POLI 244 Conference 3: Game Theory Exercises

Exercise 1

Consider the following payoff matrix, assuming that the actors are rational utility maximizers with complete information.

Payoff Matrix (Greenpeace vs. France)

		France			
		F1	**F2**	**F3**	**F4**
Greenpeace	G1	6, 5	2, 2	5, 4	1, 3
	G2	5, 5	4, 5	0, 3	3, 2
	G3	7, 7	3, 9	4, 6	2, 8

Questions:

1. Are there any dominant strategies?
2. Find the rationalizable strategies and outcomes (i.e., iteratively eliminate the strategies that are “never a best response”).
3. Find the Nash equilibria.
4. What is the expected outcome?
5. Is the expected outcome Pareto optimal?
6. Complete the following graph with the missing information (six missing outcomes), and use it to determine which outcomes are Pareto optimal.
    - **Graph Axes:**
        - Y-axis: France's expected utility
        - X-axis: Greenpeace’s expected utility
    - **Provided Points for the Graph:**
        - (G2, F1)
        - (G1, F1)
        - (G2, F2)
        - (G2, F3)
        - (G2, F4)
        - (G1, F2)
7. Are France and Greenpeace facing a cooperation problem here? If so, is this a coordination or a collaboration problem? How could it be solved?

Exercise 2

Iran intends to develop nuclear weapons. Israel tries to deter them from doing so by making a threat: “If you start developing a nuclear weapon we will bomb your nuclear reactors.” Iran does not know if Israel’s threat is serious or just a bluff. Iran has to make a choice between carrying out their original plan and build the bomb, or give up their plan. Which of the two following game trees – A or B – better captures the strategic setting of this interaction? Why?

Game Tree A (Extensive Form)

- **Player 1: Iran**
  - **Choice: Build**
    - **Player 2: Israel**
      - Choice: Serious Threat (Payoffs: -1, -50)
      - Choice: Bluff (Payoffs: 2, -2)
  - **Choice: Don't Build**
    - **Player 2: Israel**
      - Choice: Serious Threat (Payoffs: -10, 20)
      - Choice: Bluff (Payoffs: 2, -2)

Game Tree B (Extensive Form with Information Set)

- **Player 1: Iran**
  - **Choice: Build**
    - **Player 2: Israel** (This node is part of an information set, implying Israel does not know Iran's choice when making its decision)
      - Choice: Serious Threat (Payoffs: -1, -50)
      - Choice: Bluff (Payoffs: 2, -2)
  - **Choice: Don't Build**
    - **Player 2: Israel** (This node is part of the same information set as above)
      - Choice: Serious Threat (Payoffs: -10, 20)
      - Choice: Bluff (Payoffs: 2, -2)

Exercise 2 (Continued)

Questions:

1. Interpret the four possible outcomes (in either game tree). Describe the scenario in each outcome.
    - Outcome 1: (-1, -50)
    - Outcome 2: (2, -2)
    - Outcome 3: (-10, 20)
    - Outcome 4: (2, -2) (Note: This is identical to Outcome 2, implying only 3 unique outcomes by payoff value).
2. Interpret the payoffs. What do you think these values/utilities are reflecting in each case?
3. Does Iran have a (weakly or strictly) dominant strategy? What about Israel?
4. Use backward induction to find the expected outcome in game tree A.
5. You cannot find the expected outcome in game tree B using backward induction alone. Why is that? Can you find the expected outcome in any other way?
6. Represent the strategic setting depicted in game tree B in the form of a matrix.

Matrix for Game Tree B

	Israel		
	Make a serious threat	**Make a bluff**	
Iran	Build the nuclear weapon	(-1, -50)	(2, -2)
	Don’t build the nuclear weapon	(-10, 20)	(2, -2)

1. In the matrix above, find all the strictly or weakly dominated strategies, and all the Nash equilibria.
2. In the matrix above, find the only Pareto suboptimal outcome.
3. If Iran believes that there is a 50% chance that Israel is bluffing and a 50% chance that their threat is serious, what will Iran most probably choose to do?
4. Iran will most likely choose to build the weapon if they believe that the probability that Israel is bluffing is x (or greater than x). Calculate x.

Titration Curve Plot

This section describes components typically found in a titration curve plot.

Axes Information:

- **X-axis (Volume of 0.100 M NaOH added (mL)):**
    - Scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50
- **Y-axis (pH):**
    - Scale: 0, 1, 2, 3, 4, 5, 6, 7 (H=7), 8, 9, 10, 11, 12, 13, 14

Titration Curves and Associated Data:

- **Titration of weak acid CH3COOH:**
    - Equivalence point pH: 8.72
    - Associated Indicator pH Range: Phenolphthalein
- **Titration of strong acid HCl:**
    - Equivalence point pH: 7.00
    - Associated Indicator pH Ranges: Litmus, Methyl orange

> *Note: The labels "Number", "Diagram", and "Screenshot" were not used as standalone categories because all numerical data and descriptive text provided were contextually part of a titration "Plot". There was no distinct information describing a physical diagram or a screenshot.*