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Fuel Type Preference in Car Purchases: A Gender based Critical Study

Dr. Archi Mathur
Associate Professor, Faculty of Management Studies, National Law University, Jodhpur

Abstract:
Reduction of carbon emissions and a healthy lifestyle are the prime concerns of every citizen of the world. Electric cars seem to give some sort of relief from this onslaught of civilization. With India galloping fast on the road to development, modernization with environmental safe-guards is the most pragmatic way forward. But whether the consumers are ready for the shift from fossil-fuel based cars to electric versions is something to ponder about. This study highlights upon two things:

1. Whether electric cars are more preferred than the hybrid or other fuel based cars?
2. Does gender have an impact on purchase of an electric/hybrid/other fuel based cars?

Keywords: Electric Cars, Hybrid Cars, Petrol Cars, Diesel Cars, CNG Cars
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Introduction:

No doubt, to enhance the quality of standard of living, greener cars in the form of electric cars is the best option available in the market. But, the presence of other alternative modes of cars in the market, also entice the consumers. Most prominent among them is the presence of hybrid cars in the market. Hybrids are the cross overs with both fossil fuel and battery operations available simultaneously, but reduce the emission considerably. With India still not electricity proficient even for its urban households and industrial belts, these hybrids offer a more viable cost effective options. So the hybrid car is a strong competitor for electric cars in the Indian market.

Therefore, a survey was conducted to gauge the preferences of consumers. The study aims to identify the relationship between gender and car preferences based on fuel/energy type

Research Methodology:

a. **Data Collection:** A questionnaire was prepared and a survey was conducted through BolDe app (a market research surveying application). The link was shared over wide audience using Whats App and E-mail.

b. **Sample Size:** The sample size of the survey consists of 213 respondents. Out of these 213 respondents, 101 respondents were females and 112 respondents were males. The sample unit consists of respondents from various categories like housewives, entrepreneurs, salaried individuals, practicing professional, retired people, and students (from the Universities as they are the future prospects). Demographic (age, gender, income and occupation) basis of segmentation is used for this survey.

Tools/Techniques used for Data Analysis:

For testing the hypothesis, Chi Square Test will be performed. Chi Square Test is used as a statistical tool to analyze and interpret the data so collected. This test is used to study the relationship between two categorical variables. The two categorical variables included in this study are gender (male and female) and type of fuel/energy used by the car (CNG, diesel, petrol, hybrid and electric). Through the Chi Square Test, the researcher tries to determine whether the difference between the observed values and the expected values is statistically significant.

To undertake this test, firstly framing of hypothesis is done. Null hypothesis and alternate hypothesis is accordingly framed.

Hypothesis:

Set 1:

Null Hypothesis (H_0): Electric cars will be more preferred than the hybrid or fuel based cars.

Alternate Hypothesis (H_1): Electric cars will be less preferred than the hybrid or fuel based cars.

Set 2:

Null Hypothesis (H_0): There is no relation between gender and the nature of car on the basis of type of fuel/energy

Alternate Hypothesis (H_1): There is a relation between gender and the nature of car on the basis of type of fuel/energy

The significance level will be taken as 0.05 i.e. $\alpha = 0.05$
This indicates that there is a 5% risk of concluding that there exists an association between the variables taken when there is actually no association.

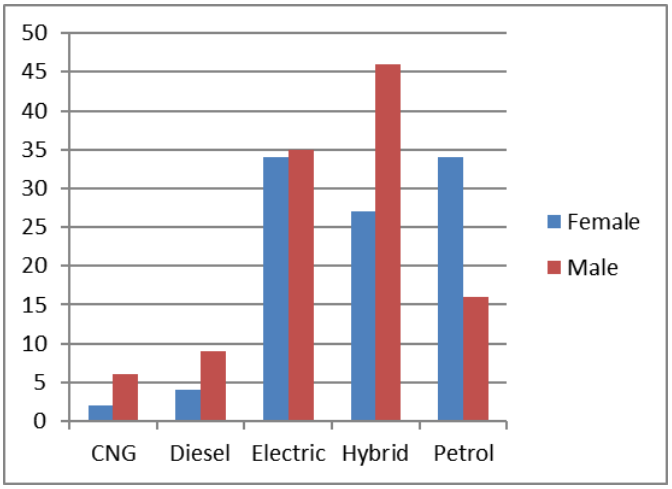
Once the hypothesis is framed, tabulation of the data will be done.

Table of Observed Values:

Observed value is the actual number of observations in a sample that belongs to a category.

