Problem Set # 5

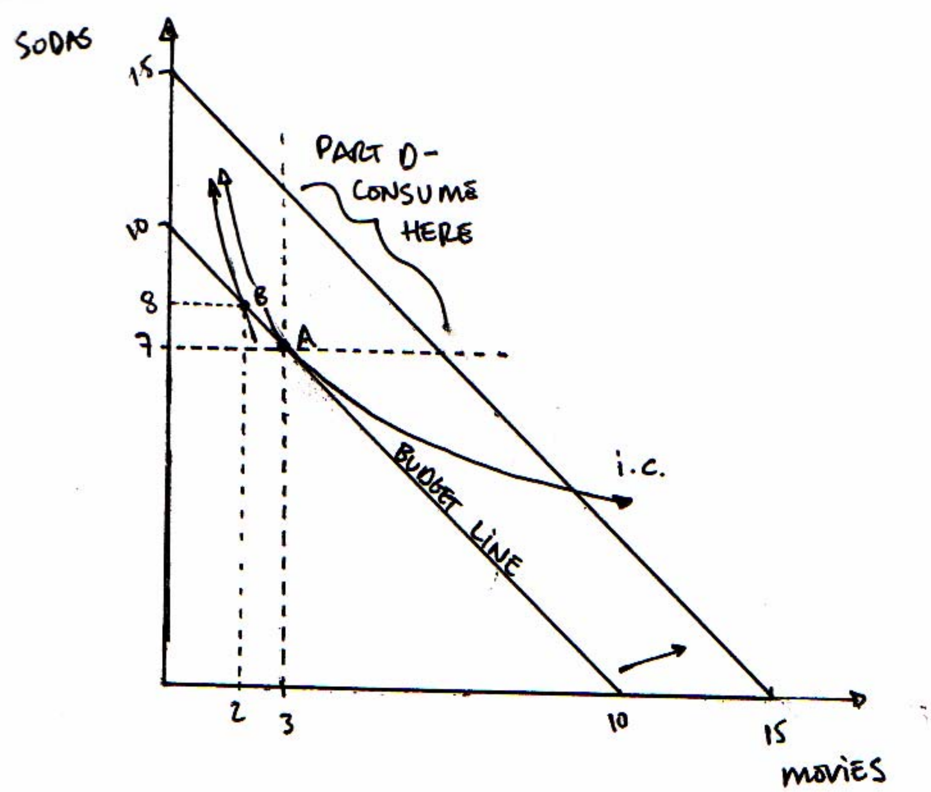
Unless told otherwise, assume that individuals think that more of any good is better (that is, marginal utility is positive). Also assume that indifference curves have their "normal" shape, that is, the MRS becomes "flatter" as you move along the x axis for any indifference curve.

1. Suppose a consumer has income of 10, and buys soda pop and movies. The price of each good is 1.
   A. Draw a budget line that represents the set of bundles this individual can afford if they use all their income. (Put movies on the X axis). Label the places where the budget line intercepts each axis and the slope of the line.
   B. Suppose that in consumer equilibrium this individual consumes 7 soda pops and 3 movies. What rules must hold in consumer equilibrium? Label this bundle in your drawing (call it point "A"). Draw an indifference curve associated with this bundle, and explain how its slope at the equilibrium point relates to the slope of the budget line.
   C. Consider the bundle 2 Movies and 8 Sodas. Label this point. What can you say about the slope of the indifference curve that passes through the point? (For example, is it bigger than, equal to, or smaller than -1?)
   D. Now suppose that income goes up to 15. Illustrate how the budget constraint will change. If both goods are normal, explain where the new equilibrium will be (your answer might consist of a region of bundles, rather than just one bundle).

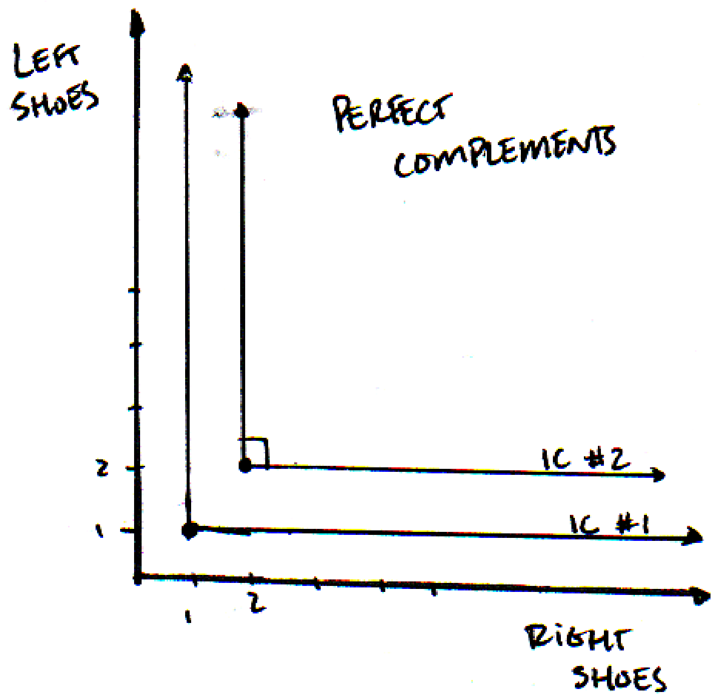
In consumer equilibrium, income is exhausted and MU per dollar spent is the same for all goods. In a picture, the equilibrium bundle will be on the budget line at a point where the indifference curve is tangent to the budget line.

