A Case Study on the Electric Vehicle Market Segmentation

by

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Problem Statement

I work for an electric vehicle (EV) start-up. The start-up is evaluating which vehicle/customer segment to target for developing its EVs. Our task is to analyze the electric vehicle market in India using segmentation analysis. Based on this analysis, we need to formulate a feasible strategy to enter the market by targeting the segments most likely to adopt electric vehicles.

What is an Electric Vehicle?

An electric vehicle (EV) is a type of vehicle that is either partially or fully powered by electric power. EVs are known for their low running costs due to fewer moving parts requiring maintenance. They are also environmentally friendly, as they consume little to no fossil fuels (petrol or diesel).

While earlier EVs used lead-acid or nickel-metal hydride batteries, modern electric vehicles predominantly use lithium-ion batteries. These batteries are favored for their greater longevity and superior energy retention, with a self-discharge rate of just 5% per month. However, despite their efficiency, lithium-ion batteries do present certain challenges, such as the risk of thermal runaway, which can lead to fires or explosions, as seen in some instances with the Tesla Model S. Nonetheless, continuous efforts are being made to enhance the safety of these batteries.

Working Principle of an Electric Vehicle

An electric vehicle operates on a fundamental scientific principle: the conversion of energy. Specifically, electrical energy is converted into mechanical energy. This conversion is carried out by an electric motor, which is an integral part of the EV's system. Various types of motors can be used in electric vehicles, each suited to different performance requirements and design considerations.

Market Study

Will Electric Vehicles Replace Conventional Vehicles?

The question arises: will electric vehicles replace conventional vehicles? The answer is a resounding YES! Due to their numerous advantages and the rapidly expanding market, EVs are poised to replace traditional vehicles.

The market for EVs is growing at three times the speed of conventional vehicles. Currently, EVs account for 30% of the market supply. Several factors make electric vehicles more attractive than their petrol or diesel counterparts:

Advantages of Electric Vehicles

Lower Running Costs

The running cost of an electric vehicle is significantly lower than that of an equivalent petrol or diesel vehicle. EVs use electricity to charge their batteries instead of fossil fuels like petrol or

diesel. They are more efficient, and the cost of electricity is typically lower than that of petrol or diesel. Additionally, using renewable energy sources can further reduce the cost and make EVs more eco-friendly. For instance, home solar panels can be used to charge EVs, lowering electricity costs even more.

Low Maintenance Costs
Electric vehicles have much lower maintenance costs because they have fewer moving parts compared to internal combustion vehicles. The servicing requirements for EVs are also less frequent and less intensive than those for conventional petrol or diesel vehicles. As a result, the yearly cost of running an electric vehicle is significantly lower.

Zero Tailpipe Emissions
Driving an electric vehicle helps reduce your carbon footprint due to zero tailpipe emissions. The environmental impact of charging EVs can be further minimized by using renewable energy options for home electricity.

Tax and Financial Benefits
Electric vehicles benefit from lower registration fees and road taxes compared to petrol or diesel vehicles. Additionally, there are various government policies and incentives, which vary by state, that make purchasing an EV more financially attractive.

Minimal Noise Pollution
Electric vehicles operate with minimal noise, thereby reducing sound pollution and contributing to a quieter, more pleasant environment.

No Exhaust or Spark Plugs
EVs do not have exhaust systems, thus eliminating air and sound pollution associated with exhaust emissions. Moreover, as they run on electrical energy, there is no need for spark plugs, further reducing maintenance needs.

Data Collection

1. Electric Vehicle Analysis (kaggle.com)
2. Firstpost
3. Electric Vehicle FY2021 Sales in India (jmkresearch.com)

Segmentation Criteria

Segmentation criteria refer to the types of information used to divide a market into distinct segments, each with identifiable characteristics. This differs from segmentation variables, which are specific attributes in empirical data used to split a sample into market segments. Effective segmentation involves identifying and clustering individuals in a data sample based on shared characteristics, then analyzing their common interests to maximize organizational profits. The main types of segmentation criteria are geographic, socio-demographic, psychographic, and behavioral.

Geographic Segmentation

Geographic segmentation divides the market based on geographic location or the residence of the customer. This approach has specific advantages:

- It allows for targeted promotions within a specific area.
- Advertising can be localized in newspapers, television, and other media relevant to the area.

However, a key disadvantage is that not all people in the same location have the same opinions and preferences.

Socio-Demographic Segmentation

Socio-demographic segmentation uses parameters like age, gender, education, and income. For example:

- Gender may be a factor when buying cosmetics.
- Income is a criterion when purchasing luxury items.
- Age influences vacation planning, with different destinations appealing to couples versus families with children.

