Intermediate Microeconomics

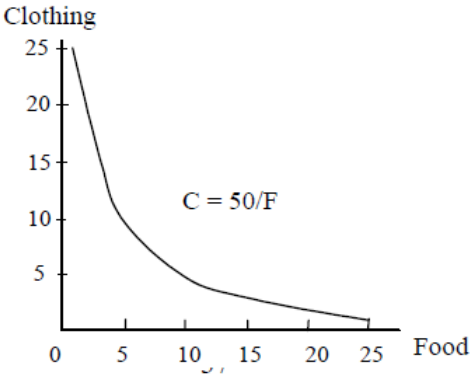
Solutions to Homework #1

1 Chapter 3: Consumer Behavior

Q1: Chapter 3, Exercise 5 in the textbook.

a. With food on the horizontal axis and clothing on the vertical axis, identify on a graph the set of points that give Bridget the same level of utility as the bundle (10,5). Do the same for Erin on a separate graph.

The bundle (10,5) contains 10 units of food and 5 of clothing. Bridget receives utility of 10(10)(5) = 500 from this bundle. Thus, her indifference curve is represented by the equation 10FC = 500 or C = 50/F. Some bundles on this indifference curve are (5,10), (10,5), (25,2), and (2,25). It is plotted in the diagram below. Erin receives a utility of $.2(10^2)(5^2) = 500$ from the bundle (10,5). Her indifference curve is represented by the equation $.2F^2C^2 = 500$, or C = 50/F. This is the same indifference curve as Bridget. Both indifference curves have the normal, convex shape.



b. On the same two graphs, identify the set of bundles that give Bridget and Erin the same level of utility as the bundle (15,8).

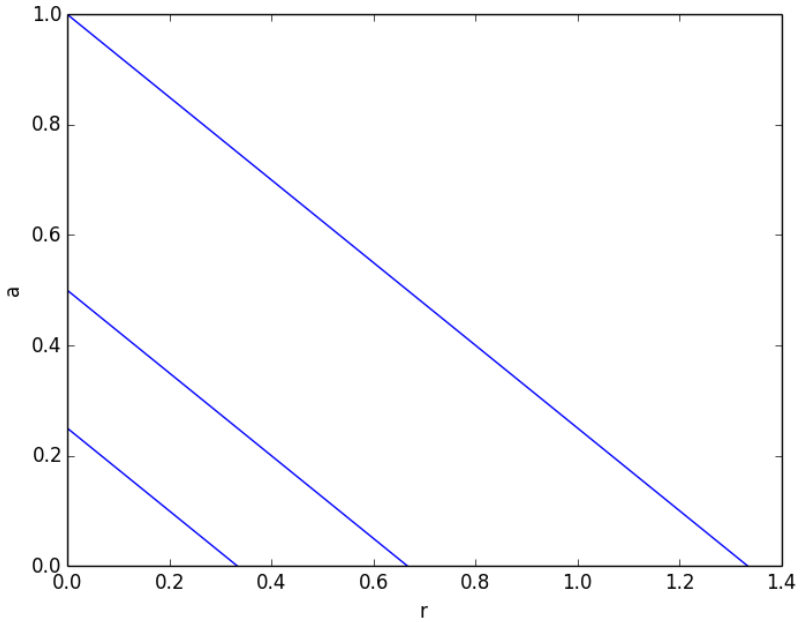
For each person, plug F = 15 and C = 8 into their respective utility functions. For Bridget, this gives her a utility of 1200, so her indifference curve is given by the equation 10FC = 1200, or C = 120/F. Some bundles on this indifference curve are (12,10), (10,12), (3,40), and (40,3). The indifference curve will lie above and to the right of the curve diagrammed in part (a). This bundle gives Erin a utility of 2880, so her indifference curve is given by the equation $.2F^2C^2 = 2880$, or C = 120/F. This is the same indifference curve as Bridget.

c. Do you think Bridget and Erin have the same preferences or different preferences? Explain.

They have the same preferences because their indifference curves are identical. This means they will rank all bundles in the same order. Note that it is not necessary that they receive the same level of utility for each bundle to have the same set of preferences. All that is necessary is that they rank the bundles in the same order.

