Econ 327: Game Theory

Midterm Exam

University of Oregon

October 29th, 2025

Version 2

ANSWER KEY

Multiple Choice

Question 1. (4 P.)
If an outcome is _____, then it is _____

a) not a Nash equilibrium, not Pareto optimal
b) **never Pareto dominated, Pareto Optimal**
c) strictly dominated for everyone, Pareto optimal
d) Pareto dominated, a Nash equilibrium

Question 2. (4 P.)
Perform Iterative Deletion of Strictly Dominated Strategies for the strategic form game below all the way to completion.
What does IDSDS tell you about the Nash equilibrium of this game?

		P_2		
		wide	narrow	thin
P_1	tall	5,9	6,2	6,2
	med	2,5	8,8	2,2
	short	6,4	2,3	5,9

a) The NE is (med,narrow)
b) The NE is (short,thin)
c) The NE is (tall,wide)
d) **IESDS by itself does not reveal the NE of this game.**
e) The NE is (short,wide)

Question 3. (4 P.)
A choice that is the best for a player **no matter what everyone else is doing** is referred to as a:

a) strictly dominated strategy
b) confidence strategy
c) Pareto optimal strategy
d) **strictly dominant strategy**

Question 4. (4 P.)
Iterative Deletion of Strictly Dominated Strategies is useful because

a) it's not useful because you will get different answers depending on which player you start with
b) **it can remove strategies which will never be played in a Nash Equilibrium**
c) it will always find all Nash Equilibria of any strategic form game
d) it removes non-credible threats

Question 5. (4 P.)
Consider the strategic form game below: What is the Nash Equilibrium?

		P_2		
		Left	Middle	Right
P_1	Up	0,1	9,0	2,3
	Straight	5,9	7,3	1,7
	Down	7,5	10,10	3,5

a) Up, Middle
b) Straight, Right
c) **Down, Middle**
d) Down, Right

Question 6. (4 P.)
I make two bets on separate games. If the UO men's basketball team beats Washington, I win \$6, but if Washington wins I lose \$6. If the UO women's team beats Colorado, I win \$12, but if Colorado wins I lose \$12. Suppose that the probability of the UO men beating Washington is $\frac{1}{3}$ and the probability of the UO women beating Colorado is $\frac{1}{2}$.
What is my expected (dollar) payout across both games?

a) \$0
b) \$2
c) -\$4
d) **-\$2**

Question 7. (4 P.)
In a **sequential-move game**, the appropriate method of analysis is:

a) Nash equilibrium in mixed strategies
b) best response dynamics
c) **backward induction (rollback analysis)**

Question 8. (4 P.)
In the **Prisoner's Dilemma**, mutual cooperation:

a) **Pareto dominates the outcome of mutual defection**
b) is stable
c) is a credible threat
d) is a dominant strategy equilibrium

Question 9. (4 P.)
Which of the following do we assume when we solve sequential games using backwards induction?

a) All playeres have perfect information
b) Some players have a first-move advantage
c) All players have the same preferences
d) **All players believe that all other players are rational**

Question 10. (4 P.)
In a two player game in which both players have 2 elements in their strategy set, it is possible for there to be 4 pure strategy Nash equilibria.

a) False, only mixed strategies can be used in a 2x2 game
b) False, pure strategy Nash must be unique
c) True, if all are Pareto dominated
d) **True, if all are weak Nash equilibria**

Long Answer

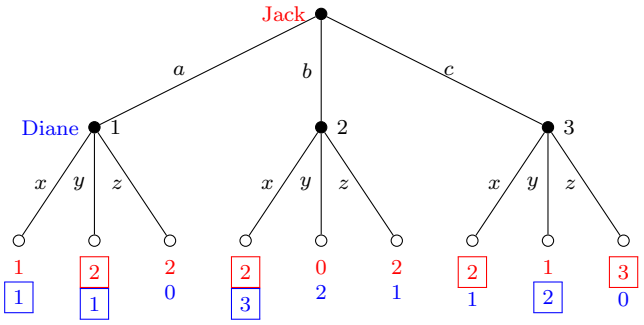
Exercise 11.
Here's a little ditty, about Jack and Diane, two American kids growing up in the heartland. The game is below.

		Diane		
		x	y	z
Jack	a	1,1	2,1	2,0
	b	2,3	0,2	2,1
	c	2,1	1,2	3,0

a) (6 P.) Find all pure Nash strategy profiles and outcomes *if Jack moves first.* Carefully detail and explain your strategy profiles.

SolutionSolution 11.11.

a) See the extensive form game tree below.



