Common-Pool Resources (Ch 34)
and
Public Goods (Ch 36)
End-of-Quarter Festivities

- Important Events:
  - Extra OH: Friday 6/4 3-5pm NH 1006
  - Review Session: Sunday 6/6 4-6pm NH 1006
  - Final Exam: Wednesday 6/9 12-3pm IV THEA1
- Format: \( \sim 12 - 15 \) MC, 2 BB questions, < 3 hours worth
- Bring: pink ParScore scantron, blue-book (large), pencil
- Don’t bring: calculator, visible phone, electronic devices
Final Exam Details

- Focus of coverage: Equilibrium (16), Monopoly (24,25), Oligopoly (27), Exchange/General Eq. (31), Externalities (34), Public Goods (36)
- For the most part: only cumulative to the extent that new material builds on old
- How to study: do workouts/quizzes/practice problems, come to OH with questions
- Next Thursday’s class: review/synthesis. Will revisit important topics/messages
- Grading: see syllabus
Common-Pool Resources and Public Goods

What do these goods/resources have in common?

- Fisheries
- (Public) freeways
- National Security
- Broadcast radio/tv
- Clean air
- National parks

If *anyone* has access to the resource or can consume the good, then *everyone* can. E.g. you can’t prevent someone from breathing air or receiving radio waves.
Public Resources and Public Goods

What do these goods/resources have in common?

- Fisheries
- (Public) freeways
- National Security
- Broadcast radio/tv
- Clean air
- National parks

We call these types of goods **non-excludable** because all consumers can consume them.
Common-Pool Resources

- Some of these goods are like ‘regular’ goods in that one person’s consumption detracts from others’ use
- E.g. fisheries can be overfished, public pastures can be overgrazed, freeways can be congested
- These types of goods are **rival** in consumption
- Goods that are non-excludable, yet rival in consumption are known as commons, or common-pool resources
Common-Pool Resources

- Problem: property rights are not well defined

- *The Tragedy of the Commons* occurs when people share the same resource without well-defined property rights

- Individuals don’t take into account the fact that their use of the resource detracts from others’ consumption

- This leads to overuse of the resource
Common-Pool Resources: Example

- All people in a village graze cows in a common field
- It costs $a = 10$ to buy a cow and it’s only value is the milk it produces
- With $c$ cows grazing on the field, total value of their milk is $f(c) = 100\sqrt{c}$.
- Milk per cow:
  \[
  \frac{f(c)}{c} = \frac{100\sqrt{c}}{c} = \frac{100}{\sqrt{c}}
  \]
- Nobody owns the land—entry is not restricted

*How many cows will and should the village raise?*
Common-Pool Resources: Example

How many cows will the village raise? (Competitive Outcome)

- Each villager will buy and graze a cow whenever she can make a profit by doing so.
- Profit from owning a cow, given $c$ cows on the field:

$$\pi = \frac{f(c)}{c} - a = \frac{100}{\sqrt{c}} - 10$$

- As long as buying a cow is profitable, someone will go ahead and buy another cow.
- I.e. stop buying cows when profit $\pi$ is zero.
- \[ \frac{100}{\sqrt{c^*}} = 10 \]
- Average product = average cost.
- $c^* = 100$ cows in equilibrium.
- Total net-value of milk is zero!
How many cows should the village raise? (Optimal Outcome)

- A “social planner” would maximize the total net-value ($\Pi$) of raising cows:

$$\max_c c \frac{f(c)}{c} - ac = \max_c f(c) - ac = \max_c 100\sqrt{c} - 10c$$

- Optimality condition: $\frac{\partial \Pi}{\partial c} = 0$
- $100\left(\frac{1}{2}\right) \frac{1}{\sqrt{c^p}} = 10$
- Marginal product = marginal cost
- $c^p = 25$
- Total net-value of milk is

$$100\sqrt{c^p} - 10c^p = 100\sqrt{25} - 10 \cdot 25 = 250$$
Common-Pool Resources: Example

- Marginal product = marginal cost: maximizes total profit
- Average product = average cost: eke out last bit of profit
The Tragedy of the Commons

- The commons are overgrazed—tragically
- A villager increases her profit by adding a cow, but lowers the profit of everyone else (and the profitability of her other cows)
- She doesn’t internalize the cost her cow imposes on the rest of the village
- Examples: over-fishing, over-loggin, over-use of parks, traffic congestion
Recall our list of some non-excludable goods.

