

Week 3

MICROECONOMIC THEORY

ECON 323 502/503

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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.,

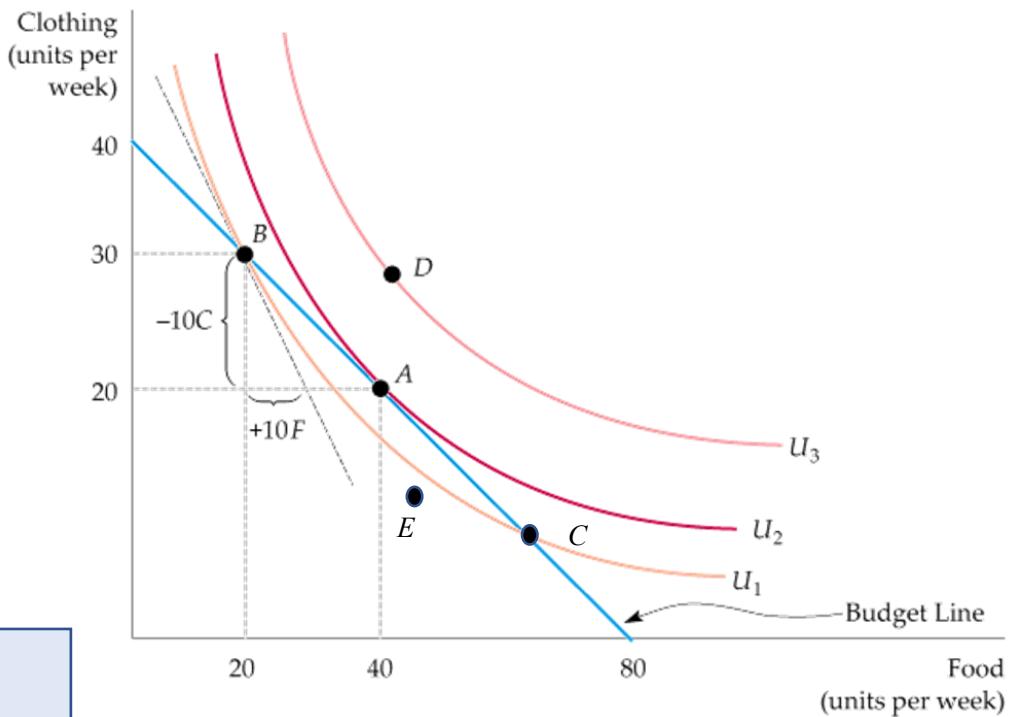
$$P_X * x + P_Y * y = I;$$

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:

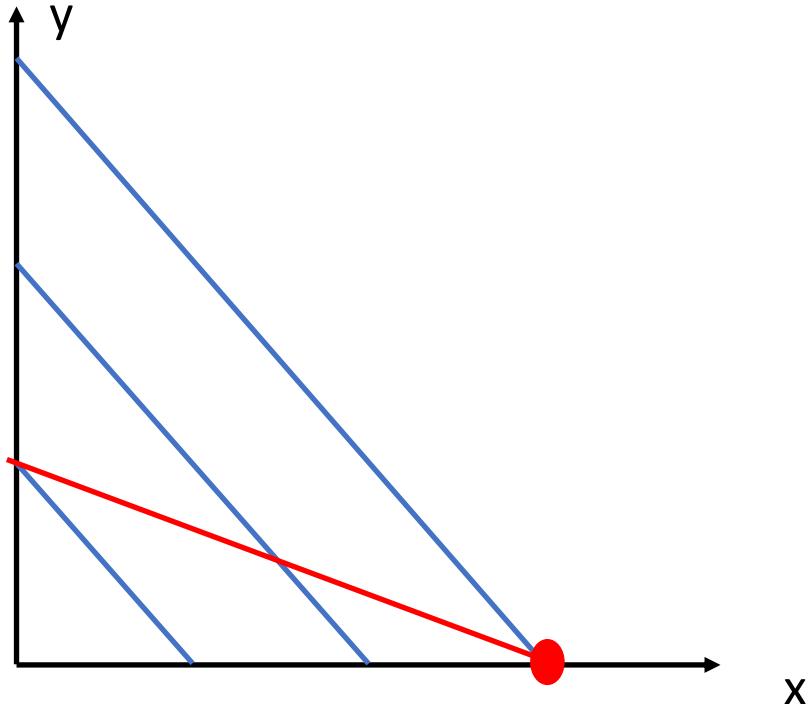
Since utility function is linear, the two goods are perfect substitutes.

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 indifference curves (perfect substitutes)

Suppose $P_x=2$, $P_Y=1$, and income $I=10$. Utility function is given by $U(x, y) = 5x+4y$.

