Optimal Strategy for Selling on GB Website Considering the Effect of Service Guarantee

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Abstract. This paper analyses whether sellers should join group-buying website and how to join group-buying website by evaluating both the service guarantee level and seller’s online price. In this study, we find that startup sellers will gain profit by joining group-buying website and these sellers should increase his service guarantee level after joining GB website. All these findings are important for sellers’ GB strategy.

Introduction

With the development of e-commerce, group-buying (GB) has becoming more and more popular in our daily life. The sellers can choose whether to join in the GB website for more profit. The consumers can buy goods or services on GB website at cheaper price. This paper will study the optimal strategy in the GB website environment from the seller’s vision. And this paper will answer the two questions: Whether the seller should join the GB website? What price and service guarantee level should the seller set if they join the GB website?

Literature Review

The group-buying model has been studied by many researchers. Kagel and Levin (2001) think online GB auction is a kind of homogeneous multi-unit auction, whose price curve steps down from one price-quantity schedule to the next[1]. Van Horn and Gustafsson (2000) think online GB enables individuals buyers to obtain the same discount as retailers who buy in large volume[2]. But the Kauffman and Wang (2002) mentioned that the earlier GB website has some drawbacks, such as:(1) the business model was too complex for the common consumer;(2) the transaction volume was so small that the discounts for the consumers is low and it is difficult for the earlier GB websites to compete with large retailers[3]. Under this condition, the fixed-priced group-buying model was born. At present, today’s group-buying model began to cancel the mininum deal amount. The sellers just need to set the GB price and the time period. Ni, Xu and Dong (2014) found that UGS model (the seller has his own GB website) is more profitable than the basic model (just start business offline) for the seller[4].

Besides, the service guarantee usually is applied to retain and attract customers by sellers. The concept of service guarantee was first introduced by Hart and C.W.L. (1993) argues that a well-designed service guarantee should be unconditional, meaningful, easy to understand and communicate, and easy to invoke and collect on[5]. Ni, Xu and Dong (2014) think GB website provides the seller a platform with certain service guarantee level. The higher the service guarantee level, more information of the seller will be browsed, but it may also bring the website cost[4].

The Base Model

We assume there is a seller doesn’t join in the GB website and he only run offline business at first. Under this condition, the seller should decide the offline price $p_0$. There will be $\varepsilon_0 - \alpha p_0$ customers coming to buy the product or service, where $\varepsilon_0$ is the seller’s base market and $\alpha$ is the coefficient.
of the impact of price on the total demand. Define $s_0$ as the service guarantee level provided by the seller, so there will be $s_0(e_0 - \alpha p_0)$ customers satisfied with the product or service and will still come to experience the product in the future. To the seller, he can control his service guarantee level by improving the service environment, service attitude, and employing new service staffs and so on, but it may cost him more. In line with Tsay and Agrawal(2000), we assume that the cost to secure the service guarantee level $s_0$ is given by $(\eta / 2)s_0^2$ [6]. Therefore, when the seller doesn’t join GB website, the seller’s profit can be described as follows:

\[
\text{Maximize} : R_0(p_0, s_0) = p_0(e_0 - \alpha p_0) + p_0s_0(e_0 - \alpha p_0) - (\eta / 2)s_0^2
\]

Subject to:

\[
0 \leq s_0 \leq 1
\]

Solving the first-order and two-order condition, we can get that:

\[
\frac{\partial^2 R_0}{\partial p_0^2} = -2\alpha(1 + s_0) < 0, \quad \frac{\partial^2 R_0}{\partial s_0^2} = -\eta < 0.
\]

The Hessian Matrix of $R_0$ is given by

\[
H = \begin{pmatrix}
-2\alpha(1 + s_0) & e_0 - 2\alpha p_0 \\
e_0 - 2\alpha p_0 & -\eta
\end{pmatrix}
\]

The Hessian Matrix is negative semi-definite because $2\alpha\eta(1 + s_0) - (e_0 - 2\alpha p_0)^2 > 0$, and we can get the following equations according to the first-order condition:

\[
p_0 = \frac{e_0}{2\alpha}
\]

\[
s_0 = \frac{p_0(e_0 - \alpha p_0)}{\eta}
\]

Under this condition, we can observe the following properties:

Property 1: If $p_0 < \frac{e_0}{2\alpha}$, $s_0$ increases when $p_0$ increases; if $p_0 > \frac{e_0}{2\alpha}$, $s_0$ decreases when $p_0$ increases.

