

Analysis of E-Commerce Sales under Repeated Game

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Abstract: Under the background of continuous and rapid development of e-commerce, this paper applies the theory of repeated game to analyze the establishment and maintenance of transaction relationship between e-stores and consumers. While consumers pursue the maximum utility value of products, enterprises pursue the maximum profit, which leads to the separation and equilibrium in the transaction process. The paper explores ways to safeguard the benefit of consumers and maximize the long-term profits of stores by establishing a profit function.

Keywords: Repeated Games; E-Commerce; Asymmetric Information

1. Introduction

Developed in the mobile Internet as the carrier of various information technologies and business models have changed the form of market economy, such as big data, internet+ and e-commerce, which can provide information and platform support for enterprises' production and manufacturing, logistics transportation, marketing, research and development and innovation, human management, scientific decision-making and other aspects of work, greatly broadening the channels for enterprises to participate in market competition, and saving enterprises' manpower, capital and time costs. Under the impact of the COVID-19 epidemic, the e-commerce sales model has gradually replaced the traditional sales model as the mainstream. However, there are still some problems in China's network security system, consumers may suffer unnecessary losses in conducting e-commerce transactions. In this context, the sales of e-commerce which based on repeated games is analyzed in order to provide certain suggestions and help for e-commerce enterprises to seek long-term development.

2. Relevant Theories

2.1 Electronic commerce

E-commerce is a business activity with which takes information network technology as the method and takes product exchange as the center, which is the informatization of all links in traditional business activities.

2.2 Repeated games

Repeated games are the repetition of basic games. In view of the influence constraints of future benefit and long-term total benefit, the decision-making behavior and game results of repeated games are usually different from one-time games.

Under repeated games, the players must consider the future and long-term benefit, which will restrict the players' behaviors and affect the players' strategic choices and game results. If static game and dynamic game model correspond to the short-term one-off relationship of social economy, repeated game corresponds to many long-term relationships that persist or recur in social economy^[1].

3. Static Game of Incomplete Information in E-commerce Sales

3.1 Theoretical assumptions

(1) All the players are rational economic men, and their goal of maximizing their own benefit.

(2)The information of the players is not completely symmetrical.

(3)The game doesn't consider the impact of other conditions, such as policy constraints of relevant departments of the policy^[2].

3.2 The establishment of a game model

We assume that the players are store A and consumer B. The products provided by store A are classified into high-class products and inferior products, consumer B has two choices: to buy or not to buy. However, store A has complete information about the products and consumer B has incomplete information about the products. All the players aim at maximizing their own utility.

Therefore, there are four scenarios for e-commerce consumption strategy selection:

(1) If store provides high-class products, consumer chooses to purchase the products after not fully understanding the products. In this case, both store and consumer receive revenue of 5 .

(2) If store provides high-class products, consumer chooses not to purchase the products after not fully understanding the products. In this case, both store and consumer receive revenue of 0 .

(3) If store provides shoddy products, consumer chooses not to purchase the products after not fully understanding the products. In this case, both store and consumer receive revenue of 0 .

(4) If store provides shoddy products, consumer chooses to purchase the products after not fully understanding the products. In this case, the revenue of store and consumer are 10, -5 respectively.

According to the above four cases, the benefit matrix of both palyers in the finite game is expressed as follows:

	buy	Don't buy
high-class products	(5,5)	(0,0)
shoddy products	(10,-5)	(0,0)

In the benefit matrix of both players of the game, the result of the game can be known by using the marking method: for the store, the supply of high-class product will get 5 units of revenue and the supply of shoddy products will get 10 units of revenue, so the rational store will choose to supply shoddy products; for consumers, if consumers can judge whether the products provided by the stores are shoddy products, if they are shoddy products, they will not choose to purchase them, if they don't purchase them, they will generate 0 unit of revenue, and if they purchase them, they will lose 5 units of revenue. Through rational judgment, the probability that the store will choose to provide shoddy products is higher, and consumers will choose not to purchase if they are unwilling to bear the purchase risk. Finally, the Nash equilibrium strategy is (shoddy products, Don't buy), which is a dominant equilibrium for each player. This is a typical prisoner's dilemma.

