

## AGTA Tutorial 2

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**Exercise 1.** Consider the (finite) 2-player zero-sum game given by the following utility matrix  $A$ , where the utilities of the maximiser (the row player) are indicated.

|    | C1 | C2 | C3 | C4 | C5 |
|----|----|----|----|----|----|
| R1 | 4  | 2  | 9  | 2  | 5  |
| R2 | 6  | 3  | 5  | 9  | 7  |
| R3 | 1  | 4  | 8  | 5  | 7  |
| R4 | 5  | 1  | 3  | 5  | 6  |

- A. Specify the linear programs that compute the optimal strategies for the maximiser (the primal) and for the minimiser (the dual).
- B. Using the “educated guess” approach that we saw in the lectures, solve this game by hand to find the optimal strategies for the two players and the value of the game.

*Hint: You may want to first try to simplify the game by eliminating redundant pure strategies.*

**Exercise 2.** Alice and Bob are playing a “match the card colour” game. Alice holds a black Ace card and a red 8 card. Bob holds a red 2 card and a black 7 card. They simultaneously choose one of their cards. If the chosen cards are of the same colour, Alice wins the game, otherwise Bob wins the game. The amount won is a number of GBP equal to the number on the winner’s card (the Ace card counts as 1).

- A. Model this game as a (finite) 2-player zero-sum game with Alice being the maximiser and Bob being the minimiser.
- B. Using the “educated guess” approach that we saw in the lectures, solve this game by hand to find the optimal strategies for the two players and the value of the game.

**Exercise 3.** Consider the (finite) 2-player game given by the following utility bimatrix.

|    | C1  | C2  | C3  | C4  |
|----|-----|-----|-----|-----|
| R1 | 7,3 | 6,4 | 5,5 | 4,7 |
| R2 | 4,2 | 7,9 | 8,6 | 8,8 |
| R3 | 6,1 | 9,7 | 2,4 | 6,9 |

- A. First, simplify the game by eliminating redundant pure strategies, if any.
- B. Compute all the MNE of the game (by hand), by formulating an appropriate system of linear equations and solving them. Justify why your system of linear equations actually computes MNE of the game.