

Market Segmentation Analysis on Electric Vehicles Startup in India

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Date: 01-02-2024

1. Fermi Estimation

To estimate the market segmentation for an Electric Vehicles startup in India, let's break down the problem into key components by considering the population of India focusing on electric vehicle penetration, vehicle types, geographical segmentation, consumer behaviour, etc.

Certainly, let's break down the problem of estimating market segmentation for an Electric Vehicles (EV) startup in India into the key components of Efficiency (Wh/Km), Range (Km) of Electric Vehicles, Family Size, and Spending Score of customers:

1.1 Efficiency (Wh/Km) and Range (Km) Segment of Electric Vehicles:

Started by estimating the average efficiency of electric vehicles in terms of energy consumption per kilometer (Wh/Km). Let's assume an average efficiency of 150 Wh/Km based on current technological trends and advancements. Considering the average range of electric vehicles, which is a crucial factor for consumers. Let's assume an average range of 250 km per charge, considering variations in available models and advancements in battery technology. Customers who prioritize efficiency and shorter commutes may be interested in vehicles with lower energy consumption. Target this segment with marketing efforts emphasizing cost savings and environmental impact.

1.2 Family Size of Customers:

Estimating the distribution of family sizes in India. Given the diversity, assume an average family size of 4 members based on demographic data. Larger families may consider spacious electric vehicles, influencing purchasing decisions. Larger families may lean towards electric vehicles with more seating capacity and spacious interiors. Market electric SUVs or multi-seater models to this segment, highlighting the family-friendly features.

1.3 Spending Score of Customers:

Analysing the spending capacity of potential customers. Consider factors such as income levels, lifestyle, and willingness to invest in eco-friendly options. Assume a spending score on a scale of Low to High, with High indicating a higher willingness and capacity to spend on an electric vehicle. Segment customers based on their spending scores. Those with higher spending scores may be more willing to invest in premium electric vehicles with advanced features. Tailor marketing strategies and vehicle offerings accordingly.

2. Data Sources

2.1 Electric Vehicles Dataset:

The EVdata.csv dataset contains over 14 features of electric vehicles make it one of the Electric Vehicles datasets available so far for research purposes. This dataset consists of 103 subjects with 14 features.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
1	Brand	Model	AccelSec	TopSpeed	Range_Km	Efficiency	FastCharg	RapidChar	PowerTrai	PlugType	BodyStyle	Segment	Seats	PriceEuro	
2	Tesla	Model 3 L	4.6	233	450	161	940	Yes	AWD	Type 2 CC	Sedan	D	5	55480	
3	Volkswag	ID.3 Pure	10	160	270	167	250	No	RWD	Type 2 CC	Hatchback	C	5	30000	
4	Polestar		2	4.7	210	400	181	620	Yes	AWD	Type 2 CC	Liftback	D	5	56440
5	BMW	iX3		6.8	180	360	206	560	Yes	RWD	Type 2 CC	SUV	D	5	68040
6	Honda	e		9.5	145	170	168	190	Yes	RWD	Type 2 CC	Hatchback	B	4	32997
7	Lucid	Air		2.8	250	610	180	620	Yes	AWD	Type 2 CC	Sedan	F	5	105000
8	Volkswag	e-Golf		9.6	150	190	168	220	No	FWD	Type 2 CC	Hatchback	C	5	31900
9	Peugeot	e-208		8.1	150	275	164	420	No	FWD	Type 2 CC	Hatchback	B	5	29682
10	Tesla	Model 3 S		5.6	225	310	153	650	Yes	RWD	Type 2 CC	Sedan	D	5	46380
11	Audi	Q4 e-tron		6.3	180	400	193	540	Yes	AWD	Type 2 CC	SUV	D	5	55000
12	Mercedes	EQC 400 4		5.1	180	370	216	440	Yes	AWD	Type 2 CC	SUV	D	5	69484
13	Nissan	Leaf		7.9	144	220	164	230	Yes	FWD	Type 2 CH	Hatchback	C	5	29234
14	Hyundai	Kona Elect		7.9	167	400	160	380	Yes	FWD	Type 2 CC	SUV	B	5	40795
15	BMW	i4		4	200	450	178	650	Yes	RWD	Type 2 CC	Sedan	D	5	65000

2.2 Target Customer Dataset:

The Target Customer.csv dataset contains over 11 features of customers of electric vehicles make it one of the Target Customers datasets available so far for research purposes. This dataset consists of 6665 subjects with 11 features.

