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SEGMENTATION AND ANALYSIS ELECTRIC VEHICLE MARKET

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FeyNN Labs
EXPERIMENT WITH YOUR KNOWLEDGE

CONTENT

Abstract

Electric vehicle (EV) market segmentation, a crucial process driven by the diverse needs and preferences of consumers. Segmentation aids in understanding varying customer needs, such as range, affordability, or specific EV features, enabling targeted marketing efforts for improved customer engagement and sales. It also informs product development, highlighting the needs of different segments and guiding the creation of products to meet these needs. Segmentation can provide a competitive edge by identifying and targeting underserved market segments. Additionally, it facilitates efficient resource allocation by focusing on segments most likely to purchase products. In essence, EV market segmentation is vital for comprehending customer needs, guiding product development, crafting effective marketing strategies, securing a competitive advantage, and ensuring efficient resource allocation.

This abstract focuses on the process of segmentation in the context of electric vehicles (EVs). Segmentation involves isolating potential target audiences based on specific criteria such as price, power, payload, and gross vehicle weight (GVW) of EVs. This process allows for a deeper understanding of the core values of various markets and what will attract them to a brand. A key advantage of this approach is the potential for lower competition.

Introduction

The Indian electric vehicle (EV) market is on a significant growth trajectory, driven by diverse consumer needs and preferences, as well as the government's ambitious EV adoption plans. The market size was USD 1.45 billion in 2021 and is projected to grow at a CAGR of 66.52% from USD 3.21 billion in 2022 to USD 113.99 billion in 2029.

The EV-Ready India dashboard projects a substantial surge in electric vehicle sales, with an impressive 45.5% Compounded Annual Growth Rate (CAGR) expected between 2022 and 2030. This growth is anticipated to be driven by the sale of electric two-wheelers, which are expected to hit Indian roads in staggering numbers by 2030.

The Indian government's target to achieve 30% electric mobility by 2030, coupled with various incentives and subsidies provided under the FAME II scheme, are further propelling the growth of the EV market.

India's EV market is diverse, encompassing electric two-wheelers, three-wheelers, cars, and buses. Electric two-wheelers and three-wheelers are gaining considerable traction due to their affordability and suitability for Indian traffic conditions.

The advent of numerous EV startups, along with established automobile manufacturers venturing into EV production, is further boosting the growth of the EV market in India. These companies are focusing not only on vehicle production but also on building robust charging infrastructure, which is crucial for widespread EV adoption.

In summary, with supportive government policies, increasing consumer awareness, and advancements in EV technology, the Indian EV market is poised for substantial growth in the coming years.

Problem Statement

The stakeholders or the founder are interested in understanding which segment of the electric vehicle (EV) market would be the most profitable for starting a business. They are also keen on identifying an entry point into the EV market that would facilitate a smooth and easy transition. They believe that such strategic insights will help them make informed decisions and ensure the success of their venture.

Specifying Ideal Target Segment

I have considering to produce small commercial vehicles (SCVs) mainly focusing on goods carrier vehicle.

Problem Statement Breakdown

There are various types of vehicles, and as a startup company, it's not feasible to produce all types of vehicles. It's more practical to focus on manufacturing a single category of vehicle, unlike large, established vehicle manufacturers that produce two or more categories. Therefore, my target is to produce small commercial vehicles (SCVs).

Fermi Estimations:

To make a Fermi estimation for the problem statement, let's break it down into key components and make approximate assumptions:

1. Market Size:

- India's population is approximately 150 Cr.
- Let's estimate that a reasonable percentage of the population is of driving age and can potentially be a customer for electric vehicles. Assuming 60% of the population is of driving age, that's around 90 Cr. potential customers.

2. Segmentation:

- Let's assume there are four major segments for electric vehicles: urban commuters, rural users, commercial fleets, and tech enthusiasts.
- We will allocate 20% to urban commuters, 10% to rural users, 40% to commercial fleets, and 30% to tech enthusiasts.

- We can consider one third of commercial vehicles are SCVs.

3. Price:

- Let consider the price range 3 – 5 lac.
- We are target to sell at least 1000 units per year.

4. Realistic Approach:

- For market entry, let's consider that the startup will need to concentrate on at least three vital aspects: affordability, charging infrastructure, and government incentives.
- Given a 10% growth rate, let's anticipate a 2-year timeframe to formulate a viable strategy and an additional 2 years to begin exerting a substantial influence in the market.

Now, we can make a Fermi estimation based on these assumptions:

- Potential market size:
    - Commercial fleets: 90 crore * 40% = 36 crore
    - SCV fleets: 36 crore * 1/3 = 12 crore
- Potential Turnover:
    - Yearly turnover: 3 – 5 lac * 1000 = 30 – 50 crore

These estimations are highly simplified and based on several assumptions. In reality, market analysis and segmentation are more complex, and many factors can influence a startup's success in the electric vehicle market. Fermi estimations are useful for obtaining rough estimates and a starting point for further detailed analysis.

First Principle Analysis:

1. Market Analysis:

- From Fermi estimation we can consider market size and segmentations.
- Customer needs: Basic customer need from an electric SCV are high payload, rum per single charge, run in any road (means have much power to run with heavy load in rough road) and affordability.

2. Competitive Landscape:

- Existing Players: The current competitor companies are Tata, Mahindra, Piaggio and YC electric.
- Barriers to Entry:
    - Lack of Consumer Awareness and Education: Limited knowledge about EVs, their benefits, and charging requirements deters consumers. 2-wheeler OEMs have managed to create more awareness.
    - Range Anxiety: Concerns about EVs' limited range and the inconvenience of finding charging stations for long journeys, particularly in a vast country like India.

- Charging Time: Slow charging times, which can take up to 8 hours for a full charge, compared to the quick refueling of internal combustion engine (ICE) vehicles.
- Standardization: Lack of standardization and interoperability between charging networks, necessitating government and industry cooperation to establish protocols and promote fast-charging technologies.
- Safety Challenges: Safety concerns related to battery technology, thermal runaways, and fire incidents need to be addressed through stringent safety standards and regulations.
- Policy and Regulatory Challenges: Inconsistent policies, subsidies, and tax incentives create uncertainty among stakeholders and impact the growth of EVs, especially with recent subsidy reductions.

3. Regulatory and Policy Environment:

Key policy initiatives related to electric vehicles (EVs) in India include:

- FAME-I Scheme (1st April, 2015 – 31st March, 2019): Focused on promoting electric and hybrid vehicle technologies.
- FAME-II Scheme (1st April 2019 – 31st March 2024): Aims to create demand for Electric Vehicles (xEVs) and develop charging infrastructure.
- PLI Scheme (Duration of 4 - 6 years): Promotes manufacturing capabilities for Advanced Automotive Products (AAT) and generates economies of scale.
- PLI Scheme for National Programme on Advanced Chemistry Cell (ACC) Battery: Aims to support the demand for EVs and renewable energy through battery production.

Incentives available for EV manufacturing include:

- Champion OEM Incentive Scheme: Offers financial incentives ranging from 13% to 18% for battery electric vehicles (BEVs) and hydrogen fuel cell vehicles.

Additional measures to support the EV industry include:

- Reduced GST rates on EVs and chargers.
- Charging infrastructure standards for private charging.
- Green license plates and exemption from permit requirements for battery-operated vehicles.
- Exemption of road taxes for EVs.
- Technology Platform for Electric Mobility (TPEM).
- Battery Swapping Policy for quick battery replacement.

Regulations issued by other ministries focus on efficient charging infrastructure development. State electric vehicle tariffs vary but often range from INR 4 to INR 6 per kWh.

The Indian EV industry is growing with support from both central and state governments, emphasizing India's intent to promote EVs and become a manufacturing hub. The industry offers an alternative to rising crude oil costs. However, the growth of EVs requires expanding charging infrastructure and improving vehicle range to achieve sustainable development.

4. Technological Considerations:

- Battery Technology:
  - Energy Density: Evolving battery tech aims to increase energy density for longer driving ranges.
  - Fast Charging: Improved fast-charging for quick top-ups during long trips.
  - Durability: Efforts to enhance battery lifespan for reduced environmental impact.
  - Cost Reduction: Ongoing work to lower battery production costs, making EVs more competitive.
  - Recycling: Exploring advanced battery recycling and repurposing for energy storage.
- Charging Infrastructure:
  - Expansion: Rapid expansion of charging networks globally, including home and fast-charging.
  - Ultra-Fast Chargers: Introduction of ultra-fast chargers for significantly reduced charging times.
  - Smart Charging: Bi-directional chargers enabling Vehicle-to-Grid (V2G) technology.
  - Mobile Apps: Mobile apps for convenient charger location, real-time data, and digital payments.
- Energy Efficiency in India:
  - Government Initiatives: Indian government promotes EV adoption through initiatives like FAME-I, FAME-II and PLI.
  - Local Battery Manufacturing: Investments in local battery production for energy efficiency.
  - Charging Infrastructure Growth: Major Indian cities see expanding charging networks.
- Partnership Consideration:
  - Battery Technology Development: Partnering with battery manufacturers and researchers to develop advanced battery technologies, including solid-state batteries, to improve energy density, charging speed, and lifespan.
  - Charging Infrastructure Expansion: Collaborating with charging station providers to expand the charging infrastructure network, especially in regions where it's underdeveloped.
  - Smart Charging Solutions: Partnering with technology companies to develop smart charging solutions that enhance grid stability, implement bi-directional charging (V2G), and enable more efficient energy management.
  - Energy Storage Integration: Collaborating with energy storage technology providers to integrate used EV batteries into stationary energy storage systems, reducing waste and creating a new revenue stream.
  - Digital Solutions: Partnering with tech companies to develop mobile apps, digital payment platforms, and real-time charging station information services to improve the EV owner experience.

- Government Initiatives: Working with government bodies to support and shape policies and incentives that promote EV adoption and research in battery and charging technologies.
- Local Manufacturing: Collaborating with local manufacturers and research institutions to establish battery production facilities, reducing dependence on imports and enhancing energy efficiency.
- Clean Energy Integration: Collaborating with renewable energy providers to align EV charging with clean energy generation, reducing the carbon footprint of EVs.
- Electric Vehicle-to-Home (V2H): Collaborating with technology firms to develop V2H solutions, allowing EVs to power homes during grid outages or peak demand, enhancing energy resilience.

5. Sustainability and Environmental Impact:

- Reducing Air Pollution: Indian cities face severe air pollution issues. EVs, with zero tailpipe emissions, are crucial for improving air quality and public health.
- Carbon Emission Reduction: EVs help India meet its climate goals by reducing carbon emissions. Sustainability aligns with global climate commitments.
- Energy Security: EVs can rely on domestically produced electricity, enhancing energy security and reducing oil imports.
- Incentives and Subsidies: Government initiatives promote eco-friendly EVs by offering incentives and subsidies for buyers.
- Eco-Friendly Branding: A green and eco-friendly image can influence customer choices and strengthen brand loyalty in the Indian market.