- $\mathbf{N_1} = (\mathbf{a},\ \mathbf{y_1}x_2x_3)$ and $(\mathbf{a}, \mathbf{y_1}x_2y_3)$
  Any set of strategies in which Jack chooses a and Diane chooses y in node 1 is a Nash as long as Diane chooses anything other than z in node 3 results in neither having regrets given the other's strategy. Diane will always play x in node 2.
  The payoffs obtained in this equilibrium are $(2, 1)$
- $\mathbf{N_2} = (\mathbf{b},\ s_1\mathbf{x_2}s_3)$
  where:
  - s_1 could be $\mathbf{x}$, $\mathbf{y}$;
  - s_3 could be either $\mathbf{x}$, $\mathbf{y}$, or $\mathbf{z}$.

  Any set of strategies in which Jack chooses b, Diane is indifferent between x and y at node 1 which is not on the equilibrium path of play, and Diane chooses x_2 given that jack chooses b.
  The equilibrium outcome of any of these Nash strategy profiles would be $(2, 3)$

Question 12.
Consider the strategic form game below:

		P_2			
		i	j	k	l
P_1	q	8, 7	5, 10	9, 7	4, 9
	r	8, 2	3, 5	10, 7	0, 8
	s	9, 9	1, 10	8, 11	4, 13
	t	0, 4	4, 5	11, 6	7, 11
	v	3, 4	3, 5	6, 6	3, 4

a) (4 P.) Does either player have any strategies they would never play if they are rational? State any strictly dominated strategies and explain why they would not be played.

b) (4 P.) Use Iterated Deletion of Strictly Dominated Strategies and write out a simplified game table with any remaining cells.

c) (4 P.) Find all Nash equilibria in pure strategies. Explain why you know that these strategy profiles are Nash, or if you cannot find any explain why not.

SolutionSolution 12.12.

a) v is strictly dominated by q because conditional on P_2's strategy, it always results in a higher payoff.

b)

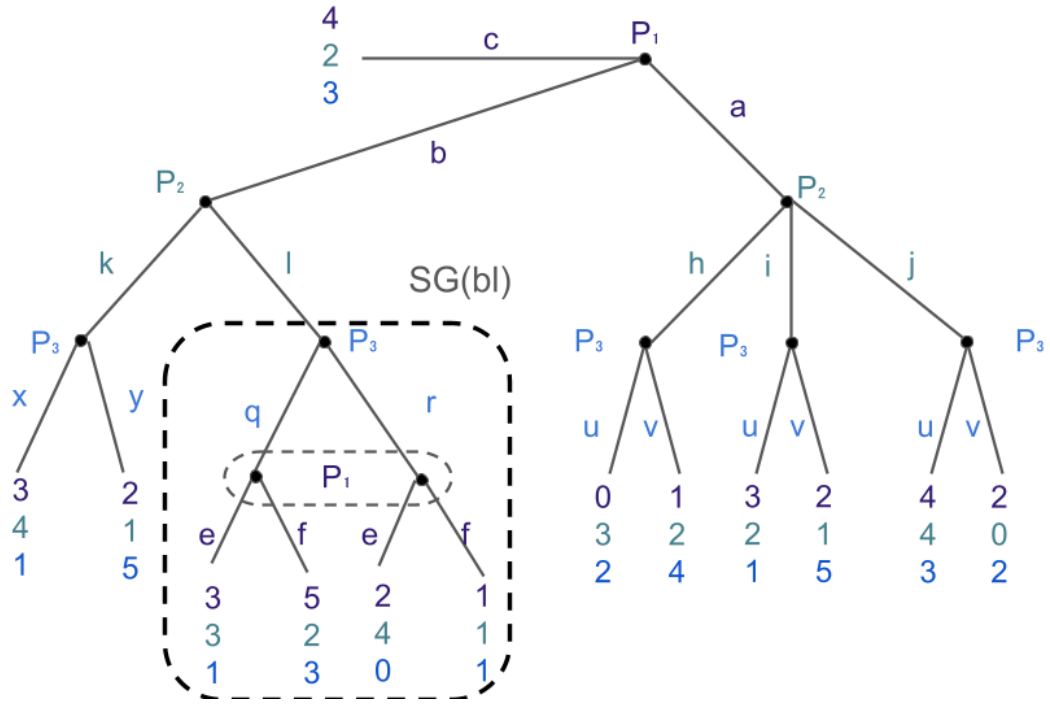
1. Eliminate v as a non-rational strategy
2. Eliminate i because it's now strictly dominated by j,l
3. Eliminate k, S.D. by l
4. Eliminate r, S.D. by t
5. Eliminate s, S.D. by t
6. Stop, no more stritcly dominated strategies

		P_2	
		j	l
P_1	q	$\underline{5}$, $\underline{10}$	4, 9
	t	4, 5	$\underline{7}$, $\underline{11}$

c) NE: $\{q, j\}$, $\{t, l\}$ These are they only pure strategy NE because we eliminated all strategies in part (a) that will never be played in any NE. We also found the intersection of either players best responses in the table from (b) which is the definition of a NE.

