Strategic Games

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April 17, 2019

Abstract

This article describes the strategic games, explains a few examples and gives a few related real life scenarios.

What are strategic games?

A game is a situation where one player's rational choice affects the other player's rational choice who is the part of the same game. This leads to the payoff(outcome) of a player getting affected by the other players who are also the part of the game.

These kind of games may contain two or more than two players and every player has a set of choices to choose. A player also has a preference function which is a function of his/her choices which talk about their preference of one choice over the other. In a game as a result of their actions, they get a payoff which depends on the choices of all the players. Mathematically, we can represent payoff as a function of choices of the players.

A preference function of a player in a game also depends on the preferences of choices of other players.

What are simultaneous games?

A simultaneous game is where players make choices at once(in a parallel manner) i.e, there is no dependency in the choices. Everyone makes a choice and then gets the payoff. It is a type of strategic game.For example, prisoner's dilemma, stag hunt,etc.

Examples of strategic games

Some common examples of strategic games are discusses below:

Prisoner's Dilemma

For understanding this example, we shall consider a situation where two people are arrested by the police for a minor theft but the police actually suspect them of committing a murder but they don't have a proper evidence to prove it. So police play a game with them, they separate the prisoners and asks each one simultaneously(it is a simultaneous game) to admit that the other prisoner has committed the crime and the one who admits goes free and the other one gets 5 years of jail and they also inform them that both of them are given this opportunity. They also ask them both to confess as they both will be sentenced for 2 years of jail each. If they remain silent they will get jailed for six months for the minor theft. If they remain silent on the whole, each will get jailed for 6 months. But if one thinks the other would betray, then he would think of the choice which is better off from his individual point of view. So if he remains silent he will get 5 years of jail if the other person confesses. So a complete rational person would always choose the one which is best for him. Prisoner's dilemma is considered a case of local-global dissonance that is the choice or action considered rational locally may not be global locally. We can condense this into a matrix as in figure 1:

		Player A	
		Stay-silent	Betray
Player B	Stay-silent	(0.5,0.5)	(0,5)
	Betray	(5,0)	(2,2)

Figure 1: Prisoner's dilemma payoff matrix. First element of the tuple represents the choice of the player B and second element represents the choice of player A. 0.5 represents half a year.

Real life examples related to prisoner's dilemma:

- The government requires everyone to do pollution check frequently. If a person thinks that everyone is doing pollution check and he doesn't do it, it isn't going to affect the environment that much. So he can refrain from spending money for pollution check. Here he is obstructing the clean environment but the person is getting profit from the clean

environment and also not paying for it. If he cooperates he needs to spend money for the check.

- In summer there are power cuts to conserve the energy, but people use UPS to provide the power during a power cut. The UPS actually stores the energy when the power is been supplied and uses it when there is power cut.If a person thinks to save power and doesn't use a UPS he undergoes a loss. He is going to stay without power and delay his work, but the one who uses UPS is obstructing the conservation of power and is gaining from it. So here we think that we are benefiting from usage of UPS but if he would have not used it, he would have conserved power.But as a rational agent he thinks of the choice he would be better off. If he would have not used UPS and the others would use then he is at loss. Considering all humans as rational agents if all obstruct the conservation and use UPS they are going to pay cost for the excess use of power, also the cost of the UPS. This is not better off than saving the power.

- In a team if everyone is working and cooperative, all team members gain from it. But if one stops working, thinking that if only he doesn't work it is not going to affect the work much.The rest of the team is working then the the person who doesn't work gains from it as he is resting. The rest of team is bearing the cost of him not working so it is a loss for the rest of the team. If everyone think in the same manner and stop cooperating, then it is loss for everyone. From an individual's point of view, if they don't trust others and stop working and everyone does the same thing thinking that they could gain from it and end up not working which is a loss.

Stag hunt

In the stag hunt case, the scenario is like two hunters go out to catch meat. There are two rabbits and a stag available for them to hunt but each hunter has a chance of getting equipment belonging to only one animal. To hunt a stag they need both the hunters and stag has more meat than the two rabbits meat. To catch a rabbit a hunter is enough. So in this case they simultaneously(it is a simultaneous game) pick one of the animal to hunt i.e, they pick the equipment necessary for that animal. Suppose if one of the hunter chooses to hunt a stag and the other one chooses to hunt a rabbit, then the one which chooses the stag doesn't get any meat. But the other hunter gets both the rabbits. If both the hunters choose to hunt stag then both get benefited and get three pieces of meat on the whole. In this case, rationality of a hunter's choice depends on the trust and belief the hunter

has on the other hunter. Here the game revolves around the trust. It is different from prisoner's dilemma because it doesn't have a particular local rational choice. This can be written down in the matrix form as in figure 2:

		Player A	
		Stag	Hare
Player B	Stag	(3,3)	(0,2)
	Hare	(2,0)	(2,2)

Figure 2: Stag hunt payoff matrix

Real life examples related to stag hunt problem:

- If we consider a cricket team and all the team members work for the same goal, the payoff is really high. If one of the players is going to reach the highest number of runs in that stadium and he is playing slowly so that he wouldn't be out and could set his record he gets a enough payoff. But it would be less compared to the all team members playing with team spirit and getting a payoff for it. If he starts playing for himself and neglects the others and stays on the pitch not making enough runs then the other players should also work for themselves. As a result, due to loss of trust each one settle down to a much lower payoff.

