Advanced Microeconomics

Lecture 1: Course Introduction & Rational Choice (Part I)

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Outline

1. Why Advanced Micro? What can we study with it?
2. Five real-world examples (what questions become answerable)
3. Course organization and assessment
4. Chapter 1 (Part I): preferences and rational choice

Why study Advanced Micro? (what you gain)

The promise

After this course, you should be able to translate a real situation into a model:

$$\text{agents} + \text{constraints/rules} + \text{information} \Rightarrow \text{predictions \& welfare implications.}$$

- Not only *solving* models, but also **building** and **reading** models.
- Not only outcomes, but **why** outcomes change when prices, rules, or information change.
- A common language used across IO, labor, finance, political economy, and market design.

Self-study note (if you miss a lecture)

When reading slides, always locate: (i) what is chosen, (ii) what is feasible, (iii) what is known by whom. Most confusions come from losing track of these three.

Course goals (what you will learn to do)

By the end of the course, you should be able to:

1. **State definitions precisely** (and know what they are for).
2. **Derive key results with main steps** (full technical details may be in notes, not on slides).
3. **Explain economic intuition clearly**: what drives behavior, equilibrium, and welfare.
4. **Apply the toolkit** to a concrete setting (project presentation in Week 12).

A practical test of "mastery"

Given a paper/model, you can identify: assumptions $\rightarrow$ solution concept $\rightarrow$ comparative statics $\rightarrow$ interpretation.

High-level themes (a roadmap, not a list of jargon)

Four recurring families of questions

1. **Choice under constraints**: How do consumers/firms respond to prices, income, technology?
2. **Strategic interaction**: What happens when your best move depends on others?
3. **Information gaps**: What if different people know different things?
4. **Rules and institutions**: How do outcomes change when we change the rules of exchange?

Takeaway

Many topics look different on the surface, but share the same backbone:

$$\text{preferences/technology} + \text{constraints} + \text{information} + \text{solution concept.}$$

Example 1: when one side knows more, trade may break down

A situation:

- Buying a used phone/car online; hiring a worker; choosing an insurance plan.
- One side has long experience with the quality/risk; the other side only sees limited signals.

What can go wrong:

- If the less-informed side suspects that "bad cases are more likely to show up", they respond with pessimistic terms (low price / low wage / unfavorable contract).
- Then good cases exit, and the remaining pool looks even worse.

What becomes answerable

Why do we see warranties, return policies, certification, disclosure laws, and screening tests? When do they restore trade, and when do they fail?

Example 2: designing rules so people reveal what they know

A situation:

- Government allocates scarce licenses (spectrum/mining).
- Platforms allocate scarce attention (ad slots, top rankings, recommendation exposure).

The difficulty:

- Participants privately know how valuable the resource is to them.
- Poor rules invite exaggeration, hiding, or strategic distortion.

What becomes answerable

How should we write the procedure (what is reported, how allocation is chosen, how payments are computed) to achieve efficiency / revenue / fairness without assuming away private information?

Example 3: a few big players competing

A situation:

- Two ride-hailing platforms choose subsidies; a few airlines compete on one route; big brands time product releases.

Two questions you can answer after this course:

- **Commitment (moving first)**: how an irreversible early action (capacity, contract, price promise) changes rivals' reactions and the final outcome.
- **Repeated interaction**: why long-run rivalry can sometimes soften (fear of retaliation), and sometimes intensify (market-share races, escalation cycles, strong network effects).

What becomes answerable

When do price wars happen? When can tacit coordination persist? How do dynamics and long-run incentives change behavior?

Example 4: matching without a price

A situation:

- College admissions, school choice, residency matching, kidney exchange.

Why procedures matter:

- Money is absent or restricted; "raise the price" is not an option.
- The rule determines whether people benefit from misreporting preferences.
- Some procedures make truthful reporting a safe/default strategy (e.g., school choice designs), reducing manipulation incentives.

What becomes answerable

How do different matching rules change outcomes and incentives? What does stability mean, and why do some rules lead to better/cleaner behavior?

Example 5: public problems where everyone benefits (but many prefer not to pay)

A situation:

- Clean air, vaccination, basic research, flood control, cybersecurity standards.

The tension:

- Everyone benefits from the outcome.
- But each individual has an incentive to free-ride on others' contributions.

What becomes answerable

When does voluntary contribution under-provide? How do taxes/subsidies/quotas change behavior and welfare? Which institutional rules can improve outcomes?

Course Organization

- Lectures: definitions + key logical steps + economic interpretation.
- Problem sets: practice modeling and derivations.
- Week 12: student project presentations.

How we use slides

Slides are a structured map: what the objects are, what assumptions are made, what the conclusion is, and what it means.

Assessment

- 40% Group project: report + presentation.
- 60% Exam: concepts and applications.
- Bonus: strong in-class performance (good questions, clear answers, constructive discussion).

A good project question

rule change $\Rightarrow$ incentives $\Rightarrow$ equilibrium $\Rightarrow$ welfare / distribution.

Motivation: why study rational choice?

