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## Agent-Based Simulation for Online Shopping Platform Rules

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**Abstract:** This study mainly researches game rules, “species” strategy and interactive mechanism in online shopping platform and explains each game agent group cooperative or competitive behavior in the electronic commerce ecosystem. Then a simulation model based on multi-agent has been established, that in order to analysis consumer preference’s effect on the electronic commerce ecosystem quantitatively and inquire into the trend of development of electronic commerce ecosystem through the simulation which is made by Starlogo simulation software.

**Key words:** Multi-agent simulation, E-commerce ecosystem, Starlogo, online shopping platform, complex adaptive system

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### INTRODUCTION

E-commerce ecosystem is a economic entity which is based on the interaction between the individual (in the business world organism) and organization in the business activities in the Internet environment. Also refers to a group where the consumers, distributors, suppliers, intermediaries, investors, producers, consumers, government provide customer service or commodity production. They carry out their duties in different functions in the electronic commerce ecosystem, but also formed a mutual dependent, interdependent and symbiotic ecosystem. In an e-commerce ecosystem, although there are different benefit driving but the personal or organizational in it shares resources, mutual benefits and coexistences and it pays attention to economic, social environment and comprehensive benefits, it keeps the continuation and development of the whole ecological system together.

In Moore (1993) published an article entitled "the new competitive ecology" article in "Harvard Business Management Review", this is the first time that the ecology viewpoint formally applied to business theory and put forward the concept of business ecosystem. After this, Moore (1996) definitely illustrated the ecosystem and evolution rules of business and pointed out that in the environment of economy integration, enterprises need to put the ecological system of enterprises as the angle of view, carried on the management to the enterprises and established the appropriate strategy in the book "the death of competition: leadership and strategy in the age of business ecosystems". Moore (2006) according to the balance level of e-commerce ecosystem, he divided the

process of development of e-commerce ecosystem into 4 phases which is exploration, development, coordination, evolution. At present, the research literature of e-commerce ecosystem is mainly focus on the concept, members, the evolution path and system construction and so on of e-commerce ecosystem.

If any node in e-commerce ecosystem destroyed or any enterprise’s interests damaged, it will affect the entire e-commerce ecosystem’s stability and balance and damage every member in the system finally.

### THE SIMULATION MODEL

In this study, the Alibaba Group (tmall, Taobao Mall) is regarded as the research object. Alibaba (Alibaba.com) was established in December 1998 and headquartered in Hangzhou of Zhejiang Province and the establishment of overseas branches is in the United States Silicon Valley, London and so on. Alibaba has attracted a large number of retailers, consumers, suppliers and many other individuals and has gathered them together in the Alibaba.com trading platform through various ways.

This study quantitatively analysis the influence of the change of the rules of the game to the e-commerce ecosystem through the simulation. Businesses of Tmall.com are divides into flagship stores, stores and specialty stores. The relationship between consumers and businesses in tmall is listed below (Fig. 1):

