ELECTRIC VEHICLE POPULATION

An internship report submitted in partial fulfillment of the requirement of degree of

BACHELOR OF TECHNOLOGY

In

COMPUTER SCIENCE ENGINEERING

Submitted

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TRAINING COMPLETION CERTIFICATE

DECLARATION

The present internship report is my original work and has not been submitted for credit toward any other academic qualification, certificate, or degree.

I, hereby, assure that the submitted work does not violate any existing copyright laws.

Signature of Student

Name of Student

System ID

ACKNOWLEGEMENT

I would like to express my deepest gratitude to my mentors and advisors for their continuous support, insightful guidance, and invaluable feedback throughout the research and writing process. I am also thankful to the organizations that provided the data sets used in these analyses, enabling me to conduct comprehensive and impactful studies.

ABSTRACT

This report presents a comprehensive market size analysis of the electric vehicle (EV) population in the United States, with a focus on the state of Washington. By leveraging historical EV registration data, the study aims to assess market penetration, predict future growth trends, and identify key factors driving market expansion. The dataset comprises various attributes including vehicle identification numbers, geographic information, vehicle specifications, and utility service details. Through detailed data analysis, the report provides insights into the current state of the EV market, highlights the most common models and manufacturers, and examines the influence of legislative districts on EV registrations. The findings offer valuable information for stakeholders involved in production, infrastructure development, and policy-making.

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Introduction

This report presents a comprehensive market size analysis of the electric vehicle (EV) population in the United States, with a focus on the state of Washington. By leveraging historical EV registration data, the study aims to assess market penetration, predict future growth trends, and identify key factors driving market expansion. The dataset comprises various attributes including vehicle identification numbers, geographic information, vehicle specifications, and utility service details. Through detailed data analysis, the report provides insights into the current state of the EV market, highlights the most common models and manufacturers, and examines the influence of legislative districts on EV registrations. The findings offer valuable information for stakeholders involved in production, infrastructure development, and policy-making.

Problem

Market Size Analysis is the process of estimating the potential sales for a product or service within a particular market segment. In the context of electric vehicles (EVs), it involves assessing the total volume of EV registrations to understand the growth of the market, forecast future trends, and help stakeholders make informed decisions regarding production, infrastructure development, and policy-making

The provided dataset contains the following columns, each representing different aspects of the electric vehicle (EV) population in the United States:

- VIN (1-10): Partial Vehicle Identification Number.
- County: The county in which the vehicle is registered.
- City: The city in which the vehicle is registered.
- State: The state in which the vehicle is registered. It appears that this dataset may be focused on Washington (WA) state.
- Postal Code: The postal code where the vehicle is registered.
- Model Year: The year of the vehicle model
- Make: The manufacturer of the vehicle.
- Model: The model of the vehicle.
- Electric Vehicle Type: The type of electric vehicle, e.g., Battery Electric Vehicle (BEV).
- Clean Alternative Fuel Vehicle (CAFV) Eligibility: Eligibility status for clean alternative fuel vehicle programs.
- Electric Range: The maximum range of the vehicle on a single charge (in miles).
- Base MSRP: The Manufacturer's Suggested Retail Price.
- Legislative District: The legislative district where the vehicle is registered.
- DOL Vehicle ID: Department of Licensing Vehicle Identification.
- Vehicle Location: Geographic coordinates of the vehicle location.
- Electric Utility: The electric utility service provider for the vehicle's location.
- 2020 Census Tract: The census tract for the vehicle's location.

The primary objective of this analysis is to leverage historical EV registration data to understand the current market penetration of EVs, predict future market growth, and identify key trends and factors driving market expansion.