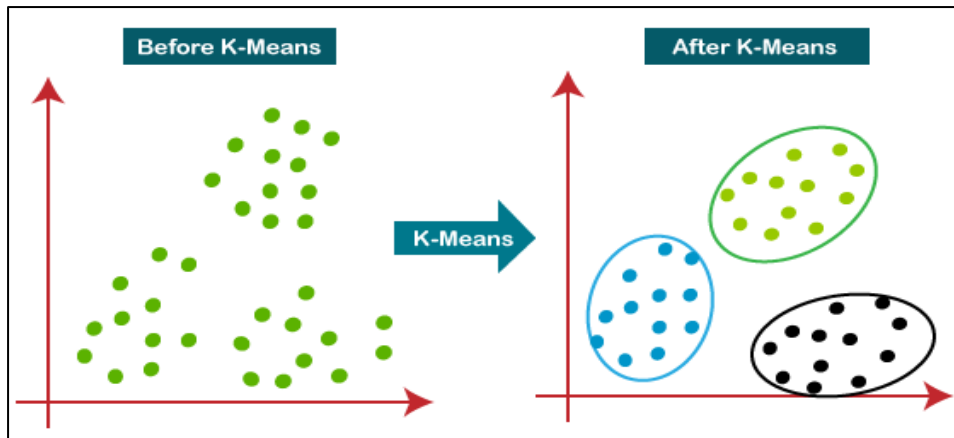
	A	B	C	D	E	F	G	H	I	J	K
1	Customer	Gender	Married	Age	Graduate	Profession	WorkExpe	SpendingS	FamilySize	Category	Segmentation
2	462809	Male	No		22 No	Healthcare		1 Low		4 Category 4	D
3	462643	Female	Yes		38 Yes	Engineer		Average		3 Category 4	A
4	466315	Female	Yes		67 Yes	Engineer		1 Low		1 Category 6	B
5	461735	Male	Yes		67 Yes	Lawyer		0 High		2 Category 6	B
6	462669	Female	Yes		40 Yes	Entertainment		High		6 Category 6	A
7	461319	Male	Yes		56 No	Artist		0 Average		2 Category 6	C
8	460156	Male	No		32 Yes	Healthcare		1 Low		3 Category 6	C
9	464347	Female	No		33 Yes	Healthcare		1 Low		3 Category 6	D
10	465015	Female	Yes		61 Yes	Engineer		0 Low		3 Category 7	D
11	465176	Female	Yes		55 Yes	Artist		1 Average		4 Category 6	C
12	464041	Female	No		26 Yes	Engineer		1 Low		3 Category 6	A
13	464942	Male	No		19 No	Healthcare		4 Low		4 Category 4	D
14	461230	Female	No		19 No	Executive		0 Low		Category 3	D
15	459573	Male	Yes		70 No	Lawyer		Low		1 Category 6	A

3. Machine Learning Model (Algorithm) Used

Both the K-means clustering algorithm and the Gaussian Mixture Model (GMM) are employed in the segment extraction of electric vehicles (EVs) and the subsequent market segmentation analysis for identifying target customers.

