

Multiple Linear Regression Model-Based Old People Sports Leisure Behavior Research under Urbanization Background

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Abstract: Presently population aging issue becomes increasingly serious, old people occupy more and more proportions in Chinese population. To some extent, old people living quality represents a country's civil living standards and a country comprehensive strength. The paper utilizes multiple linear regression models to analyze old people sports leisure demands. From six perspectives as old people gender, age, cultural standard, monthly income, income satisfaction, physical health status, it analyzes every perspective relations with pass time, relax, capacity improving, making friends and interaction, exploration of knowledge these five aspects. From obtained function relations, it gets conclusion that old people sports leisure demands have certain relations with old people classification.

Keywords: Demands classification, multiple linear regression, old people, sports leisure, urbanization.

1. INTRODUCTION

In recent years, with intensifying of population aging problem, people's attention to old people becomes higher and higher. Since 2008 China succeeded in holding Olympic Games, physical exercise consciousness have gone deeply into human's mind, especially for the old, physical exercise, leisure sports have become an indispensable part of their daily life. In the background of urbanization, aging population sports leisure problem is even the focus of relative experts and scholars researches [1].

Zhao Jia-Hua in the article "Xian city old people leisure behavior research", he took Xian city old people as research objects, adopted stratified sampling investigation method to investigate, regarded investigation result as original data, carried on validity and reliability analysis, variance analysis, cross tabulation analysis and T test on it [2]. Made research from the perspective of leisure status, leisure behavior constraint factors and satisfaction and so on, research result showed that old people physical exercise main range was home, community and place of residence nearby within 1000 meters regions [3]. Due to gender, age, characters and other aspects differences, outdoors and domestic leisure exercise time distribution were different, leisure physical exercise hobbies and participation extent were also different. The article pointed out factors that restricted old people leisure sports were various, improving old people leisure living quality needed personal, government and social multiple aspects efforts.

Gao Chun in the article "Chinese cities elderly university leisure education research—take Wuhan city as an example", took Chinese cities elderly university leisure education as

research objects. On the basis of layering investigation, made analysis of elderly university students leisure status, the author found that the old leisure motivation levels were lower, leisure way was relative single, scope that could select was narrower, leisure satisfaction was universally lower, causes for above three kinds of problems included the old weak leisure consciousness, lacking of scientific leisure views, short of elder university leisure education [4]. The author highlighted that utilitarianism society indifference, lacking of concerns and recognition on the old leisure education and other problems led to elderly university students lacking of leisure exercises. Li Wen-Chuan in the article "Shanghai city old people sports lifestyle research", selected Shanghai city old people as research objects, comprehensively applied multiple research methods [5]. The author made empirical investigation research on Shanghai city old people leisure life from behavioral agent, behavior base, behavior characteristics, and behavior efficiency four perspectives. Shanghai city old people sports lifestyle showed layering phenomenon, female old people loved comfortable group exercise ways, while male old people preferred to individual event exercise way. Shanghai city old people connected physical exercises with daily activity and lives. Physical exercise gradually replaced traditional fitness, their fitness frequency and fitness time were higher, sports intensity was relative lower, and majored in experience-type physical exercise way [6]. Chen Yue-Lin in the article "Chengdu city downtown old people leisure status and leisure way research", on the basis of analyzing Chengdu city old people traditional life, from leisure motivation, leisure time, leisure type, leisure influence factors and leisure living quality and others multiple perspectives, researched on Chengdu city old people leisure life, research result showed old people participation degree on puzzle type, exchange type, fitness type of activities were higher, but leisure activity contents were single, which affected leisure activities quality [7].

Table 1. The old leisure demands distribution.

