

The Effect of the Adulteration Ratio of Purchasing Agents on Consumers' Behavior

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Abstract. Much of the previous literature on online purchasing agents has shown that product quality is often not guaranteed, with a significant proportion of goods being counterfeit or in poor condition. Customers who are unaware of this risk tend to trust the purchasing agents and subsequently suffer a loss in utility. This study explores the relationship between the quality of products sold by purchasing agents and their sales performance. The methodology employed involves extensive games, with two key assumptions regarding customer types. The conclusions are as follows: In the market, when the proportion of high-quality goods is high, customers are likely to trust and purchase these goods. Conversely, when the proportion of low-quality goods is high, customers will inevitably end up buying low-quality goods if those dominate the market. However, if high-quality goods are available, the likelihood of customers purchasing them is influenced by the relative cost of the low-quality goods.

Keywords: extensive game, daigou, Perfect Bayes Equilibrium

1. Introduction

It is well known that online purchasing agents, also known as "daigou," often do not sell the authentic products they claim to offer. In China, many people purchase cosmetics or anime figures through daigou, believing they might be cheaper. This is especially common for overseas goods, where using a purchasing agent can reduce taxes. However, the quality of these goods is not guaranteed, yet customers often place their trust in these online agents. Typically, daigou acquires both high-quality and low-quality goods from brand counters. They then decide how to market these products—selling high-quality goods at a premium price or misleading customers by selling low-quality goods as if they were high-quality. Each sales strategy influences consumer decisions.

Previous research has employed both traditional research methods and game theory models to explore the relationship between customers and daigou. However, questions remain about the conditions under which daigou can exploit customer trust to adulterate products at a specific rate, thereby maximizing their profits. In this paper, we construct an extensive game using game trees to illustrate potential outcomes, albeit under the simplified assumption of given proportions of high-quality and low-quality goods.

In this context, "daigou" refers to purchasing agents in China who aim to maximize short-term profits, conducting most transactions via WeChat. These agents primarily promote the products they sell through WeChat Moments, reaching only a relatively small group of potential customers.

2. Literature review

2.1. Extensive games

Harsanyi's Transformation: John Harsanyi's (1967-68) groundbreaking work transformed extensive games with imperfect information into extensive games with perfect recall and perfect information of a type, allowing for the application of solution concepts from perfect information games.

Harsanyi introduced the concept of Bayesian games [1] to represent players' private information, leading to the development of Bayesian games, where players' beliefs about others' types and strategies are crucial to optimal decision-making.

Perfect Bayesian Equilibrium (PBE) [2] emerged as a cornerstone in the analysis of strategic interactions under imperfect information. Unlike complete information games, where all players' actions and payoffs are common knowledge, imperfect information games involve players who hold private information and must form beliefs about the game's state based on observable actions and events. PBE formalizes this process by specifying both players' strategies and their beliefs about the game's history and the likely actions of other players.

2.2. Signaling game theory

Signaling games refer narrowly to a class of two-player games of incomplete information in which one player is informed and the other is not. The informed player's strategy set consists of signals contingent on information and the uninformed player's strategy set consists of actions contingent on signals. More generally, a signaling game includes any strategic setting in which players can use the actions of their opponents to make inferences about hidden information. The earliest work on signaling games was Spence [3]'s model of educational signaling and Zahari [4]'s model of signaling by animals. During the 1980s researchers developed the formal model and identified conditions that permitted the selection of unique equilibrium outcomes in leading models.

2.3. Daigou markets in China

According to the Re-Hub platform's 2020 Daigou Index report, the daigou market is worth about 400 billion yuan (\$57 billion) a year in 2016 [5]. And the luxury goods daigou trade has become very popular in China during what is also known as the Daigou era. Many Chinese consumers have sought ways to buy luxury goods abroad that are unavailable or expensive in China. Anyone who lives abroad or has access to foreign products can become a daigou agent. The most used channel outside the country remains the WeChat mobile app, the most popular chat platform in China where daigou agents can share product photos or presentations with friends.

