

## **Psychology and Economics Field Exam**

**August 2017**

There are 3 questions on the exam. Please answer the 3 questions to the best of your ability. Do not spend too much time on any one part of any problem (especially if it is not crucial to answering the rest of that problem), and don't stress too much if you do not get all parts of all problems.

## Problem 1

Consider experimental subjects who are asked to work through some tedious experimental tasks. Let  $e$  be the number of tasks they choose to complete. There is a 50-50 chance that they either receive a fixed fee  $f$  or piece-rate earnings  $we$ , where  $w$  is the reward per completed task. This uncertainty is realized only after a subject finishes working on the tasks. Let  $c(e)$  be the cost of effort, with  $c' > 0$  and  $c'' > 0$ . Consider two different levels of  $f$ , corresponding to two different experimental treatments: either  $f = f_{LO}$  or  $f = f_{HI} > f_{LO}$ . This is the experimental set-up from Abeler, Falk, Goette, and Huffman (AER 2011).

**Part a.** Show that in the standard model, in which expected utility is given by  $U = u(f)/2 + u(we)/2 - c(e)$ , the number of tasks a subject chooses to complete,  $e^*$ , must satisfy  $u'(we^*) = (2/w)c'(e^*)$ . Briefly explain why  $e^*$  does not depend on  $f$ .

**Part b.** Now suppose that subjects have expectations-based reference-dependent preferences, as in Koszegi and Rabin (2006, 2007). Assume that gain-loss utility  $\mu$  is piece-wise linear, with  $\mu(x) = \eta x$  for  $x \geq 0$  and  $\mu(x) = \eta \lambda x$  for  $x < 0$ . Explain, by interpreting each term in the equation below, why if a subject chooses to complete  $e < f/w$  tasks, then the resulting expected utility will be

$$U = \frac{we + f}{2} - c(e) + \frac{1}{2}\eta \left[ \frac{1}{2}(we - we) + \frac{1}{2}\lambda(we - f) \right] + \frac{1}{2}\eta \left[ \frac{1}{2}(f - we) + \frac{1}{2}(f - f) \right]$$

**Part c.** Maintaining the assumptions from part (b), explain, by interpreting each term in the equation below, why if a subject chooses to complete  $e \geq f/w$  tasks, then the resulting expected utility will be

$$U = \frac{we + f}{2} - c(e) + \frac{1}{2}\eta \left[ \frac{1}{2}(we - f) \right] + \frac{1}{2}\eta \left[ \frac{1}{2}\lambda(f - we) \right]$$

**Part d.** Let  $e^*$  be the optimal number of tasks to complete. Show that if  $we^* < f$  then  $c'(e^*) = \frac{w}{2} + \frac{w}{4}\eta(\lambda - 1)$ .

**Part e.** Let  $e^*$  be the optimal number of tasks to complete. Show that if  $we^* \geq f$  then  $c'(e^*) = \frac{w}{2} - \frac{w}{4}\eta(\lambda - 1)$ .

**Part f.** Using the results from parts d and e, explain the intuition for the following experimental hypothesis: *Average effort should be higher when  $f = f_{HI}$  than when  $f = f_{LO}$ .*

**Part g.** Using the results from parts d and e, explain the intuition for the following experimental hypothesis: *The probability that we =  $f_{LO}$  is higher when  $f = f_{LO}$  than when  $f = f_{HI}$ ; the probability that we =  $f_{HI}$  is higher when  $f = f_{HI}$  than when  $f = f_{LO}$ .*

**Part h.** In light of what you showed above, briefly comment on the key finding in Abeler et al (2011) summarized in Figure 1, reproduced below. The first graph is the histogram of earnings (which depended on how hard people worked) in treatment LO ( $f = \$3$ ), the second is for treatment HI ( $f = \$7$ ). Is there evidence of the predictions above?