6. Pricing and Cost Analysis (Approximated):

- Electric Motor and Controller: The cost of the electric motor and its controller can vary based on the power and efficiency. For small commercial vehicles, this cost can range from ₹50,000 to ₹2,00,000 or more.
- Charging System: The onboard charging system's cost can range from ₹10,000 to ₹30,000. Keep in mind that this doesn't include charging infrastructure.
- Power Electronics: This includes components like inverters and converters. Costs can range from ₹20,000 to ₹50,000 or more.
- Transmission: Transmission systems for electric vehicles vary in price based on complexity and efficiency. Costs can range from ₹20,000 to ₹60,000.
- Braking System: Regenerative braking systems are common in EVs. The cost of regenerative braking components can vary but typically ranges from ₹10,000 to ₹20,000.
- Suspension System: Suspension components can range from ₹10,000 to ₹30,000 or more.
- Steering System: The cost of the electric vehicle's steering system typically ranges from ₹10,000 to ₹20,000.

- Wiring and Electronics: This includes the vehicle's wiring harness, sensors, and control units, with costs ranging from ₹15,000 to ₹30,000.
- Tires and Wheels: The cost of tires and wheels can vary based on the quality and size. It can range from ₹20,000 to ₹40,000 or more for a set of four.
- Body and Chassis: The cost of the vehicle's body and chassis will depend on the size and design of the commercial vehicle. Costs can range from ₹50,000 to ₹2,00,000 or more.
- Interior: This includes the cost of seats, dashboard, and other interior components, with costs ranging from ₹10,000 to ₹40,000.
- HVAC System: The heating, ventilation, and air conditioning system can range from ₹10,000 to ₹30,000.

7. Feasibility and Timeline:

- Strategy Development:
    - Pre-Planning Phase (6-12 months): This phase involves conducting market research, identifying target markets, assessing competitors, and setting initial goals.
    - Strategy Formulation (3-6 months): Develop a comprehensive business plan, including financial projections, production strategies, and supply chain management.
    - Regulatory Compliance (6-12 months): Ensure that your strategy aligns with local and international regulations, emissions standards, safety standards, and environmental requirements.
- Product Development:
    - Concept Development (6-12 months): Define the basic specifications of the EV, including size, range, and performance. Begin initial design concepts.
    - Design and Prototyping (12-18 months): Detailed engineering and design work. Build prototypes for testing and validation.
    - Testing and Validation (12-18 months): Rigorous testing of prototypes for performance, safety, and compliance.
    - Manufacturing Setup (6-12 months): Establish production facilities, supply chain, and quality control processes.
- Market Entry:
    - Market Research (6-12 months): Revisit and update market research to ensure it's up to date. Identify early adopter markets.
    - Product Launch (3-6 months): Plan and execute a launch strategy, including marketing, distribution, and pricing.
    - Market Penetration (Ongoing): Expand your market presence and customer base over time.

8. Risk Analysis:

- Policy and Regulatory Risks:

    - Frequent changes in government policies and regulations related to EV incentives and subsidies.
    - Uncertainty in import/export duties and taxes on EV components and vehicles.
    - Potential regulatory barriers and complex compliance requirements.
- Infrastructure Challenges:
    - Insufficient EV charging infrastructure, particularly in rural areas.
    - Variability in the quality and reliability of the electricity supply.
    - Limited availability of charging stations for commercial vehicles.
- Market Competition:
    - Intense competition from established and emerging local and international EV manufacturers.
    - Consumer preference for low-cost, high-efficiency vehicles that may not align with EV offerings.
- Economic Factors:
    - The cost of manufacturing EVs and components may be higher due to limited local supply chains.
    - Price sensitivity among Indian consumers, potentially impacting the affordability of EVs.
- Technological Challenges:
    - Rapid advancements in EV technology require staying updated to remain competitive.
    - Lack of skilled labor for EV manufacturing and maintenance.
- Environmental Concerns:
    - Environmental issues related to battery production, disposal, and recycling.
    - Potential adverse effects of large-scale EV adoption on India's electricity grid.
- Infrastructure Gaps:
    - The need for investment in recycling facilities for EV batteries.
    - Lack of specialized training for EV repair and maintenance.
- Consumer Adoption:
    - Limited consumer awareness and understanding of EVs, leading to hesitancy in adopting new technology.
    - Concerns about EV range and charging infrastructure availability.
- Political and Geopolitical Risks:
    - Geopolitical factors affecting the supply chain and access to essential raw materials for batteries.
    - Political instability and changes in government policy affecting the EV market.
- Currency Fluctuations:
    - Currency exchange rate fluctuations can impact the cost of importing or exporting EV components and vehicles.

- Supply Chain Disruptions:
    - Disruptions in the global supply chain, such as shortages of semiconductors, can affect EV production.

- Environmental Factors:
    - Pollution and climate-related issues in India can impact public perception of EVs.

It's crucial for potential market entrants to conduct thorough market research, establish robust local partnerships, and adapt to the specific challenges of the Indian EV market. Developing a comprehensive risk management strategy that addresses these challenges is essential for a successful market entry. Additionally, monitoring policy changes and investing in local research and development can mitigate many of these risks.

Specifying Attractive Target Segment

Knock-out Criteria:

- Low competition
- Homogeneous
- Distinct
- Matching (the organization must have the capability to satisfy segment members' needs.)

Attractive Criteria:

- Profitable
- Stable
- Sales estimates (potential sales for product item, product line, geographical area in the short, medium or long term)

Work Flow:

Data Collection:

Data collection, a vital process in research, entails the gathering, measuring, and analysis of precise insights using established and validated techniques. This allows researchers to assess their hypotheses based on the collected data. Regardless of the research field, data collection is typically the primary and most crucial step. However, the data collection approach varies across different fields of study, depending on the information needed.

This report aims to analyze the Artificial Intelligence job market in India and derive valuable insights. The data is primarily gathered from two websites: CarDekho and Open Gov. Data (OGD) India, based on an ideal segment assumption using Python and Selenium.

Web scraping techniques like Selenium are used to extract features such as vehicle name, price, power, payload, and gross vehicle weight from CarDekho. In contrast, the state and corresponding number of working charging stations are extracted from Open Gov. Data (OGD) India.

The raw dataset is present in

The clean dataset present in

Data Pre-processing:

When it comes to creating a ML model, data preprocessing is the first step marking the initilization of the process. We didn't use any dataset available on internet but webscrapped the dataset from two protals. The problem with such real life dataset is that it is incomplete, inconsistent and often lacks some attributes which we then tried to add manually. Preprocessing helped us to clean the format, organize the raw data thereby making it ready-to-go for segmentation task.

Data Cleaning:

We used numpy and pandas library to perform data cleaning. We removed useless features like data posted etc from the dataset and removed many inconsistencies in feature columns like Job Role and Location. In Location feature Some jobs requirements had multiple vacancies in multiple cities so we duplicated those, thus increasing the data, data for better segmentation. We segricated city and state for better segmentation.

A regular expression is a pattern that the regular expression engine attempts to match in the input text. A pattern consists of one or more character literals, operators, or constructs. In my case I used it to extract number from columns such as actual price value from string and other column also.

Feature Extraction:

Feature extraction refers to the process of transforming raw data into numerical features that can be processed while preserving the information in the original data set. We extracted many new features like Cloud Requirement, Linux OS Requirement, R or Python Requirements, and SQL database requirements. It yields better results than applying machine learning directly to the raw data.

Missing values occur because of various factors like missing completely at random, missing at random or missing not at random. All these may result from system malfunction during data collection or human error during data pre-processing. Nevertheless, it is important to deal with missing values before analysing data since ignoring or omitting missing values may result in biased or misinformed analysis or wrong segmentations.

One way to handle this problem is to get rid of the observations that have missing data. A better strategy would be to impute the missing values. In other words, we need to infer those missing values from the existing part of the data. There are three main types of missing data:

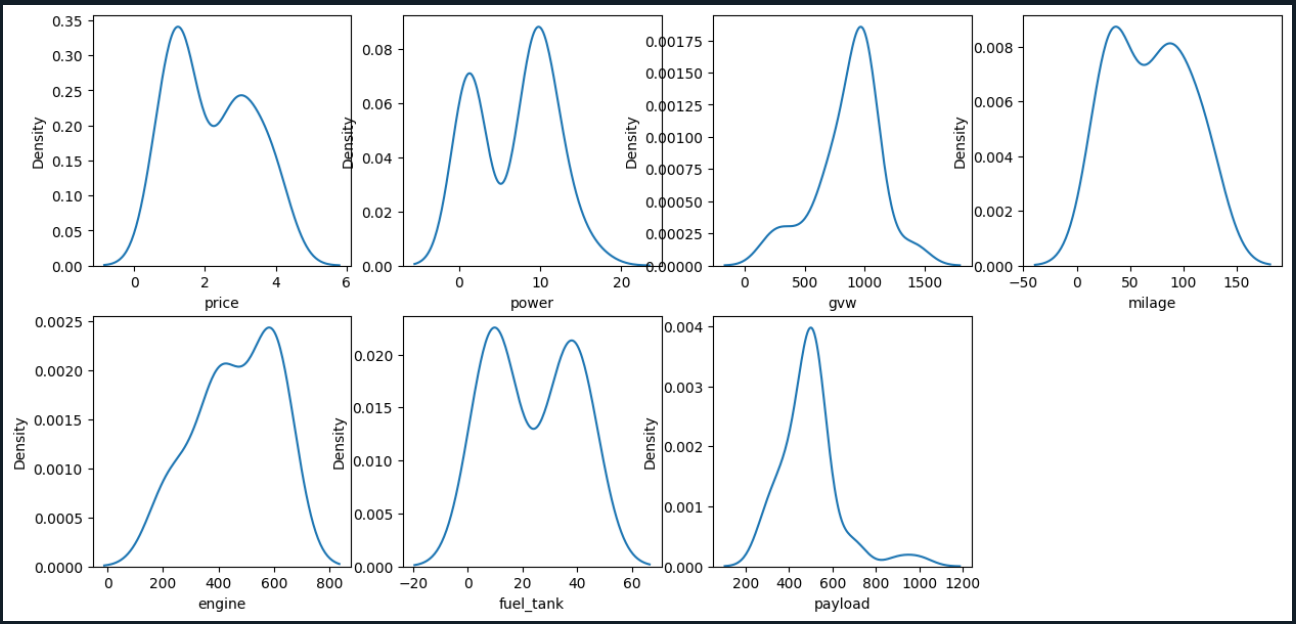
- Missing completely at random (MCAR)
- Not missing at random (NMAR)
- Missing at random (MAR)

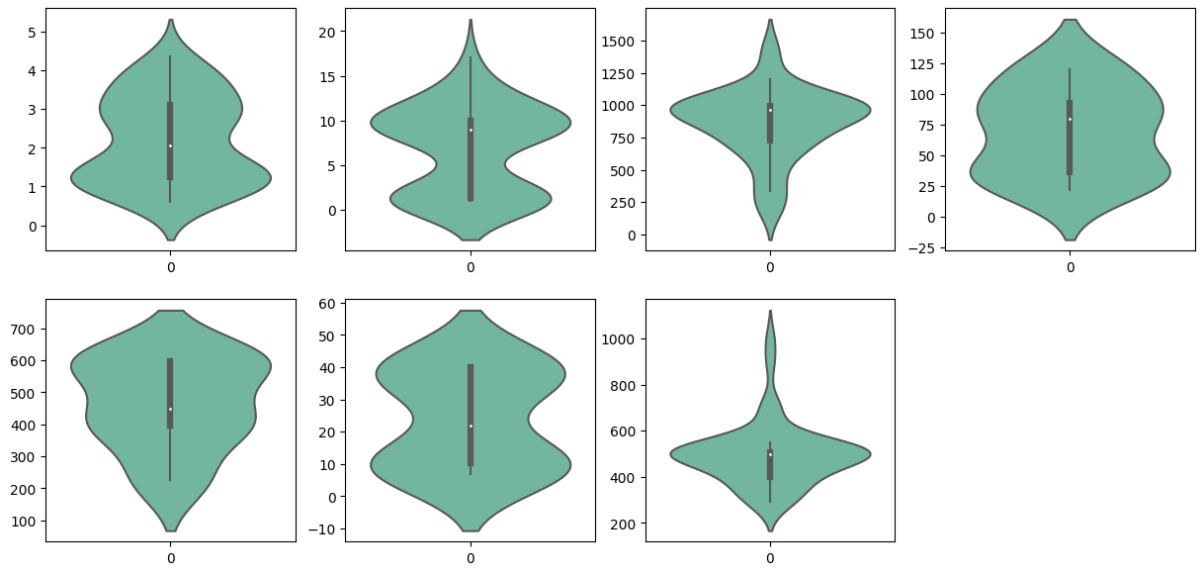
Imputation Using KNN:

The k nearest neighbors is an algorithm that uses 'feature similarity' to predict the values of any new data points. This means that the new point is assigned a value based on how closely it resembles the points in the training set. This can be very useful in making predictions about the missing values by finding the k's closest neighbours to the observation with missing data and then imputing them based on the non-missing values in the neighborhood.

