

Electric vehicle market segmentation analysis report

- Analyzing the EV market using segmentation techniques for EV vehicle startup.

By

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Abstract:

This study presents an analysis of the electric vehicle (EV) market with the aim of informing the strategic entry decisions of an Electric Vehicle Startup. The analysis employs segmentation analysis, encompassing geographic utilizing available datasets. Through a combination of data exploration, clustering techniques, and demographic profiling, insights are generated to identify key segments within the EV market.

The study begins by collecting and preprocessing datasets related to EV features, charging station locations, and demographic information. Initial exploratory data analysis provides an understanding of the market landscape and the characteristics of EV users and charging infrastructure across different regions. Subsequently, segmentation analysis is conducted, utilizing clustering algorithms to identify distinct customer segments based on a combination of geographic, demographic, and behavioural attributes.

Breakdown of problem statement:

1. Understanding the Market:

- Estimate the size of the target market for electric vehicles (EVs), considering global trends and projections.

2. Segmentation Analysis:

- Break down the market into distinct segments based on geographic, demographic, psychographic, and behavioural factors.
- Estimate the size and growth potential of each segment, considering factors such as income levels, consumer preferences, and infrastructure development.
- Analyse the preferences and behaviours of each segment to identify opportunities for market entry and product differentiation.

Data source:

I have used two datasets for analysing the EV market.

1. electriccardata_norm.csv (Which contains features of the electric vehicle like brand, model, range, etc)
2. electricvehicle_chargingstation.csv (which contains information about the charging station located in the areas with latitude and longitude)

Data preprocessing:

Python libraries used:

- pandas
- numpy
- matplotlib
- scikit-learn
- from sklearn.preprocessing imported labelEncoder()

Firstly, I imported dataset into dataframe using pandas library. And displayed the first 5 rows of dataset using head() function.

And the following preprocessing techniques done:

- Handling Missing Values: Handled the missing values by imputation (replacing missing values with a suitable estimate) or removal of rows or columns with missing values, depending on the context.
- Removing Duplicates: checked for any duplicate rows in the dataset and removed them.
- Encoding Categorical Variables: categorical variables in the dataset are encoded into numerical values for further analysis.
- Checking for Outliers: Outliers were detected and removed

```

Brand      0      RangeIndex: 103 entries, 0 to 102
Model      0      Data columns (total 14 columns):
#    Column      Non-Null Count  Dtype
---  -
0    0    Brand      103 non-null    object
1    1    Model      103 non-null    object
2    2    Accel      103 non-null    object
3    3    TopSpeed   103 non-null    object
4    4    Range      103 non-null    object
5    5    Efficiency 103 non-null    object
6    6    FastCharge 103 non-null    object
7    7    RapidCharge 103 non-null   object
8    8    PowerTrain 103 non-null    object
9    9    PlugType   103 non-null    object
10   10  BodyStyle  103 non-null    object
11   11  Segment    103 non-null    object
12   12  Seats      103 non-null    int64
13   13  PriceEuro  103 non-null    int64
dtype: int64      dtypes: int64(2), object(12)

```

Features encoding:

Categorical features are encoded using one hot encoding and label encoders techniques to transform into numerical values for analysis.

Code snippet for one hot encoding:

```
ev_features_df['feature name'] = ev_features_df['feature name'].str.split().str[0].astype(float)
```

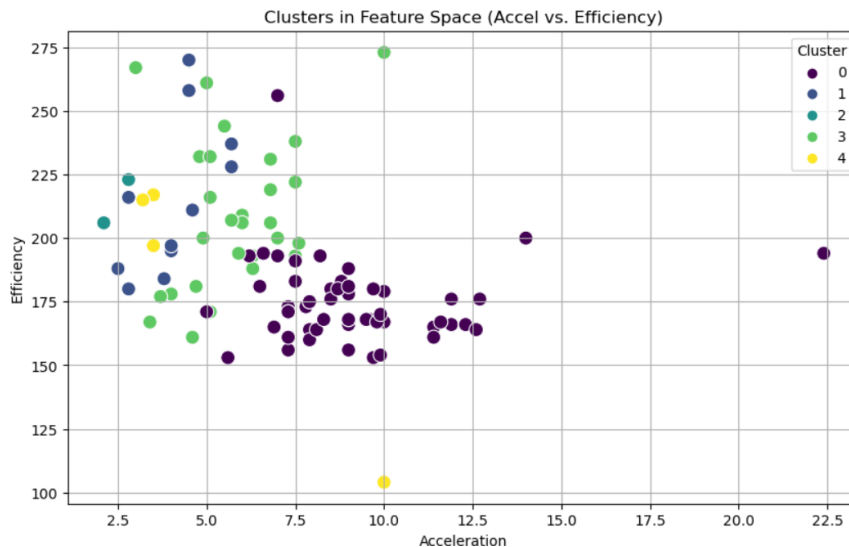
Code snippet for label encoding:

```
ev_features_df['feature name'] = label_encoder.fit_transform(ev_features_df['feature name'])
```