Q2: Suppose there are two goods: apples (a) and raspberries (r). Suppose that a consumer has a utility of the form: $U(r, a) = 4r + 3a$.

1. Draw the indifference curves for this utility function.



   If we put r on the x-axis and a on the y-axis, then the utility function for a given utility level u can be rewritten as $a = \frac{u}{3} - \frac{4r}{3}$. The indifference curves are linear, and shown for $u = 1, 2, 4$ above.

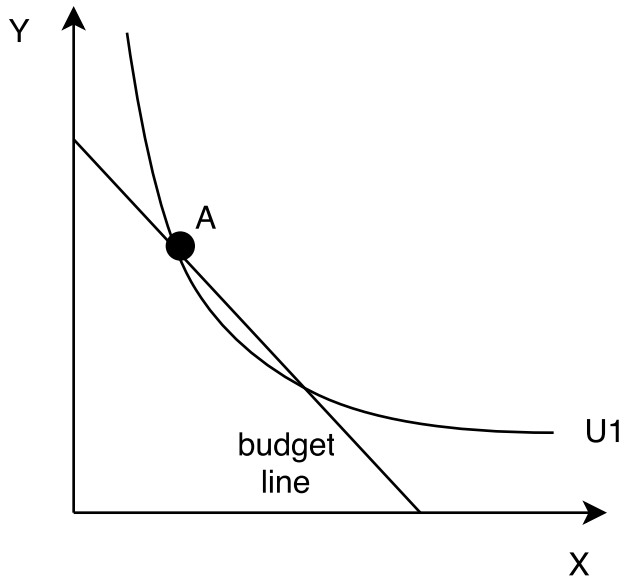
2. What is the marginal rate of substitution between raspberries and apples when the amount consumed is $r = 50$ and $a = 50$? What about at $r = 100, a = 50$?

   The marginal rate of substitution is equal to the slope of the indifference curve, which is given by $\frac{MU_r}{MU_a}$, which is constant for a linear function. The MRS is $4/3$ at every bundle.

3. What type of goods are apples and raspberries for this consumer?

   Since the MRS is constant, these goods are perfect substitutes.

Q3: A consumer whose preferences satisfy the standard assumptions is considering the market bundle A in the figure below, which lies on indifference curve $U1$.



For each of the following statements, say if it is true or false, and give a brief explanation why:

1. A is the consumer's optimal bundle, since the indifference curve intersects the budget line.

   False. The optimal bundle must lie on the highest indifference curve that intersects the budget line. For a curved indifference curve, this will be when it is tangent (that is, has exactly one point in common) to the budget line.

2. At A, the MRS is equal to the slope of the budget line.

   False. The MRS is the slope of the indifference curve, which is equal to the slope of the budget line only if they are tangent.

3. The consumer is not using all of his income at A.

   False. At every point on the budget line, the consumer is using all of his income.

4. The consumer can find another affordable point that is on a higher indifference curve than $U1$.

   True. Since A is not the optimal bundle, there must be another affordable bundle that gives a higher utility, and hence lies on a higher indifference curve.

5. The consumer should consume more of good Y since the MRS exceeds the price ratio at A.

   False. Indifference curves reach higher and higher utility as they move up and to the right. Since indifference curves cannot cross, moving from A to a point with more of

good Y will decrease utility. Instead, the consumer should move down the budget line (that is, consume more of good X and less of Y).

Q4: Chapter 3, Exercise 14 in the textbook.

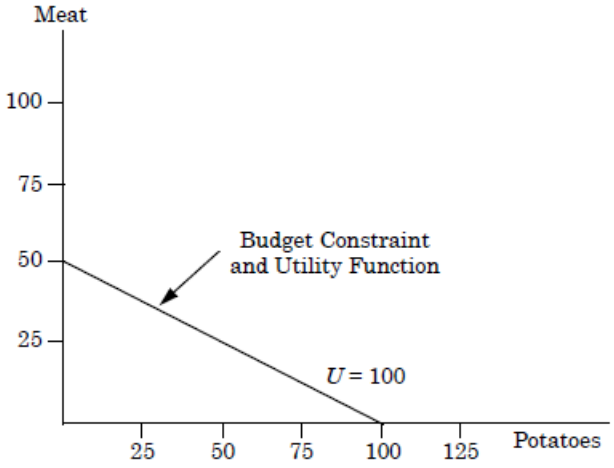
a. Suppose meat costs $4 per pound and potatoes $2 per pound. Draw her budget constraint.

