Most Important Things to Learn Today

1. Understand why free markets are inefficient when there are externalities
2. Graphically represent and calculate efficient quantity and deadweight loss
3. Know what can be done about externalities
4. Understand the government’s role in providing public goods
5. Know how to find the optimal amount of a public good
For this part of the course, consider a fully competitive market with complete information.

- Demand = marginal private benefit (MPB)
- Supply = marginal private cost (MPC)
- The market quantity $Q^{mkt}$ is where MPB=MPC.
- As we saw during the review, the market outcome is Pareto efficient if we consider only the buyers and sellers.
- But what if we consider all of society?
Externalities are direct impacts on the welfare/profit of parties outside a transaction ("bystanders").

In the absence of externalities, considering all of society is equivalent to considering only buyers and sellers, so the market outcome is efficient.

- This is a good approximation for many (most?) markets.

Externalities may be:

- **Positive** (some bystanders willing to pay to increase consumption/production by buyers/sellers): gardening, education, vaccination, fireworks, etc.
- **Negative** (some bystanders willing to pay to decrease quantity): Pollution, congestion, noise, etc.

"Production externalities" are caused by the production of a good; "consumption externalities" are caused by the consumption of a good.
Let $Q^{mkt}$ be the market quantity, and $Q^{eff}$ be the socially efficient quantity.

If there is a positive externality:
- The next unit after $Q^{mkt}$ has $MPC > MPB$, but by almost zero.
- Even a small positive externality exceeds that difference.
- Therefore, $Q^{mkt} < Q^{eff}$.

If there is a negative externality:
- The last unit in $Q^{mkt}$ has $MPB > MPC$, but by almost zero.
- By the same reasoning, $Q^{mkt} > Q^{eff}$.

In both cases, the market quantity is **not** Pareto efficient.

To generate a Pareto improvement from the competitive equilibrium, in addition to changing the quantity, some buyers/sellers have to be compensated.
With income effects, it is complicated to:
- perform quantitative welfare analysis (how to incorporate welfare of bystanders?), and
- quantify policy interventions to achieve efficiency (any intervention will cause income effects, which may shift the efficient quantity).

Going forward, we will ignore income effects (e.g. assume quasilinear utility), keeping in mind that they would not affect the direction of our conclusions.

Without income effects, we can easily define:
- **Marginal social benefit (MSB)**: MPB + benefit of consumption externality
- **Marginal social cost (MSC)**: MPC + cost of production externality

Benefit/cost of externality **may be negative**, and is judged by bystanders’ willingness to pay (well-defined since no income effect)

Positive externality: MSB > MPB or MSC < MPC

Negative externality: MSB < MPB or MSC > MPC
Efficiency with Externalities

- We want to maximize social surplus (benefit minus cost) in a market.
- Thus we want to produce a unit if and only if its social benefit exceeds its social cost.
- If marginal social benefit is decreasing in quantity and marginal social cost is increasing in quantity, then the efficient quantity $Q^{\text{eff}}$ is the quantity at which:

$$\text{Marginal Social Benefit (MSB)} = \text{Marginal Social Cost (MSC)}$$

- When there are no externalities (MPB=MSB and MPC=MSC), this condition is equivalent to MPB=MPC, which defines $Q^{\text{mkt}}$.
- Example: Suppose the MPC of a unit is 4 for the firm, and MPB is 5 for the consumer, but the unit causes a negative externality of 2 on a bystander. Suppose the good transacts. Find a Pareto improvement.
- Deadweight loss: "Triangle" between MSB and MSC, from $Q^{\text{mkt}}$ pointing toward $Q^{\text{eff}}$. 

ECON 302 (SFU)  
Externalities and Public Goods
Getting to Efficiency

There are several ways to achieve/approach efficiency, each with its own drawbacks:

1. Assign property rights and create a new market
2. Pigouvian tax/subsidy
3. Tradable permits
4. Regulation
The reason why externalities cause inefficiencies is that property rights are not well-defined.