Dataset

	0	1	2	3	4
VIN (1-10)	5YJYGDEE1L	7SAYGDEE9P	5YJSA1E4XK	5YJSA1E27G	5YJYGDEE5M
County	King	Snohomish	King	King	Kitsap
City	Seattle	Bothell	Seattle	Issaquah	Suquamish
State	WA	WA	WA	WA	WA
Postal Code	98122.0	98021.0	98109.0	98027.0	98392.0
Model Year	2020	2023	2019	2016	2021
Make	TESLA	TESLA	TESLA	TESLA	NaN
Model	MODEL Y	MODEL Y	MODEL S	MODEL S	MODEL Y
Electric Vehicle Type	Battery Electric Vehicle (BEV)	Battery Electric Vehicle (BEV)	Battery Electric Vehicle (BEV)	Battery Electric Vehicle (BEV)	Battery Electric Vehicle (BEV)
Clean Alternative Fuel Vehicle (CAFV) Eligibility	Clean Alternative Fuel Vehicle Eligible	Eligibility unknown as battery range has not b...	NaN	Clean Alternative Fuel Vehicle Eligible	Eligibility unknown as battery range has not b...
Electric Range	291	0	270	210	0
Base MSRP	0	0	0	0	0
Legislative District	37	1	36	5	23
DOL Vehicle ID	125701579	244285107	156773144	165103011	205138552
Vehicle Location	POINT (-122.30839 47.610365)	POINT (-122.179458 47.802589)	POINT (-122.34848 47.632405)	POINT (-122.03646 47.534065)	POINT (-122.55717 47.733415)
Electric Utility	CITY OF SEATTLE - (WA)|CITY OF TACOMA - (WA)	PUGET SOUND ENERGY INC	CITY OF SEATTLE - (WA)|CITY OF TACOMA - (WA)	PUGET SOUND ENERGY INC||CITY OF TACOMA - (WA)	PUGET SOUND ENERGY INC
2020 Census Tract	53033007800.0	53061051938.0	53033006800.0	53033032104.0	53035940100.0

Observations

1. Descriptive Statistics:

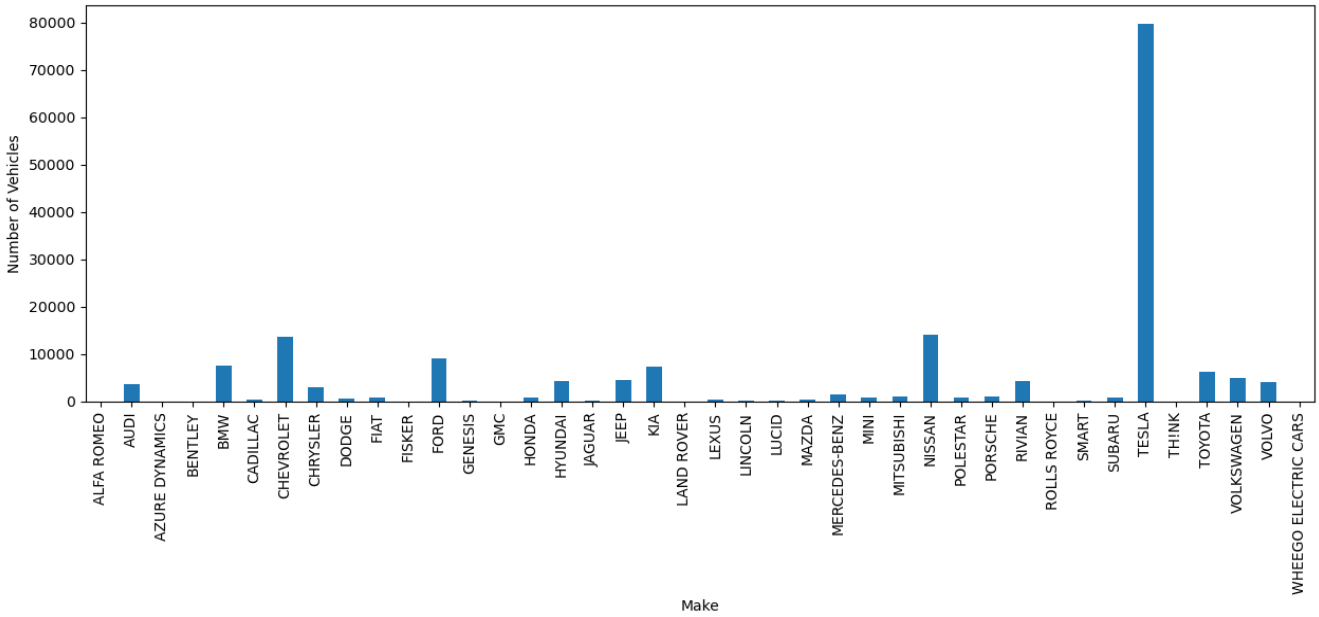
• What are the mean, median, and standard deviation of the base MSRP for the vehicles in the dataset?

