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Research on the Influencing Factors of New Energy Cars Prices

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Abstract:

This article aims to identify those factors that have an impact on new energy vehicle prices. The method of multiple linear regression is used to analyze the significant factors using 100 samples from Kaggle. Based on an assumption, 13 variables that were chosen do correlate with new energy car prices. This paper will analyze these following factors: energy type, engine power, reviews count, seating capacity, fuel tank capacity, body type, rating, no cylinder, max power rp, max power bhp, max power rpm, max power nm, transmission type. This article uses multiple linear regression models to analyze these factors' influence on new energy vehicles. Overall, new energy vehicle prices can be analyzed by the extent to which these factors affect them. By calculation, it is determined that engine power, no cylinder, and max power bhp will have a significant positive impact on the starting price. Max torque rpm and max torque nm will have a significant negative influence on the starting price.

Keywords: New energy vehicle prices; influencing factors; multiple linear regression.

1. Introduction

In the past several decades, the new energy automobile industry has become a more and more significant area of the global automobile industry. This shows the importance of governments to the increasingly acute environmental problems. In China, the government has introduced new policies to alleviate the environmental problems caused by traditional cars. In China, by the end of September 2023, the proportion of new energy vehicles had gradually increased, and the number of new energy vehicles in the country reached 18.21 million, accounting for 5.5% of the automobile industry. However, the amount of electric cars is still far from that of traditional cars [1]. At present, the world new energy vehicle market has shown a rapid growth trend; more enterprises have begun to pay attention to the new energy automobile industry, and they have also significantly increased their investment in research and development, taking BYD as an example in the first half of 2023, BYD invested more than 14.2 billion yuan, an increase of 120.2% [2]. As a result, the sales and production of electric cars in China have also increased significantly. In terms of development status, the new energy car industry has made remarkable progress. However, compared with traditional fuel vehicles, people still face some challenges and problems. Governments have introduced a series of supportive policies and promoted the research and development, production, and sales of electric cars. At the same time, technological innovation also provides a more efficient and reliable power system for new energy vehicles and improves them. However, there are still some shortcomings in market size, charging infrastructure construction, etc. Thus, the future development of new energy vehicles is crucial.

The development of new energy vehicles has not only scientific and technological constraints but also objective factors. Yuan et al. pointed out that most residents were willing to buy new energy vehicles. They analyzed the questionnaire through the binary logistic regression model to analyze the influence mechanism of residents' purchase of electric cars [3]. Through designing the questionnaire, Li found that consumer age, household annual income, understanding level of new energy vehicles, vehicle endurance, and automobile subsidy preferential types were significantly related to purchase intention [4]. Fan studied the development prospects of new energy vehicles and intelligent connected vehicles. He analyzed the strategy of new energy and intelligent connected vehicles in Shiyan City through SWOT [5]. Zhang illustrated that urban and rural infrastructure and high-speed infrastructure constrain the population of new energy vehicles. Zhang et al. analyzed firms' financial indexes and other data and summarized their difficulties in development [6]. Zhang obtained the following conclusions through the statistics and analysis of battery quality: the lag of battery technology is a major factor in the popularization of electric cars [7]. Compared with traditional vehicles, the potential risk of new energy vehicles is greater; according to Zhang statistics, every year, dozens of new energy cars are due to impact fire and explosion incidents. Xu used the generalized bass model to analyze the sales volume of new energy vehicles from 2011 to 2021 and forecast the sales volume from 2022 to 2035 [8].

Charging piles in cities are also a big factor in the research. Li and Liu took 37 cities in China as samples and concluded that the improvement of charging infrastructure can promote the promotion of electric cars [9]. Lin confirmed that some consumers will pay attention to the completeness of charging facilities [10]. Sierzchula used multiple linear regression analysis to study the relationship between variables and the market share of electric vehicles and proved that charging facilities are positively correlated with the market share of electric vehicles in a country [11].

This study will explore factors that influence the cost of new energy vehicles from the following several aspects. People‘s views on new energy vehicles, difficulties of technology, the infrastructure of the city, and the effect of the market on electric vehicles.