2.4. The application of game theory in purchasing—pricing strategies

The goal of a price promotion is to entice customers to buy a discounted product in the hope that this will make a large enough profit to compensate for the loss caused by the price reduction. In some cases, it may even attract a larger market share when first-time buyers become loyal customers. While this pricing strategy is often used in the real world, it also has a drawback. It only works if

there are no similar products to sell. By selling similar products, customers are faced with a choice during the purchase process. Since we cannot accurately predict which product customers will choose, the potential profits and market share become unrealized. Because of this, the pricing strategy actually generates less profit on sales than before and makes it useless [6].

2.5. Consumer payoffs (value) to influence purchasing methods

Our research across hundreds of brands in dozens of categories shows that it's possible to rigorously measure and strategically target the feelings that drive customers' behavior. We call them "emotional motivators." They provide a better gauge of customers' future value to a firm than any other metric, including brand awareness and customer satisfaction, and can be an important new source of growth and profitability [7].

The basic choice of a consumer is to decide whether to buy the good or not, once he feels a need and he knows (or simply believes) that a certain good could satisfy it (or he has being induced to shift the satisfaction of a need to the purchase of this "distractive" product). The consumer is planning an activity and considers this good as a useful input. We assume that the good is available and within physical and psychological reach: it may be on the shelf of the supermarket and the consumer just needs to grasp it by extending the arm. More in general, it is implicitly assumed that the good passes certain quality tests and does not include some very strong negative aspects which need to be evaluated (e.g. it is too new and unfamiliar, with the consumer being characterised by being at least somewhat neophobic) [8].

2.6. The trend of the daigou market

According to the data, 73.6% of China's luxury consumption in 2018 took place overseas. According to overseas experience, about 60% of overseas consumption was achieved through purchasing channels [9]. The regulation of the purchasing industry has reduced consumers' overseas consumption channels, which is expected to further guide the return of consumption. China's luxury consumption capacity is strong, the overall luxury consumption accounts for more than 30% of the world, but the consumption outflow phenomenon is serious, more than 70% of the luxury consumption is overseas, including Japan South Korea and Hong Kong, Macao and Taiwan as the main consumption areas.

The Daigou industry is seizing new opportunities through innovative methods like live-streaming and online channels. Utilizing these platforms allows Daigou sellers to connect directly with customers, showcasing products in real-time. This interactive approach not only enhances the shopping experience but also opens up avenues for personalized engagement, fostering stronger relationships between sellers and consumers in the evolving landscape of e-commerce [10].

3. Methods and models

3.1. Modeling the game

In the progress of mathematics calculation, this work divided customers into two different kinds in order to complete the model. We used extensive game theory to back up our ideas that the probabilities of goods' quality determine the customers' purchasing willingness.

Figure 1 shows the first circumstance; in this circumstance, customers can not tell the difference between high and low-quality goods, assuming that nature gives the goods to daigou instead of the

brands' counters. Nature apportioned the goods into high-quality ones(H) with possibility P and low-quality ones(L) with the possibility of 1-P.

Under the circumstance of having goods H, which have real high quality, selling them in the price of high-quality goods is presented as h, to which the proportion is presented as α_H ; if selling them in the price of low quality goods, then this action is recorded as l, to which the proportion is presented as $1 - \alpha_H$.

Under circumstance of having goods L, which have real high quality, selling them in the price of high quality goods is presented as h, to which the proportion is presented as α_L ; if selling them in the price of low quality goods, then this action is recorded as l, to which the proportion is presented as $1 - \alpha_L$.

Assume that daigou will claim to the customers the kinds of goods they are selling. Note that if claimed at a low price, then daigou would say that it is a low-quality object. If at a high price, then the daigou would say that it is a high quality object.

