

**Week 3**

# **MICROECONOMIC THEORY**

## **ECON 323 502/503**

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Associate Professor Huiyi Guo

Texas A&M University

# Review Marginal Rate of Substitution:

## Marginal Rate of Substitution (MRS)

- The absolute value of the slope of indifference curve:  $MRS = \left| \frac{\Delta y}{\Delta x} \right| = -\frac{\Delta y}{\Delta x}$
- The maximum amount of Good Y the consumer **is willing to** give up when increasing the consumption of Good X by one unit ----- it measures how **valuable** one unit of Good X is in terms of numbers of Good Y
- Mathematical **definition** of MRS:

$$MRS = \frac{MU_x}{MU_y}.$$

# Review Budget Line:

Budget Line: All combinations of goods for which the total amount of money spent is equal to income:

- $P_X * x + P_Y * y = I$
- $y = -\frac{P_X}{P_Y} * x + \frac{I}{P_Y}$
- Slope of budget line is:  $-\frac{P_X}{P_Y}$
- Meaning of  $\frac{P_X}{P_Y}$  : the number of Y the consumer **has to** give up when consuming one extra unit of X, to stay on the budget line ---- it measures how **costly** 1 unit of Good X is in terms of units of Good Y.
- Y-intercept  $\frac{I}{P_Y}$  : the number of Y purchased if all income is spent on Y
- X-intercept  $\frac{I}{P_X}$  : the number of X purchased if all income is spent on X

## 3.3 Consumer Choice:

- We have analyzed preferences
- We have analyzed budget constraint
- Put the two elements together and study how a consumer makes the consumption decision, i.e., how a consumer maximizes the utility given the budget constraint.
- In this class, focus on two cases of utility maximization problems.
  - The Default Case: preferences satisfy diminishing MRS and are smooth.
  - The solution can be identified graphically and analytically.
  - Other Cases: When preferences do not satisfy diminishing MRS or preferences (i.e., indifference curves) are not smooth.
  - Solve the problem with the help of a graph.

## 3.3 Consumer Choice:

### The Default Case: Diminishing MRS and Smooth Preference

Focus on the situation when the utility maximizing market basket  $(x, y)$  is in the **interior** of the first quadrant (i.e.,  $x > 0, y > 0$ ).  $(x, y)$  satisfies two conditions.

1.  $(x, y)$  falls on the budget line, i.e.,

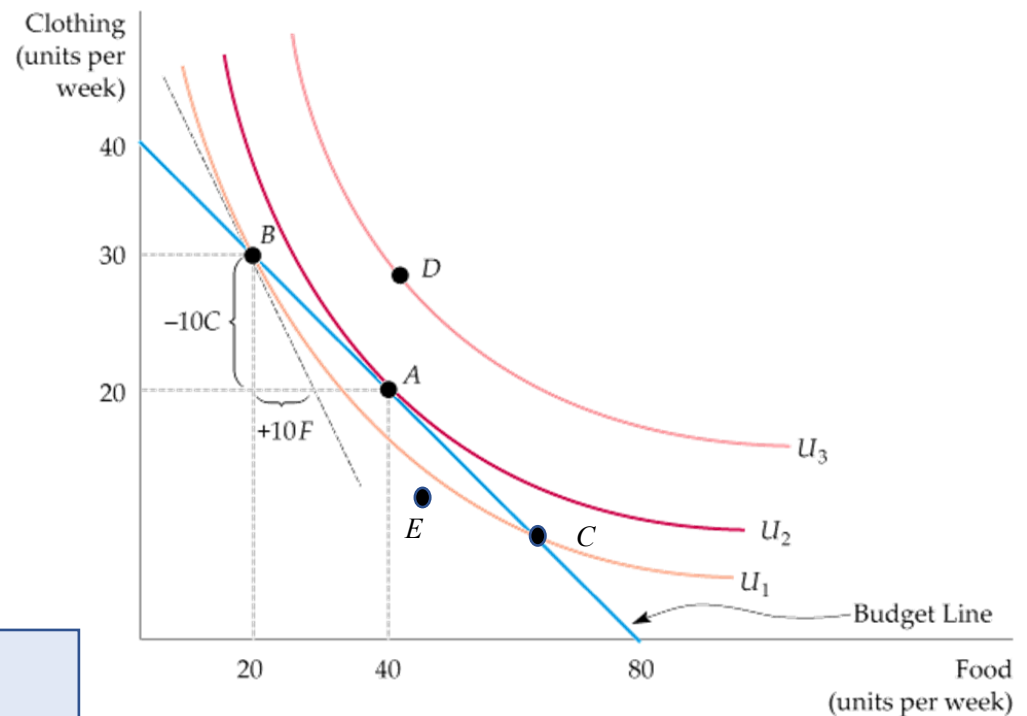
$$P_X * x + P_Y * y = I;$$

2. at  $(x, y)$ , the indifference curve and the budget line are tangent to each other, i.e.,

