Week 2

MICROECONOMIC THEORY
ECON 323 502/503

Spring 2026

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Review

- Three basic assumptions of preferences: completeness, transitivity, and more is better than less
- Indifference curve and indifference map (downward sloping parallel thin curves)
- Utility function

Chapter 3.1 Consumer Preferences

Utility and Utility Function

Make sure you know how to plot the following two types of indifference curves:

If the utility function is of the form $U(x, y) = ax + by$ with $a, b > 0$, then the indifference curves are downward sloping straight lines.

If the utility function is of the form $U(x, y) = cx^a y^b$ with $a, b, c > 0$, then the indifference curves are downward sloping curves that bend in towards the origin.

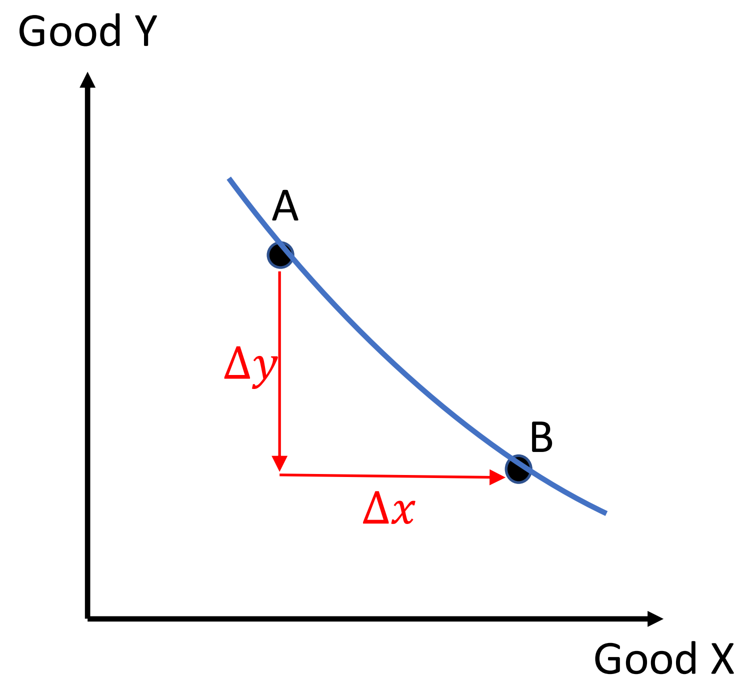
The Shape of Indifference Curves

- The **absolute value of the slope** of an indifference curve measures the consumer's marginal rate of substitution (MRS) between two goods X and Y.

- $\text{MRS} = \left|\frac{\Delta y}{\Delta x}\right| = -\frac{\Delta y}{\Delta x}.$

- **The MRS of good X** (variable on the horizontal axis) **for good Y** (variable on the vertical axis) is the maximum amount of Y that a person is willing to give up to obtain one additional unit of X.

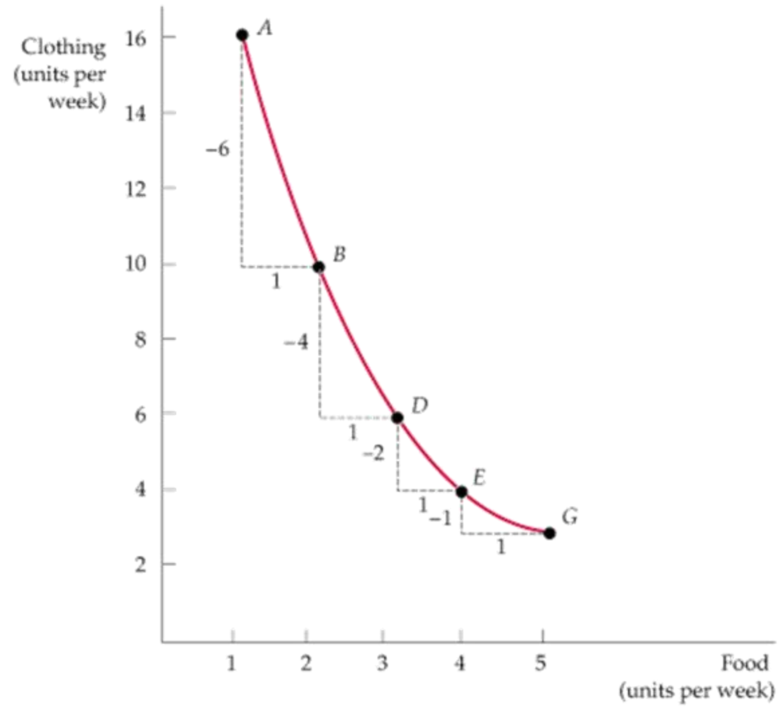
- We may denote it by $\mathbf{MRS_{XY}}$ to clearly indicate that X is on the horizontal axis and Y is on the vertical axis.