Example: \( MPC = 4 \), \( MPB = 5 \), negative externality to bystander = 2.

Suppose the bystander is given the legal right to seek compensation for the externality. What happens?

Suppose the transacting parties are given the legal right to cause the externality. What happens?

Coase Theorem: If property rights are well-defined and there are no transaction costs, an efficient outcome is achieved through negotiations over the right/obligation to generate the externalities.
Intuition: if property rights are well-defined, the buyer and the seller will take externalities into account because:

- If the externality of buying/selling is negative, they will either have to pay outsiders for the right to cause the externality, or be paid by outsiders in order not to buy/sell.
- If the externality of buying/selling is positive, they will either be able to charge outsiders for the positive externality, or have to pay outsiders to shed the obligation to buy/sell.

If there are no income effects (e.g. quasilinear utility function), then the outcome does not depend on who is assigned the property rights (as in our example).

However, and obviously, each party’s welfare does depend on who is assigned the property rights.
Assigning property rights theoretically gets rid of the externality DWL. But it only works if transaction costs are absent/low.

Example: Suppose your driving a car hurts everyone in Vancouver through air pollution, by 0.01 cents. How are you going to pay each Vancouverite 0.01 cents?

Further problem: Some people may be affected more than others, which complicates bargaining because others may pretend to be affected more than they really are.

Thus, this approach works well when the externality affects few people a lot, and doesn’t work when it affects lots of people a little.

In the latter case, it can make sense for the government to get involved on behalf of people affected by the externality.
You know from ECON 103 that taxes reduce quantity and subsidies increase quantity. So the government can use the appropriate tax/subsidy to bring quantity to $Q^{eff}$. Amount of tax/subsidy = Size of externality at $Q^{eff}$. This is called a Pigouvian tax/subsidy. Example: BC carbon tax. Drawback: need to know how big the externality is.
Tradable Permits (I)

- Give $Q^{\text{eff}}$ permits for the externality, and allow trading. Example: European carbon market.
- In practice, this is only feasible for reducing quantity. (To increase quantity, the government would impose obligations that one can get rid of by paying...)
- The demand for such permits will be MPB-MPC.
- Thus the price of permits $= \text{MPB-MPC at } Q^{\text{eff}} = \text{size of externality at } Q^{\text{eff}}$.
- This is equivalent to a Pigouvian tax if the government auctions off the permits.
- Drawback: need to know $Q^{\text{eff}}$. 

What if tradable permits are handed out instead of auctioned off?

This doesn’t change the market outcome if there is no income effect.

But the government gives up revenue that could be used to reduce distortionary taxes.

Thus economists generally favour auctioned permits over assigned permits, at least in the long run.
We saw that in our basic model, a Pigouvian tax and auctioned tradable permits are equivalent.

This is no longer true if the model has uncertainty.

Better off with tax if have a good idea of size of externality (e.g. each ton of CO$_2$ causes $x$ worth of damages).

Better off with permits if have a good idea of efficient quantity (e.g. we’re mostly fine below $x$ tons of emissions, and totally screwed above).

Tax is usually easier to administer (don’t need to keep track of permits on top of measuring emissions).
Regulation

- Examples: fuel emission standards, quotas, price floors/ceilings, etc. Are they good?
- Goal is to produce exactly the units with positive marginal social surplus (MSB-MSC).
- With Pigouvian tax and tradable permits, even if they’re not set at the right level, you at least know that the produced units are the ones generating the highest marginal social surplus because there is a uniform price on the externality.
- With regulation, this is not guaranteed. E.g. Factory A is forced to reduce emissions more than factory B, even though factory B can do it for cheaper.
- As a result, economists generally oppose regulation when a Pigouvian tax or tradable permits are feasible.
- Regulation is suitable in extreme cases like when $Q^{eff} = 0$. 

