**How game theory affects your everyday life**

[1] Should women be ***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ m\_\_\_\_\_\_\_\_\_\_\_\_\_***? Do you need to find an internship for this summer? Should your country limit its CO2 ***\_\_\_\_\_\_\_\_\_\_\_\_\_***to ***\_\_\_\_\_\_\_\_\_\_\_\_\_global \_\_\_\_\_\_\_\_\_\_\_\_\_?*** If you can't see the link between these questions, don't worry, you soon will.

[2] Game theory is everywhere, and you do not have to be an economist to understand its most i***\_\_\_\_\_\_\_\_\_\_\_\_\_***aspects. In the game theory, there's a fundamental concept — ***Nash \_\_\_\_\_\_\_\_\_\_\_\_\_*** (named after the economist John Nash). What is it then? And how is it applied in the real world?

[3] ***The definition*** of Nash equilibrium is ***\_\_\_\_\_\_\_\_\_\_\_\_\_***: It is a situation in which all people are using a Nash strategy. What is a Nash strategy? Simply the aim of doing what is best for yourself, ***taking as a \_\_\_\_\_\_\_\_\_\_\_\_\_***what others around you are doing. In economic terms, you are "best responding" to other people's actions ***in a purely \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ way.*** For example, if there were two ***\_\_\_\_\_\_\_\_\_\_\_\_\_stores*** right next to your house, your Nash strategy when buying milk in the morning would be to go to the cheaper store, given each store's price. And similarly, the Nash strategy for the storekeeper would be to price their milk just below their ***\_\_\_\_\_\_\_\_\_\_\_\_\_***in order to attract you.

[4] ***So far so \_\_\_\_\_\_\_\_\_\_\_\_\_,*** but you may wonder how this leads to anything insightful. This is where the prisoner's dilemma ***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*** In A Beautiful Mind, a movie inspired by John Nash's life story, Russell Crowe ***\_\_\_\_\_\_\_\_\_\_\_\_\_ this \_\_\_\_\_\_\_\_\_\_\_\_\_ quote***: "Adam Smith was wrong!" What is meant by this? Well, in ***\_\_\_\_\_\_\_\_\_\_\_\_\_ economic theory***, Adam Smith stated that individuals, by pursuing their own interests, were ***\_\_\_\_\_\_\_\_\_\_\_\_\_the c\_\_\_\_\_\_\_\_\_\_\_\_\_\_w\_\_\_\_\_\_\_\_\_\_\_\_***of society as a whole, a notion that developed throughout t***he \_\_\_\_\_\_\_\_\_\_\_\_\_of an "\_\_\_\_\_\_\_\_\_\_\_\_\_hand***." The beauty of Nash equilibrium is precisely that it shows ***how acting rationally*** from an individual's point of view can lead to ***\_\_\_\_\_\_\_\_\_\_\_\_\_ \_u \_\_\_\_\_\_\_\_\_\_\_\_ (or even disastrous) outcomes.***

[5] To ***\_\_\_\_\_\_\_\_\_\_*** this, we use the extremely famous example of the prisoner's dilemma. Imagine two ***\_\_\_\_\_\_\_\_\_\_*** who are being accused of ***\_\_\_\_\_\_\_\_\_\_*** by the police. The police have no evidence but decide to take both burglars to separate rooms and give them the chance to ***\_\_\_\_\_\_\_\_\_\_ to their crime.*** They cannot communicate with each other in order to decide whether to confess or not. Each of the burglars knows the following: a) If both of them confess, they each get 5 years of prison; b) If none of them confesses, they each get 1 year of prison; c) If one of them confesses and the other does not, the confessor gets 0 year of prison (***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*** is ***\_\_\_\_\_\_\_\_\_\_*** by the police) and the non-confessor gets 10 years of prison (he ***\_\_\_\_\_\_\_\_\_\_ for*** the entire crime).

