

MIT 14.13 Spring 2020 – Problem Set 1

Please answer each of the questions below. In each of your answers, concisely explain the reasoning that lead you to this answer. Writing only a numeric answer to the question is *not* enough to receive full credit!

Total: 60 points.

Question 1: Estimating Yearly Discount Factors (10 Points)

In this question you should assume that δ is defined for a year and that a year is 365 days. You should also assume that β is defined for a time unit of a day, so that anything that is in the future for the purpose of the question is discounted by β (be it a day from now or a year from now), times the relevant amount of δ (i.e. $\delta^{\text{time in years}}$).

Paul is a human being. Richard is a behavioral economist trying to understand Paul's preferences. Richard asks Paul: how much money tomorrow makes you indifferent with 10 dollars right now? Paul answers: 11 dollars.

1. (2 points) First, Richard makes the assumption that Paul has very simple preferences over time: he assumes that Paul is an exponential discounter. What is Paul's implied yearly discount factor δ given his answer?
2. (2 points) Next, Richard assumes that Paul is a quasi-hyperbolic discounter with $\beta = 0.91$. What is Paul's implied yearly discount factor δ given his answer?

When Richard gets back to his office, he regrets not having asked Paul: how much money two years from now makes you indifferent with 100 dollars one year from now?

3. (2 points) What would Paul have answered if he was in fact an exponential discounter?
4. (2 points) What would Paul have answered if he was in fact a quasi-hyperbolic discounter with $\beta = 0.91$?
5. (2 points) After this thought exercise, what do you think is a more plausible model of Paul's time preferences (or of anyone who is indifferent between 10 dollars right now and 11 dollars tomorrow)?

Problem 2: Optimal laptop policy in class (20 Points)

In Lecture 1, I introduced a policy problem: "What is the socially optimal policy regarding laptops (and other electronic devices) in 14.13?" I'll refer to this in shorthand as the 'laptop policy.' Note that we are only deciding about the laptop policy for our own course, 14.13. Assume that all other courses have their own (independent) laptop policies.

For the purposes of this problem set, let's use a Utilitarian criterion for social optimality (where the targets of the Utilitarian analysis are MIT students). In other words, the socially optimal laptop policy is the policy that maximizes the average welfare of all MIT students. As you analyze the laptop problem, remember that you are contemplating any possible laptop policy in 14.13, not necessarily the one that was actually chosen.

1. (5 points) Explain why a laptop policy in 14.13 has potential welfare implications for MIT students who end up dropping the class rather than only for the ones who actually enroll in the class. Why might we concern ourselves with students who do not end up enrolling in the class? Why does the existence and behavior of these non-enrollees influence the socially optimal laptop policy?

Let us now consider the following potential policies:

- (a) Laissez-faire, i.e. no restrictions – let students do whatever they wish to do.
 - (b) Ban laptops for everyone.
 - (c) Make the no-laptop section the default and allow students to opt out (of the no-laptop section).
 - (d) Make the laptop section the default and allow students to opt out (of the laptop section).
 - (e) Set up an active choice between the laptop and no-laptop sections.
2. (10 points) Select your most and least preferred policy and discuss, for each of them, one classical economics and one psychological reason for or against them, as opposed to the course actual policy.
 3. (5 points) How would you go about measuring the effects of your preferred policy relative to the course's actual policy or other potential policies? Assume that you have unlimited resources for this policy evaluation exercise.

Question 3: Procrastination of 14.13 problem sets (30 Points)

Amy, Jack, Bob and Carol are students in 14.13. Suppose the deadline for their first problem set is approaching—it is due in 3 days from today, so they can do the problem set on any of four days, $t = 1, 2, 3, 4$ (where $t = 1$ is today).

The instantaneous utility costs of doing the problem set in periods $t = 1, 2, 3$, and 4 are 9, 20, 30, and 40 utils, respectively, as shown in Table 1 (note that all these are negative). Assume that the problem set takes only one day to complete, late submissions are not an option, and the world ends if the problem set is not finished at all, i.e. at the beginning of day $t = 4$, if the problem set is finished by then, the student will begin, finish, and turn it in on day $t = 4$.