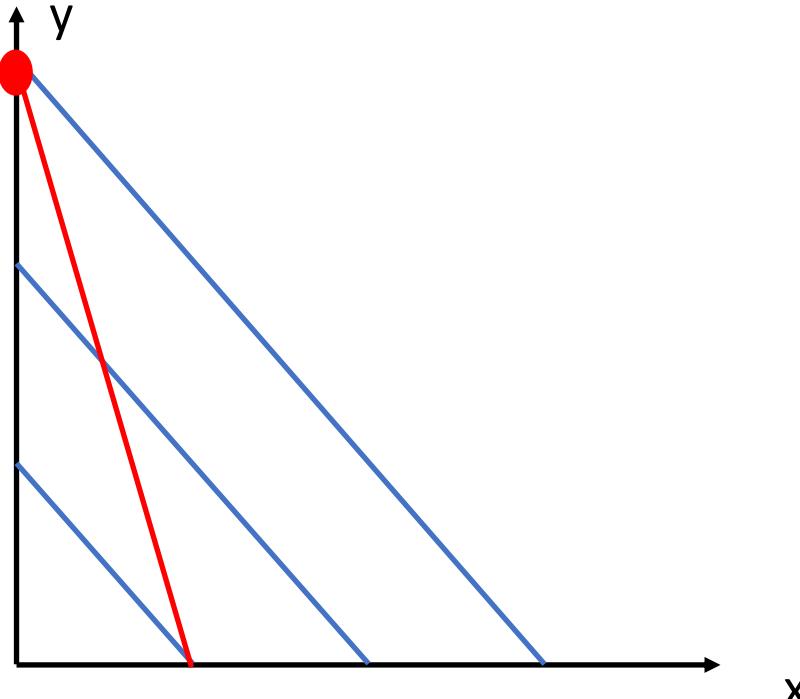
What is the utility maximizing market basket?

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)

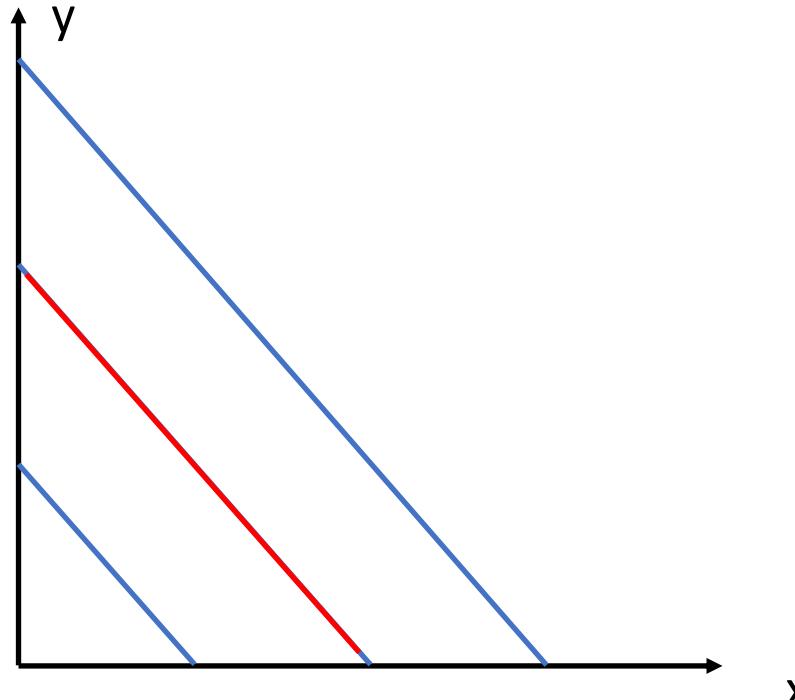
Suppose $P_x=10$, $P_y=8$, and income $I=800$. Utility function is given by $U(x, y) = 5x+4y$. Is there a unique utility maximizing market basket?

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?

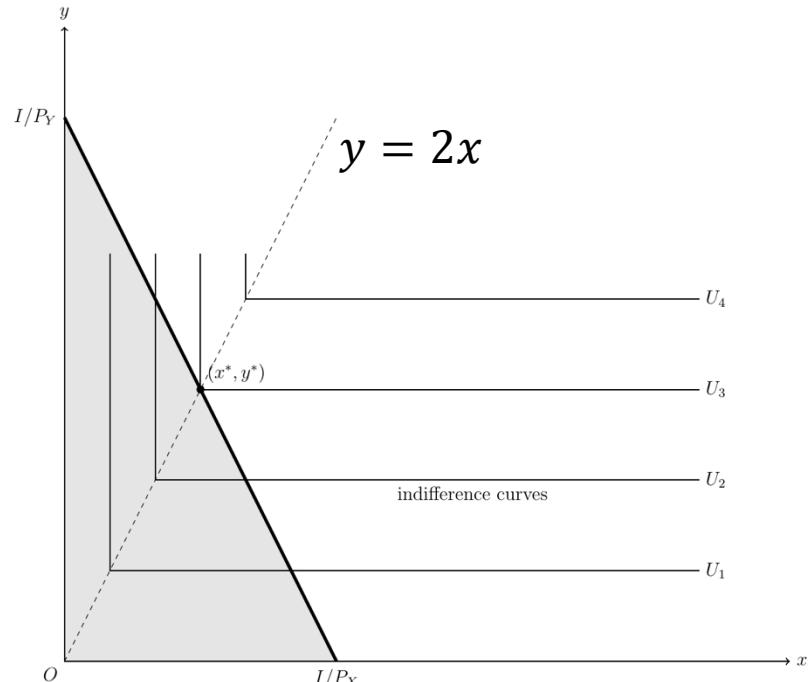
Solution:

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.

