IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 1, January 2025

DOI: 10.17148/IARJSET.2025.12136

Statistical Evaluation of User Satisfaction with Electric Vehicles

Kalange Tejashri C[1], Dr. Jagtap Nilambari A[2], Rakate Priya N[3]

Statistics Department, Tuljaram Chaturchand College, Baramati (Pune), Maharashtra, India[1]

Statistics Department, Tuljaram Chaturchand College, Baramati (Pune), Maharashtra, India[2]

Statistics Department, Tuljaram Chaturchand College, Baramati (Pune), Maharashtra, India[3]

Abstract: Electric vehicle is defined as a vehicle that can be powered by an electric motor that draws electricity from a battery and is capable of being charged from an external source. Electric vehicles (EVs) use electricity as their primary fuel or to improve the efficiency of conventional vehicle designs. EVs include all-electric vehicles, also referred to as battery electric vehicles (BEVS), and plug-in hybrid electric vehicles (PHEVs).

The introduction of electric vehicles (EVs) marks a pivotal shift in the automotive industry towards sustainable mobility. With increasing concerns over environmental degradation and the depletion of fossil fuel reserves, electric vehicles have emerged as a promising solution to mitigate these challenges. However, the successful adoption and widespread acceptance of EVs is not only on their technological advancements but also on user satisfaction.

Understanding and addressing the factors influencing user satisfaction is crucial for the continued growth and market penetration of electric vehicles. Therefore, this project aims to investigate the various dimensions of EV user satisfaction comprehensively. By delving into aspects such as cost-effectiveness, convenience, charging infrastructure, performance, and overall user experience in an effort to pinpoint the critical factors that influence consumer happiness. we seek to identify the key determinants that contribute to user satisfaction or dissatisfaction.

Ultimately, the findings of this study can serve as a valuable resource for policymakers, industry stakeholders, and researchers seeking to promote the widespread adoption and acceptance of electric vehicles. By aligning technological advancements with user expectations and preferences, we can accelerate the transition towards a sustainable and environmentally friendly transportation ecosystem while ensuring a fulfilling experience for EV users.

INTRODUCTION

The significance of this research lies in its potential to inform policymakers, manufacturers, and stakeholders in the automotive industry about the specific areas that need improvement to enhance EV user satisfaction. Furthermore, by learning more about the preferences, worries, and expectations of EV users, we can open the door for the creation of interventions and initiatives meant to promote a more satisfying and positive experience with EV ownership.

Through a combination of survey and data analysis techniques, this project will endeavor to provide a comprehensive understanding of the factors influencing EV user satisfaction. We seek to capture a nuanced perspective that considers the various demands and preferences of electric vehicle users across various demographic categories and geographic regions by utilizing both quantitative and qualitative approaches.

Our research objectives are to find which problems are mostly faced by users of electric vehicle also to check whether future choice and operating cost maintenance of EV's are dependent or not, problem faced and use of EV for long distance travelling are dependent or not, problem faced and use of EV to carry heavy load are dependent or not, performance and user satisfaction of EV's are dependent or not. We have fitted logistic regression model with response variable user satisfaction and factors affecting as Availability charging stations, Performance, Comfort, Interior Space , Reliability**,** Environmental benefits, Long distance travelling, Noise level, Government subsidy, Operating Costs Maintenance and Distance per charge to satisfaction of EV user. By using this model, we find which factors are significant for electric vehicle user satisfaction.

METHODOLOGY

Through a combination of survey and data analysis techniques, this research will endeavor to provide a comprehensive understanding of the factors influencing EV user satisfaction.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

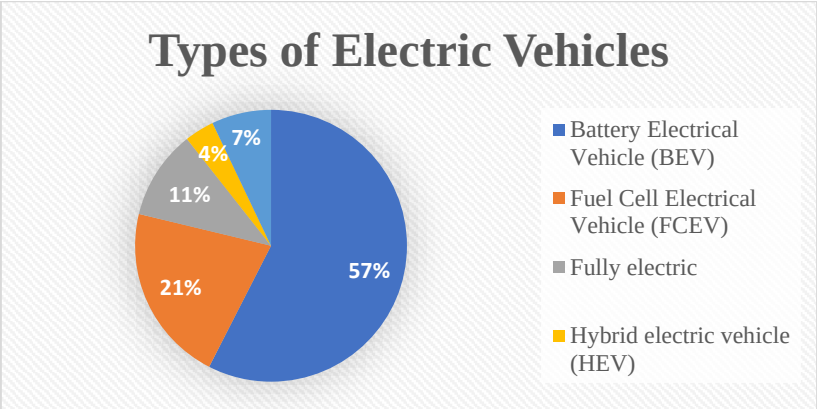
International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 1, January 2025