- A disciplined language for predicting behavior under constraints.
- The foundation for consumer theory, game theory, general equilibrium, and market design.
- A benchmark model: later we can discuss systematic deviations (framing, limited attention, etc.).

Key goal

Describe preferences and choices in a form that supports optimization, comparative statics, and welfare analysis.

Key questions (for Chapter 1)

- How do we describe an agent's ranking of alternatives?
- What properties should such rankings satisfy to be called "rational"?
- When can we represent preferences by a real-valued utility function?
- How do we connect these ideas to observed choice behavior?

Reading tip

Keep these four questions in mind; every slide in this chapter answers one of them.

Preference relation: definition

Definition 1 (Preference relation)

Let X be a set of alternatives. A preference relation $\succeq$ on X is a binary relation such that for any $x, y \in X$,

$$x \succeq y \quad \text{means "} x \text{ is at least as good as } y \text{."}$$

Define strict preference and indifference by

$$x \succ y \iff (x \succeq y \text{ and not } y \succeq x), \qquad x \sim y \iff (x \succeq y \text{ and } y \succeq x).$$

Rational preferences: two axioms

Definition 2 (Completeness)

For all $x, y \in X$, either $x \succeq y$ or $y \succeq x$ (or both).

Definition 3 (Transitivity)

For all $x, y, z \in X$, if $x \succeq y$ and $y \succeq z$, then $x \succeq z$.

Rational preference

A preference relation that is complete and transitive is called *rational*.

What is (and is not) a rational preference? Two contrasts

Example 1 (violating completeness)

A student compares two electives: "I really cannot tell which one I prefer; I refuse to rank them in any way."
Then for these two options, neither $A \succeq B$ nor $B \succeq A$ holds. This violates **completeness**.

Example 2 (violating transitivity)

A student says: $A \succ B$ (prefers A to B), $B \succ C$, but also $C \succ A$. This creates a preference cycle and violates **transitivity**.

Takeaway

Completeness rules out "cannot compare"; transitivity rules out cycles.

Why behavior may deviate: context and framing (concrete examples)

- **Endowment effect**: people demand much more to give up an item they own than they are willing to pay to acquire it.
- **Default effect**: when a choice has a default option (e.g., organ donation, pension contribution), many stick to the default even if switching is easy.
- **Framing**: the same outcomes described as "90% survival" vs. "10% mortality" can lead to different choices.

Why we still start with the rational benchmark

The classical model is a clean baseline. Many deviations can be studied as structured departures from it.

Additional assumption 1: continuity

Definition 4 (Continuity)

For any $x \in X$, the upper contour set $\{y \in X : y \succeq x\}$ and the lower contour set $\{y \in X : x \succeq y\}$ are closed.

Intuition (plain words)

If y is preferred to x, then very small changes to y should not suddenly make it worse than x. No "infinitesimal jump" in preference rankings.

A counterexample to continuity: lexicographic (dictionary) order

On $[0,1]^2$, define:

$$(x_1, x_2) \succ (y_1, y_2) \text{ if } x_1 > y_1 \text{ or } (x_1 = y_1 \text{ and } x_2 > y_2).$$

Intuition: the first coordinate is "infinitely more important" than the second.

Why this breaks the continuity intuition

Continuity is meant to rule out *priority jumps*: if two options are almost identical, their ranking should not flip violently.
Under lexicographic order, an arbitrarily small improvement in x_1 can outweigh any change in x_2. So rankings can change *discontinuously* when x_1 crosses a tie, even if the change is tiny.

A concrete analogy: medal tables

Ranking countries by *gold medals first* (and using silver/bronze only to break ties) is a lexicographic rule. If a country gains just one extra gold medal, its rank may jump ahead of many countries, even if those countries have far more total medals. This "jump" captures the intuitive non-continuity of lexicographic priorities.

Why continuity matters later

- Continuity is the key regularity condition behind **continuous utility representation**.
- Many tools (calculus, envelope arguments, tangency intuition) implicitly rely on it.

A simple message

Continuity is not cosmetic: it prevents extreme priority jumps and supports real-number indexing of indifference classes.

Additional assumption 2: monotonicity

Definition 5 (Monotonicity)

If $X \subseteq \mathbb{R}^n$ and $x \geq y$ componentwise, then $x \succeq y$.

Intuition

"More of every good is not worse." If you can increase all components, the new bundle should be at least as good.

A counterexample (why monotonicity can fail)

If one component is a "bad" (e.g., pollution exposure, commuting time), more of it can make the bundle worse. Then monotonicity in that component is not appropriate.

Why monotonicity is useful

- It rules out satiation and makes the budget constraint bind in standard consumer problems.
- It gives a clean “better direction” and supports comparative statics with prices/income.

Additional assumption 3: convexity

Definition 6 (Convexity)

If $x \sim y$, then for any $\lambda \in (0, 1)$,

$$\lambda x + (1 - \lambda) y \succeq x.$$

Intuition

If you are indifferent between two bundles, then a diversified mix should not be worse than an extreme. (Preference for "averages" / diminishing marginal rate of substitution.)

