Preferences and Utility (Ch3/4)

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2026 Spring

Consumption Theory

Components of Market Equilibrium

- ▶ Demand side: **Consumer Theory**
- ▶ Supply side: Producer Theory
- ▶ Equilibrium

Consumer Theory

- ▶ Simple intuition: assumes that consumers choose the best (Ch3, preference) bundle of goods they can afford (Ch2).
- ▶ Budget Constraint: describes what a consumer can afford
- ▶ Preferences: describe what a consumer thinks as "the best"

Outline

Describing Preferences
- ▶ Translating verbal statements into economic notation
- ▶ Establishing assumptions about rational preferences

Illustrating Preferences
- ▶ Using indifference curves

Utility Representation of Preferences
- ▶ Defining the utility function

Preference Refers to How Individuals Compare Options

Example: Ranking My Professors

- ▶ Each professor is a **bundle** of attributes (lecture quality, personality).
- ▶ Suppose their attributes are: **Prof. Zhao**: (9 stars, 5 stars); **Prof. Qian**: (8 stars, 4 stars); **Prof. Sun**: (7 stars, 9 stars)

Preference Refers to How Individuals Compare Options

Example: Ranking My Professors

- Each professor is a **bundle** of attributes (e.g., lecture quality, personality).
- Suppose their attributes are: **Prof. Zhao**: (9 stars, 5 stars); **Prof. Qian**: (8 stars, 4 stars); **Prof. Sun**: (7 stars, 9 stars)

Your ranking reflects your **preference**

- The ranking comes from binary comparisons: *"I prefer Prof. Zhao over Prof. Qian, Prof. Qian over Prof. Sun, and so on."*

How do you determine the ranking?

- Based on **satisfaction**: *"Prof. Zhao gives me the most satisfaction, followed by Prof. Qian, then Prof. Sun, etc."*
- **Utility** is a way to measure satisfaction. (Thus, rating professors is possible.)

Translating Verbal Statements into Economic Notation

Strictly Preferred ($\succ$), Weakly Preferred ($\succeq$), and Indifferent ($\sim$)

1. "I like A more than B" $A \succ B$ A is strictly preferred to B (by me)
2. "I like B more than A" $B \succ A$ I strictly prefers B to A
3. "I like A and B the same" $A \sim B$ A is indifferent to B
(4.) "I think A is at least as good as B" $A \succeq B$ A is weakly preferred to B

Q: Can One Symbol Represent All (Three) Possible Comparison Outcomes?

▶ Use $\succeq$

How Do You Describe Your Satisfaction Level (Utility)?

▶ The **utility function** assigns a numerical value to each bundle to represent your satisfaction level.

▶ $A \succeq B \Rightarrow U(A) \geq U(B)$

Three Assumptions on Preference （$\succeq$） as a Binary Relationship

Completeness

▶ Every two options can be compared, leading to a complete ranking list.

▶ Either $A \succeq B$ or $B \succeq A$ (or both).

Reflexivity

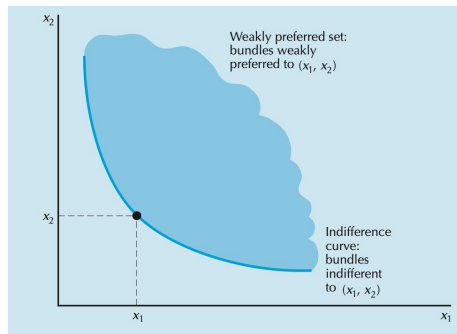▶ Any bundle is at least as good as itself.

▶ $A \succeq A$.

Transitivity

▶ Preferences are logically consistent, leading to a unique and stable ranking.

▶ If $A \succeq B$ and $B \succeq C$, then $A \succeq C$.

Are These Assumptions Obvious?
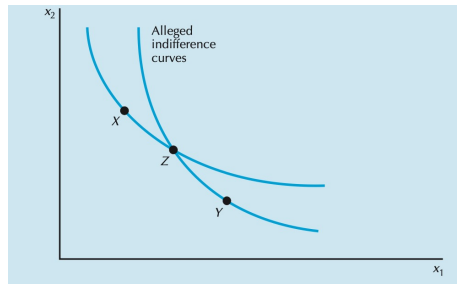
To Illustrate Preferences

The indifference curve represents all equally preferred bundles

- ▶ Consider two goods only: x_1 and x_2
- ▶ x_1: quantity of Good 1 (our focus)
- ▶ x_2: quantity of a Good 2
- ▶ Indifference Curve: $U(x_1, x_2) = u_0$

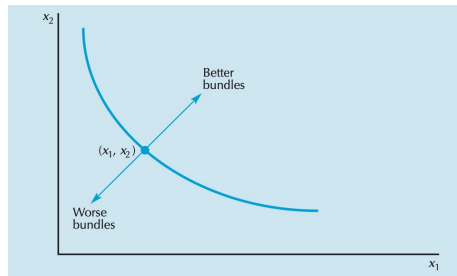 Bundles at the same indifference curve are equally preferred