Let M = meat and P = potatoes. Connie's budget constraint is

$$4M + 2P = 200, \text{ or}$$

$$M = 50 - 0.5P.$$

As shown in the figure below, with M on the vertical axis, the vertical intercept is 50 pounds of meat. The horizontal intercept may be found by setting $M = 0$ and solving for P. The horizontal intercept is therefore 100 pounds of potatoes.

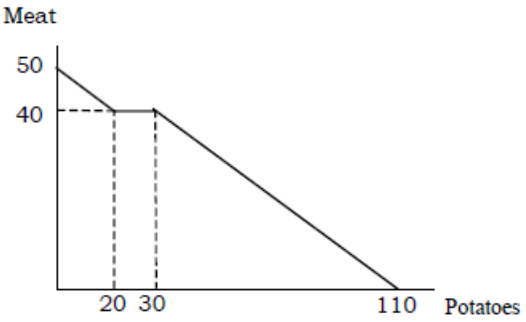


b. Suppose also that her utility function is given by the equation U(M, P) = 2M + P. What combination of meat and potatoes should she buy to maximize her utility? (*Hint*: Meat and potatoes are perfect substitutes.)

When the two goods are perfect substitutes, the indifference curves are linear. To find the slope of the indifference curve, choose a level of utility and find the equation for a representative indifference curve. Suppose U = 50, then 2M + P = 50, or M = 25 – 0.5P. Therefore, Connie's budget line and her indifference curves have the same slope. This indifference curve lies below the one shown in the diagram above. Connie's utility is equal to 100 when she buys 50 pounds of meat and no potatoes or no meat and 100 pounds of potatoes. The indifference curve for U = 100 coincides with her budget constraint. Any combination of meat and potatoes along this line will provide her with maximum utility.

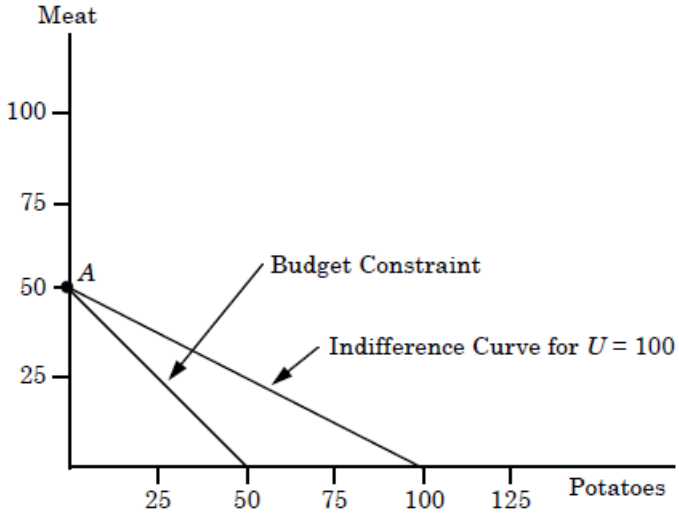
c. Connie's supermarket has a special promotion. If she buys 20 pounds of potatoes (at $2 per pound), she gets the next 10 pounds for free. This offer applies only to the first 20 pounds she buys. All potatoes in excess of the first 20 pounds (excluding bonus potatoes) are still $2 per pound. Draw her budget constraint.

With potatoes on the horizontal axis, Connie's budget constraint has a slope of –1/2 until Connie has purchased twenty pounds of potatoes. Then her budget line is flat from 20 to 30 pounds of potatoes, because the next ten pounds of potatoes are free, and she does not have to give up any meat to get these extra potatoes. After 30 pounds of potatoes, the slope of her budget line becomes –1/2 again until it intercepts the potato axis at 110.



d. An outbreak of potato rot raises the price of potatoes to $4 per pound. The supermarket ends its promotion. What does her budget constraint look like now? What combination of meat and potatoes maximizes her utility?

