Suggest solutions SØK1011 Spring 2022

1) Public goods (15 %)

1a) Most goods can be classified with respect to their excludability and rivalry. Describe in your own words what these classifications mean and provide examples of four types of goods that are different with respect to both excludability and rivalry. (2,5%)

Describe excludability where the point is that an individual can be excluded from consuming a good (either physically or demand payment). Rivalry is that one person's consumption of a good decreases or restricts another person's consumption of the good.

1b) What is a public good? How can we determine the efficient level of production of a public good? (2,5%)

A public good is both non-rival and non-excludable. Because the production of a public good will benefit everyone in the economy, the social benefit of a public good is the sum of private benefits. To determine the efficient level of production of a public good is to set the marginal social benefit equal to the marginal social cost. Analogously, the marginal social benefit is the sum of private benefits. This can be shown with equations and/or graphically.

1c) Assume we are in an economy with two individuals, Doriane and Lana. They are considering investing in a carbon capturing technology (CCT) that can slow down global warming. Doriane is generally concerned about the environment. If this CCT is produced, she will have a utility of 160. Lana is less worried than Doriane but realises that investing in technologies that limit global warming is probably smart if it doesn't cost too much. She will receive a utility of 100 if the CCT is produced. The cost of producing the CCT is 170. What type of good is the CCT? What is the economic surplus of the project? Should the CCT be produced? Will the good be produced? How can we make sure the project is realised? (7%)

Argue that the CCT is a public good. The economic surplus is 160+100-170=90. Thus, since the total utility is higher than total costs, the good should be produced. There are however coordination problems, because each individual's utility is lower than the cost of the project, and no one will initiate the project. This is not optimal, as both individuals will gain from the project being realised, but they have different incentives for how the cost should be split (equal utility or equal cost). Thus, the project will not be realised. This is where the government comes in, as a collector of taxes and a coordinator.

1d) Imagine now that Doriane's utility of the CCT is 180. Which implications does this have for the production of the public good and the individual gains compared to the situation in 1c? (3%)

Now, Doriane's utility is higher than the cost of the project. She will invest in the program irrespective of whether Lana wants to join. Lana now has incentives to free ride. Doriane's gains will now be 10, whereas Lana will have a gain of 100, as she does not pay anything for the good, but because it's a public good, she gets all the benefit.

2) Externalities (5 %)
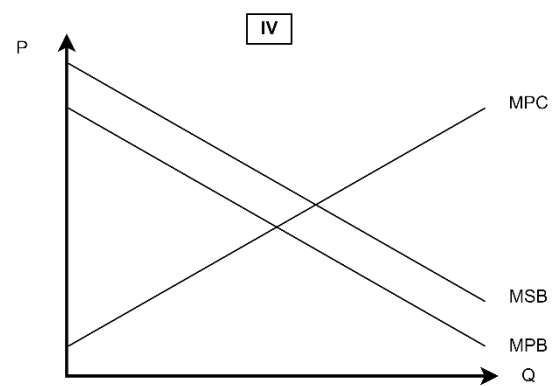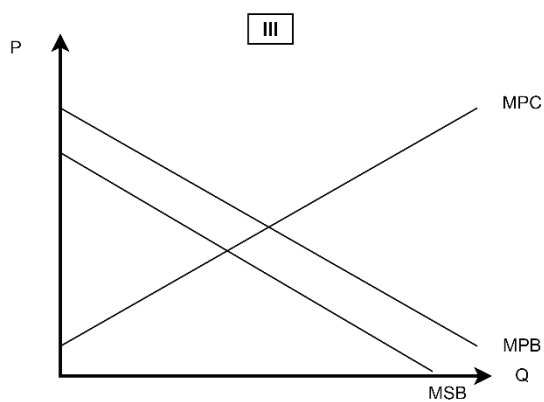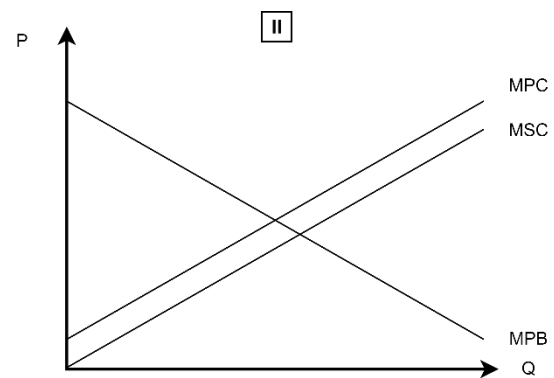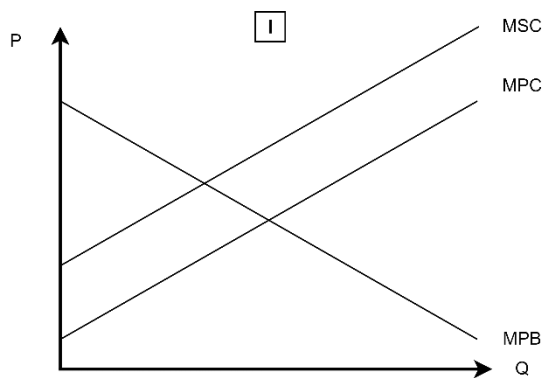
a) Consider the four graphs. They depict markets with perfect competition. MPC represents the firm's marginal cost, and MSC represents the societal marginal cost. MPB represents marginal private benefit, and MSB represents marginal societal benefit.

