

## Research on the Structure Trend of Sharing Bicycle Market

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**Abstract:** In recent years, with the rapid development of the sharing economy, sharing bicycles as a new form of sharing economy, has solved the pain point "the last mile" of the distribution pattern of urban public transit and subway, which plays an increasingly important role in the efficient urban road traffic management. In this paper, we firstly establishes the utility function model of sharing bicycles brands from the aspects of bicycle hardware, software, funds, and delivery, and analyzes Mobike, ofo, Hellobike and U-Bicycle, four major sharing bicycles brands on the market. Secondly, through the Markov chain, a bicycle market trend model is established, It is concluded that the market structure of sharing bicycles will eventually lead to an oligopoly in the current situation, and will not be dominated by one household.

### Introduction

As a new form of sharing economy, sharing bikes has attracted widespread attention since its birth, effectively solved the pain points of people's "last mile" travel, provided powerful help for urban traffic management to run more efficiently, and changed the public's travel mode<sup>[1]</sup>.

In the past two years, the enthusiasm of the sharing economy can be described as sweeping through the entire Internet circle. Especially after the rapid rise of Mobike and ofo and easy access to multiple rounds of financing, some already-watched entrepreneurs have seen the so-called enthusiasm insane. The continued fiery nature of sharing bicycles gives a real sense of the advantages and prosperity of the sharing economy. Sharing bicycles, as a new type of project, also compete on various types of users<sup>[2]</sup>. In order to win as many users as possible, companies that share bicycles must design better hardware and software to enhance the user experience and meet user requirements. Therefore, from the user's point of view, this article establishes the utility function model of bicycle brands to describe the core competitiveness of bicycle brands.

Nowadays, there is no doubt that the chaos in the sharing bicycle market has been reborn. After the share bike market was reshuffled in 2017, Wukong bike first announced its withdrawal from the sharing bike market. This thought is the world of the Mobike, and ofo, did not expect a giant halfway out of Hellobike. The competition for sharing bicycles is extremely fierce, and the market structure trend in the future is still extremely variable. After other sharing bicycle brands have been financed, there will be a new round of market layout. The sharing bicycle market will eventually have uncertainties. This article will establish a bicycle market trend model to predict the structure of its final market structure.

### Bicycle brand utility function model

Each bicycle brand has different attributes. It is very important to understand the user's preference for each option of each attribute. The degree of preference can be expressed in terms of a utility function, that is, the value (utility) of different options for an attribute to the customer. Unfortunately, it is generally difficult for users to directly and accurately give the utility function of each attribute. For example, for the price, the average customer will certainly say that the cheaper the better, but it is difficult to determine the price of 100 yuan and 200 yuan. What is the specific effect? However, the specific option configuration of each attribute of the bicycle has been determined, so if we let the user score the bicycle (you can do user feedback survey on the bicycle platform), the user can usually give specific utility more easily. We selected Mobike, ofo, Hellobike,

U-Bicycle as research objects and collected data on their hardware, software, funds, and delivery volume, as shown in Table 1:

Table 1 Related data of Mobike, ofo, Hellobike, U-Bicycle

Elements	Brands	Mobike	ofo	Hellobike	U-Bicycle
Hardware	driving method	shaft drive / chain drive	chain drive	chain drive	chain drive
	weight (kg)	≈22	≈16	≈18	≈16
	bike lock	GPS smart lock	manual lock	GPS smart lock	GPS smart lock
	tires	explosion-proof tire	ordinary tire	shock-absorbing solid tires	ordinary tire
	brake	brake	clip brake + holding brake	front and rear double brake	front and rear double brake
Software	usage mode	App+ scavenging code	App+ scavenging + cipher	App+ scavenging code	App+ scavenging code
	parked mode	flexible parking	flexible parking	flexible parking	flexible parking
	settlement method	no need to open App automatic settlement			
	deposit (yuan)	299	99	199	298
Capital	charges (yuan/an hour)	1	city: 1 on campus: 0.5	1	1
	deposit supervision	banking supervision	no public information	no public information	no public information
	cost (yuan)	about 3000	about 400	about 700	about 1000
Delivery volume	occupancy(%)	31.2	35.1	26.1	0.9

