Micro B: Problem Set 1

Dominance*

Anders Munk-Nielsen

Spring 2024

Question 1. Solve this game by Iterative Elimination of Strictly Dominated Strategies (IESDS):[1]

	t_1	t_2	t_3
s_1	5,0	3,3	1,1
s_2	2,4	2,2	3,1
s_3	2,2	1,1	0,5

Question 2. The Travellers' Dilemma: An airline loses two completely identical suitcases belonging to two different travelers. The airline knows that the suitcases are worth at most \$100 to their respective owners. Each traveler must file a claim for the lost suitcase, and the airline must decide how much to compensate each traveler. The compensated value is set as the lowest value filed by either traveler. However, to encourage honesty, the airline also imposes a fine of 2\$ on the traveler who files the higher claim, and a bonus of 2\$ to the traveler who files the lower claim. If they both claim the same amount, there both receive that amount. For simplicity, assume that the travelers can only claim $x \in \{2, 3, \dots, 100\}$.

(a) Write down the normal form of this game: players, strategy sets, payoffs.

(b) Can you solve this game by IESDS?
Hint: we require <u>strict</u> domination.

(c) What number do you think each traveler will write down? Why? An informal discussion of the reasoning will suffice. *Suppose my opponent claims x – what is my best response?*

Question 3. Reduce the following games using the IESDS algorithm

	t_1	t_2	t_3
s_1	$5,0$	$2,3$	$1,1$
s_2	$2,4$	$2,2$	$3,1$
s_3	$2,2$	$1,1$	$0,5$

Game A

	t_1	t_2	t_3
s_1	5,0	2,3	1,1
s_2	2,4	2,2	3,1
s_3	2,2	1,1	1,5

Game B

Question 4. IESDS in Python

(a) Code up IESDS in Python (Algorithm 1).

(b) Check your algorithm on the game from Question 1.

*Prior contributions by Jeppe Dinsen.

[1] In the language of Tadelis, find the *Iterated-elimination Equilibrium* (definition 4.4 on p. 65).

(c) Use your algorithm to reduce the game from Question 2 in the 2021 Exam. Check that your code correctly identifies the following strategies as dominated:

$$s^{\text{Dom}} = \{\texttt{Midrange Demon Hunter}, \texttt{Miracle Druid}, \texttt{Miracle Rogue}, \texttt{Ping Mage}\}.$$

See the accompanying notebook, `dominance.ipynb`, for tips to get started.

Algorithm 1: IESDS

```
d ← 1
while d = 1 do
    d ← 0
    for i ∈ N do
        for s_i ∈ S_i do
            for s'_i ∈ S_i \ {s_i} do
                if s'_i ≻ s_i then
                    Drop s_i from S_i
                    d ← 1
                    break ; # exit for loop over s'_i
                end
            end
        end
    end
end
```

Question 5. A 3-player game We can also write games with more than two players. Consider the game below where player 1 chooses the bi-matrix (A or B), player 2 chooses the row (C or D), and player 3 chooses the column (E or F). In each cell, the first number gives the payoff of Player 1, the second number the payoff of Player 2, and the third number the payoff of Player 3.

	E	F
C	$0, 2, 2$	$2, 1, 1$
D	$0, 1, 1$	$3, 0, 0$

A

	E	F
C	$1, 0, 1$	$3, 1, 2$
D	$1, 1, 0$	$5, 2, 1$

A

Figure 1: Player 3 chooses A or B

Find the pure strategy profile that survives iterated elimination of strictly dominated strategies.

Question 6. Largest Number Wins Michael and Jonas are playing a game instead of working. The game has the following rules: Both secretly pick a (natural) number between 1 and 5. Then they reveal the numbers to each other. If both have picked the same number, nobody gets anything. If Jonas' number is higher than Micheal's number, Michael has to pay Jonas 1 DKK. If Micheal's number is higher than Jonas', Jonas has to pay 10 DKK to Michael.

(a) Discuss whether this game seem "fair" to you, and what it means for a game to be fair (in the everyday-sense of the word)?

(b) Write the game in bimatrix form.

(c) Are there any strictly dominated strategies? Solve the game by iterated elimination of strictly dominated strategies.

(d) What is the outcome of the game if both Michael and Jonas are rational, know the other is rational, know that the other knows that they are rational ect.?