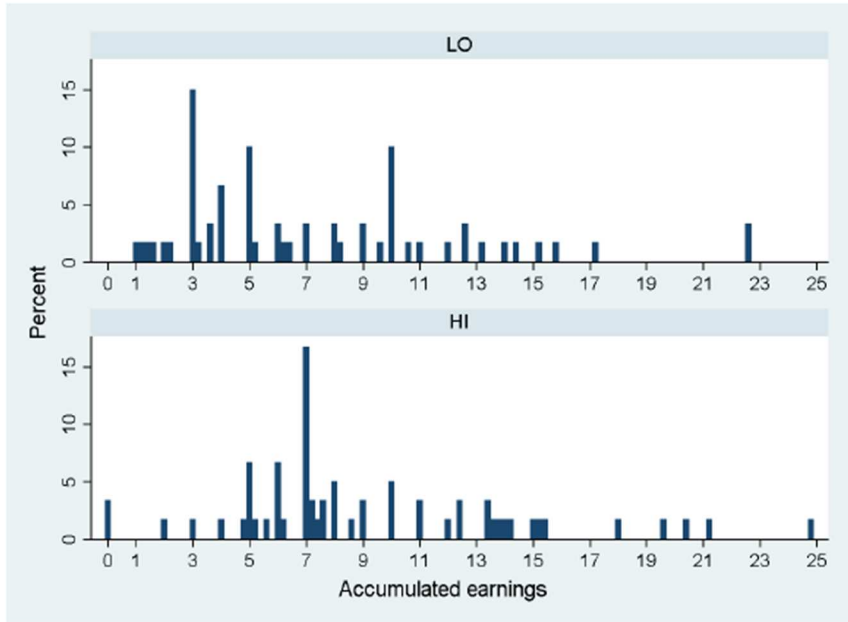


Figure 1: Histogram of Accumulated Earnings (in Euro) at Which a Subject Stopped.

**Part i.** Can you think of an alternative interpretation for the result in Figure 1 above which does not depend on expectation-based reference points?

## Problem 2

Consider a simple model of gym attendance (following DellaVigna and Malmendier 2004), where in period 0 individuals choose whether or not to sign a contract that requires them to pay a lump-sum membership fee  $L$  in period 1 and then an additional attendance price  $p$  if they attend the gym in period 2. They receive a health benefit  $b$  of attending the gym, which is a delayed benefit realized only later. They also incur a hassle cost  $c$  in period 2, which they feel immediately in period 2. In period 0 they only know that  $c$  will be drawn from a uniform distribution on the unit interval  $[0, 1]$ , with  $c$  realized only at the beginning of period 2.

Individuals are present-biased, with a common present bias factor  $\beta \leq 1$ . They thus attend the gym in period 2 if and only if  $\beta b - p - c \geq 0$ . The present-biased individuals are sophisticated, and in period 0 they choose to sign the contract if  $\beta \left[ \int_{c=0}^{c=\beta b - p} (b - p - c) dc - L \right] \geq 0$ .

**Part a.** Let  $V(p, L)$  denote an individual's expected utility from signing the contract, from the period 0 perspective. Show that for  $p < \beta b$ ,

$$V(p, L) = \underbrace{\beta(\beta b - p)}_{\text{P(attend)}} \underbrace{\left( b - \frac{\beta b + p}{2} \right)}_{\text{E(utility|attend)}} - \beta L$$

**Part b.** Show that  $\frac{dV}{dL} = -\beta$  and  $\frac{dV}{dp} = -\beta(b - p)$  for  $p < \beta b$ .

**Part c.** Let

$$W(p, L) = \underbrace{(\beta b - p)}_{\text{Pr(attend)}} \underbrace{\left( b - \frac{\beta b + p}{2} \right)}_{\text{E(utility|attend)}} - L$$

be individuals' "long-run utility." Part (b) above implies that  $\frac{dW}{dp} = -(b - p)$ , which does not depend on  $\beta$ . Do you think it is generally true (i.e., for distributions of  $c$  that are not uniform) that  $\frac{dW}{dp}$  does not depend on  $\beta$ ? Provide some (behavioral) economic intuition for what forces determine  $\frac{dW}{dp}$  for general distributions of  $c$ .

**Part d.** Suppose that the gym incurs a cost  $\psi$  whenever an individual attends the gym. And suppose also that  $p$  and  $L$  must satisfy the zero profit condition  $L + Pr(\text{attend}) \cdot p = Pr(\text{attend}) \cdot \psi$ . This zero profit condition allows us to write  $L$  as a function of  $p$ . What is  $L(p)$ ?

**Part e.** If  $L(p)$  is determined from the zero profit condition above, show that the value of  $p$  that maximizes  $V(p, L(p))$  is given by  $p^* = \psi - (1 - \beta)b$ .

**Part f.** Please provide intuition for the  $p^*$  formula above. In particular, explain why  $p^* = \psi$  when  $\beta = 1$  and why  $p^* < \psi$  when  $\beta < 1$ .

**Part g.** Suppose that the “gym economy” consists of many identical gyms, each of which incurs a cost  $\psi$  per attendance. Explain why in a competitive equilibrium of this economy, gyms will set  $p = \psi - (1 - \beta)b$  and set  $L$  to satisfy the zero-profit condition. You don’t need to do any more math here; good economic intuition is enough.

