# Dissecting Consumer Preferences of Two-Wheeler EV Features through Conjoint Analysis

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## ABSTRACT

The prominence of two-wheelers within the mobility ecosystem in India is undeniable. With growing environmental awareness and policy shifts, Electric Two-Wheelers (EVs) are projected to represent a substantial portion, ranging from 60 to 70 percent, of new vehicle sales by 2030. It is crucial to discern the features that attract consumers most in electric two-wheelers. However mere isolated factor ranking is unrealistic. EVs have both good and bad features in combination. This research employs conjoint analysis to identify the most desirable combination features, offering a more realistic and actionable insight into consumer preferences. It was found that based on importance value,  price has the most influence on overall preference and Whether the EV brand is used by persons known to the respondent has least influence on overall preference for a particular brand of two-wheeler EV. Higher battery range shows higher utility score and there is an inverse relationship between price and utility, with higher prices corresponding to lower utility. Surprisingly, the utility score of non-reputed  brand is less than reputed brand. Absence of extra fancy software features , non-removable battery and absence of Physical Service center have better utility scores. These aspects would have not been highlighted if features were not ranked as a combined profile cards.

*KEYWORDS :* *Electric Vehicles , Conjoint Analysis, Utility Scores, Importance value.*

## I.    INTRODUCTION:

In India, two wheelers have long been an integral part of mobility ecosystem, accounting for more than  70 percent of all vehicles[1]. Due to environmental consciousness and policy changes, Electric two-wheelers (EVs) are expected to account for 60 to 70 percent  of new sales in India by  2030 [1]. The increased use of electric two-wheelers aligns with global climate policies, government initiatives  and city access regulations aimed at reducing air pollution and improving traffic conditions. However, concerns about  vehicle safety ,  battery life , and  lack of charging infrastructure  could present challenges in achieving full market penetration sooner[1]. When purchasing their next two wheeler, 86 percent of consumers would consider buying an electric two-wheeler[1].  Thus it becomes imperative to understand the features of electric two wheelers that attract consumers most.

A simple ranking of features desired by consumers is easy but unrealistic. Every electric two wheeler brand comes with combination of good and bad features. Ranking combinations of features and analyzing these 'feature baskets' gives more realistic and practical results. This research article sets forth to find the top desired features using

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[1] Electric two-wheelers lead sales in India's mobility ecosystem | McKinsey.
https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/inside-indian-consumers-embrace-of-electric-two-wheelers.

conjoint analysis. Knowledge of such combined consumer preference would definitely improve the sales of electric two wheelers and help companies in tailoring their manufacturing and marketing department to address and grow in rapidly competitive electric two wheeler segment.

## II.     LITERATURE REVIEW

**Hemim, Payal, and S. Payal (2024)** examined the challenges obstructing the adoption of electric vehicles (EVs) in India and suggested potential solutions. The article identifies key hurdles such as high upfront costs, inadequate charging infrastructure, range anxiety, and lack of consumer awareness. Proposed solutions include incentivizing EV purchases, expanding charging networks, enhancing battery technology, and implementing public awareness campaigns. Addressing these challenges and implementing the suggested solutions could facilitate the wider adoption of EVs in India.

**Madan, Arhan (2023)** in their research article provide a summary of the rapidly growing electric two-wheeler market in India, highlighting key trends, opportunities, and challenges. It outlines the increasing popularity of EVs in the country, driven by factors such as rising fuel prices, environmental concerns, and government incentives. The article discusses opportunities for growth in the EV sector, including technological advancements, expanding urban markets, and evolving consumer preferences. The research also addresses challenges such as high initial costs, limited charging infrastructure, and competition from conventional two-wheelers. Overall, the article offers insights into the dynamics shaping the EV market in India.

**Chakraborty, Rahul and Chakravarty, Sujoy (2023)** investigate the factors influencing the acceptance of electric two-wheelers ( EVs) in India through a discrete choice survey. It explores preferences of potential EV buyers and identifies key factors affecting their acceptance. These factors include aspects such as pricing, performance, charging infrastructure availability, environmental concerns, and government incentives. By understanding these factors, the study aims to provide insights that could inform strategies to promote the adoption of EVs in India.