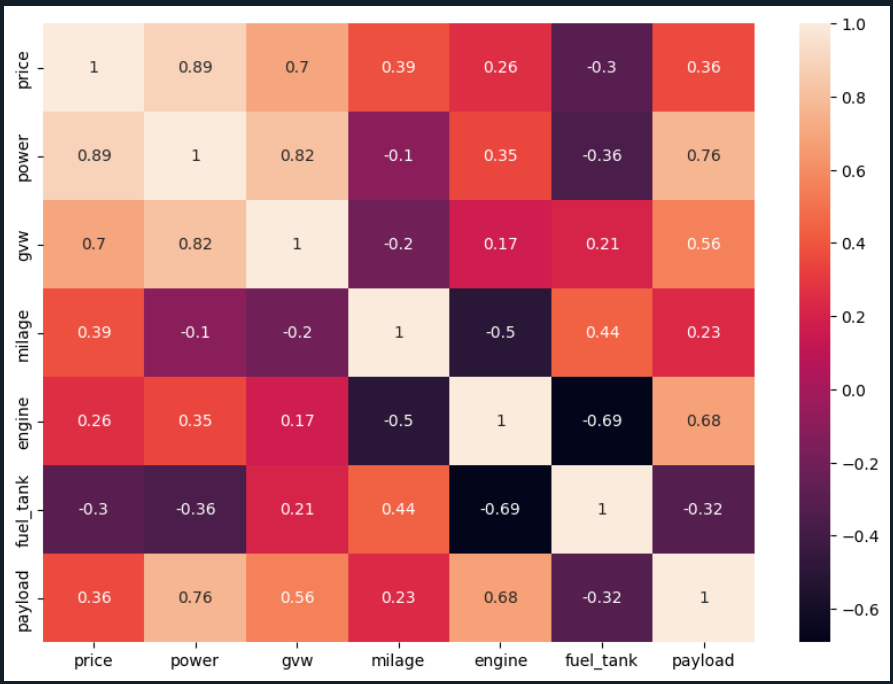
Analysis and Visualization

Three Wheeler Data:



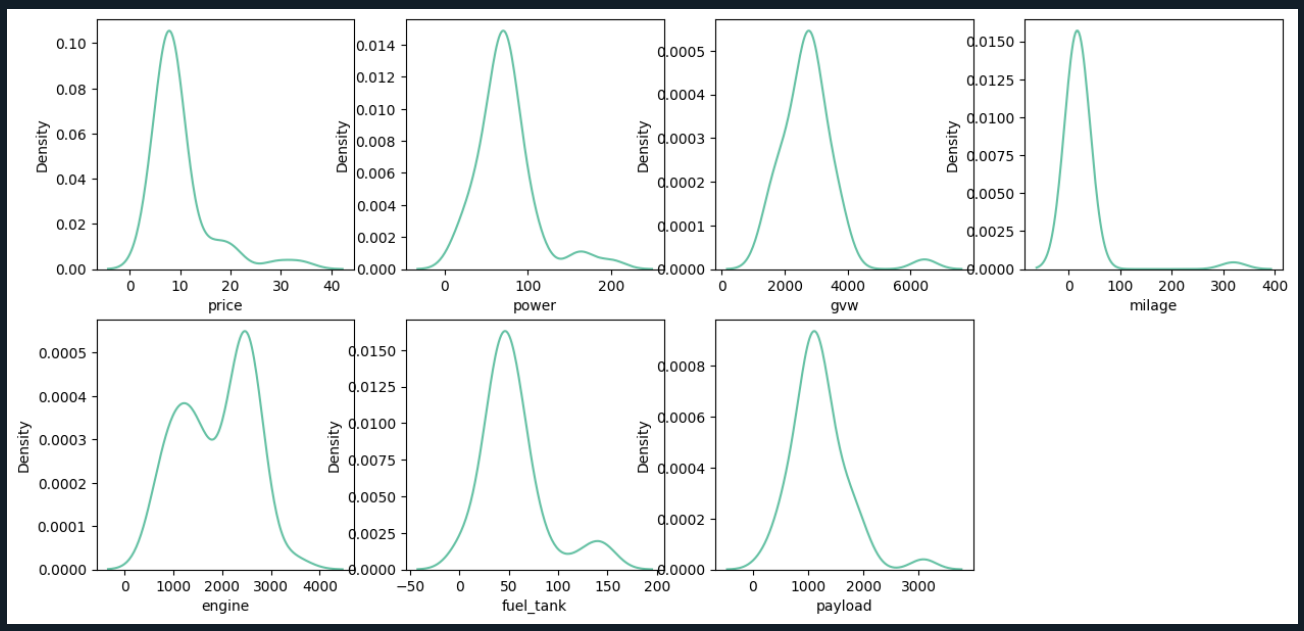


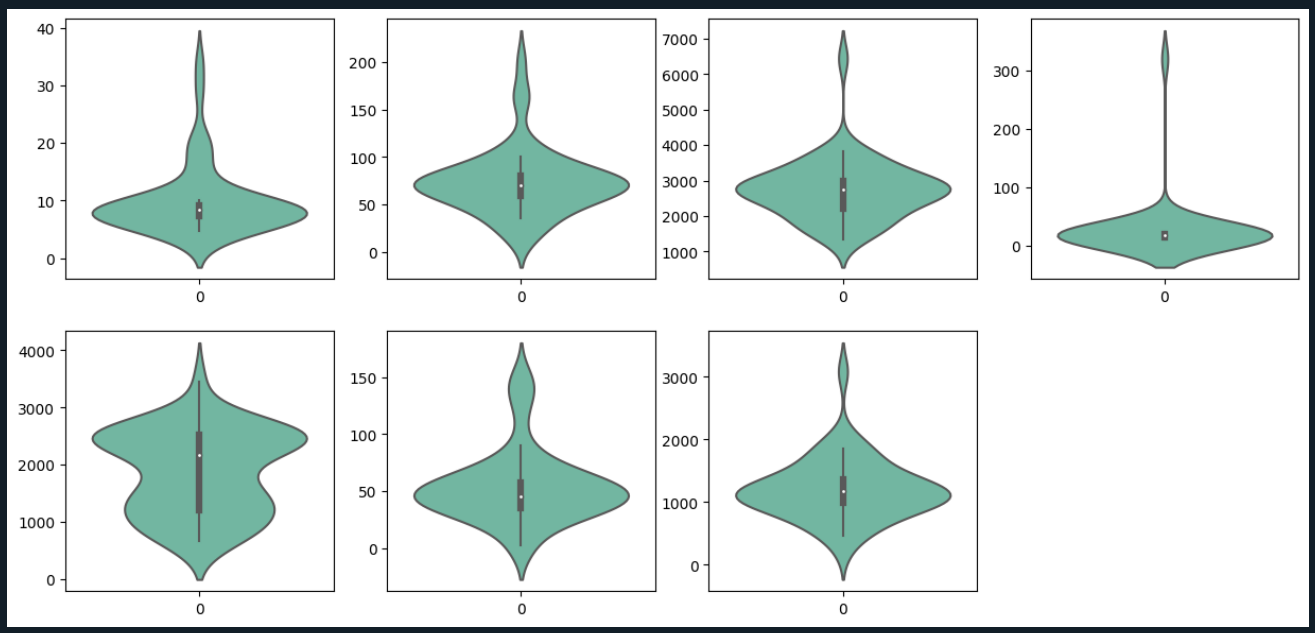
- Price: The plot shows that a large number of three wheeler vehicles are priced in the lower range, with fewer three wheeler vehicle in the higher price range. This indicates that the car prices are skewed towards the lower end.
- Power: The power plot shows a similar trend to the price plot, indicating that most three wheeler vehicles have lower power.
- Mileage: The mileage plot shows a more balanced distribution, indicating that there are three wheeler vehicles available with a wide range of mileage.
- Engine Size: The engine size plot is skewed towards smaller engines, indicating that most three wheeler vehicles have smaller engines.
- Fuel Tank Capacity: The fuel tank capacity plot shows that most three wheeler vehicles have a fuel tank capacity in the lower to mid-range.
- GVW (Gross Vehicle Weight): The GVW plot is skewed towards the lower end, indicating that most three wheeler vehicles have a lower GVW.



Price exhibits a strong correlation with power, gross vehicle weight, and payload, indicating that significant changes in these factors will likely lead to substantial variations in price.

