Week 2

MICROECONOMIC THEORY
ECON 323 502/503

Spring 2026

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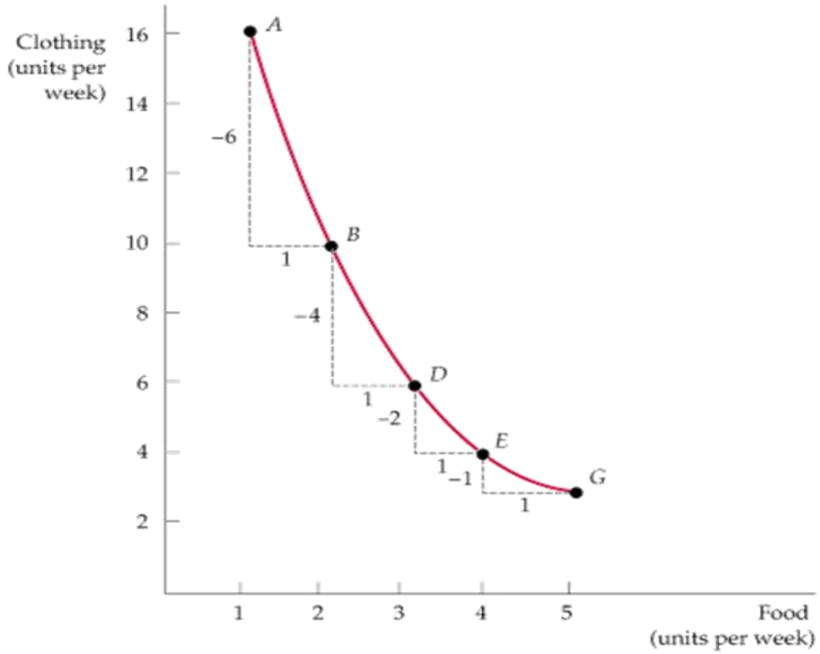
Review:

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 **<u>is willing to</u>** 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

The assumption of diminishing marginal rate of substitution

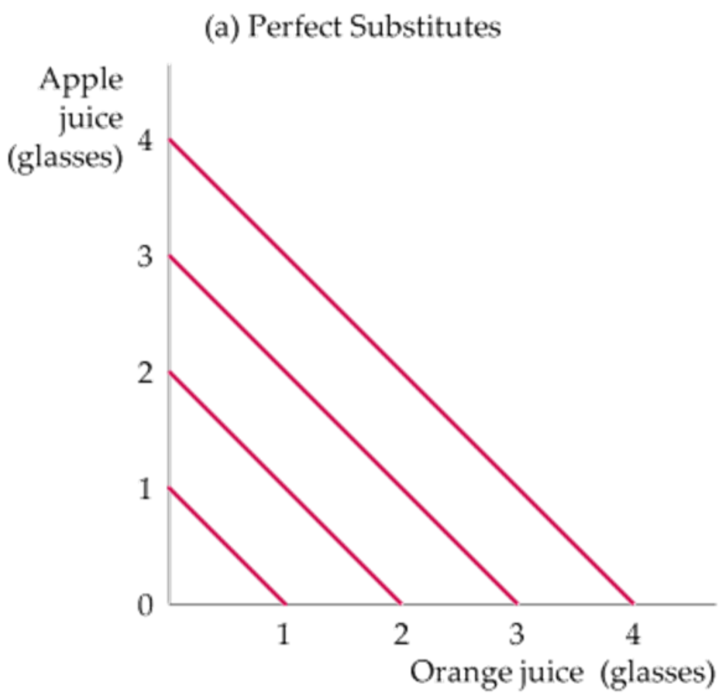
- The indifference curve bows in towards the origin

