EFR summary

Microeconomics, FEB11001X

2025-2026

Lectures 1 to 10

Weeks 1 to 4

Details

Subject: Microeconomics 2025-2026

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Microeconomics - IBEB
Lecture 1, week 1

What is (micro)economics

Economics is a science that studies how people, firms, and organisations behave and make choices when there is scarcity.
Microeconomics in particular is the study of individual choices and the study of group behaviour in individual markets.
Macroeconomics is the study of broader aggregations of markets.
Economists study **how** and **why** people make choices. Therefore economics is better at explaining individual markets than the entire economy.

The Cost-Benefit approach to decisions

Economists assume that choices are made based on the cost-benefit analysis.
The main question of the cost-benefit analysis is if you should do a particular activity:
Should I do activity X?
$B(x)$ = Benefit of activity X
$C(x)$ = Cost of activity X
If $B(x) > C(x)$ you **should** do activity X.
If $B(x) < C(x)$ you **shouldn't** do activity X.
If $B(x) = C(x)$ you are indifferent.

The reservation price of activity x = the price at which a person would be indifferent about doing x and not doing x.
If $B(x) - C(x) > B(y) - C(y)$:

- $B(x) - C(x) = B(y) - C(y) + r$ (reservation price)

So there is a reservation price for which you are indifferent about doing activities x and y.

The Cost-Benefit approach to decisions

Pitfall 1. Ignoring implicit costs

Implicit costs are costs that are not explicit. This is the loss of alternatives when one alternative is chosen.

An example of this is: if you spend 3 hours watching TikTok each day, you aren't able to do anything else. For example, go to work or hang out with your friends. You might have been able to earn 50€ in those 3 hours. This way something free like Tiktok will cost you money in the form of implicit costs.
Costs and benefits are reciprocal. It doesn't matter if you subtract those 50€ from the benefits or treat them as costs. Just make sure you don't count them twice!

Pitfall 2. Failing to ignore sunk costs.

Sunk costs are costs that are beyond recovery at the time a decision is made and so should be ignored. Because these costs are beyond recovery they are irrelevant.

An example of this is: Imagine you bought a concert ticket for 50€ and it isn't possible to resell this ticket. At the night of the concert you get invited to a free party which you would enjoy more than the concert. Should you go to the party or not?
In this case, you should definitely go to the party because the 50€ for the concert is beyond recovery and therefore should be ignored. This way you should go to the party.

Pitfall 3. Measuring costs and benefits as proportions rather than absolute monetary amounts

In your decision making you should only measure costs as absolute monetary amounts and not as proportions. So it shouldn't matter if you save 10€ on a TV of 500€, or 10€ on a shirt of 20€.

Pitfall 4. Failure to understand average vs. marginal distinctions

Marginal costs = Increase in total cost resulting from carrying out one additional unit of an activity.
Marginal benefit = Increase in total benefit that results from carrying out an additional unit of an activity.
You should increase your level of activity as long as **marginal B(x) >= marginal C(x)**

Average cost = Average cost of undertaking n units activity = **Total cost / n**
Average benefit undertaking n units of activity = **Total benefit / n**

The **optimal amount** of a continuously variable activity is when **MC = MB** (Marginal cost is equal to Marginal benefit).

Different approaches to choice behaviour

Positive approach: What do people choose, and how do we declare what they choose?
Normative approach: What ought or what should people choose?

The positive approach emphasizes declaring and understanding. This is used in Science, advertising, and managing people.

The normative approach helps people to make good decisions. It is important that it's good for those people.

Not all choices are good in the Cost-Benefit analysis

Economics assumes that people are rational. That doesn't mean that all the decisions are "good". People make mistakes.
The Homo-Economicus: Stereotypical decision maker in self-interest model.

Economic agent: Individual or group making choices. A group can also be a single agent. For example, if Apple increases their iPhone prices. In this case, Apple is a single agent.

Three principles of economists

1. People make choices by **optimising**: They try to make the best choices.
2. Lots of attention goes to the **equilibrium**: a situation where no one wants to change their choices.
3. **Empirical analysis**: Economists use data to test and prove their theories.

Causality: What causes what?

Observation: a statement based on something one has seen, heard or noticed.
For example: When the sun shines, there are a lot of people on the beach.

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Lecture 2, week 1

The market

Definition: A market exists of all the buyers and suppliers of a good or service.
Markets come in all forms and sizes. Place, anonymity and time are all important factors of defining the market.
Economists are among others interested in:

1. Explaining the price of a good (P)
2. Explaining the quantity traded (Q)

The **demand curve** describes the relation between the quantity of a good that demanders want to buy and the price of that good.
Law of demand: Empirical observation that if the price of a product falls, the quantity demanded increases.
$Q = f(P)$
=> $\frac{dQ}{dP} = f'(P) < 0$

Two explanations for the law of demand:

1. Increase in price: which makes people look for alternatives: substitution-effect
2. Increase in price: something has to change: income-effect

The **supply curve** describes the relation between quantity of a good that suppliers want to sell and the price.
Law of supply: empirical observation that suppliers want to sell more if the price rises.

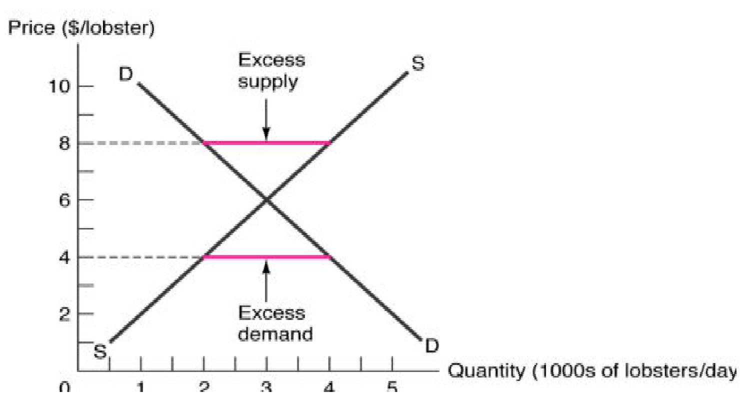
$$Q = f(P)$$
$$\frac{dQ}{dP} = f'(P) > 0$$

Two ways of reading the supply and demand curves:
Horizontal interpretation: The quantity that is offered/demanded at a certain price.
Vertical interpretation: The price that the market will move towards at a certain quantity offered/demanded.