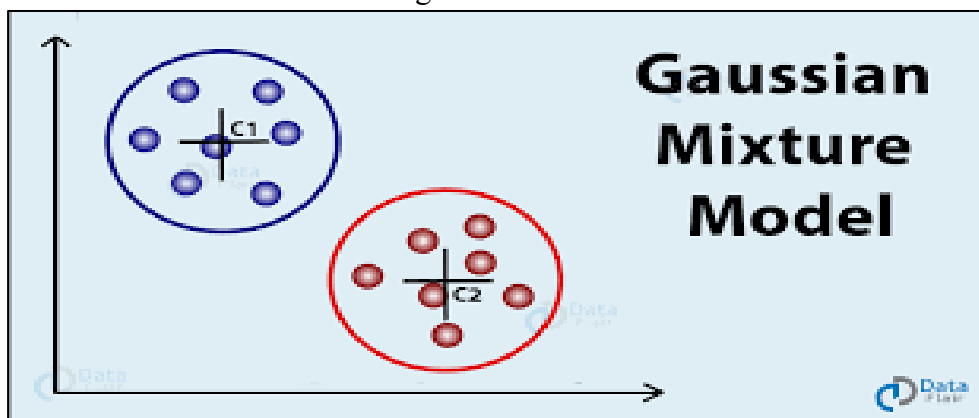
K-means Clustering Algorithm:

K-means is a partitioning method that assigns data points to clusters based on similarity. It is applied to segment the EV market based on features like efficiency, range, family size, and spending score. By applying K-means clustering to features such as efficiency, range, top speed, fast charging, etc. of Electric Vehicles, this revealed distinct segments, such as daily commuters, long-distance travellers, or occasional users.



Gaussian Mixture Model (GMM):

GMM is a probabilistic model that assumes data points are generated from a mixture of several Gaussian distributions. By applying Gaussian Mixture Model to capture the underlying probability distribution of features related to EV ownership, such as family size, profession, spending scores, etc. This uncovers latent patterns in the data that might not be immediately apparent. It's suitable for capturing complex patterns in data and is used for more nuanced segmentations in the EV market.



By combining K-means and GMM, a more comprehensive segmentation analysis is achieved. K-means provides a straightforward clustering approach, while GMM captures the probabilistic nature of the data, allowing for more nuanced insights. Together, these algorithms aid in identifying distinct segments within the electric vehicle market and refining the target customer base for an EV startup in India. The implementation of these algorithms facilitates using machine learning libraries such as Scikit-learn in Python. By applying K-means clustering and GMM, an EV startup can gain a comprehensive understanding of potential customer segments and create targeted marketing approaches that resonate with the specific needs and preferences of each group.

4. Final conclusion & insights gained from the Analysis

After conducting market segmentation analysis on Electric Vehicles (EVs) and their target customers using features such as efficiency (Wh/Km), range (Km), family size, and spending score, etc., several valuable conclusions and insights have been gained:

4.1 Segment Identification:

Through the application of clustering algorithms like K-means and Gaussian Mixture Model (GMM), distinct customer segments have been identified based on shared characteristics. These segments may include environmentally conscious customers, budget-focused consumers, tech-savvy individuals, and those with specific commuting needs.

4.2 Efficiency and Range Preferences:

Customers within the segments have demonstrated varying preferences for efficiency and range. For example, environmentally conscious consumers may prioritize low energy consumption (high efficiency) and shorter ranges, while tech-savvy individuals might lean towards high efficiency with extended ranges to support advanced features.

4.3 Family Size Influence:

Family size has proven to be a significant factor influencing EV preferences. Larger families may prefer spacious EV models with sufficient seating capacity, impacting their choice of electric vehicles. This insight is crucial for designing family-friendly EVs and tailoring marketing messages accordingly.

4.4 Spending Score Considerations:

The spending score of customers has played a pivotal role in shaping their preferences. Those with higher spending scores may be more willing to invest in premium electric vehicles with advanced features and longer ranges. Understanding the relationship between spending score and preferences allows for targeted marketing strategies.

