**Energy and Resource Economics (IKT3610)**
**Study questions (3)**
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1. ***LCOE:*** Suppose that a company is planning to implement a solar farm project for its own use. The specificities of the project is given below. Answer the two questions according to the table below. Note that *Const.* stands for the construction period, while *Oper.* stands for the operation periods.

   a- Take the discount rate as $r = 0.08$. What is the LCOE in this case? Show your work. (You can use a software, such as, MS Excel, to do the computations.)

   b- Let the electricity tariff/price rate be \$0.15/kWh. Can grid parity be achieved for this project? Why/Why not? Explain.

***Project: Gold Solar***

| | | Years | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Const.** | **Oper.** | **Oper.** | **Oper.** | **Oper.** | **Oper.** |
| | Periods | **0** | **1** | **2** | **3** | **4** | **5** |
| **Total costs ($)** | | | | | | | |
| Initial Investment | | 1,000 | - | - | - | - | - |
| O&M costs | | - | 50 | 52 | 54 | 56 | 58 |
| Fuel costs | | - | - | - | - | - | - |
| | | | | | | | |
| **Total Energy Output** | | | | | | | |
| Yearly output (kWh) | | - | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 |

2. ***Strategic Interactions:*** Why are the predictions of the prisoner's dilemma so imoprtant to natural resource management?

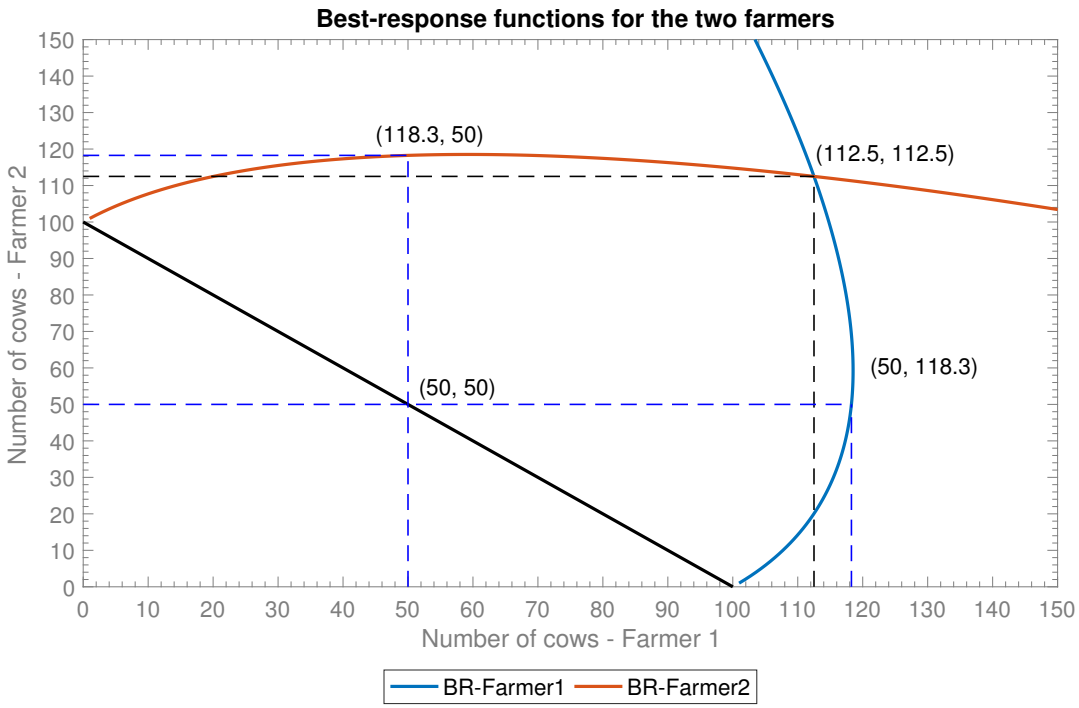
3. ***Tragedy of Commons:*** Why is Elinor Ostrom more optimistic about the world's commons than Garett Hardin?