**The simulation hypothesis:** Let's make the following simulation conditions based on the Tmall’s reality situation:

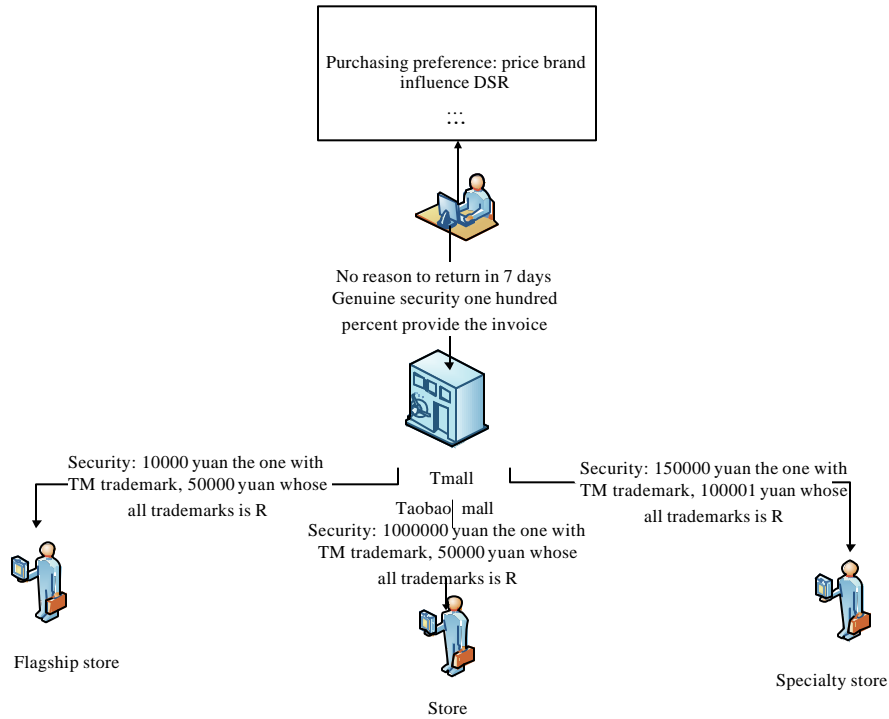


Fig. 1: The relationships among consumers and businesses in tmall

- There are three types of businesses in the simulation environment: the flagship stores, stores and specialty stores, Tmall Mall charges different technical service fee and deposit for the three merchants
- There is no difference between the goods provided by big or small merchants, the quality of the goods is also the same, in addition businesses all provide good services
- The number of consumers is fixed, the consumers have preferences and this preferences do not change in a long time; part of the consumer prefer to brand goods and another part of consumer prefer to the seller who provided the cheaper commodities
- The merchants could boost their own brand influence by increasing the advertising investment and so on

**Agents' attributes:** According to the hypothesis of the condition of the simulation and the analysis of the whole system, the business agent is the flagship stores, stores and specialty stores and consumers in the simulation system. Tmall is regarded as a trading platform to study but the agent involved in the game (Guoyin Jiang, 2010).

Then business attributes include: cost, price, sales-volume, sales, brand, advertising-cost, score, annual-fee, security, capital, profit. Profit refers to the business's gain use yuan as it's unit. The calculation formula of the

Table 1: Explanation of the consumer classification

| Categories                  | Color | Brand scores | Price scores |
|-----------------------------|-------|--------------|--------------|
| Brand-preferred businessmen | White | 1            | 0            |
| Price-preferred businessmen | Blue  | 0            | 1            |

profit is different according to the difference of shop score and sales, formula is as follows:

When shops average score below 4.6 points:

$$\text{Profit} = \text{Sales} - \text{Salesvolume} \times \text{Cost} - \text{Advertisingcost} - \text{Annualfee} \times 1000$$

When shops average score is not less than 4.6 points:

When sales < salesnumber1:

$$\text{Profit} = \text{Sales} - \text{Salesvolume} \times \text{Cost} - \text{Advertisingcost} - \text{Annualfee} \times 1000$$

When salesnumber1 <= sales < saleanumber2:

$$\text{Profit} = \text{Sales} - \text{Salesvolume} \times \text{Cost} - \text{Advertisingcost} - \text{Annualfee} \times 1000 \times \frac{1 - \text{Returnratel}}{100}$$

When sales >= salesnumber2:

$$\text{Profit} = \text{Sales} - \text{Salesvolume} \times \text{Cost} - \text{Advertisingcost} - \text{Annualfee} \times 1000 \times 1 \frac{1 - \text{Returnrate}^2}{100}$$

The majority of consumers refer to the shopping agent in small mall. According to the hypothesis of the condition of simulation, consumers are divided into the following two categories according to the price-preference and brand-preference:

**Designing agents' behavior**

**The businesses behavior rules:** The rule of business is learning from adjacent businesses. Businesses will be compared with their adjacent business's sales, at first every merchant should find out the merchant whose sales is the maximum among its adjacent businesses and save the commodity price and brand value.