Assumptions had done as below:

with high quality merchandise, the cost of goods=2, the price of goods=3, consumer value=4

with low quality merchandise, he cost of goods=c, the price of goods=1, consumer value=2

Note that only if consumer bought the goods, there would occur the consumer value. Therefore to explain the utilities showed in the trees: with high quality of goods (H) being sold by daigou, if customers choose the action to purchase (y), then the utility would be (1,1), which has the possibility of (β_h) , with the sequence that daigous' payoffs first then the customers' utility. Customers' utility is represented by the consumer value minus the price of goods.

The same rules apply on the circumstance when no purchasing actions have done (n), with possibility $(1 - \beta_h)$. Daigou can keep the goods with no loss on cost of the goods if individuals do not purchase because all the assumptions are based on one to one sales, which is the most common situation on the platform WeChat.

With low quality of goods (L) being sold by daigous, if customers choose the action to purchase (y), then the utility would be (-1,3), which has the possibility of (β_l) . If customers do not purchase (n), the possibility will be $(1 - \beta_l)$.

There are two information sets which presented as μ_h and μ_l .

There are 8 equilibria in total and consumers will take different action when daigou offer high-quality goods or low-quality goods. Solutions are following.

equilibrium 1: When P is larger than $\frac{1}{2}$, $\{ \alpha_H = \alpha_L = 1, \mu_h = P > \frac{1}{2}, \mu_l \in [0,1], \beta_h = 1, \beta_l = 1 \}$.

equilibrium 2: When P is equal to $\frac{1}{2}$, $\{ \alpha_H = \alpha_L = 1, \mu_h = P = \frac{1}{2}, \mu_l \in [0,1], \beta_h > \frac{1-c}{3-c}, \beta_l = 1 \}$.

equilibrium 3: When P is equal to $\frac{1}{2}$, $\{ \alpha_H = \alpha_L = 1, \mu_h = P = \frac{1}{2}, \mu_l = 0, \beta_h = \frac{1-c}{3-c}, \beta_l = 1 \}$.

equilibrium 4: When P is smaller than $\frac{1}{2}$, $\{ \alpha_H = 1, \alpha_L = \frac{P}{1-P}, \mu_h = \frac{1}{2}, \mu_l = 0, \beta_h = \frac{1-c}{3-c}, \beta_l = 1 \}$.

Then in the second situation, which consumer value is 0 when consumer receive low-quality good.

equilibrium 5: When P is larger than $\frac{3}{4}$, $\{ \alpha_H = \alpha_L = 1, \mu_h = P > \frac{3}{4}, \mu_l \in [0,1], \beta_h = 1, \beta_l \in [0,1] \}$.

equilibrium 6: When P is equal to $\frac{3}{4}$, $\{\alpha_H = \alpha_L = 1, \mu_h = P = \frac{3}{4}, \mu_l \in [0,1], \beta_h > \frac{1-c}{3-c}, \beta_l \in [0,1]\}$. And equilibrium 7: When P is equal to $\frac{3}{4}$, $\{\alpha_H = \alpha_L = 1, \mu_h = P = \frac{3}{4}, \mu_l = 0, \beta_h = \frac{1-c}{3-c}, \beta_l = 0\}$.

equilibrium 8: When P is smaller than $\frac{3}{4}$, $\{\alpha_H = 1, \alpha_L = \frac{P}{3(1-P)}, \mu_h = P = \frac{3}{4}, \mu_l = 0, \beta_h = \frac{1-c}{3-c}, \beta_l = 0\}$.