Observation

- `The Mean of Base MSRP is 0.00`
- `The Median of Base MSRP is 0.0`
- `The Standard Deviation of Base MSRP is 0.00`

2. Data Distribution:

• What is the distribution of vehicle makes in the dataset? Represent it using a bar chart.



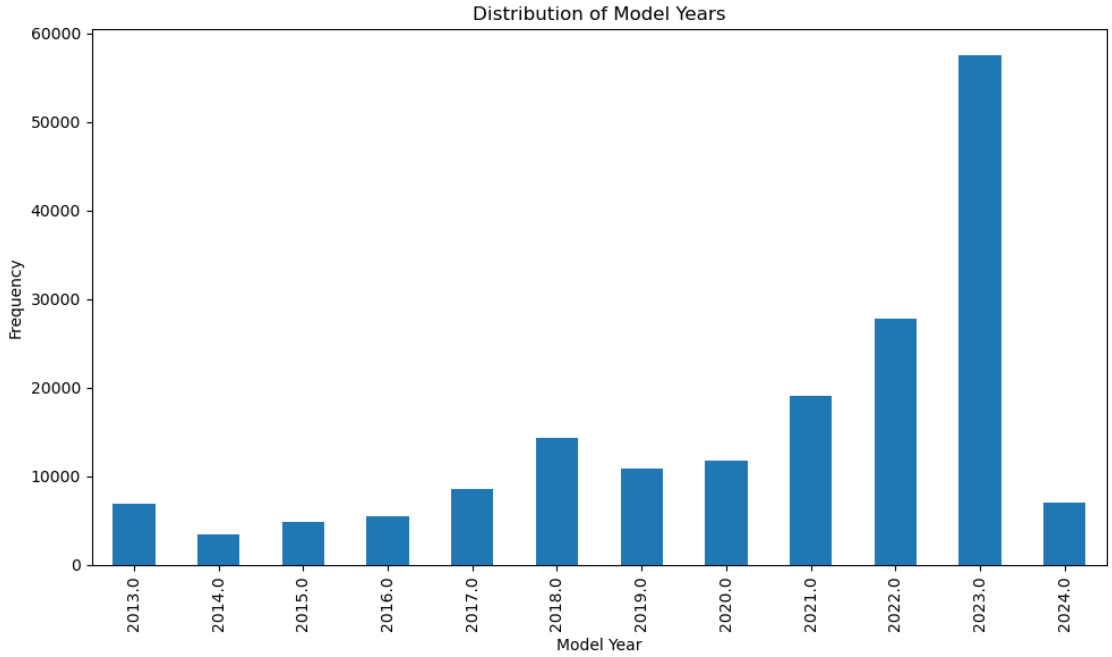
3. Model Year Analysis:

- What are the most common model years in the dataset? Provide

1. A frequency table
2. histogram.

Observation

- ```
  Model Year
  2013.0     6862
  2014.0     3509
  2015.0     4844
  2016.0     5483
  2017.0     8562
  2018.0    14323
  2019.0    10940
  2020.0    11768
  2021.0    19132
  2022.0    27776
  2023.0    57587
  2024.0     7080
  ```
  ```



Observation

- The year between 2023 had seen the most common modles in a year.

4. Electric Vehicle Type:

• What is the proportion of Battery Electric Vehicles (BEV) versus other types of electric vehicles?

Observation

- The raito of Battery Electric Vehicles (BEV) to other types of electric vehicles is 13921 : 177866.
- Or Battery Electric Vehicles (BEV) is 78.26% more compared to other electric vehicles.

5. Electric Range Analysis:

• What is the average electric range for vehicles of different makes? Provide a summary tabe.

Observation

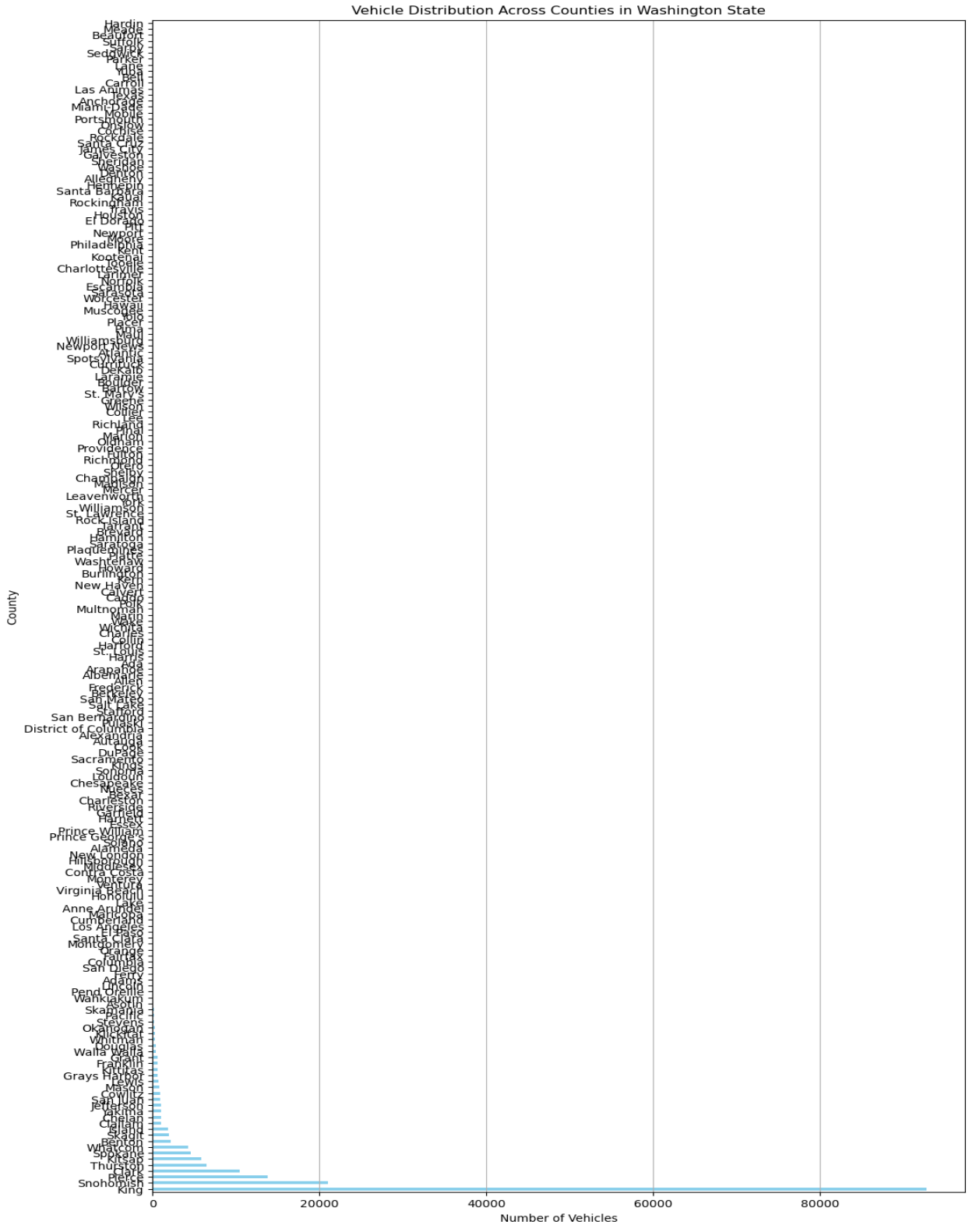
- Summary Table for vehicles of different Make and Electric Range:

	Make	Electric Range
0	ALFA ROMEO	33.000000
1	AUDI	46.454745
2	AZURE DYNAMICS	56.000000
3	BENTLEY	19.666667
4	BMW	34.711427
5	CADILLAC	8.798429
6	CHEVROLET	76.570332

7	CHRYSLER	32.212162
8	DODGE	32.000000
9	FIAT	85.645408
10	FISKER	8.755102
11	FORD	10.812914
12	GENESIS	0.000000
13	GMC	0.000000
14	HONDA	46.600240
15	HYUNDAI	15.858715
16	JAGUAR	163.254310
17	JEEP	22.365402
18	KIA	38.850175
19	LAND ROVER	25.000000
20	LEXUS	18.800000
21	LINCOLN	23.543071
22	LUCID	0.000000
23	MAZDA	25.781513
24	MERCEDES-BENZ	9.346130
25	MINI	18.016704
26	MITSUBISHI	30.646138
27	NISSAN	79.839501
28	POLESTAR	30.399660