According to the previous assumption, different categories of business means the difference of its capital and the degree of their attention to brand influence and price, therefore in the following rules businesses all learn the optimal business strategy with different behaviors according to their different categories.

- **Flagship store:** Because its capital is relatively small, according to this characteristics, they mainly attract consumers by the price advantage and maintain their price advantage, the advertising cost will be relatively conservative and this is the principle
- **Exclusive shop:** The capital of exclusive shop is larger than the flagship store but less than the specialty stores, the main characteristic of exclusive

shop is to learn adjacent businesses behavior and to adjust the price appropriately and invest into advertising. Exclusive shop doesn't pursue the absolute price and brand advantage

- **Specialty stores:** Capital of the specialty stores is the most and they mainly use brand advantage to attract consumers, specialty stores focus on improving their brand influence and its brand advantage is obtained by increasing advertising-cost when learning optimal business behavior, at the same time, because the advertising investment is relatively higher, so its smaller price cut when need to use the price strategy.

**Behavioral of consumers:** Consumers search for merchants randomly and initiatively rules. Its saying that in the simulation we make consumers call on businesses randomly and initiatively, consumers choose one direction randomly and forward 10 after each trade.

Transaction rule, according to the assumption about the simulation conditions in the front, consumers have two types of preferences, so they compare with their adjacent businesses based on their own preferences everytime before trading.

**SIMULATION RESULT**

Under the simulation environment, the number of flagship shops, exclusive shop and specialty shops are equal, the average selling price of businesses are equal and the annuity of technical service are equal and then according to the previous assumptions, at this point set the value of each parameter. While the simulation interface is follow (Apratim Mukherjee, 2012) (Fig. 2).

- The amount of customer of price-preferred businesses is equal to brand-preferred businesses means brand-preferred = 50. The experimental simulation results are as follows

In this polygon, the red line represents flagship shop, the yellow line represents the stores and the green line represents specialty stores. It can be seen the biggest-selling shop is specialty stores (Fig. 3). In Fig. 5, the overall volatility trend of the commodity prices are basically identical exclusive that the average selling price of the flagship shop is the lowest and the average selling price of the specialty stores is the highest. So three kinds of businesses' sales amount, the largest business sales is specialty stores and the smallest is flagship shop. Under this condition, the three types of businesses' profit is basically equal, profits are small (Fig. 6), just because the specialty stores put more investment into advertisement.

Table 2: Four types

| Categories                        | Explain  |
|-----------------------------------|--|
| Price > :price and brand >=:brand | Commodity price is higher than the optimal commodity price and brand value is not lower than the optimal brand value     |
| Price <=:price and brand >=:brand | Commodity price is not higher than the optimal commodity price and brand value is not lower than the optimal brand value |
| Price <=:price and brand <:brand  | Commodity price is not higher than the optimal commodity price and brand value is less than the optimal brand value      |
| Price > :price and brand <:brand  | Commodity price is higher than the optimal commodity price and brand value is less than the optimal brand value          |

Table 3: The learning behavior of the flagship store

| Situation                         | Behavior  |
|-----------------------------------|---|
| Price > :price and brand >=:brand | More substantial of price cuts, lowest price limit                |
| Price <=:price and brand >=:brand | Modest price increases  |
| Price <=:price and brand <:brand  | Modest price increases, small increase advertisingcost            |
| Price > :price and brand <:brand  | More substantial of price cuts, small increase in advertisingcost |

