The probabilistic view of Group purchase

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Abstract

In this study, we use computer simulation to clarify the statistical foundation of the "group purchase" behavior, which assumes the decision of a consumer possesses probabilistic nature. The competing producers are set to have the same starting fund, daily cost, and the probability of attraction to consumers. The simulation runs until anyone of the producers bankrupts. Without grouping, the average survival time, T_{ave} of the producers is inverse proportional to P and reaches maximum when both producers have the same attraction. When the consumers are grouped, the T_{ave} is reduced to 30 % for the producers that are equivalent in attraction, whereas no discrepancy for the attraction differs more than 2 %. It implies the strategy of grouping of the consumers only effects when two producers are in equal status. This might explain the small company would provide a larger discount to the grouped consumers. It is found that the distributions of the daily income plays significant role on the survival of the producers. The deviation is larger for the grouped rather than that for the individual consumers. It reveals the grouping implying a severer fluctuation, which may rapidly drive the system soon approaching to the steady state that only one producer survives.

Keywords: group buy, group purchase, team shopping, simulation, stochastic process, competition, survival time, fluctuation, probability, statistics

1. Introduction

"Group purchase" ("group buy" or "team shopping"), which is to gather individual consumer to bargain. It is often interpreted that the producer may obtain extra surplus by selling lower price (e.g. wholesale price) with large quantity to the grouped consumers (1). The producer can save the cost on marketing and stock of products or reduce the risk on price reduction and demand uncertainty in the future (2–4). This behavior is often seen on the electronic commerce through internet, or electronic commerce, where the group purchase works very actively (1, 5, 6). Many researches study the group negotiation mechanism such as collective wisdom of the large number of buyer on bargaining or products investigation (7). Some papers study the profit of the seller, such as reduction of the demand uncertainty, cost on marketing, storage, or etc (8, 9). Nevertheless, seldom paper focuses the effect of grouping itself.

In this paper, we study the group itself: without the benefit mentioned above, what is the effect of grouping itself? In our model, the producer does not reduce the price when the consumers get alliance. Hence, the consumers team up together without gaining any wisdom nor bargain strategies. That is, they just buy together coincidentally. The consumers randomly choose two competing producers have identical assets and cost, and provide identical products in all details including quality, price, and etc. In other words, the consumers have the same benefit no matter which producer they choose. The probability for the consumers to buy or not to buy is P or (1-P), respectively. We simulate how the individual consumers effect on the two identical producers and followed by team up the consumers. It is found that one of the two competing producers will eventually close. The producer closes even earlier when the consumers coalesced. Further analysis reveals that the grouping makes the distribution of the producer's daily income deviated larger when the consumer coalesced. That is, the grouped consumer makes competition even vigorous, which may soon drive the competing producers to the steady state that one of the competitors bankrupts.

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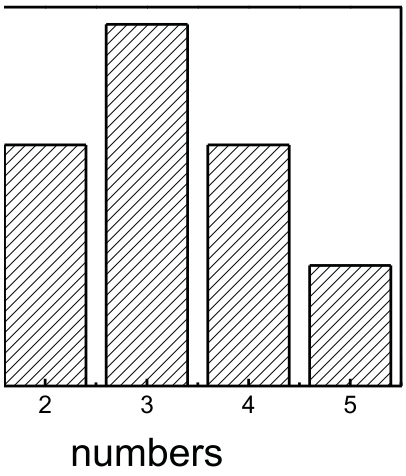

Figure 1: The comparison of T_{ave} of the producers with individual or grouped consumers.

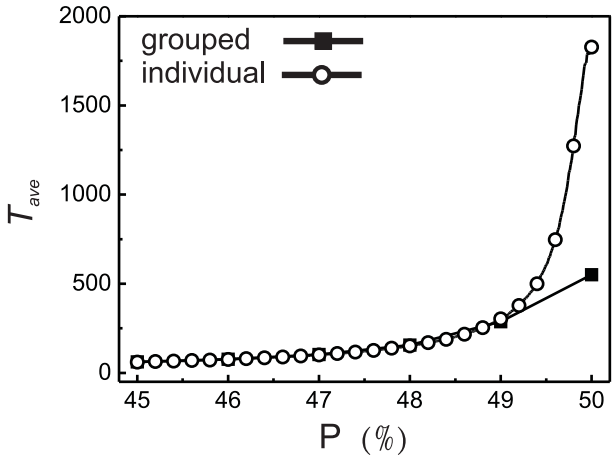

Figure 2: The comparison of the daily income of the producers with individual (∘)or grouped (■) consumers.

2. Simulation

We take the advantage of computer simulation, in which conditions can be well controlled. For avoiding the preference (or bias), the consumers choose which producers to purchase by an attraction probability P comprising all possible factors influencing the choice. We take N consumers purchase products from two competing producers selling the same products with the same starting fund F and daily cost D. It is set P for one producer and (1-P) for the other (for two identical producers, P = 50 %). For simplicity, the cost for a consumer on a unit of the products, U is set to be equal. The price for the product is set to be M for each item and each consumer purchase the products one item per unit time (day). For not losing the generality, we set D equals $1/2 \times M \times M$. That is, the expectation daily income for each producer is zero. The producer goes bankrupt when it runs out of the fund. (One may set the terminating condition to the other expected values of daily income.)