- Fisheries
- (Public) freeways
- National Security
- Broadcast radio/tv
- Clean air
- National parks

Some of these, e.g. fisheries we labeled rival because one person’s use detracts from that of others.
Public Resources and Public Goods

Recall our list of some **non-excludable** goods.

- Fisheries
- (Public) freeways
- National Security
- Broadcast radio/tv
- Clean air
- National parks

For others, e.g. clean air, radio waves, this is not the case.
Recall our list of some **non-excludable** goods.

- Fisheries
- (Public) freeways
- National Security
- Broadcast radio/tv
- Clean air
- National parks

We call such goods **non-rival** because each consumer can consume all of the good, without reducing it’s availability/quality to others.
A good that is both \textbf{non-excludable} and \textbf{non-rival} is called a (pure) public good. Public good users care little about who else uses it. Knowing this, individuals have an incentive to free-ride, relying on others to provide (enough of) the good. Because of this, public goods are under-provided.
Public Goods: Examples

- National Security
- Broadcast radio/tv
- Clean air
- National parks
- Road and highways (disregarding congestion)
Key questions:

- When should public goods be provided and how much?

- When will they actually be provided and how much?

- How can we get people to truthfully reveal their willingness to pay for a public good?
When *should* a public good be provided?

- Suppose it costs $c$ to provide the good
- Two consumers, $A$ and $B$
- Have reservation prices $r_A$, $r_B$
- If their payments (to provide the good) are $g_A$ and $g_B$...
- They need $g_A + g_B \geq c$ to provide the good
When *should* a public good be provided?

- For the payments to be individually rational, we need $g_A \leq r_A$ and $g_B \leq r_B$.

- If $r_A + r_B > c$, then they can provide the good without anyone paying more than his or her reservation price.

- In other words, $r_A + r_B > c$ means that it is Pareto-improving, or efficient, to supply the good.
When will a public good be provided privately?

- Suppose $r_A > c$ and $r_B < c$
- Then $A$ would supply the good even if $B$ contributes nothing
- Free-riding: $B$ enjoys the good for free
Providing Public Goods

When will a public good be provided privately?

- Now suppose $r_A < c$ and $r_B < c$
- Then neither will supply the good alone
- Yet, if $r_A + r_B > c$, it is Pareto-improving to supply it
- $A$ and $B$ may try to free-ride on each other, causing no good to be supplied
Free-Riding

Let’s take a closer look at free-riding, and how it may be overcome.

- Suppose $A$ and $B$ each have just two actions: individually supply a public good, or not.
- Cost of supply $c = 100$
- $A$ values the good at 80
- $B$ values the good at 65
- $80 + 65 > 100$, so supplying the good is Pareto-improving
Free-Riding

What are the NE?

\[(\text{Don't buy, Don't buy})\text{ is the unique NE, and it is inefficient.}\]
Free-Riding

How can we overcome this problem?

- **Possible solution**: let $A$ and $B$ make partial contributions to supplying the good
- E.g. $A$ contributes 60 and $B$ contributes 40
- $A$’s payoff from the good if contributes is $20 > 0$
- $B$’s payoff from the good if contributes is $25 > 0$
New game:

<table>
<thead>
<tr>
<th></th>
<th>Contribute</th>
<th>Don’t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contribute</td>
<td>20, 25</td>
<td>−60, 0</td>
</tr>
<tr>
<td>Don’t</td>
<td>0, −40</td>
<td>0, 0</td>
</tr>
</tbody>
</table>

- What are the NE?
- Both (Contribute, Contribute) and (Don’t, Don’t) are NE.
Free-Riding

- Allowing partial contributions makes possible the supply of a public good when no individual will supply the good alone.
- But what contribution scheme is best?
- Also, free-riding can persist even with contributions.