With sufficient data, socio-demographic segmentation can provide clear insights into who the customers are and their preferences. However, it may not always accurately reflect product preferences.

Psychographic Segmentation

Psychographic segmentation groups people based on psychological criteria such as interests, beliefs, aspirations, preferences, and benefits sought. This type of segmentation is more complex because:

- There are many influencing factors, and these factors vary among individuals.
- Multiple segmentation variables are often needed.

The main advantage of psychographic segmentation is the ability to cluster customers based on shared psychological traits, which can maximize profits. For example, travelers interested in historic pilgrimages can be grouped together, reducing company costs and increasing profitability.

Behavioral Segmentation

Behavioral segmentation focuses on the similarities in customers' behaviors. This includes:

- Immediate online behavior and positive feedback.
- Past offline behavior or negative feedback.

This type of segmentation directly analyzes how customers interact with a website or a product, providing useful insights for market segmentation.

Pre-Processing Data Before Performing Segmentation

1. Categorical Variables

Two common pre-processing procedures are used for categorical variables:

- **Merging Levels:** When categorical variables have too many distinct levels, it can be useful to merge some levels before analysis. This simplifies the data and makes the analysis more manageable.
- **Converting to Numeric**: If it makes sense, categorical variables can be converted to numeric ones. This can facilitate certain types of analysis, such as distance-based methods or regression models.

2. Numerical Variables

For numerical variables, especially in distance-based segmentation methods, it is essential to consider the range of values:

- The range of a segmentation variable influences its relative weight in the analysis. For example, if one variable is binary (e.g., whether a customer likes fast food) and another is continuous (e.g., expenditure ranging from $0 to $1000), the scales need to be normalized to ensure they are weighted appropriately.

3. Univariate Variables

Univariate analysis involves examining one variable at a time:

- Example: In a McDonald’s dataset, if we use age as the feature, we can classify the output based on this variable alone. If individuals who gave positive feedback (rating 4 or above) are typically around the age of 20, this insight can be used to segment the market.

4. Bivariate Variables
Bivariate analysis is more analytical than univariate analysis and involves examining two variables simultaneously:

- Example: If a dataset includes age and expenditure, bivariate analysis can help compare these two variables to find correlations or patterns. This analysis can reveal relationships between two factors that can be used for more refined segmentation.

5. Multivariate Variables
Multivariate analysis involves examining more than two variables:

- This type of analysis is more complex and can involve techniques like Principal Component Analysis (PCA) to reduce the dimensionality of the data.
- Example: When dealing with multiple variables such as age, income, and spending habits, multivariate analysis helps in understanding the combined effect of these variables and identifying patterns or clusters in the data.

