

EV MARKET SEGMENTATION ANALYSIS

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Github Link : https://github.com/arsenta/EV_market_seg/blob/main/EV_Vehicle_Sales.ipynb

Problem Statement

India's Electric Vehicle (EV) market is growing fast, but startups often struggle to determine which segment (e.g., 2-wheelers, 3-wheelers, buses) is most suitable for entry. The goal of this project is to identify the best-performing EV vehicle category in India by analyzing sales trends and applying machine learning segmentation.

Background

India is experiencing a significant shift in its transportation landscape, driven by the widespread adoption of Electric Vehicles (EVs). The nation's rapid urbanization, growing population, and increased income levels have fueled the embrace of EVs as an eco-friendly alternative. Among these, electric two-wheelers have emerged as pioneers due to their affordability and wide consumer acceptance. These vehicles are reshaping India's mobility narrative, offering a sustainable solution to the challenges of pollution and greenhouse gas emissions.

The Indian government has played a vital role in fostering this change, implementing policies that encourage local manufacturing and support a robust network of manufacturers, dealers, and service providers. This report presents a data-driven market segmentation analysis of the Indian Electric Vehicle (EV) sector, utilizing insights derived from the dataset [smev_data.xlsx](#) and code implemented in [EV_Vehicle_Sales.ipynb](#). The aim is to identify EV vehicle segments and trends in the Indian market to guide startup strategies and investments.

Objective

To identify EV segments with the highest growth and market viability based on historical sales data by:

- Analyzing adoption patterns across categories
 - Segmenting categories based on sales metrics
 - Recommending the best product direction for an EV startup
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Dataset Overview

- Source: [smev_data.xlsx](#), sheet: 'EV Industries'
 - Records: 24 entries (4 categories × 6 years)
 - Columns:
 - category (E-2 Wheeler, E-3 Wheeler, E-4 Wheeler, E-Bus)
 - financial_year (2017–18 to 2022–23)
 - num_vehicles (annual units sold)
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Tools Used

- Jupyter Notebook: [EV_Vehicle_Sales.ipynb](#)
 - Libraries: pandas, numpy, matplotlib, seaborn, scikit-learn
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Methodology

1. Data Cleaning & Preparation

- Converted sales column to numeric, handled NaNs
- Pivoted data: category as rows, years as columns

financial_year category	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	Total_Sales	Average_Sales	Growth_Rate
E-2 Wheelers	1981.0	27478.0	26512.0	44294.0	249615.0	728090.0	1077970.0	307991.428571	366.536598
E-3 Wheelers	91970.0	116031.0	143051.0	90898.0	172543.0	401882.0	1016375.0	290392.857143	3.369708
E-4 Wheelers	2242.0	2407.0	2404.0	5201.0	19782.0	48105.0	80141.0	22897.428571	20.456289
E-Buses	35.0	75.0	369.0	373.0	1198.0	1917.0	3967.0	1133.428571	53.771429

2. Feature Engineering

Created the following features per EV category:

- Total Sales across years
- Average Sales
- Growth Rate = (Latest Sales - Earliest Sales) / Earliest Sales

financial_year category	Total_Sales	Average_Sales	Growth_Rate
E-2 Wheelers	1077970.0	307991.428571	366.536598
E-3 Wheelers	1016375.0	290392.857143	3.369708
E-4 Wheelers	80141.0	22897.428571	20.456289
E-Buses	3967.0	1133.428571	53.771429

3. Clustering

- Used StandardScaler to normalize the features
- Applied KMeans clustering with k=2 (chosen using silhouette score)
- Visualized clusters in 2D using sales features

Key Findings

Cluster Segmentation (k=2):