The equilibrium

The equilibrium quantity and price is the intersection of the supply & demand curves. This is the point where all the participants are 'satisfied'. 'Satisfied' in this case means that buyers and sellers are buying/selling the amount they want to at that price.
So: $Qs(P) = Qd(P)$

If the price-quantity pair is above the equilibrium: excess supply
If the price-quantity pair is above the equilibrium: excess demand



Determinants of demand/supply

Determinants of demand:

- Incomes
  - **Normal goods**: If income increases, quantity demanded increases.
  - **Inferior goods**: if income increases, quantity demanded decreases.
- Tastes
- Price of substitutes and complements
- Expectations
- Populations

Determinants of demand:

- Technology
- Factor prices (production prices)
- Expectations
- Weather

Government intervention

Government intervention often disrupts market equilibrium and ends up doing more harm than good.

An example is rental policy. In lots of cities the rent prices are too high for the poor. A reaction from politicians on this is the point system. The renting price is based on objective criteria instead of supply and demand. This results in excess demand. Another problem with this is that the poor people might prefer to use the extra money on something else, so the government would be better off giving the money to the people instead of cheaper houses.

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Lecture 2/3, week 1

Rational choice model

A **model** is a simplified description of reality.

Structure of an economic model:

1. Description of possibilities of economic agent
2. Description of his goals.

A combination of both leads to an explanation of his behaviour.

A few assumptions need to be made for now to decide:

1. Complete information
2. One period
3. Other people don't matter

The budget curve (opportunity set)

The options of Charlie are depending on the price of beer, the price of pizza and his **monthly income**. Which makes: $M = PbB + PzZ$

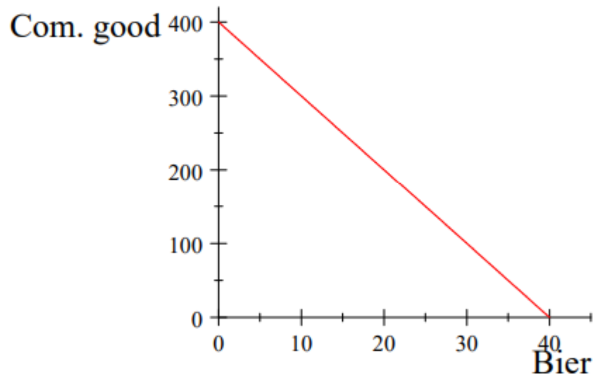
Which can be rewritten as a line by writing $B = \frac{M-PzZ}{Pb}$

It's slope coëfficiënt = -(Pp/Pb) and can be interpreted as that if Charly wants to buy one extra pizza he should sacrifice Pp/Pb beers.

In reality instead of the choice being between two goods the choice might be between millions of goods. This can be written as:

$$M = \sum_{i=1}^{N} PiGi$$

Imagine instead of wanting to be looking at all goods we want to look at one good, and another good which consists of all other goods. This is the '**Composite good**'. The price of the composite good = 1.



Description of his goals

We describe what an agent wants with help of preference orders: A scheme by which a person organises alternatives based on desirability.
For the preference orders there are a few assumptions:

1. **Completeness:**
   For any two bundles A and B, the consumer can compare them:
   A is preferred to B, or B is preferred to A, or the consumer is indifferent.
2. **More is Better (Monotonicity):**
   If a bundle A has *more of at least one good* and *no less of the other*, then A is preferred to C.
3. **Transitivity:**
   If A is preferred to C and C is preferred to D, then A is preferred to D.
4. **Continuity:**
   If a bundle A is only slightly different from B, preferences don't jump suddenly.
   Meaning: if A is preferred to B, then bundles *very close to A* are also preferred to B. (This ensures smooth indifference curves.)
5. **Convexity:**
   If the consumer is indifferent between A and C, then any mixture (combination) of A and C is at least as good as A or C.
   This is why indifference curves are **bowed inward** (people like **variety**).

A few exceptions on transitivity:

- Football games: if Feyenoord wins from Ajax, And Ajax wins from PSV it doesn't necessarily mean Feyenoord will win from PSV.
- Collective preference orders based on majority (votes)

The indifference curve

An indifference curve is a set of bundles between which a consumer is indifferent.

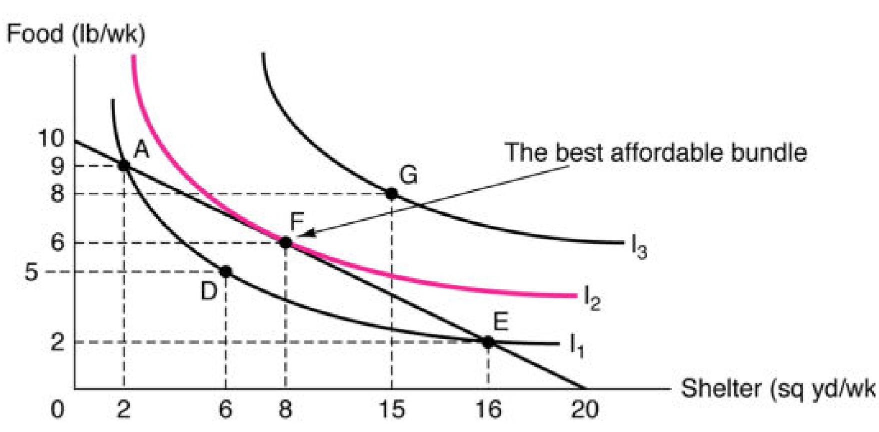
Marginal rate of substitution (MRS) is the slope coëfficient of the indifference curve: Which means how much of product A you are willing to give up for an extra product B.

Indifference map:
- Unlimited amounts of indifference curve
- The higher the curve, the higher the utility
- Different persons have different indifference curves and therefore also different indifference maps
- Indifference curves cannot cross each other.

Two ways to learn about indifference curves:
1. Asking questions about all sorts of bundles.
2. Statistics (How do income & prizes affect a choice)

How to maximise utility

The goal of the consumer is to maximise its utility (trying to reach the highest indifference curve)
The highest indifference curve is reached when the MRS (slope coëfficient of indifference curve) is equal to the slope coëfficient of the budget constraint.
So when: $MRS = \frac{Px}{Py}$



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Rational choice model into mathematics

The structure of the economic model can be written as:
max. U (x, y) s. t. y = f(x)
U (x, y) describes the indifference map (all the indifference curves)
y = f(x) describes the budget constraint.
Maximising this will make sure all the resources are used optimally.

The utility function is described as U = U(x, y) where U stands for utility.
Utility is something positive, so therefore we want to maximise our utility.
More-is-better implies:
$\frac{\partial U}{\partial Y} = UY > 0; \frac{\partial U}{\partial F} = UF > 0$
Which makes sure the marginal utility is greater than zero.

If you write the differential of U(F, S) it can be written as: $MRS = \frac{dF}{dS} =- \frac{Us}{Uf}$

Ordinal vs. marginal utility

Ordinal utility: People can say bundle A is better than bundle B but the number U (utility) has no meaning in itself.
Cardinal utility: The number in itself has meaning because you can compare people's utility number against each other.