Chapter 3.1 Consumer Preferences

The Shape of Indifference Curves

- In this picture, the indifference curve bows in towards the origin.
- When F increases, MRS_{FC} decreases.
- In this case, we say the preference satisfies the assumption of diminishing marginal rate of substitution.
- This is our fourth basic assumption about preferences.



Chapter 3.1 Consumer Preferences

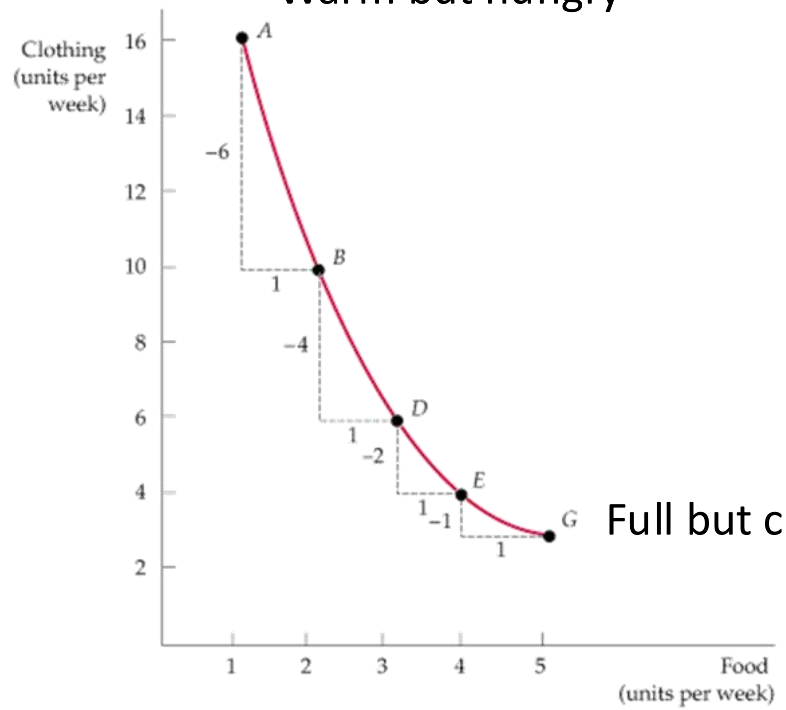
The Shape of Indifference Curves

- Why is the assumption of diminishing marginal rate of substitution is reasonable?

- When F is low but C is high,
- Warm but hungry
- Willing to give up a lot of clothing in exchange for one additional unit of food
- MRS is high

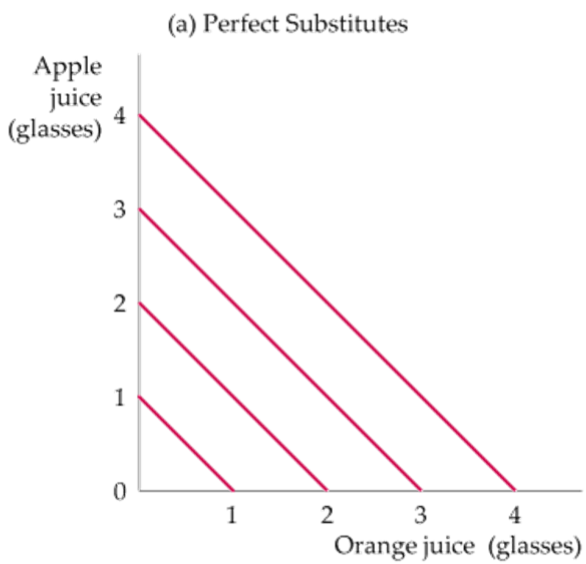
- When F is high but C is low,
- Full but cold
- Not willing to give up a lot of clothing in exchange for one additional unit of food
- MRS is low