		Pass Time	Relax	Capacity Improving	Make Friends and Interaction	Explore Knowledge
Gender	Man	17.44%	46.51%	27.91%	3.49%	4.65%
	Woman	19.15%	43.62%	25.53%	9.57%	2.13%
Age	60-64	16.07%	41.07%	33.93%	7.14%	3.57%
	65-69	14.63%	46.34%	26.83%	7.32%	4.88%
	70-74	15.15%	45.45%	27.27%	6.06%	3.03%
	75-79	19.35%	51.61%	16.13%	6.45%	3.23%
	80 and above	31.58%	42.11%	21.05%	5.26%	0.00%
Cultural standard	Junior high school and below	20.73%	42.68%	29.27%	6.10%	1.22%
	Senior high school or technical secondary school	16.95%	50.85%	22.03%	6.78%	3.39%
	Undergraduate course	16.67%	41.67%	27.78%	5.56%	8.33%
	Master and above	0.00%	33.33%	33.33%	33.33%	0.00%
Monthly income	Less than 1000Yuan	38.71%	25.81%	29.03%	6.45%	0.00%
	2000-3000 Yuan	13.46%	55.77%	25.00%	3.85%	1.92%
	Above 3000Yuan	10.34%	44.83%	31.03%	10.34%	3.45%
Income satisfaction	Very satisfied	13.33%	46.67%	33.33%	6.67%	0.00%
	Satisfied	14.47%	51.32%	23.68%	7.89%	2.63%
	General	24.07%	42.59%	22.22%	5.56%	5.56%
	Dissatisfied	21.74%	34.78%	34.78%	8.70%	0.00%
	Very dissatisfied	16.67%	33.33%	33.33%	0.00%	8.33%
Physical health status	Very good	20.26%	48.72%	48.72%	10.26%	5.13%
	Good	12.00%	48.00%	48.00%	5.33%	4.00%
	General	22.92%	41.67%	27.08%	6.25%	2.08%
	Poor	47.06%	35.29%	11.76%	5.88%	0.00%
	Very bad	0.00%	0.00%	0.00%	0.00%	0.00%

The paper aims to research on different types of old people sports demands problem, old people are classified according to gender, age, cultural standards and others, sports demand will be considered from passing time, relaxing, capacity improving, making friends and interaction as well as exploring knowledge and so on.

2. DATA PROCESSING AND REGRESSION MODEL INTRODUCTION

Data collection takes Chengdu city old people as investigation objects, uses layering sampling investigation way, investigation result is as Table 1 shows.

Data is from the article “Chengdu city downtown old people sports leisure status and sports leisure way research”.

2.1. Multiple Linear Regression Models

Multiple linear regression analysis models are:

$$\begin{cases} y = \beta_0 + \beta_1x_1 + \dots + \beta_mx_m + \varepsilon \\ \varepsilon \sim N(0, \sigma^2) \end{cases} \quad (1)$$

In formula $\beta_0, \beta_1, \dots, \beta_m, \sigma^2$ all are parameters that are uncorrelated to x_1, x_2, \dots, x_m , all are unknown, from which $\beta_0, \beta_1, \dots, \beta_m$ are regression coefficients.

Table 2. Gender classification old people demands status table.

Type	Pass Time	Relax	Capacity Improving	Make Friends and Interaction	Explore Knowledge
1	0.1744	0.4651	0.2791	0.349	0.465
2	0.1915	0.4362	0.2553	0.957	0.213

Table 3. Age classification old people demands status table.

Type	Pass Time	Relax	Capacity Improving	Make Friends and Interaction	Explore Knowledge
1	0.1607	0.4107	0.3393	0.0714	0.0357
2	0.1463	0.4634	0.2683	0.0732	0.0488
3	0.1515	0.4545	0.2727	0.0606	0.0303
4	0.1935	0.5161	0.1613	0.0645	0.0323
5	0.3158	0.4211	0.2105	0.0526	0.00

Now it has n pieces of independent observation data $(y_i, x_{i1}, \dots, x_{im})$, $i = 1, \dots, n, n > m$, by formula (1), it gets:

$$\begin{cases} y_i = \beta_0 + \beta_1 x_{i1} + \dots + \beta_m x_{im} + \varepsilon_i \\ \varepsilon_i \sim N(0, \sigma^2), i = 1, \dots, n \end{cases} \quad (2)$$

Record:

$$X = \begin{bmatrix} 1 & x_{11} & \dots & x_{1m} \\ \vdots & \vdots & \dots & \vdots \\ 1 & x_{n1} & \dots & x_{nm} \end{bmatrix}, Y = \begin{bmatrix} y_1 \\ \vdots \\ y_n \end{bmatrix} \quad (3)$$

$$\varepsilon = [\varepsilon_1 \quad \dots \quad \varepsilon_n]^T, \beta = [\beta_0 \quad \beta_1 \quad \dots \quad \beta_m]^T$$

Formula (1) can also express as

$$\begin{cases} Y = X\beta + \varepsilon \\ \varepsilon \sim N(0, \sigma^2 E_n) \end{cases} \quad (4)$$

Among them, E_n is n order unit matrix.

Multiple linear regression models are on the basis of lots of data, utilizing regression way to express data that has no rules to have certain function relationship. The model respectively considers gender, age, cultural standard, monthly income, income satisfaction and physical health status classified old people group and passing time, relaxing, capacity improving, making friends and interaction as well as exploring knowledge these five aspects functional relationships.

2.2. Classification According to Gender

For Table 1 gender type data, it does processing and gets Table 2 data, contents are as Table 2 shows. To convenient to make regression, transform percentage into decimals, male is using "1" to express, female is using "2" to express.