Then we define:

Bicycle Brand Attribute Ranking Score = 4 - Ranking (1)

The specific results are shown in Table 2.:

**Table 2 Ranking of 4 Bicycle Brand Attributes**

Elements	Bicycle attributes	Mobike		ofo		Hellobike		U-Bicycle	
		Rank	Score	Rank	Score	Rank	Score	Rank	Score
Hardware	driving method(A1)	1	3	2	2	2	2	2	2
	weight (kg) (A2)	3	1	1	3	2	2	1	3
	bike lock(A3)	1	3	2	2	1	3	1	3
	Tires(A4)	2	2	3	1	1	3	2	2
	brake(A5)	1	3	2	2	2	2	2	2
Software	usage mode(A6)	1	3	2	2	1	3	1	3
	parked mode (A7)	1	3	1	3	1	3	1	3
	settlement method (A8)	1	3	1	3	1	3	1	3
Capital	deposit (A9)	3	1	1	3	2	2	3	1
	charges(A10)	2	2	1	3	2	2	2	2
	deposit supervision(A11)	1	3	2	2	2	2	2	2
Delivery volume	occupancy(A12)	2	2	1	3	3	1	4	0

The table below shows the user's scores for the specific options for the bicycle brand attributes in Table 2.

Table 3 User Scores Specific Options for Bicycle Brand Attributes

Option 2 \ Option 1		Hardware			Software			Capital		Delivery volume			
		driving method (A1)	weight (kg) (A2)	bike lock (A3)	tires (A4)	brake (A5)	usage mode (A6)	parked mode (A7)	settlement method (A8)	deposits (A9)	charges (A10)	deposit supervision (A11)	occupancy (A12)
Hardware	driving method (A1)	2	2	6	7	8	4	2	2	3	7	2	4
	weight (kg) (A2)	2	1	4	4	5	2	2	2	2	3	2	2
	bike lock(A3)	6	4	1	6	7	3	4	2	2	4	1	2
	Tires(A4)	7	4	6	2	9	3	3	2	3	4	3	3
	brake(A5)	8	5	7	9	5	6	3	6	7	7	5	8
Software	usage mode(A6)	4	2	2	3	4	2	6	2	3	4	3	4
	parked mode (A7)	2	2	4	3	3	4	2	4	5	6	4	6
	settlement method (A8)	2	2	2	2	6	1	4	5	3	4	1	2
Capital	deposit(A9)	3	2	2	3	7	3	6	4	5	9	4	4
	charges(A10)	7	3	4	4	7	3	6	4	5	9	4	4
	deposit supervision(A11)	2	2	1	3	5	1	4	1	4	4	4	3
Delivery volume	occupancy(A12)	4	2	2	3	4	2	6	2	3	4	3	3

In Table 3, the corresponding utility for option 1 is  $2 p_j (j = A_1, \dots, A_{12})$ , The utility of option 2 is  $p_i (i = A_1, \dots, A_{12})$ , Suppose the utility of options 1 and 2 is linearly additive, That is, when the option 1 is  $j$ , the option 2 is  $i$ , The utility of brand bike  $c(i, j)$  uses the sum of the two to estimate:

$$c(i, j) = p_j + q_i$$

(2)

In order to compare the quality of the different estimates, 144 parameters to be determined ( $p_j$  and  $q_i$ ). 144 sets of data are given in the table. The least square method is used to determine  $p_j$  and  $q_i$ , ie, the objective function at this time is:

$$\min \sum_i \sum_j [c(i, j) - c_0(i, j)]^2$$

(3)

Among them,  $c_0(i, j)$  is the data in the table.