Gender	Nature of Car on the basis of Type of Fuel/Energy					
	CNG	Diesel	Electric	Hybrid	Petrol	Grand Total
Female	2	4	34	27	34	101
Male	6	9	35	46	16	112
Grand Total	8	13	69	73	50	213

Table 1



Graph 1

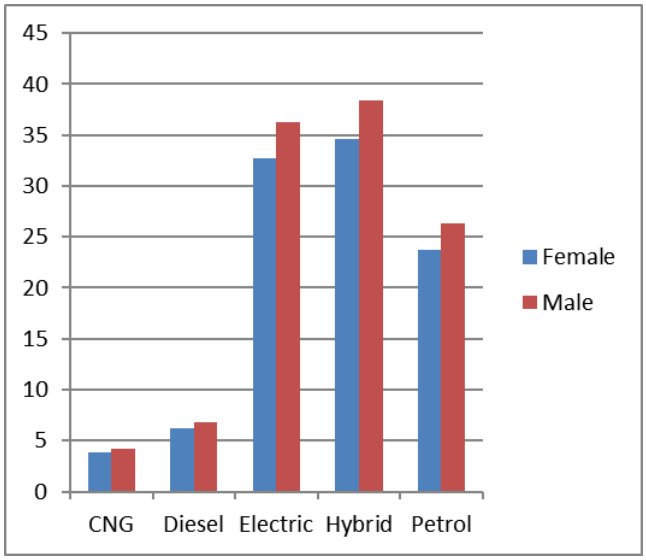
Table of Expected Values:

The expected value is the frequency that would be expected in a cell if the variables are independent.

Expected Value: Row Total * Coloumn Total / Grand Total

Gender	Nature of Car on the basis of Type of Fuel/Energy				
	CNG	Diesel	Electric	Hybrid	Petrol
Female	3.79	6.16	32.72	34.61	23.71
Male	4.21	6.83	36.29	38.38	26.29

Table 2



Graph 2

Calculation of χ^2 Value:

Observed Value (O)	Expected Value (E)	(O-E)	$(O-E)^2$	$(O-E)^2/E$
2	3.79	-1.79	3.2041	0.8454
4	6.16	-2.16	4.6656	0.7574
34	32.72	1.28	1.6384	0.0501
27	34.61	-7.61	57.9121	1.6733
34	23.71	10.29	105.8841	4.4658
6	4.21	1.79	3.2041	0.7611
9	6.83	2.17	4.7089	0.6894
35	36.29	-1.29	1.6641	0.0458
46	38.38	7.62	58.0644	1.5129
16	26.29	-10.29	105.8841	4.0275
			Summation $(O-E)^2/E$	$\chi^2 = 14.8287$

Table 3

The Chi Square Calculated Value is **14.8287**

Comparison of the Calculated Value of the χ^2 with the Tabulated Value is done.

χ^2 Tabulated Value:

For this, the degrees of freedom have to be calculated. The formula for degrees of freedom is:

Degree of Freedom = (Coloumn -1) (Row-1)
f = (5-1) (2-1)
f = 4

Then using the chi square table for degrees of freedom 4 and significance value of 0.05, the χ^2 Tabulated Value is calculated.

So χ^2 tabulated value will be 9.488

If the Chi Square Calculated Value is more than the Chi Square Tabulated Value or the critical value, then the Null Hypothesis (H_0) is rejected and the Alternate Hypothesis (H_1) is accepted. Accordingly, the Null Hypothesis (H_0) *'Electric cars will be more preferred than the hybrid or fuel based cars*' is rejected and the Alternate Hypothesis (H_1) '*Electric cars will be less preferred than the hybrid or fuel based cars*' is accepted.

As the calculated value is more than the critical value, we have sufficient evidence to say that there is an association between the type of gender and the nature of car preferred on the basis of type of fuel/energy. Hence the Null Hypothesis (H_0) '*There is no relation between gender and the nature of car on the basis of type of fuel/energy*' is rejected and the Alternate Hypothesis (H_1) '*There is a relation between gender and the nature of car on the basis of type of fuel/energy' is accepted*.

This further shows that the as the critical value is greater than the expected value, it cannot be attributed to chance and our sample supports the hypothesis of a difference.

This can further be ascertained by calculating the p value.

Calculation of p value:

The two tailed p value with a Chi Square Calculated Value of 14.8287 and degrees of freedom 4 equals 0.0051.
If the p value is smaller than or equal to 0.05, then the variables have a statistically significant association and the Null Hypothesis (H_0) can be rejected.

ie. $p \leq \alpha$
or $p \leq 0.05$
$0.0051 \leq 0.05$

If the p value is less than or equal to the significance level, the Null Hypothesis (H_0) is rejected and concluded that there is a statistically significant association between the variables. And by conventional criteria, the difference is considered to be very statistically significant. Therefore, the Null Hypothesis (H_0) '*Electric cars will be more preferred than the hybrid or fuel based cars*' can be rejected and the Alternate Hypothesis (H_1) '*Electric cars will be less preferred than the hybrid or fuel based cars*' can be accepted. Similarly, the Null Hypothesis (H_0) '*There is no relation between gender and the nature of car on the basis of type of fuel/energy*' is rejected and the Alternate Hypothesis (H_1) '*There is a relation between gender and the nature of car on the basis of type of fuel/energy*' is accepted.