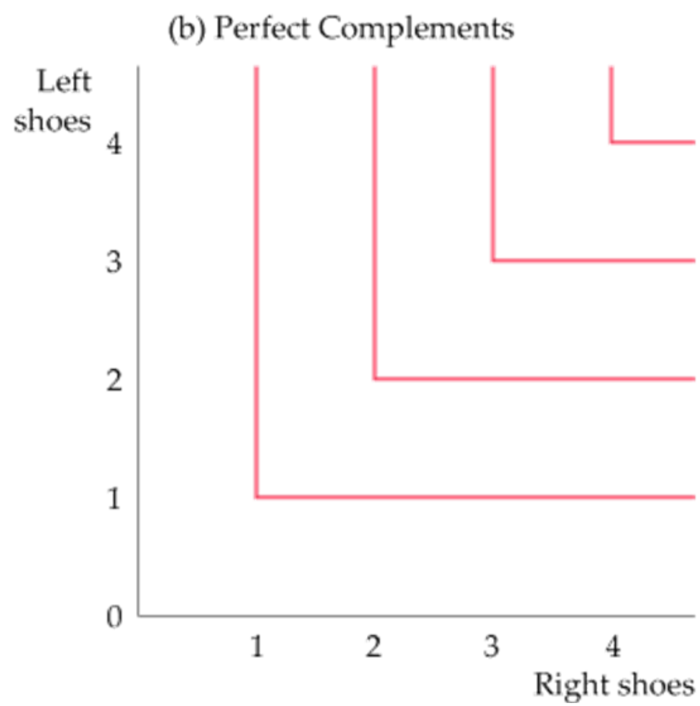


Review:

Two important examples that do not satisfy the diminishing MRS assumption:

- Perfect substitutes: MRS is constant everywhere
- Perfect complements: MRS is either 0 or infinity





Review:

Marginal utility (MU) is the additional satisfaction obtained from consuming one additional unit of some good. Namely, it is the rate at which utility level increases when the consumption of some good increases.

- Marginal utility of Good X: $MU_x = \frac{\Delta U(x,y)}{\Delta x}$
- Marginal utility of Good Y: $MU_y = \frac{\Delta U(x,y)}{\Delta y}$
- I will provide the numerical value/function form of the marginal utility when needed.

Given that marginal utility is introduced, we have the following mathematical **definition** of MRS:

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

3.2 Budget Constraints

- **Budget constraints:** Constraints that consumers face as a result of limited incomes.

- **The Budget Line**: All combinations of goods for which the total amount of money spent is equal to income. (I -- income, P_X -- price of Good X, P_Y -- price of Good Y)

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

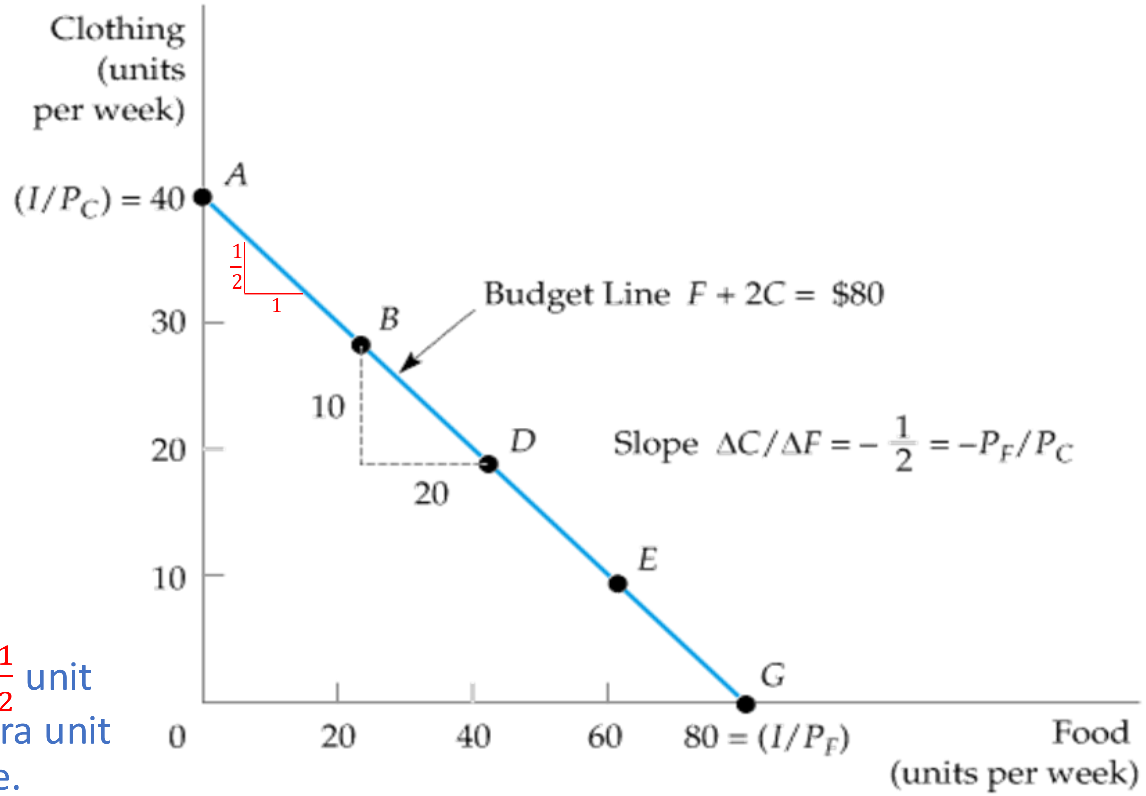
- Can you draw this budget line?

