Monmouth COLLEGE

- Name: _____
- Date: _____
- Section: _____

ECON 300: Intermediate Price Theory

Problem Set #7 - Part #2: Suggested Solutions

Fall 2024

Problem 1. Battle of the Sexes

Consider two players (Players 1 and 2) interacting in a static game of complete information. Each player's actions consist of either theater (T) or ballet (B). The game is played once, and the payoffs are as follows:

- If both players choose T, player 1 receives 10 and player 2 receives 5.
- If both players choose B, player 1 receives 5 and player 2 receives 10.
- If one player chooses T, while the other chooses B, their payoffs are 0 each.

1.A Express this game in its normal form representation.

		Player 2	
		T	B
Player 1	T	10,5	0,0
	B	0,0	5,10

1.B Does either player have a dominant / dominated strategy?

No, there is no dominant / dominated strategy.

- If player 2 plays T player 1 should play T ($10 > 0$).
- If player 2 plays B player 1 should play B ($5 > 0$).
- If player 1 plays T player 2 should play T ($10 > 0$).
- If player 1 plays B player 2 should play B ($5 > 0$).

1.C Find all Nash Equilibria for this game.

The pure strategy Nash equilibria for this game are (T, T), and (B, B).

		Player 2	
		T	B
Player 1	T	10,5	0,0
	B	0,0	5,10

Problem 2. Prisoner's Dilemma

Consider two players (Players 1 and 2) interacting in a static game of complete information. Each player's actions consist of either stay silent (S) or testify (T). The game is played once, and the payoffs are as follows:

- If both players choose S, both players receive 10.
- If both players choose T, both players receive 1.
- If player 1 chooses S while player 2 chooses T, player 1 receives 0, and player 2 receives 12.
- If player 1 chooses T while player 2 chooses S, player 1 receives 12, and player 2 receives 0.

2.A Express this game in its normal form representation.

		Player 2	
		S	T
Player 1	S	10,10	0,12
	T	12,0	1,1

2.B Does either player have a dominant / dominated strategy?

Yes, for both players, T is the dominant strategy.

- If player 2 plays S player 1 should play T ($12 > 10$).
- If player 2 plays T player 1 should play T ($1 > 0$).
- If player 1 plays S player 2 should play T ($12 > 10$).
- If player 1 plays T player 2 should play T ($1 > 0$).

2.C Find all Nash Equilibria for this game.

The unique pure strategy Nash equilibrium for this game is (T, T).

		Player 2	
		S	T
Player 1	S	10,10	0,12
	T	12,0	1,1

Problem 2. Prisoner's Dilemma (continued)

Consider two players (Players 1 and 2) interacting in a static game of complete information. Each player's actions consist of either stay silent (S) or testify (T). The game is played once, and the payoffs are as follows:

- If both players choose S, both players receive 10.
- If both players choose T, both players receive 1.
- If player 1 chooses S while player 2 chooses T, player 1 receives 0, and player 2 receives 12.
- If player 1 chooses T while player 2 chooses S, player 1 receives 12, and player 2 receives 0.

2.D If this game is repeated 2 times, will the players be able to cooperate?

No.

- At the second round, there will be no incentive for both players to play S, so each player knows that cooperation will fall apart on the second round.
- Each player knows this in the first round, therefore they will behave as if the first round is the final round.
- Therefore, at the first round, there will be no incentive for either party to cooperate.

2.E If this game is repeated 100 times, will the players be able to cooperate?

No.

- At the 100th round, there will be no incentive for both players to play S, so each player knows that cooperation will fall apart on the 100th round.
- Each player knows this in the 99th round, therefore they will behave as if the 99th round is the final round.
- Therefore, there is no incentirve for either player to cooperate on the 99th round, so each player knows that cooperation will fall apart on the 99th round.
- This chain of logic repeats, and cooperation will not be attainable.

2.F If this game is repeated indefinitely, will the players be able to cooperate?

Potentially possible, but not guaranteed. Since there is no "terminal round," each player will come up with a strategy over time. If the discount factor for both individuals are not excessively high, a trigger strategy will acheive cooperation.

Problem 3. Game of Chicken

Consider two players (Players 1 and 2) interacting in a static game of complete information. Each player's actions consist of either avoid (A) or continue straight (S). The game is played once, and the payoffs are as follows:

- If both players choose A, both players receive 10.
- If both players choose S, both players receive 0.
- If player 1 chooses A while player 2 chooses S, player 1 receives 1, and player 2 receives 15.
- If player 1 chooses S while player 2 chooses A, player 1 receives 15, and player 2 receives 1.

3.A Express this game in its normal form representation.

		Player 2	
		A	S
Player 1	A	10,10	1,15
	S	15,1	0,0

3.B Does either player have a dominant / dominated strategy?