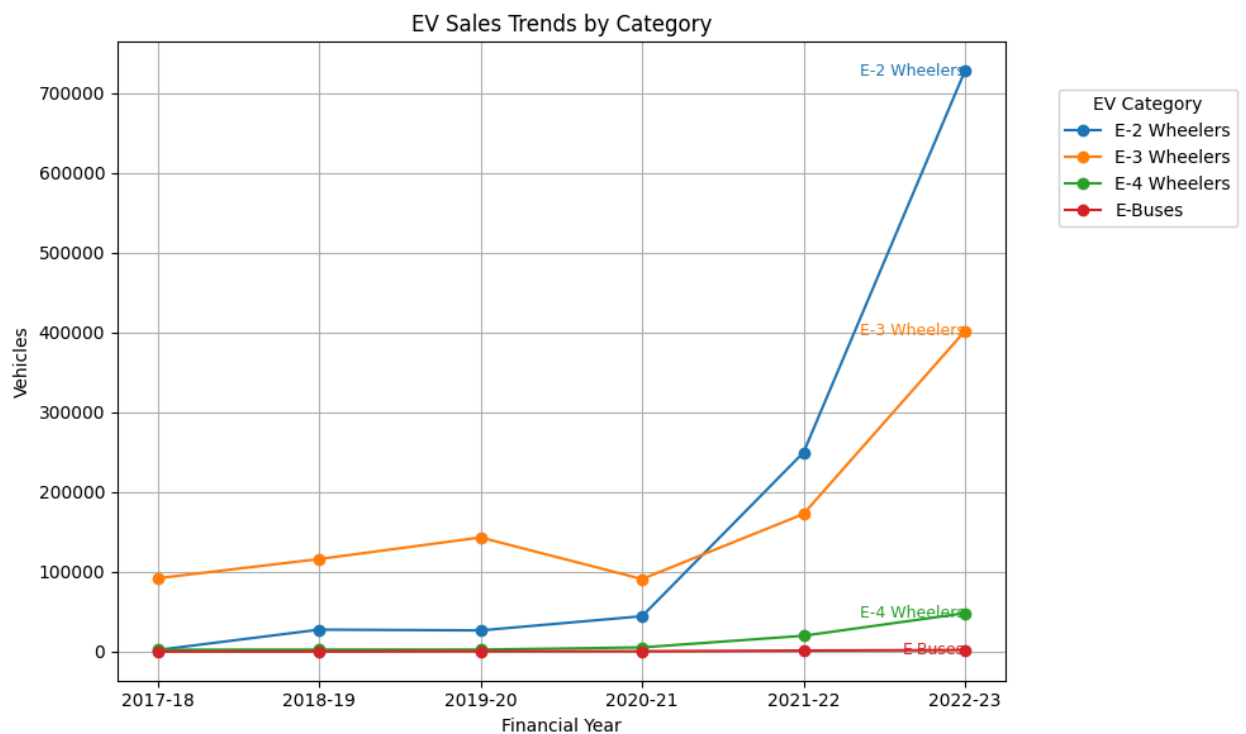
- Cluster 0: High-growth segments → E-2 Wheeler, E-3 Wheeler
- Cluster 1: Stable/low-growth → E-4 Wheeler, E-Bus

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Segment 0 Profile:
Categories: ['E-2 Wheelers', 'E-3 Wheelers']
Average Total Sales: 1047172.50
Average Annual Sales: 299192.14
Average Growth Rate: 184.95
This segment represents high-growth, high-volume EV categories. These could be attractive but potentially competitive markets.