In which of these markets do we have positive externalities and in which of these markets do we have negative externalities? Provide one example for each graph of situations where these externalities might appear. Explain for each graph if the socially optimal production is lower or higher than the market solution. (5%)

I and III are negative externalities, and thus, the produced amount in the market is higher than the socially optimal amount. The opposite is true for II and IV. It is important to distinguish between externalities on the supplier side and the demand side.

Examples: I) Pollution, II) technology that leads to spill over, III) alcohol, IV) Vaccine

3) Externalities pt. 2 (30 %)

The production of a good x leads to pollution that is harmful to the environment. The damage function is given by $C_s(x) = 3x^2$, where x is the total production of the good. Assume that the good is produced under perfect competition. The market cost function of producing the good is given by $C(x) = 5x^2$. The market price of the good is given by $P = 1600 - x$.

a) Find the level of production of x under perfect competition. What is the societal damage of production? (5%)

$x \approx 146$ and the societal damage is 63,948.

b) What is the optimal production? What is the societal damage under optimal production? Draw a graph showing both the market solution and the optimal solution. (5%)

$x \approx 94$ and the societal damage is 26,508. Bonus if candidates write the X produced in the graph, draw the cost functions starting from the origin and show the increasing marginal societal costs.

c) Consider now a situation similar to a) and b), but the demand function is now given as $P = 900$. Draw a graph and calculate the level produced in the market and the optimal level of production. Calculate the damage of both production outcomes. (5%)

X*=56 with a damage of 9,408 and X^M=90 with a damage of 24,300. The graph should be drawn so that the demand curve is flat/horizontal.

d) Use the level of production in both the market and optimal situation found in task c. Imagine that one extra unit is produced in both cases. Calculate the new damage in the optimal and the market situation. Comment on the result. (10%)

When X* increases with 1, the damage is now 9747, thus an increase of 339. When XM increases with 1, the damage is 24846, an increase of 543. Even if the increase in production is the same (one unit), the damage increases more. This is due to the damage function being squared, so a higher level of production will lead to a higher damage per extra unit produced.

e) How can the market and optimal production be aligned? (10%)

Shortly discuss taxes and quotas, and especially the pros and cons of them. Taxes are preferable because they bring income to the state but are harder to set correctly because you need to know the precise damage function. This is especially true in our case as the damage function is squared. The advantage of quotas is that the state can set the maximum amount produced (which the candidates have calculated), however, they don't provide a steady income for the state (after initially sold).

Task 4 (50%)

Consider a firm which faces the following demand curve for its product:

$$P = 100 - 5X$$

Where P is the price of the product and X the quantity. The firm has a true marginal cost equal to 20.

The firm has a profit maximizing behavior.

Linear case seen in class: a = 100, c = 20 and b =5

a) What are the price and the quantity at the equilibrium for this market in a perfect competition setting? What are the profit of the firm and the consumer surplus in that case? (5%)
Use as notation P_P for the price at equilibrium, X_P for the quantity at equilibrium, π_P for the profit of the firm and CS_P for the consumer surplus in the perfect competition setting.