A counterexample to convexity: runner's example

Runner's preference (non-convex)

A runner likes running exactly 5 km or exactly 10 km, but dislikes running 7.5 km.
Then two equally good options (5 and 10) have an average (7.5) that is worse.

Why we care

Without convexity, preferred sets can be disconnected and choice behavior can be "lumpy". Convexity supports well-behaved demand and clean tangency intuition later.

Rational choice from a feasible set

Definition 7 (Choice from a feasible set)

Given a feasible set $B \subseteq X$ (the set of possible alternatives under constraints), a rational decision-maker chooses $x \in B$ such that

$$x \succeq y \quad \text{for all } y \in B.$$

Rule of thumb

In any model: first identify X (alternatives) and B (feasible set). Then ask what changes B (prices, rules, information).

Example: consumer choice

- Alternatives: $X = \{(q_1, q_2) : q_1, q_2 \geq 0\}$.
- Budget set: $B = \{(q_1, q_2) : p_1 q_1 + p_2 q_2 \leq m\}$.

Interpretation

Prices and income determine what is feasible; preferences determine which feasible bundle is chosen.

From preferences to utility: what representation means

Goal

Find a function $u : X \to \mathbb{R}$ such that

$$x \succeq y \iff u(x) \geq u(y) \qquad (\forall x, y \in X).$$

Why it matters

A utility representation turns preference comparison into numerical comparison, which enables optimization and comparative statics.

Why lexicographic order cannot have a *continuous* utility representation (idea)

Under lexicographic order, any increase in x_1—no matter how tiny—dominates any change in x_2.

Key intuition

Fix a point (a, b). Consider a sequence of points $(a + \epsilon_n, 0)$ with $\epsilon_n \downarrow 0$.
Lexicographic order ranks every $(a + \epsilon_n, 0)$ strictly above $(a, 1)$, even though $(a + \epsilon_n, 0) \to (a, 0)$.

What continuity would force

If a continuous u represented the preference, then $u(a + \epsilon_n, 0) \to u(a, 0)$. But the preference ranking forces $u(a + \epsilon_n, 0) > u(a, 1)$ for all n, which cannot be reconciled with continuity once we compare limits.

Debreu (1954): continuous preferences admit continuous utility (standard version)

Theorem (Debreu, 1954; standard commodity-space version)

Let $X \subseteq \mathbb{R}^n$ (with the usual topology). If $\succeq$ on X is complete, transitive, and continuous, then there exists a continuous function $u : X \to \mathbb{R}$ such that

$$x \succeq y \iff u(x) \geq u(y) \qquad (\forall x, y \in X).$$

Reference

G. Debreu (1954), "Representation of a Preference Ordering by a Numerical Function," in *Decision Processes*, Wiley.

Reading guide

Do not memorize the theorem statement. Remember the message: continuity is what allows preferences to be "indexed" by a real-valued function.

Sketch of the construction (why continuity helps)

Intuitive idea (not a full proof)

1. Fix a reference alternative x_0.
2. For any x, think of "how far" x is from x_0 along a preference path.
3. Continuity ensures we can assign real numbers to indifference sets without jumps.

Takeaway

A utility function is a *labeling device* for preference rankings. The existence of such labeling is a mathematical statement—continuity makes it possible.

Ordinal vs. cardinal utility

Ordinal utility (deterministic consumer theory)

Only rankings matter. If u represents $\succeq$, then any strictly increasing transformation $f(u)$ represents the same $\succeq$.

Cardinal utility (appears under risk/uncertainty)

Differences/ratios of utility levels matter (e.g., expected utility theory).

Indifference curves (preview)

When $X \subset \mathbb{R}^2$, we often visualize preferences via indifference curves:

$$u(x_1, x_2) = \text{constant}.$$

Each curve is a set of bundles that are equally preferred.

Under monotonicity

Higher indifference curves correspond to strictly better bundles.

Why this matters

This picture becomes a workhorse for consumer choice, substitution patterns, and later welfare analysis.

A simple utility maximization example (what representation buys us)

Consider $u(x_1, x_2) = x_1^{\alpha} x_2^{\beta}$ with $\alpha, \beta > 0$, and budget $p_1 x_1 + p_2 x_2 \leq m$.

Result (standard)

Solving the Lagrangian yields

$$x_1^* = \frac{\alpha}{\alpha + \beta} \frac{m}{p_1}, \qquad x_2^* = \frac{\beta}{\alpha + \beta} \frac{m}{p_2}.$$

Interpretation

Representation lets us compute how choices respond to prices and income. Next lecture we formalize demand and connect it to observed choices.

End of Lecture 1

- Preferences: rationality (completeness + transitivity).
- Regularity assumptions: continuity / monotonicity / convexity (definitions, intuition, counterexamples, and why they matter).
- Rational choice from a feasible set.
- Utility representation and Debreu (1954).
- Ordinal vs. cardinal utility; indifference curves as a visualization tool.

Next lecture

Chapter 1 continues: revealed preference and duality (consumer theory foundations).

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Core references for the course

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References II

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Q&A

Questions?