	Brand	Model	Accel	Efficiency	FastCharge	RapidCharge	PowerTrain	Seats	PriceEuro	Range_numerical	Brand_encoded	Model_encoded
0	Tesla	Model 3 Long Range Dual Motor	4.6	161.0	940.0	1	0	5	55480	450.0	30	46
1	Volkswagen	ID.3 Pure	10.0	167.0	250.0	1	2	5	30000	270.0	31	33
2	Polestar	2	4.7	181.0	620.0	1	0	5	56440	400.0	23	0
3	BMW	iX3	6.8	206.0	560.0	1	2	5	68040	360.0	2	101
4	Honda	e	9.5	168.0	190.0	1	2	4	32997	170.0	9	78
5	Lucid	Air	2.8	180.0	620.0	1	0	5	105000	610.0	15	4
6	Volkswagen	e-Golf	9.6	168.0	220.0	1	1	5	31900	190.0	31	83
7	Peugeot	e-208	8.1	164.0	420.0	1	1	5	29682	275.0	22	81

Segment extraction:

Segment extraction is a crucial step in market segmentation analysis, where the goal is to identify distinct groups or segments within a target market based on shared characteristics or behaviours.



The scatter plot reveals distinct clusters based on acceleration, efficiency, and price, suggesting varying performance and affordability among electric vehicle models.

Algorithm used for creating segment:

The K-means clustering algorithm was used for segment extraction. K-means is an unsupervised machine learning algorithm that partitions data into K clusters based on similarities in feature space. The algorithm iteratively assigns data points to the nearest cluster centroid and updates the centroids until convergence.

Segment Analysis:

Our analysis delves into the segmentation of the electric vehicle (EV) market in India, focusing on various vehicle characteristics that define distinct consumer segments. Through this segmentation, we aim to gain insights into the preferences and needs of potential EV buyers, facilitating strategic decision-making for market entry and product development.

The segmentation is primarily based on vehicle features, reflecting demographic preferences and requirements of prospective EV users. Key features include acceleration, efficiency, fast charging capability, seating capacity, and price. These features provide valuable insights into the diverse needs and preferences of different consumer segments.

Segment Profiles:

Segment A:

Description: This segment comprises vehicles characterized by high acceleration and efficiency levels.

Key Features:

Acceleration: Mean of 12.19 m/s²

Efficiency: Mean of 168.71 km/kWh

Fast Charge: Limited data available

Seats: Mean of 3.43 seats

Price: Mean of €22,693.71

Insights: Segment A vehicles offer superior performance in terms of acceleration and efficiency, making them ideal for consumers seeking high-performance EVs at a relatively affordable price point.

Segment B:

Description: This segment consists of vehicles with moderate acceleration and efficiency levels, coupled with a higher seating capacity.

Key Features:

Acceleration: Mean of 8.66 m/s²

Efficiency: Mean of 168.73 km/kWh

Fast Charge: Mean of 293.18 kW

Seats: Mean of 4.68 seats

Price: Mean of €34,799.23

Insights: Segment B vehicles offer a balance between performance and practicality, with moderate acceleration and efficiency levels suitable for everyday use.

Segment C:

Description: This segment includes vehicles with moderate acceleration and efficiency levels, alongside enhanced fast charging capabilities.

Key Features:

Acceleration: Mean of 7.82 m/s²

Efficiency: Mean of 180.93 km/kWh

Fast Charge: Mean of 401.00 kW

Seats: Mean of 4.93 seats

Price: Mean of €41,199.10

Insights: Segment C vehicles cater to consumers prioritizing fast charging convenience, making them suitable for long-distance travel and urban commuting.

Segment D:

Description: This segment comprises vehicles with lower acceleration and efficiency levels but significant fast charging capacity.

Key Features:

Acceleration: Mean of 5.41 m/s²

Efficiency: Mean of 186.67 km/kWh

Fast Charge: Mean of 618.00 kW

Seats: Mean of 5.27 seats

Price: Mean of €58,487.93

Insights: Segment D vehicles are designed for consumers requiring extensive fast charging capabilities, such as commercial fleet operators and long-haul commuters.