29	PORSCHE	42.693152
30	RIVIAN	0.000000
31	ROLLS ROYCE	0.000000
32	SMART	62.325926
33	SUBARU	1.350181
34	TESLA	60.214775
35	TH!NK	100.000000
36	TOYOTA	28.095102
37	VOLKSWAGEN	22.927058
38	VOLVO	16.135737
39	WHEEGO ELECTRIC CARS	100.000000

6. County Distribution:

• How are vehicles distributed across different counties in Washington state? Represent the distribution using a barh chart.


Vehicle Distribution Across Counties in Washington State
County
Number of Vehicles
0
20000
40000
60000
80000
King
Snohomish
Pierce
Clark
Thurston
Kitsap
Spokane
Whatcom
Benton
Skagit
Franklin
Chelan
Yakima
Jefferson
San Juan
Cowlitz
Mason
Grays Harbor
Lewis
Douglas
Whitman
Okanogan
Stevens
Pacific
Skamania
Wahkiakum
Pend Oreille
Adams
Lincoln
Ferry
San Diego
Columbia
Fairfax
Orange
Montgomery
Santa Clara
El Paso
Los Angeles
Cumberland
Maricopa
Anne Arundel
Lake
Honolulu
Virginia Beach
Monterey
Contra Costa
Middlesex
Hillsborough
New London
Alameda
Solano
Prince George's
Prince William
Hudson
Harlem
Riverside
Garfield
Charleston
Bexar
Nueces
Chesapeake
Loudoun
Solano
Kings
Sacramento
DuPage
Cook
Alameda
Alexandria
District of Columbia
Pulaski
San Bernardino
Stafford
Salt Lake
San Mateo
Frederick
Berkeley
Allen
Abbeville
Ada
Arapahoe
Harris
St. Tammany
Colin
Charles
Wichita
Wake
Mann
Multnomah
Polk
Cabell
Calvert
New Haven
Burlington
Howard
Washtenaw
Platte
Plaquemines
Saratoga
Hamilton
Broward
Fairfax
Rock Island
St. Lawrence
York
Williamson
Leavenworth
Mercer
Madison
Champaign
Shelby
Otero
Richmond
Hinds
Providence
Oldham
Marion
Hall
Richland
Lea
Collier
Wilson
Greene
St. Mary's
Barrow
Boulder
Laramie