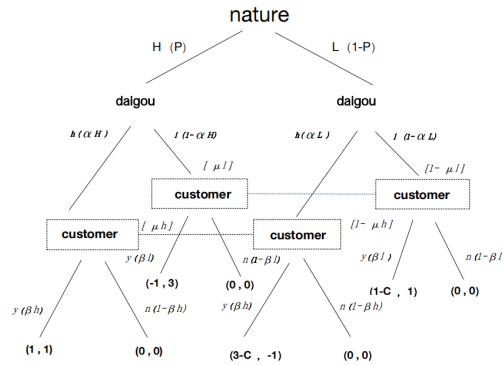


Figure 1. Game tree for customers unable to distinguish

3.2. Solutions

The mathematical solution in this game shown in the figure needs a solution (equilibrium) concept to find out the rational decision that the consumer will make with imperfect information. If a player's strategy is optimal in this sense, it is sequentially rational. The solution concept here is to find the Perfect Bayesian Equilibrium(PBE).

First market:

(1)The payoffs for daigou in the first scenario where the goods received are in high quality(H)

$$h : 1 \times \beta_l + (0) \times (1 - \beta_h) = \beta_h$$

$$l : (-1) \times \beta_l + (0) \times (1 - \beta_l) = -\beta_l$$

β_h must $\geq \beta_l$ as a figure for prob;

Hence, selling high-quality goods at a high price is worthwhile in any case. So the figure for $\alpha_H = 1$.

(2)Use Bayes' rule to show μ_h, μ_l .

$$\mu_h = \frac{P \times \alpha_H}{P \times \alpha_H + (1-P) \times \alpha_L}$$

$$\mu_l = \frac{P \times (1 - \alpha_H)}{P \times (1 - \alpha_H) + (1-P) \times (1 - \alpha_L)}$$

So the results shows that $\mu_h = \frac{P \times \alpha_H}{P \times \alpha_H + (1-P) \times \alpha_L} = \frac{P}{P + (1-P) \times \alpha_L} \geq p, \mu_l = 0$ when $\alpha_L < 1$; undefined but within $[0,1]$ when $\alpha_L = 1$.

(3)When consumers sees high quality of goods(h),the utility calculated as followed:

$$y : 1 \times \mu h + (-1) \times (1 - \mu h) = 2\mu h - 1$$

$$n : 0$$

this can be divided into three circumstances $\Rightarrow$

$$\beta h = 1 \text{ if } \mu h > \frac{1}{2}$$

$$\beta h \in [0, 1] \text{ if } \mu h = \frac{1}{2}$$

$$\beta h = 0 \text{ if } \mu h < \frac{1}{2}$$

(4)When consumers sees low quality of goods(l),the utility calculated as followed:

$$y : 3\mu l + 1 \times (1 - \mu l) = 2\mu l + 1$$

$$n : 0$$

Therefore customers will only purchase goods when sold as high qualities, so the figure for $\beta h = 1$ in any case.

(5)The payoffs for daigou in the second scenario where the goods received are in low quality(L)

$$h : \beta h \times (3 - c) + 0 = 3\beta h - c\beta h$$

$$l : \beta l \times (1 - c) + 0 = \beta l \times (1 - c)$$

Therefore α_L can have three circumstances depend whether the solution for h is positive, negative or zero, which is on the value of $\beta h \Rightarrow$

$$\alpha_L = 1 \text{ if } \beta h > \frac{1-c}{3-c}$$

$$\alpha_L \in [0, 1] \text{ if } \beta h = \frac{1-c}{3-c}$$

$$\alpha_L = 0 \text{ if } \beta h < \frac{1-c}{3-c}$$

Now consider the value that will occur a PBE:

①When $P > \frac{1}{2}$;

$$\text{Hence } \mu h \geq P > \frac{1}{2};$$

$$\text{Since } \mu h > \frac{1}{2}, \text{ then } \beta h = 1$$

$$\text{Since } \beta h = 1, \text{ then } \alpha_L = 1$$

$$\text{If } \alpha_L = 0, \text{ then } \mu h = 1, \beta h = 1, \alpha_L = 1,$$

which contradict with the assumption.

$$\text{If } \alpha_L \in [0, 1], \text{ then } \beta h = \frac{1-c}{3-c} < \frac{1}{3}, \mu h = \frac{1}{2}, \alpha_L = 1,$$

which contradict with the assumption.