Regarding part C, we know that at the point 8 sodas and 2 movies the slope of the IC will be steeper than the budget line, reflecting the fact that if we give up one soda, we will be able to afford so many more movies that our utility will rise.

If both goods are normal, than we know that as income rises we will consume more of both goods. Thus, only points on the new budget line associated with both more movies and more soda are possible



2. Suppose that goods A and B are perfect compliments. Draw a set of indifference curves for perfect compliments, and explain why the curves look the way they do. Be able to do the same for perfect substitutes.



3. Suppose that you consume two things: ND football games and french fries. Your income is 60, the price of football games is 20, and the price of a serving of fries is 10 (expensive fries!). Consider this table of marginal utilities:

Quantity	MU from football	MU from servings of fries
1	200	100
2	150	75
3	100	50
4	50	20
5	25	10
6	20	5

A. What is the opportunity cost of going to a football game?
The OC of a football game is 2 servings of french fries.

B. Your study friend Mr. Silly notes that if you consume one football game, and one serving of fries, the marginal utility per dollar spent from both goods is 10. So is this the equilibrium?
No, because not all your income is spent. So we could increase utility by spending more of our income on things.

C. Suppose that you consumed 1 football game and 4 servings of fries. Why is this not the equilibrium? What is the equilibrium?
At this point, the marginal utilities per dollar spent are not equal—you would raise utility by consuming more football and less fries (you should confirm this). If you make a table like we did in class, you will be see that at two games and two

servings of fries, income is exhausted and MU per dollar spent is the same for both goods, so this is the equilibrium.

4. Again, suppose you consume ND football games and french fries. As before, your income is 60, the price of football games is 20, and the price of a serving of fries is 10.

Now, suppose that the marginal utility you get for consuming your last serving of fries is $\frac{1}{2\,fries}$, where *fries* is the total servings you consumed. For example, if you consumed 5 servings of fries, your marginal utility from the fifth serving would be $\frac{1}{2*5}=\frac{1}{10}$.

Similarly, the marginal utility from the last football game you go to is $\frac{1}{games}$. So, for example, if you went to 3 games, the last game would give you a marginal utility of $\frac{1}{3}$.

A. What must be true about marginal utility per dollar spend on fries and football games in equilibrium? Based on this, figure our what the ratio of football games to fries must be in equilibrium (I asked you to do something similar in problem #7 of problem set 4).

This is a fun problem! We know in equilibrium marginal utility per dollar spent will be equal for all goods. That is, $\frac{MU_{games}}{P_{games}}=\frac{MU_{fries}}{P_{fries}}$. *From the problem, we can write this as* $\frac{\frac{1}{games}}{P_{games}}=\frac{\frac{1}{2\,fries}}{P_{fries}} \Rightarrow \frac{1}{games*P_{games}}=\frac{1}{2\,fries*P_{fries}}$. *Plugging in for prices, we see* $\frac{1}{games*20}=\frac{1}{2\,fries*10} \Rightarrow 20\,fries=20\,games \Rightarrow fries=games$. *We'll consume the same number of fries and games in equilibirum*

B. Recall that for all for any model with two goods *X* and *Y*, on the budget line it must be true that $P_x X + P_y Y = M$, where $P_x X$ is the total amount you spend on good X, $P_y Y$ is what you spend on *Y*, and *M* is income. Write down the budget line for this problem, putting the information for prices and income into this equation. You should be left with an equation that has two variables, *fries* and *games*.

So the equation is $20\,games + 10\,fries = 60$

C. Using your answer to part A, substitute for one of the variables in part B, so that now the budget-line equation is only an equation with one variable. Solve this equation. What is the equilibrium quantity of games and fries consumed?