**Bhat, Furqan and Verma, Ashish (2023)** examine consumer intentions to accept electric two-wheelers ( EVs) in India, utilizing a valence theory approach to uncover the influence of identity and utility. It delves into how factors such as identity and perceived utility shape consumer attitudes towards EVs. The valence theory framework helps to understand the positive and negative aspects associated with adopting EVs and how these factors influence consumer intentions. By analyzing identity and utility perceptions, the study aims to shed light on the underlying motivations and barriers impacting the acceptance of EVs among consumers in India.

**Patel, Meghana and Raval, Chirag (2023)** investigate customer awareness regarding electric two-wheelers in Patan City. Their research examines the level of knowledge among consumers in Patna City about two wheel EVs, including their features, benefits, and availability. The research aims to understand the extent to which consumers in this specific location are aware of two wheel EV as an alternative mode of transportation. This analysis may provide insights into potential areas for improvement in marketing strategies or educational campaigns to enhance awareness and promote the adoption of two wheel EV in Patna City.

### III.     OBJECTIVES OF THE STUDY
- Formulate orthogonal design of Two wheeler Electric Vehicles features
- Derive Importance value of features
- Derive Utility scores of individual features in the design

## IV.     METHODOLOGY

### Sample and Sampling Method

10 prominent two –wheeler showrooms were chosen using convenient sampling method in Chennai city. In total, 110 customers were selected by simple random sampling from the 10 showrooms and structured questionnaire related to electric two wheelers was administered. The respondents were also asked to rank 20 profile cards (Combinations of features). Out of 110 questionnaires received, 10 questionnaires were rejected for multiple common rankings. A total of 100 questionnaires with profile cards were used for analysis.

### Measure and Procedure

Based on literature review, the main features of two wheeler electric vehicles were chosen and were converted into orthogonal design. They are delineated below:

a) **Distance EV can travel in single charge:** The distance that two wheeler EV can travel forms an important criteria in selection of the EV . The distances EV can go in a single charges are:

Below 40 km,40 km to 60 km,60 km to 100 km and 100 km to 140 km.

b) **Price of EV:** This factor represents the price of EV and they are:

Below Rs.80,000,Rs.80,000 to Rs.1,20,000,Rs.1,20,000 to Rs.1,40,000 and Above Rs.1,40,000.

c) **Fancy Features**  : Fancy features are prominent in many EVs and they include Maps, Music, Proximity Alert etc. Presence (Yes) or absence (No) of these features was considered in the profile cards.

d) **Battery can be removed:** Consumers in multi-storeyed apartments consider if battery can be removed from EV for charging. Presence (Yes) or absence (No) of this feature was considered in the profile cards.

e) **Physical service center:** Some EV companies do not have physical service center and service is done through mobile service vans. Presence (Yes) or absence (No) of physical brick and mortar  service centre  was also considered in the profile cards.

f) **EV from reputed company:** Consumers of EVs are varied and some will buy only from established traditional (Internal Combustion Engine) companies and avoid new EV companies. Whether the EVs are from reputed companies or not  was also considered in the profile cards.

g) **Brand used by relatives friends :** Since EVs are new trend, consumers prefer to buy brands which has already been tried by their relatives, friends or colleagues . Whether the EV brand is used by known persons or not  was also considered in the profile cards.

Based on above features, a combination of features called Profile cards were created which was ranked by the respondents. There are 16 profile cards and 4 hold out cards which are depicted in table 1.