No, there is no dominant / dominated strategy.

- If player 2 plays A player 1 should play S ($15 > 10$).
- If player 2 plays S player 1 should play A ($1 > 0$).
- If player 1 plays A player 2 should play S ($15 > 10$).
- If player 1 plays S player 2 should play A ($1 > 0$).

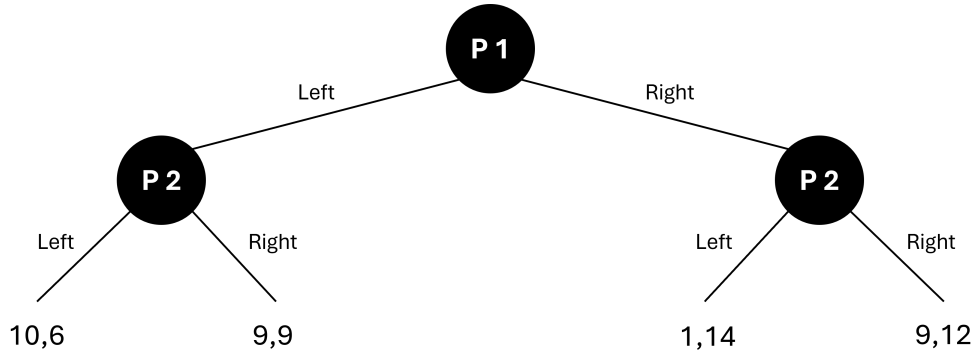
3.C Find all Nash Equilibria for this game.

The pure strategy Nash equilibria for this game are (S, A), and (A, S).

		Player 2	
		A	S
Player 1	A	10,10	1,15
	S	15,1	0,0

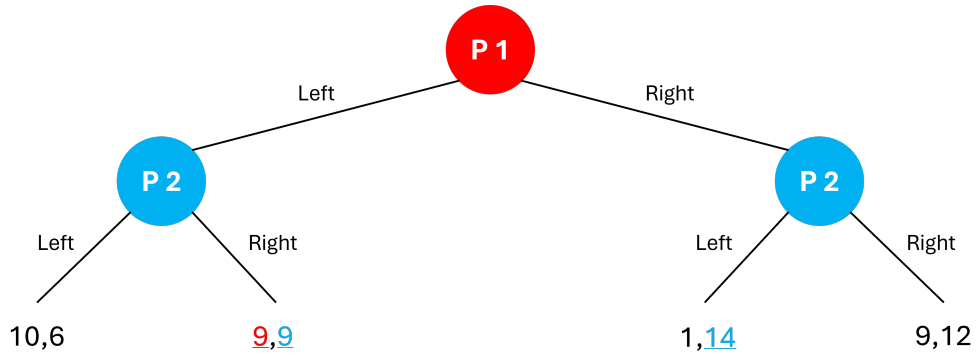
Problem 4. Dynamic Games of Complete Information

Consider two players (Players 1 and 2) interacting in a dynamic game of complete information. The extensive form of the game can be expressed as follows:



4.A Find all subgame perfect Nash Equilibria.

The unique subgame perfect Nash equilibrium for this game is (L,RL).



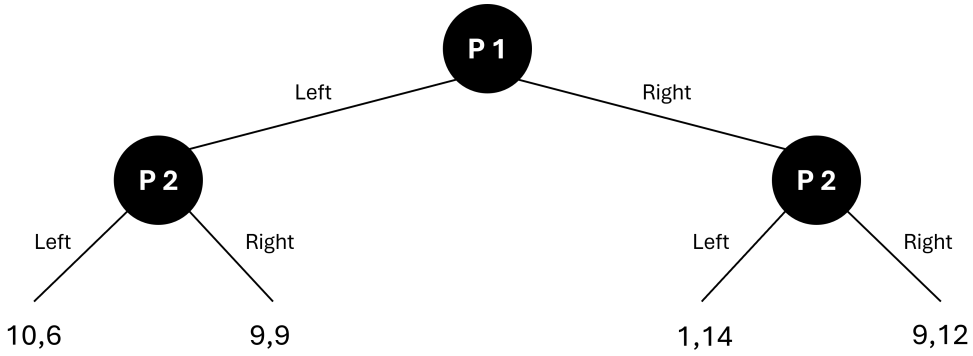
4.B Express this game in its normal form representation.

Remember that player 2's strategy must account for "what to play when in either of the nodes."

		Player 2			
		LL	LR	RL	RR
Player 1	L	10,6	10,6	9,9	9,9
	R	1,14	9,12	1,14	9,12

Problem 4. Dynamic Games of Complete Information (continued)

Consider two players (Players 1 and 2) interacting in a dynamic game of complete information. The extensive form of the game can be expressed as follows:



4.C Find all Nash Equilibria using the normal form from 4.B.