$\Rightarrow \{ \alpha_H = \alpha_L = 1, \mu_h = P > \frac{1}{2}, \mu_l \in [0,1], \beta_h = 1, \beta_l = 1 \}$, which is the only equilibrium under this circumstance.

② When $P = \frac{1}{2}$;

(Need to determine that whether $\alpha_L = 1$ or $\alpha_L = 0$ or $\alpha_L \in [0,1]$);

$$\mu_h = P = \frac{1}{2}; \beta_h \in [0,1];$$

$$\text{if } \beta_h > \frac{1-c}{3-c}; \Rightarrow \alpha_L = 1$$

$$\text{If } \beta_h \leq \frac{1-c}{3-c}; \Rightarrow \alpha_L = 0 \text{ or } \alpha_L \in [0,1]$$

Hence $\alpha_L = 1$ has 2 equilibrium

If $\alpha_L = 0$, then $\mu_h = 1, \beta_h = 1$.

Which contradict with the assumption that $\mu_h = \frac{1}{2}$.

so that $\alpha_L = 1$

$$\Rightarrow \{ \alpha_H = \alpha_L = 1, \mu_h = P = \frac{1}{2}, \mu_l \in [0,1], \beta_h > \frac{1-c}{3-c}, \beta_l = 1 \}$$

and $\{ \alpha_H = \alpha_L = 1, \mu_h = P = \frac{1}{2}, \mu_l = 0, \beta_h = \frac{1-c}{3-c}, \beta_l = 1 \}$

③ When $P < \frac{1}{2}$;

(Need to determine that whether $\alpha_L = 1$ or $\alpha_L = 0$ or $\alpha_L \in [0,1]$);

$$\text{If } \alpha_L \in [0,1]; \text{ then } \beta_h = \frac{1-c}{3-c}, \text{ then } \mu_h = \frac{1}{2};$$

$$\text{So } \frac{P}{P+(1-P)\alpha_L} = \frac{1}{2};$$

$$\text{Then } \alpha_L = \frac{P}{1-P}$$

$$\Rightarrow \{ \alpha_H = 1, \alpha_L = \frac{P}{1-P}, \mu_h = \frac{1}{2}, \mu_l = 0, \beta_h = \frac{1-c}{3-c}, \beta_l = 1 \}$$

In the first market there are 4 equilibrium in total.

Second market:

The second situation about customers is that they have the ability to tell the difference between high and low goods, but in reality this kinds of customers are rare to be found. So the second model will be presented in a more precise way, with methods used as same as above.

It is noted that since customers can tell the low quality of goods, then the consumer value will be 0 when purchasing low ones.

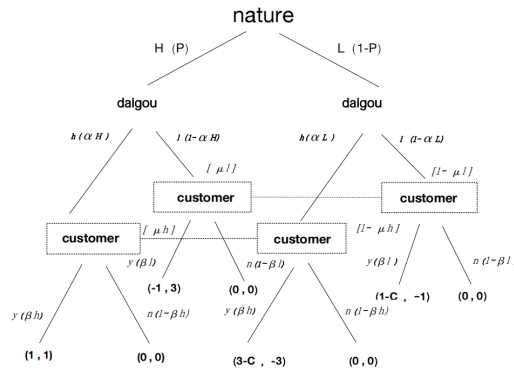


Figure 2. Game tree for customers able to distinguish

(1)The payoffs for daigou in the first scenario where the goods received are in high quality(H)

$$h : 2 \times \beta h + (0) \times (1 - \beta h) = 2\beta h$$

$$l : 0$$

2Bh must ≥ 0 as a figure for prob;

Hence selling high quality goods as a high price is worthwhile in any case. So the figure for $\alpha_H = 1$.