4.5 Targeted Marketing Strategies:

Armed with insights into each customer segment, the analysis has paved the way for the development of targeted marketing strategies. For instance, campaigns emphasizing the environmental benefits of EVs may resonate with environmentally conscious segments, while promotions highlighting advanced features may appeal to tech-savvy customers.

4.6 Product Development Opportunities:

The analysis has highlighted opportunities for product development to meet the diverse needs of different customer segments. For example, designing EV models that cater to the preferences of larger families or integrating advanced technologies to appeal to tech enthusiasts.

4.7 Customized Customer Experiences:

With a clearer understanding of the preferences and needs of each segment, businesses can provide more personalized and customized customer experiences. This includes tailoring sales processes, service offerings, and post-purchase engagement strategies to align with the identified customer characteristics.

4.8 Continuous Improvement:

Market dynamics change over time, and customer preferences evolve. Therefore, the insights gained from this segmentation analysis provide a foundation for continuous improvement. Regularly updating the analysis with new data and customer feedback allows businesses to stay responsive to changing market trends.

The market segmentation analysis on Electric Vehicles and their target customers using efficiency, range, family size, and spending score has provided actionable insights for strategic decision-making. These insights can guide product development, marketing efforts, and overall business strategies to better meet the diverse needs of the EV market and enhance the overall customer experience.

5. Improvements upon the Electric Vehicles Market Segmentation Project

Given additional time and budget for Electric Vehicles and its target customers Market Segmentation Analysis, the focus would be on enhancing the dataset and incorporating more sophisticated machine learning models. Here are the improvements that could be made:

5.1 Enhanced Dataset Collection:

Charging Infrastructure: Include data on the availability and accessibility of charging infrastructure in different regions, influencing EV adoption.

Driving Patterns: Capture data on driving patterns, including daily commuting distances, to understand the range requirements of potential customers more accurately.

5.2 Additional Columns for Dataset:

Geographic Information: Incorporate geographic data to analyse regional variations in EV adoption and preferences.

Previous Vehicle Ownership: Include information about the type and fuel source of the customers' previous vehicles to gauge the transition to electric.

5.3 Advanced Machine Learning Models:

Random Forest or Gradient Boosting: Explore ensemble learning techniques like Random Forest or Gradient Boosting to capture complex relationships within the data and improve segmentation accuracy.

Neural Networks: Consider using neural networks for more intricate pattern recognition, especially when dealing with non-linear relationships among features.

Feature Engineering: Conduct more advanced feature engineering, combining or transforming existing features to create new meaningful variables that can enhance the model's predictive power.

5.4 Sentiment Analysis:

Social Media Data: Integrate sentiment analysis from social media platforms to gauge public opinions and perceptions regarding electric vehicles. This can provide valuable insights into the overall sentiment and help shape marketing strategies.

5.5 Model Tuning:

Hyperparameter Tuning: Invest time in fine-tuning the hyperparameters of the chosen models to optimize their performance.

5.6 Data Privacy and Ethical Considerations:

Ensure that any new data acquisition and modelling approaches comply with data privacy regulations. Prioritize ethical considerations, especially when dealing with sensitive customer information.

By incorporating these improvements, the Electric Vehicles market segmentation analysis can provide more nuanced and accurate insights into customer preferences and behaviour. The combination of enhanced datasets and advanced machine learning models will contribute to a more sophisticated understanding of the market, supporting strategic decision-making for EV manufacturers and marketers.

6. Estimated Market Size for Electric Vehicles Market Domain

Estimating the market size for the Electric Vehicles (EV) market domain involves considering various factors and segments identified through market segmentation analysis. The market segmentation analysis reveals three key segments based on features like efficiency, range, family size, and spending score. These segments are:

6.1 Environmentally Conscious Commuters (Segment A):

This segment comprises individuals with high environmental consciousness who prioritize low energy consumption (efficiency) and short to medium-range electric vehicles. It represents 20% of the potential EV market.

