Research on E-coupon Distribution Based on Online Shop Marketing

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Abstract: We conduct a systematic study for online marketing based on e-commerce platforms (online shops) to test several major electronic coupon distribution models. We show that mass distribution of e-coupons without customer information will eliminate the price discrimination effect. We analyze the pattern of issuing Internet coupons based on past customer purchase information, including fixed face value and changing face value. We have found that with the reduction of costs of consumer profiling, it is higher of product price for merchants. In terms of commodity price and market share, changing face value is better than fixed when the accuracy of consumer analysis reaches a certain standard.

1. Introduction

With the rapid development of modern logistics and information technology, e-commerce has entered a stage of rapid expansion. The booming online shopping has also made network promotion and mobile promotion more popular, and the application of electronic coupons has become more and more widespread. Electronic coupon, or e-coupon, is an electronic form of coupon that is produced, distributed, and used in various electronic media [1]. In essence, the promotion strategy of electronic coupons is actually a price discrimination strategy implemented by merchants [2].

Extensive research has been devoted to testing the effectiveness of coupons. Blattberg and Neslin [3] discussed the literature on a large number of coupon, using “price discrimination” as the main goal of the coupon. Shaffer [4] believed that companies should accurately place coupons and reasonably determine the face value of coupons. Song et al. [5] studied the effect of product types, consumer characteristics, and the attributes of coupons on the exchange rate of electronic coupons. Achadinha [6] used TAM to analyze the impact of consumer economic perception and convenience.

In summary, the literature on coupon is abundant and many valuable conclusions have been obtained. However, there is little research on coupon distribution models for online stores. Now, online shopping has become daily routine for consumers. Based on this, we have developed an analysis framework based on the Salop model of the online shop coupon distribution model, and put forward corresponding suggestions for the coupon distribution of online shop merchants.

2. Model description and basic assumption

Assuming the market is a unit circle, consumers are evenly distributed on the circle. Consumers have the common reservation price V for the product and each consumer purchase at most one unit of the product. The product is located at a point on the unit circle and sold at price p. Consumers will give appropriate evaluations for the online shopping process. The farther away from the product, the lower the satisfaction level, and the transaction cost per unit distance is represented by t.

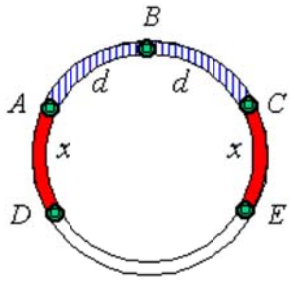

Figure1. Market distribution of online shop

3. Model analysis

3.1 No distribution of e-coupons

In figure 1, point B represents the product sold by online shops. Points A and C indicate those marginal consumers who have no difference in whether or not to purchase the product. By the equation: V-p-dt=0, we can get the distance of marginal consumer $d = \frac{V-p}{t}$. The area from A to C is the market coverage of the online shop. By deriving, we can get the optimal solution for each variable as:

$$p^* = \frac{V}{2}, \Pi^* = \frac{V^2}{2t}, k^* = 2d^* = \frac{V}{t}$$

3.2 Mass distribution of e-coupons.

Since the merchant does not have detailed analysis of the past customers' purchase records, only random distribution can be selected. The marginal cost of distributing e-coupons is fixed, so the cost is linear with probability. We can get the cost function is $C(m) = b_1 m$. As loyal online shoppers, AC part of consumers will do online shopping regardless of whether they receive e-coupons. Consumers who do not choose online shopping will do depending on the face value of the coupon. D and E are used to represent the marginal consumers who receive e-coupons. AD and CE part of the electronic preferential exchange rate is set to n. According to figure 1, the following equation can be obtained:

$$V - p - dt - xt + f = 0 \quad (1)$$

Since r-p-dt=0, we get $x = \frac{f}{t}$. Then the expected value of x is $E(x) = \frac{mf}{t}$. Total revenue of the online store consists of two parts, $\Pi_1$represents the first part of the income, which comes from loyal consumers. So we can get $\Pi_1 = 2[(1-m)dp + md(p-f)]$. Π_2 indicates the second part of the income, that consumers who are not eligible for online shopping without receiving the electronic coupons will be exchanged for $n \in [0,1]$. $\Pi_2 = 2\bar{x}n(p-f) = \frac{2nmf}{t}(p-f)$. Total profit of the merchant is $\Pi_t = \Pi_1 + \Pi_2 - C(m)$, which can be expressed as:

$$\Pi_t = 2[(1-m)dp + md(p-f)] + \frac{2nmf}{t}(p-f) - b_1 m \quad (2)$$

Subject to $0 \le m \le 1, 0 \le p \le V, 0 \le f \le p, 0 \le \frac{V-p}{t} \le \frac{1}{2}, 0 \le \frac{f}{t} \le \frac{1}{2} - \frac{V-p}{t}$

First, we can assume that the coupon function is maximized, ie n=1. From the model we can infer$(1-m^*)f^* = 0$. We can get that all customers who enter the online shop can receive the e-coupon. In this case, the profit of the merchant is $\Pi_t = \frac{V^2}{2t} - a_1 - b_1$, so the profit of the merchant is $\Pi_t \le \frac{V^2}{2t} - a_1 - b_1$.

Proposition 1.Under the condition that the electronic coupons are issued and used conveniently, merchants cannot achieve the purpose of price discrimination and make profits by randomly issuing e-coupons.

3.3. Distribution of e-coupons based on customer information

3.3.1 Fixed face value e-coupons to consumers

First, the business analyzes the consumer purchase record for daily sales activities. These consumers are loyal to online shopping, and merchants will not issue e-coupons to them. Next, the merchant conducts statistical analysis on the consumer purchase records of large-scale promotional. In this period, the newly added consumers are those who would consider online shopping only after obtaining e-coupons. Merchants will issue e-coupons to these consumers.

