

**Problem 1 (3p)** Similarly like in the problem set 3, consider the first price sealed auction with two bidders but common value of the object being sold. As before each player observes a random variable  $t_i$  that is independently drawn from uniform distribution on  $[0, 1]$  but the actual value of the object is now  $v = t_1 + t_2$ . Thus given only his only information the expected value of the object is  $t_i + 0.5$  as in problem from the previous list. Then after betting  $b_i \geq 0$ , the payoffs are the following:

$$u_i(b_1, b_2, t_1, t_2) = \begin{cases} (t_i + t_2) - b_i & \text{if } b_i > b_{-i}, \\ 0 & \text{if } b_i < b_{-i}, \\ \frac{1}{2}(t_i + t_2 - b_i) & \text{if } b_i = b_{-i}. \end{cases}$$

Find NE of this game in linear strategies, i.e. find numbers  $\alpha$  and  $\beta$  such that  $b_i = \alpha t_i + \beta$  is the equilibrium strategy. Show that for each value of  $t_i$  the equilibrium bid is lower in this auction than in the private-value auction from the previous list.

**Problem 2 (3p)** Consider a Cournot duopoly with linear inverse demand  $p = a - bQ$ , where  $Q = q_1 + q_2$ . Assume now that each company know its own marginal costs, but does not know marginal costs of the other. Marginal cost can be  $c_h$  or  $c_l$  with probabilities  $\mu$  and  $1 - \mu$ . Let  $c_h > c_l$ . Find all Bayesian Nash equilibria of this game.

**Problem 3 (4p)** Consider the following game with two players meeting in a pub. Player A is "Wimpy" with probability 0.2 and "Surly" with probability 0.8. Player A knows its type and decides to order "beer" or "quiche". Then observing A's order B decides to "Concede" or "Fight". B does not know A's type. Payoffs are given by:

Player's A type	Players A action	Players B action	Payoff
Surly	Beer	Fight	(1, 0)
Surly	Beer	Concede	(3, 1)
Surly	Quiche	Fight	(0, 0)
Surly	Quiche	Concede	(2, 1)
Wimpy	Beer	Fight	(0, 1)
Wimpy	Beer	Concede	(2, 0)
Wimpy	Quiche	Fight	(1, 1)
Wimpy	Quiche	Concede	(3, 0)

(i) Find all Bayesian-Nash equilibria.

(ii) Find all WPBE.