Small Commercial Vehicle Data:





- Price: The plot shows that a large number of three wheeler vehicles are priced in the lower range, with fewer three wheeler vehicle in the higher price range. This indicates that the car prices are skewed towards the lower end.
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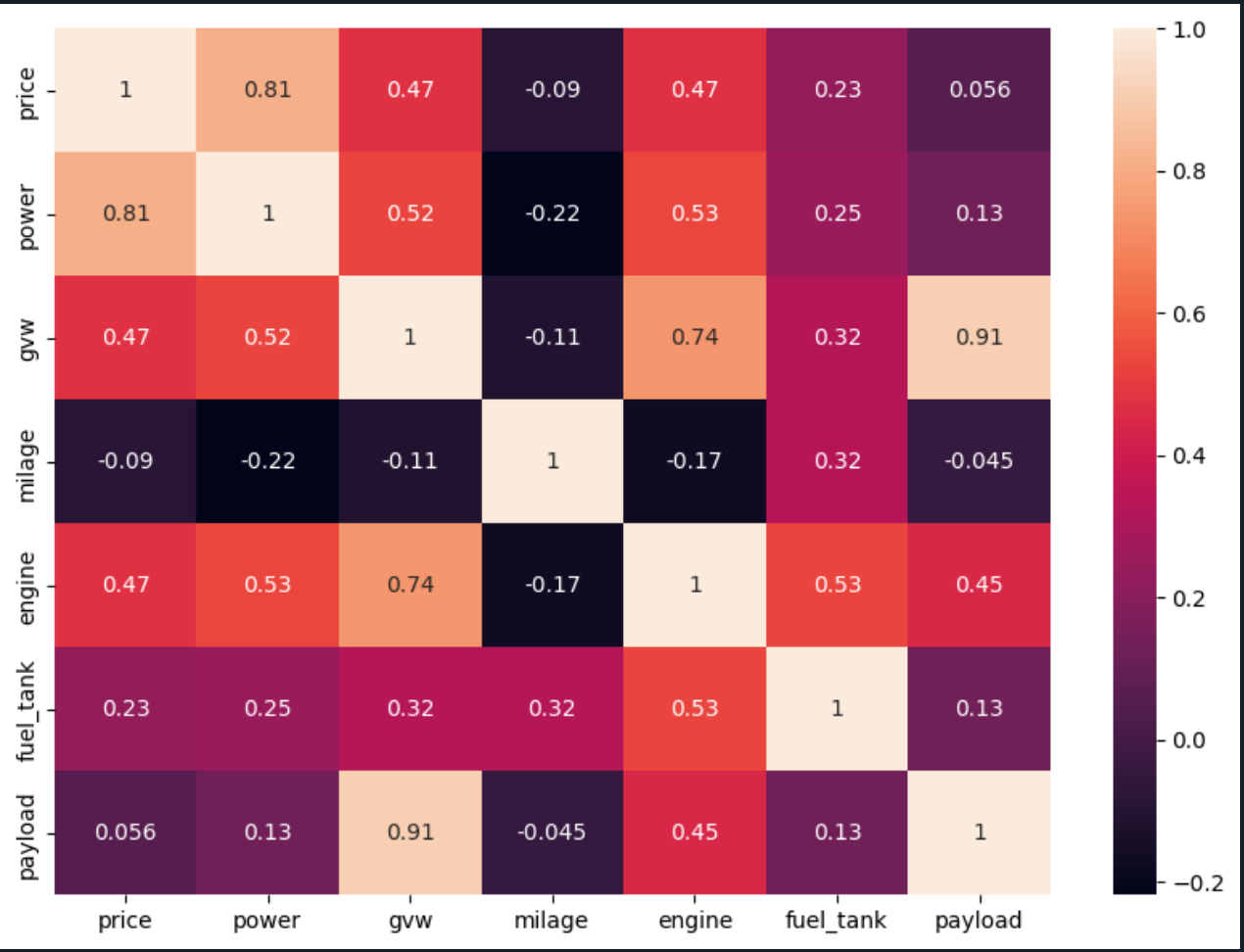
- GVW (Gross Vehicle Weight): The GVW plot is skewed towards the lower end, indicating that most three wheeler vehicles have a lower GVW.
- Mileage: The mileage plot shows a more balanced distribution, indicating that there are three wheeler vehicles available with a wide range of mileage.

- Payload: The payload plot shows that most three wheeler vehicles have a payload in the lower to mid-range.
- Fuel Tank Capacity: The fuel tank capacity plot shows that most three wheeler vehicles have a fuel tank capacity in the lower to mid-range.
- Engine Size: The engine size plot is skewed towards smaller engines, indicating that most three wheeler vehicles have smaller engines.



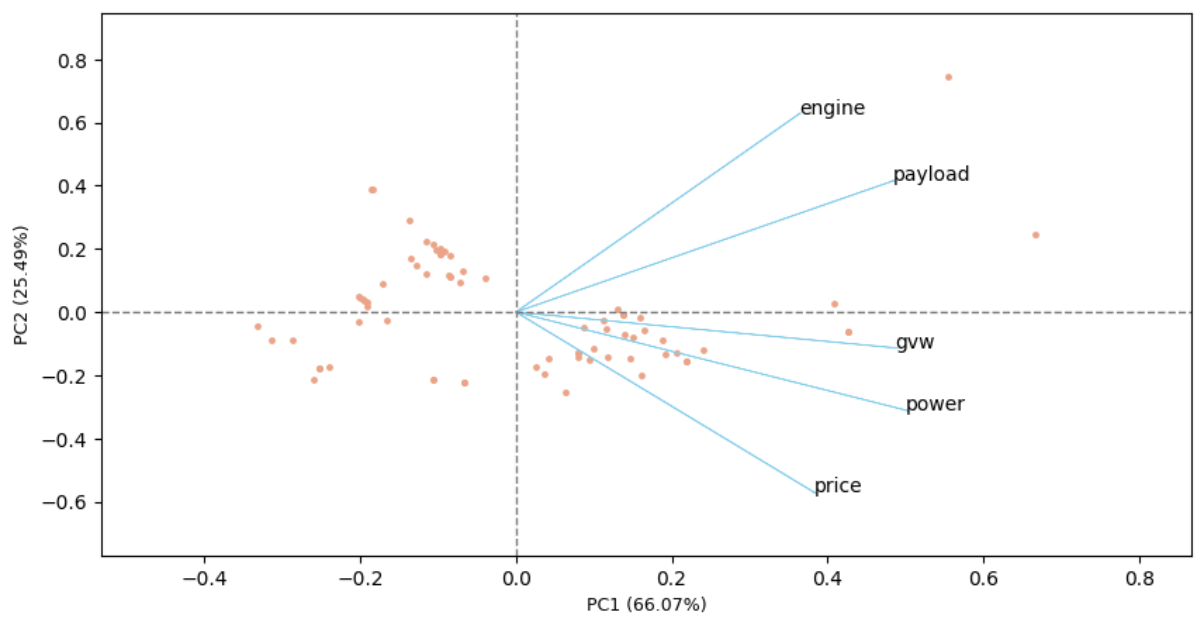
Price exhibits a strong correlation with power indicating that significant changes in these factors will likely lead to substantial variations in price.

Principal Components Analysis:

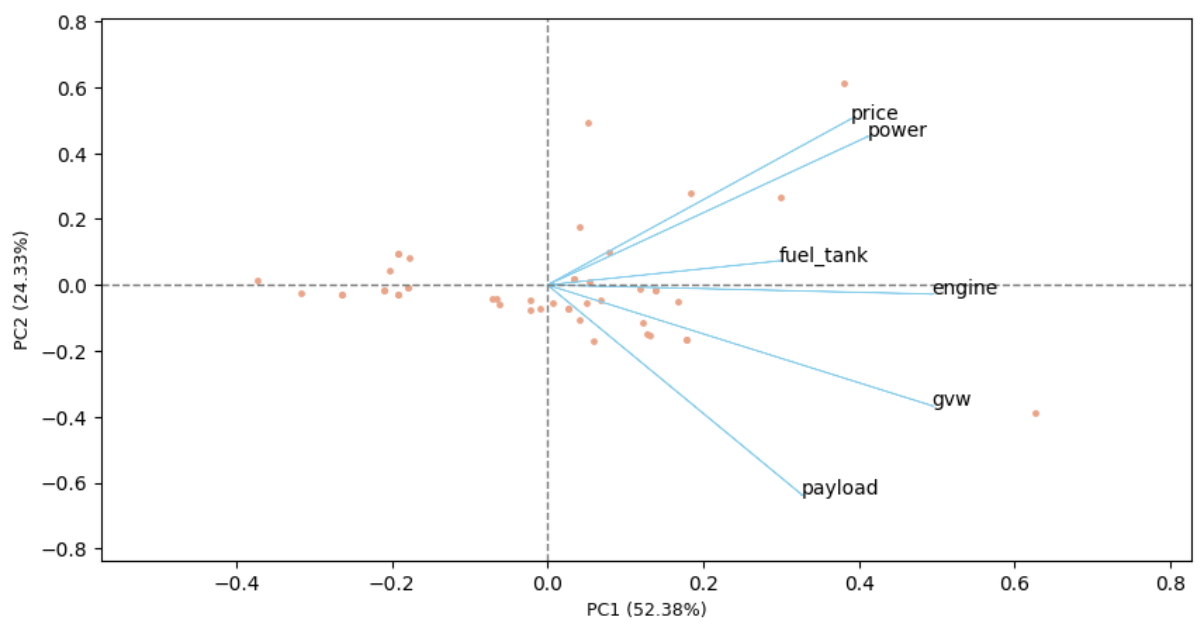
Principal Components Analysis (PCA) is a technique that transforms a multivariate dataset into a new set of variables, called principal components, which are uncorrelated and ordered by importance. The first principal component accounts for the most variability, the second accounts for the second most, and so on.

PCA works off the covariance or correlation matrix of several numeric variables. If all variables are measured on the same scale and have similar data ranges, it is not important which one to use. If the data ranges are different, the correlation matrix should be used.

Three Wheeler Data:



Small Commercial Vehicle:



Extracting Segment:

Clustering is a technique in unsupervised machine learning that segregates data points into multiple groups or clusters. The aim is to ensure that data points within the same group are more alike to each other than they are to data points in other groups.

Distance-Based Method

To identify groups of similar consumers, a concept of similarity or dissimilarity is required, which in mathematical terms is a distance measure. A distance measure must meet certain criteria. One such criterion is symmetry, which means:

d(x, y) = d(y, x)

Another criterion is that the distance of a vector to itself and only to itself is 0: d(x, y) = 0 ⇔ x = y. Moreover, most distance measures satisfy the so-called triangle inequality:

d(x, z) ≤ d(x, y) + d(y, z)

The triangle inequality implies that if one travels from x to z with a stopover at y, the total distance will be at least as long as going directly from x to z. The Euclidean distance is the most commonly used distance measure in market segmentation analysis.

$$d(x,y) = \sqrt{\sum_{i=1}^{n}(y_i - x_i)^2}$$

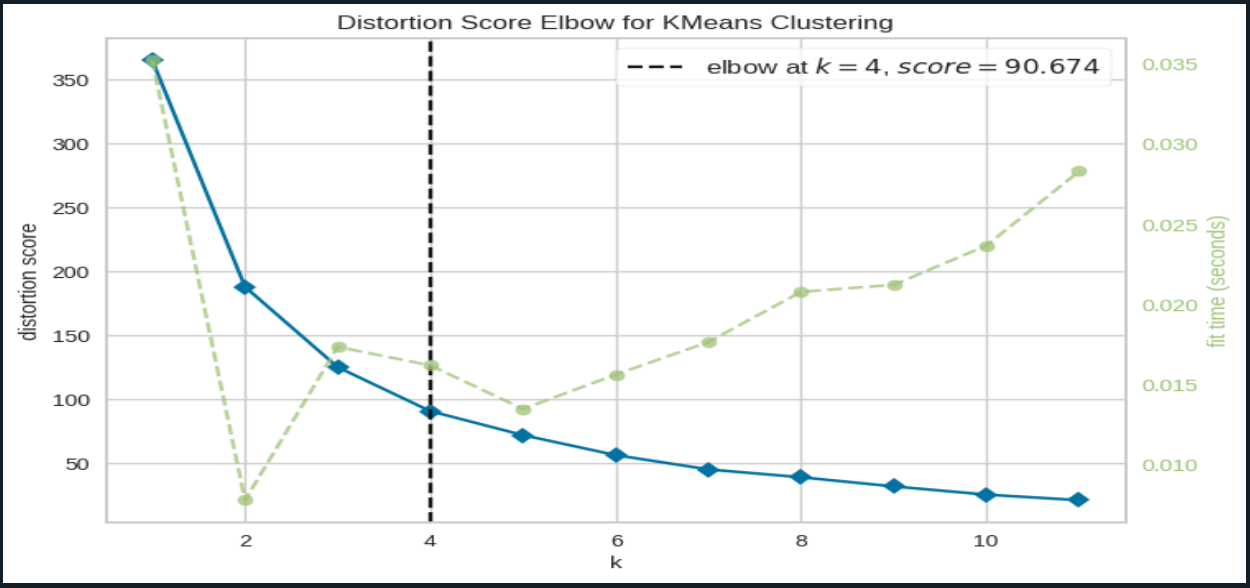
Manhattan or absolute distance:

$$d(x,y) = \sum_{i=1}^{n}|x_i - y_i|$$

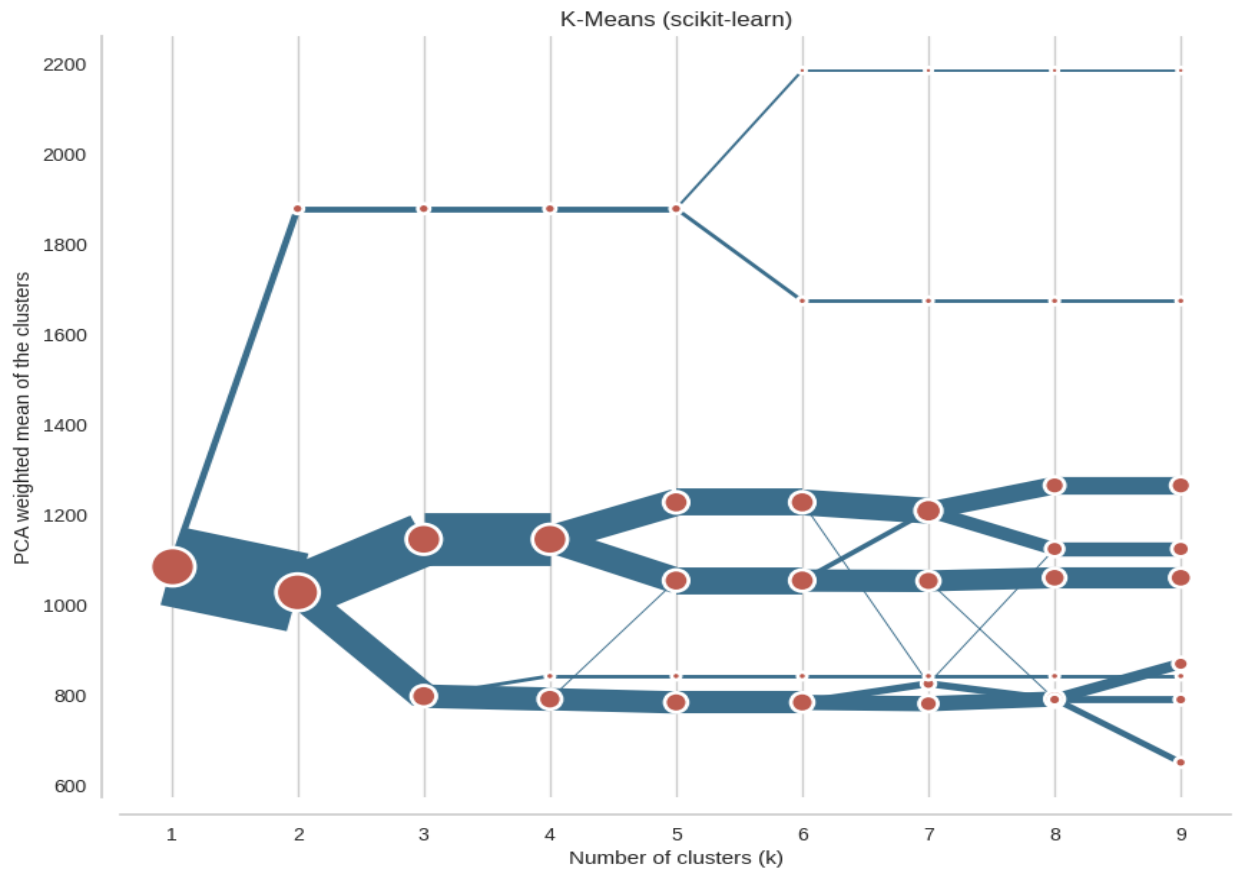
Note: **Features that have more than half of their values missing are not included in the segmentation variable, meaning the data is clustered excluding these features. On the other hand, features that contain less missing values are imputed using the KNN imputer.**

Choosing Optimal k for k-means: I used elbow method with silhouette score.

Three Wheeler Data:

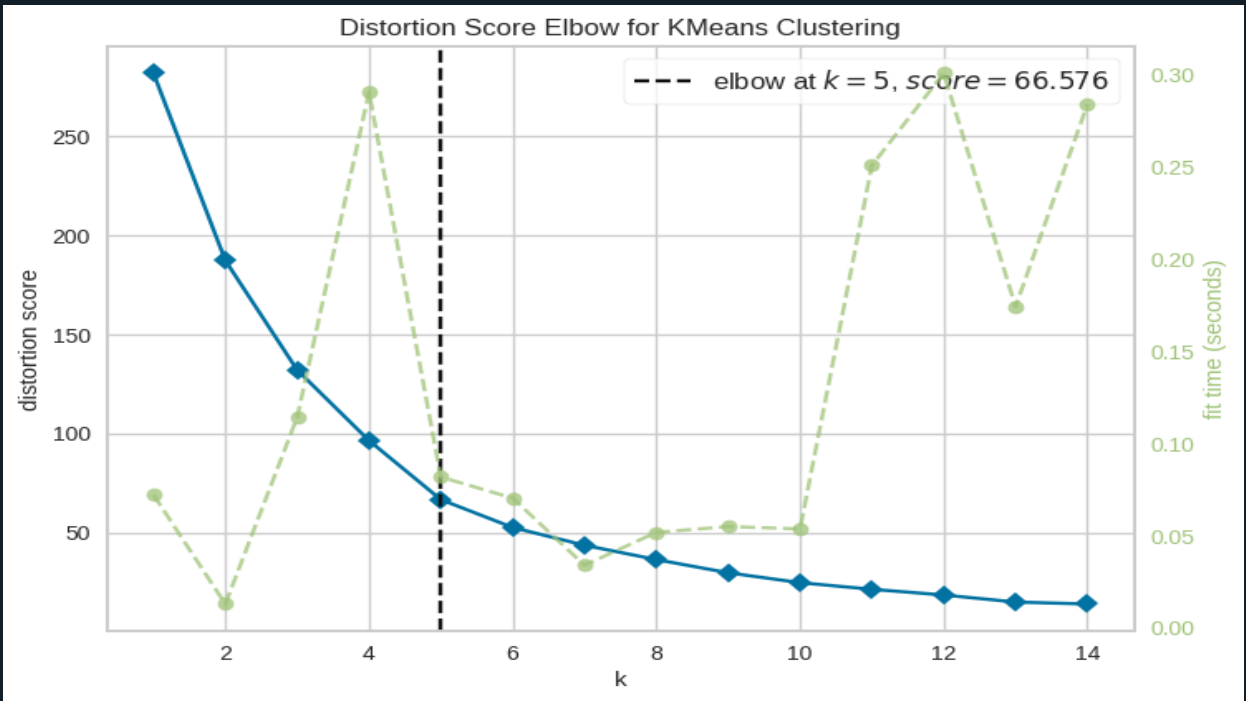


The optimal number of clusters for three wheeler data is 4.

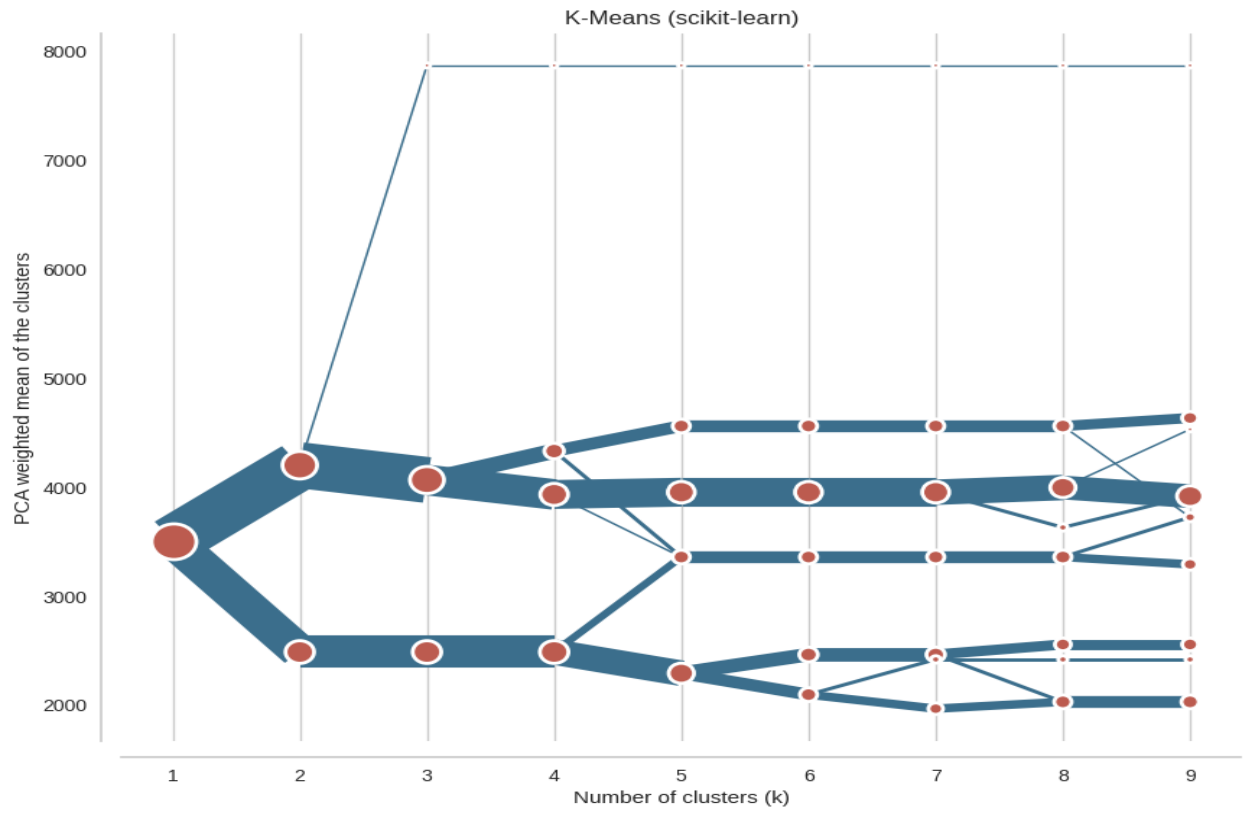


The plot above illustrates the degree of distinction between the segments.