With the price of potatoes at $4, Connie may buy either 50 pounds of meat or 50 pounds of potatoes, or any combination in between. See the diagram below. She maximizes utility at $U = 100$ at point A when she consumes 50 pounds of meat and no potatoes. *This is a corner solution.*

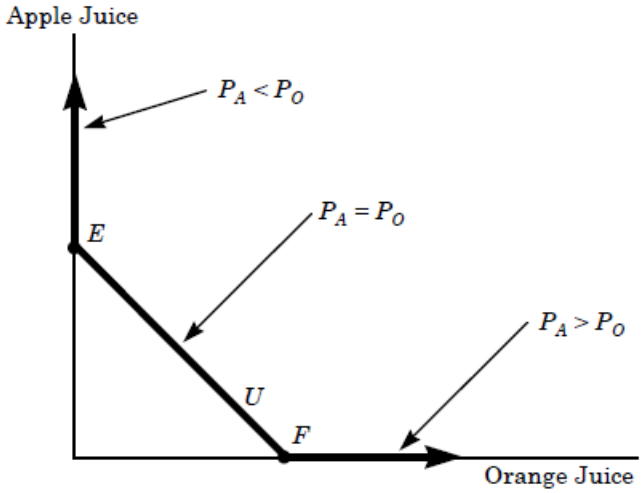


Q5: Chapter 4, Exercise 4 in the textbook.

4. a. Orange juice and apple juice are known to be perfect substitutes. Draw the appropriate price-consumption curve (for a variable price of orange juice) and income-consumption curve.

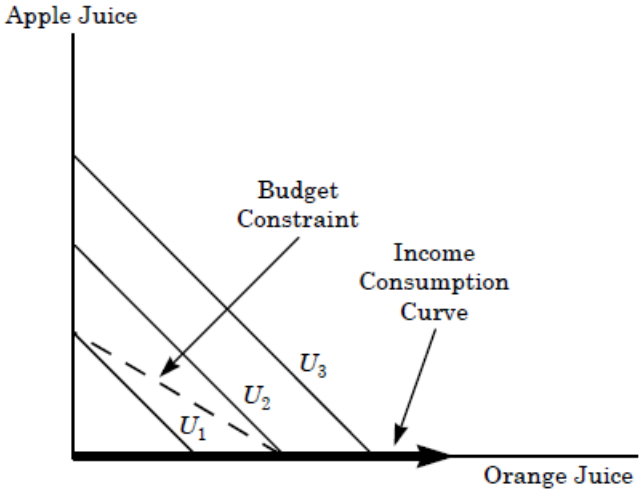
We know that indifference curves for perfect substitutes are straight lines like the line EF in the price-consumption curve diagram below. In this case, the consumer always purchases the cheaper of the two goods (assuming a one-for-one tradeoff).

If the price of orange juice is less than the price of apple juice, the consumer will purchase only orange juice and the price-consumption curve will lie along the orange juice axis of the graph (from point F to the right).



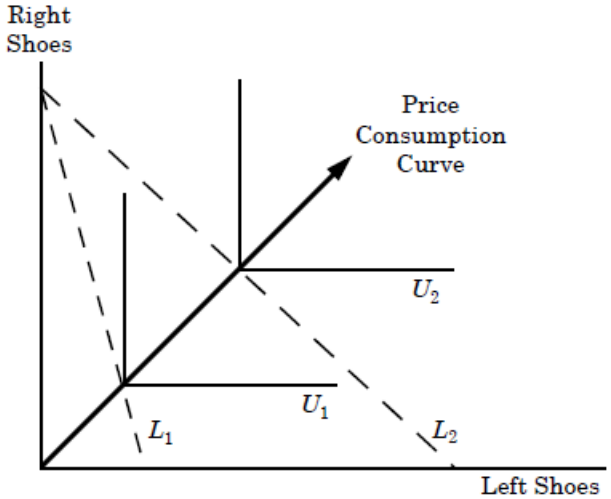
If apple juice is cheaper, the consumer will purchase only apple juice and the price-consumption curve will be on the apple juice axis (above point E). If the two goods have the same price, the consumer will be indifferent between the two; the price-consumption curve will coincide with the indifference curve (between E and F).