Economics of happiness makes use of cardinal utility:
People from different countries were asked how happy they are on a scale of 4. An interpretation of this scale of 4 is that they were asking on which utility scale people are.
The answers got used to decide how happy people were, and it concluded that richer countries reported a higher utility than poorer countries.

So what is **important for utility**:

- Relative income position
- Marital status: A divorce is compensated by 100.000 Euros higher income.
- Work versus no work
- Security: Risk aversion
- Children makes you deeply unhappy

Solving the optimisation problem

We solve the optimisation problem with two methods:

1. The **Lagrange method**
2. The **substitution method**

The lagrange method:

1. Set up the lagrange function: $L(x, y) = U(x,y) - \lambda(ax + by - m)$
2. Set up the first order conditions:
   a. $Ux(x, y) - \lambda a = 0$
   b. $Uy(x, y) - \lambda b = 0$
   c. $ax + by = m$
3. Divide 2a and 2b: $\frac{Ux(x,y)}{Uy(x,y)} = \frac{a}{b}$
4. Solve the rest of the variables with this answer.

The substitution method:

1. Rewrite: $ax + by = m$ into for example: $y = \frac{m-ax}{b}$
2. Substitute y into U(x, y) so that makes $U(x, \frac{m-ax}{b})$
3. Take the derivative of U.
4. Optimise the derivative of U.

You can also solve problems with even more variables by setting up the first-order derivatives by putting all the first partial derivatives and the budget constraint together.

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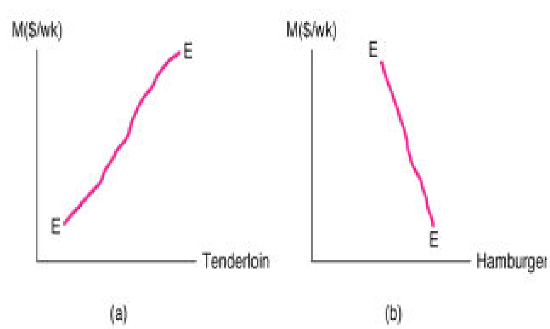
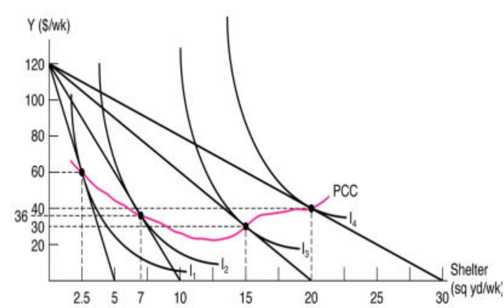
Lecture 5&6, week 2

Analysing the demand curve

Individual demand curve: how does the quantity demanded of a person change when prices differ?
Another name for the individual demand curve is the **price-consumption curve**(PCC). It shows for every price the best bundle (in relation to the different budget constraints and the indifference map).
A price increase will always make a person worse off, because he will reach a lower indifference curve.

Engel curve, Q = f(M), shows the relation between income and the quantity demanded.
With normal goods: f'(M) > 0
With inferior goods: f'(M) < 0



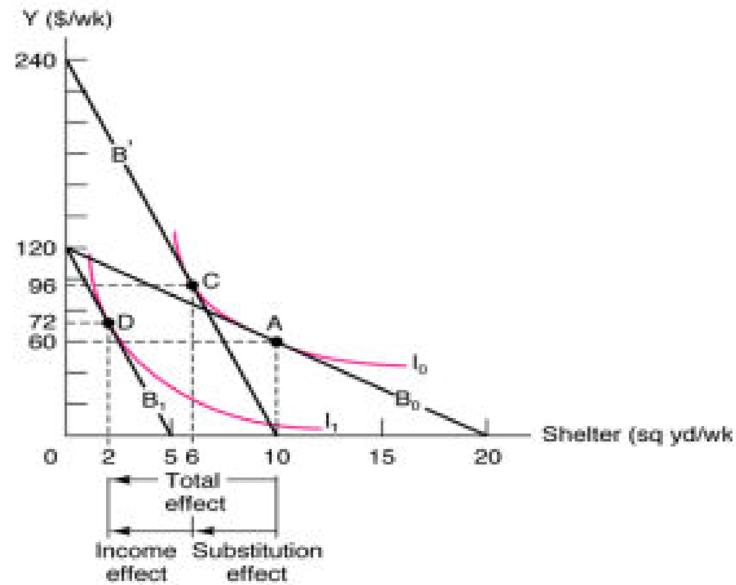


Effect when the price changes

There are two reasons why the quantity demanded changes when the price increases:

1. The **income-effect**: Lower real income (Engel curve)
2. **Substitution-effect**: Looking for alternatives.

To distinguish substitution effect and income effect: shift new budget equation to the point where the initial utility can be achieved.

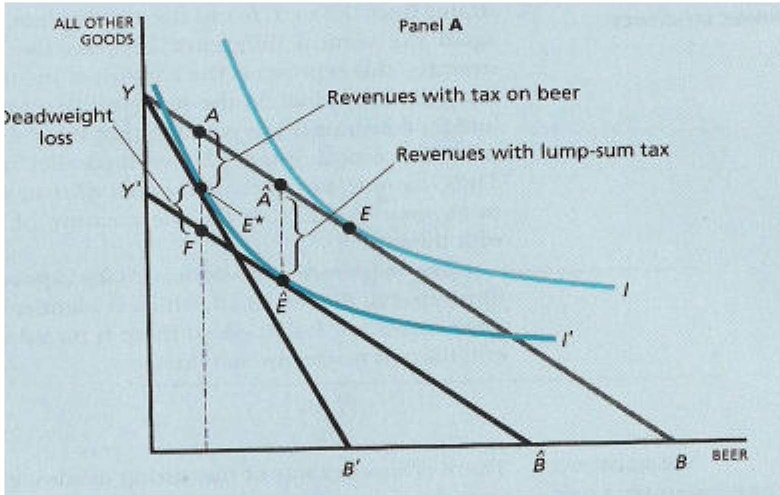


The difference between C and D in shelter is the income effect.
The difference between A and C in shelter is the substitution effect.

Government taxing

When the government set a tax on a product there will be changes in the budget curve of the consumer and will therefore change the utility the consumer is reaching.
We want to make the tax as efficient as possible:
A situation is inefficient if it is possible for the government to
achieve higher returns while the consumer receives the same utility.

When putting a tax on a product the budget curve will change:
PxX + PyY = M -> (Px + t) +PyY = M
When putting a tax on income the budget curve will change:
PxX + PyY = M -> PxX + PyY = M - T



Income tax will reach higher returns while the consumer receives the same utility. Therefore not changing the VAT rate on a product and taxing income is more efficient. The tax on for example alcohol can be justified for other reasons, like health.

