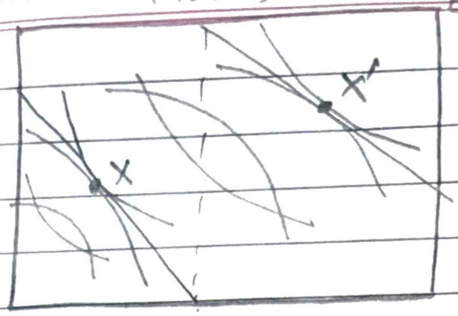
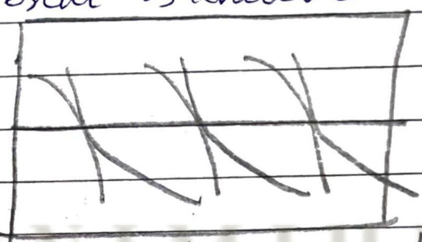
Smokers and Non smokers.



Coase Theorm.

The efficient outcome (amount) of good involved in the externality is independent of the distribution of property rights; such a result is known as Coase theorm.



Production Externality - Seperate firms

Steel: $\max\limits_{s,x} \; P_s \cdot s - c_s(s,x)$.

Fishery: $\max\limits_{f} \; P_f \cdot f - c_f(f,x)$.

FOC: $P_s = \dfrac{\Delta c_s}{\Delta s}$, $0 = \dfrac{\Delta c_s}{\Delta x}$ } Steel firm.

$P_f = \dfrac{\Delta c_f}{\Delta f}$ } fishery.

Merger.

$$\max_{s,f,x} \; P_s \cdot s + P_f \cdot f - c_s(s,x) - c_f(f,x)$$

FOC: $P_s = \dfrac{\Delta c_s}{\Delta s}$ $\quad P_f = \dfrac{\Delta c_f}{\Delta f}$

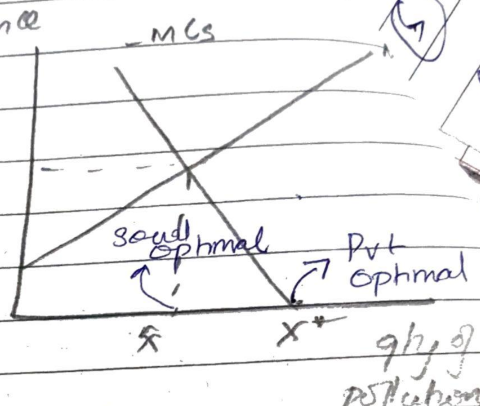
$$0 = \frac{\Delta c_s}{\Delta x} + \frac{\Delta c_f}{\Delta x}$$

$$-\frac{\Delta c_s}{\Delta x} = \frac{\Delta c_f}{\Delta x} \quad \text{— } (*)$$

$$-MC_s = MC_f$$

→ Social cost and Private cost.

$$-MC_f = MC_s$$



→ pollution voucher

$$\min_{x_1, x_2} \; c_1(x_1) + c_2(x_2).$$

$$\text{s:} \quad x_1 + x_2 = X.$$

$$\text{FOC:} \quad \frac{\Delta c_1}{\Delta x_1} = \frac{\Delta c_2}{\Delta x_2}.$$

→ Taxation:

$$\max_{s, x} \; P_s \cdot s - c_s - tx.$$

$$\text{FOC:} \quad P_s = \frac{\Delta c_s}{\Delta s}, \quad \frac{-\Delta c_s}{\Delta x} - t = 0.$$

$$(*) \Rightarrow \frac{-\Delta c_s}{\Delta x} = \frac{\Delta c_f}{\Delta x} \Rightarrow t = \frac{\Delta c_f}{\Delta x}$$

→ Fishery has the right to clean water:

Steel mill: $\max_{s, x} \; P_s \cdot s - qx - c_s.$

Fishery: $\max_{f, x} \; P_f \cdot f + qx - c_f$:

$$\text{FOC:} \quad P_s = \frac{\Delta c_s}{\Delta s}, \quad q = -\frac{\Delta c_s}{\Delta x}$$

$$P_f = \frac{\Delta c_f}{\Delta f}, \quad q = \frac{\Delta c_f}{\Delta x}.$$

ECONIMIUM
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$$\Rightarrow \frac{-\Delta c_s}{\Delta x} = \frac{\Delta c_f}{\Delta x}$$

(5) Steel mill has right to pollute.

Steel :- $\max_{s,x} \; p_s \cdot s + q(\bar{x} - x) - c_s$

FOC : $p_s = \frac{\Delta c_s}{\Delta s}$; $-q - \frac{\Delta c_s}{\Delta x} = 0$

Fishery : $\max_{f,x} \; p_f \cdot f - q(\bar{x} - x) - c_f$

FOC : $p_f = \frac{\Delta c_f}{\Delta f}$; $q - \frac{\Delta c_f}{\Delta x} = 0$

Tragedy of the commons.

$$\max_{c} \; f(c) - ac$$

c – no of cows.

f(c) – value of milk. FOC : → $MP(c^*) = a$.

f(c)/c – value per cow. if $MP(c) > a \Rightarrow c \uparrow$

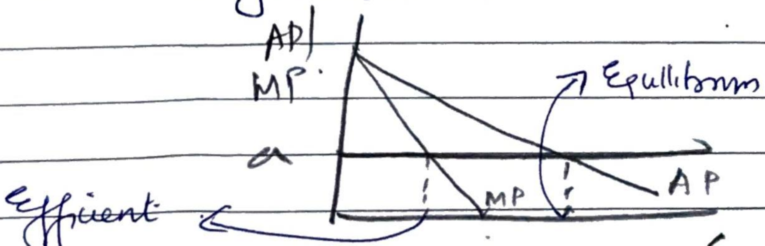
a – cost of cow. $MP(c) < a \Rightarrow c \downarrow$.