Assuming that the price of orange juice is less than the price of apple juice, the consumer will maximize her utility by consuming only orange juice. As income varies, only the amount of orange juice varies. Thus, the income-consumption curve will be the orange juice axis in the figure below. If apple juice were cheaper, the income-consumption curve would lie on the apple juice axis.

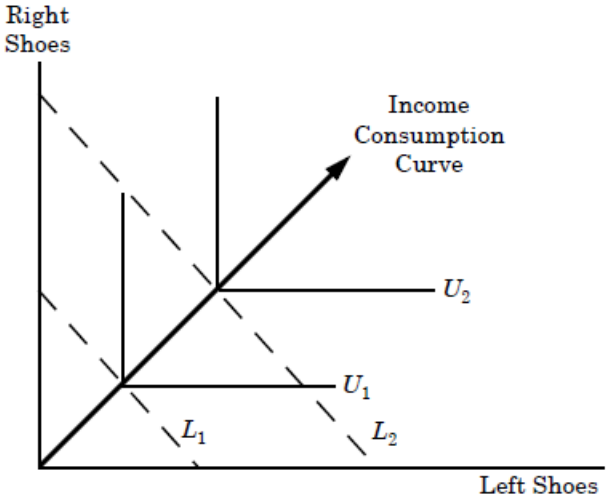


4. b. Left shoes and right shoes are perfect complements. Draw the appropriate price-consumption and income-consumption curves.

For perfect complements, such as right shoes and left shoes, the indifference curves are L-shaped. The point of utility maximization occurs when the budget constraints, L_1 and L_2 touch the kink of U_1 and U_2. See the following figure.



In the case of perfect complements, the income consumption curve is also a line through the corners of the L-shaped indifference curves. See the figure below.



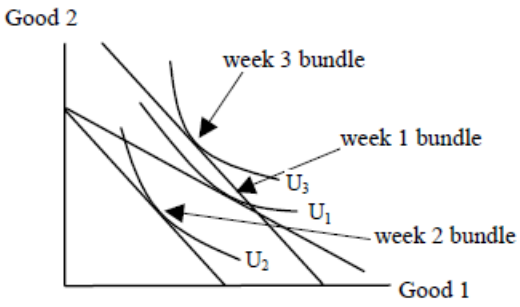
Q6: Chapter 4, Exercise 5 in the textbook.

5. Each week, Bill, Mary, and Jane select the quantity of two goods, X_1 and X_2, that they will consume in order to maximize their respective utilities. They each spend their entire weekly income on these two goods.

a. Suppose you are given the following information about the choices that Bill makes over a three-week period:

	x_1	x_2	P_1	P_2	I
Week 1	**10**	**20**	**2**	**1**	**40**
Week 2	**7**	**19**	**3**	**1**	**40**
Week 3	**8**	**31**	**3**	**1**	**55**

Did Bill's utility increase or decrease between week 1 and week 2? Between week 1 and week 3? Explain using a graph to support your answer.

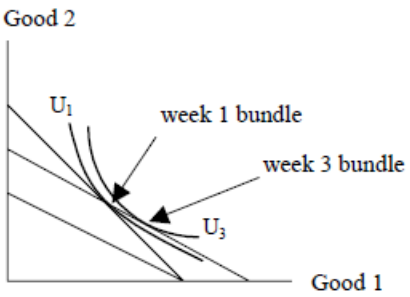


Bill's utility fell between weeks 1 and 2 because he consumed less of both goods in week 2. Between weeks 1 and 2 the price of good 1 rose and his income remained constant. The budget line pivoted inward and he moved from U_1 to a lower indifference curve, U_2, as shown in the diagram. Between week 1 and week 3 his utility rose. The increase in income more than compensated him for the rise in the price of good 1. Since the price of good 1 rose by \$1, he would need an extra \$10 to afford the same bundle of goods he chose in week 1. This can be found by multiplying week 1 quantities times week 2 prices. However, his income went up by \$15, so his budget line shifted out beyond his week 1 bundle. Therefore, his original bundle lies within his new budget set as shown in the diagram, and his new week 3 bundle is on the higher indifference curve U_3.