[6] Clearly in this situation, ***the c\_\_\_\_\_\_\_\_\_\_ o\_\_\_\_\_\_\_\_\_\_ o\_\_\_\_\_\_\_\_\_\_*** for burglars is for nobody to confess, so that they each get only 1 year of prison. However, will this outcome be ***a\_\_\_\_\_\_\_\_\_\_ a***s predicted by classical theory? Put yourself in the burglars' position when they decide whether to confess or not: If the other burglar confessed, your ***s\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_***  is to do the same, to get 5 instead of 10 years of prison. If the other burglar did not confess, your self-interest is to do the opposite, to get 0 instead of 1 year of prison.

[7] We conclude that no matter what the other burglar does, your ***\_\_\_\_\_\_\_\_\_\_ r\_\_\_\_\_\_\_\_\_\_ i***s to confess. Since both burglars ***r\_\_\_\_\_\_\_\_\_\_ in the same way***, they will both ***\_\_\_\_\_\_\_\_\_\_ up confessing***, which leads to the Nash equilibrium: Both burglars confess no matter what the other burglar does, and they both end up getting 5 years of prison, even though this is not the collectively optimal outcome for them. Both of them would in fact be ***bett\_\_\_\_\_\_\_\_\_\_ er off*** if they agreed not to confess, but their ***personal \_\_\_\_\_\_\_\_\_\_ make this agreement \_\_\_\_\_\_\_\_\_\_***.

[8] The reason why this example is so famous is that it relates to many ***\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_ phenomena*** in which ***\_\_\_\_\_\_\_\_\_\_ behaviors*** lead to negative outcomes for society. In sports, all professional athletes would be better off if no one used ***p\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_ drugs***. The problem is that when no one uses these drugs, an individual athlete might be ***\_\_\_\_\_\_\_\_\_\_*** to use them in order to perform better than everyone else (the ***e\_\_\_\_\_\_\_\_\_\_***  of confessing when the other burglar does not in the prisoner's dilemma). This then leads many other athletes to consume performance-enhancing drugs, and any athlete who decides not to consume these drugs would ***suffer from a \_m\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_c\_\_\_\_\_\_\_ d\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.***

[9] This also applies to environmental policies regarding CO2 emissions. The world as a whole needs to stop climate change, but each country ***i\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*** has an economic interest in emitting CO2 for their industrial production, which leads to ***g\_\_\_\_\_ i\_\_\_\_\_\_\_\_\_\_***. You can think by yourself about the other examples I introduced: women having to put on makeup because everyone else does, students looking for internships because everyone else will have one to show on their CV. Examples are ***\_\_\_\_\_\_\_\_\_\_***, and sometimes they ***e\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ i\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*** that are extremely frustrating to economists.

[10] The concept of Nash equilibrium allows us to understand why some society issues require particular forms of intervention if we want to reach ***d\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*** outcomes. ***L\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ b\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ agreements*** and communication are generally the way to overcome the problem caused by ***personal i\_\_\_\_\_\_\_\_\_\_*** in situations such as global warming. Of course, ***this is much easier \_\_\_\_\_\_\_\_\_\_than done*** in a ***g\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_of economic c\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*** where no country wants to go first in depriving themselves of polluting for production.

答案：

**How game theory affects your everyday life**

[1] Should women be ***wearing makeup***? Do you need to find an internship for this summer? Should your country limit its CO2 ***emissions*** to ***fight global warming?*** If you can't see the link between these questions, don't worry, you soon will.

[2] Game theory is everywhere, and you do not have to be an economist to understand its most ***insightful*** aspects. In the game theory, there's a fundamental concept — ***Nash equilibrium*** (named after the economist John Nash). What is it then? And how is it applied in the real world?