Table 1: Profile Cards With Combination Of Features

| Card ID | Distance EV can travel in single charge | Price of EV | Maps Music Proximity Alert and fancy features | Battery can be removed | The company has physical service center | Buy EV from reputed company | Brand used by relatives friends |
|---|---|---|---|---|---|---|---|
| 1 | 40 km to 60 km | Above  Rs.1,40,000 | Yes | Yes | Yes | Yes | No |
| 2 | Below 40 km | Above  Rs.1,40,000 | Yes | No | No | No | Yes |
| 3 | Below 40 km | Rs.80,000            to Rs.1,20,000 | No | Yes | No | No | No |

| 4 | Below 40 km | Rs.1,20,000 to Rs.1,40,000 | No | No | Yes | Yes | No |
|---|---|---|---|---|---|---|---|
| 5 | 60 km to 100 km | Rs.80,000 to Rs.1,20,000 | Yes | Yes | No | Yes | Yes |
| 6 | 100 km to 140 km | Rs.1,20,000 to Rs.1,40,000 | Yes | Yes | No | Yes | No |
| 7 | 40 km to 60 km | Rs.1,20,000 to Rs.1,40,000 | No | Yes | No | No | Yes |
| 8 | 100 km to 140 km | Below Rs.80,000 | No | No | No | Yes | Yes |
| 9 | 60 km to 100 km | Rs.1,20,000 to Rs.1,40,000 | Yes | No | Yes | No | Yes |
| 10 | 100 km to 140 km | Above Rs.1,40,000 | No | Yes | Yes | No | Yes |
| 11 | 40 km to 60 km | Rs.80,000 to Rs.1,20,000 | No | No | Yes | Yes | Yes |
| 12 | Below 40 km | Below Rs.80,000 | Yes | Yes | Yes | Yes | Yes |
| 13 | 40 km to 60 km | Below Rs.80,000 | Yes | No | No | No | No |
| 14 | 60 km to 100 km | Below Rs.80,000 | No | Yes | Yes | No | No |
| 15 | 60 km to 100 km | Above Rs.1,40,000 | No | No | No | Yes | No |
| 16 | 100 km to 140 km | Rs.80,000 to Rs.1,20,000 | Yes | No | Yes | No | No |
| 17a | 60 km to 100 km | Below Rs.80,000 | Yes | No | Yes | Yes | No |
| 18a | 100 km to 140 km | Below Rs.80,000 | Yes | Yes | No | Yes | Yes |
| 19a | Below 40 km | Below Rs.80,000 | No | No | No | Yes | Yes |
| 20a | 60 km to 100 km | Below Rs.80,000 | No | Yes | No | No | No |

a: Hold out cards.

Each Profile card was ranked by the participants.

## V.    DATA ANALYSIS

A conjoint analysis was conducted using the profile rankings provided by the participants. From this analysis, Importance value and utility scores were derived.

**Importance Value:**

The importance value is the relative importance of each feature. The calculations are performed independently for each subject, and the final results are then averaged across all participants.

The values are calculated by determining the utility range for each factor individually and dividing it by the sum of the utility ranges for all factors. As a result, these values represent percentages and collectively add up to 100. The importance value is tabulate in table 3:

Table 3: Importance Value*

| Features | Importance Value |
|---|---|
| Reputed Brand | 6.156 |
| Battery Range | 10.347 |
| Price | 43.904 |
| Extra Software Features | 9.212 |
| Removable Battery | 15.592 |
| Physical Service Center | 5.596 |
| Used by know persons | 9.193 |

*Averaged Importance Score

The importance value indicates that price has the most influence on overall preference. This result has been vindicated by higher sale of Ola after it reduced its price. Whether the EV brand is used by persons known to the respondent has least influence on overall preference for a particular brand or model of two wheeler EV. The ranked importance value is show in table 3:

Table 3: Ranked Importance Value

| Features | Importance Value |
|---|---|
| Price | 43.904 |
| Removable Battery | 15.592 |
| Battery Range | 10.347 |
| Extra Software Features | 9.212 |
| Used by know persons | 9.193 |
| Reputed Brand | 6.156 |
| Physical Service Center | 5.596 |

**Utility Score Calculation**

Utility Score indicates the preference of a factor or feature over all other factors of features. Conjoint analysis was conducted to derive the utility scores for each factor level. A higher utility score indicates a greater preference for that particular factor. These utility scores are presented in Table 2.