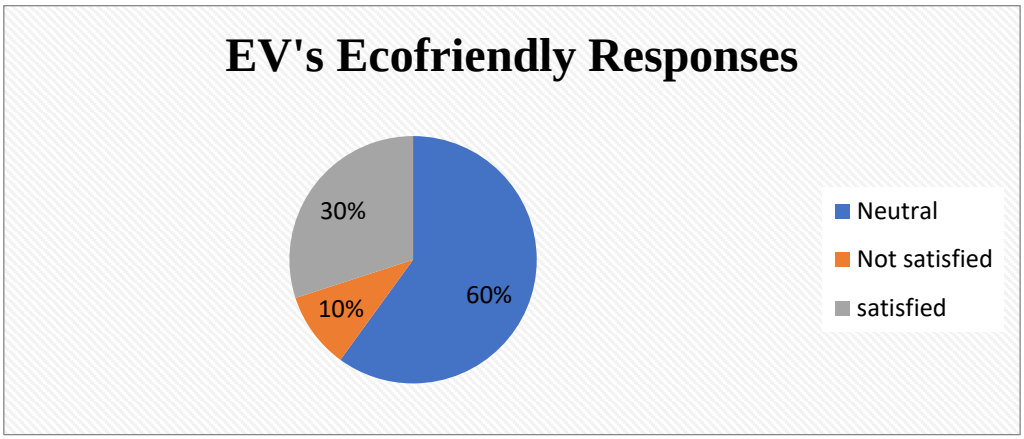
DOI: 10.17148/IARJSET.2025.12136

Questionnaire is a research instrument consisting of a series of a series of question and other prompts for the purpose of gathering information from respondents. The data is a primary data collected using a self-designed and made questionnaire. Study is conducted through distribution of questionnaires The data is collected using a Google form.

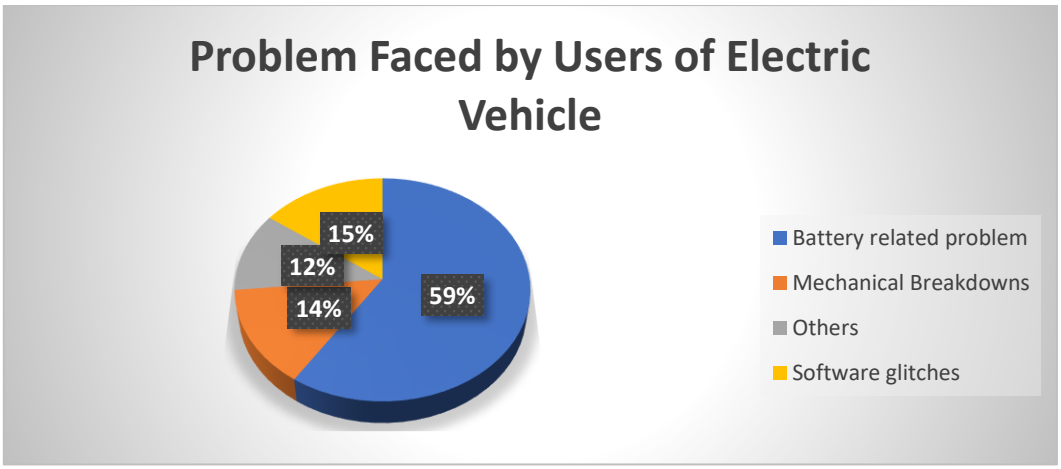
Statistical Analysis:



From the above pie chart we observe that most of the users are prefer to use Battery Electric Vehicles (BEV).



Most of users are satisfied that EV's are ecofriendly while some of them are unable to decide.



From the pie chart we observe that about 59% of users are facing battery related problems. About 14 % users are facing mechanical breakdowns and 15% users are facing problems regarding software glitches.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 1, January 2025

DOI: 10.17148/IARJSET.2025.12136

CHI-SQUARE TEST FOR INDEPENDENCE OF ATTRIBUTES

1) Future choices and operating cost maintenance of EV's

Hypothesis:

H_0: Future choices and operating cost maintenance of EV's are independent.

H_1: Future choices and operating cost maintenance of EV's are not independent.

Chi-squared calculated value is 21.0992 and p-value = $2.621e^{-05}$

If the p-value is less than 0.05 then we reject the null hypothesis otherwise we accept it.

Here, p-value = 2.621e-05 < 0.05, hence we reject H_0 at 5% level of significance. i.e. Future choices and operating cost maintenance of EV's may not be independent i.e. Future choices depend on operating cost maintenance of EV's.

2) Problem faced and use of EV's for long distance travelling.

Hypothesis:

H_0: Problem faced and use of EV's for long distance travelling are independent.

H_1: Problem faced and use of EV's for long distance travelling are not independent.

Chi-squared calculated value is 5.1389 and p-value = 5.1389

If the p-value is less than 0.05 then we reject the null hypothesis otherwise we accept it.

Here, p-value = 0.1619 > 0.05, Therefore we may accept H0. at 5% level of significance. i.e. Problem faced and use of EV's for long distance travelling may be independent.

3) Problem faced and use of EV's to carry heavy load by EV's user

Hypothesis:

H_0: Problem faced and use of EV's to carry heavy load are independent.

H_1: Problem faced and use of EV's to carry heavy load are not independent.

Chi-squared calculated value is 4.0581and p-value = 0.2553

If the p-value is less than 0.05 then we reject the null hypothesis otherwise we accept it.