Utilize Matlab to program above multiple linear regression models, by calculating, it gets following results.

$$\begin{aligned} b &= (0.4260, 0, 0, 1.6447, 0) \\ stats &= (1, 80.9530, 0.0022) \end{aligned}$$

By consulting table, it is clear that R2 is on behalf of decision coefficient (R represents correlation coefficient), its value is 1, it shows the equation is highly linear correlated.

By Matlab calculated result, it is clear:

$$\hat{y} = 0.426 + 1.6447x_4 \quad (5)$$

Among them, y represents gender, x_4 represents probability of making friends and interaction. From formula (5), it is clear that probability of making friends and interaction is related to gender.

2.3. Classification According to Age

For Table 1 age type data, it does processing and gets Table 3 data, contents are as Table 3 shows. To convenient to make regression, transform percentage into decimals, 60-64 years old people use "1" to express, 65-69 years old people use "2" to express, 70-74 years old people use "3" to express, 75-79 years old people use "4" to express, 80 years old and above such people use "5" to express.

For Table 3 contents, utilize Matlab to program above multiple linear regression models, by calculating, it gets following results.

$$\begin{aligned} b &= (104.8714, -62.4181, -136.1791, -108.3835, 0, -31.8631) \\ stats &= (1, 72.8240, 0.022) \end{aligned}$$

By consulting table, it is clear that R2 is on behalf of decision coefficient (R represents correlation coefficient), its value is 1, it shows the equation is highly linear correlated.

Table 4. Cultural standards classification old people demands status table.

Type	Pass Time	Relax	Capacity Improving	Make Friends and Interaction	Explore Knowledge
1	0.2073	0.4268	0.2927	0.0610	0.0122
2	0.1695	0.5085	0.2203	0.0678	0.0339
3	0.1667	0.4167	0.2778	0.0556	0.0833
4	0.00	0.3333	0.3333	0.3333	0.00

Table 5. Monthly income classification old people demands status table.

Type	Pass Time	Relax	Capacity Improving	Make Friends and Interaction	Explore Knowledge
1	0.3871	0.2581	0.2903	0.0645	0.00
2	0.1346	0.5577	0.2500	0.0385	0.0192
3	0.1034	0.4483	0.3103	0.1034	0.0345

By Matlab calculated result, it is clear:

$$\hat{y} = 104.8714 - 62.4181x_1 - 136.1791x_2 - 108.3835x_3 - 31.8631x_5 \quad (6)$$

Among them, \hat{y} represents age type, x_1 represents pass time demand probability, x_2 represents relax demand probability, x_3 represents capacity improving demand probability, x_4 represents make friends and interaction demand probability. From formula (6), it is clear that explore knowledge demand is unrelated to age.

2.4. Classification According to Cultural Standards

For Table 1 cultural standards type data, it does processing and gets Table 4 data, contents are as Table 4 shows. To convenient to make regression, transform percentage into decimals, education background as junior high school and below is using "1" to express, education background as senior high school or technical secondary school is using "2" to express, education background as undergraduate course is using "3" to express, education background as master and above is using "4" to express.

For Table 4 contents, utilize Matlab to program above multiple linear regression models, by calculating, it gets following results.

$$b = (-1.5712 \ 0 \ 3.2538 \ 0 \ 13.4613 \ 29.614)$$

$$\text{stats} = (1, 69.6220, 0.0013)$$

By consulting table, it is clear that R2 is on behalf of decision coefficient (R represents correlation coefficient), its value is 1, it shows the equation is highly linear correlated.

By Matlab calculated result, it is clear,

$$\hat{y} = -1.5712 + 3.2538x_2 + 13.4613x_4 + 29.614x_5 \quad (7)$$

Among them, \hat{y} represents cultural background type, x_2 represents relax demand probability, x_4 represents make friends and interaction demand probability, x_5 represent explore knowledge demand probability. From formula (7), it is clear that pass time and capacity improving demands are unrelated to cultural standards.

2.5. Classification According to Monthly Income

For Table 1 monthly income type data, it does processing and gets Table 5 data, contents are as Table 5 shows. To convenient to make regression, transform percentage into decimals, income that is less than 1000Yuan is using "1" to express, income that is 2000-3000 Yuan is using "2" to express, above 3000Yuan is using "3" to express.

For Table 5 contents, utilize Matlab to program above multiple linear regression models, by calculating, it gets following results.

$$b = (6.8273, -11.0627, -5.9858, 0, 0, 0)$$

$$\text{stats} = (1, 63.5420, 0.0013)$$

By consulting table, it is clear that R2 is on behalf of decision coefficient (R represents correlation coefficient), its value is 1, it shows the equation is highly linear correlated.