(2)Use Bayes' rule to show μ_h, μ_l .

$$\mu_h = \frac{P \times \alpha_H}{P \times \alpha_H + (1-P) \times \alpha_L}$$

$$\mu_l = \frac{P \times (1 - \alpha_H)}{P \times (1 - \alpha_H) + (1-P) \times (1 - \alpha_L)}$$

So the results shows that $\mu_h = \frac{P \times \alpha_H}{P \times \alpha_H + (1-P) \times \alpha_L} = \frac{P}{P + (1-P) \times \alpha_L} \geq p, \mu_l = 0$ when $\alpha_L < 1$; undefined but within $[0, 1]$ when $\alpha_L = 1$.

(3)When consumers sees high quality of goods(h),the utility calculated as followed:

$$y : 1 \times \mu_h + (-3) \times (1 - \mu_h) = 4\mu_h - 3$$

$$n : 0$$

this can be divided into three circumstances $\Rightarrow$

$$\beta h = 1 \text{ if } \mu_h > \frac{3}{4}$$

$$\beta h \in [0, 1] \text{ if } \mu_h = \frac{3}{4}$$

$$\beta h = 0 \text{ if } \mu_h < \frac{3}{4}$$

(4)When consumers sees low quality of goods(l),the utility calculated as followed:

$$y : 3\mu_l + (-1) \times (1 - \mu_l) = 4\mu_l - 1$$

$$n : 0$$

this can be divided into three circumstances $\Rightarrow$

$$\beta l = 1 \text{ if } \mu_l > \frac{1}{4}$$

$$\beta l \in [0, 1] \text{ if } \mu_l = \frac{1}{4}$$

$$\beta l = 0 \text{ if } \mu_l < \frac{1}{4}$$

(5) The payoffs for daigou in the second scenario where the goods received are in low quality(L)

$$h : \beta h \times (3 - c) + 0 = 3\beta h - c\beta h$$

$$l : \beta l \times (1 - c) + 0 = \beta l \times (1 - c)$$

Therefore α_L can have three circumstances depend whether the solution for h is positive, negative or zero, which depends on the value of $\beta h \Rightarrow$

$$\alpha_L = 1 \text{ if } \beta h > \frac{1-c}{3-c}$$

$$\alpha_L \in [0, 1] \text{ if } \beta h = \frac{1-c}{3-c}$$

$$\alpha_L = 0 \text{ if } \beta h < \frac{1-c}{3-c}$$

Under this circumstance there will have 4 equilibrium. The methods used as same as above.

4. Test results and discussions

4.1. Analyse and interpretation

When the consumer and daigou's expected value have reached an equilibrium, which means in this scenario daigou and customers will make transactions which endeavors to maximize their utilities.

(1) When P is larger than $\frac{1}{2}$, $\{ \alpha_H = \alpha_L = 1, \mu_h = P > \frac{1}{2}, \mu_l \in [0, 1], \beta_h = 1, \beta_l = 1 \}$ is equilibrium 1. When the high-quality goods account for a relatively high proportion of the total goods, the daigou will certainly sell the high-quality goods as high goods and sell the low goods as high goods. And consumers will buy the products.

Since consumers will think that the goods they buy have a high probability of high goods, and the probability of purchasing low goods is very small. They don't think they would buy low goods, so consumers will buy the products daigou offers. So daigou will sell all goods as high.

(2) When P is equal to $\frac{1}{2}$, $\{ \alpha_H = \alpha_L = 1, \mu_h = P = \frac{1}{2}, \mu_l \in [0, 1], \beta_h > \frac{1-c}{3-c}, \beta_l = 1 \}$ is equilibrium 2.

And $\{ \alpha_H = \alpha_L = 1, \mu_h = P = \frac{1}{2}, \mu_l = 0, \beta_h = \frac{1-c}{3-c}, \beta_l = 1 \}$ is equilibrium 3.

