Lecture Note 12: Public Goods

Up to now, we've implicitly been talking about **private goods**, which have two important properties:

- **Rivalry**: only one person can consume the good.
  - If I eat an apple, you can't eat the same apple.
  - If I sit in seat 23F on a flight from Sacramento to NYC, you can't sit in the same seat on the same flight.
- **Excludability**: the owner of the good has both the physical means and the social/legal right to prevent others from using it.
  - I keep my economics textbooks locked in my office.
  - My boarding pass gives me the exclusive right to sit in 23F.

By contrast, **public goods** are *non-rival* (my use of a public good doesn't affect your ability to use it) and *non-excludable* (it's impossible or prohibitively difficult to deny people access to the good).

- Clean air (everyone breathes the same air).
- National defense (everyone in the country gets it).
- A lighthouse (every ship in the area can see it).
- Marketing strategies (they're easy to copy).

Whereas markets are often quite good at allocating private goods efficiently (if not equitably), markets systematically <u>underprovide</u> public goods.

To explain this, I'll share an embarrassing story from my college years. But first, a little more vocabulary ...

Classifying goods based on rivalry and excludability

We classify goods into four categories based on rivalry and excludability. (Not all goods fall neatly into a single category—it's more of a spectrum.)

	excludable	non-excludable
rival	private goods	common goods
non-rival	club goods	public goods

Club goods are excludable but non-rival, at least up to a point. (If enough people use them, congestion can make them rival.)

- Consider Netflix. Lots of people can use Netflix at the same time: in fact, the marginal cost of production is basically zero.
- But Netflix limits access to its shows: you have to pay for an account.

Common goods are rival but non-excludable.

- Ocean fisheries are a classic example. Fish are a rival good: the more one ship catches, the harder it is for other ships to catch fish. But fishing stocks are non-excludable: it's very difficult to limit access.
- Common goods are vulnerable to the **tragedy of the commons**.* Fishing imposes a negative externality, since it makes it harder for other fishers to catch fish. Since fishers only care about their private costs (ignoring the external damage), the result is overfishing.†

*This colorful phrase originally referred to English villages, where herders were allowed to let their cows graze on communal pasture lands known as "commons". The "tragedy" is overgrazing.

†There's a negative externality on the fish themselves, too: depending on one's ethical point of view, one might want to include animal welfare in the definition of social surplus.

Public goods, free riders, and an embarrassing story involving mice

Here's the problem with public goods:

- Since they're non-rival/non-excludable, everybody benefits from them.
- But nobody wants to pay for them: we all want someone else to pay.
- We call this the **free-rider problem**.

Now for the embarrassing story. When I was a junior in college, my roommate and I had a pretty serious mouse infestation in our room.

- It was gross.
- Even worse: each of us wanted the other one to deal with it.

To understand our dilemma, let's put some numbers on this:

- Let $Q \equiv q_1 + q_2$ be total time spent dealing with the mice.
- Let q_1 be the time I spend, q_2 be the time my roommate spends.
- $p_1(Q) = 8 - Q$ is my private marginal benefit (i.e., demand) curve.
- $p_2(Q) = 8 - Q$ is my roommate's private marginal benefit curve.
- Each of us has a marginal cost $MC = 12$ for each unit we contribute.

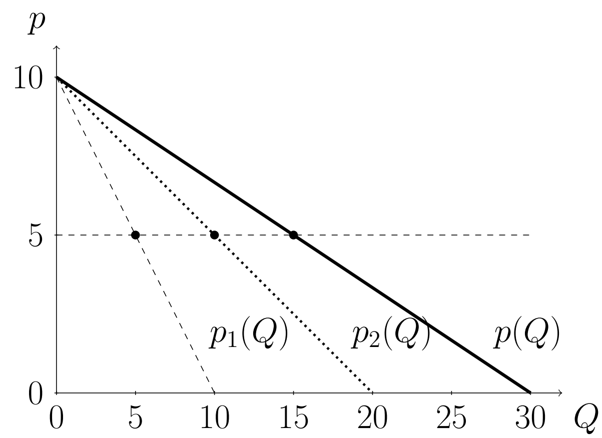
Just as we did with externalities, we want to answer two questions:

- How much time <u>should</u> we spend dealing with mice? (social optimum)
- How much time <u>will</u> we spend dealing with mice? (Nash equilibrium)

To think about what's socially optimal, we need to think about the *social marginal benefit* curve.