Warm but hungry



Full but cold

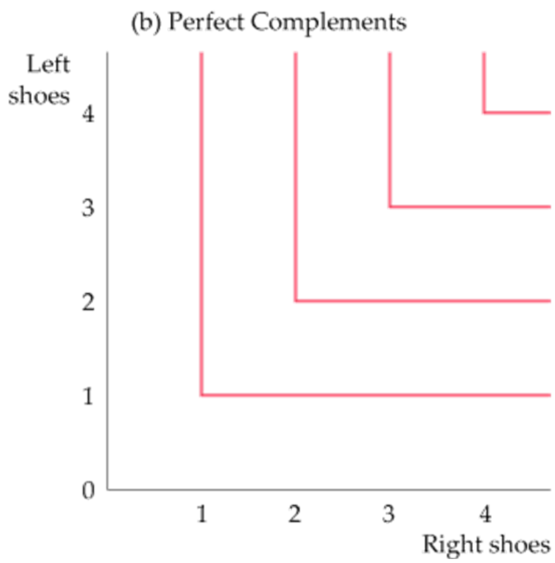
Perfect Substitutes and Perfect Complements



- A consumer only cares about the total glasses of juice he/she consumes, rather than whether the juice is apple juice or orange juice.
- Violate the assumption diminishing MRS.

- Definition: Two goods are said to be perfect substitutes if the MRS is constant.
- Notice that MRS does not have to be 1. (e.g. 2 wings vs 1 drumstick)
- E.g. Linear utility function: $U(x, y) = ax + by$

Perfect Substitutes and Perfect Complements

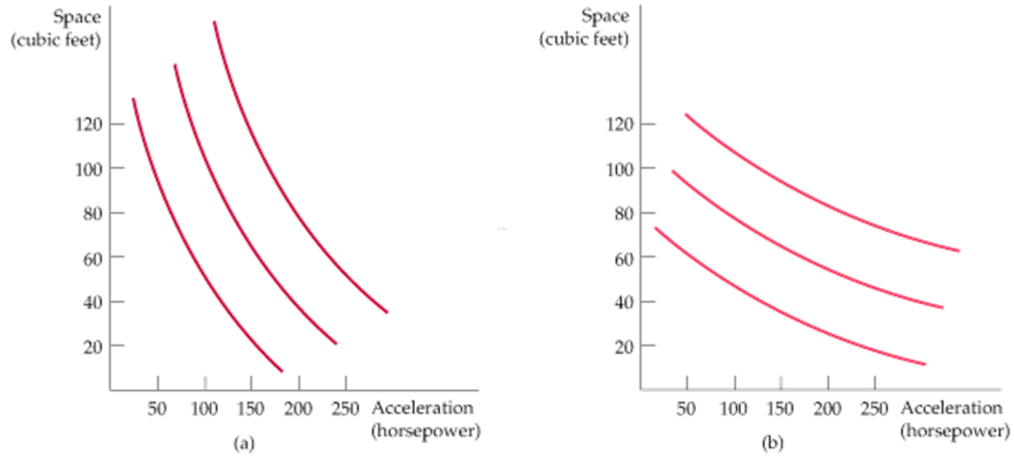


- A consumer only wants to consume the two goods in certain proportion, leftover good is of no value

- Violate the assumption diminishing MRS.