Property 1 shows the relationship between $p_0$ and $s_0$. When $p_0$ is small, i.e. $p_0 < \frac{e_0}{(2\alpha)}$, the seller will improve his service guarantee level to match with his higher price when he wants to increase the product or service price. When $p_0$ is high enough, i.e. $p_0 > \frac{e_0}{(2\alpha)}$, the seller will prefer to decrease his service level when he increases the service or product price. Because under this condition, if he increases the price, the number of customers coming to experience the service will decrease and he doesn’t need to improve service guarantee level. Otherwise it will waste his resource and money.

Proposition 1: Given $R_0$ is concave in $p_0$ and $s_0$, the seller’s optimal offline price and inchoate service guarantee level are given by: $p_0^* = \frac{e_0}{(2\alpha)}$, $s_0^* = \frac{e_0}{(4\alpha\eta)}$, and the corresponding seller’s profit is $R_0^* = \frac{e_0^2}{(4\alpha)} + \frac{e_0^4}{(32\alpha^2\eta)}$. 552
The Group-Buying Model Considering the Seller Joining the GB Website

In this model, we consider the seller has joined the GB website to attract more customers by using the lower online price. But more customers coming to experience the service may increase service failure, so it is necessary for the sellers to change his service guarantee level. When the seller joins the GB website, he doesn’t change the offline price, but he needs to decide the online price $p_g$ and the new service guarantee level $s$. If the seller joins the GB website, then there will be $e_g - \alpha p_g$ new customers buying online coupons and experience the vouchers offline where $e_g$ is the website’s basic average click volume. Sellers usually join the GB website for attracting new customers and hope they can come to experience it again by paying the full price $p_0$. So in the future, they will exit GB website. And there will be $s(e_0 - \alpha p_0 + e_g - \alpha p_g)$ customers who are satisfied in the former period coming to buy the products again by paying the full price. Therefore, when the seller joins GB website and exits GB in the future, the seller’s profit can be described as follows:

Maximize: $R_g(p_g, s) = p_0(e_0 - \alpha p_0) + \tau p_g(e_g - \alpha p_g) + p_0 s(e_0 - \alpha p_0 + e_g - \alpha p_g) - \frac{\eta}{2} s^2$

Subject to:

$0 \leq s \leq 1$ (5)

Solving the first-order and two-order condition, we can get that

$\frac{\partial^2 R_g}{\partial p_g^2} = -\alpha \tau < 0, \quad \frac{\partial^2 R_g}{\partial s^2} = -\eta < 0$

The Hessian Matrix of $R_g$, which determines the joint concavity is given by

$H = \begin{pmatrix} -\alpha \tau & -\alpha p_0 \\ -\alpha p_0 & -\eta \end{pmatrix}$ (6)

Given that the Hessian Matrix is negative semi-definite, which means $\alpha \tau \eta - \alpha^2 p_0^2 > 0$, we can get the following equations according to the first-order condition:

$p_g = \frac{2e_g \tau - e_0 s}{4\alpha \tau}$ (7)

$s = \frac{p_0 (e_0 - \alpha p_0 + e_g - \alpha p_g)}{\eta}$ (8)

Property 2: $s$ increases as $p_g$ decreasing when the seller joins the GB website and $p_g$ will increases as $\tau$ increases.

Property 2 shows that sellers should provide the higher level service guarantee as the online price of the service getting cheaper because the cheaper online price can attract more customers and improve the service guarantee level can decrease the corresponding service failure. And when the profit sharing ratio given by the website is high, the seller will correspondingly increases the online price.

Proposition 2: Given $R_g$ is concave in $p_g$ and $s$, the seller’s optimal online price and service guarantee level are given by:

$p_g^* = \frac{8\alpha \eta e_g - 2e_0^2 e_g - e_0^3}{2\alpha (8\alpha \eta - e_0^2)}, \quad s^* = \frac{2\tau e_0 (e_0 + e_g)}{8\alpha \eta - e_0^2}$

and the corresponding seller’s profit is

$R_g^* = \frac{e_0^2}{4\alpha} + \frac{64\alpha^3 \tau^3 \eta^3 e_g^2 - 2e_0^6 - 8\alpha \tau^2 \eta e_0^2 e_g^2 - 2\tau e_0^5 e_g + 8\alpha \tau^2 \eta e_0^4 + 16\alpha \tau^2 \eta e_0^3 e_g}{4\alpha (8\alpha \eta - e_0^2)^2}$. 