Segment E:

Description: This segment represents high-end vehicles with exceptional efficiency and fast charging capabilities.

Key Features:

Acceleration: Mean of 5.93 m/s²

Efficiency: Mean of 237.90 km/kWh

Fast Charge: Mean of 487.00 kW

Seats: Mean of 5.00 seats

Price: Mean of €74,269.40

Insights: Segment E vehicles target affluent consumers seeking premium EVs with advanced features, including rapid charging and extended range capabilities.

Segment F:

Description: Represents vehicles with lower acceleration and efficiency levels but significant fast charging capacity.

Key Features:

Acceleration: Mean of 3.96 m/s²

Efficiency: Mean of 193.92 km/kWh

Fast Charge: Mean of 672.50 kW

Seats: Mean of 4.83 seats

Price: Mean of €119,690.75

Insights: Segment F vehicles cater to consumers seeking extensive fast charging capabilities, making them suitable for long-haul travel and commercial use. Despite lower acceleration and efficiency, the segment targets consumers willing to invest in premium EVs with advanced charging infrastructure.

Potential Segments:

Based on the segmentation analysis, potential segments for market targeting and product development include:

1. Performance Enthusiasts: Consumers seeking high-performance EVs with superior acceleration and efficiency (Segment A).
2. Urban Commuters: Individuals prioritizing practicality and convenience for daily commuting needs (Segment B).
3. Long-Distance Travelers: Consumers requiring fast charging capabilities for extended travel distances (Segment C).
4. Commercial Operators: Businesses and fleet operators in need of vehicles with extensive fast charging infrastructure (Segment D).
5. Luxury Buyers: Affluent customers interested in premium EVs with advanced features and technology (Segment E).

By understanding the distinct needs and preferences of each segment, our startup can tailor its product offerings and marketing strategies to effectively target and engage potential customers, maximizing market penetration and growth opportunities

Charging Station Dataset Analysis:

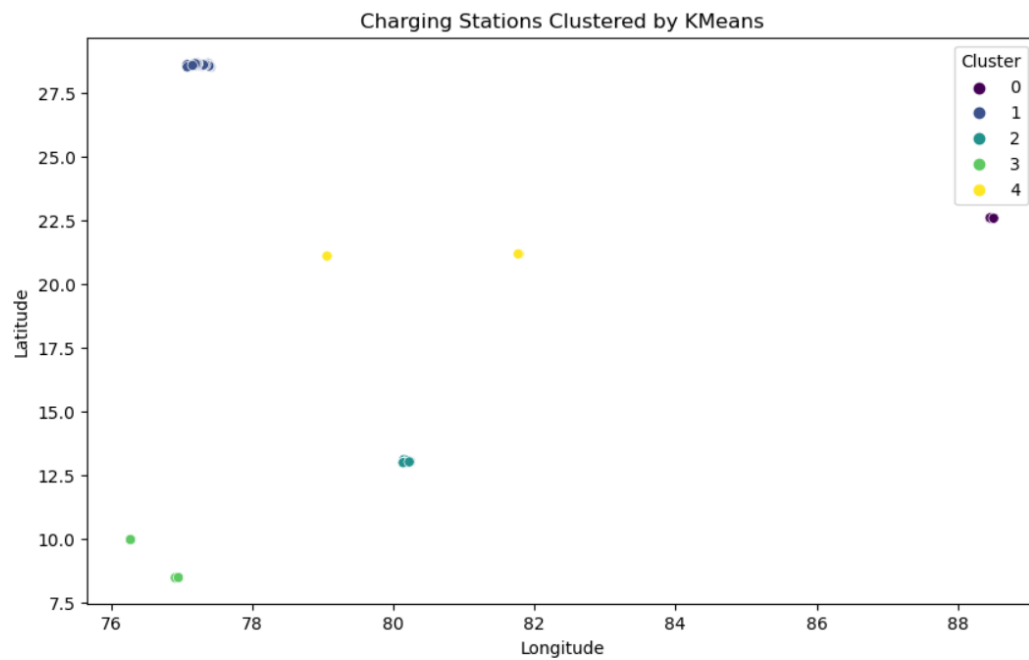
Overview:

The charging station dataset provides insights into the distribution and characteristics of electric vehicle (EV) charging infrastructure across different regions. This analysis aims to understand the geographical distribution of charging stations and identify key patterns and trends that can inform market entry strategies for our EV startup.

Geographical Distribution:

The dataset contains information about charging stations located in various regions across India, including their latitude and longitude coordinates.