3.2 Budget Constraints

Suppose

- income is \$80,
- P_F = \$1 per unit,
- P_C = \$2 per unit.

- $1F + 2C = 80$
- $2C = -F + 80$
- Hence, $C = -\frac{1}{2}F + 40$
- The consumer **has to** give up $\frac{1}{2}$ unit of C when consuming one extra unit of F, to stay on the budget line.



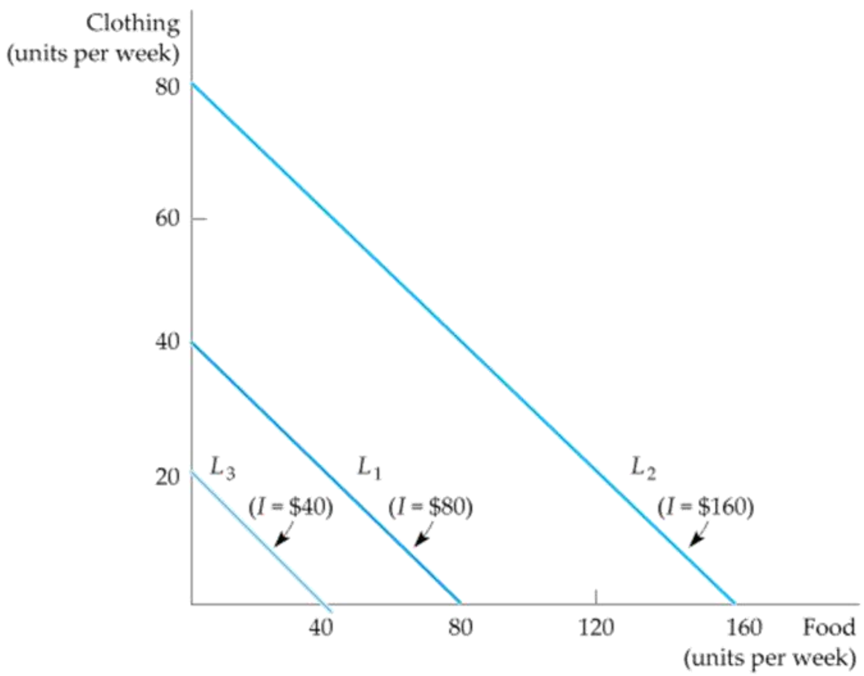
3.2 Budget Constraints

In general:

- $P_X * x + P_Y * y = I$
- $y = -\frac{P_X}{P_Y} * x + \frac{I}{P_Y}$
- 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

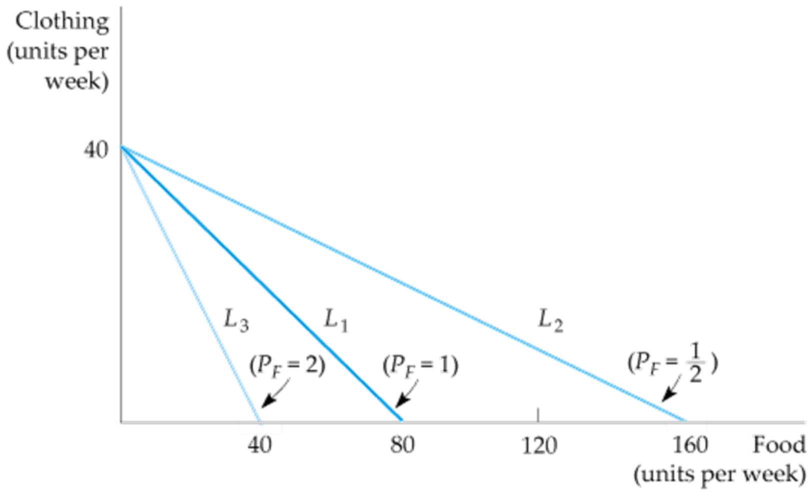
3.2 Budget Constraints

- $F + 2C = \$80$.
- A **change in income** causes the budget line to **shift** parallel to the original line (L_1).
- When the income of \$80 (on L_1) is increased to \$160, the budget line shifts outward to L_2.
- If the income falls to \$40, the line shifts inward to L_3.