Price is equal to the marginal cost = 20 = P_P.

Then $20 = 100 - 5X => X_P = 80/5 = 16$

Profit of the firm equals to zero

Consumer surplus: $CS_P = \frac{(100 - 20)\times16}{2} = 640$

b) Calculate the price and the quantity at the equilibrium in the monopoly case. (4%)
Use as notation P_M for the price at equilibrium, X_M for the quantity at equilibrium.

From formula of the class that $P_M = (a+c)/2 = 60$ and $X_M = (a - c)/2b = 8$

c) Show the monopoly equilibrium in a graph and illustrate the socioeconomic loss of efficiency by the monopoly. Explain briefly why an efficiency loss occurs. (6%)
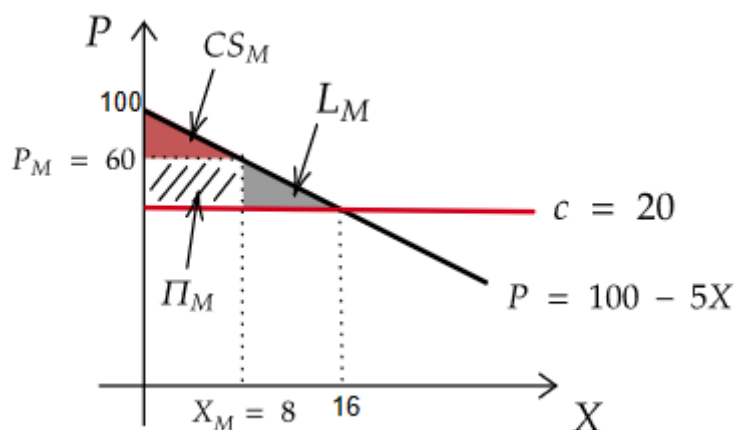
The efficiency loss must be explained and particularly it must be mentioned that it occurs because the price is not equal to the marginal cost.

d) Calculate the profit of the monopolist, the efficiency loss and the consumer surplus. Compare those values to the one calculated in question a) and conclude (8%)

Use as notation π_M for the profit of the firm, CS_M for the consumer surplus and L_M for the efficiency loss in the monopoly setting.

$$\pi_M = (P_M - c) \times X_M = (60\ \text{-}20) \times 8 = 40 \times 8 = 320$$

$$CS_M = \frac{(a - P_M) \times X_M}{2} = \frac{(100 - 60) \times 8}{2} = 160$$

$$L_M = \frac{(P_M - c) \times (X_P - X_M)}{2} = \frac{(60 - 20) \times 8}{2} = 160$$

Imagine that the state wants to regulate the monopoly. The state decides to regulate by setting the price on the market. The aim of the state is to maximize the socioeconomic surplus. In the case the firm incurs a deficit, the state has to compensate for it, so the state wants to avoid a deficit of the firm.

e) What is the optimal price the state should choose? (3%)

Given that the objective of the state is to maximize the socioeconomic surplus, the state should choose the price equal to the marginal cost.

In reality, the state is not able to observe the true marginal cost of the firm. The state decides to ask the firm what its marginal cost is in order to fix the price. The state cannot know whether the firm is going to tell the truth or not.

f) Given the monopolist objective, what marginal cost should it tell the state? Is the monopolist giving its true marginal cost or another one? Explain briefly. (4%)

Given that the objective of the monopoly is to maximize its surplus, it wants to be in the monopoly situation. Given that the state is going to decide on price = marginal cost, the monopolist has interest to lie and say marginal cost = 60. That way the state fixes the price to 60 and the firm maximizes its profit.