Individual curve to market curve

The market demand curve is the sum of the individual demand curves.
Summing the individual demand curves will give the market demand curve.
An example:

$P = 16 - 2Qa \ -> \ Qa = 8 - \frac{1}{2}p$

$P = 8 - 2Qb \ -> \ Qb = 4 - \frac{1}{2}p$

$P <= 8 \ -> \ \Sigma Qi = Q = 12 - P \ -> P = 12 - Q$

$P > 8 \ -> \ P = 16 - 2Q$

Price Elasticity (ε)

Managers would like to know how strong the demand reacts to the price.
Price elasticity = the resulting percentage change in quantity of a percent change in price.

$\varepsilon = \frac{dQ}{dP} * \frac{P}{Q}$

There are three possibilities for **price elasticity**:

$\varepsilon < -1$: **Elastic demand**, demand decreases more than one percent when price increases one percent.

$\varepsilon = -1$: **Unit-Elastic demand**, demand decreases one percent when price increases one percent.

$\varepsilon > -1$: **Elastic demand**, demand decreases less than one percent when price increases one percent.

Income elasticity = the resulting percentage change in quantity of a percent change in income.

$\eta = \frac{dQ}{dM} * \frac{M}{Q}$

Three possibilities for income elasticity:

$\eta < 0$ -> **inferior goods**

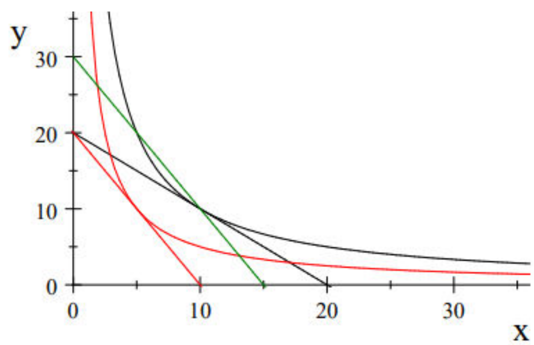
$0 <= \eta <= 1$ -> **Normal goods**

$\eta > 0$ -> **Luxury goods**

Price compensation

Price compensation means that you have so much more income that you can buy the same bundle you used to buy when prices were lower.

Price compensation will lead into higher utility, because the budget curve will go over the old indifference curve you used to reach. -> See illustration



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Lecture 7, week 3

The Intertemporal Consumption Choice Model

Up till now we made the assumption that the consumer spends his entire income. In reality consumers also save money and get loans. Therefore the question rises: how does a consumer distribute his consumption over time?

Therefore we make use of two periods: today and the future.

We also assume that there are no initial assets and no inheritances.

Intertemporal Choice

- Trade-off between consuming today (C_1) and consuming tomorrow (C_2).
- Consumer has income M_1 today and M_2 tomorrow (no inflation ⇒ prices constant).
- Consumption decisions involve saving or borrowing.
- Normalise $pC_2 = 1$.

Intertemporal Opportunity Cost

In chapter 4, the opportunity cost between goods x and y was -Px/Py.
Here, the cost of consuming today vs tomorrow is the interest rate **r**.

The gross opportunity cost of consuming today is $(1 + r)$, and thus, the slope of the budget line = $-(1 + r)$.

For $r \geq 0$, the line is steep → borrowing is costly.
To transform tomorrow's M euros in today's euros: $M \rightarrow M / (1 + r)$
To transform today's M euros in tomorrow's euros: $M \rightarrow M \times (1 + r)$

Intertemporal Budget Constraint

If today's consumption C_1 is on x-axis and C_2 on y-axis:

- If all income is consumed tomorrow: $C_2 = M_2 + M_1(1 + r)$
- If all income is consumed today: $C_1 = M_1 + M_2 / (1 + r)$
- Slope of budget constraint: $-(1 + r)$

We can read the budget constraint from either today's or tomorrow's perspective.

The intertemporal budget constraint in today's euros: $C_1 + C_2 / (1 + r) \leq M_1 + M_2 / (1 + r)$
The intertemporal budget constraint in tomorrow's euros: $(1 + r)C_1 + C_2 \leq (1 + r)M_1 + M_2$

Note: If the borrowing rate > lending rate, the constraint has a kink at the endowment (M_1, M_2).

Intertemporal Indifference Curves

Preferences over (C_1, C_2) are written as $U(C_1, C_2) = \bar{U}$.
The slope (MRS) is known as the Marginal Rate of Time Preference (MRTP):

$$MRTP = -Uc_1/Uc_2$$

Consumer maximises: $$\max_{C_1, C_2} U(C_1, C_2) - \lambda \left(C_1 + \frac{C_2}{1+r} - M_1 - \frac{M_2}{1+r} \right)$$

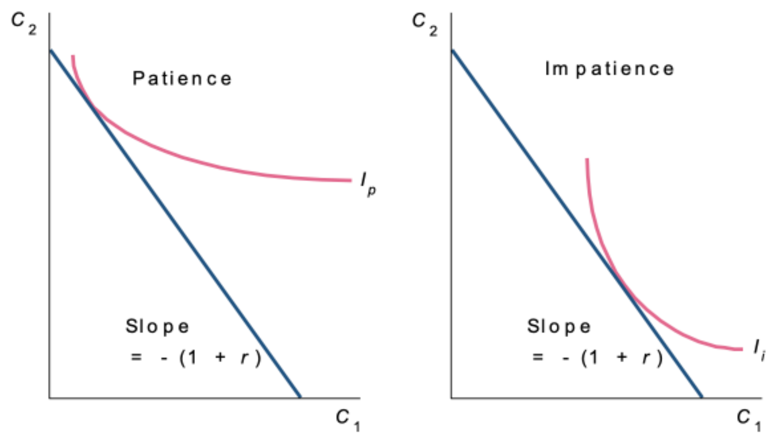
Optimum condition: $$MRTP(C_1^*, C_2^*) = -(1+r)$$

This condition is also known in macroeconomics as the Euler equation

Patience and Saving

If $C_1^* < M_1$ → consumer is not spending all his present income; He saves: $S_1 = M_1 - C_1$
Tomorrow, he can consume: $C_2 = M_2 + (1 + r)(M_1 - C_1)$.

- Patient if: MRTP < (1 + r).
- Impatient if: MRTP > (1 + r).



Modelling Patience in Utility

- Utility function with time-preference parameter β: $U(C_1, C_2) = u(C_1) + \beta u(C_2)$.
- $u(\cdot)$ increasing and concave
- β = gross rate of time preference = $1 / (1 + \delta)$; δ = net rate of time preference.
- Rewriting the Euler equation: $UC_1/UC_2 = \beta\,(1 + r) = (1 + r)/(1 + \delta)$.