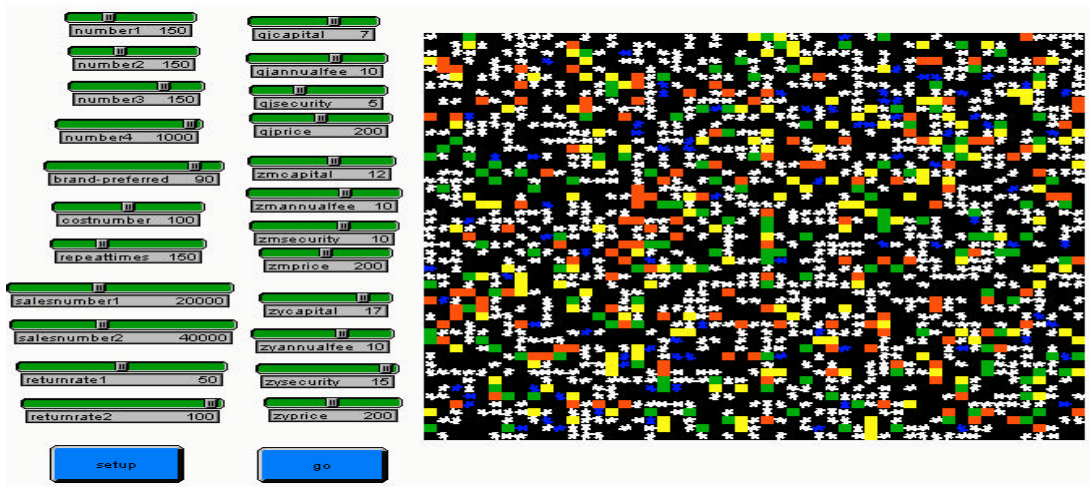


Fig. 2: Pictures from the experiments of simulation

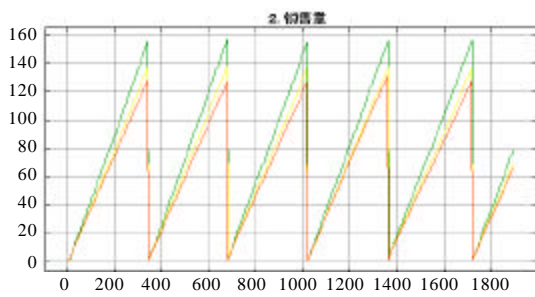


Fig. 3: Average sales volume-1

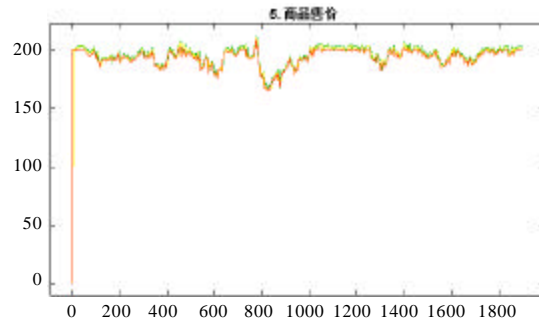


Fig. 5: Average price-1

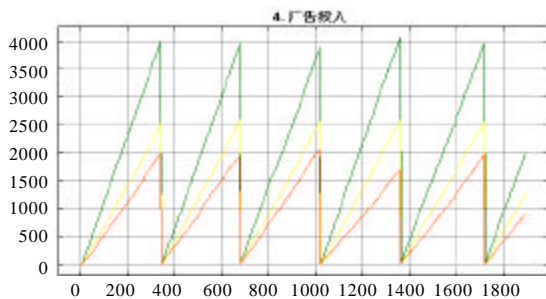


Fig. 4: Average advertising-cost-1

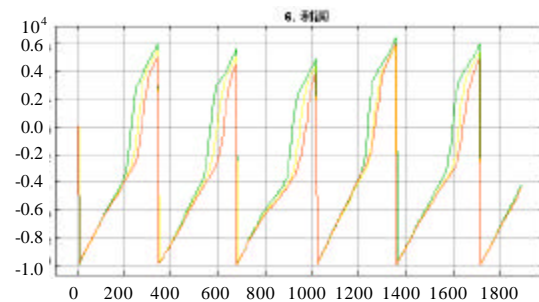


Fig. 6: Average profit-1

- The amount of customer of price-prefer businesses is greater than brand-prefer businesses, we make brand-preferred = 10 in the experiment. The experimental simulation results are as follows:

