Factor Analysis-Based Research on the Influence Factors that are Easy to Ignore for Automotive Energy Saving and Emission Reduction

Yuang Jiang [1, *, #], Feiming Zhao [2, #]

[1] College of Naval Architecture and Ocean Engineering, Dalian Maritime University, Dalian, China

[2] School of Shipping Economics and Management, Dalian Maritime University, Dalian, China

* Corresponding Author Email: jiang2220201082@dlmu.edu.cn

[#]These authors contributed equally.

Abstract. This paper uses models such as factor analysis for multidimensional information of survey subjects. Through literature research and the actual situation, we identify the factors that the public tends to ignore about energy saving and emission reduction, construct an econometric model to get specific mathematical expressions of the influencing factors, and find out the factors with a higher degree of importance. And based on the model results, we propose targeted suggestions.

Keywords: Factor Analysis, Influence Factors, Automotive Energy Saving, Emission Reduction.

1. Introduction

Since the 18th Party Congress, the concept of green and low-carbon life advocated by General Secretary Xi Jinping has been deeply rooted in people's hearts and minds and is gradually changing people's lifestyles and ideologies [1]. At present, the transportation industry as one of the key areas of concern for energy saving and emission reduction, in order to achieve energy saving and emission reduction, countries have been promoting automotive energy saving and emission reduction work [2]. China has mainly carried out the following work for automotive energy saving and emission reduction: in order to guide and encourage the development of energy-saving and environmentally friendly vehicles and new fuel vehicles [3]. The new energy vehicle safety level will be comprehensively improved, and the average electricity consumption of new pure electric passenger cars will be significantly reduced.

2. Factor analysis-based research on the influence factors that are easy to ignore for automotive energy saving and emission reduction

2.1. Related Analysis

According to the pre-survey literature reading: engine performance, improve the quality of fuel, good driving habits of drivers, natural factors, legal policy guidance, improve the efficiency of automotive mechanical transmission, the reasonable choice of automotive filters, improve the degree of oil lubrication, antifreeze and other nine factors are the most easily ignored by the public automotive energy saving and emission reduction factors, the factor analysis will be conducted to follow up the investigation [4]. Set the engine performance variable to x_1 and the improved fuel quality variable to x_2. The driver's good driving habits variable is set to x_3, and the natural factors variable is set to x_4. The variable of legal policy orientation is set to x_5, the variable of improving the efficiency of automobile mechanical transmission is set to x_6, the variable of reasonable selection of automobile filters is set to x_7, the variable of improving the degree of oil lubrication is set to x_8, and the variable of selection of antifreeze is set to x_9.

Table.1. Table of correlation coefficients

Variables	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9
x_1	1.000								
x_2	0.682	1.000							
x_3	0.646	0.647	1.000						
x_4	0.664	0.674	0.641	1.000					
x_5	0.744	0.689	0.724	0.690	1.000				
x_6	0.677	0.717	0.676	0.724	0.743	1.000			
x_7	0.703	0.729	0.695	0.763	0.795	0.760	1.000		
x_8	0.672	0.639	0.653	0.614	0.721	0.633	0.669	1.000	
x_9	0.135	0.421	-0.564	0.452	0.069	0.121	0.107	0.145	1.000

The correlation coefficient Table1 shows that the correlation coefficient among the factors is positive and is between 0.5-0.8, and the variables are significantly correlated, when the improvement of any point will have an impact on other aspects, based on this paper for the factor analysis to determine the most representative impact factors [5].

2.2. Factor Extraction

Factor extraction was performed on the original variables to obtain Table 2. most of the information of the known factors could be explained, and the overall effect of factor extraction was relatively satisfactory.

Table.2. Common factor variance table

Name of influencing factor	**Initial**	**Extraction**
Performance of the engine	1.000	0.704
Improving the quality of fuel	1.000	0.716
Good driving habits of the driver	1.000	0.821
Natural factors	1.000	0.725
Legal policy guidance	1.000	0.765
Improving the efficiency of automobile mechanical transmission	1.000	0.810
Proper selection of automotive filters	1.000	0.901
Improving the degree of oil lubrication	1.000	0.814
Selection of antifreeze	1.000	0.745

According to Table 3 below, it can be seen that there are 2 factors with eigenvalues greater than 1, but their cumulative variance contribution is only 72.265%, which does not explain most of the information of the original data. Therefore, 3 common factors were extracted, and their cumulative variance contribution rate was 82.454%, which explained most of the information of each indicator.

