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Analysis on the Influencing Factors of People'S Bicycle Purchase based on Logistic Regression

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Abstract

With the aggravation of environmental pollution and urban traffic congestion, building a "green, livable, low-carbon, people-oriented" traffic environment has become a new task of urban traffic development, and "slow traffic" has become a research hotspot. Based on binary logistic regression, this paper analyzes the influencing factors of people's bicycle purchase in slow traffic, and finds out what has a significant impact on people's bicycle purchase from eight factors: gender, income, number of family children, education level, whether there is a room, number of cars, commuting distance and living area. According to the experimental results, the corresponding countermeasures and suggestions are put forward, in order to better promote the slow traffic-- bicycle travel, and establish a more low-carbon and environmental protection travel system.

Keywords

Slow Traffic; Binary Logistic Regression; Influencing Factors; Bicycle Purchase.

1. Introduction

In recent years, with the development of urbanization and motorization and the continuous improvement of national living standards, the number of private cars has increased significantly, which not only caused the relative lack of road resources, but also brought serious pollution to our environment. Driven by social demands, governments around the world have issued many relevant policies to ease traffic pressure and advocate low-carbon life. Urban traffic congestion has gradually become a prominent problem restricting the sustainable development of the world economy and society. In the long run, it is necessary to consider and solve the problem from other levels and perspectives, especially from the perspective of "low-carbon travel, green transportation" transportation concept innovation. Therefore, the government has begun to give strong support to public transportation and bicycle systems, people's awareness of environmental protection has gradually been awakened, and slow traffic represented by bicycles and walking has gradually returned. Respected by all walks of life. Therefore, based on the influence of the background of the times, it is of great significance to study people's bicycle purchase behavior and obtain the influencing factors of people's bicycle purchase choice behavior. This paper takes bicycles as the research object, and based on the Logistic model, surveys 1,000 people from all walks of life in Europe, Oceania, and South America. Through the statistical survey and research objects, eight factors affecting the purchase of bicycles, including gender, income, number of children in the family, education level, whether there is a house, the number of cars owned, commuting distance and living area, are analyzed. Slow traffic - bicycle travel, to establish a more low-carbon and environmentally friendly travel system.

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2. The Existing Theoretical Research on Influencing Factors of Bicycle Choice Behavior

In recent years, the influencing factors of people's choice of bicycle travel have also attracted extensive attention of scholars. Lian Sheng, Li Xiaoda, etc. [1] investigated the factors influencing bicycle purchase behavior based on the hierarchical Logit model. The analysis results show that factors such as age, income, education level, whether they have a public bicycle card, and convenience are all factors that citizens choose to buy bicycles. the main factor of influence. Li Peng, Jiang Shuping, Cao Xiufen [2] took Baoding City as an example to study the influencing factors of bicycle travel among urban residents. Based on a survey of 586 urban residents, the results showed that: gender, age, average monthly household income, convenience of bicycle travel, public transportation The network density and the impact of low-carbon city construction on daily life cognition have a significant impact on the choice of bicycle travel by urban residents. Yang Chen, Wang Wei et al[3] studied the influence of individual factors on the choice of bicycle commuting, and the estimated results showed that: travel distance, perceived benefit, car ownership and whether bicycle commuting were significantly correlated. Yang Ninghun, Li Kang et al[4] studied the influencing factors of bicycle travel choice based on Binary logistic model. The results showed that: age, owning a private car, policy decision support, walking distance to the station too far and infrastructure conditions. The travel choices of public bicycles, in which policy decision support and the distance from walking to the station are the main factors affecting the choice of bicycles in third-tier cities. Lin Yuping, Fang Jie, et al.[5] Analysis of public bicycle travel characteristics based on Logistic regression—taking Fuzhou as an example. Zhu Yan and Gan Hongcheng[6] conducted a study on the willingness to choose a short-distance bicycle travel mode, showing that women, 25-45 years old, middle- and low-income groups, living alone and unmarried groups are more willing to choose bicycles. Li Yu [7] studied the influencing factors of the choice behavior of shared bicycles in cities, and found that the educational level of personal attributes has a significant influence on the choice behavior of shared bicycles. Ma Xinwei and Ji Yanjie[8] analyzed the influencing factors of the travel characteristics and modes of users who buy bicycles. Retirees, corporate employees, and people who are highly sensitive to Internet technology and online payment services are more inclined to buy bicycles. Although these scholars have done a lot of analysis and research on the influencing factors of purchasing and choosing bicycle travel, the influence of the three factors of different regions, whether there is a house, and the number of children have not been involved, and the specific change process is also affected. Not clearly stated. On the basis of previous research, this paper analyzes and studies the influence of three factors: different regions, whether there is a house, and the number of children owned, and through the survey data to make a specific change process of the influence of each factor on bicycle purchase behavior. Explain clearly.

