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# Tutorial 2 - Water and Land Economics

## EXERCISE 1

A household consumes potable water and vegetables. Her preferences are represented by the money-metricized utility function: $u(W_P, V) = 2\sqrt{W_P} + \sqrt{V}$, where $W_P$ and $V$ denote respectively the quantities of potable water and vegetables consumed.

A farmer produces vegetables using irrigation water through the linear technology given by: $V \leq 2W_I$, where $W_I$ is the quantity of the irrigation water input.

A water operator is in charge of the exploitation of a finite river flow $\overline{W}$. Irrigation water and potable are assumed to be of the same quality. The exploitation and delivering of water are free.

1) Considering farming is efficient, write the utility as a function of both kinds of water. Derive the marginal utility of irrigation water and potable water. Explain why the whole flow of the river will be used in optimum.
2) Write the social planner's objective as a function of potable water only and solve for the optimum allocation of the resource between its both uses.
3) Compute the willingness-to-pay of the society for one extra unit of irrigation water in farming and for one extra unit of potable water in consumption respectively.
4) Compute the marginal opportunity cost of non-delivering the last unit of water when the resource is optimally allocated. How much the society is ready to pay for this unit?

## EXERCISE 2

A household consumes water. Her preferences are represented by the money-metricized utility function: $u(W) = 4\sqrt{W}$.

A water operator exploits a river flow $\overline{W}$ and delivers this resource to the household's place. To do so, the operator incurs a transportation cost of $c = 1$ per unit of water.

1) Write the social planner program and find out the optimal quantity of water $W^*$ under the following assumptions:

a) $\overline{W} = 2$ (scarce resource)
b) $\overline{W} = 16$ (abundant resource)

2) Upon the technology set above, assume the existence of a competitive market for water at the household's place. Solve the optimization problems of the household and the operator. Draw the resulting demand and supply functions in the $(p, W)$ space. Is the equilibrium allocation optimal?
3) Assume now that the operator behaves as a monopoly. Furthermore, assume he is able to extract the whole consumer surplus, i.e. he is able to make the household pay each unit consumed her willingness-to-pay. Briefly explain why, in this context, the first-best equilibrium will necessarily be reached. Draw the operator rent and express it formally.
4) Under the same assumptions as in question 3), how much a potential operator is ready to pay to get the rights to exploit the river?