In class exercise

Q1.

A. C: chicken sandwich, F: French Fries

Budget constraint: $6C + 2F \leq 18$

B. P(C)=6, P(F)=2, C: chicken sandwich quantity, F: French Fries quantity

U(C): Utility of chicken sandwich, U (F): Utility of French Fries

MU(C): Marginal Utility of chicken sandwich, MU (F): Marginal Utility of French Fries

MU(C)/P(C): Marginal Utility of chicken sandwich per dollar

MU (F)/P(F): Marginal Utility of French Fries per dollar

<u>**Method 1**</u>**: PRICINPLE OF RATIONAL CHOICE(not recommended!).** This will not give your correct answers all the time, unless you have a continuously differentiable utility function. (Don't worry if you don't know "continuously differentiable".) You need to use method 2 to check it. By the principle of rational choice,

$$MRS_{FC} = \frac{P_F}{P_C} = \frac{2}{6} = \frac{1}{3}$$

<u>**Method 2:**</u> **GO THROUGH THE TABLE.** This method is quite messy, but it will always give you the correct answer.

Based on the conditions, we have the following table.

C	U(C)	MU(C)	MU(C)/P(C)	F	U(F)	MU(F)	MU(F)/P(F)
0	0			0	0		
1	15	15	2.5	1	11	11	5.5
2	25	10	1.67	2	21	10	5
3	31	6	1	3	30	9	4.5
4	34	3	0.5	4	37	7	3.5
5	36	2	0.33	5	42	5	2.5
				6	47	5	2.5
				7	51	4	2
				8	53	2	1
				9	55	2	1
				10	56	1	0.5

In order to maximize the total utility, you need to maximize the utility you obtain from each dollar you spend, i.e. try to maximize (MU/P) of each dollar when you decide whether to buy chicken sandwich or French fries. Follow the following steps:

a. Decide where to spend the first dollar of $18: chicken sandwich or French fries? (See Figure 1) Because MU(F)/P(F)=5.5>MU(C)/P(C)=2.5, so buy French fries first. You spend $2 buying one unit of French fries, then you have $ 16 (=$18-$2) left.

b. Then decide where to spend your next dollar. (See Figure 2) Because MU(F)/P(F) of the second unit French fries=5>MU(C)/P(C)=2.5, so buy second unit of French fries. You spend $2 buying one unit of French fries, then you will have $ 14 (=$16-$2) left.
c. Repeat the same steps as above. After you bought 6th unit of French fries, you have $6 (=$18-$12) left. Then you determine where to spend your next dollar. (See Figure 3) Because MU(F)/P(F) of the 7th unit French fries=2<MU(C)/P(C)=2.5, so buy one unit of chicken sandwich. You spend $6 in buying one unit of chicken sandwich, then you have $0 (=$6-$6)

In a word, <u>the consumption bundle to maximize your utility is 1 unit of chicken sandwich and 6 units of French fries</u>. The Marginal utility of 1st unit of chicken sandwich is 15, the Marginal utility of 6th unit of chicken sandwich is 5. Then,

$$MRS_{FC} = \frac{MU_F}{MU_C} = \frac{5}{15} = \frac{1}{3}$$

(We see that method 2 and method 1 have the same answer in this problem, but you will see they are different in the next problem.)

C	U(C)	MU(C)	MU(C)/P(C)	F	U(F)	MU(F)	MU(F)/P(F)
0	0			0	0		
1	15	15	2.5	1	11	11	5.5
2	25	10	1.67	2	21	10	5
3	31	6	1	3	30	9	4.5
4	34	3	0.5	4	37	7	3.5
5	36	2	0.33	5	42	5	2.5
				6	47	5	2.5
				7	51	4	2
				8	53	2	1
				9	55	2	1
				10	56	1	0.5

Figure 1

C	U(C)	MU(C)	MU(C)/P(C)	F	U(F)	MU(F)	MU(F)/P(F)
0	0			0	0		
1	15	15	2.5	1	11	11	5.5
2	25	10	1.67	2	21	10	5
3	31	6	1	3	30	9	4.5
4	34	3	0.5	4	37	7	3.5
5	36	2	0.33	5	42	5	2.5
				6	47	5	2.5
				7	51	4	2
				8	53	2	1
				9	55	2	1
				10	56	1	0.5

Figure 2

C	U(C)	MU(C)	MU(C)/P(C)	F	U(F)	MU(F)	MU(F)/P(F)
0	0			0	0		
1	15	15	2.5	1	11	11	5.5
2	25	10	1.67	2	21	10	5
3	31	6	1	3	30	9	4.5
4	34	3	0.5	4	37	7	3.5
5	36	2	0.33	5	42	5	2.5
				6	47	5	2.5
				7	51	4	2
				8	53	2	1
				9	55	2	1
				10	56	1	0.5

Figure 3

C. P(C)=3, P(F)=2, C: chicken sandwich quantity, F: French Fries quantity

Method 1: (not recommended!)

Method 2:

Based on the conditions, we have the following table.

