Homework #3 Psychology 101
Spr 03
Prof Colin Camerer

This is available 130 pm Wed 20 May and due Friday 29 May at 130 pm (in the box outside my office or my Baxter 1st floor mailbox). Collaboration policy: Open book. Work by yourself. After you complete answers you may check them with others, but then continue to work alone. Also show your work when it is useful for us to see that you are working through algebraic steps correctly. (Also there is partial credit for a correct sequence of steps even if you get the wrong answer to an algebra slip; but there is even *more* credit if you check your work and find the slips yourself!). **There is a 50% penalty per day for late homework unless you have a written medical excuse. Remember that game reports are due 2 June 130 pm. (See syllabus on the web for details if you've forgotten.)**

1. (10 points each part) An incumbent firm operates in a local computer market, which is a natural monopoly in which only one firm can survive. The incumbent can price Low, losing 40 in profits, or High, losing nothing. It knows its own operating cost C, which is 20 with probability .75 and 30 with probability .25. A potential entrant knows those probabilities, but not the incumbent's exact cost. The entrant can enter at a cost of 100, and its operating cost of 25 is common knowledge. The incumbent firm prices first (choosing Low or High) and then the entrant decides whether to enter or not. The firm with the highest operating cost immediately drops out if it has a competitor, and the survivor earns the monopoly revenue of 150.
   (a) Draw the extensive form (tree form) for this game.
   (b) Why is there no perfect equilibrium in which the incumbent prices Low only when its costs are 20 (i.e., no separating equilibrium in which Low is chosen only at the low cost)?
   (c) In a perfect Bayesian equilibrium in which the incumbent prices Low regardless of its costs (a pooling equilibrium), what do the out-of-equilibrium beliefs have to specify? (I.e. what does the entrant think p(C=20|High) is?)
   (d) What are two different perfect Bayesian equilibria for this game? (Remember that a perfect Bayesian equilibrium specifies choices by each player which are best responses to one another, beliefs after out-of-equilibrium moves, and the beliefs must be the limit of a sequence of "trembles" in which the out-of-equilibrium move is made with probabilities epsilon that converge to zero).
   (e) What is a set of out-of-equilibrium beliefs that do not support a pooling equilibrium at the Low incumbent price? (I.e., if both C types of incumbent firms choose Low, what is a belief p(C=20|high) that "breaks" the equilibrium or makes Low pricing a suboptimal move for one of the C-type incumbents).

2. (10 points each part) An economy has two types of jobs, G and B (for good and bad), and two types of workers, Q and U (for qualified and unqualified). The population consists of 60% Q and 40%U. In a B job, either type of worker produces 10 units of output. In a G job, a Q worker produces 100 and an U worker produces 0. Companies have many job openings of each type ("excess demand for labor") and must pay for each type of job a wage equal to the expected amount that the person they give the job to will produce. Companies cannot directly observe a worker's type before hiring, but Q workers can signal their skill by getting educated. The cost of getting educated to level n for a Q worker is $n^2/2$ and for a U worker is $n^2$. These costs are measured in units of output and n must be an integer.

(a) What is the minimum level of n that will achieve a separating equilibrium (i.e. an equilibrium in which only Q's purchase the n units of education).
(b) Now suppose the signal is made unavailable (it is too costly, or firms are not allowed to use it in making hiring decisions). Which jobs will be filled by which workers, at what wages? Who will gain and who will lose from this change?

3. (10 pts) "If you believe in game theory and you are crossing a one-way street, you only need to look one way. If you believe in behavioral game theory, you look both ways, and you are more likely to look both ways if you are a pedestrian crossing rather than crossing in a car." Explain what this claim means in language of (behavioral) game theory.

4. (10 points each part) Fact: In games with mixed-strategy equilibria, the frequencies with which experimental subjects actually choose different strategies tend to be between 1/n (if there are n strategies in the game) and the mixed-strategy equilibrium prediction.

(a) Define quantal-response equilibrium. Define Nash equilibrium, and explain why quantal-response equilibrium generalizes Nash equilibrium mathematically.

(b) Explain how quantal-response equilibrium can usually account for the fact stated above in this question.

5. (10 pts) Describe one way in which the experiments on the "Tunisian bazaar" mechanism studied by Rapoport, Erev and Zwick (the seller doesn't know the buyer's valuation, and posts a series of prices over time which the buyer can take or leave) are quite consistent with the game theory prediction.

6. (10 pts) Describe roughly how face-to-face communication changes behavior (compared to simply making one-time offers) in the "sealed-bid mechanism" (or "bilateral call market") studied experimentally by Radner and Schotter, and by Valley et al.

7. (Bayes' rule, 10 points each part). A person presents at an AIDS clinic and belongs to a demographic group with a .001 chance of having AIDS. They take an AIDS test which is 95% accurate (i.e. if they have AIDS the test will say so with .95 probability, and if they *don't* have AIDS the test will say that they don't have AIDS with .95 probability).

(a) What is their Bayesian posterior probability of having AIDS?

(b) Can you think of a (rough) psychological explanation why a person with a positive AIDS test (i.e. a test that says they have AIDS) might be pleasantly surprised to find out your answer to (a)? (Be brief here, and you can be vague).