Cases:

- 1. $r = \delta \Rightarrow C_1^* = C_2^*$ (equal consumption)
- 2. $r > \delta \Rightarrow C_1^* < C_2^*$ (patient consumer)
- 3. $r < \delta \Rightarrow C_1^* > C_2^*$ (impatient consumer)

Effects of Changes in r, M_1 and M_2

If r increases the opportunity cost of present consumption increases
If r decreases the opportunity cost of present consumption decreases
Substitution effect: C_1 ↓ (both borrowers and lenders).
Income effect: Borrower C_1 ↓, Lender C_1 ↑.

Therefore, the total effect is ambiguous.

Change in M_1 or M_2:

1. Change in current income (M_1) → C_1 and C_2 rise less than 1-for-1.
2. Change in future income (M_2) → C_2 and C_1 rise less than 1-for-1.
3. Permanent change ($\Delta M_1 = \Delta M_2$) → C_1 and C_2 increase almost equally (if $\delta \approx r$).

Friedman's Permanent Income Hypothesis

- Permanent income: total income in present value, $Y_p = M_1 + M_2/(1 + r)$.
- Permanent income changes → reflected one-for-one in consumption.
- Temporary income changes → mostly saved.
- We consume permanent income but save temporary income.

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Lecture 8, week 3

Probability Theory

Deterministic and Random Variables

- Deterministic variable: has a fixed, certain value (e.g. income = €1000).
- Random variable: value not known ex-ante; represents a lottery or gamble.

Examples:

- Coin flip → Heads/Tails ($p = ½$ each)
- Dice roll → 1 to 6 ($p = 1/6$ each)
- Lottery draw → 1 to N ($p = 1/N$ each)

Events and Support

Event: specific outcome of a random variable.
Support: all possible outcomes.

Discrete: finite set (e.g. dice, coin).
Continuous: infinite set within an interval (e.g. GDP, income).

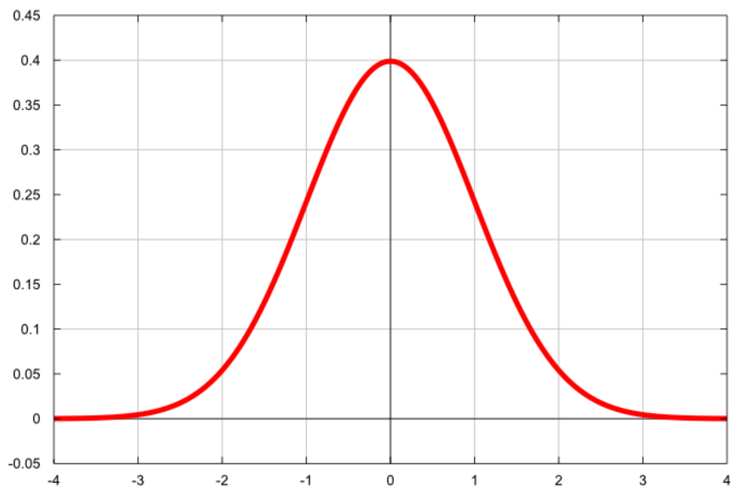
Probabilities and Probability Distributions

- Probability $p = Pr(X = x)$ lies between 0 and 1.
- The sum of all probabilities = 1 ($\Sigma p_i = 1$).
- For a continuous variable, $Pr(X = x)=0$ because there are infinite outcomes.
- Use a Probability Density Function (PDF) to describe likelihoods.

Probability Density Function (PDF)

- Describes how likely each value of X is.
- For continuous X: ∫ f(x)dx = 1.

Standard Normal Distribution: Bell-shaped, symmetric around 0

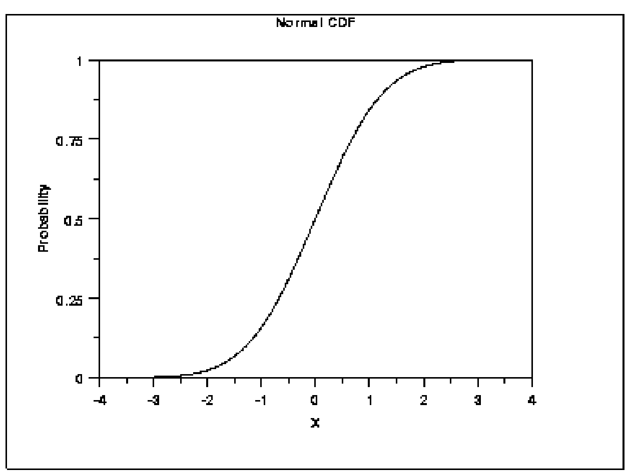


Discrete Distributions

- Represented by frequency histograms showing how often each value occurs.
- Height of each bar = probability or frequency

Cumulative Distribution Function (CDF)

- Gives probability that X ≤ x: F(x) = Pr (X ≤ x).
- Always increasing; F(−∞)=0, F(+∞)=1.
- Example (dice): Pr(X<3)=1/3.
- Standard Normal CDF = S-shaped curve from 0 to 1



Expected Value (Mean)

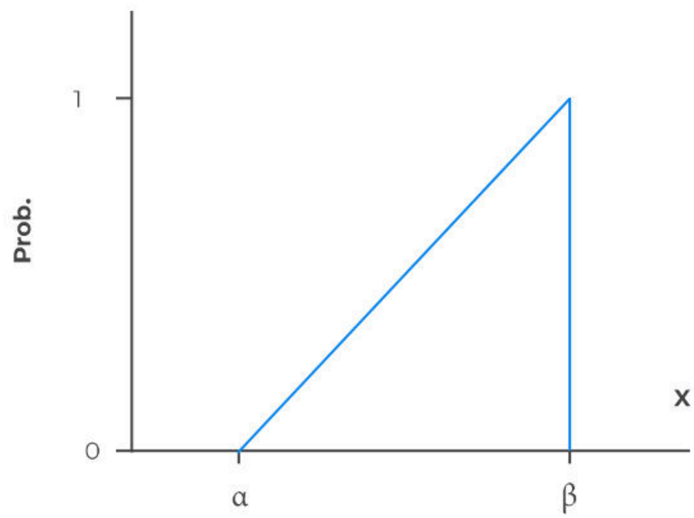
- Weighted average of all possible outcomes.
- For discrete X: $E(X)=\Sigma\, p_i x_i$
- For continuous X: $E(X) = \int x\, f(x)dx$

Examples:

- Dice → E(X)=3.5

Uniform Distribution

A uniform distribution is a continuous distribution where all outcomes are equally likely.



Support = [a, b]

- PDF: $f(x)=1/(b-a)$
- CDF: $F(x)=(x-a)/(b-a)$
- Mean: $E(X)=(a+b)/2$

Conditional Expectations (Uniform Distribution)

If X ~ Uniform[a, b]:

- $E(X \mid X < x)=(a+x)/2$
- $E(X \mid X > x)=(x+b)/2$

Key Notes

- Uncertainty is represented by random variables.
- PDFs and CDFs describe distributions of possible outcomes.
- Expected value summarises average outcome.
- The uniform and normal distributions are foundations for analysing expected utility and decision-making under risk in upcoming lectures.