C	U(C)	MU(C)	MU(C)/P(C)	F	U(F)	MU(F)	MU(F)/P(F)
0	0			0	0		
1	15	15	5	1	11	11	5.5
2	25	10	3.33	2	21	10	5
3	31	6	2	3	30	9	4.5
4	34	3	1	4	37	7	3.5
5	36	2	0.67	5	42	5	2.5
				6	47	5	2.5
				7	51	4	2
				8	53	2	1
				9	55	2	1
				10	56	1	0.5

Similar to above, follow the following steps:

a. Decide where to spend the first dollar of $18: chicken sandwich or French fries? (See Figure 4) Because MU(F)/P(F)=5.5>MU(C)/P(C)=5, so buy French fries first. You spend $2 buying one unit of French fries, then you will have $ 16 (=$18-$2) left.

b. Repeat the same steps as above. After you bought 2nd unit of French fries, you have $14 (=$18-$4) left. Then decide where to spend your next dollar. (See Figure 5) Because MU(F)/P(F) of 3rd unit French fries=4.5<MU(C)/P(C)=5, so buy one unit of chicken sandwich. You spend $3 buying one unit of French fries, then you have $ 11 (=$14-$3) left.

c. Then decide where to spend your next dollar. (See Figure 6) Because MU (F)/P(F) of 3rd unit French fries=4.5>MU(C)/P(C) of 2nd unit chicken sandwich=3.33, so buy 3rd unit of

French fries. You spend \$2 buying one unit of French fries, then have \$ 9 (=\$11-\$2) left. By the same token, you buy 4th unit of French fries and have \$7 (=\$9-\$2) left.

d. Then decide where to spend your next dollar. Because MU (F)/P(F) of 5th unit French fries=2.5<MU(C)/P(C) of 2nd unit chicken sandwich=3.33, so buy 2nd unit of chicken sandwich. You spend \$3 buying one unit of French fries, then you will have \$ 4 (=\$7-\$3) left.

e. Then decide where to spend your next dollar. Because MU (F)/P(F) of 5th unit French fries=2.5>MU(C)/P(C) of 3rd unit chicken sandwich=2, so buy 5th unit of French fries. You spend \$2 buying one unit of French fries and have \$ 2 (=\$4-\$2) left. By the same token, you buy 6th unit of French fries and have \$2 (=\$2-\$2) left.

In a word, <u>the consumption bundle to maximize your utility is 2 unit of chicken sandwich and 6 units of French fries.</u> The Marginal utility of 2nd unit of chicken sandwich is 10, the Marginal utility of 6th unit of chicken sandwich is 5. Then,

$$\mathrm{MRS_{FC}} = \frac{\mathrm{MU_F}}{\mathrm{MU_C}} = \frac{5}{10} = \frac{1}{2}$$

(Note this is different from $\frac{P_F}{P_C} = \frac{2}{3}$)

C	U(C)	MU(C)	MU(C)/P(C)	F	U(F)	MU(F)	MU(F)/P(F)
0	0			0	0		
1	15	15	5	1	11	11	5.5
2	25	10	3.33	2	21	10	5
3	31	6	2	3	30	9	4.5
4	34	3	1	4	37	7	3.5
5	36	2	0.67	5	42	5	2.5
				6	47	5	2.5
				7	51	4	2
				8	53	2	1
				9	55	2	1
				10	56	1	0.5

Figure 4

C	U(C)	MU(C)	MU(C)/P(C)	F	U(F)	MU(F)	MU(F)/P(F)
0	0			0	0		
1	15	15	5	1	11	11	5.5
2	25	10	3.33	2	21	10	5
3	31	6	2	3	30	9	4.5
4	34	3	1	4	37	7	3.5
5	36	2	0.67	5	42	5	2.5
				6	47	5	2.5
				7	51	4	2
				8	53	2	1
				9	55	2	1
				10	56	1	0.5

Figure 5

C	U(C)	MU(C)	MU(C)/P(C)	F	U(F)	MU(F)	MU(F)/P(F)
0	0			0	0		
1	15	15	5	1	11	11	5.5
2	25	10	3.33	2	21	10	5
3	31	6	2	3	30	9	4.5
4	34	3	1	4	37	7	3.5
5	36	2	0.67	5	42	5	2.5
				6	47	5	2.5
				7	51	4	2
				8	53	2	1
				9	55	2	1
				10	56	1	0.5

Figure 6

Some extra exercise

This problem could be more difficult if it is given as follows: P(C)=3, P(F)=2, C: chicken sandwich quantity, F: French Fries quantity. Please find out the consumption bundle that maximizes total utility and the corresponding MRS_{FC}. (Try to do it by yourself and check the answers to see whether you master this method or not.)

C	U(C)	MU(C)	MU(C)/P(C)	F	U(F)	MU(F)	MU(F)/P(F)
0	0			0	0		
1	15	15	5	1	11	11	5.5
2	25	10	3.33	2	21	10	5
3	34	9	3	3	30	9	4.5
4	37	3	1	4	37	7	3.5
5	39	2	0.67	5	42	5	2.5
				6	47	5	2.5
				7	51	4	2
				8	53	2	1
				9	55	2	1
				10	56	1	0.5

Answers:

a. Repeat the same steps of problem C until step e.

b. Now you have bought 2 chicken sandwiches and 4 French fries, and $4 dollars left. Because MU (F)/P(F) of 5th unit French fries=2.5<MU(C)/P(C) of 3rd unit chicken sandwich=3, so buy 3rd unit of chicken sandwich. You spend $3 buying one unit of chicken sandwich and have $ 1 (=$4-$3) left. You can buy nothing more and the utility of your last $4 is 9 (which is MU(C) of 3rd unit of chicken sandwich). **Since you haven't used up all you budget in this consumption bundle (let's call it Choice 1), you have another choice that clears the budget**: buy two more units (i.e. 5th and 6th) of French

fries. Then the utility of your last $4 is 10 (=5+5, which is the sum of MU(F) from 5^{th} and 6^{th} unit of French fries). This utility is bigger than that of choice 1.

Hence, the consumption bundle to maximize total utility is 2 chicken sandwich and 6 French fries, and $0 left.

$$\mathrm{MRS_{FC}} = \frac{\mathrm{MU_F}}{\mathrm{MU_C}} = \frac{5}{10} = \frac{1}{2}$$