We can see from the results of the simulation, the flagship shop's strategy is the optimal when the amount of consumers of the price-preferred businesses is larger than the brand-preferred businesses, on account of the assume that the flagship shops draw consumers mainly by price. The three types of businesses all shared tactics

but distinctively in learning behaviors. We can draw from the Fig. 9, the overall volatility trend of the commodity prices are basically identical exclusive that the average selling price of the flagship shop is the lowest. The flagship shops have an advantage in sales volume (as shown in Fig. 7) when the larger consumers of price-preferred businesses, it's sales is more than the other types of businesses either, as well the least investment in advertisement (Fig. 8) so flagship shops' profits is the largest (Fig. 10).

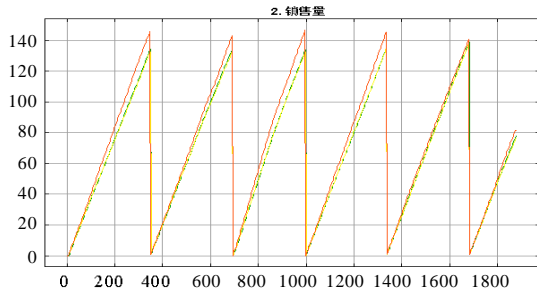


Fig. 7: Average sales volume-2

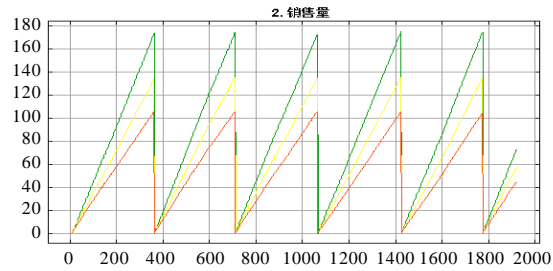


Fig. 11: Average sales volume-3

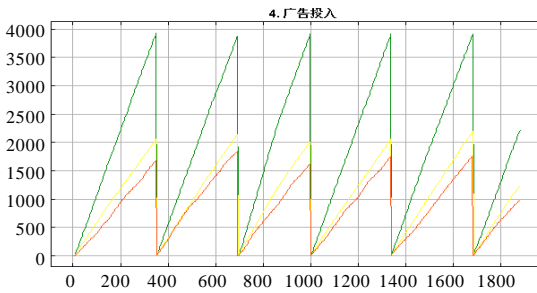


Fig. 8: Average advertising-cost-2

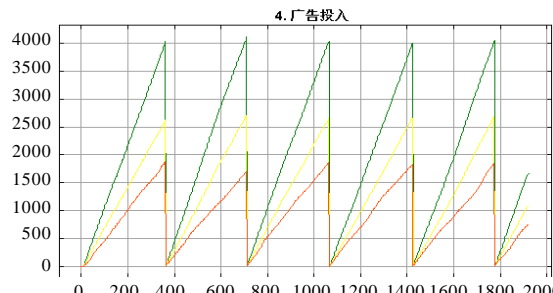


Fig. 12: Average advertising-cost-3

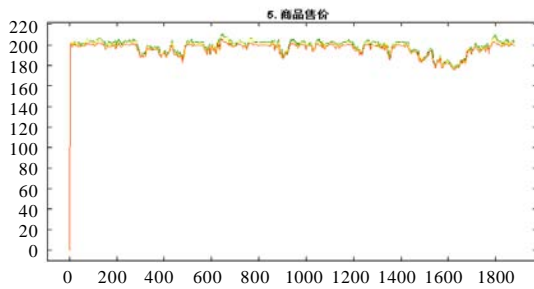


Fig. 9: Average price-2

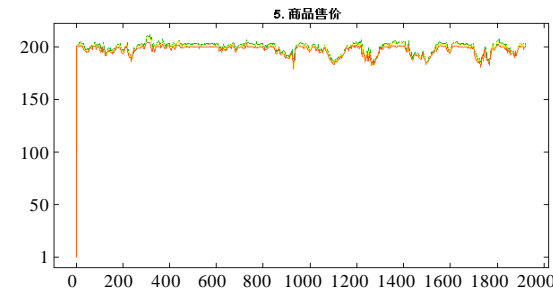


Fig. 13: Average price-3

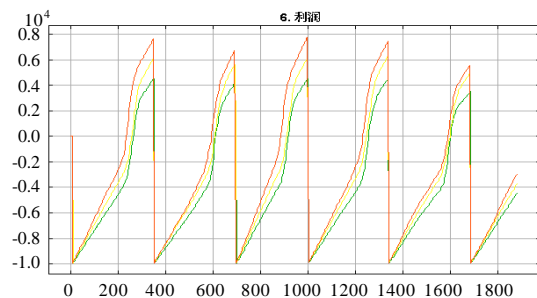


Fig. 10: Average profit-2

- The amount of customer of price-prefer businesses is less than brand-prefer businesses, we make brand-prefer = 90 in the experiment. The experimental simulation results are as follows:

We can see from the results of the simulation, the specialty stores's strategy is the optimal when the amount of consumers of the brand-preferred businesses is larger than the price-preferred businesses, on account of the assume that the specialty stores attract consumers mainly by brand. It can be observed from Fig. 12 the specialty stores put the most investment in advertisement, so the larger consumers of price-preferred businesses the specialty stores have an obvious advantage in sales volume (as presents in Fig. 11), the specialty stores' sales are far more than the other types of businesses as a result of it's selling price is also higher than the other two types of businesses. Under this condition the specialty stores's profits are obvious higher than the other types of businesses, many flagship shops

