

## The prisoner's dilemma

Let's say that two persons A and B committed a crime together, and were arrested. So, the police interrogate them. What is a good strategy for the police to obtain cooperation from the criminals? The police suggest the following. If any of them cooperates, while the other doesn't cooperate, the one who cooperates does not get any sentence in prison, and the other one gets 9 years in prison. If none of them cooperates, each serves in prison for 1 year. If both cooperate, both serve in prison for 7 years.

Given this, what would each criminal think that he should do? See the table below.

	A cooperates with police	A doesn't cooperate with police
B cooperates with police	A: 7 years B: 7 years	A: 9 years B: 0 years
B doesn't cooperate with police	A: 0 years B: 9 years	A: 1 year B: 1 year

Table 1: Prisoner's dilemma

Let's see from the point of view of A. There are two cases: B cooperating with the police, or not cooperating. If B cooperates with police, it's better for A to cooperate with police because he gets 7 years himself if he cooperates with the police, while he gets 9 years if he doesn't cooperate. If B doesn't cooperate with the police, it's also better for A to cooperate with the police, because he gets 0 years if he cooperates, while he gets 1 year if he doesn't cooperate. So, A will conclude that he should cooperate.

Similarly, B will consider the two cases, i.e., the case in which A cooperates with the police and the case in which A doesn't cooperate with the police, and conclude that he also should cooperate with the police.

Thus, both A and B will cooperate with the police, and voila, each of them will get 7 years in prison. If they simply choose not to cooperate with the police, they will only get 1 year each! In other words, they will be better off! So, this is a dilemma. Each criminal chooses what he thinks is the best for himself, but the end result is much worse than the case in which each of them chooses what is better for himself.

How about if the two criminals were close friends or a married couple, and do not want to betray the other, because each of them does not want his partner to serve long in prison? Surely, he would feel bad about being set free for betrayal while his partner would have to serve long in prison. Then, each of them would not cooperate with the

police, and each of them will get only 1 year in prison. In other words, in such a case, the criminals will cooperate with each other rather than with the police.

You may think that this is just a fictional example which we may never encounter in our lives. Yes, indeed. Actually, I am not sure whether this is the strategy police uses, but similar examples are all around in our society.

Let me give you some real examples. Two Korean companies competed fiercely to get a construction project in Libya. Each company cut its bidding price so that the Libyan government could choose their company. I do not remember the exact number, which I read in a newspaper decades ago, so let me invent the numbers. See the table below. I wrote how much money each company will get. For a simple analysis, let's assume that the Libyan government chooses the lowest bid, and when the bids are the same, they choose one of them with 50 % of chance. So, if a certain company gets the project with 50% chance, I just wrote half of the amount of the money that would be offered.

	A bids \$ 300 million	A bids \$ 400 million
B bids \$ 300 million	A: \$ 150 million B: \$ 150 million	A: \$ 0                      B: \$ 300 million
B bids \$ 400 million	A: \$ 300 million B: \$ 0	A: \$ 200 million B: \$ 200 million

Table 2: Bid by Korean companies for a Libyan construction project

Now, we can analyze what each company should do from its own point of view, as we did for the prisoner's dilemma. The analysis is exactly the same. Each company will conclude that bidding for a lower amount of money is good for them, just as each criminal will conclude that cooperating with the police is better for him.

Now, recall that in our earlier example of prisoner's dilemma, we saw that the criminals' decisions change if they choose to cooperate with each other. If they cooperate with each other, they only get 2 years in prison in total.

A similar thing can happen in this case too. If the two Korean companies cooperated with each other and promised each other not to bid a low price, but to bid a high price, they would be better off, if we count the total amount of money they will get. In the former case, they will get \$ 300 million, and in the latter case, they will get \$ 400 million. In other words, if they bid high together, the Libyan government does not have an option to pay a low price for its construction project and is forced to pay a high price.

In this situation, what would the Korean government do? From the perspective of the Korean government, it doesn't really matter which company gets the project as long as it is Korean. As the most competent candidates in this project were Korean companies, and it was unlikely that any companies other than the Korean ones get

the project, the Korean government actually tried to dissuade the two companies from cutting their bidding prices.

I do not remember reading whether the Korean government's dissuasion was successful or not. If any of you know what happened, let me know.

Anyhow, sometimes companies do succeed in cooperating in such a manner. From 1999 to 2008, Korean Airlines and Asiana Airlines offered domestic routes at prices no more different than 500 won (500 won is approximately 40 US cents). When they raised their prices, they did almost at the same time, within the difference of less than month [1]. Such cooperation is called "collusion" and illegal in many countries, including South Korea and the United States. In 2010, Korean Airlines had to pay 48.742 billion won, and Asiana Airlines 20.66 billion won as fine for collusion [2].

Why is collusion illegal? It's because the customers cannot use the product or the service of providers at a lower price. Actually, if you take an intro economic class, you will learn that the gain of the companies when they collude is less than the loss of customers due to the higher price they have to pay. In other words, when things are considered all together, it is a loss. However, some company owners insist that the collusion should be legalized, because this loss is small, and we would spend more money in investigating the collusion.

So far, we have seen examples in which two companies are concerned, i.e., the two construction companies and the two airlines, but sometimes collusion of multiple entities happens as well.

A good example is OPEC (The Organization of the Petroleum Exporting Countries). OPEC has 13 nations as its members. If the member countries decrease the production of petroleum, the price will soar, which will make the member countries earn more money. This will happen when the cooperation between the member countries works well. However, for each member country, there is a strong temptation not to decrease the production of petroleum. If a certain member country increases the production of petroleum, while the other countries decrease the production of petroleum more than this member country increases, this member country will be able to sell the petroleum at a high price (because the total production has decreased) with a large amount. In prisoner's dilemma, it's just like you betray your partner and are released from prison. As this temptation is large, and each member state wants to increase the production of petroleum, while it wants the others to decrease, it is not easy to make an agreement between member countries, and it is not easy to decide the production quota. Should a big country with a lot of facilities have a high quota? Should a country in an economic crisis have a high quota? Each member country has its own argument. And what if the negotiation fails, and some member countries decide to quit OPEC? Indeed, there are some petroleum producing countries which are not members of OPEC.

Indeed, cooperation is not easy, and the temptation for betrayal is high. Another example. When I tried to get a room to study in Seoul, the landlord said that she could offer a room at a low price, but I should not tell anyone else that she was offering a room at this rate. Apparently, she wanted to betray other landlords, but she didn't want them to know because she would be in trouble. I later learned that I was eligible to live in a dormitory, and I ended up living in a dormitory.

## References

[1] <http://www.jejusori.net/news/articleView.html?idxno=53767>

[2] <https://www.asiae.co.kr/article/2010052710122008140>