$$MRS_{XY} = \frac{P_X}{P_Y}.$$

Absolute value of  
slope of the  
indifference curve

Absolute value  
of the slope of  
the budget line



## 3.3 Consumer Choice:

### The Default Case: Diminishing MRS and Smooth Preference

What can this consumer do to improve his/her utility if the consumption bundle is on the budget line but  $MRS_{XY} > \frac{P_X}{P_Y}$ ?

This consumer can increase the consumption of X and decrease Y a bit and still stay on the budget line

What can this consumer do to improve his utility if the consumption bundle is on the budget line but  $MRS_{XY} < \frac{P_X}{P_Y}$ ?

Similarly, one can show that the consumer should increase consumption of Y and decrease X.

## A Homework Question

Bill currently uses his entire budget to purchase some positive units of Pepsi and positive units of hamburgers. The price of Pepsi is \$1 per can, the price of a hamburger is \$2, Bill's current marginal utility from Pepsi is 4, and his current marginal utility from hamburgers is 6. Bill could increase his utility by:

- A) increasing Pepsi consumption and reducing hamburger consumption.
- B) We do not have enough information to answer this question.
- C) increasing hamburger consumption and reducing Pepsi consumption.
- D) decreasing his consumption of both goods.
- E) maintaining his current consumption choices.

Assume for now that Pepsi -- horizontal axis, hamburger -- vertical axis. Then  $MRS = 4/6$  (MU of Pepsi over that of hamburger). The absolute value of slope of budget line  $= 1/2$  (price of Pepsi over that of hamburger). Notice that Bill has already used his entire budget, and  $MRS >$  absolute value of slope of budget line. Benefit from increasing Pepsi and decreasing hamburger. Answer is A.

## 3.3 Consumer Choice:

### The Default Case: Diminishing MRS and Smooth Preference

Example: Suppose a consumer has a utility function  $U(x, y) = x^{0.5}y^{0.5}$ , for which  $MRS_{XY} = \frac{y}{x}$ . Suppose the income level is 100.  $P_X = 10, P_Y = 2$ .

- What is the utility maximization market basket?

Solution:

- Solve for  $(x, y)$  such that

$$1) P_X x + P_Y y = I, \text{ i.e., } 10x + 2y = 100.$$

$$2) MRS_{XY} = \frac{y}{x} = \frac{P_X}{P_Y}, \text{ i.e., } \frac{y}{x} = 5.$$

We can derive from (2) that  $y = 5x$ , then plug into (1).

This gives us  $10x + 2 * (5x) = 100$ . Hence,  $x = 5$ .

Plugging  $x = 5$  into  $y = 5x$ , we have  $y = 25$ .

Hence, the utility maximizing market basket is  $(5, 25)$ .



## 3.3 Consumer Choice:

Other Cases: Solve with the help of a graph

### Example: Linear indifferent curves (perfect substitutes)

Suppose  $P_x=1$ ,  $P_y=2$ , and income  $I=10$ . Utility function is given by  $U(x, y) = 5x+4y$ . What is the utility maximizing market basket?

Solution:

