

## Exam in ECON4260, Fall 2021

### Problem 1: Wicked and kind environments (24p)

For a class with 10 students, we have been given the following information.

**Text A:** “In the class, 50% of the students play an instrument. Of those who play an instrument, 40% have no parent who plays an instrument, the rest of them have parents where at least one plays an instrument. Of those who do not play an instrument, 80% have no parent who plays an instrument, the rest of them have parents where at least one plays an instrument.

When information is given like this, most people – even after statistical training – have problems answering the question Q below. Most people get it wrong. The question is:

**Q:** What is the probability that a student plays an instrument, given that at least one of the parents plays an instrument?

- a) (6p) How would you rephrase the information A in terms of natural frequencies, as discussed in the curriculum paper Hoffrage et al. (2002), such that a significantly larger share of respondents would be able to answer correctly?

In one of the curriculum papers, Vallée-Tourangeau et al. (2015), participants were provided with physical objects – cards with pictures on both sides – to help their thinking. Providing subjects with such cards significantly increased the number of subjects that get the correct answer to Q, and most subjects get it right.

- b) (6p) What type of cards, and what number of each type, would you provide for information to supplement Text A above, to follow the design in Vallée-Tourangeau et al. (2015)?

The examples above show that subjects’ ability to assess the probabilities correctly depend to a large degree on how the information is presented and on the availability of, e.g. physical objects appropriate to help thinking. If subjects are unable to assess probabilities, they are also less likely to choose rationally in situations involving these probabilities. Thus, subjects’ rationality may depend on the environment in which they make their decisions: subjects may make more rational choices in a “kind” environment where information is given in a kind way and with appropriate tools for thinking, compared to a more “wicked” environment where information is abstract and tools for thinking are not available.

- c) (12 p) Discuss the implication of this kind versus wicked environment distinction for how we interpret results from lab experiments where subjects violate standard theories of Homo Economicus.

Do you think that the results discussed in a) and b) can be used to defend an assumption that humans are reasonably rational after all? Justify your answer.

*Problem 2 (Time inconsistency and self-control problems)*  
**Weight: 36% (with equal weight = 6% on each subproblem)**

In parts (a)–(e) you will analyze the behavior of a decision maker by means of the multi-self model; that is, a model for one-person decision-making where every decision node in the decision tree corresponds to a separate self having preferences over the remaining choices in the decision tree. The decision maker will be assumed to have  $(\beta, \delta)$  preferences; that is, they have a per-period discount factor  $\delta$  and, in addition, discount all future periods by an additional factor  $\beta$ .

- (a) Let the decision maker in period 1 be indifferent between  $x$  units of consumption in the present period (period 1), 60 units of consumption in the first future period (period 2), and 75 units of consumption in the second future period (period 3). For which values of  $x$  does the decision maker have present-biased preferences?

For parts (b)–(e), assume that the decision maker in period 1 is indifferent between 36 units of consumption in the present period (period 1), 60 units of consumption in the first future period (period 2), and 75 units of consumption in the second future period (period 3). Assume that the decision-maker has to do a task in one of these three periods, with a cost equal to a consumption reduction of 40 if done in period 1, a consumption reduction of 60 if done in period 2, and a consumption reduction of 90 if done in period 3.

- (b) When will a naïve decision maker plan to do the task? When will the task be done?  
(c) When will a sophisticated decision maker plan to do the task? When will the task be done?

For parts (d) and (e), assume that the decision maker can pay  $c$  in period 1 to become committed to doing the task in period 2.

- (d) What is the greatest  $c$  that the a naïve decision maker would want to pay for the commitment?  
(e) What is the greatest  $c$  that the a sophisticated decision maker would want to pay for the commitment?

In part (f), analyze the behavior of a decision maker by means the dual-self model; that is, a model where a long-term planner controls a series of short-term doers at a cost. Assume that the long-term planner is indifferent between 60 in period 2 and 75 in period 3 if the control costs are not taken into account. Assume as above that the decision-maker has to do a task in one of these three periods, with a cost equal to a consumption reduction of 40 if done in period 1, a consumption reduction of 60 if done in period 2, and a consumption reduction of 90 if done in period 3.