- Definition: Two goods are said to be perfect complements if the MRS is either zero or infinity.
- Notice that the kinks do not have to be on 45-degree line. (1 espresso vs 2 milk)

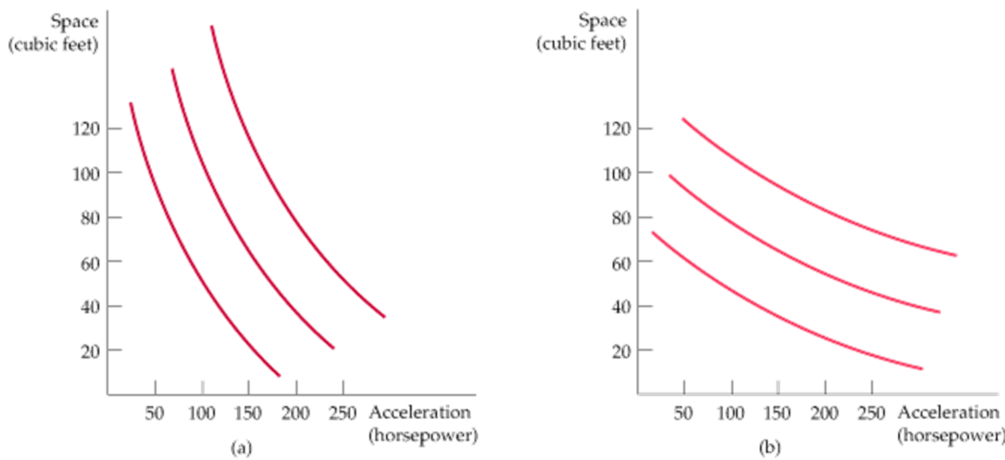
Bonus Quiz Question 1: Among the following two indifference maps, one belongs to a Ford Explorer (larger space) owner, and one belongs to a Mustang (strong acceleration) owner. Among (a) and (b), which one is more likely to belong to a Ford Explorer owner? (Hint: Use the meaning of MRS)



Bonus Quiz Question 2: Suppose Martha can make bread with 1 teaspoon of yeast and 2 cups of flour. Martha likes more bread, but leftover yeast or flour is not useful to her. In this case, her indifference curves look like ____.

A. Right angles
B. Downward sloping straight lines
C. Curves bending in towards the origin
D. Upward sloping straight lines

Bonus Quiz Q1: Among the following two indifference maps, one belongs to a Ford Explorer (larger space) owner, and one belongs to a Mustang (strong acceleration) owner. Among (a) and (b), which one is more likely to belong to a Ford Explorer owner? (Hint: Use the meaning of MRS)



Solution: (b). A Ford Explorer owner is more likely to care a lot about space. This consumer is not willing to giving up too much space in exchange for additional acceleration. Hence, MRS of should be low.

Bonus Quiz Q2: Suppose Martha can make bread with 1 teaspoon of yeast and 2 cups of flour. Martha likes more bread, but leftover yeast or flour is not useful to her. In this case, her indifference curves look like ____.

A. Right angles
B. Downward sloping straight lines
C. Curves bend in towards the origin
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Solution: A. Yeast and flour are perfect complements in this example. Notice that the consumption ratio of perfect complements does not have to be 1:1.

Chapter 3.1 Consumer Preferences

Marginal Utility and Marginal Rate of Substitution

If you are given utility functions instead, how to compute MRS?

- First, lets introduce a concept called marginal utility.
- Definition: **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.

Chapter 3.1 Consumer Preferences

Computing Marginal Utility from Utility Functions (Optional)

Mathematically, MU_x is the partial derivative of $U(x, y)$ with respect to x. Namely, if you view $U(x, y)$ as a function of x only and view y as a constant number, MU_x is the derivative of $U(x, y)$ with respect to x.

Example: $U(x, y) = x^{0.5}y^{0.5}$.

- When computing MU_x , view y as a constant number and x as the variable. Compute derivative.
- Then $MU_x = 0.5x^{-0.5}y^{0.5}$

- When computing MU_y , view x as a constant number and y as the variable. Compute derivative.
- Then $MU_y = 0.5x^{0.5}y^{-0.5}$

Computing Marginal Rate of Substitution from Marginal Utility

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

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

Why? (Optional, two slides later)