By Matlab calculated result, it is clear,

$$\hat{y} = 6.8273 - 11.0627x_1 - 5.9858x_2 \quad (8)$$

Among them, \hat{y} represents monthly income type, x_1 represents pass time demand probability, x_2 represents relax demand probability. From formula (8), it is clear that pass

Table 6. Income satisfaction classification old people demands status table.

Type	Pass Time	Relax	Capacity improving	Make Friends and Interaction	Explore Knowledge
1	0.1333	0.4667	0.3333	0.0667	0.00
2	0.1447	0.5132	0.2368	0.0789	0.0263
3	0.2407	0.4259	0.2222	0.0556	0.0556
4	0.2174	0.3478	0.3478	0.0870	0.00
5	0.1667	0.3333	0.3333	0.00	0.0833

Table 7. Physical health status classification old people demands status table.

Type	Pass Time	Relax	Capacity Improving	Make Friends and Interaction	Explore Knowledge
1	0.2026	0.4872	0.4872	0.1026	0.0513
2	0.1200	0.4800	0.4800	0.0533	0.0400
3	0.2292	0.4167	0.2708	0.0625	0.0208
4	0.4706	0.3529	0.1176	0.0588	0.00
5	0.00	0.00	0.00	0.00	0.00

time and relax demands are related to monthly income extent.

demand probability. From formula (9), it is clear that explore knowledge demand is unrelated to income satisfaction.

2.6. Classification According to Income Satisfaction

For Table 1 income satisfaction type data, it does processing and gets Table 6 data, contents are as Table 6 shows. To convenient to make regression, transform percentage into decimals, very satisfied with income is using “1” to express, satisfied with income is using “2” to express, general satisfaction with income is using “3” to express, dissatisfied with income is using “4” to express, very dissatisfied with income is using “5” to express.

For Table 6 contents, utilize Matlab to program above multiple linear regression models, by calculating, it gets following results.

$$b = (39.7432, -35.3581, -50.6063, -35.9495, 23.5369, 0)$$

$$stats = (1, 65.7570, 0.0024)$$

By consulting table, it is clear that R2 is on behalf of decision coefficient (R represents correlation coefficient), its value is 1, it shows the equation is highly linear correlated.

By Matlab calculated result, it is clear,

$$\hat{y} = 39.7432 - 35.3581x_1 - 50.6063x_2 - 35.9495x_3 + 23.5369x_4 \quad (9)$$

Among them, \hat{y} represents age type, x_1 represents pass time demand probability, x_2 represents relax demand probability, x_3 represents capacity improving demand probability, x_4 represents make friends and interaction

2.7. Classification According to Physical Health Status

For Table 1 physical health status type data, it does processing and gets Table 7 data, contents are as Table 7 shows. To convenient to make regression, transform percentage into decimals, old people health status is very good that will use “1” to express, health status is good that will use “2” to express, health status is general that will use “3” to express, health status is poor that will use “4” to express, health status is very bad that will use “5” to express.

For Table 7 contents, utilize Matlab to program above multiple linear regression models, by calculating, it gets following results.

$$b = (5.000, 0.5309, 1.8780, -5.9761, -20.5750, 0)$$

$$stats = (1, 64.6650, 0.0019)$$

By consulting table, it is clear that R2 is on behalf of decision coefficient (R represents correlation coefficient), its value is 1, it shows the equation is highly linear correlated.

By Matlab calculated result, it is clear:

$$\hat{y} = 5.000 + 0.5309x_1 + 1.8780x_2 - 5.9761x_3 - 20.5750x_4 \quad (10)$$

Among them, \hat{y} represents age type, x_1 represents pass time demand probability, x_2 represents relax demand

probability, x_3 represents capacity improving demand probability, x_4 represents make friends and interaction demand probability. From formula (10), it is clear that explore knowledge demand is unrelated to physical health status.

CONCLUSION

Linear regression analysis is a mathematical tool that researches variables correlations; it can help us to use variable assigned value to estimate another variable assigned value. The model application field is very wide, such as talents demand problem, engineering technical problem and other aspects analysis problems. The paper applies multiple linear regression models into researching old people sports leisure demands problem, researches sports demands relationship with old people age, gender, cultural standards, monthly income and other aspects from multiple perspectives. Probability of making friends and interaction is related to gender. Demand of exploring knowledge is unrelated to age. Pass time and capacity improving demands are uncorrelated to cultural standards. Pass time and relax demands are related to monthly income extent. Demand of exploring knowledge is unrelated to income satisfaction. Demand of exploring knowledge is unrelated to physical health status. In future old people sports leisure demands problems researches, above conclusion will play important driving roles.

CONFLICT OF INTEREST

The author confirms that this article content has no conflict of interest.

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