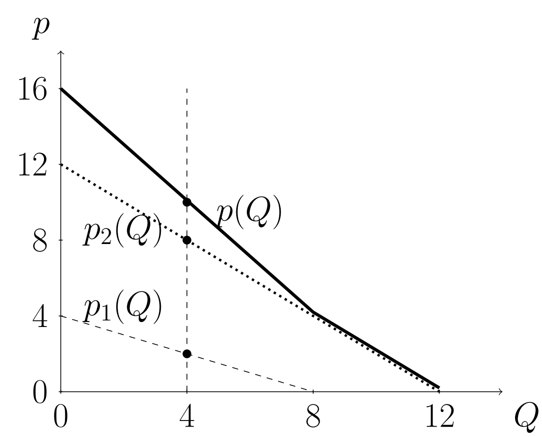
The demand curves for public vs. private goods

When we analyze the market for a private good, we construct the market demand curve by summing the individual demand curves horizontally.



- The market demand curve for a *private* good tells us: at each price p, how many units will consumers buy?
- Example: suppose $p_1(Q) = 10 - Q$, $p_2(Q) = 10 - \frac{1}{2}Q$.
- When $p = 5$, agent 1 wants $Q_1 = 5$ units and agent 2 wants $Q_2 = 10$.
- Total demand is thus $Q_T = 15$ units.
- Market demand: $p(Q) = 10 - \frac{1}{3}Q$

By contrast, when we're analyzing a public good, we construct the market demand curve by summing the individual demand curves vertically.



- The market demand curve for a *public* good tells us: what is the social marginal benefit at each possible Q?
- Example: suppose $p_1(Q) = 4 - \frac{1}{2}Q$ and $p_2(Q) = 12 - Q$.
- When $Q = 4$, agent 1's PMB is 2, agent 2's PMB is 8, and the SMB is 10, since both agents consume the good at the same time.
- Market demand:

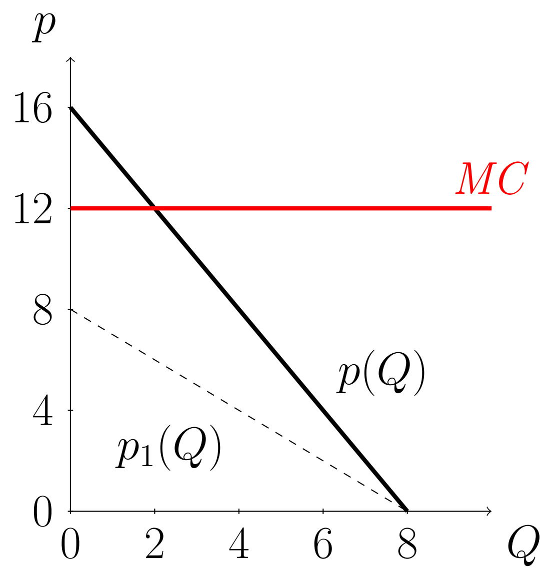
$$p(Q) = \begin{cases} 16 - \frac{3}{2}Q & \text{if } Q \leq 8 \\ 12 - Q & \text{if } Q > 8 \end{cases}$$

And now, back to the mice

Since $p_1(Q) = p_2(Q) = 8 - Q$, the social marginal benefit curve is

$$p(Q) = 16 - 2Q$$

Let's start by finding the social optimum:



We find the social optimum by setting the social marginal benefit equal to the social marginal cost:‡

$$SMB(Q) = SMC(Q) \implies 16 - 2Q = 12 \implies Q_s = 2$$

What about the Nash equilibrium?