Small Commercial Vehicle Data:



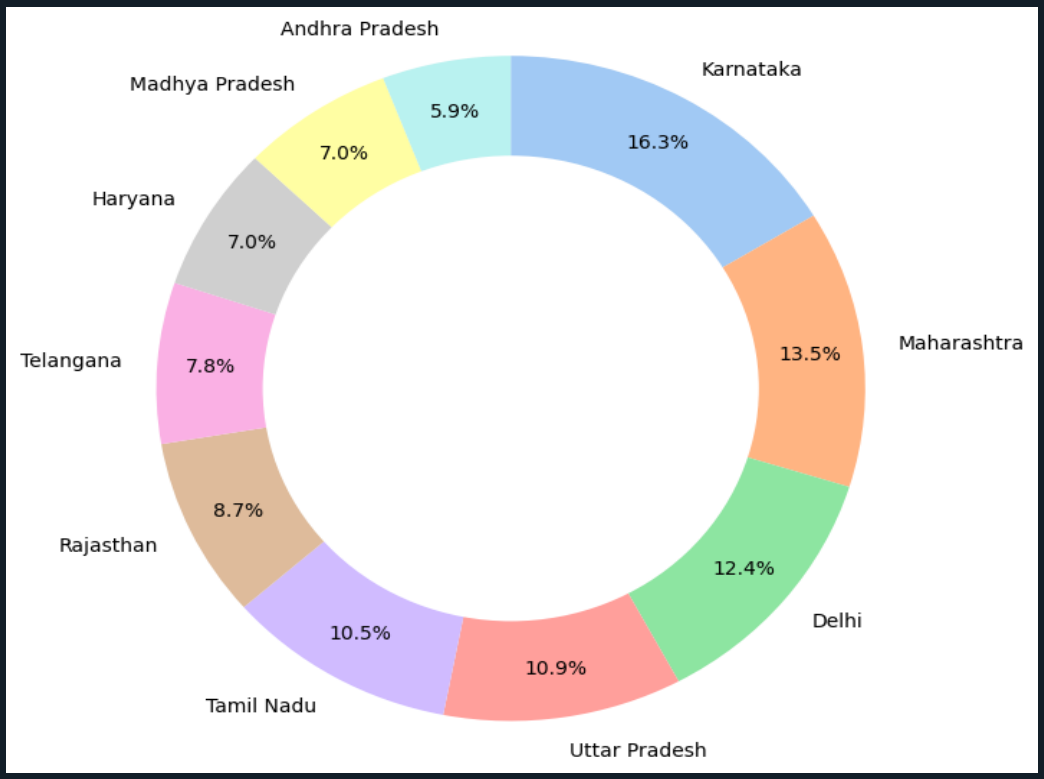
The optimal number of clusters for three wheeler data is 5.



The plot above illustrates the degree of distinction between the segments.

Geographic Segmentation:

By analyzing charging station data of India provided by OGD platform India. We get,



Highest numbers of charging station present in state Karnataka then Maharashtra then followed by Delhi, Uttar Pradesh and Tamil Nadu.

The government policies for each state are:

Karnataka

The Government of Karnataka has implemented several policies to promote the adoption and manufacturing of electric vehicles (EVs) in the state[1][2][4]:

1. Karnataka Electric Vehicle and Energy Storage Policy (2017): This policy aims to make Karnataka a preferred investment destination for EV manufacturing[1]. It encourages auto rickshaws, cab aggregators, corporate fleets, and school buses/vans to achieve 100% electric mobility by 2030[1][2].

2. Investment Promotion Subsidies: The policy offers subsidies on the value of fixed assets for micro, small, and medium manufacturing enterprises[2].

3. Exemptions and Concessions: The policy provides exemptions from stamp duty, concessional registration charges, reimbursement of land conversion fee, exemption from tax on electricity tariff, and subsidy for setting up effluent treatment plants[2].

4. Support for EV Infrastructure: The government plans to make industrial land available for establishing EV parks and zones, set up necessary infrastructure through public-private partnership (PPP) mode, identify potential land on a long lease basis for setting up EV charging stations and battery swapping infrastructure, and offer incentives for setting up the first lot of 100 fast charging stations[2].

5. EVs in Non-Transport and Transport Vehicles: Tax exemption is provided for all electric non-transport and transport vehicles[4].

6. EVs in Private Transport: There is a flexible stage carrier permit policy for e-buses allowing multiple/variable routes outside BMTC Area. The government also encourages electric two-wheeler taxis to support short distance shared mobility[4].

Maharashtra

The Government of Maharashtra has implemented several policies to promote the adoption and manufacturing of electric vehicles (EVs) in the state[5][6][7][8][9]:

1. Maharashtra State Electric Vehicle Policy (2021): This policy aims to make Maharashtra a leading state in terms of EV adoption and manufacturing[5]. It provides fiscal and non-fiscal incentives to accelerate the adoption and manufacturing of EVs in the state[5][6].

2. Incentives and Subsidies: The government has rolled out a Rs 930 crore policy that's valid till 31 March, 2025[3]. The policy offers substantial cost benefits and incentives on electric vehicles[4]. Additionally, the state is also offering Early Bird incentives eligible for electric vehicles purchased before December 31, 2021[8].

3. Exemptions: Owners of electric vehicles will not have to pay road tax and registration fees[5]. EVs will be exempt from road tax and registration charges[7].

4. Infrastructure Support: It is now mandatory to reserve parking spaces for electric vehicles in residential and commercial areas as well as in government offices[9].

5. Vision & Mission: The policy aims for EVs to make up 10 percent of all new vehicle registrations – around three lakh vehicles a year – in the state by 2025[7]. The vision is to transform Maharashtra into a leading state in terms of adoption of electric vehicles in the country[6].

Delhi

The Government of Delhi has implemented several policies to promote the adoption and manufacturing of electric vehicles (EVs) in the state[10 11 12 13 14]:

1. Delhi Electric Vehicles Policy (2020): This policy, which was extended until December 31, 2023[11 12], aims to improve Delhi's air quality by facilitating the inclusion of electric vehicles across all modes of transport[14]. The policy intends to deploy 25% of all new vehicles to be battery-operated vehicles by 2024[15].

2. Incentives: Delhi was the first state to design evidence-informed financial incentives such as waiver of road tax and registration fee, scrapping incentives, purchase incentives, etc[14]. The government has rolled out a Rs 930 crore policy that's valid till March 31, 2025[12]. Additionally, the state is also offering Early Bird incentives eligible for electric vehicles purchased before December 31, 2021[11].

3. Exemptions: Owners of electric vehicles will not have to pay road tax and registration fees[14].

4. Infrastructure Support: It is now mandatory to reserve parking spaces for electric vehicles in residential and commercial areas as well as in government offices[14].

5. Financing: On the financing front, Delhi has set up a broad, non-lapsable EV fund for the implementation of the Policy using the feebate model of taxing polluting vehicles to fund the incentives for EVs[14].

6. Management and Operations: A state EV cell was set up for institutionalising the management and day-to-day implementation of the EV Policy[14].

Uttar Pradesh

The Government of Uttar Pradesh has implemented several policies to promote the adoption and manufacturing of electric vehicles (EVs) in the state[16 17 18 19 20]:

1. Uttar Pradesh Electric Vehicle Manufacturing and Mobility Policy (2022): This policy aims to make Uttar Pradesh a leading state in terms of EV adoption and manufacturing[16]. It

provides fiscal and non-fiscal incentives to accelerate the adoption and manufacturing of EVs in the state[16][17].

2. Incentives and Subsidies: The government has rolled out a Rs 930 crore policy that's valid till March 31, 2025[18]. The policy offers substantial cost benefits and incentives on electric vehicles[19]. Additionally, the state is also offering Early Bird incentives eligible for electric vehicles purchased before December 31, 2021[19].

3. Exemptions: Owners of electric vehicles will not have to pay road tax and registration fees[20].

4. Infrastructure Support: It is now mandatory to reserve parking spaces for electric vehicles in residential and commercial areas as well as in government offices[20].

5. Financing: On the financing front, Uttar Pradesh has set up a broad, non-lapsable EV fund for the implementation of the Policy using the feebate model of taxing polluting vehicles to fund the incentives for EVs[20].

6. Management and Operations: A state EV cell was set up for institutionalising the management and day-to-day implementation of the EV Policy[20].

Tamil Nadu

The Government of Tamil Nadu has implemented several policies to promote the adoption and manufacturing of electric vehicles (EVs) in the state[21][22][23][24][25]:

1. Tamil Nadu Electric Vehicle Policy (2023): This policy aims to make Tamil Nadu a leading state in terms of EV adoption and manufacturing[21]. It provides fiscal and non-fiscal incentives to accelerate the adoption and manufacturing of EVs in the state[21][22].

2. Incentives and Subsidies: The government has rolled out a Rs 930 crore policy that's valid till March 31, 2025[23]. The policy offers substantial cost benefits and incentives on electric vehicles[24]. Additionally, the state is also offering Early Bird incentives eligible for electric vehicles purchased before December 31, 2021[24].

3. Exemptions: Owners of electric vehicles will not have to pay road tax and registration fees[25].

4. Infrastructure Support: It is now mandatory to reserve parking spaces for electric vehicles in residential and commercial areas as well as in government offices[25].

5. Financing: On the financing front, Tamil Nadu has set up a broad, non-lapsable EV fund for the implementation of the Policy using the feebate model of taxing polluting vehicles to fund the incentives for EVs[25].

6. Management and Operations: A state EV cell was set up for institutionalising the management and day-to-day implementation of the EV Policy[25].

While the policies of Karnataka are indeed attractive, the state already hosts a significant number of established electric vehicle (EV) manufacturing companies. This results in a highly competitive environment, both in terms of production and marketing. Therefore, I have decided to consider other options that offer a balance between favorable policies and market potential.

Mumbai, with its high population, emerges as a promising choice. The state policies, although not as aggressive as Karnataka, are still reasonably supportive of EV businesses. The large consumer base that Mumbai offers can be advantageous for market penetration.

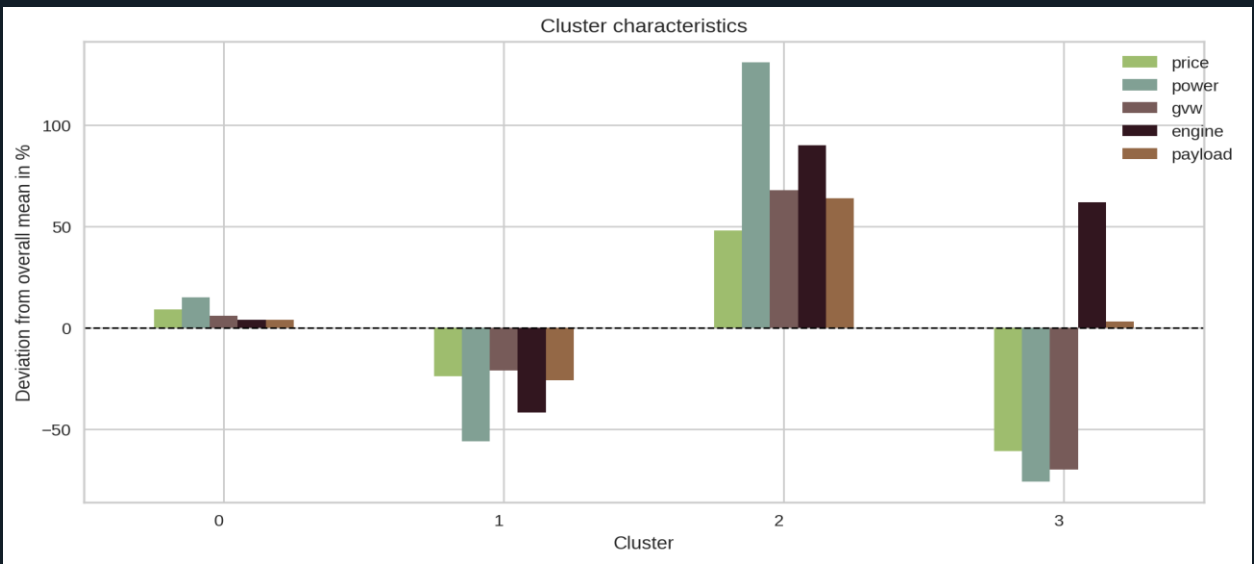
Additionally, Pune could be another viable option given its proximity to Mumbai and the growing demand for EVs in the city. It would also be beneficial to initiate marketing efforts in these cities to create awareness and demand for our product.