2. Methods

2.1 Data Source

The data set used in this paper is fetched from the Kaggle website. It was from 2011 to 2023. The first data set contains people‘s views on new energy vehicles. Other datasets include other factors related to electric vehicles. The first data set includes 8357 data, 400 of which are samples.

2.2 Variable Selection

The original data set has a very large amount of data, and some of it isn‘t useful for the study. The data contains 13 variables (energy type, engine power, reviews count, seating capacity, fuel tank capacity, body type, rating, no cylinder, max power rp, max power bhp, max power rpm, max power nm, transmission type) and one dependent variable (Popularity). The specific description of this data set is in Table 1:

Table 1. List of Variable

Name	Type	Range
energy type	Categorical	Electric
engine power	Numerical	998-6750
reviews count	Numerical	14-2392
vehicle capacity	Numerical	2-8
fuel tank capacity	Numerical	27-90
body type	Categorical	Hatchback SUV MUV Sedan
rating	Numerical	3.5-4.5
no cylinder	Numerical	3-8
max power rp	Numerical	3400-8500
max power bhp	Numerical	10.80-759.01
max power rpm	Numerical	2200-6750
max power nm	Numerical	16.1-850
transmission type	Categorical	Manual Automatic

2.3 Method Introduction

In this study, the linear regression model is proper because these factors have a more direct relationship, and these factors are relatively independent and don‘t influence each other. By this model, the relationship between factors and the popularity of electric vehicles can be explained better.

The paper uses a multiple linear regression model to compare the situation with and without considering the interaction terms. This section will mainly aim to compare the significance of the two models and the accuracy of the results. Eventually, it will enable the optimized processing of models. The multiple linear regression model is a linear regression model with multiple explanatory variables. It is used to explain the linear relationship between the explained variable and multiple other explanatory variables.

3. Results and Discussion

3.1 Descriptive Analysis

Figure 1 is a histogram of engine horsepower. As can be seen from the graph, the horsepower of most vehicles ranges from 1000 to 3000.

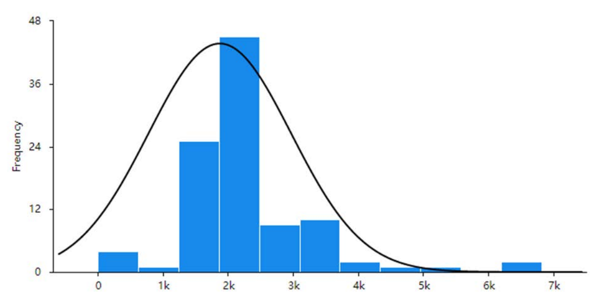

Fig. 1 Engine power histogram

Figure 2 is a scatter plot of the maximum torque corresponding to the selling price. The graph shows that the vehicles with the most torque between 200 and 400 are generally proportional.

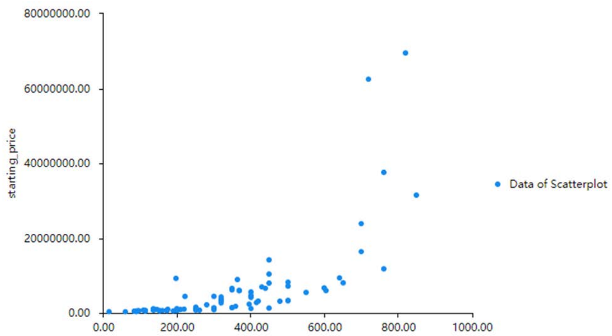

Fig. 2 Max torque nm plot

Table 2 is a descriptive analysis of 13 variables (fuel type, engine power, reviews count, vehicle capacity, no cylinder, fuel tank capacity, transmission type, max power rp, max power bhp, max torque rpm, max torque nm, rating, and body type):