- No matter what Q is, $p_1(Q) = PMB_1(Q) = 8 - Q < 12 = PMC$.
- I have a dominant strategy: $q_1^* = 0$. So does my roommate: $q_2^* = 0$.
- Nash equilibrium: $q_1^* = q_2^* = 0 \implies Q^{\text{Nash}} = 0$.
  (It was not my finest hour.)

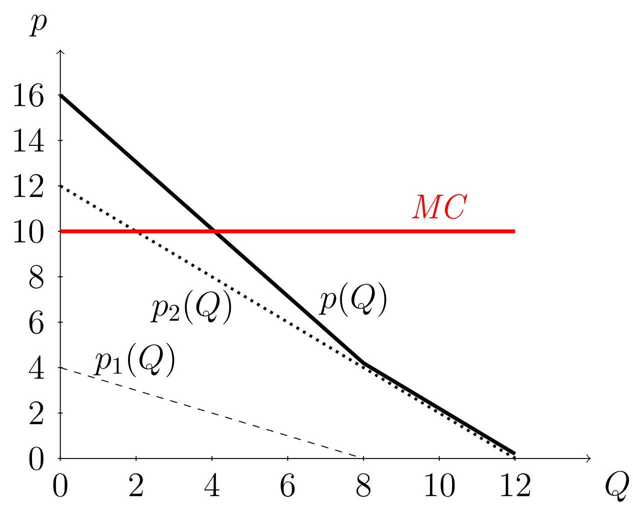
Since $Q^{\text{Nash}} < Q_s$, we say there is **underprovision** of the public good.

‡Since the marginal cost is 12 regardless of who deals with the mice, the social marginal cost equals 12, and (from the standpoint of Pareto efficiency) it doesn't matter who deals with the mice.

<u>**Why neater roommates end up doing the cleaning**</u>

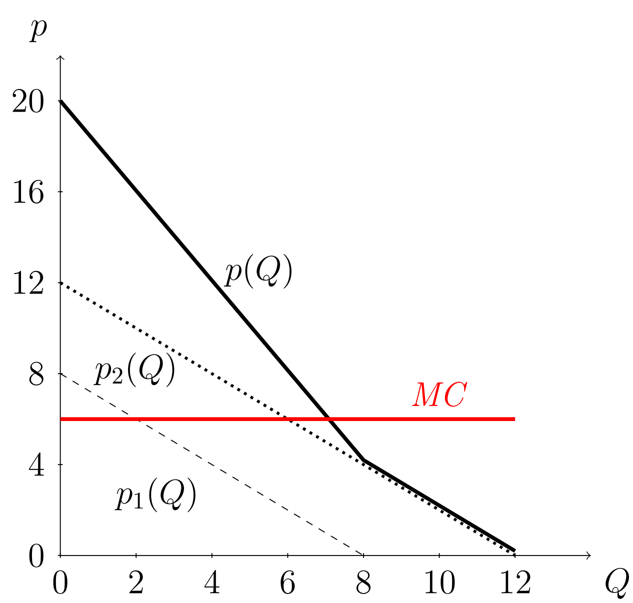
Two roommates are deciding how much time to spend cleaning their apartment. The marginal cost of an hour of cleaning is 10; the private (and social) marginal benefits are shown below.

What are the Nash equilibrium quantities of cleaning chosen by each agent (q_1^* and q_2^*)? How much total cleaning would be socially optimal (Q_s)?



- Social optimum: $Q_s = 4$, where social marginal benefit (i.e., the market demand curve) intersects the marginal cost.
- Roommate 1's private marginal benefit is always less than MC, so $q_1^* = 0$. Knowing this, roommate 2 chooses $q_2^* = 2$, where $p_2(Q)$ intersects MC.

What if we shift roommate 1's demand curve up and lower the MC to 6?



- Social optimum: $Q_s = 7$, where social marginal benefit intersects the (social) marginal cost.
- If each lived alone, they'd choose $q_1^* = 2$ and $q_2^* = 6$.
- But since they live together, roommate 1 can free-ride on roommate 2. Nash equilibrium quantities are $q_1^* = 0$, $q_2^* = 6$.