3. Data and Variable Description

3.1 Data Overview

People’s choice of bicycle purchase behavior is affected by many factors. The data in this paper comes from a questionnaire survey. Before conducting a formal questionnaire survey, the preliminary research preparations include literature review, pre-investigation, analysis and summary, etc., and finally a formal questionnaire is formed. A total of 1,000 questionnaires were collected from 3 regions, including 300 in Europe, 192 in Oceania, and 508 in South America; 491 women and 509 men; 478 people with incomes ranging from 0-50,000 US dollars, and 447 people with incomes ranging from 60,000-100,000 US dollars. , 75 people have an income of $110,000-170,000; 277 have 0 children, 170 have 1, 210 have 2, 135 have 3, and 127 have 4. , 81 were 5; 255 were educated at high school or below, 571 were university, and 174 were postgraduate; 243 were 0, 267 were 1, and 405 were 2 There are 85 people who are 3 and above; 685 people have a house and 315 people do not have a house; 366 people have a commuting distance of 0-1 km, 331 people have a 1-5 km distance, and 303

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people have a commute distance of more than 5 kilometers. ; 481 people are willing to buy a bicycle, and 519 people are unwilling to buy a bicycle.

Randomly split 1000 samples of people buying bicycles into 700 training samples and 300 testing samples. In this way, the required training sample set and test sample set are obtained. Finally, the test effect of the regression model is verified through the comparison of the precision rate P value of the training set and the test set, the recall rate R value of the test set and the F value of the comprehensive evaluation index.

3.2 Variable Setting

The dependent variable is whether to buy a bicycle, "Yes" is purchased, and "No" is not purchased, which are set to "0" and "1" respectively. There are eight independent variables, and gender is divided into male and female, which are set to "0" and "1" respectively. Income 0-50000, 60000-100000 and 110000-170000 are set to "0", "1", "2" respectively. The number of children in the family is 0, 1, 2, 3, 4, and 5 are set to "0","1", "2", "3", "4", "5" respectively. Europe, Oceania, and South America are set to "0", "1", and "2" respectively. High school and below, university, postgraduate and above are set to "0", "1", "2" respectively. The number of cars owned is 0, 1, 2, 3 and above, respectively, set to "0", "1", "2", "3". Set to "0" and "1" for those with a room and those without a room, respectively. The commuting distances of 0-1 km, 1-5 km, and more than 5 km are set to "0", "1", and "2" respectively. Those who are willing to buy bicycles and those who are unwilling to buy are set to "0" and "1" respectively. In this experiment, the value set to "0" is the control group. See Table 1 for details:

Table 1. Definition and Description of Variables

Influencing factors	Variable definitions
gender (x1)	male=0, female=1
income (x2)	0-50000 Dollars=0, 60000-100000 Dollars=1, 110000-170000 Dollars=2
Number of children (x3)	0 children =0, 1 children =1, 2 children =2, 3 children =3, 4 children =4, 5 children =5
education level (x4)	High school education and below = 0, college = 1, Graduate and above = 2
Do you have a room (x5)	Have a room =1, No room =0
Number of cars owned (x6)	0 = 0, 1 = 1, 2 = 2, 3 and more = 3
commuting distance (x7)	0-1 km= 0, 1-5km = 1, more than 5km = 2
living area (x8)	Europe=0, Oceania=1, South America=2

4. Model and Results Analysis

In this study, regression analysis was carried out on the factors influencing the purchase of bicycles. Since the value range of the dependent variable is only 0, 1, it is a binary variable, and there is no linear relationship between the dependent variable and the independent variable, so the binary Logistic regressionmodel can be used for analysis.

