

Analysis on Online Shopping Under Prisoner's Dilemma

Roger Li

Beijing No.101 High School, Haidian District, Beijing, 100091 China
Email: drewroger@sina.com

ABSTRACT

Prisoner's Dilemma refers to the situation where different individual decision makers always have an incentive to choose the way that creates a less than optimal outcome for the other individual. Online shopping is one of the situations that involves Prisoner's Dilemma. Thus, analyzing and understanding the real-life situation of Prisoner's Dilemma in online shopping and giving advises to online sellers according to the analysis of the online credibility is extremely important. That is why this study is conducted in the first place. By now, the main cause of the dilemma in online shopping is that both the consumer and the seller have the tendency to betray the transaction and to gain the maximum profits for themselves after establishing a dilemma table and analyzing the choices of buyers and sellers. Since Prisoner's Dilemma is discovered to exert negative effect on both side of the deal, general advises for sellers to establish credibility have been proposed in this paper, including spreading out the signals that shows their reliability.

Keywords: Prisoner's Dilemma, online shopping, temptation of betrayal, credibility in online shopping, advises for online sellers

1. INTRODUCTION

Along with the advance of technology, shopping online has already become a trend for people since it provides convenience for both the consumers and sellers. It is indeed a time-saving and energy-saving way of shopping, which provides a huge benefit for people who doesn't have enough spare time to shop in physical stores. However, in the increasingly sophisticated e-commerce environment today, the phenomena of online cheating and selling low-quality products have occurred [4]. This paper aims to stress the basic principle and reasons of the existence of credibility problem according to the basic theory of Prisoner's Dilemma, and give simple advises to online sellers how to build up reliability.

1.1. The Concept of the Prisoner's Dilemma

The prisoner's dilemma is a paradox in decision-making analysis in which two individual decision-makers or entities behaving in their self-interests or other incentives to choose in a way that does not produce the optimal consequence. "The typical prisoner's dilemma is set up in such a way that both parties choose to protect themselves at the expense of the other participant" [3]. As a result, both participants discover themselves end up with a worse state than if they had decided to cooperate in the decision-making process. The prisoner's dilemma is one of the most well-known concepts in modern game theory. "This interdependence causes each player to consider the other player's possible decisions, or strategies, in formulating his strategy"[2]. Game theory investigates the best strategy for each participant to adopt to maximize the payoff.

1.2. The Origin of the Prisoner's Dilemma

The prisoner's dilemma illustrates a situation that two parties, separated and unable to communicate with each other, must choose between either co-operating with the other or not. The origin of the prisoner's dilemma is that there are two suspects, who were charged as bank robbers, have been arrested and are being interrogated in separate rooms. The authorities couldn't obtain the information from any other witnesses, and they can only verify the case if they can convince at least one of the suspects to betray his co-conspirator and testify to the crime. Each bank robber is faced with the choice to either cooperate with his co-conspirator and keep silent or to defect from the gang and testify for the prosecution. If they both decide to co-operate and remain silent, the authorities will only be able to convict the suspects on a lesser charge, which means only one year in jail each. If one of them testifies and the other does not, the one who testifies will be free and the other will get three-year imprisonment. However, if both testify against the other, both of them will get two years in jail for being partly participated in a robbery. In this case, the result of the prisoner's dilemma is clear that each robber will always have an incentive to defect, regardless of the choice of the other. As a result, both suspects can minimize their total sentence time if both of the robbers decide to cooperate, resulting in only 2 years in total, but the incentives that they each face individually will always impel each of them to betray the other and end up jailing the maximum time between the two of them of 4 years total. Two suspects have entered a miserable dilemma that there is a substantial possibility for both of them to end up with a desirable consequence, but the result is a mutual disadvantage for each of the suspects. This inevitable result is called "Nash Equilibrium." The

experiment of a prisoner's dilemma reflects the reality that individual rationality can sometimes lead to collective irrationality.