3.2 Budget Constraints

- $F + 2C = \$80$.
- A **change in the price of one good** causes the budget line to **rotate** about one intercept.
- When the price of food falls from \$1.00 to \$0.50, the budget line rotates outward from L_1 to L_2.
- However, when the price increases from \$1.00 to \$2.00, the line rotates inward from L_1 to L_3.



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.

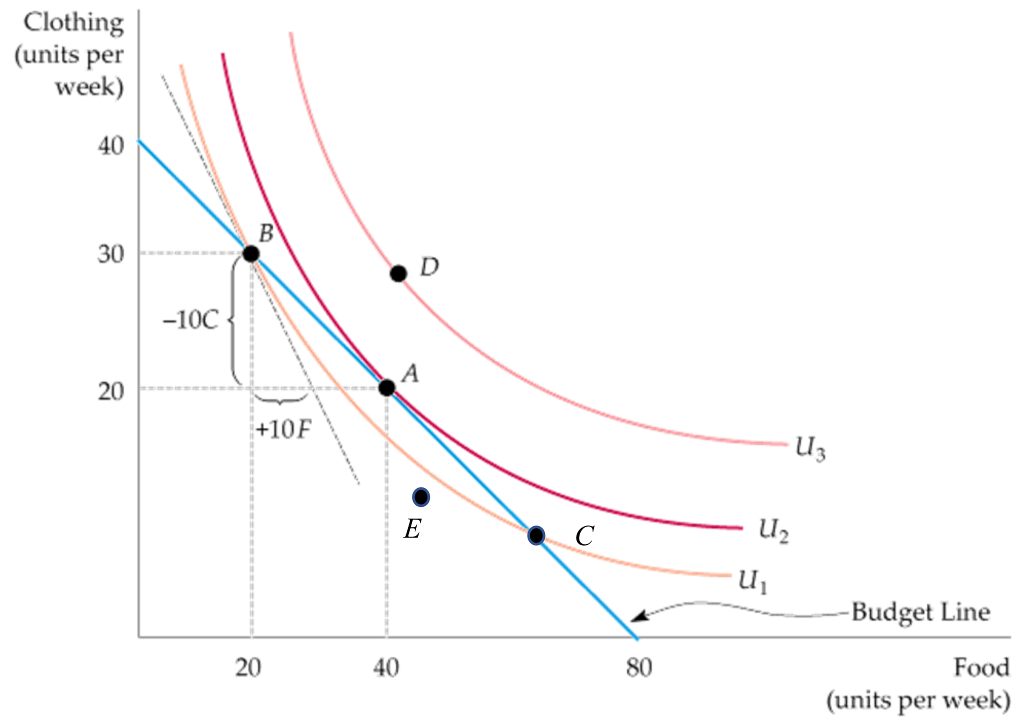
  - Other Cases: When preferences do not satisfy diminishing MRS or preferences (i.e., indifference curves) are not smooth.
  - Solve the problem with the help of a graph.

3.3 Consumer Choice:

The Default Case: Diminishing MRS and Smooth Preference

Which market basket maximizes the consumer's utility given the budget constraint?