- (f) If, due to the control costs, the decision maker prefers to postpone the task until the last period 3 (in which case, the task must be done then and, hence, there are no control costs), what would they be willing to pay in period 2 for a commitment made in period 1, obliging the decision maker to do the task in period 2?

### Problem 3 – Weight: 40%

Two identical countries are considering whether to reduce their emissions of a damaging air pollutant. Emissions of the pollutant spreads uniformly across both countries, and emissions from one country causes similar environmental damages in both countries.

Each country has two options: Abate (reducing its emissions), or emit (not reducing its emissions). For each country  $i = 1, 2$ , let  $c_i$  = country  $i$ 's abatement cost;  $b_i = b$  = country  $i$ 's environmental benefits, identical for both countries; and  $x_i = b - c_i$  = country  $i$ 's net material payoff.

If country  $i$  abates,  $c_i = 4$  billion dollars; if it emits,  $c_i = 0$ .

For *each* country that abates, *both* countries get an environmental benefit of 3 billion dollars each. If no country abates, there is no environmental benefit.

Countries' net material payoffs  $x_i$  can thus be expressed as in Table 1 below.

|       | Abate | Emit  |
|-------|-------|-------|
| Abate | 2, 2  | -1, 3 |
| Emit  | 3, -1 | 0, 0  |

Table 1. Net material payoffs, billion dollars. Country 1 is the row player, country 2 is the column player. Country 1's net payoffs before commas, Country 2's net payoff after commas.

a) (Counts 2,5%) Is (abate, abate) a Nash equilibrium if each country acts as if it has self-interested preferences, and this is common knowledge?

b) (Counts 12,5%) Is (abate, abate) a Nash equilibrium if each country  $i = 1, 2$  acts as if it has inequality averse preferences according to Fehr and Schmidt (1999, on the course reading list), with  $\alpha_i = 1,5$  and  $\beta_i = 0,4$ , and this is common knowledge? Provide a verbal, intuitive explanation of your result.

c) (Counts 12,5%) Can (Abate, Abate) be a Nash equilibrium if each country acts as if it has morally motivated preferences as follows, and this is common knowledge? Please provide a verbal, intuitive explanation of your result.

Let country  $i$ 's preferences be given by  $U_i = x_i - \frac{1}{2}(c_i - c^*)^2$ ,

where  $c^*$  = the morally ideal cost of abatement, defined here as a country's abatement cost if choosing the strategy that would, *if* chosen by both countries, maximize the sum  $(x_1 + x_2)$ .

d) (Counts 12,5%) Can (abate, abate) be a fairness equilibrium if each country  $i = 1, 2$  acts as if it has reciprocal preferences according to the model indicated below, and this is common knowledge? Please provide a verbal, intuitive explanation of your result.

Let country  $i$ 's preferences be given by  $U_i = x_i + k_{ij}\tilde{k}_{ji}$ , where  $i \neq j$  and

$$k_{ij} = x_j(s_i, b_{ij}) - \frac{1}{2}[x_j^{\max}(b_{ij}) + x_j^{\min}(b_{ij})]$$

$$\tilde{k}_{ji} = x_i(b_{ij}, c_{iji}) - \frac{1}{2}[x_i^{\max}(c_{iji}) + x_i^{\min}(c_{iji})]$$

Here,  $k_{ij} = i$ 's kindness towards  $j$ ;  $\tilde{k}_{ji} = i$ 's belief about  $j$ 's kindness towards  $i$ ;  $s_i = i$ 's strategy;  $b_{ij} = i$ 's belief about  $j$ 's strategy;  $x_j^{\max}(b_{ij})$  is the largest net material payoff  $i$  could secure to  $j$ , given  $i$ 's belief about  $j$ 's strategy  $b_{ij}$ ; and  $x_j^{\min}(b_{ij})$  is the smallest net material payoff  $i$  could secure to  $j$ , given  $b_{ij}$ . Finally,  $c_{iji} = i$ 's belief about  $j$ 's belief about  $i$ 's strategy.