Our goal is to eliminate the order of the specific products of different configurations. We hope that  $c(i, j)$  and  $c_0(i, j)$  will maintain the same order: That is to any  $(i, j)$  and  $(k, l)$ , at that time  $c_0(i, j) + 1 \leq c_0(k, l)$ , and as much as  $c_0(i, j) + 1 \leq c(k, l)$ . (" + 1 " here means that  $c(i, j)$  is strictly less than  $c(k, l)$  and at least 1), Thus, the objective function is:

$$\min \sum_{i,j} \sum_{k,l} (1 + p_j + p_i - p_l - p_k)$$

(4)

The summation in (4) is simply the summation of  $(i, j)$  and  $(k, l)$  satisfying  $c_0(i, j) + 1 \leq c(k, l)$ . Use lingo software to solve the following results, as shown in Table 4.

**Table 4 Bicycle Attributes Utility**

	hardware			software			capital	Delivery volume				
Element	driving method (A1)	weight (kg) (A2)	bike lock (A3)	tires (A4)	brake (A5)	usage mode (A6)	parked mode (A7)	settlement method (A8)	deposit (A9)	charges (A10)	deposit supervision (A11)	occupancy (A12)
utility	19	1	12	19	42	7	15	4	18	30	4	9

Then we define:

$$\text{Core competitiveness} = \sum \text{utility} * \text{bicycles attribute ranking score}$$

(5)

The specific results are shown in Table 5:

**Table 5 Core Competitiveness Ranking**

Attributes	utility	Mobike attribute Ranking score	ofo attribute Ranking score	Hellobike attribute Ranking score	U-Bicycle attribute Ranking score
Driving method(A1)	19	3	2	2	2
weight (kg) (A2)	1	1	3	2	3
bike lock(A3)	12	3	2	3	3
Tires(A4)	19	2	1	3	2
brake(A5)	42	3	2	2	2
usage mode(A6)	7	3	2	3	3
Parked mode (A7)	15	3	3	3	3
Settlement method (A8)	4	3	3	3	3
Deposit(A9)	18	1	3	2	1
Charges(A10)	30	2	3	2	2
Deposit supervision(A11)	4	3	2	2	2
Occupancy(A12)	9	2	3	2	0
Total Score = Utility * Bicycle Attribute Ranking Score		444	418	417	363
Core competitiveness ranking		1	2	3	4

From Table 5, we can finally find out that Mobike ranked first in the core competitiveness ranking of bicycle brands, followed by ofo, Hellobike, and U-Bicycle.

### Sharing Bicycle Market Trend Model

We studied Mobike, ofo, Hellobike and U-Bicycle to explore the evolution of bicycle market. According to historical data based on user usage of bicycle platforms in the past two years<sup>[3,4]</sup>, these data are represented by the following hypothetical transition matrix Table 6 and Fig. 1.

Table 6 Four bicycle platform users transfer matrix

Next status \ Current status	Mobike	ofo	Hellobike	U-Bicycle
Mobike	0.37	0.28	0.23	0.12
ofo	0.22	0.40	0.25	0.13
Hellobike	0.18	0.28	0.44	0.10
U-Bicycle	0.27	0.23	0.22	0.28

