

Module 5: "Dynamic games of incomplete information"

Lecture 29: "Dynamic Game with Incomplete Information"

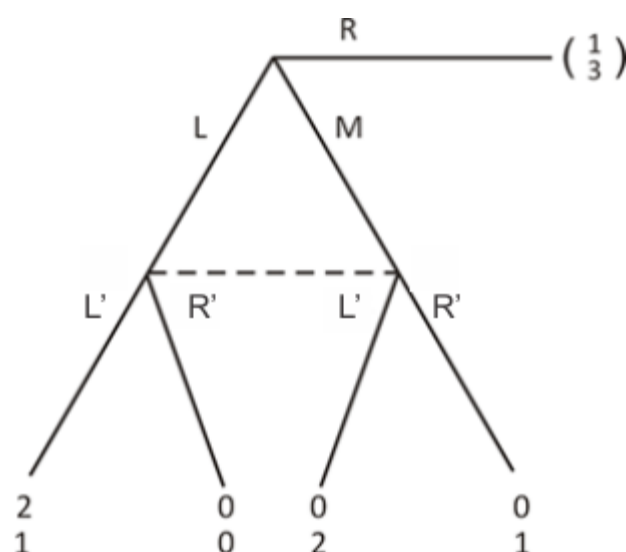
The Lecture Contains:

- Dynamic Game with Incomplete Information
- Unreasonable NE/SPNE
- PBNE : Definition

◀ Previous Next ▶

Dynamic Game with Incomplete Information**Equilibrium Concept : Perfect Bayesian Nash Equilibrium**

- A Refined Solution Concept for richer games

Example :

- Player 1 chooses among 3 actions - L, M & R
- If he/she chooses R , game ends.
- If player 1 chooses either L or M, then player 2 learns that R is not chosen but does not know which of L and M is chosen
- Here Nature reveals player 1's type to 1 but not to 2
 - player 2 therefore does not know the complete history of the game.

Module 5: "Dynamic games of incomplete information"

Lecture 29: "Dynamic Game with Incomplete Information"

Game in NFG representation & Nash Equilibrium

		Player 2	
		L'	R'
Player 1	L	2,1	0,0
	M	0,2	0,1
	R	1,3	1,3

- Two NE - (L, L') and (R, R')
- Only one subgame - the whole game itself
- Two SPNE as well

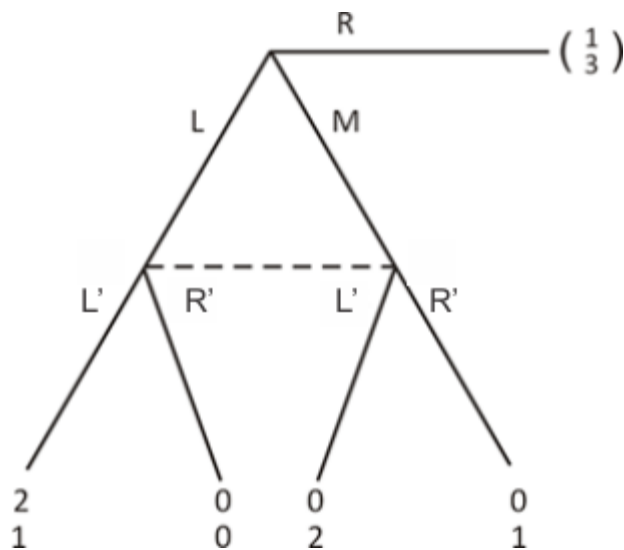
◀ Previous Next ▶

Module 5: "Dynamic games of incomplete information"

Lecture 29: "Dynamic Game with Incomplete Information"

Unreasonable NE/SPNE

(R, R') : Unreasonable/implausible equilibrium



- If player 2 gets the move, strategy R' will be strictly dominated by strategy L'
- (R, R') involves a noncredible threat
 - here player 2 is giving a threat to player 1, that in case player 1 does not play R then player 2 will play R'
 - Such a threat is noncredible because player 2 itself gets worse off by the carrying out threat

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Lecture 29: "Dynamic Game with Incomplete Information"

PBNE : Definition

PBNE rules out such unreasonable Nash Equilibrium/Subgame reflect Nash Equilibrium by considering the following requirement :

Requirement 1:

At each information Set (I-set), the player with the move must have a belief about which node in the I-set has been reached

- A belief is a probability distribution over the nodes in the I-set.

Requirement 2:-

Given their beliefs, the players strategies must be sequentially rational

i.e. at each I-set, the action taken by the player must be optimal given the players' beliefs and other players' subsequent strategies.

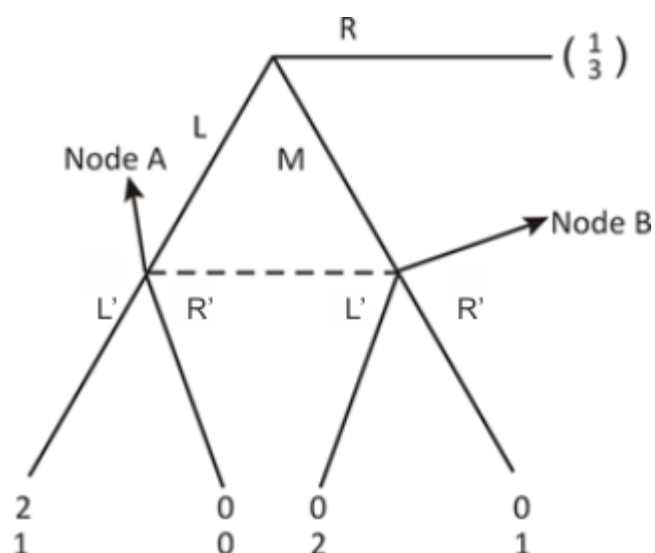
◀ Previous Next ▶

Module 5: "Dynamic games of incomplete information"

Lecture 29: "Dynamic Game with Incomplete Information"

PBNE: Definition (Contd.)

Requirement 1 & 2: Example



When the play of the game reaches the I- set of player 2, then the concerned player has a belief about whether node A or node B has been reached

Let p be the probability with which he believes that node A has been reached.[Requirement 1]

Expected payoff to player 2 from playing $R' = (1-p)$

Expected payoff to player 2 from playing $L' = p \cdot 1 + (1-p) \cdot 2$

$$= 2 - p$$

∴ Expected payoff from playing $L' >$ Expected payoff from playing R'

Hence no matter what the beliefs of player 2 are, player 2's optimal strategy is to play L' and not R' [Requirement 2]

Note: For this example, only two requirements are sufficient to rule out the implausible equilibrium (R, R')

But in general, the complete definition of PBNE has some more requirements.

The discussion will continue in the next lecture.