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Lecture 9, week 4

Uncertainty in economics

Preferences under Uncertainty

In the real world, individuals face uncertain outcomes — wealth, income, or returns can vary.

Von Neumann–Morgenstern Expected Utility Model

To model behavior under uncertainty, economists use the Von Neumann Morgenstern (VNM) expected utility model.

The VNM utility function assigns utility to each possible outcome of a random variable (a gamble).

Note: Agents rank uncertain prospects by their expected utility, not by expected money.

Diminishing marginal utility (U″ < 0) is *not always assumed* — it depends on risk attitude.

The Expected utility of a gamble (E(U)): expected value of utility over all possible outcomes of the gamble.

$$E[U(x)] = \sum p_i U(x_i)$$

Attitudes Toward Risk

1. Risk Aversion

- Utility: increasing and concave (U′ > 0, U″ < 0).
- Prefers the utility of the *average outcome* to the average utility of outcomes:

$$U[E(X)] > E[U(X)]$$

- Always refuses a fair gamble.
- Graph: curved upward, flattening as wealth increases

Interpretation: prefers certainty; will accept a lower but guaranteed return to avoid risk.

2. Risk Neutrality

- Utility: linear in money, $U(M)=\alpha M$
- Indifferent between certain outcomes and fair gambles.

$$U[E(X)] = E[U(X)]$$

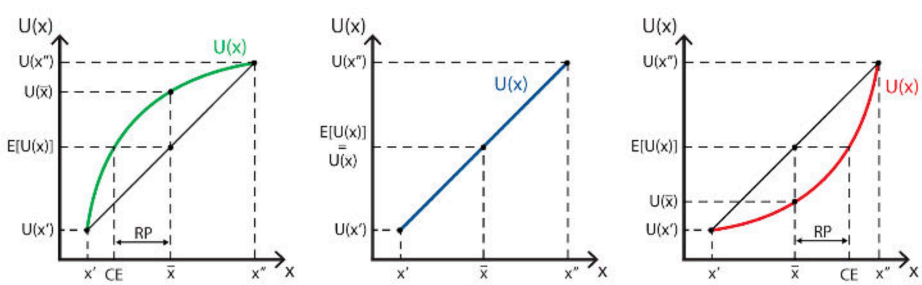
- Typical of firms or investors focused on *expected profits only*.

3. Risk-Loving (Risk-Seeking)

- Utility: increasing and convex (U″ > 0).
- Prefers extremes to average

$$U[E(X)] < E[U(X)]$$

- Accepts fair gambles since upside is valued more than downside is disliked.



Risk averse individual
$E[U(x)] < U(\bar{x})$

Risk neutral individual
$E[U(x)] = U(\bar{x})$

Risk loving individual
$E[U(x)] > U(\bar{x})$

Certainty Equivalent (CE) and Risk Premium

For a risky lottery, the certainty equivalent (CE) is the guaranteed income level yielding the same utility as the expected utility of the gamble:

$$U(CE) = E[U(X)]$$

For a risk-averse agent: CE < Expected Value (EV).

The risk premium is:

$$\pi = EV - CE$$

It measures how much one is willing to pay to remove risk.

Insurance

- Risk-averse individuals are willing to pay a premium to avoid uncertainty.
- Full insurance removes risk completely: income becomes independent of accidents.

An example of what you could be insuring is your health. Let's say there's a ⅔ chance you stay healthy and a ⅓ chance you get sick. Your expected utility will be EU=⅔ x 600+ ⅓ x 150 = 500. We are also assuming you are risk averse. The amount you are willing to pay for insurance = M, if you stay healthy, - M corresponding to the expected utility which lies on the same indifference curve.

The Value of Information – Advisors and Experts

- Risk-averse individuals value information because it reduces uncertainty.
- They are willing to pay for advice that improves decision quality.

Example:
A boy must choose between:

- Becoming a tennis player: 0.01×€250M if successful, 0.99×€0.2M if not.
- Opening a pub: guaranteed €1M

Utility: U(M)= $\sqrt{M}$

Without advice:

$$EU(Tennis) = 0.01\sqrt{250M} + 0.99\sqrt{0.2M} < \sqrt{1M}$$

→ Chooses the pub.

If a perfect advisor reveals the true outcome beforehand:

$$EU(with\ advice) = 0.01\sqrt{250M - P} + 0.99\sqrt{1M - P}$$

Setting $EU(with\ advice) = 1000$ gives $P_{max} \approx €276,690.$

He'd pay up to that much for perfect information.

If advisor only charges when news is good:

Theoretical $P_{max} \approx 249M$ -> showing that "pay on success" can extract almost all returns.

Takeaway: Risk-averse people will pay for information, but they should beware of biased incentives.

Bias and Advice Example – Parents and Dating

- You consider dating someone; the outcome's quality qqq is uncertain (distributed over [-μ, μ]).
- Your parent knows *q* but has a **bias** (cost *c*<0) against you dating.
- They advise "yes" if c + q > 0 → q > -c

Interpretation:

- A *positive* recommendation from a biased parent is highly credible.
- A *negative* one may cause you to miss good opportunities.

Moral Hazard and Adverse Selection

Moral Hazard

Occurs **after** a contract is made — one party's behavior changes because the other bears the risk.

Examples:

- Drivers being less careful once insured.
- Workers being lazy when effort isn't monitored.

Adverse Selection

Occurs before a contract — one side hides private information about risk or quality. Example: unhealthy people are more likely to buy health insurance ("market for lemons").

Signaling and Information Disclosure

When preferences are misaligned, signaling helps reveal private information.

1. Costly-to-Fake Principle:
   - For a signal to be credible, it must be costly or difficult to imitate.
   - Examples: advertising, elite education, reputation, luxury goods.

2. Full-Disclosure Principle:

   - Silence implies the worst — individuals disclose even unfavorable information to avoid suspicion.
   - Examples:
     - Firms offering long warranties (Toyota 5 years, Kia 7 years).
     - Applicants disclosing facts that might otherwise appear hidden.

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Adverse Selection

Adverse selection = problems that arise when one party in a market transaction has more information than the other (hidden information).
This often leads to market failure.

Applications

A. Professional Guilds

- Professions like doctors, lawyers, accountants, and teachers often have barriers to entry (licenses, degrees, guilds).
- These barriers reduce adverse selection by ensuring quality — screening out unqualified individuals.