Chapter 3.1 Consumer Preferences

Marginal Utility and Marginal Rate of Substitution

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

Example: When $MU_x = y^2$ and $MU_y = 2xy$,

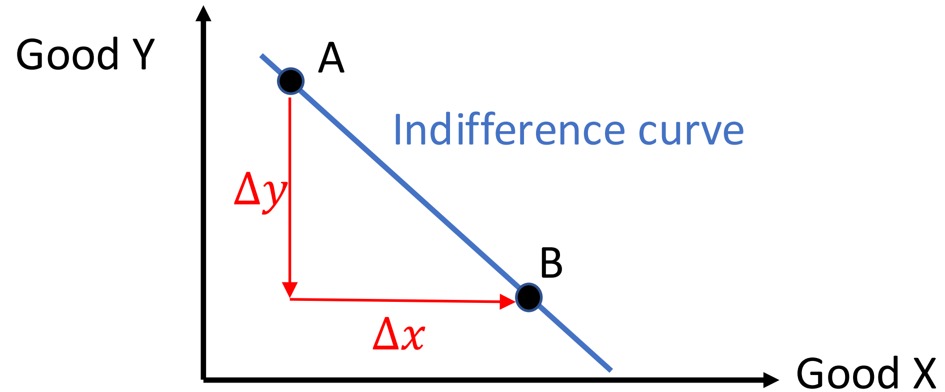
- then $MRS = \frac{MU_x}{MU_y} = \frac{y}{2x}$.

Example: When $MU_x = 0.5x^{-0.5}y^{0.5}$ and $MU_y = 0.5x^{0.5}y^{-0.5}$,

- then $MRS = \frac{MU_x}{MU_y} = \frac{0.5x^{-0.5}y^{0.5}}{0.5x^{0.5}y^{-0.5}} = (\frac{0.5}{0.5})(\frac{x^{-0.5}}{x^{0.5}})(\frac{y^{0.5}}{y^{-0.5}}) = x^{-1}y = \frac{y}{x}$.

Chapter 3.1 Consumer Preferences

Why is $MRS = \frac{MU_x}{MU_y}$? (Optional, read on your own first!)



- Pick any two <u>close</u> points A and B on the same indifference curve. Suppose the consumption of Good X is changed by Δx, consumption of Good Y by Δy.

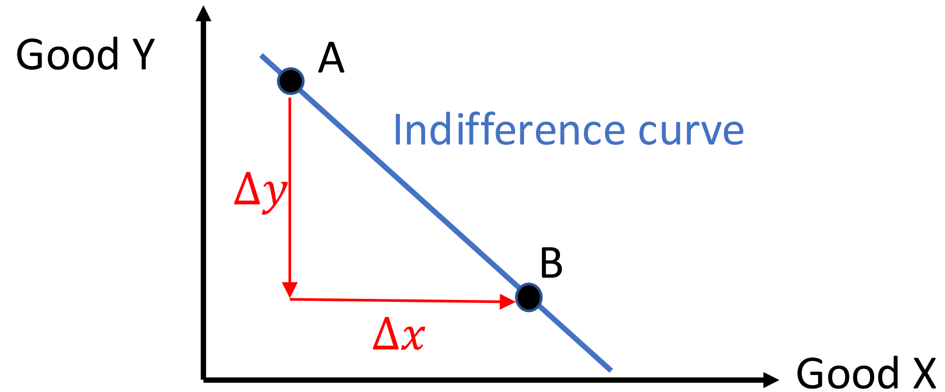
- Δx additional Good X changes the utility by roughly
- $MU_x \cdot \Delta x$

- Δy additional Good X changes the utility by roughly
- $MU_y \cdot \Delta y$

- The total effect is $MU_x \cdot \Delta x + MU_y \cdot \Delta y$.

Chapter 3.1 Consumer Preferences

Why is $MRS = \frac{MU_x}{MU_y}$? (Optional, read on your own first!)



- As A and B are on the same indifference curve, $MU_x \cdot \Delta x + MU_y \cdot \Delta y = 0.$
- Move $MU_x \cdot \Delta x$ to RHS: $MU_y \cdot \Delta y = -MU_x \cdot \Delta x$
- Divide both sides by Δx: $MU_y \frac{\Delta y}{\Delta x} = -MU_x$
- Then divide both sides by MU_y: $\frac{\Delta y}{\Delta x} = -\frac{MU_x}{MU_y}$
- Since $MRS = \left|\frac{\Delta y}{\Delta x}\right|$ by definition, $MRS = |\frac{\Delta y}{\Delta x}| = | -\frac{MU_x}{MU_y}| = \frac{MU_x}{MU_y}$