Here, p-value = 0.2553 > 0.05, Therefore we may accept H_0 at 5% level of significance. i.e. Problem faced and use of EV's to carry heavy load may be independent.

4) Performance of EV's and user satisfaction

Hypothesis:

H_0: Performance of EV's and user satisfaction of EV's are independent.

H_1: Performance of EV's and user satisfaction of EV's are not independent.

Chi-squared calculated value is 9.464 and p-value = 0.008809

If the p-value is less than 0.05 then we reject the null hypothesis otherwise we accept it.

Here, p-value = 0.008809 < 0.05, Therefore we may reject H_0 at 5% level of significance. i.e. Performance of EV's and user satisfaction may be dependent.

5) Problem faced and distance travelled (in km) per week by EV's

Hypothesis:

H_0: Problem faced and distance travelled (in km) per week by EV's are independent.

H_1: Problem faced and distance travelled (in km) per week by EV's are not independent.

Chi-squared calculated value is 9.5286 and p-value = 0.39

If the p-value is less than 0.05 then we reject the null hypothesis otherwise we accept it. Here, p-value = 0.39 > 0.05, thus we may accept H_0 at 5% level of significance. i.e. Problem faced and distance travelled (in km) per week of EV's may be independent.

FITTING OF LOGISTIC REGRESSION MODEL

Outline of model:

Consider the dichotomous response variable Y as

Y = 1 if Electric Vehicle user is satisfied

= 0 if Electric Vehicle user is not satisfied

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 1, January 2025

DOI: 10.17148/IARJSET.2025.12136

X_1: Availability charging stations
X_2: Performance Comfort Interior Space Reliability
X_3: Satisfaction about Environmental benefits
X_4 : type_of_charging_station
X_5: problem_faced
X_6: Long distance travelling
X_7: Satisfaction about Noise level
X_8: carry_heavy_load
X_9: Beneficiary of Government subsidy
X_{10}: Satisfaction about Operating Cost Maintenance
X_{11}: Distance per charge

We want to test

H_0: Independent variables for user satisfaction are not adequate.
v/s
H_1: Independent variables for user satisfaction are adequate.

R-output:-

```
> model=glm(User_satisfaction~.,family="binomial",data=d)
> summary(model)
Call: glm(formula = User_satisfaction ~ ., family = "binomial", data = d)
```

Deviance Residuals:

Min	Q_1	Median	Q_3	Max
-3.0108	0.1140	0.2240	0.3969	1.5837

Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-0.70458	0.93964	-0.750	0.453350
X_1	-0.31801	0.87814	-0.362	0.717244
X_2	-0.07413	0.91935	-0.081	0.935737
X3	-0.21768	0.5070	-0.429	0.667665
X4	0.20665	0.31654	0.653	0.513855
X5	0.33138	0.84563	0.392	0.695151
X_6	1.63644	1.29522	1.263	0.206429
X_7	-0.24905	1.10860	-0.225	0.822247
X_8	0.04871	0.79677	0.061	0.951255
X_9	-0.45327	0.81720	-0.555	0.579124
X_{10}	2.91310	0.76669	3.800	0.000145 ***
X_{11}	0.7183	0.2409	2.981	0.00287 **

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Dispersion parameter for binomial family taken to be 1)
 Null deviance: 95.706  on 112  degrees of freedom
Residual deviance: 60.313  on 101  degrees of freedom
AIC: 84.313
Number of Fisher Scoring iterations: 6
```

G = Null deviance - Residual deviance

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 1, January 2025

DOI: 10.17148/IARJSET.2025.12136

= 90.706 – 60.313

G = 30.393

Chi-Square $_{tab}$ = 19.675

Result: Here G exceeds Chi-Square table value.

Therefore, we may reject Ho at 5% level of significance.

Conclusion: At least one regressor may be significant. Here we observe that Operating Cost Maintenance and Distance per charge are the significant variables for the EV user satisfaction.

CONCLUSIONS

- The most preferable type of electric vehicle is Battery Electric Vehicles (BEV).
- Most of users are facing battery related problems.
- Future choice of EV user depends on operating cost maintenance of EV's.
- Problem faced and use of EV's for long distance travelling may be independent.
- Problem faced and use of EV's to carry heavy load may be independent.
- Performance of EV's and user satisfaction may be dependent.
- Problem faced and distance travelled (in km) per week of EV's may be independent.
- From logistic regression we observe that Operating Cost Maintenance and Distance per charge are the significant variables for the EV user satisfaction.

REFERENCES

[1]. Dinis, L. C. (n.d.). Exploring electric vehicles attribute and users satisfaction based on driving experience.

[2]. Lebeau K., V. M. (n.d.). Consumers attitude towards battery electric vehicle : A lagre scale survey.

[3]. Pradhan, A. P. (n.d.). A STUDY OF CONSUMER PERCEPTION TOWARDS E-VEHICLAE IN VADODHARA CITY . *IJCRT*.

[4]. Praveenkumar, M. V. (n.d.). An impact of Customers perception towards Electric Vehicle in Coimbatore City . *International Journal of Research Publication and Reviews*.