First, we let the consumers purchase the product individually. We simulate 10000 times for a each P and (1-P) setting. The number of days that the producer bankrupts for each run is recorded. Second, we let the consumers coalesce together in different size by some distributions. Example of a distribution of the group size is shown as Fig. 1. Each group of consumers makes the choice according to the attraction probability P. The simulation is terminated when one of the producers runs out of the fund, the same as the condition for the individual consumers. Each P and (1-P) setting is also run for 10000 times.

3. Results

One of the producers will close eventually no matter the consumers coalesce or not, i.e., one of them will bankrupt. That is, they do not share the income from the consumers when the attraction probability is the same, i.e., P = 50 %. Therefore, the competition of the two producers can be resolved by the unit of time of each run of simulation.

The average survival time T_{ave} as a function of attraction probability P is shown in Fig. 2. When the P is the same for both producer, the competition lasts the longest indicating the least competing case. The survival time is shorten when the attraction is unequal, i.e., one is more attractive to the other that P is less than 50 % ((1-P) is more than 50 %). The black square (■) in Fig. 2 shows the average survival time T_{ave} as a function of attraction probability P for the grouped consumers. Without grouping, the average survival time, T_{ave} is inverse proportional to P. The T_{ave} reaches maximum when both producers have the same attraction, i.e., P = 50 %. It reduces to 5 % of the maximum when the two have 10 % difference in attraction, i.e., P = 45 %. In other words, the producer that attracts 45 % of the consumers closes much earlier than the one that attracts 55 %. The open circle (∘) in Fig. 2 presents the T_{ave} when the consumers

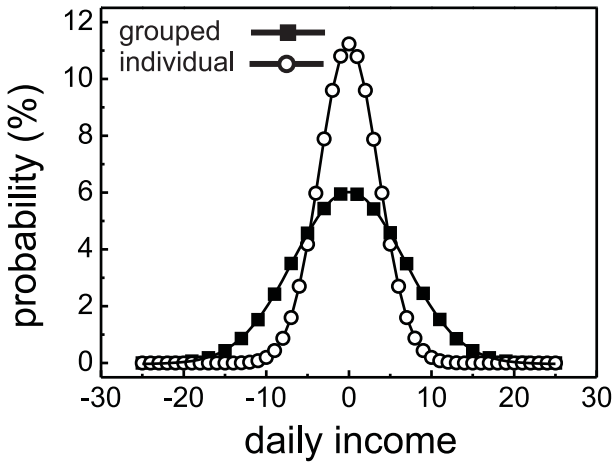

Figure 3: The comparison of the daily income of the producers with individual (∘)or grouped (■) consumers. Both of the distribution follows a normal distribution pattern with average of zero. The deviation of the grouped is larger than the individual ones.

are grouped. It is reduced to 30 % when the producers are equivalent in attraction, i.e., P near 50 %. It indicates that the survival of the producer is more difficult when the consumers are grouped. When the attraction is not equal, i.e., P < 50 %, the T_{ave} is shorten. However, the difference between group buying and individual buying becomes small.

Further analysis on the distribution of daily income of the producers with P = 50% is shown in Fig. 3. The black square (■) and open circle (∘) are the distribution of the producers with grouped and individual consumers, respectively. Both distributions have the same average of zero as the expected value, but different in the deviation. It is larger when the consumers are grouped. The larger deviation indicates the instability of the daily income that drives one of the producers run out of money sooner.

4. Discussion

The producer with higher attraction can survive longer, while the producer with lower attraction go bankrupt sooner. The survival time can indicate the competition of the two producer under such condition. The shorter survival time, the more competitive. That is, the grouped consumers make the situation more competitive. In the view of the producer, nothing is changed: the same products, the same service, the same price, and etc (the same attraction probability in our model). Once the consumers coalesce, it faces a severer competition environment. When the producer receive an order of large amount, it may bring a lot of income but also bring its competitor into a dangerous situation. This is the power of the grouping itself.

For reducing the stress from competition to enhance the survival opportunity, the producer should avoid the grouping of the consumer. One of the example is Synnex Technology International Corporation, one of the leading distributors of computers, cell phones, and other 3C products (10). The policy on downstream dealer asks the dealer orders products one item each time. The strategy is to reduce the cost of the stocking of the dealers. That is, the dealer can have many kinds of the products, but one item for each. However, it increases the cost on transportation to distribute the products to the dealers. Our results show, nevertheless, this policy also prevent the grouping of the dealers.

Additionally, in the view of the producers, the expected daily income is the same no matter the consumers coalesce or not. However, the distributions of the daily income are different in the deviation, not the average. The larger deviation indicates the instability in daily income that sometimes much and sometimes less. The smaller deviation indicates that the daily income is close to a constant that near the average. In other words, the larger deviation in daily income may bring the producer more income occasionally. However, it also brings the two competitors soon approaching to the steady state that one of the two goes bankrupt. The larger deviation in daily income can be considered as ”high risk”. However, it does not always bring the producer ”high return” in our model. It implies that ”high risk, high return” does not employed when the fund is limited, the income is fluctuated, and a least income is required.

5. Conclusion

The power of grouping itself is not only a collection of wisdom to bargain, but also force the producers into a more competitive situation. The producer would like to reduce the price to the grouped consumers not only for saving the cost on marketing or stocking, but also for relieving the stress of competition. Additionally, the expectation value (e.g. daily income) is not sufficient for making a decision on a system with probabilistic nature. One needs to consider the deviation of the distribution of the results.

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