

Principles of Economics and Management I

Ciências ULisboa · MMAEG · 2026/2027

Problem Set 1 · Economic Thinking and Scarcity

Session 1 · LN01

Exercise level: [Easy] routine / warm-up [Medium] typical test level [Hard] challenge (above test level, to consolidate mastery)

1. (2 points) [Easy] **Accounting cost and opportunity cost.** An MMAEG student has 10 free hours over the weekend. She can spend them studying or on *freelance* programming work, at €25 per hour. She decides to study for 6 hours and also spends €15 on photocopies.
 - (a) (1 point) What is the accounting cost of the 6 hours of study? And the surplus she gives up?
 - (b) (1 point) What is the opportunity cost of the decision?
2. (2 points) [Easy] **Sunk costs.** A firm has spent €500,000 developing a portfolio management algorithm. To launch it, the firm needs a further €100,000 in adaptation work, which would generate revenue of €150,000; without the adaptation, revenue is zero. The CFO wants to abandon the project, because €600,000 of total cost exceeds €150,000 of revenue.
 - (a) (1 point) Identify the sunk cost and explain why it is irrelevant to today's decision.
 - (b) (1 point) Carry out the correct marginal analysis and decide.
3. (3 points) [Medium] **Marginal thinking and the first order condition.** A firm has total benefit $B(q) = 120q - 5q^2$ and total cost $C(q) = 20q + 3q^2$, with $q \geq 0$.
 - (a) (1 point) Obtain marginal benefit $MB(q)$ and marginal cost $MC(q)$.
 - (b) (1 point) Find the q^* that maximizes $B(q) - C(q)$ and confirm that it satisfies $MB = MC$.
 - (c) (1 point) Compute the net benefit at q^* and check the second order condition.
4. (3 points) [Medium] **Production possibilities frontier.** An economy produces technology services (x) and agricultural goods (y), with frontier $x^2 + 4y^2 = 100$, $x, y \geq 0$.
 - (a) (1 point) Find the maximum y when $x = 0$ and when $x = 6$.
 - (b) (1 point) Obtain the marginal rate of transformation $MRT = -dy/dx$.
 - (c) (1 point) Compute the opportunity cost of moving x from 6 to 8 and explain why it is increasing.
5. (5 points) [Hard] **Optimal allocation of a scarce resource.** A fund has €100 million to allocate across two projects, with expected returns $R_1(K_1) = 40\sqrt{K_1}$ and $R_2(K_2) = 60\sqrt{K_2}$ and constraint $K_1 + K_2 = 100$.
 - (a) (2 points) Set up the problem and derive the first order conditions. Show that at the optimum the marginal returns are equal.
 - (b) (2 points) Find K_1^* and K_2^* .
 - (c) (1 point) An innovation doubles the return of project 2 to $120\sqrt{K_2}$. Recompute and interpret.

6. (5 points) **[Hard] Comparative advantage and the joint frontier.** A consultancy has two analysts with 40 hours a week each. Per hour, *A* produces 4 reports or 2 models; *B* produces 1 report or 3 models.
- (a) (1 point) Compute the opportunity costs and identify each analyst's comparative advantage.
 - (b) (2 points) Derive the joint production possibilities frontier and its kink point.
 - (c) (2 points) To produce 100 reports, what is the maximum number of models and the allocation of hours?