To Illustrate Preferences
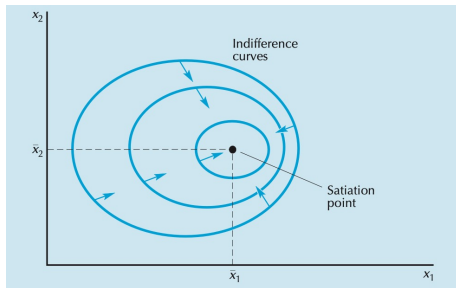
Indifference curves cannot cross

- ▶ Different curves represent different sanctification levels (utilities).
- ▶ If indifference curves across X, Y, and Z would all have to be indifferent to each other
- ▶ and thus could not lie on distinct indifference curves.
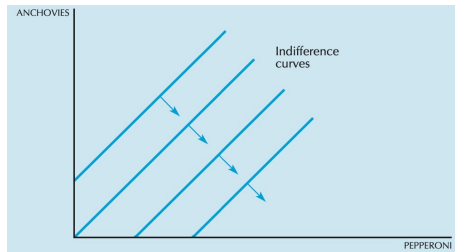
Well-behaved Preference: (Positive) Monotonicity

- **Monotonic Preference:** More of both goods is better,
  $A(x_1 + \Delta_{x_1}, x_2 + \Delta_{x_2}) \succ B(x_1, x_2)$
- Curve 1: $U(x_1, x_2) = u_1$; Curve 2: $U(x_1, x_2) = u_2$.
- If $u_2 > u_1$, then Curve 2 must lie above or to the right of Curve 1

- **Strict Monotonic Preference:** More of any good is better,
  $B(x_1 + \Delta_{x_1}, x_2) \succ A(x_1, x_2)$,
  $C(x_1, x_2 + \Delta_{x_2}) \succ A(x_1, x_2)$
- $\Rightarrow$ negative slope
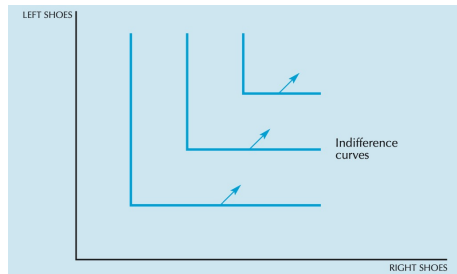
Preference Violating Monotonicity

(a) Satiated Preference

(b) x_2 is a bad

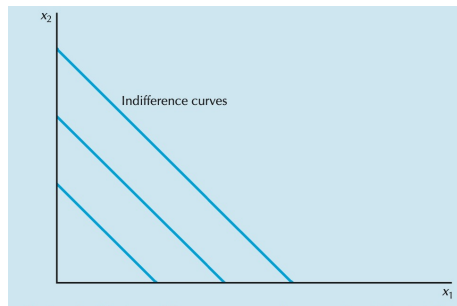# Extreme Preferences: Two Goods Cannot Be Substituted

Perfect Complements

- ▶ **Perfect complements** are goods that are always consumed together in fixed proportions.
- ▶ Say one unit of x_1 must be consumed with one unit of x_2 together,
- ▶ Then the utility function: $U(x_1, x_2) = U(min\{x_1, x_2\})$
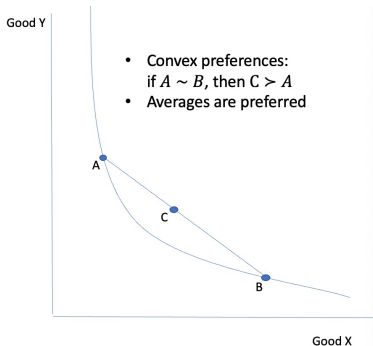
- ▶ Q: Is this a strict monotonic preference?

Extreme Preferences: Two Goods Can Be Fully Substituted

Perfect Substitutes

- ▶ Two goods are **perfect substitutes** if the consumer is willing to substitute one good for the other at a constant rate.
- ▶ Say one unit of x_1 leads to the same satisfactions level as one unit of x_2
- ▶ Then the utility function: $U(x_1, x_2) = U(x_1 + x_2)$
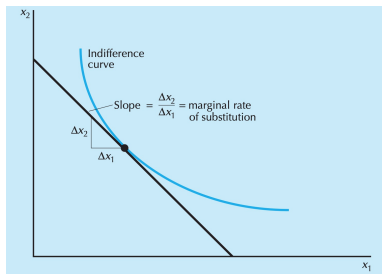- ▶ Indifference curves are straight lines: $x_1 + x_2 = a_n$