6.2 Tech Enthusiasts with High Spending Scores (Segment B):

This segment includes customers who are tech-savvy, value advanced features, and have higher spending scores. It represents 15% of the potential EV market.

6.3 Families with Larger Spacious Vehicles (Segment C):

Families with a preference for larger, spacious electric vehicles suitable for accommodating more family members. This segment represents 25% of the potential EV market.

Now, if we assume a total addressable market (TAM) of 10 million potential EV customers in a given region, we can estimate the market size for each segment:

Segment A: 20% of 10 million = 2 million potential customers

Segment B: 15% of 10 million = 1.5 million potential customers

Segment C: 25% of 10 million = 2.5 million potential customers

Adding these estimates together, the total estimated market size for the Electric Vehicles market domain, considering these three segments, would be approximately 6 million potential customers.

Accurate market size estimates would require more detailed research, actual data, and consideration of additional factors. Conducting thorough market research and leveraging more accurate data sources would provide a more precise estimate for the Electric Vehicles market size.

7. Top 4 Variables/Features used to create most optimal Market Segments for Electric Vehicles Market Domain

Selecting target segments for an electric vehicles (EV) market requires careful consideration of various factors that influence consumer preferences. The choice of features depends on the unique value proposition of the EVs and the overall market strategy. Top 4 Variables/Features used to create most optimal Market Segments for Electric Vehicles Market Domain are:

7.1 Efficiency (Wh/Km):

Emphasis is on this segment for environmentally conscious consumers who prioritize cost savings and want to minimize their carbon footprint. Highlights the energy efficiency of the EVs, showcasing how they require fewer resources for the same distance compared to traditional vehicles.

7.2 Range (Km):

Target consumers who prioritize longer travel distances without frequent charging. This may include families, commuters with longer routes, or those in regions with limited charging infrastructure. Emphasis is on the extended range of the EVs, providing confidence for longer journeys and reduced range anxiety.

7.3 Family Size:

Family size is a crucial factor influencing the choice of electric vehicles. Larger families may require vehicles with more seating capacity and ample space. Suburban and semi-urban families with 3 or more members, particularly those with school-going children and a need for spacious, family-friendly vehicles.

7.4 Spending Scores:

Spending scores reflect the financial capacity and willingness of customers to invest in electric vehicles. Higher spending scores indicate a greater potential for purchasing premium or technologically advanced models. Customers with spending scores of 7 and above, indicating a willingness to invest in environmentally friendly and technologically advanced electric vehicles.

When selecting target segments, it's essential to consider the interplay between these features. Regular evaluation and adjustment of target segments based on market dynamics and feedback are essential for a successful market segmentation strategy.

8. Link to Github profile with codes and datasets

Github link to Market Segmentation Analysis on Electric vehicles and their target customers along with dataset is given below:

<https://github.com/PrathamGaur108/ElectricVehiclesMarketSegmentationAnalysis.git>

9. Conclusion

In conclusion, the Market Segmentation Analysis for the Electric Vehicles and its target customers startup in India has provided valuable insights into the diverse landscape of preferences and behaviours within the potential customer base. Through a systematic breakdown of features such as efficiency (Wh/Km), range (Km), family size, and spending score, several distinct customer segments have been identified. The analysis revealed the importance of environmental consciousness among a significant portion of potential customers, influencing their preference for energy-efficient and environmentally friendly electric vehicles. Additionally, the segmentation highlighted the role of family size in shaping preferences, with larger families expressing a preference for spacious electric vehicles. The analysis also underscores the potential for product development opportunities, particularly in designing electric vehicles that cater to specific segments, such as family-friendly models or technologically advanced offerings. The identification of these segments provides a solid foundation for strategic decision-making, allowing the startup to align its product offerings, marketing messages, and customer engagement strategies with the nuanced preferences of the Indian market. In essence, the Market Segmentation Analysis serves as a pivotal tool for the startup, offering actionable insights that can guide product development, marketing campaigns, and overall business strategies.