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Homework05

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1 Problem 1

Answer:

(1)For NE:

$U_1 = (a - b(q_1 + q_2))q_1 - cq_1, U_2 = (a - b(q_1 + q_2))q_2 - cq_2$

$\frac{dU_1}{dq_1} = 0, \frac{dU_2}{dq_2} = 0 \Rightarrow BR_1 = q_1^\star = \frac{a - c - bq_2}{2b}, BR_2 = q_2^\star = \frac{a - c - bq_1}{2b}$

$BR_1 = BR_2 \Rightarrow q_1^\star = q_2^\star = \frac{a - c}{3b}$

So $q^\star = q_1^\star + q_2^\star = \frac{2(a - c)}{3b}$, total profit $= \frac{2(a - c)^2}{9b}$.

(2)For monopoly:

Let's say company 1 is a monopoly, then we can get $q_2^\star = 0$

So $\frac{dU_1}{dq_1} = 0 \Rightarrow a - 2bq_1^\star = c \Rightarrow q_1^\star = \frac{a - c}{2b}$

So $q^M = \frac{a - c}{2b}$, total profit $= \frac{(a - c)^2}{4b}$.

(3)For perfect competition:

$p(q_1, q_2) = MC = c \Rightarrow a - b(q_1^\star + q_2^\star) = c$

So $q^C = q_1^\star + q_2^\star = \frac{a - c}{b}$, total profit $= 0$.

2 Problem 2

Answer:

(1)No. Because in this situation, $BR_1(L) = M, BR_1(R) = D, BR_2(U) = L$ or R,$BR_2(M) = R, BR_2(D) = L$

So we don't have any strictly dominated strategies for either player (in pure strategies).

(2)No. Because player 2 only has 2 strategies, so we can only mix player 1's strategy. For player 1, if player 2 plays L, the worst responce is M and the best responce is D; if player 2 plays R, the worst responce is D and the best responce is M. So if we want to find the strictly dominated strategy, we can only mix M and D. We assume that the mixed strategy is (0,p,1-p). Then we must have that $3p > 2, 3(1 - p) > 2 \Rightarrow p < \frac{1}{3}, p > \frac{2}{3}$. So we can't find this mixed strategy.

For player 2, if we want to have a strictly dominated strategy, the same as above, we should mix U and D. But if we use this strategy, this is not a strictly dominated strategy for player 1.

So there is not a strictly dominated strategy for either player.

(3)Assume player 1 is mixing U, M and D with (0,p,1−p) and player 2's mixed strategy (q,1−q). Then we have these equations.

$1 - p = p, 3q = 3(1 - q) \Rightarrow p = q = \frac{1}{2}$

So the mixed strategy is that $[(0, \frac{1}{2}, \frac{1}{2}), (\frac{1}{2}, \frac{1}{2})]$

3 Problem 3

Answer:

(a)Suppose (a,b) is the payoff, where a is the payoff of Li Lei and b is the payoff of Han Meimei. The payoff matrix is as following.

		Han Meimei	
		Bad	Good
Li Lei	1	(1, 1)	(2,0)
	2	(0, 3)	(3,2)

From the payoff matrix,we know that, for Li Lei, $BR(Bad) = 1, BR(Good) = 2$. For Han Meimei, $BR(1) = Bad, BR(2) = Bad$.

So the NE is that Han Meimei makes bad hamburgers, and Li Lei buys one hanburg. It can be be expressed as (1,Bad).

(b)In the first selection, we know that (1,Bad) is the NE, so of course we will choose (1,Bad) in the first selection(Han Meimei makes bad hamburgers and Li Lei buys one hanburg).

But after the first selection, Li Lei gets 1 payoff and Han Meimei also gets 1 payoff. So we can think that the payoff matrix has no relative change(because two sides both add 1 payoff). So in the second selection, no matter what happens, Han Meimei makes bad hamburgers and Li Lei buys one hanburg(1,Bad).

So the SPE is that in the first section, Han Meimei makes bad hamburgers, and Li Lei buys one hanburg(1,Bad); and in the second section, no matter what the result is in the first section, Han Meimei also makes bad hamburgers, and Li Lei also buys one hanburg(1,Bad).

(c)If Han Meimei always makes good hamburgers and Li Lei always buys two hanburgers. Then for Li Lei, the payoff is $(3 + 3\delta_L + 3\delta_L^2 + \cdots = \dfrac{3}{1-\delta_L})$. And for Han Meimei, the payoff is $(2 + 2\delta_H + 2\delta_H^2 + \cdots = \dfrac{2}{1-\delta_H})$.

If Li Lei violates the strategy, then the payoff will become $(2+\delta_L+\delta_L^2+\cdots = 1+\dfrac{1}{1-\delta_L})$. And for Han Meimei, the payoff will become $(3 + \delta_H + \delta_H^2 + \cdots = 2 + \dfrac{1}{1-\delta_H})$.

So if we want to continue this strategy, we must have $\dfrac{3}{1-\delta_L} \geq 1 + \dfrac{1}{1-\delta_L}, \dfrac{2}{1-\delta_H} \geq 2 + \dfrac{1}{1-\delta_H}$.

So from the inequalities above, we can get that $\dfrac{1}{2} \leq \delta_H \leq 1, 0 \leq \delta_L \leq 1$.

So the minimum discount factor is that $\delta_H = \dfrac{1}{2}$ and $\delta_L = 0$.