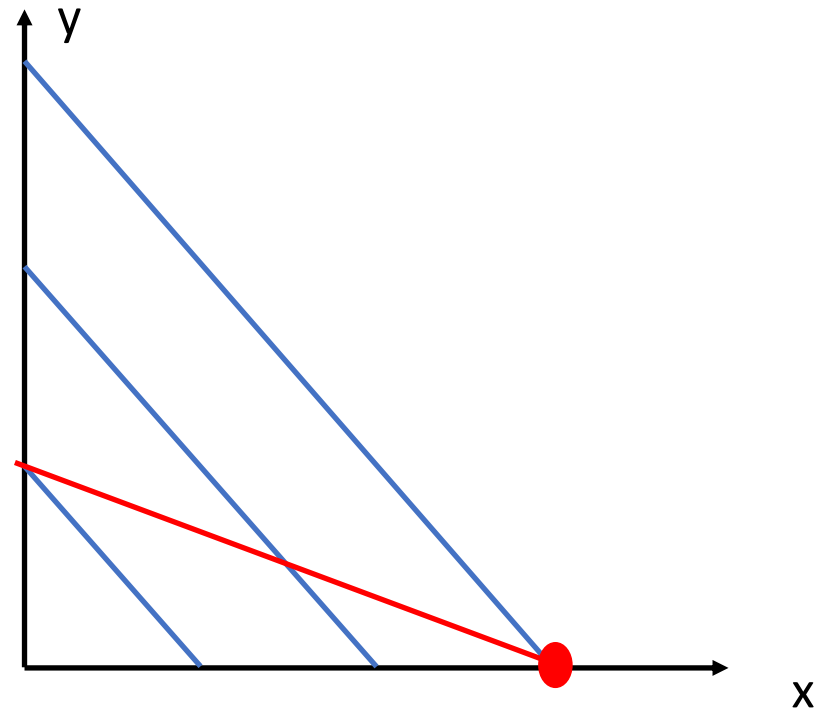
Since utility function is linear, the two goods are perfect substitutes.

To find MRS, set  $5x+4y=1$  (or some other constant number) for example.

Then,  $y = -\frac{5}{4}x + \frac{1}{4}$  and  $MRS_{xy} = \frac{5}{4}$ .

Notice that  $MRS > P_x/P_y$ .

It is optimal to spend all money on Good X and the optimal market basket is  $(I/P_x, 0)$ , i.e.,  $(10, 0)$ .



## 3.3 Consumer Choice:

Other Cases: Solve with the help of a graph

### Example: Linear indifferent curves (perfect substitutes)

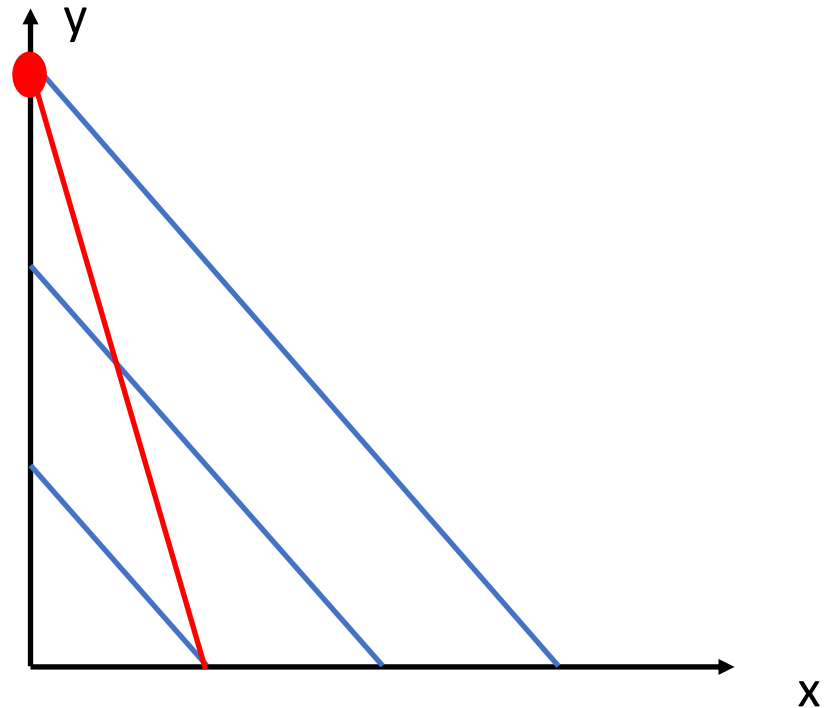
Suppose  $P_x=2$ ,  $P_y=1$ , and income  $I=10$ . Utility function is given by  $U(x, y) = 5x+4y$ . What is the utility maximizing market basket?

Solution:

We know from the previous example that  $MRS = \frac{5}{4}$ .

Notice that  $MRS < P_x/P_y$

It is optimal to spend all money on Good Y and the optimal market basket is  $(0, I/P_y)$ , i.e.,  $(0, 10)$ .



