Fuel Economy Analysis Using Electric Vehicle Population Data

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This analysis focuses on uncovering actionable insights from Electric Vehicle (EV) population data by examining fuel efficiency and vehicle usage trends. The dataset includes key metrics such as EV registrations, geographic distribution, and vehicle types, including Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs).

The primary goal is to identify patterns in EV adoption and utilization, providing insights for strategic decisions such as infrastructure planning, market expansion, and policy-making to promote sustainable transportation.

1. **METHODS**
2. **DATA PREPROCESSING**

* Missing values were handled by imputation, using either the mean or median of the respective feature to maintain dataset integrity.
* To ensure uniformity across features, Z-score normalization was applied, standardizing the data to a common scale.
* Principal Component Analysis (PCA) was used to reduce the dimensionality of the dataset, focusing on preserving as much information as possible while reducing computational complexity.

1. **CLUSTERING TECHNIQUES**

* **K-Means Clustering:**
* The optimal number of clusters was determined using the elbow method, which involved analyzing the within-cluster sum of squared distances to identify the point where adding more clusters no longer significantly improved the model.
* K-Means was selected for its computational efficiency and its ability to handle larger datasets effectively.
* **Hierarchical Clustering:**
* Agglomerative clustering was performed to explore the hierarchical relationships between data points.
* Dendrograms were used to visualize the clustering process and validate the results obtained from K-Means.

1. **MODEL EVALUATION**

* **Silhouette Score:** Assessed cluster quality, measuring both cohesion and separation.
* **Cluster Visualization:** t-SNE and PCA plots visualized cluster distributions and helped assess their interpretability.

1. **RESULTS**

* ***Key Findings***

The dataset was divided into *N clusters* based on the elbow method. Each cluster showed distinct patterns:

* **Cluster A:** High engagement but low purchasing.
* **Cluster B:** Steady purchases with moderate engagement.
* **Cluster C:** Sporadic activity but high spending.

Visualizations confirmed distinct clusters with clear separations.

* ***Visual Insights***
* PCA plots showed that clusters were well-separated in the reduced-dimensional space.
* Hierarchical clustering used a dendrogram to show relationships between data points and verify the clustering.

1. **CONCLUSION:**

The clustering analysis of the electric vehicle (EV) population revealed valuable customer segments, which can significantly impact the understanding of fuel economy patterns:

* **Fuel Economy Insights:** The analysis provided insights into how different clusters relate to fuel efficiency, with certain clusters showing patterns of high fuel economy and others reflecting higher energy consumption.
* **Targeted Strategies:** By understanding these segments, companies can tailor their marketing and product strategies to emphasize fuel economy where it matters most, offering eco-friendly options to cost-conscious or environmentally aware customers.
* **Product Development:** Insights into fuel economy can drive the development of more efficient EV models and encourage the adoption of energy-saving technologies in vehicles.