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Table 2. Hosmer Test Results

step	Bangla	degrees of freedom	salience
1	8.803	8	0.659

Table 3. Contingency table for the Hosmer-Lameshaw test

		don't buy a bike		buy a bike		sum
		Measured	expect	Measured	expect	
step 1	1	82	82.484	19	18.516	101
	2	73	71.797	29	30.203	102
	3	69	64.297	31	35.703	100
	4	58	59.877	43	41.123	101
	5	42	50.272	57	48.728	99
	6	54	47.751	47	53.249	101
	7	43	42.650	56	56.350	99
	8	37	39.517	62	59.483	99
	9	42	36.096	59	64.904	101
	10	19	24.259	78	72.741	97

For binary Logistic regression model analysis with spss, it mainly depends on the significance of Hosmer test (Table 2). If the degree of fit is greater than 0.05, it means that the model has a good degree of fit. The significance test of the Hosmer test we do The result is 0.659, which is a good level, and the model can be used for research analysis.

4.1 Logistic Regression Model Building

First build the model:

$$\text{Logit}(\text{P}) = b_0 + b_1 x_1 + \cdots + b_n x_n \tag{1}$$

According to the definition of Logit transformation, formula (1) is transformed to get:

$$\text{logit}(\text{P}) = \ln\left[\frac{\text{P}}{1-\text{P}}\right] \tag{2}$$

The P/(1–P) in formula (2) is called the odds or the odds of experiencing events (Odds), that is, the ratio of the probability of something happening to the probability of not happening. In this article, the ratio number means the ratio of people who choose to buy a bicycle to those who choose not to buy a bicycle. Formula (2) can be obtained after calculation:

$$\text{P} = [\text{Exp}(b_0 + b_1 x_1 + \cdots + b_n x_n)]/(1 + \text{Exp}(b_0 + b_1 x_1 + \cdots + b_n x_n)) \tag{3}$$

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Exp(bn) is the Odds Ratio (OR value), which means the ratio of the probability that people choose to buy a bicycle and choose not to buy a bicycle relative to the control group.

4.2 Reasonableness Test

Table 4. Training set classification table

		(predict)		
		buy	do not buy	correct percentage
(actual)	buy	373	24	94.0
	do not buy	54	249	82.2
Overall percentage				88.9

Table 5. Test set classification table

		(predict)		
		buy	do not buy	correct percentage
(actual)	buy	121	17	87.7
	do not buy	15	147	90.7
Overall percentage				89.3

It can be seen from Table 4 and Table 5 that the accuracy rates of the training set classification table and the test set classification table are 88.9% and 89.3% respectively, and the accuracy of the test set is 88.9% and 89.3% respectively. The accuracy of the test set is $P = \frac{TP}{TP+FP} = \frac{121}{121+17} = 87.7\%$, The test set recall is $R = \frac{TP}{TP+FP} = \frac{121}{121+1} = 89.0\%$, Test set comprehensive evaluation index $F = 2 * P * \frac{R}{P+R} = 88.3\%$, It can be seen that the test error of the model is small, and the generalization ability is better, that is, the test effect is good.

4.3 Model Results Analysis

According to (Table 6) spss analysis results of binary logistic regression model, we can know that:

First, in people's traditional thinking, men may love sports more than women, so the probability of buying bicycles may be higher, but the experimental results show that gender factors have no significant impact on people's choice of whether to buy bicycles, and women are slightly higher. For men, women are 1.023 times more likely to buy than men.

Second, income has a significant impact on people's choice of whether to buy a bicycle. Compared with the income of 10,000-50,000 yuan, the probability of buying a bicycle with an income of 60,000-100,000 is 0.466 times, and the probability of buying a bicycle with an income of more than 100,000 is 0.466 times. Its 0.681 times, the survey results show that it is not that people with higher incomes do not like slow traffic—bicycle travel. Low-income people, because of their limited financial strength, may have a car beyond their budget, and they are more inclined to buy low-priced and environmentally friendly bicycles. Middle-income people are more reluctant to buy bicycles because their jobs are busier, their time costs are higher, and they also have a certain economic strength, so they are more willing to choose other modes of travel. High-income groups have economic freedom

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and are more willing to pursue their favorite lifestyles, and green and healthy bicycle travel is also pursued by some of them.