## 3.3 Consumer Choice:

Other Cases: Solve with the help of a graph

### Example: Linear indifferent curves (perfect substitutes)

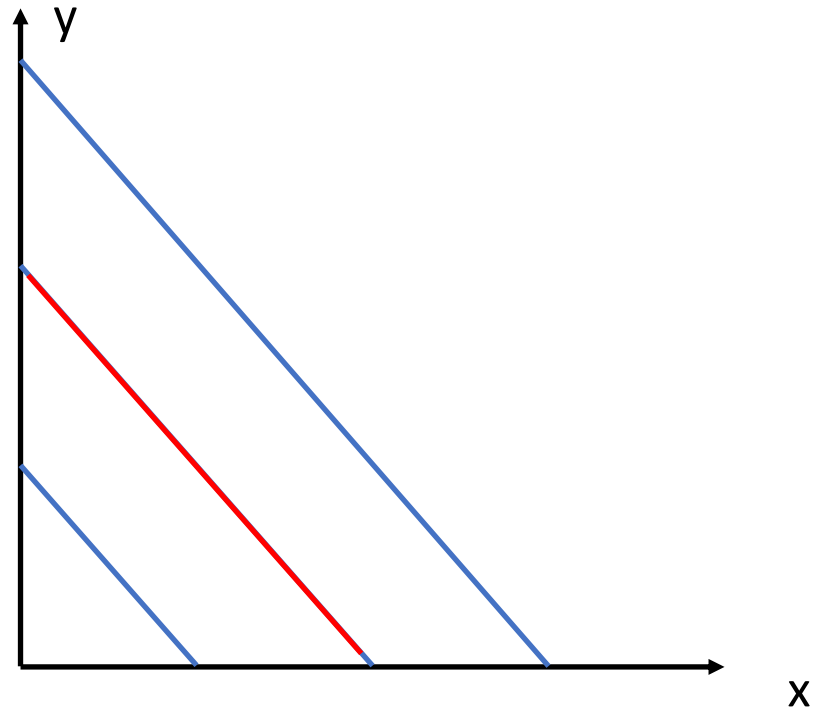
Suppose  $P_x=10$ ,  $P_y=8$ , and income  $I=800$ . Utility function is given by  $U(x, y) = 5x+4y$ . Is there a unique utility maximizing market basket?

Solution:

We know from the previous example that  $MRS = \frac{5}{4}$ .

Notice that  $MRS = P_x/P_y$ .

There are multiple optimal market baskets. Every market basket on the budget line is optimal.



## 3.3 Consumer Choice:

Other Cases: Solve with the help of a graph

### Example: Linear indifferent curves (perfect complements)

Suppose  $P_X=2$ ,  $P_Y=4$ , and income  $I=60$ . Good X and Good Y are perfect complements and the kinks of the indifference curve fall on the line  $y = 2x$ . What is the utility maximizing market basket?

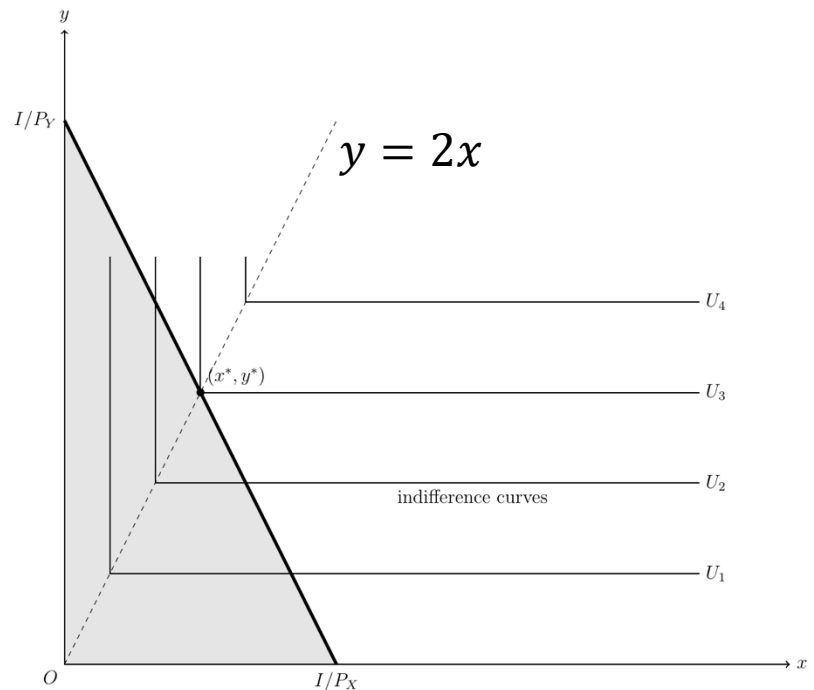
#### Solution:

From the graph, we see that the utility maximizing market basket is at a kink.