Electric Vehicle Sales Trends

Fig. 1: FY2021 Quarterly Sales Trend – Registered EVs

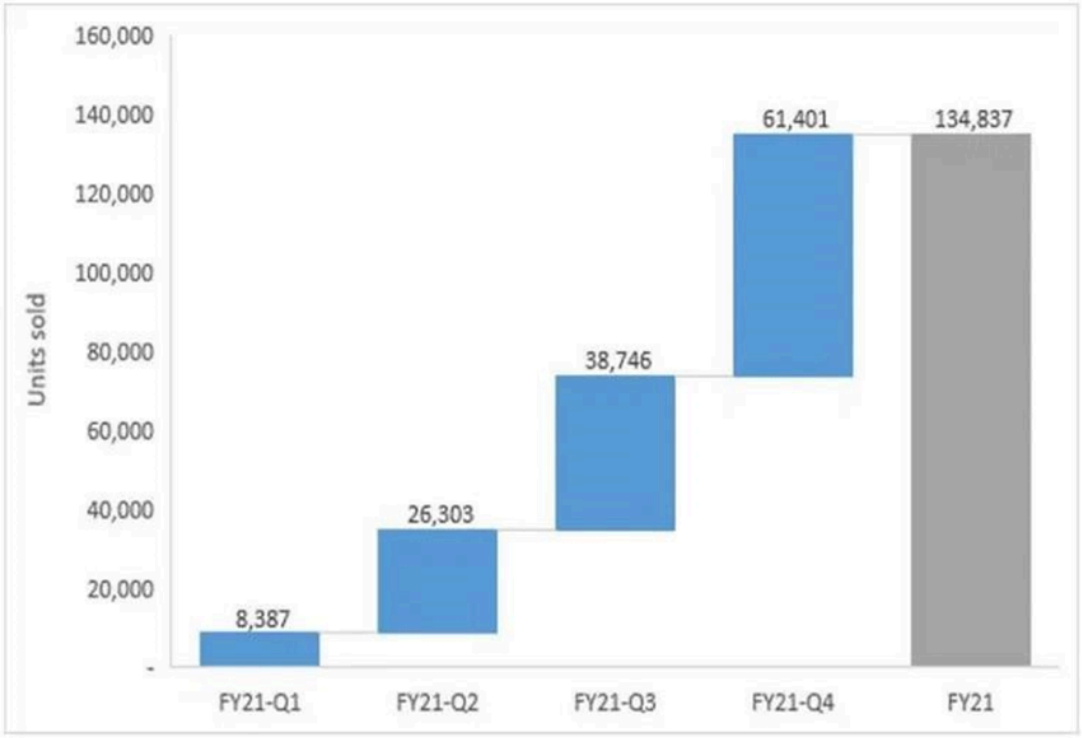
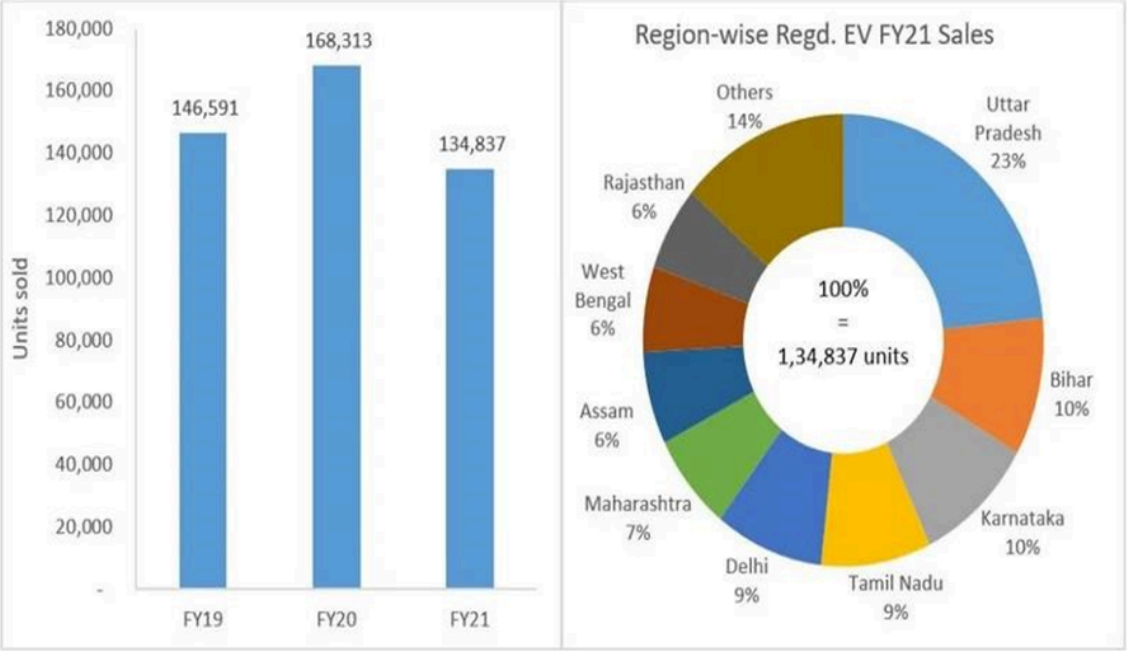


Fig. 2: FY Sales Trend – Registered EVs



Code Implementation

GitHub Link:

1. **Electric Vehicle Market Segment**

   https://github.com/Akhushah/Feynn_Labs_Internship_2024/blob/main/Project%202.1%20Electric%20Vehicle%20Market_EDA.ipynb

2. **State-wise tax relaxation, subsidy, and fuel price analysis**
   https://github.com/Akhushah/Feynn_Labs_Internship_2024/blob/main/Project%202.1%20State_wise_cars_data_analysis.ipynb

3. **State-wise Pollution data analysis**
   https://github.com/Akhushah/Feynn_Labs_Internship_2024/blob/main/Project%202.1%20State_wise_Pollution_data_analysis.ipynb

Conclusion

Based on the above analysis and visualizations, this report provides valuable insights for any company looking to launch an EV start-up in India. Our focus has been on the 4-wheeler EV market, which has been examined in detail to understand the customer space and market trends.

Key takeaways include:

- **Market Growth:** The EV market in India is expanding rapidly, with significant potential for 4-wheeler EVs.
- **Segmentation Analysis:** By applying geographic, socio-demographic, psychographic, and behavioral segmentation criteria, we can better understand the diverse preferences and behaviors of potential customers.
- **Advantages of EVs:** Lower running and maintenance costs, zero tailpipe emissions, tax and financial benefits, minimal noise pollution, and no need for exhaust systems or spark plugs make EVs highly attractive to consumers.