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Compare the Two Models

To the sellers, whether joining the GB website depends on the profit between the two cases.

Proposition 3: The difference on the price and the total profit under the two cases is:

\[
(1) \quad \Delta p = p^*_g - p^*_0 = \frac{8a\alpha \eta (e_g - e_0) - 2e_0^2 e_g}{2a(8a\alpha \eta - e_0^2)};
\]

\[
(2) \quad \Delta R = R^*_g - R^*_0 = \frac{64a^2 \tau^2 \eta^2 e_g^2 + 16a\alpha \eta e_0^3 e_g + e_0^6}{32a^2 \eta (8a\alpha \eta - e_0^2)}.
\]

Usually, sellers have more potential offline customers than potential online customers, so \( e_g < e_0 \) and \( 8a\alpha \eta (e_g - e_0) - 2e_0^2 e_g < 0 \). We can see that the symbol of \( \Delta p \) and \( \Delta R \) is dependent on \( 8a\alpha \eta - e_0^2 \) and we can get the following property:

Property 3: If \( e_0 > \sqrt{8a\alpha \eta} \), \( p^*_g > p^*_0 \) and \( \Delta R < 0 \); if \( e_0 < \sqrt{8a\alpha \eta} \), \( p^*_g < p^*_0 \), and \( \Delta R > 0 \).

To the seller, if his offline base market is high enough, i.e. \( e_0 > \sqrt{8a\alpha \eta} \), it is not suitable for the seller to join the GB market. But if the seller’s base market is relatively small, joining the GB market will bring him more profit. Bigger the base market of the seller or the GB market, more profit will the seller gain. Seller will improve his service guarantee level after joining the GB website because the GB price \( p^*_g \) is smaller than offline price \( p_0 \). This property can also be described in the Figure 1 which is based on our numerical example.

![Figure 1](attachment:image.png)

Figure 1. \( \alpha = 12, \tau = 0.75, e_g = 700, \eta = 50000. \)

When the seller is a startup one and his base market \( e_0 < \sqrt{8a\alpha \eta} \), he will join the GB website. And under this condition, we can also get the following properties:

Property 4: If \( \tau \in \left( e_0^2 / (8a\eta), \tau_2 \right) \), \( R_g \) will decrease with \( \tau \); if \( \tau \in (\tau_2, 1) \), \( R_g \) will increase with \( \tau \), where \( \tau_2 = (2e_0^2 e_g + e_0^4) / (8a\alpha \eta e_g^2) \).

From property 4, we can see that when the profit sharing ratio is relatively low, i.e. \( \tau \in (\tau_2, 1) \), seller’s profit will increase with the given sharing ratio, but when \( \tau \in \left( e_0^2 / (8a\eta), \tau_2 \right) \), seller’s profit will decrease with the given sharing ratio. Because the seller will increases the online price \( p_g \) with the profit sharing ratio and there will be less customers come to buy the product on the website, also the seller will decreases the service guarantee level because less customers come to experience. So the seller’s profit will not always increases with the profit sharing ratio.

We can see more interesting outcomes in Figure 2. In the case \( e_g = 700 \), seller’s profit will start to increase with the profit sharing ratio when \( \tau = 0.71 \). However in the case \( e_g = 550 \), seller’s profit
will start to increase with profit sharing ratio when $\tau = 0.91$. So when the group-buying website’s base click volume is relatively low, the seller should be more careful when the websites increases the profit sharing rate because he may gain less profit with large possibility.

![Figure 2](image)

Figure 2. The setting is $\alpha = 12, \eta = 50000, \epsilon_0 = 1000$.

Conclusion

This paper is the first to evaluate the service guarantee level with seller’s online price. In the base model, we provide the seller’s profit when he doesn’t join the GB website and find that sellers will not always increases his service guarantee level with price because when the price is too high, less customers will come to experience. In the second model, we explore the seller’s profit when he joins the GB website and quits the website in the future. In the new model, we find that seller will increase the service guarantee level because more customers will come to experience. Further, we compare the two models, and find that when the seller is mature, it is not suitable for him to join the website, but when the seller is a startup one, joining the GB website will bring more profit for him. More important, we find that when the given profit sharing ratio is relatively low, sellers will not always gain more with the higher ratio.

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