The pure strategy Nash equilibria are (L,RL) and (L,RR).

Player 1 \ Player 2	LL	LR	RL	RR
L	10,6	10,6	9,9	9,9
R	1,14	9,12	1,14	9,12

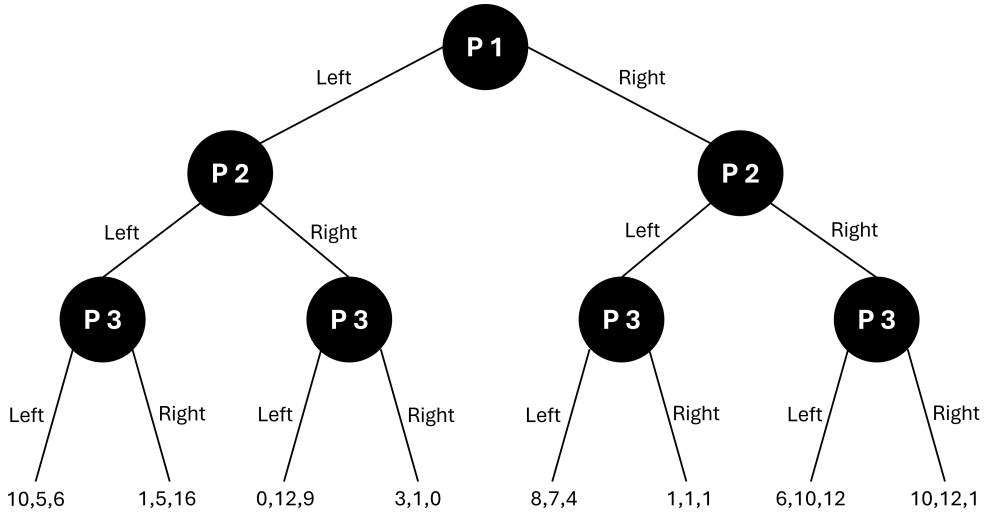
4.D Does your answer from 4.A and 4.C match? If not, why would they be different?

The Nash equlibria we get from the normal form has an additional strategy of (L, RR). However, this strategy is not in player 2's best interest, and should not be considered a valid option in the dynamic game. RR means that "whether player 1 plays L or R, player 2 will play R."

But suppose that player 1 actually plays R. If player 2 plays R at this stage, they will earn 12 as payoff, and if player 2 plays L at this stage, they would have earned 14. It is difficult to capture this sequential nature of decision making in the normal form, and therefore often leads to illogical strategies.

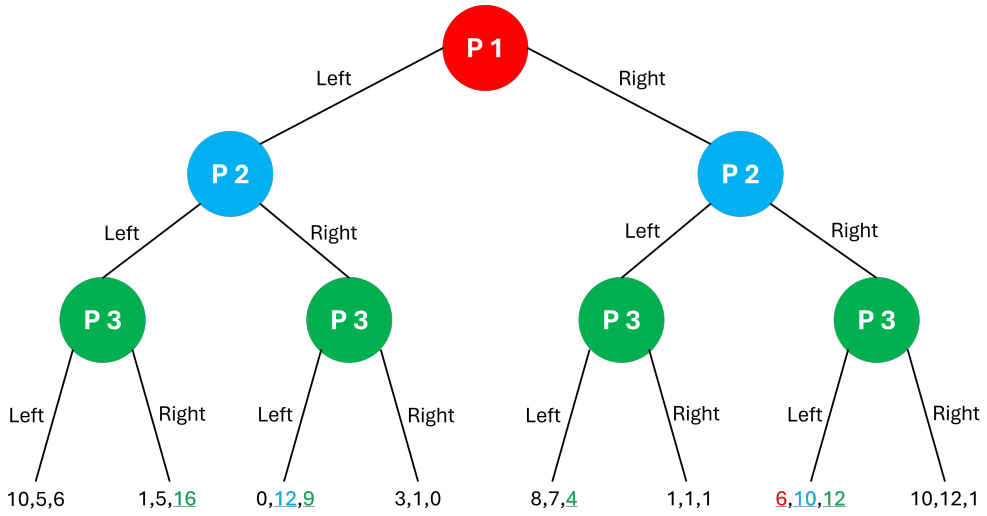
Problem 5. Dynamic Games of Complete Information with Three Players

Consider three players (Players 1, 2, and 3) interacting in a dynamic game of complete information. The extensive form of the game can be expressed as follows:



5.A Find all subgame perfect Nash Equilibria.

The unique subgame perfect Nash equilibrium for this game is (R,RL,RLLL).



- Score: _____
- Extra Credit: _____