

### Problem Set 1

(I) Consider a game with two players: Player 1 and Player 2. Player 1's action set is  $\{u,d,s\}$  and Player 2's action set is  $\{U,D\}$ . Their payoffs are given in the matrix below.

		Player 2	
		U	D
Player 1	u	0 4	0 2
	d	4 2	0 1
	s	2 6	2 6

(1) Suppose that the game is played only once and that both players move simultaneously. Find the Nash Equilibrium/Equilibria.

(2) Suppose instead that Player 1 moves first and then does Player 2 (he observes Player 1's action before he moves). Construct the game tree for this game. Find the Subgame Perfect Nash Equilibrium (SPNE).

(II) Consider a game with two players (1 and 2) and three possible actions for each. Player's 1 action set is  $\{U, M, D\}$  and Player's 2 action set is  $\{L, M, R\}$ . Suppose that the game is played only once, that both players move simultaneously and that the payoffs are given below. Calculate the best response functions for each player and the Nash Equilibrium/Equilibria of the game.

		Player 2		
		L	M	R
Player 1	U	5 5	2 6	1 8
	M	6 2	4 4	2 3
	D	8 1	3 2	0 0

(III) Consider two firms in the cereal market. They can decide to produce either Crispy (C) or Sweet (S) cereal and their profits are given in the matrix below.

		Firm 2	
		C	S
Firm 1	C	-5 -5	10 20
	S	20 10	-5 -5

(1) Suppose that both firms announce their decisions simultaneously. What will be outcome of the game be? ( i.e. find the Nash Equilibrium/equilibria).

(2) Suppose Firm 2 moves first and his action is known to Firm 1 when it moves. Draw the game tree and find the SPNE.

(3) Suppose Firm 1 moves first and his action is known to Firm 2 when it moves. Draw the game tree and find the SPNE.

**(IV)** Consider two identical firms (Firm 1 and Firm 2) that produce an homogenous product . The demand for their product is :

$$P = 200 - Q, \quad \text{where } Q = q_1 + q_2.$$

Each firm has a cost function:  $C(q_i) = 20 q_i$  ( i.e. the  $Mc_i$  is 20 and there are no fixed costs)

(1) Calculate the Cournot Equilibrium (price and quantities, profits). Graph the reaction functions and show the Cournot equilibrium in the graph.

(2) Calculate output, prices and profits if the 2 firms collude. Assume that each firm is going to produce half of the collusive output.

(3) Suppose Firm 1 is producing at the collusive output level. Calculate the output level that Firm 2 will choose if it wants to maximize current period profits. Calculate profits for both firms. What are the implications for the survival of a collusive agreement?