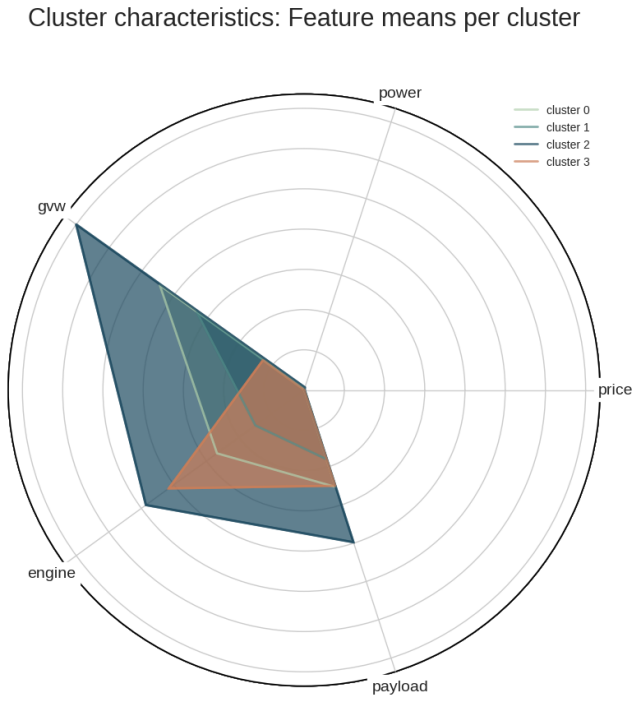
By adopting this strategy, we can navigate through the competition while leveraging the opportunities offered by these high-potential markets.

Profiling and Describing Potential Segments

Three Wheeler Data:

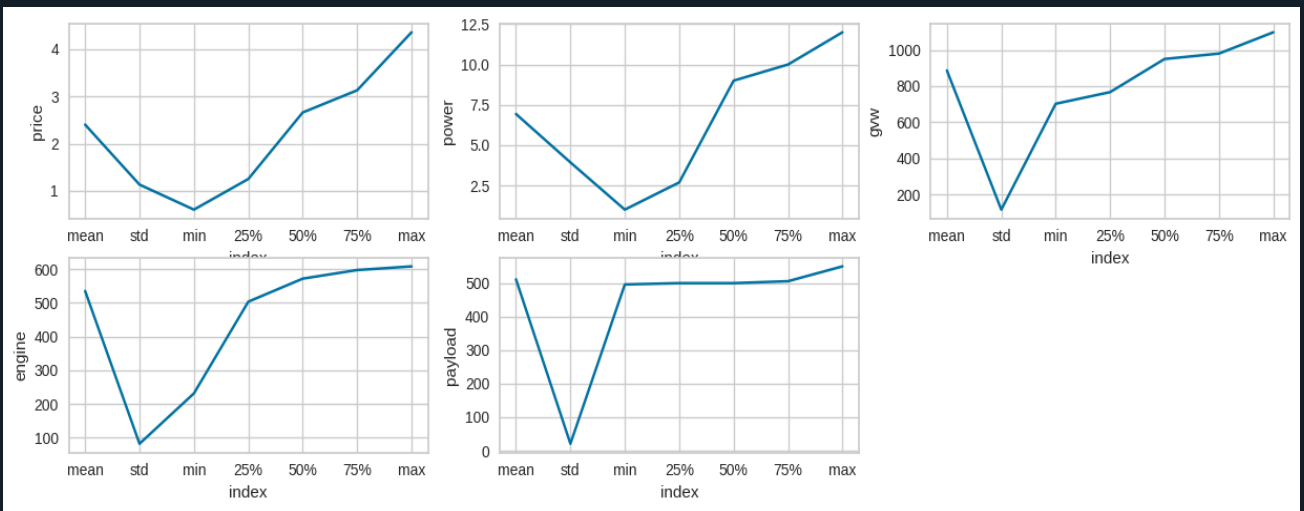
Using k-means unsupervised machine learning algorithm we made 4 clusters from our dataset.





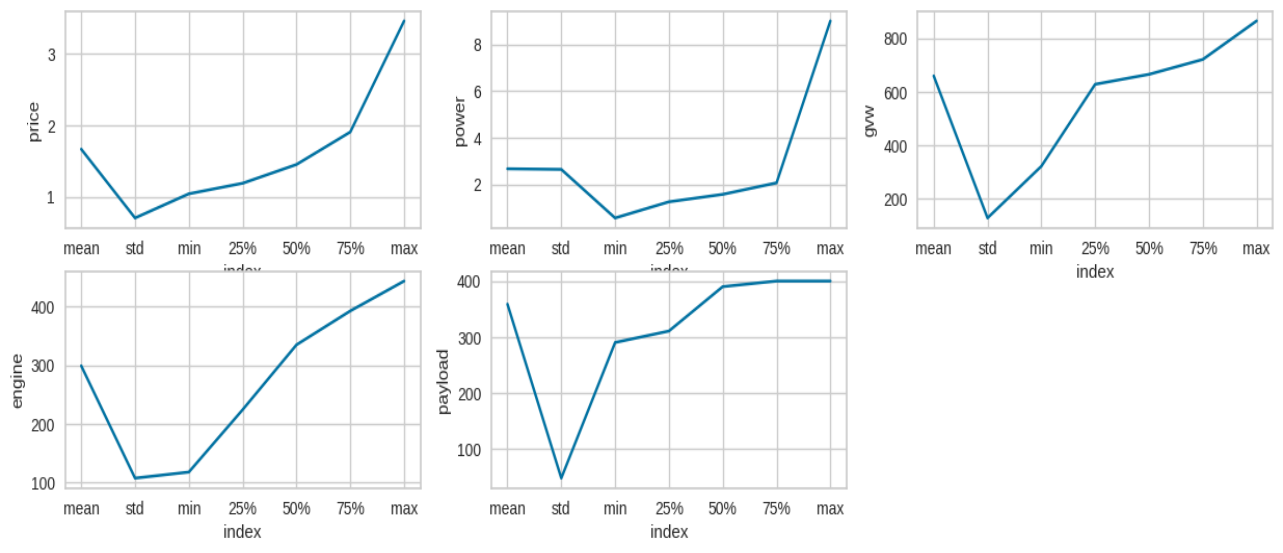
- Cluster 0 includes vehicles that are within the average price range, and exhibit medium values for payload, power, and engine size.
- Cluster 1 consists of vehicles that are priced averagely, but have low values for payload, power, and engine size.
- Cluster 2 is characterized by vehicles that fall within the high range for price, payload, power, and engine size.
- Cluster 3 comprises vehicles with a medium payload range, low power and price range, but a high engine size range.

Describing Cluster 0:



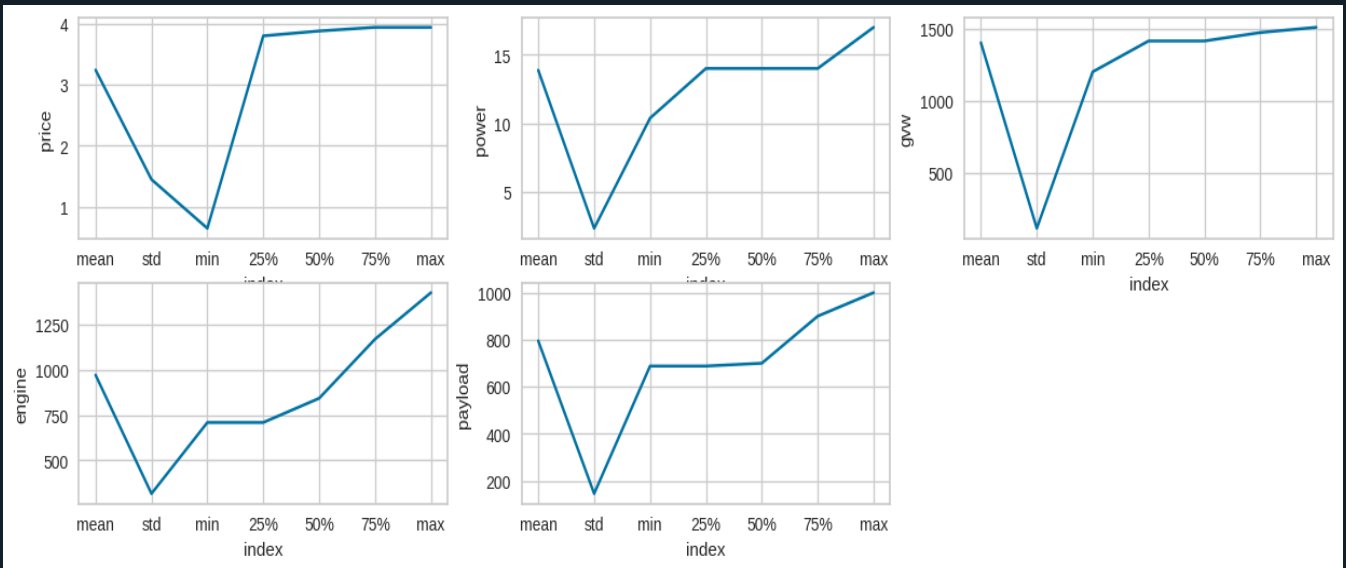
The average price and power of the vehicles are considerably lower than what I'm seeking.

Describing Cluster 1:



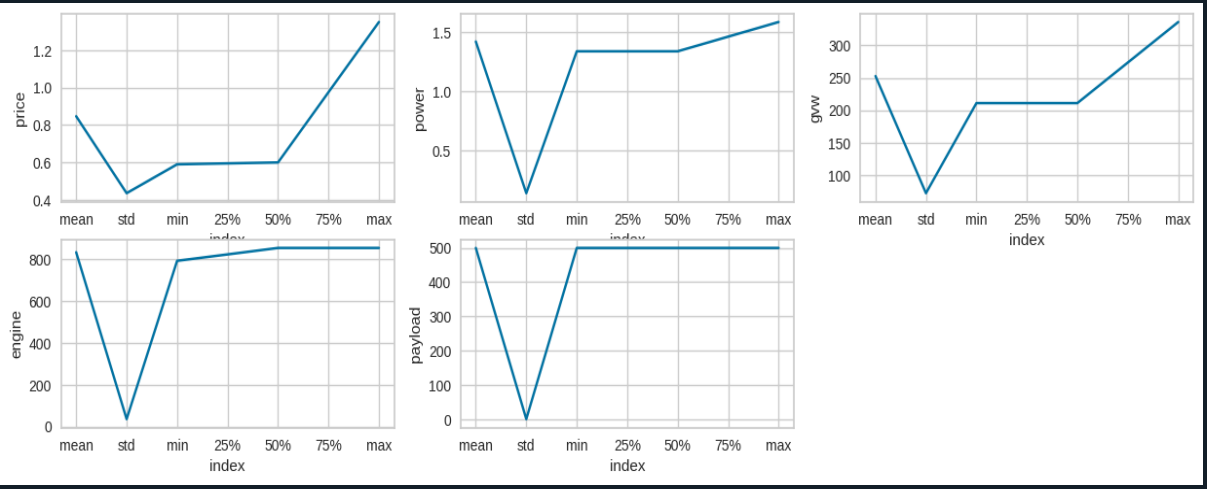
The average price and power of the vehicles are considerably lower than what I'm seeking.