When there's about the same amount of high goods in the market as low goods, the agent will certainly sell the high-quality goods as high goods and sell the low goods as high goods. But consumers will have a chance of $\frac{\text{price of low good} - \text{the cost of low}}{\text{price of high} - \text{the cost of low}}$ (or higher) of buying the products if the agents say it is high good, and will buy the low goods in the market.

Since consumers may buy low goods, so they are worried that they will spend money on high goods. to buy low goods, so they will buy high goods according to a certain proportion related to price of low and high good and cost of low good. Although a higher possibility of low goods, consumers also buy the products. So daigou still sell all goods as high.

(3) When P is smaller than $\frac{1}{2}$, $\{ \alpha_H=1, \alpha_L=\frac{P}{1-P}, \mu_h=\frac{1}{2}, \mu_l=0, \beta_h=\frac{1-c}{3-c}, \beta_l=1 \}$ is equilibrium 4.

When there's a lot of low stuff on the market, agent will sell the high-quality goods as high goods, and have a chance of $\frac{\text{The possibility of high}}{1-\text{The possibility of high}}$ of selling low-quality goods as low goods. And consumers will have a chance of $\frac{\text{price of low good}-\text{the cost of low}}{\text{price of high}-\text{the cost of low}}$ of buying the products if the agents say it is high good, and will buy the low goods in the market.

Since consumers may certainly buy low goods at a high price. So they may hesitate to buy high goods and have a certain possibility to buy. Knowing that consumer may not buy high good in any conditions, so daigou only offer some of low products as high and the rest of it as low. In this case, low goods have consumer value, so people also buy low product as low.

Then, in the second situation, the consumer value is 0 when the consumer receives a low-quality good.

(4) When P is larger than $\frac{3}{4}$, $\{ \alpha_H=\alpha_L=1, \mu_h=P>\frac{3}{4}, \mu_l \in [0,1], \beta_h=1, \beta_l \in [0,1], \}$ is equilibrium 1.

When the high-quality goods account for a relatively high proportion of the total goods, the agent will certainly sell the high- quality goods as high goods and sell the low goods as high goods. And consumers will buy what the market calls high goods, but consumer may not purchase low-quality goods, depending on what they want.

Since there is large proportion of high product, consumers will think that the goods they buy have a high probability of high goods, and the probability of purchasing low goods is very small. They don't think they would buy low goods. Daigou would sell all as high because high goods is everywhere in the market, which low quality almost unable to sell.

(5) When P is equal to $\frac{3}{4}$, $\{ \alpha_H=\alpha_L=1, \mu_h=P=\frac{3}{4}, \mu_l \in [0,1], \beta_h>\frac{1-c}{3-c}, \beta_l \in [0,1] \}$ is equilibrium 2. And $\{ \alpha_H=\alpha_L=1, \mu_h=P=\frac{3}{4}, \mu_l=0, \beta_h=\frac{1-c}{3-c}, \beta_l=0, \}$ is an equilibrium 3.

When there's about the 3/4 ratio of high goods in the market as low goods, the agent will certainly. sell the high-quality goods as high goods and sell the low goods as high goods. And consumers will have a chance of $\frac{\text{price of low good}-\text{the cost of low}}{\text{price of high}-\text{the cost of low}}$ of buying the products if the agents say it is high good, consumer will not buy the low-quality stuff in the market.

Since consumer still believe that high goods are general in the market. They also don't think they would buy low goods. Low good is useless to them, they're less likely to buy low. So they will buy high goods according to a certain proportion related to the price of low and high goods and the cost of low goods. Daigou only sell high as high because they can't earn any when they offer low goods.

(6) When P is smaller than $\frac{3}{4}$, $\{ \alpha_H=1, \alpha_L=\frac{P}{3(1-P)}, \mu_h=P=\frac{3}{4}, \mu_l=0, \beta_h=\frac{1-c}{3-c}, \beta_l=0, \}$ is equilibrium 4.

