whether movie tickets are a normal or inferior good and whether they are an ordinary or Giffen good. Be certain to explain your answers.

From the above demand equation, it is clear that when income increases, the optimal number of movie tickets increases telling us that movie tickets are a normal good. The demand equation also tells us that when the price of movie tickets goes up, the optimal number of movie tickets goes down. This makes movie tickets an ordinary good.