Describing Cluster 2:



Around 75% of the vehicles in this cluster are priced closely to my preferred price. The power aligns almost perfectly with my preference, and the average payload is also in line with my requirements. This makes this segment an optimal choice for me. Additionally, the limited number of vehicles in this segment suggests lower competition.

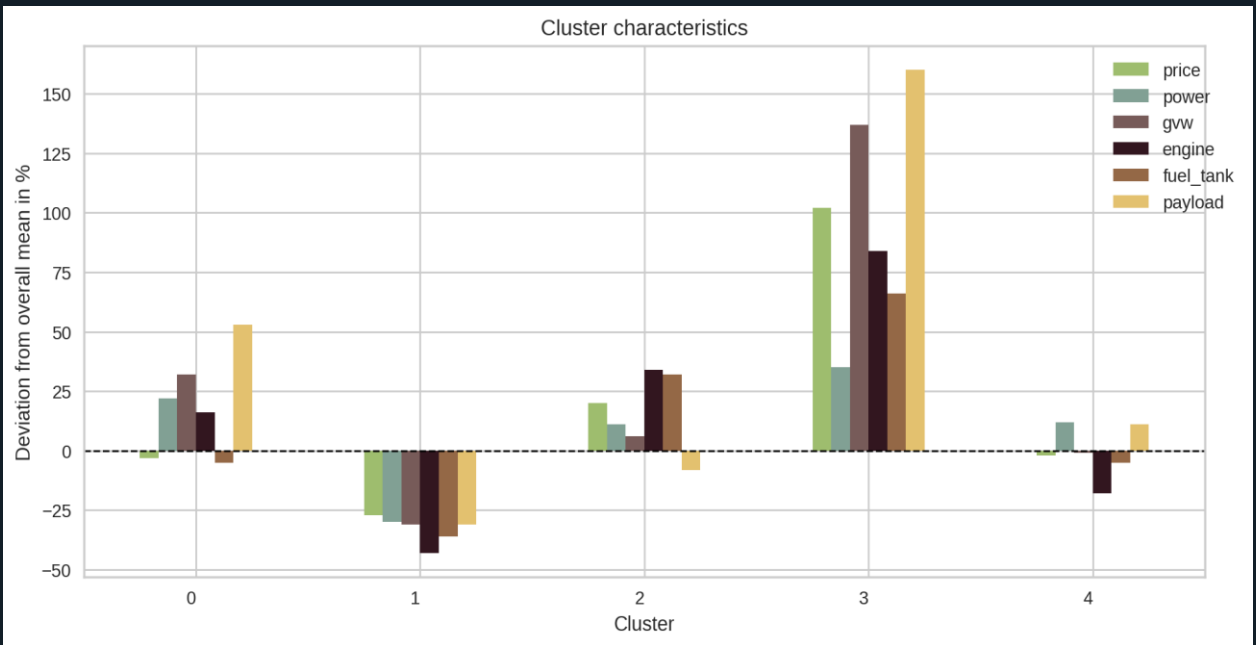
Describing Cluster 3:



The price is much lower than desired.

Small Commercial Vehicle Data:

Using k-means unsupervised machine learning algorithm we made 5 clusters from our dataset.



- Cluster 0 includes vehicles that fall within the high range for payload, with power and engine size slightly above average.
- Cluster 1 consists of vehicles that are in the low range for payload, power, and engine size.
- Cluster 2 is characterized by vehicles that are slightly above average in terms of price and power, but have a payload slightly below average.
- Cluster 3 comprises vehicles that fall within the high range for price, power, and payload.

- Cluster 4 encompasses vehicles that are average in price, with power and payload slightly above average.

The lowest price in each segment is higher than my target, with the exception of Cluster 1. While the specifications may seem underrated, from my perspective, a few Small Commercial Vehicles (SCVs) stand out and meet my desired specifications.

```
df_fuel[df_fuel['cluster']==1]
```

	price	power	gvw	engine	fuel_tank	payload	cluster	fuel_type	payload	name
1	4.21	19.0	1670.000000	700.00000	30.000000	750.0	1.0	NaN	750.0	Tata Ace gold
2	4.38	16.0	1345.000000	670.00000	10.500000	600.0	1.0	NaN	600.0	Mahindra Jeeto
7	9.21	36.0	1840.000000	1547.44969	49.802106	600.0	1.0	Electric	600.0	Tata Ace EV
11	4.73	64.0	1600.000000	1196.00000	70.000000	625.0	1.0	NaN	625.0	Maruti Suzuki Super Carry
12	7.28	44.0	2120.000000	798.00000	30.000000	1000.0	1.0	Diesel	1000.0	Tata Intra V10
13	5.71	26.0	1802.000000	909.00000	30.000000	900.0	1.0	NaN	900.0	Mahindra Supro Profit Truck Mini
15	6.84	47.0	2185.000000	909.00000	33.000000	1050.0	1.0	NaN	1050.0	Mahindra Supro Profit Truck Maxi
16	8.50	53.0	2275.000000	1199.00000	2.500000	1000.0	1.0	CNG+Petrol	1000.0	Tata Intra V20 Bi Fuel
20	4.73	64.0	1600.000000	1196.00000	70.000000	625.0	1.0	NaN	625.0	Maruti Suzuki Super Carry
21	7.28	44.0	2120.000000	798.00000	30.000000	1000.0	1.0	Diesel	1000.0	Tata Intra V10
22	5.71	26.0	1802.000000	909.00000	30.000000	900.0	1.0	NaN	900.0	Mahindra Supro Profit Truck Mini
24	6.84	47.0	2185.000000	909.00000	33.000000	1050.0	1.0	NaN	1050.0	Mahindra Supro Profit Truck Maxi
25	8.50	53.0	2275.000000	1199.00000	2.500000	1000.0	1.0	CNG+Petrol	1000.0	Tata Intra V20 Bi Fuel
36	3.91	72.0	1510.000000	1196.00000	40.000000	920.0	1.0	NaN	1280.0	Mahindra Bolero Pikup ExtraStrong
44	19.50	163.0	1658.029308	1898.00000	59.370557	225.0	1.0	NaN	NaN	Isuzu D-MAX V-Cross

The Tata Ace Gold and Mahindra Jeeto fall within my desired price range and their specifications align with my requirements. While the Maruti Suzuki Super Carry and Mahindra Bolero Pickup ExtraStrong also fit within my budget, their power specifications present a significant challenge for an Electric Vehicle (EV). Therefore, the Tata Ace Gold and Mahindra Jeeto are the ideal choices based on my criteria.

Selecting Target Segment

Cluster 2 of the three-wheeler vehicles meets my desired Small Commercial Vehicle (SCV) specifications, with an average price of 3.3 lakhs, average power of 14 hp, and an average payload of 800 Kg. In the four-wheeler SCV category, only two models, the Tata Ace Gold and Mahindra Jeeto, appeal to me based on my requirements.

Customising the Marketing Mix

Customising the Marketing Mix involves tailoring the four key elements of marketing - Product, Price, Promotion, and Place - to best fit the needs of a specific target segment.

1. Price: Changes might be made to prices or discount structures to make them more appealing to the target segment.

2. Product: This could involve designing new products or modifying existing ones to better meet the needs of the target segment.

3. Place: Suitable distribution channels are selected to ensure that the product is easily accessible to the target segment.

4. Promotion: New communication messages and promotion strategies are developed that resonate with the target segment.

This approach ensures that the marketing strategy is not seen as independent from other strategic decisions. It's often part of what's referred to as the segmentation-targeting-positioning (STP) approach, which starts with market segmentation, followed by targeting, and finally positioning.

In essence, customising the marketing mix is about making sure that every aspect of your marketing strategy is aligned with the needs and preferences of your target market.

1. Price:

While the electric vehicle (EV) market is expanding, many customers are yet to be captivated by it. Therefore, I've decided to start with low-budget EVs, which require less initial capital. As our brand is new, a significant portion of our capital will need to be allocated towards brand building and promotion. Consequently, I believe that producing EVs priced around 5 lakhs would be an ideal strategy.

2. Product:

The business venture under consideration involves the production of a small commercial electric vehicle (EV). Based on the analysis of data extracted from the three-wheeler and SCV data segment, it has been determined that the ideal electric small commercial vehicle (SCV) should have a payload capacity ranging from 800 to 1000 Kg. Additionally, it should be equipped with a power output of 15 horsepower.

To enhance the safety features of the vehicle, it is proposed to design it with four wheels instead of the conventional three. This modification is expected to provide better stability and control, thereby reducing the risk of accidents.

Furthermore, in terms of design and durability, it is suggested to draw inspiration from successful models in the small commercial vehicle market such as the Tata Ace Gold and Mahindra Jeeto. These vehicles are known for their robust build and reliability, qualities that are highly valued in this segment.

By incorporating these features and specifications into the design of the electric SCV, it is anticipated that the product will be well-received in the market, thereby ensuring the profitability and success of the business venture.

3. Place:

In order to effectively sell our product, we will establish connections with electric vehicle showrooms that range from moderately popular to highly popular. Building strong relationships and partnerships with these showrooms is crucial for our business. This will not only provide us with a physical platform to showcase our small commercial electric vehicles but also enable us to tap into their customer base.

Furthermore, we will leverage the power of e-commerce to extend our reach. Listing our product on popular online platforms such as Droom can significantly enhance our visibility. Online platforms have the advantage of a vast user base, which means our product can be viewed by potential customers from various locations. This strategy will allow us to reach a wider audience and increase the chances of sales.

In addition, we will ensure that our product listings are comprehensive and appealing. High-quality images, detailed product specifications, and competitive pricing will be some of the key elements of our online presentation. We believe that a strong online presence, coupled with strategic partnerships with physical showrooms, will drive the success of our small commercial electric vehicle business.

4. Promotion:

From geographic electric market segmentation, we get insight about which city people can be best for market. We can t

Promoting small commercial electric vehicles in Mumbai and Pune can be achieved through a variety of strategies:

- Local Partnerships: Partner with local businesses and influencers who can help promote your products. This could include vehicle dealerships, eco-friendly businesses, local celebrities, and influencers.
- Events and Expos: Participate in local events, trade shows, and expos. These platforms allow you to showcase your products to a large audience and interact directly with potential customers.
- Test Drives: Organize test drive events where potential customers can experience your electric vehicles first-hand. This can be a powerful selling point.
- Local Advertisements: Advertise in local newspapers, radio stations, billboards, and other forms of traditional media that have a wide reach in Mumbai and Pune.
- Community Engagement: Engage with the community through CSR activities. Sponsor local events or collaborate with educational institutions for awareness programs about the benefits of EVs.
- Showrooms: Establish or choose existing showrooms at strategic locations where potential customers can view your products, learn about their features, and make purchases.
- Customer Service: Provide excellent customer service. Word-of-mouth referrals from satisfied customers can significantly boost your brand image and sales.
- Online Presence: In addition to the physical presence, maintain a strong online presence through a user-friendly website, active social media profiles, and online advertisements.

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