When there's a lot of low stuff on the market, agent will sell the high-quality goods as high goods, and have a chance of $\frac{\text{The possibility of high}}{3(1-\text{The possibility of high})}$ of selling low-quality goods as low goods. And consumers will have a chance of $\frac{\text{price of low good}-\text{the cost of low}}{\text{price of high}-\text{the cost of low}}$ of buying the products if the agents say it is high good, consumer will not buy the low-quality stuff in the market.

Since consumers will not believe high goods in the market. So they may hesitate to buy high goods and have a certain possibility to buy. Daigou also will sell part of the products as high, but selling as low cannot earn any profit because consumers will not buy any low products.

4.2. Discussion

People will find that there are high goods and low goods in the market. This model mainly expresses how consumers deal with the information sent by purchasing agents and respond to it so as to achieve a market equilibrium. This model is helpful for us to study more potential purchasing methods so that consumers' decision-making and purchasing can reach a balance. Yet there still exists problems such that the model is not accurate enough. The ratio of high-quality goods may vary in different market, so there will be a small amount of deviation.

In our reality, about 70 to 90 per cent of the goods are low in the market. Low stock has a small profit for customers. So the buyer will sell high goods as high goods, there is a probability of 0.25 low goods as low goods, 75% probability of low goods as high goods.

5. Conclusion

We want to know about how sales strategy influences consumer decisions.

So, we use a signaling game to create a model tree and calculate to find a solution by Perfect Bayesian Equilibrium(PBE). There are 8 equilibriums when daigou offers different strategies. And each effect are shown below:

In a market where consumers see value in low goods:

(1) When the high-quality goods account for a relatively high proportion of the total goods, the agent will certainly sell the high-quality goods as high goods and sell the low goods as low goods. And consumers will buy what the market calls high goods and low goods.

(2) When there's about the same amount of high goods in the market as low goods, the agent will certainly sell the high-quality goods as high goods and sell the low goods as low goods. But consumers will have a chance of $\frac{\text{price of low good} - \text{the cost of low}}{\text{price of high} - \text{the cost of low}}$ of buying the products if the agents say it is high good, and will buy the low goods in the market.

(3) When there's a lot of low stuff on the market, agent will sell the high-quality goods as high goods, and have a chance of $\frac{\text{The possibility of high}}{1 - \text{The possibility of high}}$ of selling low-quality goods as low goods. And consumers will have a chance of $\frac{\text{price of low good} - \text{the cost of low}}{\text{price of high} - \text{the cost of low}}$ of buying the products if the agents say it is high good, and will buy the low goods in the market.

In the market where consumer see no value in low-quality goods:

(1) When the high-quality goods account for a relatively high proportion of the total goods, the agent will certainly sell the high-quality goods as high goods and sell the low goods as low goods. And consumers will buy what the market calls high goods, but consumer may not purchase low-quality goods, depending on what they want.

(2) When there's about a 3/4 ratio of high goods in the market as low goods, the agent will certainly sell the high-quality goods as high goods and sell the low goods as low goods. And consumers will have a chance of $\frac{\text{price of low good} - \text{the cost of low}}{\text{price of high} - \text{the cost of low}}$ of buying the products if the agents say it is high good, consumer will not buy the low-quality stuff in the market.

(3) When there's a lot of low stuff on the market, agent will sell the high-quality goods as high goods, and have a chance of $\frac{\text{The possibility of high}}{3(1 - \text{The possibility of high})}$ of selling low-quality goods as low goods.

And consumers will have a chance of $\frac{\text{price of low good} - \text{the cost of low}}{\text{price of high} - \text{the cost of low}}$ of buying the products if the agents say it is high good, consumer will not buy the low-quality stuff in the market.

Acknowledgment

Xinzhe Liu, Xinyin Zhang and Zeyu Qiu contributed equally to this work and should be considered co-first authors.

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