Table 2. Descriptive statistics

Name	minimum	Maximum	Mean	SD	Median
energy type	1.00	4.00	3.17	1.04	4.00
engine power	0.00	6750.0	1864.01	1095.95	1498.00
reviews count	2.00	2392.00	220.90	422.24	68.50
vehicle capacity	2.00	8.00	5.30	1.06	5.00
no cylinder	0.00	12.00	4.08	1.739	4.00
fuel tank capacity	0.00	90.00	45.04	2.73	47.00
transmission type	1.00	3.00	1.40	0.77	1.00
max power rp	3400.00	8500.00	4788.00	1708.72	5500.00
max power bhp	10.80	759.01	182.27	128.93	147.51
max torque rpm	2200.00	6750.00	3290.81	1293.14	3500.00
max torque nm	16.10	850.00	311.85	188.80	270.00
rating	3.50	4.500	4.45	0.17	4.50
body type	1.00	10.00	7.81	2.62	9.00

3.2 Logistic Regression Results

Various factors, including the type of energy type, engine power, max power rp, max power nm, max power rpm, max power bhp, reviews count, no cylinder, vehicle capacity, transmission type, fuel tank capacity, rating, body type, were utilized as independent variables. Starting costs served as the dependent variable (Table 3).

Table 3. Model results

	Nonnormalized coefficient		Standardization coefficient	t	p	Collinearity diagnosis	
	B	Standard error	Beta			VIF	Tolerance
Constant	4892956.208	10491449.606	-	0.466	0.642	-	-
energy type	-364240.738	533719.253	-0.036	-0.682	0.497	2.066	0.484
engine power	3306.723	1072.816	0.344	3.082	0.003**	9.182	0.109
reviews count	-82.838	1015.703	-0.003	-0.082	0.935	1.222	0.819
no cylinder	1643493.103	646446.755	0.271	2.542	0.013*	8.393	0.119
vehicle capacity	-117633.855	440221.088	-0.012	-0.267	0.790	1.469	0.681

	Nonnormalized coefficient		Standardization coefficient	t	p	Collinearity diagnosis	
transmission type	409893.597	622473.674	0.030	0.658	0.512	1.560	0.641
fuel tank capacity	-35696.114	18046.919	-0.080	-1.978	0.051	1.218	0.821
rating	-1688301.820	2358865.115	-0.028	-0.716	0.476	1.138	0.879
body type	-171209.473	172993.074	-0.043	-0.990	0.325	1.372	0.729
max torque rpm	-2105.304	658.698	-0.258	-3.196	0.002**	4.819	0.208
max power bhp	82071.771	11406.074	1.004	7.195	0.000**	14.366	0.070
max torque nm	-34371.034	7819.580	-0.615	-4.396	0.000**	14.477	0.069
max power rp	354.973	529.505	0.058	0.670	0.504	5.437	0.184
R^2	0.884						
Adjust R^2	0.866						
F	F (13,86)=50.191, p=0.000						
D-W value	2.053						

* p<0.05 ** p<0.01

According to Table 3 above, the linear regression results of maximum power bhp, engine displacement, and no_cylinder are all greater than 0, which are 81184.929 (t=8.447, p=0.000<0.01). 1710568.537 (t=2.698, p=0.008<0.01), 3236.236 (t=3.034, p=0.003<0.01), indicating that these three factors have significant positive factors on the starting price. The analysis results of maximum torque nm and maximum torque speed are less than 0, which are -34886.736 (t=-5.268, p=0.000<0.01) and -2176.593 (t=-3.406, p=0.001<0.01). It shows that these two factors have a significant negative effect on the starting price. Other factors have little influence on the dependent variable.

4. Conclusion

Summary analysis shows that engine power, no cylinder, max power bhp will have a significant positive impact on starting price. Max torque rpm and max torque nm will have a significant negative influence on the starting price. But energy type, reviews count, vehicle capacity, transmission type, fuel tank capacity, rating, body type, and max power RP does not affect the starting price. Based on the above conclusions, technology companies should increase their investment in engine horsepower and other aspects during the research and development stage, improve product competitiveness, bring more fierce competition to the market, promote the development of the new energy vehicle industry, reduce prices, and further increase the number of new energy vehicles, which will have a greater impact on environmental protection.

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