Two ways to say grazing halt condition < $AP = a$, $\pi_c = 0$

ie $\frac{f(\hat{c})}{\hat{c}} = a$.

Pvt ownership ⇒ $MC = a$.

Common prop ⇒ overgrazing ($\pi = 0$)



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$$x_1 + g_1 = \omega_1$$
$$x_2 + g_2 = \omega_2$$
$$g_1 + g_2 \geq c$$

Reservation price criteria $u_1(\omega_1 - r_1, 1) = u_1(\omega_1, 0)$

// same public

Pareto improvement

$$u_1(\omega_1, 0) < u_1(x_1, 1)$$
$$u_1(\omega_2, 0) < u_2(x_2, 1)$$

$$\Rightarrow \omega_1 - r_1 < \omega_1 - g_1$$
$$\omega_2 - r_2 < \omega_2 - g_2$$

$\Rightarrow \left.\begin{array}{l} r_1 > g_1 \\ r_2 > g_2 \end{array}\right\}$ necessary condition for purchase of TV to be pareto improv.

$\Rightarrow r_1 + r_2 > g_1 + g_2 = c$ } — sufficient condition

Quasilinear pref.

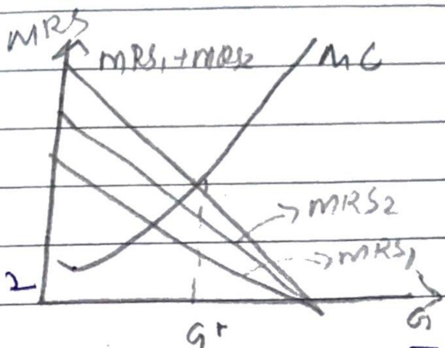
$$u_1(x_1, G) = x_1 + v_1(G)$$
$$u_2(x_2, G) = x_2 + v_2(G)$$

$$\Rightarrow r_1 = v_1(c)$$
$$r_2 = v_2(c)$$

Free riding game matrix

		Player B	
		Buy	Dont Buy
Player A	Buy	-50, -50	-50, 100
	Dont Buy	100, -50	0, 0 ★

...nisation problem that determines the PE allocation of public good



$$\max_{x_1, x_2, G} u_1(x_1, G)$$

such that $u_2(x_2, G) \geq \bar{u}_2$

$$x_1 + x_2 + c(G) = \omega_1 + \omega_2$$

$$L = u_1(x_1, G) - \lambda[u_2(x_2, G) - \bar{u}_2] - \mu[x_1 + x_2 + c(G) - \omega_1 - \omega_2]$$

FOC:

$$\frac{\partial L}{\partial x_1} = \frac{\partial u_1}{\partial x_1} - \mu = 0 \quad \text{— (1)}$$

$$\frac{\partial L}{\partial x_2} = -\lambda \frac{\partial u_2}{\partial x_2} - \mu = 0 \quad \text{— (2)}$$

$$\frac{\partial L}{\partial G} = \frac{\partial u_1}{\partial G} - \lambda \frac{\partial u_2}{\partial G} - \mu \cdot \frac{\partial c}{\partial G} = 0 \quad \text{— (3)}$$

(3) ÷ μ $\quad \frac{1}{\mu} \cdot \frac{\partial u_1}{\partial G} - \frac{\lambda}{\mu} \frac{\partial u_2}{\partial G} = \frac{\partial c}{\partial G}$ — (*)

$$\Rightarrow \mu = \frac{\partial u_1}{\partial x_1} \quad \text{— (4)}$$

~~put in~~ solving (2) for μ/λ.

$$\Rightarrow \frac{\mu}{\lambda} = -\frac{\partial u_2}{\partial x_2} \quad \text{— (5)}$$

(4) and (5) in (*)

$$\frac{\partial u_1 / \partial G}{\partial u_1 / \partial x_1} + \frac{\partial u_2 / \partial G}{\partial u_2 / \partial x_2} = \frac{\partial c(G)}{\partial G}.$$

ie $\quad MRS_1 + MRS_2 = MC(G).$

Quasilinear Pref and public good.

$$u_i(x_i, G) = x_i + v_i(G)$$

$$|MRS_1| = \frac{\partial u_1/\partial G}{\partial u_1/\partial x_i} = \frac{\Delta v_1(G)}{\partial G}$$

$$MRS_2 = \frac{\partial u_2/\Delta G}{\partial u_2/\partial x_i} = \frac{\partial u_2(G)}{\partial G}$$

$$MRS_1 + MRS_2 = MC(G)$$

$$\Rightarrow \frac{\Delta v_1(G)}{\Delta G} + \frac{\Delta v_2(G)}{\Delta G} = MC(G)$$ independent of x_i.

Free rider maximisation exercise.

$$\max_{x_1, g_1} (x_1, g_1 + g_2)$$ $C(G) = G$, $MC = 1$.

Such that $x_1 + g_1 = \omega_1$ g

$MRS_1 = 1$ $MRS_2 = 1$ So, one persons contribute there may be a chance the other freerider

Person 1 contributes
Person 2 freerider.