$(x^*, y^*)$  satisfies the following system of equations:

- The kinks satisfy  $y = 2x$ .
- The budget line is  $2x + 4y = 60$ .

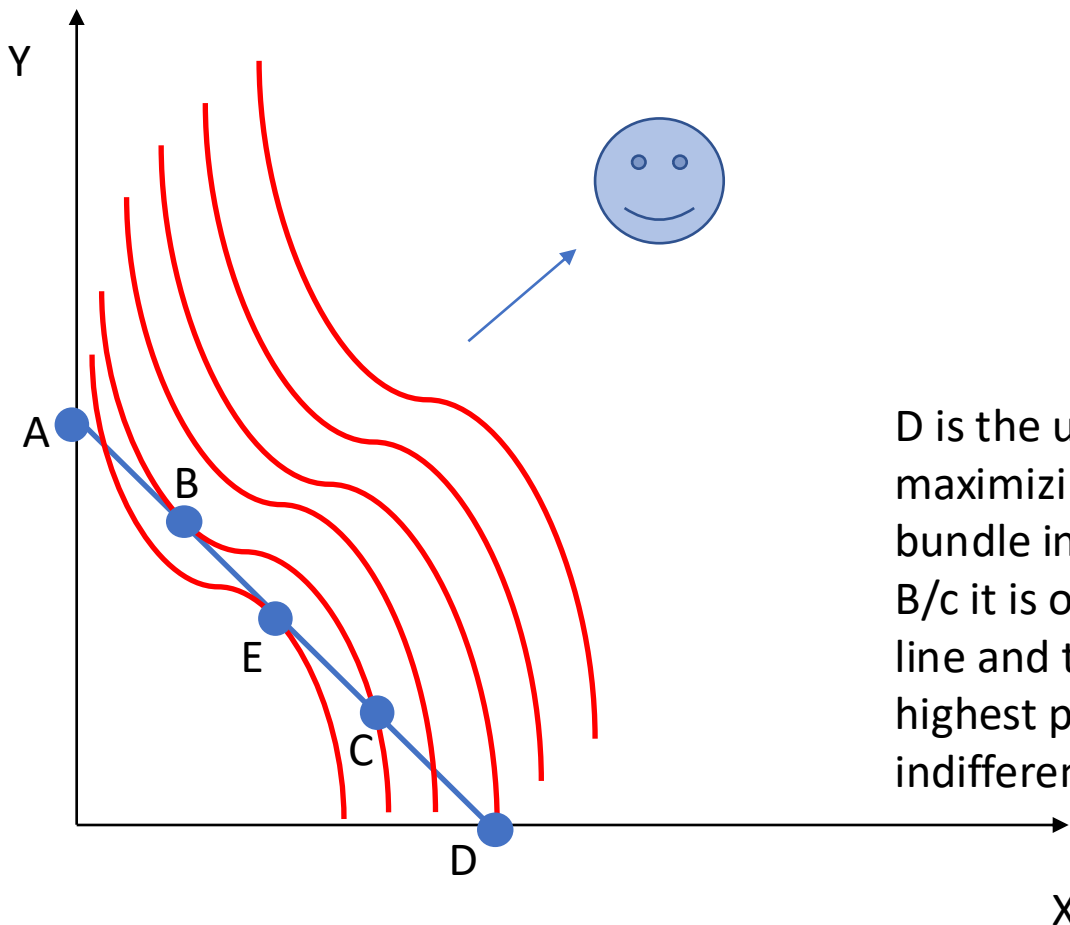
Then you can solve  $(x^*, y^*) = (6, 12)$  from the system of equations.



## 3.3 Consumer Choice:

Other Cases: Solve with the help of a graph

**Crazier indifference map. Find the point on the budget line that touches the highest indifference curve. Notice that the preference does not satisfy the assumption of diminishing MRS.**



D is the utility maximizing consumption bundle in this problem! B/c it is on the budget line and touches the highest possible indifference curve!