**Table 2: Utility Score**

| Features | | Utility Estimate |
|---|---|---|
| Reputed Brand | Yes | -.435 |
| | No | .435 |
| Battery Range | Below 40 km | .539 |
| | 40 km to 60 km | 1.078 |
| | 60 km to 100 km | 1.617 |
| | 100 km to 140 km | 2.156 |
| Price | Below Rs.80,000 | -2.543 |
| | Rs.80,000 to Rs.1,20,000 | -5.086 |

| | Rs.1,20,000 to Rs.1,40,000 | -7.629 |
|---|---|---|
| | Above Rs.1,40,000 | -10.172 |
| Extra Software Features | Yes | 1.665 |
| | No | 3.330 |
| Removable Battery | Yes | 2.760 |
| | No | 5.520 |
| Physical Service Center | Yes | .690 |
| | No | 1.380 |
| Used by know persons | Yes | 1.550 |
| | No | 3.100 |
| (Constant) | | 3.513 |

From the above utility score table, it is seen that, as expected, higher battery range shows higher utility score and there is an inverse relationship between price and utility, with higher prices corresponding to lower utility (larger negative values mean lower utility).

Interesting, when consumers are presented with combination of features to rank, the utility score of non-reputed brand is less than reputed brand. This explains why initially new brands like Ather and Ola sold more than Bajaj, TVS EV brands.

Although studies have shown extra fancy software features are an attractive feature, when asked to rank it in combination with other features, the utility value is less [Yes (1.665) < No (3.330)]. Similarly, non-removable battery is favored over removable battery [Yes (2.760) < No (5.520)] and presence of Physical Service center [Yes (0.690) < No (1.380)]. The brands used by known persons is not preferred over brands used by known persons [Yes (1.550) < No (3.100)] when it comes to two wheeler EVs.

The utilities scores are expressed in a common unit, hence they can be added together to give the total utility of any combination. For example, the total utility of a EV with Reputed brand 'Yes', Battery Range 'Below 40 km' , Price 'Below Rs.80,000', Extra Software 'Yes', Removable: -0.435+0.539+(-2.543)+1.665+2.760+0.690+1.550 + 3.513= 7.739.

The Best Combination for maximum utility is found to be: Reputed Brand: 0.435 (No), Battery Range: 2.156 (100 km to 140 km), Price: -2.543 (Below Rs.80,000), Extra Software Features: 3.330 (No), Removable Battery: 5.520 (No), Physical Service Center: 1.380 (No), Used by known persons: 3.100 (No), (Constant): 3.513. Total Utility Estimate = 16.891

## VI.     FINDINGS AND DISCUSSION

The research has brought forth interesting findings which would not have come to light with mere single features ranking. When forced to rank combination of features, the highest ranked feature is found to be Price (Importance Value: 43.904) followed by Removable Battery (Importance Value: 15.592), Battery Range (Importance Value: 10.347), Extra Software Features(Importance Value: 9.212), Used by know persons(Importance Value: 9.193), Reputed Brand(Importance Value: 6.156) and Physical Service Center(Importance Value: 5.596). The most important insight is that brand reputation and presence of physical service center is not as important as price and Battery Range. The Utility Score derived by conjoint analysis is practically a customization template. Two wheeler Electric Vehicle companies can chose to address its target segment by permutations of the features based on feature's utility score.

## VII. CONCLUSION

The novel use of conjoint analysis has illuminated critical insights into consumer preferences within the two-wheeler Electric Vehicle (EV) market. By delving beyond singular feature rankings, the research has uncovered a nuanced landscape that defies simplistic categorization. Armed with insights from this study, EV companies are empowered to tailor their offerings to cater precisely to their target segments. In essence, the research underscores the importance of holistic analysis in discerning the complex interplay of consumer preferences. By leveraging these insights, stakeholders can navigate the evolving landscape of the two-wheeler EV market with confidence and precision, fostering a new era of consumer-centric innovation and market leadership.

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