Well-behaved Preference: Convexity

- Convex preferences:
  if $A \sim B$, then $C \succ A$
- Averages are preferred

Good Y

Good X

- ▶ **Convex preference:** Weighted averaged bundles are weakly preferred to extremes.
- ▶ Bundle $A(x_1, y_1)$, Bundle $B(x_2, y_2)$
- ▶ Weighted averaged bundles: $C(tx_1 + (1-t)x_2, ty_1 + (1-t)y_2), t \in (0,1)$
- ▶ Convexity: $C \succeq A, C \succeq B$

- ▶ **Strict Convex preference:** Weighted averaged bundles are strictly preferred to extremes.
- ▶ ⇒ slope of the indifferent curve becomes flatter as you move right
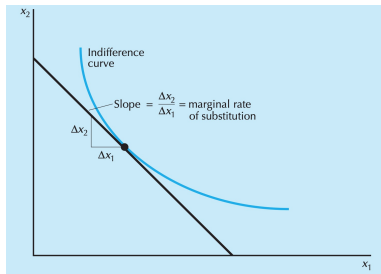
Slope of Indifference Curve

Marginal Rate of Substitution (MRS)

- ▶ Slope:= $\frac{\Delta x_2}{\Delta x_1}$
- ▶ Marginal Rate of Substitution (MRS) of Good 1 (for Good 2):= $\frac{\Delta x_2}{\Delta x_1}$

- ▶ Strict Monotonicity: To maintain in the same indifference curve, taking a little of Good 1 ($\Delta x_1 < 0$) away requires giving him a little more of Good 2 ($\Delta x_2 \geq 0$)
- ▶ Strict Convexity: The more of Good 1 you have already consumed, the less of Good 2 is needed to substitute for additional units of Good 1.
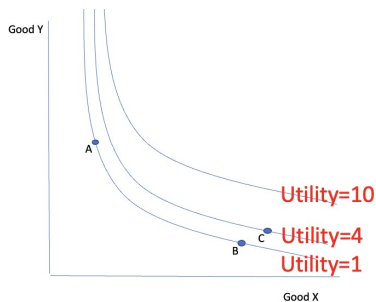
Move Along A Given Indifference Curve

Marginal Rate of Substitution (MRS)

- ▶ MRS$:= \frac{\Delta x_2}{\Delta x_1} = -\frac{MU_1}{MU_2}$
- ▶ <u>Marginal Utility of Good 1 $:= MU_1$</u>
- ▶ $MU_1 := \frac{\partial U}{\partial x_1} = \frac{U(x_1 + \Delta_{x_1}, x_2) - U(x_1, x_2)}{\Delta x_1}$

- ▶ $MU_1 * \Delta x_1 + MU_2 * \Delta x_1 = \Delta U = 0$
- ▶ MRS represents the (relative) marginal willingness to pay for Good 1 in terms of Good 2.
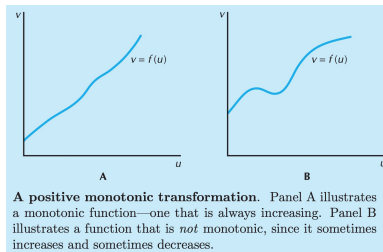
Labeling Different Indifference Curves

Utility Function: Assigning a Number to Every Bundle

- ▶ The utility function should represent preferences: If $A \succeq B$, then $U(A) \geq U(B)$.
- ▶ The assigned number represents the utility level.

- ▶ The utility representation of a given preference is not unique:

  the slope of the indifference curve matters, but the specific labeling of different indifference curves does not.
- ▶ See Examples

Utility Representation of Preferences

(Positive) Monotonic Transformation

A positive monotonic transformation. Panel A illustrates a monotonic function—one that is always increasing. Panel B illustrates a function that is *not* monotonic, since it sometimes increases and sometimes decreases.
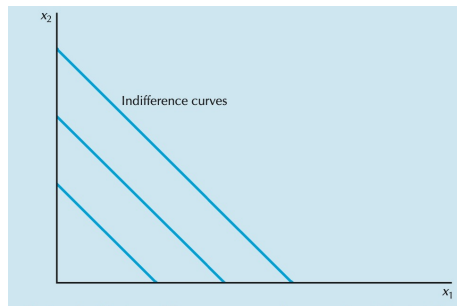
- ▶ Positive monotonic function $f(u)$:
  $u_1 > u_2 \Rightarrow f(u_1) > f(u_2)$.
- ▶ If $U(x_1, x_2)$ represents a preference, then $V = f(u)$ represents the same preference.