Table.3. Total Variance Explanation Table

Influencing Factors	**Initial Eigenvalue**			**Extraction of the sum of squares of loads**		
	Total	**Variance Ratio**	**Cumulative %**	**Total**	**Variance Ratio**	**Cumulative %**
1	5.025	41.787	41.787	5.025	41.787	41.787
2	0.453	30.478	72.265	10.478	72.265	72.265
3	0.405	10.189	82.454	11.203	82.454	82.454
4	0.352	4.026	86.48			
5	.0306	3.367	89.847			
6	0.235	3.356	93.203			
7	0.224	2.198	95.401			
8	0.213	2.452	97.853			
9	0.145	2.105	100			

In summary, it was found that when the number of factors was 2, the factors obtained from the cumulative variance had more obvious practical significance, so the number of factors was determined to be 3. and the rotated component matrix was calculated as shown in Table 4 below.

Table.4. Rotated component matrix

Name of influencing factor	Common factors		
	1	2	3
Performance of the engine	**0.724**	0.221	0.175
Improving the quality of fuel	0.110	**0.672**	0.198
Good driving habits of the driver	0.383	0.229	**0.827**
Natural factors	**0.806**	0.268	0.302
Legal policy guidance	**0.524**	0.161	0.377
Improving the efficiency of automobile mechanical transmission	0.147	**0.715**	0.387
Proper selection of automotive filters	0.221	0.390	**0.594**
Improving the degree of oil lubrication	0.267	**0.799**	0.401
Selection of antifreeze	0.154	0.124	**0.663**

Combining the above table, three male factors were extracted. Among them, the first public factor comes from the performance of engine, natural factors, and legal policy orientation to explain 41.787% of the total information, named as the external factors factor. The second public factor comes from improving the quality of fuel, improving the efficiency of vehicle mechanical transmission, and improving the degree of oil lubrication, which explains 30.478% of the total information and is named as the factor of improvement measures [6]. The third public factor comes from good driving habits of drivers, reasonable selection of car filters, and selection of antifreeze, and is named as energy saving and emission reduction awareness factor, which explains 10.189% of all the information.

3. Results

3.1. Calculating factor scores.

Combining the above results, the following factor formula was derived using weighted least squares estimation of factor scores and solved using SPSS programming. Let Y be the expectation of the effect of energy saving and emission reduction of automobiles, Y_1 as the factor of external factors, Y_2 as the factor of measures that can be improved, Y_3 as the awareness of energy saving emission reduction, X_1 as the performance of engines, X_2 as the improvement of fuel quality, X_3 as the good driving habits of drivers, X_4 as the natural factors, X_5 as the legal policy orientation, X_6 as the improvement of mechanical transmission efficiency of automobiles, X_7 as the reasonable selection of automobile filters, X_8 as the improvement of oil lubrication, and X_9 as the selection of antifreeze.

The scores of each common factor are calculated as follows:

$$Y_1 = 0.715X_1 + 0.741X_2 + 0.147X_3 - 0.468X_4 - 0.578X_5 + 0.020X_6 + 0.887X_7 + 0.09X_8 - 0.158X_9$$

$$Y_2 = -0.516X_1 - 0.148X_2 + 0.547X_3 + 0.394X_4 + 0.745X_5 + 0.826X_6 - 0.216X_7 + 0.564X_8 + 0.103X_9$$

$$Y_3 = -0.124X_1 + 0.218X_2 + 0.647X_3 + 0.194X_4 + 0.145X_5 + 0.126X_6 - 0.216X_7 + 0.714X_8 + 0.801X_9$$

The degree of influence of each factor can be weighted and evaluated comprehensively by using factor analysis, and the combined degree of influence of each factor can be calculated by constructing an evaluation function.

3.2. Analysis of results

Table 5 Factors that can be easily overlooked.

First level classification	Second level classification
External factors	Natural factors
	Legal policy guidance
	Performance of the engine
Possible improvement measures	Improving the efficiency of automobile mechanical transmission
	Improving the quality of fuel
	Improving the degree of oil lubrication
Awareness of energy saving and emission reduction	Good driving habits of the driver
	Selection of antifreeze
	Proper selection of automotive filters

4. Conclusions

From the contribution rate of the dependent variable of the common factor the effect of the energy saving, and emission reduction awareness factor is greater than that of the improveable measures factor, which is greater than that of the external factors factor. In terms of energy saving and emission reduction awareness factor, people can only realize the importance of energy saving and emission reduction by reasonably choosing auto filters, good driving habits of drivers, and the selection of antifreeze, and only then can they improve the reasonable expectation of the effect of energy saving and emission reduction of automobiles. As for the factor of measures that can be improved, the reasonable expectation can only be achieved by improving the efficiency of automobile mechanical transmission, improving the quality of fuel, and improving the degree of oil lubrication. In summary, the order of importance of each influencing factor can also be derived. In order of importance, they are good driving habits of drivers, reasonable selection of automobile filters, improving the efficiency of automobile mechanical transmission, improving the degree of oil lubrication, selection of antifreeze, improving the quality of fuel, performance of engines, legal policy guidance, and natural factors [7].

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