

ECN 275/375 Environmental and natural resource economics

Exercise set 3

Exercise 3.1 – Technical and economic efficiency in production space

Production possibility sets define what is possible to produce with a given set of resources (expenditures or costs), C . The frontier of a production possibility set captures the trade-offs between different productions.

- Draw a *production possibility set* for two products y_1 and y_2 . Explain briefly why the production possibility set is convex to the origin. Remember to label the axis.
- In the same figure place a point for an allocation that is *technically inefficient* (point A), and two points that are *technically efficient* (points B and D). Explain why your point A is technically inefficient.
- Add a relative price line for the two goods, and indicate given the relative price line the *economically efficient allocation*, E, of the two products.
- Explain why point E in (c) is unlikely to be an *efficient allocation* if input or product prices do not reflect the true costs of production.

Exercise 3.2 – Efficiency in consumption

Utility possibility sets depict possible combinations of utility in an economy.

- For a 2-person (consumers A and B) economy, draw a utility possibility set. Remember to label the axis.
- Insert a *Pareto-inefficient (-inferior)* allocation (point F) in the graph, and indicate what is the possible region of *Pareto improvements* for this set under self regarding utilities (absence of envy or “warm glow”). Explain why this allocation (F) is *Pareto inefficient*.
- Insert two allocations that are *Pareto optimal*¹ (points G and H) in the figure from (a). Explain why these points are *Pareto optimal*.
- Draw a typical indifference curve representing society’s welfare function $W(U^A, U^B)$ in the same figure. Indicate what is the *welfare maximizing* allocation (point M). Explain why this point is *welfare maximizing*.

Exercise 3.3 – Welfare impacts of a reduction in uncertainty

- Draw a utility function (quite similar to Figure 2 on page 4 in the risk note for this lecture), with mean wealth \bar{W} with equal chance of the low and high wealth allocations, W_L and W_H respectively. Indicate the welfare levels associated with the risky (low and high) wealth allocation, and the maximum welfare enhancing *cost of risk bearing* (CORB).
- In figure in (a), insert a new low and high wealth allocation, W_L^N and W_H^N respectively with equal probability, and the same mean wealth, \bar{W} , as in (a). Indicate the difference in welfare from the risky situation in (a), and explain the reason for this difference.
- Why does the maximum welfare enhancing CORB in (b) decline compared to (a).

¹ Alllocations that are *Pareto optimal* are also called *Pareto efficient*.

Exercise 3.4 – Quasi-option value calculation

Consider the decision tree for the quasi-option value from the risk note (Figure 5).

- (a) Calculate the expected values of deciding now (commit) or delaying the decision one time period (wait) using the values: $V_0 = 20$, $V_{high} = 300$, $V_{low} = 40$, $\rho = .4$, $D_0 = 60$, and $D_1 = 120$ with no updating of the probability for a high conservation value (ρ remains at .4).
- (b) What is the optimal decision, to “commit” or “wait”? Explain why.
- (c) Assume the optimal decision in (b) was “wait”. What happens then in the next time period?