Question 13.

Consider the extensive form game below:



a) (4 P.) First, focus on the subgame outlined in the dashed box and labelled SG($b\ell$)[1].
Write out this sequential subgame as a normal form table.

b) (4 P.) Solve for all Nash equilibria in SG($b\ell$).

c) (4 P.) Now based on your answer above, what can you say about any subgame perfect Nash equilibria in the whole game?

d) (4 P.) Solve for all subgame perfect Nash in the entire game. Outline your work to justify your answer. If you cannot find any Nash, explain why not.

SolutionSolution 13.13.

a) Either version acceptable:

P_3 / P_1

	e	f
q	1,3	3,5
r	0,2	1,1

P_1 / P_3

	q	r
e	3,1	2,1
f	5,3	1,1

b) For subgame $b\ell$, (q,f) is the only pure strategy Nash.

c) SPE means that players are rational in every subgame. So a Nash in SG(bl) must be part of a SPE in the whole game.

d) Backwards induction:

- P_3 chooses y over x, v over u if h or i, but u over v if j. Based on argument above, only rational for them to play q if ℓ.
- Based on P_3, P_2 chooses l if b and j if a.
- Based on argument from (c), P_1 plays f if ℓ, and using previous backwards induction, they should also choose b.

SPE is {(b,f),(ℓ,j),(x,q,v,v,u)}

Question 14.

Crude oil is transported across the globe in enormous tanker ships called Very Large Crude Carriers (VLCCs). Assume that the price of new VLCCs (in millions of dollars) is determined by the function $P = 166 - Q$, where $Q = q_{Korea} + q_{Japan}$. (That is, assume that only Japan and Korea produce VLCCs, so they are a duopoly.) Assume that the cost of building each ship is \$9 million in both Korea and \$14 million in Japan. That is, $c_{Korea} = 9$, $c_{Japan} = 14$, where the per-ship cost is measured in millions of dollars.

a) (4 P.) Solve for *Korea*'s best response rule to Japan's price.

b) (4 P.) Solve for *Japan*'s best response rule to Korea's price.

c) (4 P.) Graph the best-responses with the x-axis as Korea's price and the y-axis as Japan's price.

d) (4 P.) Solve for all Nash Equilibria. Explain why they are stable.

SolutionSolution 14.14.

a) $BR_{Korea}(q_{Japan}) = \frac{166 - q_{Korea} - 9}{2} = 78.5 - 0.5q_{Korea}$

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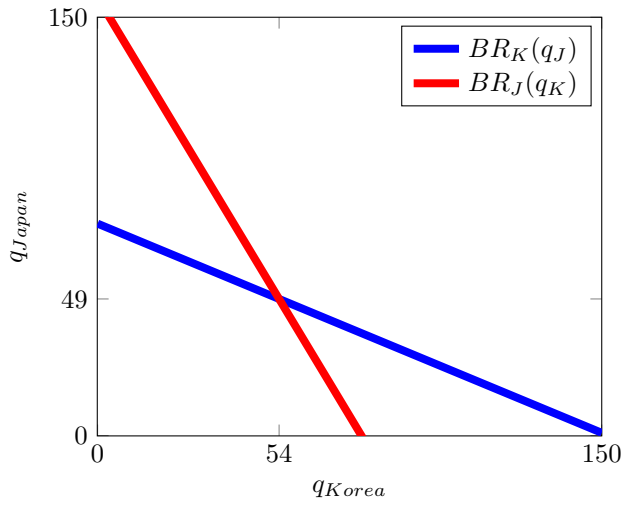
4 points if correct answer, 3 if correct setup shown in work but algebra mistakes, 2 points if incorrect answer and missing work or incorrect setup, 1 point if wrong answer and no work/justification.

b) $BR_{Japan}(q_{Korea}) = \frac{166 - q_{Japan} - 14}{2} = 76 - 0.5q_{Japan}$

c) Graph:



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4 if graph matches key. 3 if wrong but makes sense from previous work or obvious minor error. 2 if wrong but well labelled and seems plausible. 1 if unlabelled and unclear how it fits with student's work.

d) The only NE is $q_K = 54, q_J = 49$ These quantities are stable because if for example, Korea sets a lower price, they would earn less profit. Same for Japan.

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4 points if numbers are correct explained. 3 if numbers are off but match work above and well explained. 2 if wrong numbers and doesn't make sense with previous work or explanation. 1 if wrong answers with no work/explanation.