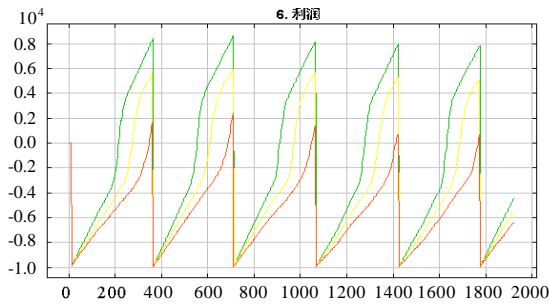


Fig. 14: Average profit-3

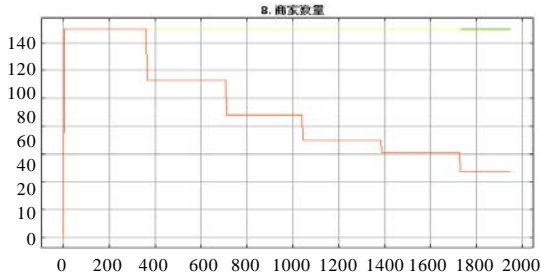


Fig. 15: The change of merchants quantity

businesses drop out the platform of tmall.com because of the negative of margin (Fig. 15).

**CONCLUSION**

From the results of the emulating about the structure which is made up of different consumers, it could be seen that for businesses to deciding when settled Lynx Mall they must go into market investigation, analyze consumer preferences and choose the right strategy about price and brand. Three types of businesses' profits difference are smaller and they can permanence across the entire ecosystem when the amount of consumers of price-preferred and brand-preferred businesses are similarity; the flagship store's strategy to attract consumers by price advantage is better and it's profits are higher, but in this case, businesses of the entire ecosystem play chess each other leading to the whole

commodity price in a lower level and the total profits drop when there is a wide range in the ratios of consumers of price-preferred businesses to brand-preferred; the specialty stores's strategy to enhance the influence of brand has obvious advantages and it's profits are far greater than flagship stores and specialty stores, specialty stores and flagship stores may appear even negative profits and be eliminated by ecosystem when the consumers of price-preferred businesses is less than brand-preferred.

So, although each species of the e-commerce ecosystem has its own different roles and functions they are linked closely in fact. The roles or policy of one population changed may lead to other populations and even the whole e-commerce ecosystem change.

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