Gender	Values	Nature of Car on the basis of Type of Fuel/Energy						
		CNG	Diesel	Electric	Hybrid	Petrol	Total	%
Female	Observed Value	2	4	34	27	34	101	47.42
	Expected Value	3.79	6.16	32.72	34.61	23.71		
Male	Observed Value	6	9	35	46	16	112	52.58
	Expected Value	4.21	6.83	36.29	38.38	26.29		
Total		8	13	69	73	50	213	
%		3.76	6.10	32.4	34.27	23.47		100

Table 4

From the above table, following inference/observations can be made:

1. The observed value for the CNG car in the category of female and male population is 2 and 6 respectively; therefore amounting to 1.98% females and 5.36% males preferring to purchase CNG car. There is also not much difference in the expected value of the CNG car which stands at 3.79 and 4.21 respectively for female and male population.

2. For the Indian population which used to drive diesel and petrol cars mostly, very striking revelation has emerged in the diesel cars category. Just like the fate of CNG, the observed value for diesel cars in the category of female and male population is 4 and 9 respectively; thereby amounting to 3.96% females and 8.03% males preferring diesel cars out of the total population. There is also not much difference in the expected value of the diesel car which stands at 6.16 and 6.83 respectively for female and male population.

3. Now on comparing the electric, hybrid and petrol cars, it was found out that:

a. The observed value for the electric car in the category of female and male population is 34 and 35 respectively; therefore amounting to 33.66% females and 31.25% males preferring to purchase an electric car. The expected value of the electric car stands at 32.72 and 36.29 respectively for female and male population. This means that the expected value of male population preferring electric cars was higher than the female population; though by only a small margin.

b. The observed value for the hybrid car in the category of female and male population is 27 and 46 respectively; therefore amounting to 26.73% females and 41.07% males preferring to purchase a hybrid car. Therefore, from the data collected, it can be seen that the hybrid cars are more preferred by the male population as compared to the female population. Furthermore, the expected value of the hybrid car stands at 34.61 and 38.38 respectively for female and male population. This means that the expected value of the female population preferring hybrid cars is also more when compared with its observed value.

c. The observed value for the petrol car in the category of female and male population is 34 and 16 respectively; therefore amounting to 33.66% females and 14.28% males preferring to purchase a petrol car. This indicates that females prefer petrol cars more than their male counterparts. The expected value of the petrol car stands at 23.71 and 26.29 respectively for female and male population. This means that the expected value of male population preferring petrol cars is much higher when compared to its observed value. On the other hand, the expected value of female population preferring petrol cars is much lower than its observed value.

4. While comparing observed and expected cell counts, it was found out that in the category of female respondents, the observed value for hybrid cars was 27 while the expected value was 34.61. Similarly, the observed value for petrol cars was 34 while the expected value was 23.71. This means that these are the cells which have more or less observations than would be expected if H_0 were true. It can also be seen for the male population also. The observed value for hybrid cars is 46 as compared to the expected value of 38.38. Similarly, for petrol cars, the observed value is 16 as compared to its expected value of 26.29.

If the two variables are associated, then the distribution of observations for one variable will defer depending on the category of the second variable.

If two variables are independent, then the distribution of observations for one variable will be similar for all categories of the second variable.

Keeping this into consideration, we can say that in case of the female respondents and hybrid cars, the observed value was 27 and the expected value is 34.61. The expected value is much more than the observed value than if the variables were independent. This shows that the two variables (females and hybrid car) are associated. Similarly again in the case of female population and petrol cars, the observed value is 34 and the expected value is 23.71. Here the observed count seems to be much larger than would be expected if the variables were independent.

Further more, we can say that in case of the male respondents and hybrid cars, the observed value is 46 and the expected value is 38.38. Here the observed count seems to be much larger than would be expected if the variables were independent. This shows that the two variables (males and hybrid car) are associated.
And again in the case of male population and petrol cars, the observed value is 16 and the expected value is 26.29. Here the expected value is much more than the observed value than if the variables were independent. This shows that the two variables (males and petrol car) are associated.

5. The cells which contribute the most to the value of χ^2 are the female respondents & petrol car category (4.4658) and male respondents and petrol car category (4.0275). The smallest contributions come from female respondents & electric car category (0.0501) and male respondents & electric car category (0.0458).

Summary:

From this study, it can be summarized that the preference for hybrid cars is much more than cars in any other category. It is hugely preferred by the males but females preferences of petrol cars is substantial enough to not to be ignored by the car manufacturers. The most striking feature of this study is the petrol car category which will be facing the consequences of the presence of electric and hybrid cars in the market. Though the females will be preferring more of electric and petrol cars; but the fact that the knowledge about the functionality of the cars and the decision making regarding the same lies with the males, it can be ascertained that there is going to be high demand for hybrid cars in the Indian market as compared to other car categories.
Furthermore, not enough is done by marketers to target female consumers for their hybrid/electric versions. They can be their biggest segment for features like eco-friendly, economy and ease of drive.

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