A



3.3 Consumer Choice:

The Default Case: Diminishing MRS and Smooth Preference

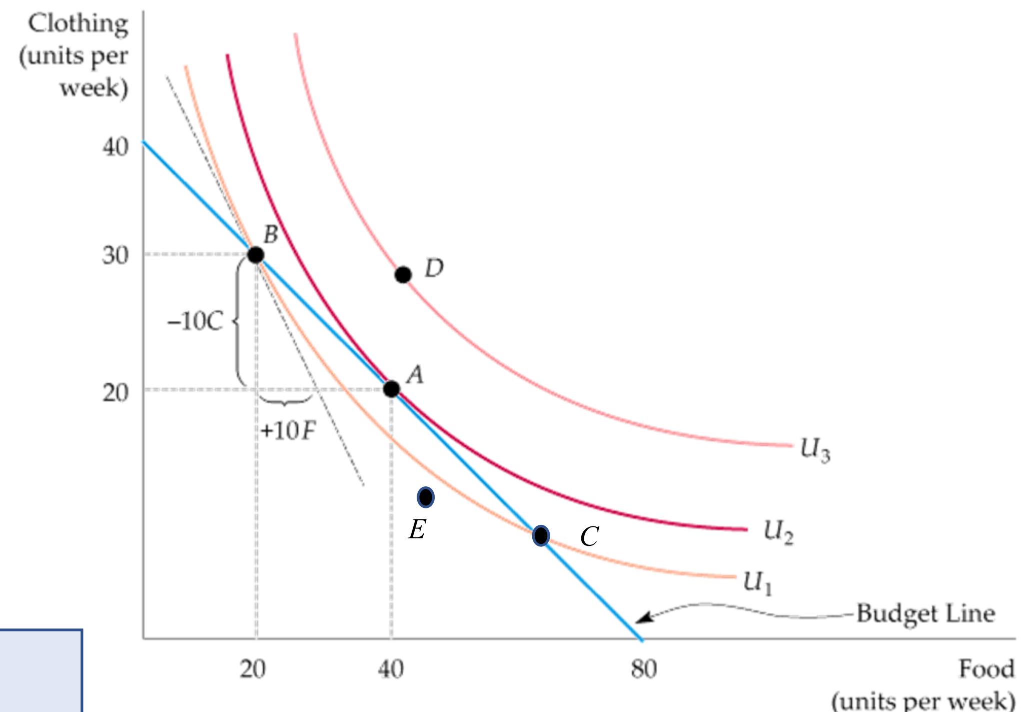
Focus on the situation when the utility maximizing market basket (x, y) is in the interior of the first quadrant (i.e., $x > 0, y > 0$). (x, y) satisfies two conditions.

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.,

$$\underbrace{MRS_{XY}}_{\text{Absolute value of slope of the indifference curve}} = \underbrace{\frac{P_X}{P_Y}}_{\text{Absolute value of the slope of the budget line}}.$$



3.3 Consumer Choice:

The Default Case: Diminishing MRS and Smooth Preference

What can this consumer do to improve his/her utility if $P_X * x + P_Y * y < I$?

By using the remaining income to buy more Good X and more Good Y.

Since more is better than less, the consumer's utility will increase.

3.3 Consumer Choice:

The Default Case: Diminishing MRS and Smooth Preference

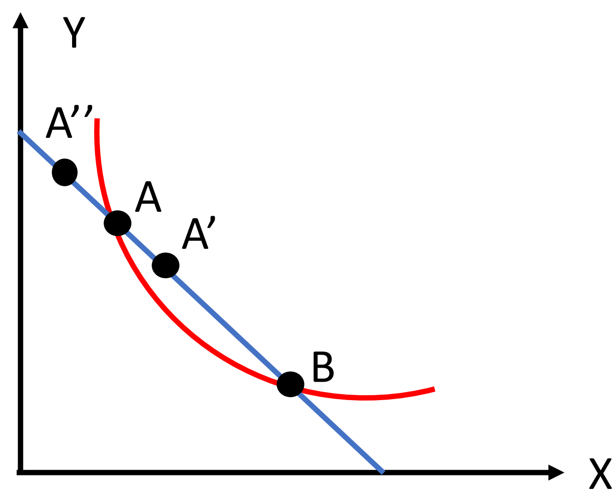
What can this consumer do to improve his/her utility if the consumption bundle is on the budget line but $MRS_{XY} > \frac{P_X}{P_Y}$?

❑ At A, $MRS_{XY} > \frac{P_X}{P_Y}$.

i.e., relative value of one extra unit of X is higher than the relative cost of one extra unit of X

- This consumer can increase the consumption of X and decrease Y a bit and still stay on the budget line: e.g., by going to A'.

- When the change is small (so that A' is still to the northwest of B), this consumer can attain a higher indifference curve.



3.3 Consumer Choice:

The Default Case: Diminishing MRS and Smooth Preference

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.

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:

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) $P_X x + P_Y y = I$, i.e., $10x + 2y = 100$.

  2) $MRS_{XY} = \frac{y}{x} = \frac{P_X}{P_Y}$, 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 $(5, 25)$.