**Part h.** Keep assuming the competitive equilibrium from part (g). Suppose that Calvin Voltt, a renowned researcher applying behavioral economics to health decisions, decides that it is a good idea to provide incentives for gym attendance to counteract the fact that most people seem to go to the gym less than they wanted to due to self-control problems. Calvin runs a large scale field experiment with a particular gym branch and finds that financial incentives do indeed increase gym attendance. Assuming that the gym branch maintains its standard pricing  $p^* = \psi - (1 - \beta)b$  during the experiment, explain why this field experiment actually created socially inefficient gym attendance while it was being run.

**Part i.** Keep assuming the competitive equilibrium from part (g). Suppose that Calvin cleverly measures people’s present bias  $\beta$  and attendance health benefits  $b$ , and convinces the government to provide financial incentives of  $r = (1 - \beta)b$  per gym attendance. To maintain a balanced budget, these incentives must be funded through a lump-sum tax equal to  $T = r \cdot Pr(\text{attend})$  per individual. Assume that the attendance incentives are obtained by individuals instantaneously in period 2, while the lump-sum tax is paid in period 1, alongside the membership fee  $L$ .

In the long-run, the competitive gym economy will adjust its contract terms  $(L, p)$  in response to this government incentive policy. Explain why when the equilibrium adjusts, gyms will set  $p = \psi$ , and the net effect of the government intervention on individuals’ (long-run) welfare will be zero. Again, no math is necessary, unless it’s easier for you to derive everything formally.

**Part j.** Keep assuming the competitive equilibrium from part (g). While Calvin was running field experiments on financial incentives for gym attendance, a clever grad student named Dean convinced a different gym branch to run a field experiment in which individuals are offered commitment contracts for exercise. These commitment contracts have the form that individuals can choose to put up some amount of money  $K$ , which they lose unless they actually go to the gym. Explain why even when  $b > 1 + \psi$ , offering individuals these commitment contracts can only lead to inefficiencies in gym attendance.

**Part k.** Please comment on the broad lesson that parts (h), (i), (j) are conveying about “behaviorally-informed” interventions.

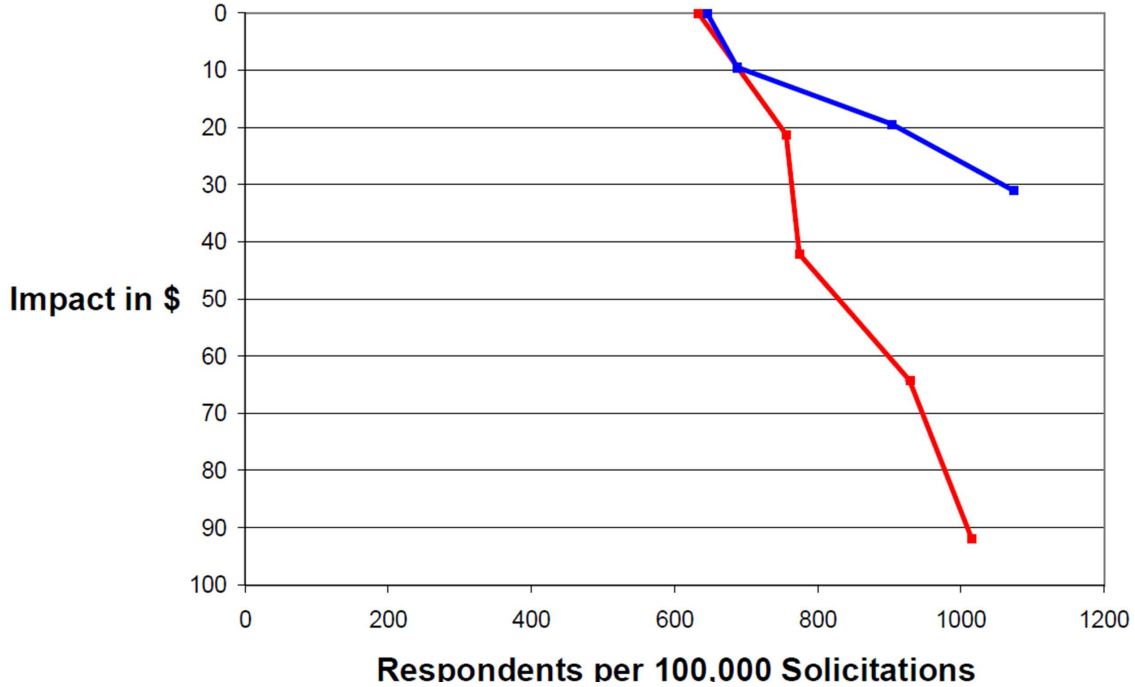
### Problem 3

This question focuses on self-control and procrastination.