Third, people who own a car have a significant impact on whether or not to buy a bicycle, which is 2.59 times the probability of buying a bicycle for people without a car. However, with the increase in car ownership, the probability of people buying a bicycle is decreasing. People with three or more vehicles were even less willing to buy a bicycle than those without a car, just 0.92 times more likely to buy a bicycle than those without a car.

Fourth, the number of children in the family has a significant impact on people's choice of whether to buy a bicycle. People with one child are 3.257 times more likely to buy a bicycle than those without children. People with two children were 3.014 times more likely to buy a bicycle than those without children, a slight decrease compared to one child. Those with three children were 2.822 times more likely to buy a bicycle than those with no children, those with four children peaked at 4.581 times the probability of buying a bicycle for those with no children, and those with five children were none People with children are 2.326 times more likely to buy a bicycle. So children have a positive influence on people buying bicycles.

Fifth, in the traditional sense, people may think that people with higher education levels have stronger awareness of environmental protection and are more likely to choose bicycles to travel. However, the experimental results of this paper show that education factors have no influence on people's choice of bicycle purchase or not. It is not significant. Compared with those with high school education and below, the probability of buying a bicycle is 1.222 times higher for college students, but the probability of purchasing a bicycle for those with a graduate degree or above is slightly lower than that of college students. of people are 1.182 times more likely to buy a bike, and overall the difference is small, so the study's conclusions are counterintuitive. That is to say, the environmental protection concept of green and low-carbon travel should also be promoted to people with high education.

Sixth, commuting distance has a significant impact on people's choice of whether to buy bicycles. Compared with people with a commuting distance of 0-1 kilometers, people with a commuting distance of 1-5 kilometers are 1.921 times more likely to buy a bicycle. People with more than 5 kilometers are 1.974 times more likely to buy a bicycle, which means that people with longer commutes are more likely to buy a bicycle.

Seventh, whether there is a house has no significant impact on people's choice of whether to buy a bicycle or not. Compared with people who do not buy a house, those who have a house are 0.938 times more likely to buy a bicycle, which is lower than the probability of buying a bicycle without a house.

Eighth, people living in Oceania are 1.035 times more likely to buy a bicycle than those living in Europe, which is almost indistinguishable; but people living in South America are 2.547 times more likely to buy a bicycle than those living in Europe. So it's not that the environmentally conscious Europeans we imagined prefer bicycle travel.

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Table 6. Binary Logistic Regression Analysis Results

variables in the equation									
		B	standard error	Wald	degrees of freedom	salience	Exp(B)	95% confidence interval for EXP(B)	
								lower limit	upper limit
step 1	gender(1)	0.023	0.135	0.029	1	0.866	1.023	0.785	1.334
	income			8.343	2	0.015			
	income(1)	-0.764	0.295	6.703	1	0.010	0.466	0.261	0.831
	income(2)	-0.385	0.289	1.768	1	0.184	0.681	0.386	1.200
	Number of children in the family			19.967	5	0.001			
	Number of children in the family (1)	1.181	0.332	12.642	1	0.000	3.257	1.699	6.245
	Number of children in the family (2)	1.103	0.347	10.097	1	0.001	3.014	1.526	5.952
	Number of children in the family (3)	1.037	0.333	9.693	1	0.002	2.822	1.469	5.422
	Number of children in the family (4)	1.522	0.346	19.355	1	0.000	4.581	2.326	9.026
	Number of children in the family (5)	0.986	0.348	8.042	1	0.005	2.681	1.356	5.301
	education level			0.664	2	0.718			
	education level (1)	0.201	0.270	0.552	1	0.457	1.222	0.720	2.075
	education level (2)	0.167	0.216	0.598	1	0.439	1.182	0.774	1.803
	have a room (1)	-0.064	0.159	0.163	1	0.687	0.938	0.687	1.280
	Number of cars owned			24.180	3	0.000			
	Number of cars owned (1)	0.952	0.340	7.841	1	0.005	2.590	1.330	5.042
	Number of cars owned (2)	0.665	0.308	4.664	1	0.031	1.945	1.063	3.556
	Number of cars owned (3)	-0.083	0.284	0.086	1	0.769	0.920	0.527	1.606
	commuting distance			14.252	2	0.001			
	commuting distance (1)	0.653	0.208	9.825	1	0.002	1.921	1.277	2.889
	commuting distance (2)	0.680	0.189	12.927	1	0.000	1.974	1.363	2.860
	living area			24.170	2	0.000			
	living area (1)	0.034	0.190	0.032	1	0.857	1.035	0.713	1.501
	living area (2)	0.935	0.196	22.818	1	0.000	2.547	1.735	3.737
	constant	-1.790	0.464	14.895	1	0.000	0.167	0.785	1.334