The above-mentioned prisoner's dilemma can be solved by introducing a punishment mechanism. If the store and the consumer sign an agreement with legal effect: if the store provides shoddy products to the consumer in order to earn a high profit, the store will be punished by 8 units, and the ultimate benefit will be 2 units. If such a restraint mechanism exists, the rational store will choose to provide high-class products, and the transaction can proceed normally. Same effect can be achieved if repeated games are considered.

4. Infinite Repeated Game Analysis of E-commerce Sales

There is only pure strategy Nash equilibrium in the above-mentioned one-off static game, (shoddy products, Don't buy) with a mutual benefit of (0,0), which isn't the best strategy combination in the sense of pareto. The two players in the game have neither maximized their own benefit nor the overall benefit. In view of the fact that both players in the game are rational economic persons and the store has credibility problems, the equilibrium strategy combination of single game can only be the dominant equilibrium strategy shared by both players,(shoddy products, Don't buy). However, if this game is repeated indefinitely, as the number of transactions gradually increasing, both players of the game with economic rationality will gradually realize that the Nash equilibrium is not optimal, and store only provide high-class products is beneficial to both players, because any betrayal will cause the other player to retaliate in the next round of game.

Assuming that both players in the repeated game are bounded rational, and they make strategies to maximize their own benefit under a given situation.

The game between store and consumer is a long-term process, as long as the players subjectively believe that the game can be continued. If the number of games is enough, the game can be regarded as a randomly ended repeated game similar to the infinite repeated game. The idea of game analysis and decision-making is equal to the infinite repeated game. In the infinite repeated game of this game, we can find a perfect equilibrium in which both players cooperate with each other^[3].

Considering that it isn't certain whether the next transaction will occur before each game, assuming that the probability of the next transaction after each game is p . In view of the purchasing effect of consumers, if the store provides shoddy products, it will receive 10 units of revenue, however, consumers will lose from purchasing shoddy products and will not choose to purchase again, the store revenue will be 0 in the future. If store continues to provide high-class products, consumer will continue to purchase if his own utility is satisfied, store will receive 5 units of revenue for the first time and $5p$ units of revenue for the second transaction. By analogy, a store revenue function is constructed to discount the store's expected revenue:

$$R = \sum_{i=1}^n (5 p^k) - C \quad (1)$$

In formula (1), C represents fixed costs, n represents the number of transactions.

$$R = \frac{5}{1-p} - C \quad \text{When the number of transactions is large enough.}$$

The necessary condition for the continuation of the transaction is that the store will receive higher revenue from providing high-class products than from providing inferior products.

$$\frac{5}{1-p} \geq 10 \quad (2)$$

Formula (2) indicates that when the probability of the next transaction is higher than 0.5, the store will choose to provide high-class products and a continuous transaction relationship will be established between store and consumer. This is the main reason why stores and consumers maintain a long-term purchase relationship under repeated game, that is, the two players of the game maintain a cooperative relationship to satisfy their own utility to resist the temptation of benefits brought by short-term or one-time transactions.

Of course, the above conclusion is only limited to the case where the number of games is enough, that is, both players don't know the number of games, as long as the players know the number of games, they will adopt the strategy of betraying each other for the last time^[3]. In real life, in order to develop long-term profits and maintain the image of the store, the store must establish the concept of providing high-class products for consumers.

5. the repeated game under the shop to pursue profit maximization method

Under the repeated game, the stores realize the win-win benefits of the stores and consumers through relationship marketing. The increase in store profits can increase the input of product elements and promote the improvement of product quality.

Constructing the Probability Function of Store Consumers to Continue Trading;

$$p = \frac{b}{a} \quad (3)$$

In formula (3), a represents the current product transaction volume, b represents the previous product transaction volume. By means of formula (1), it isn't difficult to find that stores can consider to maximize their own benefit from two aspects: reduce fixed cost input, increase the volume and number of product transactions.

6. Conclusions

Through the above simple repeated game analysis of e-commerce sales, it isn't difficult to find that enterprises should make full use of relationship marketing to establish long-term relationship with customers and maintain customer loyalty if they want to obtain lasting profits in the fierce competition. This requires enterprises to always aim at improving customer satisfaction in the process of product production, marketing and service. The core of relationship marketing is to maintain customers, provide customers with highly satisfactory products and services, and carry out marketing activities on the basis of maintaining long-term relationship with customers by strengthening the contact with customers to achieve the marketing

objectives of the enterprise. Relationship marketing advocates a win-win strategy for both enterprises and customers.

References

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