[3] ***The definition*** of Nash equilibrium is ***straightforward***: It is a situation in which all people are using a Nash strategy. What is a Nash strategy? Simply the aim of doing what is best for yourself, ***taking as a given*** what others around you are doing. In economic terms, you are "best responding" to other people's actions ***in a purely individual and self-interested way.*** For example, if there were two ***convenience stores*** right next to your house, your Nash strategy when buying milk in the morning would be to go to the cheaper store, given each store's price. And similarly, the Nash strategy for the storekeeper would be to price their milk just below their ***competitor*** in order to attract you.

[4] ***So far so simple,*** but you may wonder how this leads to anything insightful. This is where the prisoner's dilemma ***comes in.*** In A Beautiful Mind, a movie inspired by John Nash's life story, Russell Crowe ***pronounces this memorable quote***: "Adam Smith was wrong!" What is meant by this? Well, in ***classical economic theory***, Adam Smith stated that individuals, by pursuing their own interests, were ***maximising the collective welfare*** of society as a whole, a notion that developed throughout t***he allegory of an "invisible hand***." The beauty of Nash equilibrium is precisely that it shows ***how acting rationally*** from an individual's point of view can lead to ***collectively undesirable (or even disastrous) outcomes.***

[5] To ***illustrate*** this, we use the extremely famous example of the prisoner's dilemma. Imagine two ***burglars*** who are being accused of ***robbery*** by the police. The police have no evidence but decide to take both burglars to separate rooms and give them the chance to ***confess to their crime.*** They cannot communicate with each other in order to decide whether to confess or not. Each of the burglars knows the following: a) If both of them confess, they each get 5 years of prison; b) If none of them confesses, they each get 1 year of prison; c) If one of them confesses and the other does not, the confessor gets 0 year of prison (***collaboration*** is ***rewarded*** by the police) and the non-confessor gets 10 years of prison (he ***pays for*** the entire crime).

[6] Clearly in this situation, ***the collectively optimal outcome*** for burglars is for nobody to confess, so that they each get only 1 year of prison. However, will this outcome be ***attained a***s predicted by classical theory? Put yourself in the burglars' position when they decide whether to confess or not: If the other burglar confessed, your ***self-interest*** is to do the same, to get 5 instead of 10 years of prison. If the other burglar did not confess, your self-interest is to do the opposite, to get 0 instead of 1 year of prison.

[7] We conclude that no matter what the other burglar does, your ***best response i***s to confess. Since both burglars ***reason in the same way***, they will both ***end up confessing***, which leads to the Nash equilibrium: Both burglars confess no matter what the other burglar does, and they both end up getting 5 years of prison, even though this is not the collectively optimal outcome for them. Both of them would in fact be ***better off*** if they agreed not to confess, but their ***personal temptations make this agreement infeasible***.

[8] The reason why this example is so famous is that it relates to many ***real-life phenomena*** in which ***individualistic behaviors*** lead to negative outcomes for society. In sports, all professional athletes would be better off if no one used ***performance-enhancing drugs***. The problem is that when no one uses these drugs, an individual athlete might be ***tempted*** to use them in order to perform better than everyone else (the ***equivalent*** of confessing when the other burglar does not in the prisoner's dilemma). This then leads many other athletes to consume performance-enhancing drugs, and any athlete who decides not to consume these drugs would ***suffer from a major comparative disadvantage.***

[9] This also applies to environmental policies regarding CO2 emissions. The world as a whole needs to stop climate change, but each country ***individually*** has an economic interest in emitting CO2 for their industrial production, which leads to ***global inaction***. You can think by yourself about the other examples I introduced: women having to put on makeup because everyone else does, students looking for internships because everyone else will have one to show on their CV. Examples are ***everywhere***, and sometimes they ***entail inefficiencies*** that are extremely frustrating to economists.

[10] The concept of Nash equilibrium allows us to understand why some society issues require particular forms of intervention if we want to reach ***desirable*** outcomes. ***Legally binding agreements*** and communication are generally the way to overcome the problem caused by ***personal incentives*** in situations such as global warming. Of course, ***this is much easier said than done*** in a ***global context of economic competition*** where no country wants to go first in depriving themselves of polluting for production.