5. Conclusion and Suggestion

This paper analyzes and studies eight factors that affect the purchase of bicycles, including gender, income, number of children in the family, education level, whether there is a house, the number of cars owned, commuting distance and living area. The experimental results are not only consistent with the previous conclusions, but also There are conclusions that contradict the previous ones. For example, the experimental results of this paper show that education level and gender are not the main factors affecting people's bicycle purchase, which is inconsistent with the conclusions of Li and Cao's research, but income, car ownership, and commuting distance will affect people's bicycle purchase. Purchase behavior has a significant impact, which is consistent with Lian, Yang, Wang and their research. At the same time, the experimental results of the new three factors, the number of children in the family, whether there is a house, and the living area are also different. The number of children

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in the family has a significant impact on people's bicycle purchase behavior. It's big, but there is little difference between those who have and those who don't have a house.

According to the research results of this paper, some countermeasures and suggestions are given for reference:

(1) First of all, it is necessary to strengthen the riding awareness of travelers, and encourage the transformation of riding awareness into action. Under the background of encouraging green travel, the government will pass on cycling as a low-carbon, green, environmentally friendly and healthy life concept to people, and disseminate and promote it through publicity slogans, social public service advertisements and other media forms, which will effectively promote Bike purchase. In the process of publicity and promotion, do not ignore groups with high education, and at the same time strengthen the publicity and promotion of middle-income groups.

(2) Because having children has an obvious positive impact on bicycle purchases, cities with high fertility rates are more likely to implement bicycle travel policies, and such cities can be selected through big data (9), when implementing relevant reform policies. Take such cities as pilot cities, see the response of the masses, tighten the opinions of the masses, and then implement the policy reform on a large scale.

(3) Since the research areas of this paper are in Europe, Oceania, and South America, the development momentum of shared bicycles is not as high as that in China, and people's purchase demand for bicycles will not be greatly affected by the shared bicycle market. South America is more active in bicycle purchases, and Europe and Oceania The publicity and promotion of the company should also be strengthened to focus the target group on "short-distance car travelers". While promoting the concept of green cycling to promote bicycle purchases, the government should also vigorously develop the urban shared bicycle industry.

(4) In terms of urban planning and design, the government should pay full attention to the construction of cycling road facilities to meet the cycling needs of travelers. People with longer commuting distances are more willing to buy bicycles and choose bicycles as a travel tool, indicating that travelers are positive about this healthy, low-carbon and environmentally friendly travel method. However, the riding road conditions greatly affect the traveler's willingness to ride. Bicycles should be fully considered in urban planning and design, so as to leave enough space for design and planning. For cities with limited planning space, the road network structure can be appropriately optimized, the supporting facilities of cycling roads can be increased, the road surface smoothness can be improved, and the The convenience and comfort of riding.

(5) In terms of traffic organization optimization, strategies such as traffic guidance and behavioral education can be used to improve cyclists' sense of security, avoid unsafe problems caused by mixed vehicle types and mixed vehicles, so that cyclists can ride at ease and naturally. It will promote the demand of the bicycle market, and also achieve the purpose of guiding the traffic flow of the road network and improving the utilization rate of road resources.

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