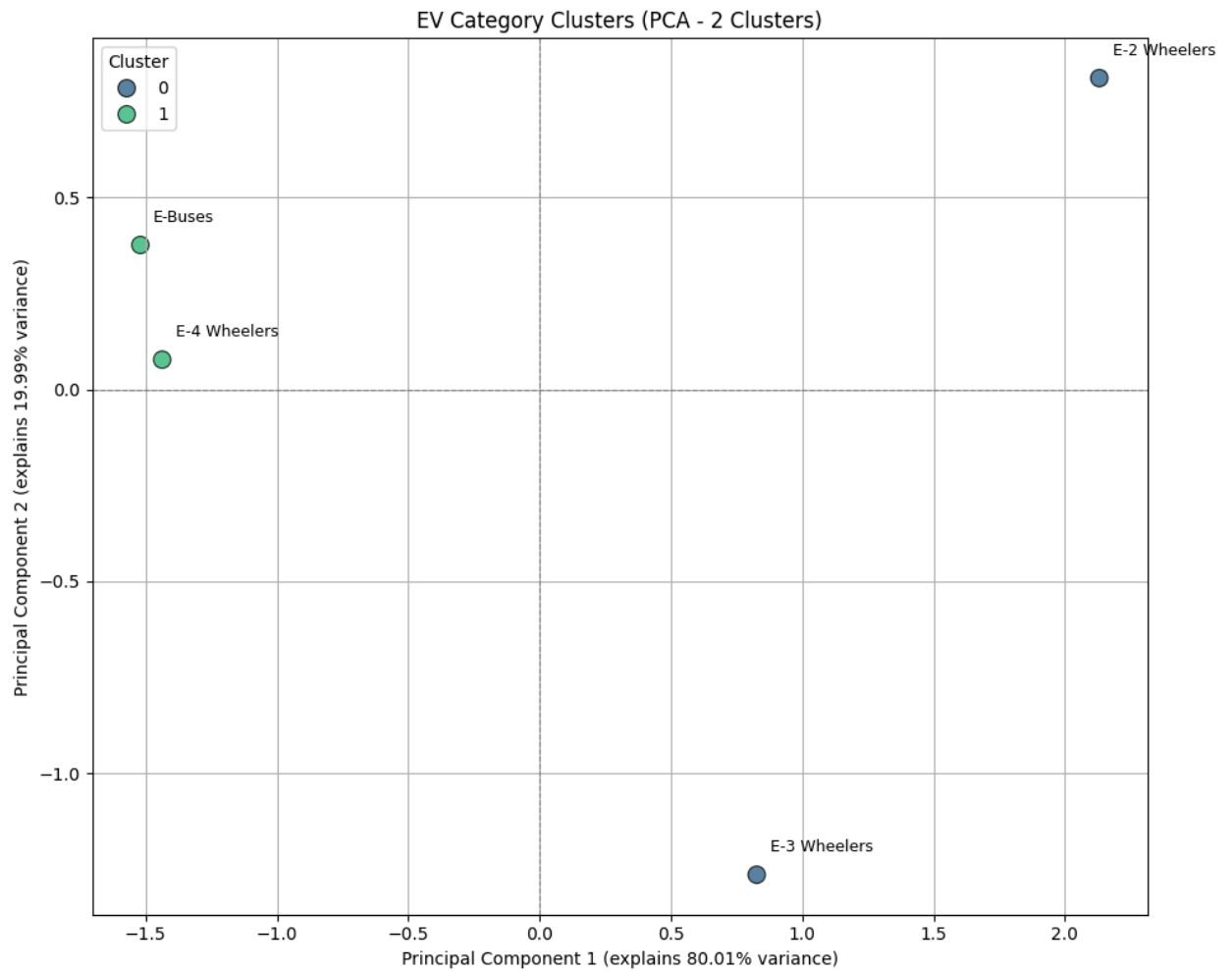
Segment 1 Profile:
Categories: ['E-4 Wheelers', 'E-Buses']
Average Total Sales: 42054.00
Average Annual Sales: 12015.43
Average Growth Rate: 37.11
This segment represents lower-volume, lower-growth EV categories. These might be niche or less promising markets currently.
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Visuals:

- Annotated line plot shows rapid rise in E-2W and E-3W since 2020



- PCA scatter plot confirms clear cluster separation



Strategic Insights & Recommendations

High-Potential EV Segments

- E-2 Wheeler: Urban mass-market vehicles with massive growth post-2020
- E-3 Wheeler: Last-mile delivery and shared mobility demand rising fast

Lower-Potential Segments

- E-Bus: High cost, slow infrastructure rollout
- E-4 Wheeler: Expensive, still niche in public adoption

Startup Strategy

- Enter E-2W/E-3W market with affordable, high-range vehicles
 - Focus on delivery/logistics use cases
 - Offer swappable/faster-charging battery models
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Limitations & Future Scope

- Data limited to category-level only; state-wise breakdown would improve localization
 - Could add forecasting (Exponential Smoothing / Prophet)
 - Include pricing, subsidy, and infra columns for better regression modeling
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Final Conclusion

The analysis shows India's EV opportunity is driven by two key segments: electric 2-wheelers and 3-wheelers. These categories dominate in growth and volume. For new startups, these segments offer the lowest entry barrier and the highest upside.

Starting with E-2Ws or E-3Ws is the most viable strategy to establish a foothold in the rapidly expanding Indian EV ecosystem.

Data Source

- Society of Manufactures of Electric Vehicles, (2023, October),
<https://www.smev.in/ev-industry>

Notebook

- https://github.com/arsenta/EV_market_seg/blob/main/EV_Vehicle_Sales.ipynb