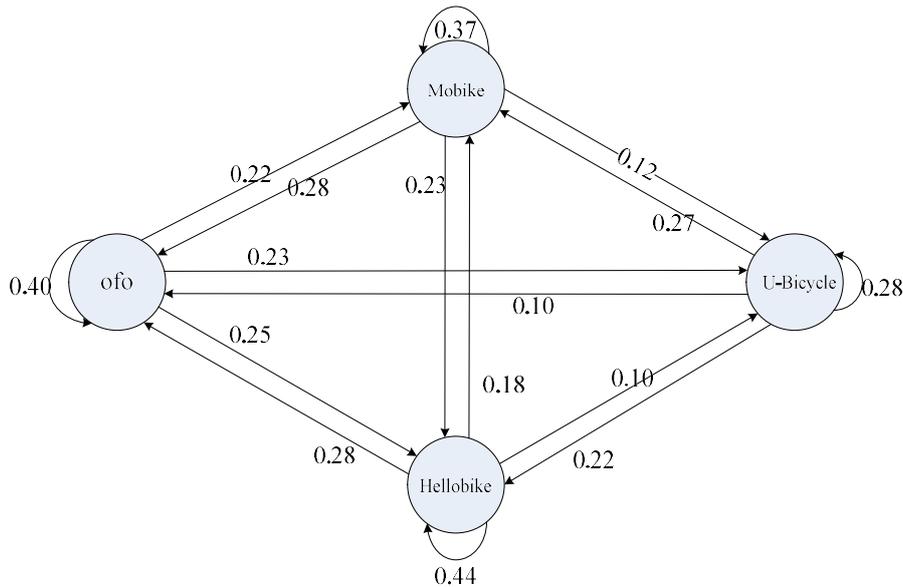


Fig.1 Four bicycle platforms users transfer Markov chain

Define the following variables:

$B_n$  = the percentage of users who choose Mobike at the nth period

$F_n$  = the percentage of users who choose ofo at the nth period

$M_n$  = the percentage of users who choose Hellobike at the nth period

$L_n$  = the percentage of users who choose U-Bicycle at the nth period

Using the above data, the following equations are obtained:

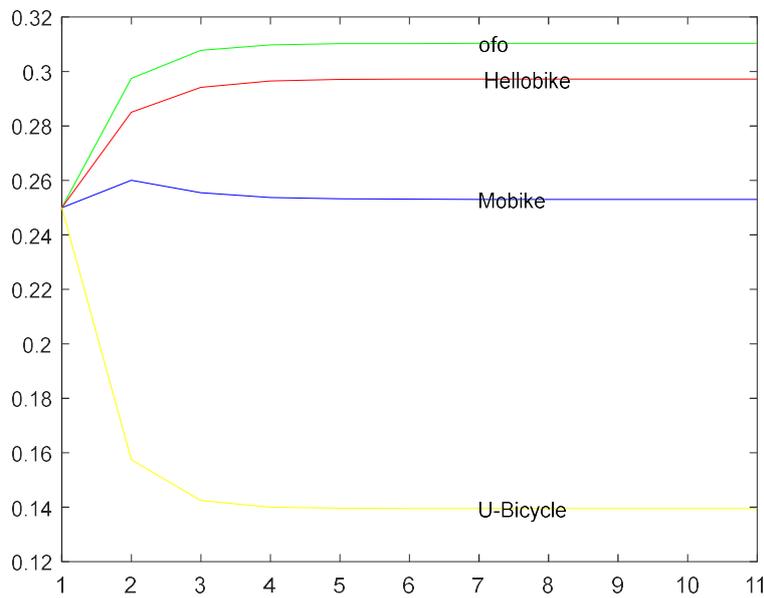
$$\begin{cases} B_{n+1} = 0.47B_n + 0.35F_n + 0.08M_n + 0.10L_n \\ F_{n+1} = 0.30B_n + 0.56F_n + 0.08M_n + 0.10L_n \\ M_{n+1} = 0.18B_n + 0.37F_n + 0.35M_n + 0.10L_n \\ L_{n+1} = 0.32B_n + 0.30F_n + 0.09M_n + 0.29L_n \end{cases}$$

(6)

Assume that case 1: The percentage of users choosing Mobike, ofo, Hellobike and U-Bicycle each accounted for 1/4 at the beginning; case 2: The percentage of users choosing Mobike, ofo, Hellobike and U-Bicycle each accounted for 0.7, 0.1, 0.1, 0.1 at the beginning. The numerical solution of equation (6) gives the long-term transformation trend of the percentage of bicycles in each specific area, and can obtained the digital result of selecting the percentage at each period, the sum of these percentages is equal to 1. Table 7, Fig. 2 and Table 8, Fig. 3 show the results of Case 1 and Case 2 in the form of charts.