A geographical analysis reveals the spatial distribution of charging stations, highlighting clusters of high-density charging infrastructure in specific regions.

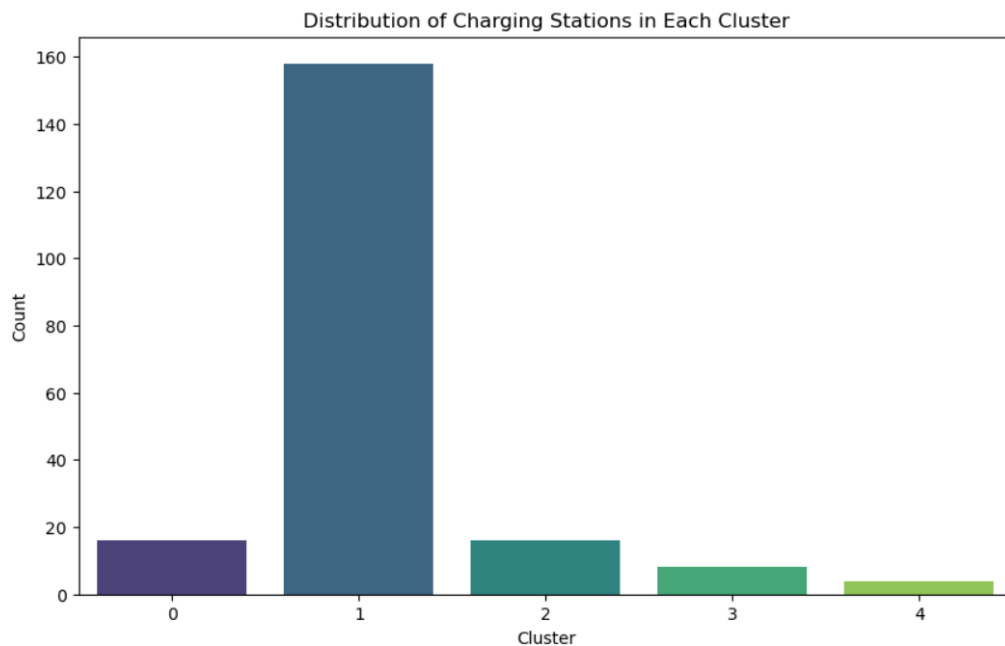


Cluster Distribution:

- Cluster 1: 158 charging stations
- Cluster 2: 16 charging stations
- Cluster 3: 16 charging stations
- Cluster 4: 8 charging stations
- Cluster 5: 4 charging stations

Insights:

- Cluster 1 appears to have the highest concentration of charging stations, indicating areas with significant charging infrastructure.
- Clusters 2 and 3 also have a considerable number of charging stations, suggesting moderate density regions.
- Clusters 4 and 5 have relatively fewer charging stations, representing areas with lower charging infrastructure density.



Customizing the marketing mix:

Product:

Develop EV models tailored to the unique needs and preferences of each segment.

Focus on performance, efficiency, and fast-charging capabilities based on segment requirements.

Price:

Implement flexible pricing strategies to offer competitive pricing within each segment.

Consider discounts, financing options, and subscription models to enhance affordability.

Place (Distribution):

Establish a robust distribution network with convenient access to charging infrastructure.

Collaborate with strategic partners to expand dealership networks and charging station locations.

Promotion:

Craft targeted marketing campaigns highlighting key features and benefits specific to each segment.

Utilize digital advertising, social media, and influencer partnerships to reach and engage with target audiences effectively.

Insights and recommendation:

Segment F :

This segment represents a niche market of affluent consumers who prioritize premium features and are willing to pay a premium price for exceptional performance and advanced technology.

This segment exhibits characteristics such as moderate acceleration (mean: 3.96), high efficiency (mean: 193.92), and relatively fast charging capabilities (mean: 672.5).

The price range (mean: \$119,690.75) suggests a higher-end market segment with potential for premium EV offerings.

Segment 1 (Charging Stations): This segment represents regions with a high concentration of EV charging stations, indicating strong infrastructure support for EV adoption.

Combining these insights, the best segment for entry into the Indian EV market would be areas or regions characterized by a high concentration of EV charging stations (Segment 1), particularly in urban centers where affluent consumers reside. These regions would be ideal for introducing high-end vehicles (Segment F) tailored to meet the preferences of consumers seeking premium features and advanced technology in their EVs. By targeting affluent urban consumers in regions with robust charging infrastructure, the company can position itself as a provider of premium EVs with exceptional performance and charging capabilities, thereby maximizing market penetration and revenue potential.