The state has doubts about whether the firm is telling the truth. It can decide to trust or not the marginal cost the firm is declaring. If the state does not trust the firm's declaration, it subtracts 10 to the marginal cost given by the firm.

g) What is the equilibrium quantity for a price equal to 10? Calculate the profit of the firm, the efficiency loss and the consumer surplus. Show graphically. (7%)

Use as notation P_{R1} for the price at equilibrium, X_{R1} for the quantity at equilibrium, π_{R1} for the profit of the firm, CS_{R1} for the consumer surplus and L_{R1} for the efficiency loss in the regulation by the state setting.
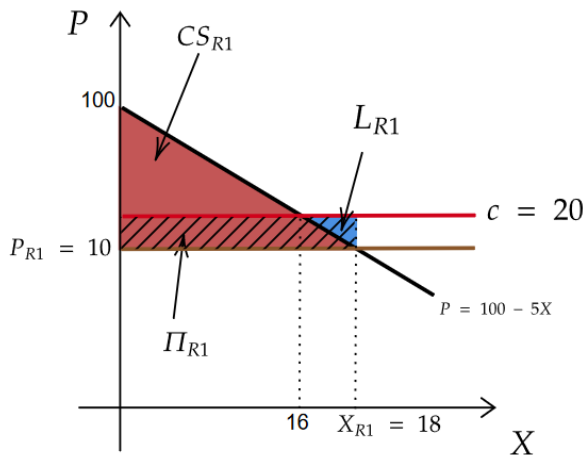
Price is equal to marginal cost the state believes in = 10.

Then $10 = 100 - 5X \Rightarrow X_{R1} = 90/5 = 18$

$\pi_{R1} = (P_{R1} - c) \times X_{R1} = (10 - 20) \times 18 = -10 \times 18 = -180$

$CS_{R1} = \dfrac{(a - P_{R1}) \times X_{R1}}{2} = \dfrac{(100 - 10) \times 18}{2} = 810$

$L_{R1} = \dfrac{(c - P_{R1}) \times (X_{R1} - X_P)}{2} = \dfrac{(20 - 10) \times 2}{2} = 10$

h) What is the equilibrium for a price equal to 50? Calculate the profit of the firm, the efficiency loss and the consumer surplus. (4%)

Use as notation P_{R2} for the price at equilibrium, X_{R2} for the quantity at equilibrium, π_{R2} for the profit of the firm, CS_{R2} for the consumer surplus and L_{R2} for the efficiency loss in the regulation by the state setting.

Price is equal to marginal cost the state decides = 50 = P_{R2}

Then $50 = 100 - 5X \Rightarrow X_{R2} = 50/5 = 10$

$\pi_{R2} = (P_{R2} - c) \times X_{R2} = (50 - 20) \times 10 = 30 \times 10 = 300$

$CS_{R2} = \dfrac{(a - P_{R2}) \times X_{R2}}{2} = \dfrac{(100 - 50) \times 10}{2} = 250$

$L_{R2} = \dfrac{(P_{R2} - c) \times (X_{R2} - X_P)}{2} = \dfrac{(50 - 20) \times 6}{2} = 90$

Imagine now that this is a game where the two players are the firm and the state.

The firm can either tell the truth about its marginal cost or lie about it. If the firm tells the truth, it tells the state its true marginal cost. If the firm lies, it tells the state that its marginal cost is the one found in question f).

The state can trust the firm or not. If the state trusts the firm, it assumes the marginal cost is the one given by the firm. If the state does not trust the firm, it assumes the marginal cost is the one given by the firm minus 10.

i) Establish the payoff matrix for this game. (4%)

		State	
		Trust	Do not trust
Firm	Lies	$\pi_M = 320$ $SO = \pi_M + CS_M = 480$	$\pi_{R2} = 300$ $SO = \pi_{R2} + CS_{R2} = 550$
	Truth	$\pi_P = 0$ $SO = \pi_P + CS_P = 640$	$\pi_{R1} = -180$ $SO = \pi_{R12} + CS_{R1} = 630$

j) What is the Nash equilibrium of this game? Explain how you find it and comment on this equilibrium. (5%)

Firm action:

- If state chooses to trust, then firm best strategy is to lie
- If state chooses to not trust, then firm best strategy is to lie

State action:

- If firm chooses to lie, then state best strategy is to not trust
- If firm chooses to tell the truth, then state best strategy is to trust

Firm's best strategy is always to lie, it adopts this behavior. State's best strategy is to not trust, so the Nash equilibrium is that the state does not trust, and the firm lies.