1.3. Prisoner's Dilemma in Online Shopping

Online shopping requires basic interaction between the consumers and the industry of e-commerce. However, some consumers often complain about the fact that they are receiving fake or low-quality products, so they are trying to either receive a normal good or to pay a low price. Assuming that there is a consumer who wants to purchase a commodity in an online shopping platform, such as Taobao, Jingdong, or Amazon. The quality of this commodity can be classified in quality into two different kinds, namely high-quality and low-quality. However, the consumers won't be able to determine and inspect the quality of this commodity since they purchase this commodity online. Although the online seller has indicated the quality level of his/her product, the consumers still won't be able to tell whether the producer is telling the truth or not. At the same time, the item can be purchased at two different prices, namely a high price and a low price. As a result, the situation can be divided into four different consequences: High price with high quality, high price with low quality, low price with high quality, and low price with low quality [5]. Such a situation exactly resembles the characteristic of the Prisoner's Dilemma. As a result, the following table is established to analyze the circumstance.

Table 1 Prisoner's Dilemma between buyers and sellers

	Seller provides a high-quality product	Seller provides a low-quality product
Buyer pays a high price	The seller earns \$10 Buyer earns \$10	The seller earns \$15 Buyer earns \$-5
Buyer pays a low price	The seller earns \$-5 Buyer earns \$15	The seller earns \$7 Buyer earn \$7

1.4. Analysis of Buyer and Seller under Prisoner's Dilemma Model

1.4.1. Dominant strategy for the buyer

The return of the purchase of the consumer can be expressed in terms of the monetary value: if the consumer pays a high price for a high-quality product, the total return for the consumer is \$10; if the consumer pays a low price for a high-quality product, the total return for the consumer is \$15; if the consumer pays a high price for a low-quality

product, the total return for the consumer is \$-5; if the consumer pays a low price for a low-quality product, the total return for the consumer is \$7.

As a result, the most beneficial and profitable way for the buyer to operate in this dilemma is to pay the low price regardless of the quality of the goods provided by the seller. Therefore, according to the analysis above, it may convincingly conclude that the dominant strategy for the buyer is to pay a low price.

1.4.2. Dominant strategy for the sellers

The profit for the seller also can be demonstrated by the monetary value and be attributed into four different consequences: if the seller provides a high-quality product to a high-price payer, the total profit for the seller is \$10; if the seller provides a low-quality product to a high-price payer, the total profit for the seller is \$15; if the seller provides a high-quality product to a low-price payer, the total profit for the seller is \$-5; if the seller provides a low-quality product to a low-price payer, the total profit for the seller is \$7. The analysis of the seller's operation during the dilemma can be concluded that the most profitable choice for the seller is to provide low-quality products to the buyers, so the dominant strategy for the seller is providing products in low-quality.

1.5. Temptation of Betraying between the Two Parties

In conclusion, the buyer will always be more cost-efficient if he/she chooses to pay less regardless of the seller's choice. On the other hand, the seller will always be better off if he/she provides a low-quality product to the buyer regardless of the price paid by the buyer. This is a typical representative case of prisoner's dilemma that takes place between customers and producers, which perfectly illuminates the principle of game theory that there is a possibility for both of the buyer and seller to end up with a mutual-beneficial return, but the outcome of the game seems to be bound to be worse for both sides of the game. Prisoner's dilemma can be regarded as a static game that if the basic condition of the game can be altered, the participants can steer out of the dilemma and thus change the final result toward their expectations. Admittedly, if both participants have an opportunity to communicate and consult with each other about their actions and keep their promises, they might be able to embrace a better consequence. However, there are still question marks over the creating of trusts within both sides of the participants. Can they resist the temptation of betraying the other? After all, betrayal can lead to a better outcome. This is the moment in which credibility becomes extremely important.