ECON 302 (SFU)  Externalities and Public Goods  16 / 25
Moral of the Story

- Ideally, solve the externality problem by assigning property rights.
- Often not feasible.
- Good alternative solutions: use Pigouvian taxes/subsidies or auctioned off tradable permits. Key: change the market, but still use it!
- Permits assigned for free are corporate giveaways.
- Except in extreme cases or in cases where taxes/permits are infeasible, regulation is a suboptimal solution.
A pure public good is **both non-rival and non-excludable**.

- **Non-rival**: My consumption of a good doesn’t reduce others’ benefit from it. (E.g. uncongested road, knowledge)
- **Non-excludable**: Cannot make people pay to enjoy the good. (E.g. fireworks, untolled road)
- Together, these imply that providing a public good to one buyer causes a **large positive externality**: others automatically get to enjoy the good (non-excludability), and nobody has a negative effect on others (non-rivalry).
Underprovision of Public Goods

As we saw previously, this means that the $Q^{mkt} < Q^{eff}$.

For public goods, this is an especially big problem: MPB is one person’s benefit for the good, while MSB is everyone’s benefit added up (due to non-rivalry).

Suppose you were in charge of buying national defence for all of Canada, with your own money. How much would you spend?

What would you like to do?

But public goods are non-excludable → **free-rider problem**: people don’t have to pay, and can "free ride" on others’ provision of the good.
Solution 1: Make the Good Excludable

- This only works for some goods: can put tolls on a road, but can’t make national defence excludable.
- Example: Demand for bridge crossings $Q = 50 - P$ per day, marginal cost of a crossing = 0 (no congestion), but maintenance cost = 600 per day (independent of road use).
- Suppose nobody values the bridge at over $600/day. Will any single person pay for the maintenance of the bridge if it is not excludable?
- To cover the maintenance cost with revenues from the bridge itself, would need to make it a toll bridge, and charge $20-30/crossing.
- Is that efficient?
The government could instead make the bridge free, and pay the maintenance fee out of its general fund.

Is that efficient (in this market)?

Whether this is efficient overall is not clear: the government needs to get the money from somewhere.

That "somewhere" is often distortionary taxes, in which case the DWL from taxes needs to be compared to the DWL from not subsidizing.
Another Example (I)

The bridge example was a 0/1 decision: there is either a bridge or there isn’t. The only thing that could be varied is the number of people if the good is made excludable.

There are also situations where the amount of public goods can be any number.

Example: Deciding how many minutes \( (x) \) fireworks should last.

There are 4 people in town, and suppose each person has quasilinear utility \( u(m, x) = m - x(x - 10) \), where \( m \) is money.

Let the marginal cost and price of fireworks be constant at 8/minute.
Another Example (II)

- 4 people each value $x$ minutes of fireworks at $-x(x - 10)$; $MC = P = 8$/minute.
- How long would fireworks last if person 1 buys them?
  - Person 1 would choose $x$ to maximize $I - 8x - x(x - 10)$, where $I$ is the initial budget.
  - First-order condition: $-8 - 2x^* + 10 = 0$
  - Thus $x^* = 1$
- Would persons 2, 3 and 4 buy extra minutes?
Another Example (III)

- 4 people each value $x$ minutes of fireworks at $-x(x-10)$; $MC = P = 8$/minute.

- What is the efficient length of fireworks?
  - We want to maximize the sum of utilities. Ignoring the initial budgets (which are constants), we maximize $-8x - 4x(x - 10)$.
  - First-order condition: $-8 - 8x^{\text{eff}} + 40 = 0$
  - Thus $x^{\text{eff}} = 4$

- How could the efficient length be achieved?
Public goods are non-rival and non-excludable.

They are underprovided on the private market because of the free-rider problem.

Sometimes, the problem can be solved by making the good excludable - this forces users to pay.

But this is inefficient when $P > MC$ is required to raise enough revenue (like in our example, where $MC = 0$).

The government can also subsidize the good or provide the good itself.

This can be efficient in that specific market, but can cause inefficiencies through taxes elsewhere.