If we substitute in for, say, games, we get $20games + 10games = 60$; *we consume 2 games in equilibrium. From part A we then know that we consume 2 servings of fries in equilibrium as well.*

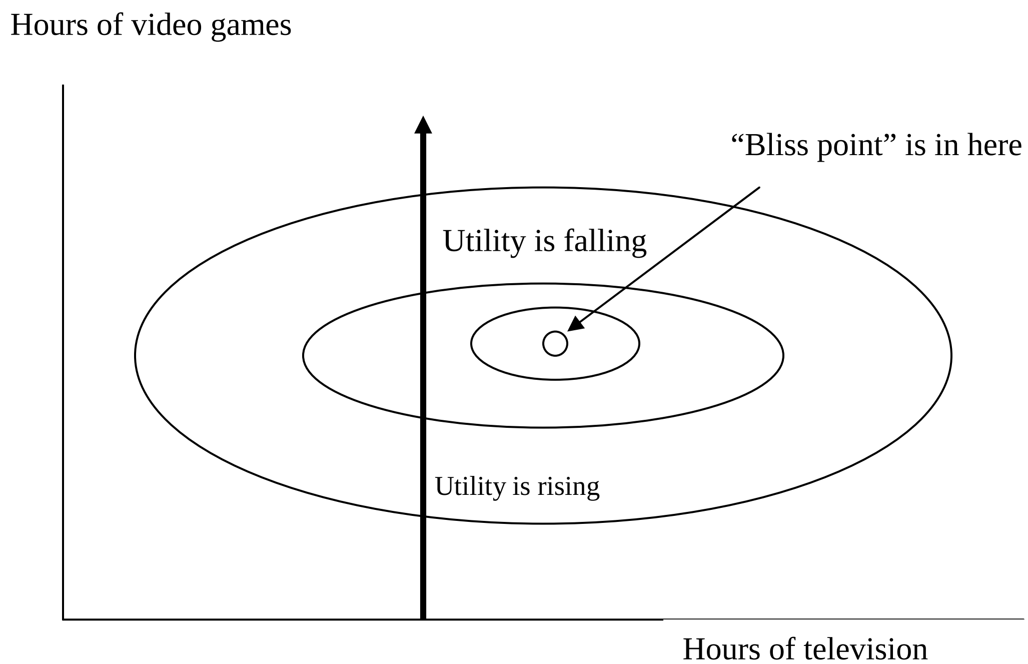
5. Repeat problem 4, but now suppose that the marginal utility of fries is just $\frac{1}{fries}$.

Now what is the equilibrium? (It is okay if the equilibrium has fractions).

Now, if you solve part A you find that you consume twice as many fries in equilibrium as games (that is, fries = 2games). Plug this into the budget line and you get that the equilibrium is 3/2 games and 3 servings of fries.

6. Repeat problem 4 (so use the original marginal utility of fries), but now suppose that the price of a football game is 40. Now what is the equilibrium?
As in part A of problem 5, you find here that in equilibrium fries = 2games. But now when you plug things into the budget line, you should get that you go to one game in equilibrium, and consume 2 servings of fries.

7. Consider a set of indifference curves that looks like this:



Suppose that utility rises as we head towards the center of these circles. Is the set of preferred bundles convex? From the picture above, is there any evidence that this person's preferences violate the law of diminishing marginal utility? Intuitively explain how preferences might look like this (in other words, tell me what is happening to this person's satisfaction from consuming tv and video games).

For each indifference curve, the set of preferred bundles is the area inside the circle, and it is a convex set.

There is no evidence that the law of diminishing marginal utility is violated. To see this, consider picking a point on the x-axis and moving straight up. Looking at the indifference curves as we do so shows us what happens to total utility as we increase consumption of video games—in other words, it shows us the marginal utility of video games. At first, as we move towards the innermost circles, our total utility is rising, so marginal utility is positive (and it could be either increasing or decreasing). Then, as we start to leave the innermost circles, our utility starts to fall—suggesting that marginal utility is now negative. The same logic applies if we started at the y-axis and moved horizontally to the right (in which case we would be learning about the marginal utility of hours of television). So there is nothing in the picture that suggests that the law of diminishing marginal utility is violated.

Intuitively, this is a picture of an individual who most prefers a certain amount of television and a certain amount of movies, and is actually made worse off if they consume more than these most-preferred levels. We can imagine that at the center of all of the circles there is a point that gives the person the desired amount of both goods at once, this is called the "bliss point." A person would choose this point over any other—even if offered a huge amount of video games and hours of television, they would choose the bliss point.

8. Suppose that the utility from consuming hours of studying (denoted *s*) and consuming hours of chilling out (denoted *c*) can be represented by the following *maringal utility* functions

$$mu(s) = 1/s$$

$$mu(c) = 1/c$$

where *mu*(*s*) is the marginal utility gained from the last hour of studying, and similarly for *mu*(*c*). Suppose the price of studying is 1$, and the price of chilling out is 3$. What will be the ratio of studying to chilling out in the consumer's equilibrium? In other words, in equilibrium, what will the ratio of *s* over *c* be equal to?

Rule 2 of consumer equilibrium says that

$$\frac{mu(s)}{P_s} = \frac{mu(c)}{P_c} \quad \Rightarrow \quad \frac{mu(s)}{1} = \frac{mu(c)}{3}$$

or,

$$3mu(s) = mu(c) \quad \Rightarrow \quad 3/s = 1/c$$

so

$$3 = s/c$$

So this consumer will spend three times as much on studying as they will on chilling out.