**Table 7** User-selected iterative solution at case 1

Mobike	ofo	Hellobike	U-Bicycle
0.2600	0.2975	0.2850	0.1575
0.2555	0.3078	0.2942	0.1425
0.2537	0.3098	0.2965	0.1400
0.2532	0.3102	0.2971	0.1396
0.2531	0.3102	0.2972	0.1395
0.2530	0.3103	0.2972	0.1395
0.2530	0.3103	0.2972	0.1395
0.2530	0.3103	0.2972	0.1395
0.2530	0.3103	0.2972	0.1395
0.2530	0.3103	0.2972	0.1395



**Fig.2** The user-selected solution graphic at case 1

**Table 8** User-selected iterative solution at case 2

Mobike	ofo	Hellobike	U-Bicycle
0.3260	0.2870	0.2520	0.1350
0.2656	0.3077	0.2873	0.1394
0.2553	0.3100	0.2951	0.1396
0.2535	0.3102	0.2968	0.1395
0.2531	0.3102	0.2971	0.1395
0.2531	0.3103	0.2972	0.1395
0.2530	0.3103	0.2972	0.1395
0.2530	0.3103	0.2972	0.1395
0.2530	0.3103	0.2972	0.1395
0.2530	0.3103	0.2972	0.1395

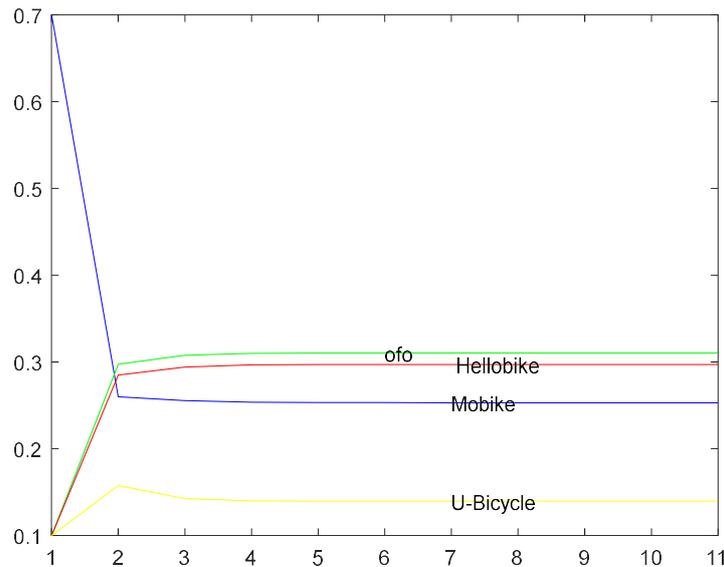


Fig.3 the user-selected solution graphic at case 2

Comparing the results of case 1 and case 2, we can be known that, regardless of the initial market share of Mobike, ofo, Hellobike and U-Bicycle, each accounted for 0.25 or 0.7, 0.1, 0.1, 0.1 respectively. The final result is ofo has the largest market share, followed by Hellobike, Mobike, and U-Bicycle.

## conclusion

In order to promote the harmonious development of sharing bicycles and urban construction, this paper studies the market structure of sharing bicycles. By establishing a sharing bicycle brand utility function model and a sharing bicycle market trend model, the bicycle brand core competitiveness score and its long-term change trend in a specific region are calculated, and it is clear that the core competitiveness of ofo and Hellobike has obvious advantages. But in the long run, sharing bicycles' own heavy mode determines that the market will end the contention of a hundred schools of thought in a short time, leaving only a few, that is, the market structure trend is ultimately the oligopoly market rather than the monopolized market, not a single one.

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