**Part a.** Consider the results in Ausubel (1999), the field experiment by a credit card company which randomized the pre- and post-teaser interest rate. Describe briefly the experiment and the main results from Table 1 below; in particular, focus on the response rate.

TABLE 1: SUMMARY OF MARKET EXPERIMENTS					
MARKET EXPERIMENT	MARKET CELL	NUMBER OF SOLICITATIONS MAILED	EFFECTIVE RESPONSE RATE	PERCENT GOLD CARDS	AVERAGE CREDIT LIMIT
MKT EXP I	A: 4.9% Intro Rate 6 months	100,000	1.073%	83.97%	\$6,446
MKT EXP I	B: 5.9% Intro Rate 6 months	100,000	0.903%	80.18%	\$6,207
MKT EXP I	C: 6.9% Intro Rate 6 months	100,000	0.687%	80.06%	\$5,973
MKT EXP I	D: 7.9% Intro Rate 6 months	100,000	0.645%	76.74%	\$5,827
MKT EXP III	A: Post-Intro Rate Standard - 4%	100,000	1.015%	82.96%	\$5,666
MKT EXP III	B: Post-Intro Rate Standard - 2%	100,000	0.928%	77.69%	\$5,346
MKT EXP III	C: Post-Intro Rate Standard + 0%	100,000	0.774%	76.87%	\$5,167
MKT EXP III	D: Post-Intro Rate Standard + 2%	100,000	0.756%	76.98%	\$5,265
MKT EXP III	E: Post-Intro Rate Standard + 4%	100,000	0.633%	73.62%	\$5,095

**Part b.** Explain as clearly as you can how the numbers in this Table translate into the numbers in the key figure of the paper, reproduced below. It may help to remember that the average pre-teaser rate balance is \$2,000 and the average post-teaser rate balance is \$1,000. Also, borrowers are observed for 21 months, so that is how the impact of picking one card or another is calculated.



**Part c.** What do we learn from the fact that the two lines -- the two demand curves -- have very different slopes?

Ausubel and Shui (2009) write a model to explain the facts in Ausubel (1999). They assume that consumers have an existing credit card, and receive each quarter credit card offers which may be better than the existing one. Not unlike in the Fang and Silverman paper above, they assume an immediate cost of switching  $-k$  and a delayed benefit of saving on borrowing costs (assuming they pick a better credit card). They assume that each period lasts a quarter and that consumers receive offers and at the beginning of each quarter decide whether to switch or not to a new credit card. The Table below reports the key estimated parameters.

Table 4: Estimated Parameters <sup>a</sup>

	Sophisticated Hyperbolic	Naive Hyperbolic	Exponential
$\beta$	0.7863 (0.00192)	0.8172 (0.003)	
$\delta$	0.9999 (0.00201)	0.9999 (0.0017)	0.9999 (0.00272)
$k$	0.02927 \$293 (0.00127)	0.0326 \$326 (0.00139)	0.1722 \$1,722 (0.0155)

**Part d.** Comment on the findings in the last column for the ‘standard’ model (that is,  $\beta = 1$ ). Are the magnitudes of the switching costs (captured by the \$ amount in the row for parameter  $k$ ) plausible?

**Part e.** How do the estimated parameters change as we allow  $\beta < 1$ , both in the sophisticated and naive case?

**Part f.** Comment on the similarity between the naive and the sophisticated results -- Can you single out an assumption which is critical to the results?

**Part g.** Consider the set-up we discussed in class for signing-up for a 401(k) plan. There is an immediate one-time cost  $-k$  followed by a delayed benefit  $b$  received on each day after the first period. While the time period is the day, the employer is allowed to take decisions only every  $T$  days. That is, if  $T = 360$ , only once a year, if  $T = 1$  every day, etc. You showed in a problem set that a naive agent procrastinates if

$$\frac{\beta\delta T}{1-\beta} \lesssim k \leq \frac{\delta b}{1-\delta}$$

Provide as much intuition as you can on what the expression above indicates (including what ‘procrastination’ means in this context) and comment in particular on the role of the parameter  $T$ . Relate if opportune to the previous parts of this Problem 3.

**Part h.** For a sophisticated agent, we discussed how the different selves can engage in a war of attrition between selves, but that in any case one can derive a bound of the longest delay  $L$  that a self will tolerate before investing right away. After solving, the delay  $L$  is:

$$L \approx k \frac{1-\beta}{\beta b}.$$

Why does  $T$  not play a role in this formula? Compare with the naive case, and relate to the above parts of this Problem 3.