The marginal consumers of the no e-coupon segment are at points A and C, and the marginal consumers of the e-coupon segment are at points D and E. We assume that the consumer analytics cost b_2 is linearly related to the coupon portion x. Then the total net profit is equal to $\Pi_t = \Pi_N + \Pi_C - C(x)$, where $\Pi_N = 2dp, \Pi_C = 2x(p-f), C(x) = 2b_2x$. Therefore

$$\mathrm{Max}\frac{2}{t}(Vp - p^2 + pf - f^2 - b_2f) \tag{3}$$

Subject to $0 \le p \le V, 0 \le f \le p, 0 \le \frac{V-p}{t} \le \frac{1}{2}, 0 \le \frac{f}{t} \le \frac{1}{2} - \frac{V-p}{t}$

The optimal solution for each variable as:

$$f^* = \frac{V-2b_2}{3}, p^* = \frac{2V-b_2}{3}, k^* = \frac{2}{3t}(2V-b_2), \Pi_t^* = \frac{2}{3t}\left[V^2 - Vb_2 + {b_2}^2\right]$$

Proposition 2.Only if $2b_2 < V < \frac{3t-2b_2}{2}$, the merchant issues e-coupons with face value of $\frac{V-2b_2}{3}$, and consumers who account for $\frac{2}{3t}(2V-b_2)$ receive the discount. Voucher, the total profit of the merchant increases $\frac{(V-2b_2)^2}{6t}$.

3.3.2 Changing face value e-coupons to customers

Because the face value of the coupon is not fixed, merchants first need to predict the location of marginal consumers in the coupon issuing part. It is difficult for merchants to perfectly estimate the transaction cost of the consumer. However, in order to expand the market, merchants will overestimate the transaction cost of the consumer as much as possible within the allowable range. Assuming that merchants overestimate or fully estimate the transaction costs of consumers with probability q, for all consumers xi is within the range of $[0,x_m]$, $q=\Pr\{x_i \le x_{ii}\}$.Π_I indicates the price of the product paid by the consumer i who owns the e-coupon Π_I is given by

$$\Pi_I = \begin{cases} p - f_i & \text{probability } q \\ 0 & \text{probability } 1-q \end{cases}$$

Therefore, the expected profit of consumer i is $E(\Pi_I) = q(p - x_{ii}t)$, For the profit of the entire e-coupon portion, we can calculate the total profit of the consumer in the $x_{ii} \epsilon [0,x_m]$ area

$$\Pi_c = 2\int_0^{x_m} q(p - x_{ii})dx_{ii}$$

Similar to the fixed face value e-coupon, the consumer analytics cost b_2 is linearly related to the coupon portion x_m. Merchants who take into account the cost and benefits comprehensively combine of their own technology to get the best accuracy choice. We assume that merchants generate secondary costs in order to achieve accuracy q, then the consumer analysis cost is $C(x,q) = 2b_2x_m + a_2q^2$ therefore, the total profit of the merchant is $\Pi_t = \Pi_I + \Pi_C - C(x,q) = 2\left(\frac{V-p}{t}\right)p + 2\int_0^{x_m} q(p-xt)dx - (2b_2x_m + a_2q^2)$

$$\mathrm{Max}\left(\frac{2Vp-2p^2+2tqpx_m-qx_mt^2-2tb_2x_m-ta_2q^2}{t}\right) \tag{4}$$

Subject to $0 \le p \le V, 0 \le f \le p, 0 \le \frac{V-p}{t} \le \frac{1}{2}, 0 \le x_m \le \frac{1}{2} - \frac{V-p}{t}$

The optimal solution for each variable as:

$$p^* = \frac{V - b_2}{2 - q}, x_m^* = \frac{qV - 2b_2}{qt(2 - q)}, \Pi_t^* = \frac{a_2 tq^4 - 2a_2 tq^3 - 2b_2 q + V^2 q + 2b_2^2}{2tq(2 - q)}, k^* = \frac{2(V - b_2)}{t(2 - q)}$$

Proposition 3.Only if $\frac{2b_2}{q} + \sqrt{2a_2 t(2 - q)} < V < \frac{t(2-q)-2b_2}{2(1-q)}$, the merchant issues changing face value e-coupons, and consumers who account for $\frac{2(qV-2b_2)}{qt(2-q)}$ receive the discount. Voucher, the total profit of the merchant increases $\frac{2a_2 tq^4-4a_2 tq^3+V^2 q^2-4Vbq+4b_2^2}{2tq(2-q)}$.

4. Discussion on the mode of electronic coupon issuance

In this chapter, we will make a detailed comparison and analysis of the two forms of coupon placement, studying the impact of online shops on product prices and profits in the case of e-coupons.

Proposition 4. When $q > \frac{V+b_2}{2r-b_2}$, the indefinite value coupon is higher than the fixed denomination coupon in terms of product price, market share and consumer coupon ratio.

Proposition5. When positioning electronic coupons is profitable, online merchants will increase the product price of online shoppers who are loyal. In addition, the lower cost of consumer analysis makes merchants charge higher product prices.

The profits generated by the two location-based e-coupon models depend on the parameters of the model. The condition that the target coupon model generates more profit than the other one can be derived based on parameter values, but the structure is quite complex and we won't discuss it in detail.

5. Conclusion

We have studied several major electronic coupon distribution modes available in online stores. Without analyzing customer information, such as setting coupons on the front page of online stores, merchants will not be able to obtain profits by randomly distributing electronic coupons. We have found that online merchants will charge higher prices to consumers with lower transaction costs while launching targeted e-coupons to expand the market. Lower customer analysis costs will result in higher prices for merchant products.

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