- In the case of politicians, like MLAs(members of legislative assembly) of a government. If everyone work for the betterment of the state then the outcome or payoff is going to be enormously big. But some of the politicians are corrupted. Then the one's which are honest get less payoff as some of the funds are taken by the corrupted politicians. Then the rest also work for their own motives instead of working for the government. In this case, there should be trust and belief on the other politicians of the working government. If each one thinks about their own betterment then on the whole the payoff they get is less compared to trying for the betterment of government. So in this case they need to trust the other politicians and believe in them.

Bach or Stravinsky

Bach and Stravinsky decide on going to a date. Bach wants to go to a baseball match and Stravinsky wants to go to a dance concert. They prefer to spend the night together to go alone. They both choose simultaneously

where to go without talking to each other. If they both choose to go to baseball match Bach would be more happy as they went to his choice of place, but Stravinsky isn't as much as happy as Bach as they didn't go to her choice of place but she is better off as she is with Bach. In the same manner, if they choose to go to dance concert Stravinsky is more happy compared to Bach and Bach isn't that happy but he prefers to be with Stravinsky than to be alone. If Bach chooses to go to baseball match and Stravinsky chooses to go to dance concert they both end up spending the night alone. But they go to their respective choice of places. But if Bach chooses to go to dance concert and Stravinsky chooses to go to baseball they both end up spending night alone and not going to the place of their interest. We can represent this information in the form of matrix as in figure 3:

		Bach	
		C1	C2
Stravinsky	C1	(2,3)	(0,0)
	C2	(1,1)	(3,2)

Figure 3: Bach or Stravinsky payoff matrix.C1 represents Bach's choice that is baseball match and C2 represents Stravinsky's choice that is dance concert.

Real life examples related to Bach or Stravinsky example:

- In the colleges, generally companies would like to do a collaborative research work. The companies would like to research on a problem which is useful in their product. The colleges would like to work on an open research projects which gives the students wide range of knowledge and they could get their graduation. Both the college and company wants to work together but they couldn't decide which one to choose. If they work on the project the company wants then students graduation gets affected. If they work on the project the college is interested in, where the company has no use of working on, then their money will get wasted on the project which affects their business. So here there is conflict of interest but they prefer to work together.

- A boy wants to go abroad for his higher studies, but his father wants him to study in India. They both prefer to be with each other to being separate. They decide simultaneously where to go. If they choose to go to other country the boy is happy but the father is not as happy

as his as he is not in India. If they stay in India, father is happy but son is not as staying in India isn't his choice. If the father chooses abroad and son chooses India both are not happy as those were not there preferences and they are not together also. If they choose to go to their respective choices that is the father chooses India and the son chooses abroad. They aren't together but they go to their choice of places which is better off compared to staying separately in each others preference place.

Chicken Game

The setup of this game is like two people are riding the bicycles and are racing on a hill and they are nearing the edge of the hill, now they have to decide simultaneously if both of them continue to race where they will reach the edge of the hill, fall off the hill and die. If one of them stops, then the other declares himself winner and the greatest. He will also call the player who stopped a coward but stopping is better than dying even though it creates a negative effect on the one who stopped. If both them stop then they both are safe and there is no negative effect on the both. We can condense down this into matrix as in figure 4:

		Player A	
		Stop	Continue
Player B	Stop	(0,0)	(-2,2)
	Continue	(2,-2)	(-100,-100)

Figure 4: Chicken game payoff matrix

Real life examples related to chicken game:

- In case of a war if two countries are continuously fighting they are not stopping and countries are going to face food shortage and a number of people will die. This is complete negative effect as people are dying. If one of them stops the war they will be called cowards and the one who wins has positive effect and is called the great. If both the countries stop there is no negative effect.

- In social media two people are abusing each other and they are scolding each other. If they don't stop they are going to ruin each other. This is known as mad i.e, mutually assured destruction. One has to stop, the one who stops will be called chicken by the other. If both of them stop at once there will be no effect.

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Conclusion

This article discussed about the strategic games like prisoner's dilemma, stag hunt, Bach or Stravinsky and chicken game. These strategic games can be related to many real life problems and can be used to analyze the issues.

References:

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