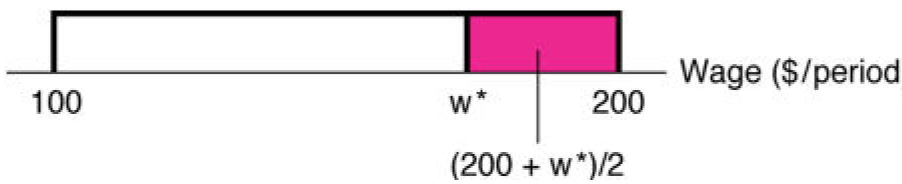
B. Finding a Partner

- Dating involves hidden information: people don't fully know each other's quality or preferences.
- People use signals to reduce uncertainty — joining dating platforms or revealing info (education, job, hobbies).
- Being on a dating site itself is a signal.
- Universities also act as matching markets — e.g., graduates of law programs are much more likely to marry each other (Eika et al., 2019).

Search Theory

A crucial question in search theory is when do you stop looking and when do you go into action.

Imagine you are looking for a job and every job pays between 100 and 200 euros. Looking for another job costs you 10 euros each time, and the salary is uniform divided. So 1 euro extra from 100 euros is worth as much as 1 euro extra from 199 euros.



The benefit of looking for a new job is: $Pr(W > W^*)[E(W|W > W^*) - W^*]$. Where Pr(W>W*) stands for the chance that W* > W, so the chance that you find a higher result by searching.

The expected gain in the case if W* > W is: [E(W|W > W*)-W*).
If you are looking for the amount where you should stop searching is: $\frac{200-W^*}{2} * \frac{200-W^*}{200-100} = 10(price\ of\ looking)$. A more general formula can be written as $\frac{max-W^*}{2} * \frac{max-W^*}{max-min} = price$

Statistical Discrimination

Employers make judgments based on group averages when individual productivity is uncertain.

Example:

Group productivity is uniformly distributed between 10 and 30 → average 20.
An employer offers wage = average productivity = €20/hour.

If a worker takes a test that is correct only half the time:

- Test score = 24 → estimated productivity = (24 + 20)/2 = 22
- Test score = 16 → estimated productivity = (16 + 20)/2 = 18

The employer updates expectations between the test score and the group mean. Two workers with identical scores but from different groups (different average abilities) get different offers.

This creates statistical discrimination — differences in expected productivity across groups lead to wage gaps.

This explains why university reputation and program choice affect pay — your "signal" acts as insurance against uncertainty.

However, above-average individuals are initially underpaid, and below-average ones are overpaid.

Producer theory

The definition of products is anything which supplies utility, now or in the future. (not only physical goods).

Definitions of production are: a process that creates utility, now or in the future. Or a process that production factors (inputs) turns into products (outputs)

Examples of inputs are: labor, capital, land, energy, raw materials, entrepreneurship, and knowledge. Output is anything that supplies utility, now or in the future.

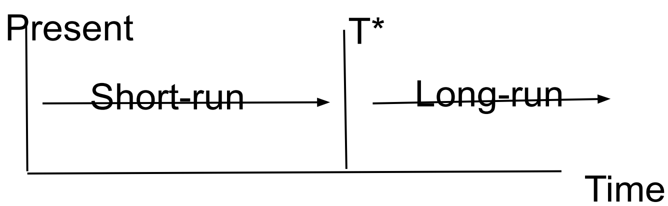
The production function: Input -> Business/production function -> output
In this course the only inputs (production factors) we are gonna use are labour, which we describe as L, and capital, which we describe as K.

We can write the production function as Q = F(K, L), where Q is the amount of products we produce. Function F is the production technology.
An example of a production function is the Cobb-Douglas production function: $Q = mK^aL^b$ with $a,\ b \in [0,\ 1)$ and $m > 0$

Long vs. short run

The producer chooses the production factors (inputs). Some choices are able to be changed quickly, these are variable inputs, other choices aren't possible to change quickly, these are fixed inputs.

T* is the time it takes to change all production factors (see illustration)

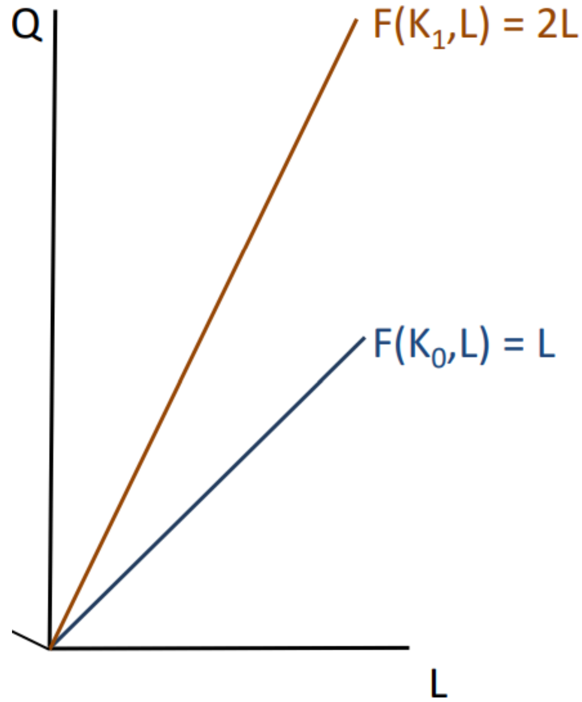


In the **short-run** there is at least 1 production factor 'fixed'.
In the **long-run all** production factors are 'variable'.

In this course Labor 'L' is always variable and Capital 'K' is fixed.

Production in the short-run

If we have a production function $F(K, L)=KL$ and capital is fixed in the short run to $K = K_0 = 1$ we can illustrate that (see illustration). Later we change $K = K_1 = 2$, therefore the production function also changes.



The short-run production function always goes through the origin.

Total, average and marginal product

Total product (TP):
- How much gets produced: Q (production function)

Average product (AP):
- Output per unit variable input
- The average product of labour: $AP_L = \frac{Q}{L} = \frac{F(K,L)}{L}$

Marginal product (MP):
- How much changes the output with the change of 1 unit of an input.
- The marginal product of labour: $MP_L = \frac{dQ}{dL} = \frac{\partial F(K,L)}{\partial L}$

Effects of labour in the short-run:
If there is one person he will do everything. If there are multiple people there will be specialisation (Adam Smith), and if there are too many people they get in each other's way. This effect is called the law of diminishing returns.