1.6. The Importance of Credibility in Online Shopping

The fact that credibility is of vital importance to a seller's reputation is hardly a surprise. At the same time, the reputation of an online store can originate credibility. "When you establish credibility, your clients, customers, and peers respect you, vouch for you, and continue to use your business because they feel connected to what you say, do, and stand for" [1]. As a result, no one would deny the fact that the importance of reputation to the survival of an online store should never be overlooked. If an online store can gain a high reputation from its credibility, and thus guarantee the quality of its products to the customers, getting out of the dilemma is around the corner. Credibility can also come from the following consequences. For instance, if the rule in a criminal gang is to kill the one who betrays the associates, members in this gang will live up to their promises because the outcome for a member to betray the group is extremely heavy. In this extreme case, cooperation will become reliable and credible. As for online shopping, if the seller will be timely punished for selling low-quality product at an overly high price, such as compulsory shut, the seller would not choose to betray the deal in the first place. On the other hand, if the game between two participants is not a one-off but repetitive intercourse, the calculation of both participants will change since one of them is constantly losing money. As a consequence, one of the participants, especially the sellers, may decide to get taken advantage of by the other several times to show sincerity and credibility, so both participants will be more likely to reach a long-term cooperative relationship, avoiding the situation of a persistent dilemma. Therefore, as for online sellers, one of the most important factors that influence the final success in e-commerce platforms is to send out a proper signal that shows the credibility of the products, yielding the best result for both participants.

1.7. Advise for Online Sellers

Sending out signals is crucial for sellers if they want to build up their reputations and credibility, so they need to come up with the channels and methods to spread out their signals. Also, one of the obstacles faced by sellers is the complexity of the evaluation of their products by the consumers. Therefore, as for the quality and effect of a specific product, the more difficult it is for buyers to assess and evaluate before their purchase, the more important it is for sellers to send out the signals in time. The example of perfume can be an appropriate demonstration of this analysis. As for a perfume producer, no matter how many adjectives are used to describe the product, the costumers still can't tell what it smells like, so perfume producers prefer to offer free samples to attract customers, which is difficult for online producers to imitate. Therefore, the situation faced by online producers to advertise the

products to the public to gain public interest and reliance causes the most severe difficulty to the sellers.

2. CONCLUSION

Business is a mystery, and perhaps its essence is a secret that will never be known. The interaction between producers and customers contains a variety of obstacles, including the prisoner's dilemma. What the participants who get involved in such a dilemma can do is to open themselves up to new knowledge, which leads to new perspectives, new analyses, new insights, and new ideas, guiding or reserving the outcome towards mutual-benefit. Producers and buyers employ the quality of production and the price they pay as weapons to countermove regarding the strategy of the opponent. During the interaction, different calculations and considerations will yield different outcomes, causing different obstacles for both of the participants. For sellers, credibility is an essential factor that affects online sellers' performance and sales during the purchasing process. However, it is extremely difficult for e-commerce producers to convince the buyers that their products are reliable and trustworthy through literal and verbal advertisement. However, the specific real-world examples of Prisoner's Dilemma in online shopping are not given in this article. As a result, more investigations and surveys are required to give further evidence. When a specific example can be applied into the article, the importance of credibility in online shopping can be interpreted more profoundly, and thus make a change of the online shopping environment.

ACKNOWLEDGMENT

First and foremost, I would like to show my deepest gratitude to my teachers in my high school, who have taught me the basic concept of the game theory and the Prisoner's Dilemma and also provided me with valuable guidance in every stage of my paper. Further, I would like to thank all my friends and classmates for supporting and encouraging me. I couldn't complete this thesis without their enlightening instructions.

REFERENCES

- [1] Aguilar, T. (2017). Importance of Credibility: Brand Awareness, Trust. <https://aguilarpr.com/importance-of-credibility/>
- [2] Brams, S., & Davis, M. (2020). Game theory. <https://www.britannica.com/science/game-theory>

[3] Chappelow, J. (2020, January 29). Prisoner's Dilemma Definition. <https://www.investopedia.com/terms/p/prisoners-dilemma.asp>

[4] Dorothee Honhon, Kyle Hyndman. Flexibility and Reputation in Repeated Prisoner's Dilemma Games. 2020

[5] Baozhuang Niu, Jingmai Wang, Carman K. M. Lee, et al. "Product + logistics" bundling sale and co-delivery in cross-border e-commerce. 2019, 19(4):915-941.