4. ***Strategic Interactions - Repeated Common Property Games:*** Recall the common grazing exercise solved in the class. The visual format of the solutions are presented in the following figure. We have solved for the Nash equilibrium for the static game, that is, when the game was played for one. Now suppose that the common grazing problem is repeated over ten years and the players adopt a tit-for-tat strategy. Take the discount rate as $r = 0.5$.

   a- What is the discounted sum of profits when both farmers cooperate? Show your work.

   b- What is the discounted sum of profits when one player decides to deviate and play the Nash quantity (which we calculated using the best-response function). Show your work.

   c- Do you think that both farmers will continue cooperating over ten years? Why or why not?




5. ***Common-Pool Resources (Fisheries)*** Assume that the relationship between the growth of a fish population and the population size can be expressed as $g = 4S – 0.1S^2$, where $g$ is the growth in tons and $S$ is the size of the population (in thousands of tons). Given a price of \$100 a ton, the marginal benefit of smaller population sizes (and hence larger catches) can be computed as $20S – 400$.

   a- Compute the population size that is compatible with the maximum sustainable yield. What would be the size of the annual catch if the population were to be sustained at this level?

   b- If the marginal cost of additional catches (expressed in terms of the population size) is $MC = 2(160 – S)$, what is the population size that is compatible with the efficient sustainable yield?

6. ***Economics of Climate Change:*** Do you think that the imposition of a tax on currently uncontrolled greenhouse gas emissions would represent a move toward efficiency. Why or why not? Explain.

7. ***Economics of Climate Change:*** Relying on a series of regional systems (like the EU ETS), rather than a true global system, for controlling greenhouse gases increases the importance of the leakage problem. Do you agree? Why or why not? Explain

8. ***Economics of Climate Change:*** Two firms can control/abate emissions with the following

cost functions:

$$TC_1(a_1) = \$\frac{7}{2}a_1^2,$$
$$TC_2(a_2) = \$\frac{3}{2}a_2^2, \tag{1}$$

where $a_1$ and $a_2$ are the amount of abatement (or emissions reduction) by the first and second firms, respectively. Assume that with no regulation, each firm causes 20 units and a total of 40 units of emissions.

a- Compute the cost-effective allocation of control responsibility if a total reduction of 20 units of emissions is required. Moreover, draw a graph to show your answer.

Assume now that the control authority wants to reach its objective of 20 units of emissions reduction by using an emissions charge system, such as an emissions tax.

b- What per-unit charge should be imposed? How much revenue would the authority collect from this policy?

c- While auctioned allowances raise revenue, cap-and-trade (a.k.a, emissions trading) programs that gift the allowances to users free of charge (a.k.a, grandfathering) do not. Does this difference matter? Why?/Why not? Explain.

9. ***Cost & Benefits of Abatement*** Let the benefit of emissions (caused by a polluting activity) is $B(e) = 10e - .25e^2$. One the other hand, let the cost of emissions (a.k.a., external costs) be $C(e) = 0.5e^2$.

   a- What is the abatement cost function? Show your work.

   b- What is the abatement benefit function? Show your work.

10. ***Economics of Climate Change:*** Suppose two countries with domestic cap-and-trade polices are considering linking their two systems. Country A has a cap of 20 tons of emissions, a domestic marginal cost of abatement of \$10 and an uncontrolled emissions level of 60 tons, while Country B has a cap of 40 tons, a domestic marginal cost of abatement of $\$1a$ where $a$ stands for the tons of emission abatement, and an uncontrolled emissions level of 80 tons.

    a- Before linkage what would be the prices in the two separate markets and how much abatement would each country choose?

    b- If these two markets were linked by allowing each country to buy from and sell allowances to the other, what would be the prices in the two markets? How much would each country abate? Describe the transfer of allowances, if any, that would take place between the two countries.