Period t	$u(\text{Pset}_t = 0)$	$u(\text{Pset}_t = 1)$
1	0	-9
2	0	-20
3	0	-30
4	0	-40

Table 1: Instantaneous utility of (not) doing the problem set

Each student's utility function is as follows:

$$U_t = \begin{cases} u(\text{Pset}_t) + \beta \sum_{\tau=t+1}^4 \delta^{\tau-t} u(\text{Pset}_\tau) & \text{for } 1 \leq t \leq 3, \\ u(\text{Pset}_t) & \text{for } t = 4. \end{cases} \quad (1)$$

where $u(\text{Pset}_t)$ is the (negative) instantaneous utility of doing the problem set on day t with $\text{Pset}_t = 1$ if the student works on the problem set in period t and $\text{Pset}_t = 0$ if the student does not work on the problem set in period t .

1. (2 points) Briefly explain this utility function. What do the parameters β and δ measure? What do we typically assume about these parameters?
2. (2 points) Amy is an exponential discounter with $\beta = 1, \delta = 1$, i.e. she does not discount the future at all. When will Amy do the problem set?

3. (2 points) Jack is an exponential discounter with $\beta = 1, \delta = 1/2$. When will Jack do the problem set? Explain in words why Jack and Amy do the problem set at different times.
4. (3 points) Bob is a fully naive hyperbolic discounter with $\beta = \frac{1}{4}, \delta = 1$, and $\hat{\beta} = 1$. That is, Bob is present-biased, but he does not take into account his future present bias when making decisions. When will Bob do the problem set?
5. (2 points) On day 0 (before day 1), if you ask Bob when he'll get the problem set done, what will he predict – assuming that he is too busy on day 0 so that day 0 itself is not an option?
6. (3 points) Carol is a fully sophisticated hyperbolic discounter with $\beta = \frac{1}{4}, \delta = 1$, and $\hat{\beta} = \beta = \frac{1}{4}$. That is, Carol is present-biased, but she fully takes into account her future present bias when making decisions. When will Carol do the problem set? Explain in words why Carol and Bob do the problem set at different times.
7. (4 points) Marlon is a partially naive hyperbolic discounter with $\beta = \frac{1}{4}, \delta = 1$, and $\hat{\beta} = \frac{4}{5}$. Marlon is present-biased and has illusions about his amount of present bias at future periods. When will Marlon do the problem set? (*Hint: According to the partial naivet model, at each period Marlon predicts his future behavior to be that of a fully sophisticated hyperbolic discounter with discount factor $\hat{\beta}$.*)

Suppose now that a big snowstorm is announced for days 3 and 4. Doing the pset during the snowstorm is even worse because everybody else can go skiing/snowshoeing. Only Marlon is unaffected because he misses the warm weather of Sicily and hates going out in the snow, thus we will ignore him for this question. For everyone else, the instantaneous utility costs of doing the problem set in periods $t = 1, 2, 3, 4$ is now 9, 20, 84 and 88, and everyone perfectly anticipates these utility costs from Day 0.
8. (2 points) When will Bob do the problem set?
9. (2 points) Does the snowstorm affects Bob's long-term utility, as evaluated by his period $t = 0$ self? In what direction? No action can be taken in period $t = 0$ – think of period $t = 0$ as a very busy day.
10. (2 points) When does Carol do the pset? How is her long-term utility (from day 0) affected by the snowstorm? Why?

Now suppose that a Californian tech startup, SnowBiz, can trigger or prevent a snowstorm for a fee.
11. (2 points) On day 0, SnowBiz goes and asks Bob whether he wants to pay them to create the snowstorm described in question 8. Is Bob willing to pay anything for this snowstorm? What could SnowBiz do to increase his willingness to pay?
12. (2 points) On day 0, SnowBiz goes and asks Carol whether she wants to pay them to *prevent* the snowstorm. How much is Carol willing to pay? Assume that 1 util in day 0 is worth 1 dollar.
13. (2 points) Why are things so different for Carol and Bob? Think of the snowstorm as a commitment device. Why is it the case that it helps Bob but it hurts Carol? What is the lesson here about commitment devices?

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