b. Now consider the following information about the choices that Mary makes:

	x_1	x_2	P_1	P_2	I
Week 1	**10**	**20**	**2**	**1**	**40**
Week 2	**6**	**14**	**2**	**2**	**40**
Week 3	**20**	**10**	**2**	**2**	**60**

Did Mary's utility increase or decrease between week 1 and week 3? Does Mary consider both goods to be normal goods? Explain.



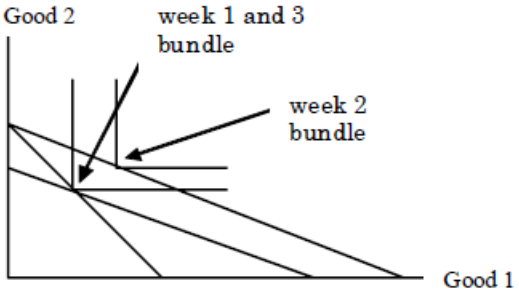
Mary's utility went up. To afford the week 1 bundle at the new prices, she would need an extra \$20, which is exactly what happened to her income. However, since she could have chosen the original bundle at the new prices and income but did not, she must have found a bundle that left her slightly better off. In the graph to the right, the week 1 bundle is at the point where the week 1 budget line is tangent to indifference curve U_1, which is also the intersection of the week 1 and week 3 budget lines.

The week 3 bundle is somewhere on the week 3 budget line that lies above the week 1 indifference curve. This bundle will be on a higher indifference curve, U_3 in the graph, and hence Mary's utility increased. A good is normal if more is chosen when income increases. Good 1 is normal because Mary consumed more of it when her income increased (and prices remained constant) between weeks 2 and 3. Good 2 is not normal, however, because when Mary's income increased from week 2 to week 3 (holding prices the same), she consumed less of good 2. Thus good 2 in an inferior good for Mary.

c. Finally, examine the following information about Jane's choices:

	x_1	x_2	P_1	P_2	I
Week 1	**12**	**24**	**2**	**1**	**48**
Week 2	**16**	**32**	**1**	**1**	**48**
Week 3	**12**	**24**	**1**	**1**	**36**

Draw a budget line-indifference curve graph that illustrates Jane's three chosen bundles. What can you say about Jane's preferences in this case? Identify the income and substitution effects that result from a change in the price of good X_1.



In week 2, the price of good 1 drops, Jane's budget line pivots outward and she consumes more of both goods. In week 3 the prices remain at the new levels, but Jane's income is reduced. This leads to a parallel leftward shift of her budget line and causes Jane to consume less of both goods. Notice that Jane always consumes the two goods in a fixed 1:2 ratio. This means that Jane views the two goods as perfect complements, and her indifference curves are L-shaped. Intuitively if the two goods are complements, there is no reason to substitute one for the other during a price change, because they have to be consumed in a set ratio. Thus the substitution effect is zero. When the price ratio changes and utility is kept at the same level (as happens between weeks 1 and 3), Jane chooses the same bundle (12, 24), so the substitution effect is zero.

The income effect can be deduced from the changes between weeks 1 and 2 and also between weeks 2 and 3. Between weeks 2 and 3 the only change is the \$12 drop in income. This causes Jane to buy 4 fewer units of good 1 and 8 less units of good 2. Because prices did not change, this is purely an income effect. Between weeks 1 and 2, the price of good 1 decreased by \$1 and income remained the same. Since Jane bought 12 units of good 1 in week 1, the drop in price increased her purchasing power by (\$1)(12) = \$12. As a result of this \$12 increase in real income, Jane bought 4 more units of good 1 and 8 more of good 2. We know there is no substitution effect, so these changes are due solely to the income effect, which is the same (but in the opposite direction) as we observed between weeks 1 and 2.