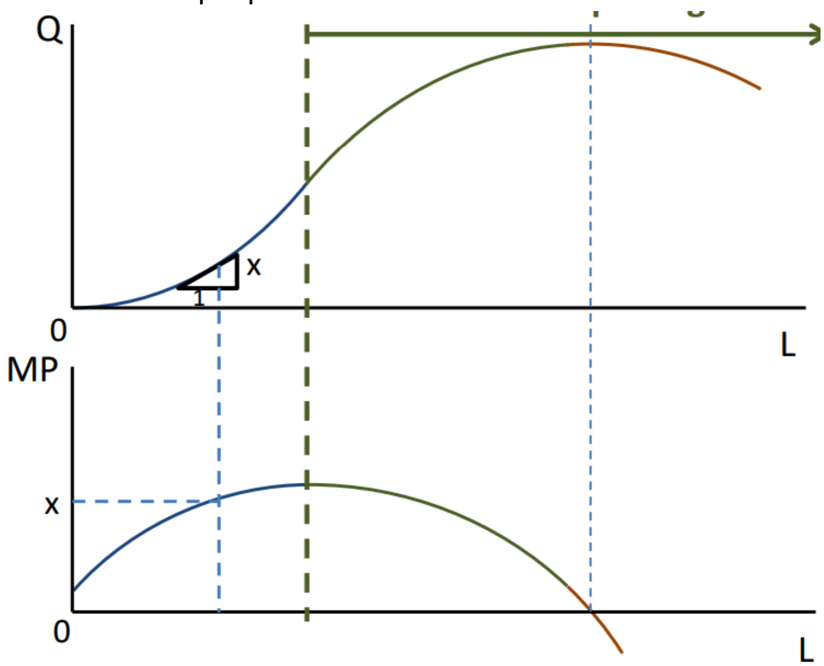
A more formal definition of the law of diminishing returns is: a principle stating that profits or benefits gained from something will represent a proportionally smaller gain as more money or energy is invested in it.

The law of diminishing returns, works for every short-run input although it doesn't work in the long-run. For example if we multiply our restaurant (long-run because it also affects fixed costs) and place it on the other side of town it won't necessarily give less returns than the first restaurant.

Properties of the marginal product of labour (MP_L):

- Slope coefficient of the total product (TP)
- Rises for L if L is small (specialisation)
- Decreases if L is bigger (law of diminishing returns)
- TP: The inflection point is at the start of diminishing returns
- The MP can be negative for L if L is big (people get in each other's way)
- The start of negative returns is when $MP_L = 0$

See the illustration for these properties illustrated.



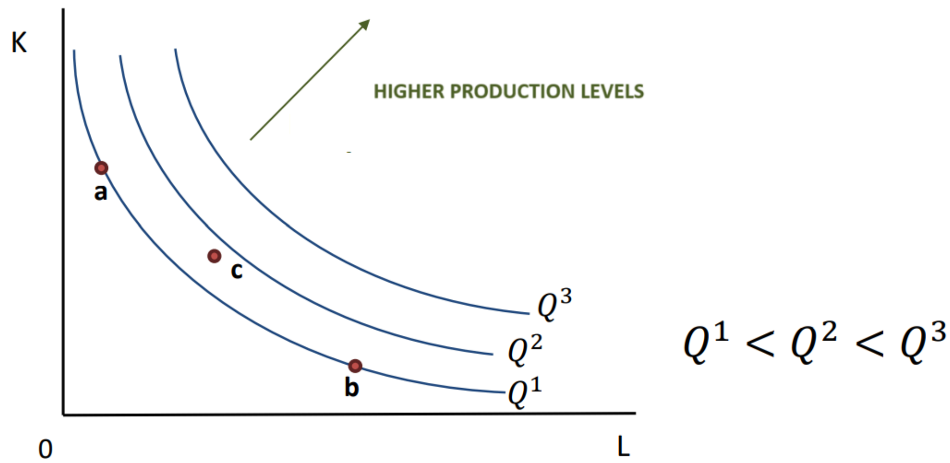
Properties of the average product:

- The coefficient of the origin to a point on the production curve
- When L -> 0: $AP_L = MP_L$
- MP > AP => AP increases
- Maximum AP_L : $AP_L = MP_L$ (not the point in the origin)
- MP < AP => AP decreases

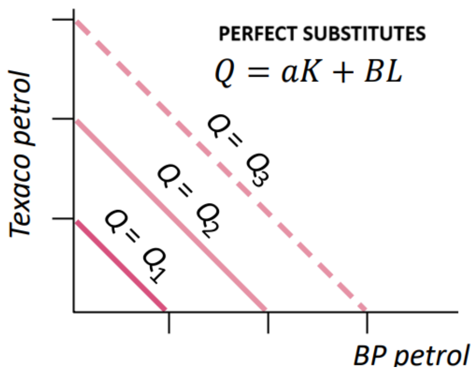
If we want to maximise production in the short-run with certain amounts of labours we should make sure $MP_{L1} = MP_{L2}$

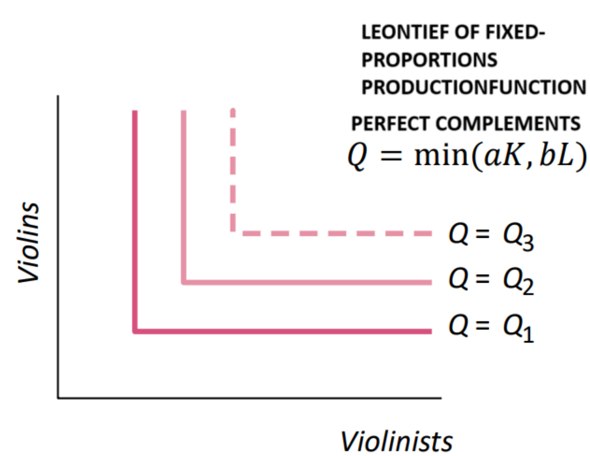
Production in the long-run

In the long-run all production factors are variable. The production function will be described as Q = F(K, L). We can show this graphically with an isoquant map. This isoquant map consists of unlimited amounts of isoquant curves for which the amount of production is the same, regardless of the distribution of the production factors.



Perfect substitutes and complements also work the same for the isoquant map. These types of functions are illustrated below:





The marginal rate of technical substitution (MRTS): is the absolute value of the slope coefficient of the isoquant.

MRTS = $|\frac{dK}{dL}|$

The economic interpretation of the MRTS is the ratio to which capital can be exchanged for labour without changing the production quantity

Returns to scale

Returns to scale is about what happens with the production when you increase the production factors (inputs) proportionally. So both with the same proportion

- Increasing returns to scale
  $F(cK, cL) > cF(K, L)$
  This can happen because of specialisation, or the law of big numbers.
- Constant returns to scale
  $F(cK, cL) = cF(K, L)$
- Decreasing returns to scale
  $F(cK, cL) < cF(K, L)$
  This can happen when people for example get in each other's way while working. This is not the same as the law of diminishing returns.

Example exercise: Decide if the production function $F(K, L) = K^{1/4}L^{1/2}$ has increasing, constant or decreasing returns to scale.
Solution: $F(cK, cL) = c^{1/4}K^{1/4}c^{1/2}L^{1/2} = c^{3/4}K^{1/4}L^{1/2} < cF(K, L)$ so this function has decreasing returns to scale.