- ▶ Bundle $A(x_1, x_2)$ might located at difference indifference curve: $U(x_1, x_2)$ to $V(x_1, x_2) = f(U)$
- ▶ Slope of indifference curve is the same (Chain Rule):

$$-MRS = \frac{MU_1}{MU_2} = \frac{\frac{\partial U}{\partial x_1}}{\frac{\partial U}{\partial x_2}} = \frac{f'(U)\frac{\partial U}{\partial x_1}}{f'(U)\frac{\partial U}{\partial x_2}} = \frac{\frac{\partial V}{\partial x_1}}{\frac{\partial V}{\partial x_2}}$$

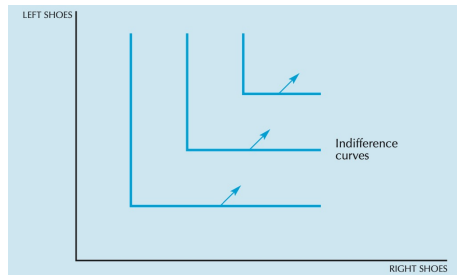# Utility Representation of Perfect Substitutes

Basic Form: $U(x_1, x_2) = ax_1 + bx_2$.

- ▶ Two goods are **perfect substitutes** if the consumer is willing to substitute one good for the other at a constant rate.
- ▶ $MRS = -\frac{a}{b}$: one unit of x_1 leads to the same satisfaction level as $\frac{a}{b}$ unit of x_2

- ▶ Check the Marginal Utility and MRS of $V(x_1, x_2)$:
  - ▶ Case 1: $V := f(U) = kU + b, k > 0$
  - ▶ Case 2: $V := f(U) = U^2$

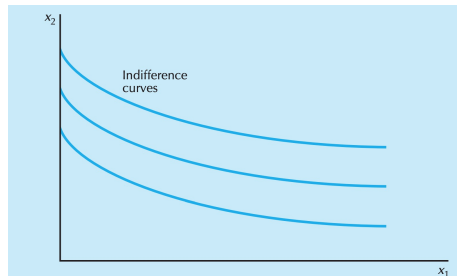## Utility Representation of Perfect Complements

Basic Form: $U(x_1, x_2) = \min\{ax_1, bx_2\}$.

- ▶ **Perfect complements** are goods that are always consumed together in fixed proportions.
- ▶ one unit of x_1 must be consumed with $\frac{b}{a}$ unit of x_2 together
- ▶ MRS?

- ▶ Check the Marginal Utility and MRS of $V(x_1, x_2)$:
  - ▶ Case 1: $V := f(U) = kU + b, k > 0$
  - ▶ Case 2: $V := f(U) = U^2$

Utility Representation of Quasi-linear Preferences
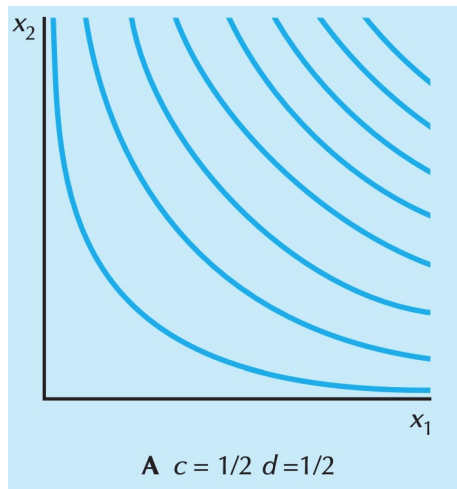
Basic Form: $U(x_1, x_2) = v(x_1) + x_2$.

x_2

Indifference
curves

x_1

Quasilinear preferences. Each indifference curve is a vertically shifted version of a single indifference curve.

▶ Recall previous examples when we interpret Good 2 as the **money** spent on all goods except Good 1.

▶ $|MRS| = v'(x_1)$

▶ Check the Marginal Utility and MRS of $V(x_1, x_2)$:
  ▶ Case 1: $V := ln(x_1) + x_2$
  ▶ Case 2: $V := \sqrt{x_1} + x_2$

Utility Representation of Cobb-Douglas Preferences

Basic Form: $U(x_1, x_2) = x_1^c x_2^d$.

A $c = 1/2$ $d = 1/2$

- ▶ Named after Paul Douglas and Charles Cobb.
- ▶ Indifference curves look well-behaved.
- ▶ $-MRS = \frac{cx_2}{dx_1}$

- ▶ Check the Marginal Utility and MRS of $V(x_1, x_2)$:
  - ▶ Case 1: $V := ln(U)$
  - ▶ Case 2: $V := U^2$

Summary

What We Have Learned

- ▶ Three fundamental assumptions of preference:
  Completeness, Reflexivity, and Transitivity.
- ▶ Two additional assumptions for well-behaved preferences:
  Monotonicity and Convexity.
- ▶ ⇒ Diminishing (absolute value of) Marginal Rate of Substitution.
- ▶ A monotonic transformation of a utility function represents the same
  preferences.

What's Next?

- ▶ Consumer Choices (Ch5): Finding the best affordable bundle (Ch2) that
  maximizes utility (Ch3-4).