DeKalb
Cumpuck
Spotsylvania
Atlantic
Newport News
Williamsburg
Maui
Placer
Ada
Idaho
Muscogee
Hawaii
Worcester
Sarasota
Escambia
Norfolk
Lancaster
Charlottesville
Lonoke
Kootenai
Kent
Philadelphia
Moore
Newport
Pitt
El Dorado
Houston
Travis
Kauai
Rockingham
Santa Barbara
Hennepin
Allegheny
Denton
Washoe
Sheridan
Galveston
James City
Santa Cruz
Rockdale
Cecilia
Dunlow
Portsmouth
Mobile
Miami-Dade
Anchorage
Las Animas
Texas
Carroll
Bell
Yuba
Parker
Sedgwick
Surry
Suffolk
Beaufort
Marion
Hardin

Observation

- King has the greatest number of vehicles in the Washington state around 53%

7. Price Analysis:

• Compare the average base MSRP of vehicles eligible for the Clean Alternative Fuel Vehicle (CAFV) program versus those that are not

Observation

- Average Base MSRP for CAFV Eligible: $0.00, Not Eligible: $0.00

8. Geographical Analysis:

• How does the base MSRP vary across different cities in Washington state?

Observation

	City	Base MSRP
0	Aberdeen	0.0
1	Aberdeen Proving Ground	0.0
2	Acme	0.0
3	Adairsville	0.0
4	Addy	0.0
5	Adna	0.0
6	Airway Heights	0.0
7	Alameda	0.0
8	Alderdale	0.0
9	Alderwood Manor	0.0

9. Legislative Districts:

• Which legislative districts have the highest number of registered electric vehicles? Provide a ranked list

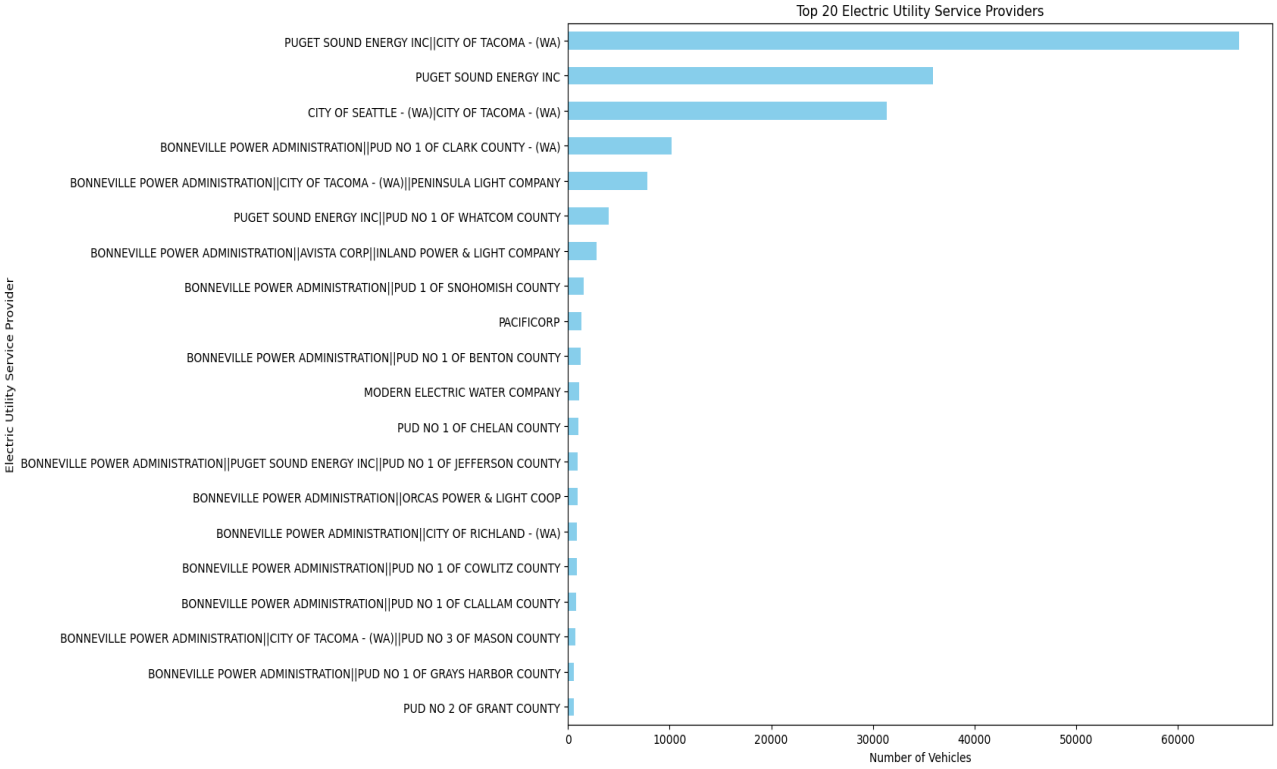
Observation

- 41 legislative districts have the highest number of registered electric vehicles
- Ranked List:
- Legislative District
  41.0 8831
  45.0 7425
  5.0 6810
  48.0 6631

```
1.0     6265
Name: count, dtype: int64
Legislative District
9     5
16    4
3     2
40    2
6     1
Name: count, dtype: int64
```

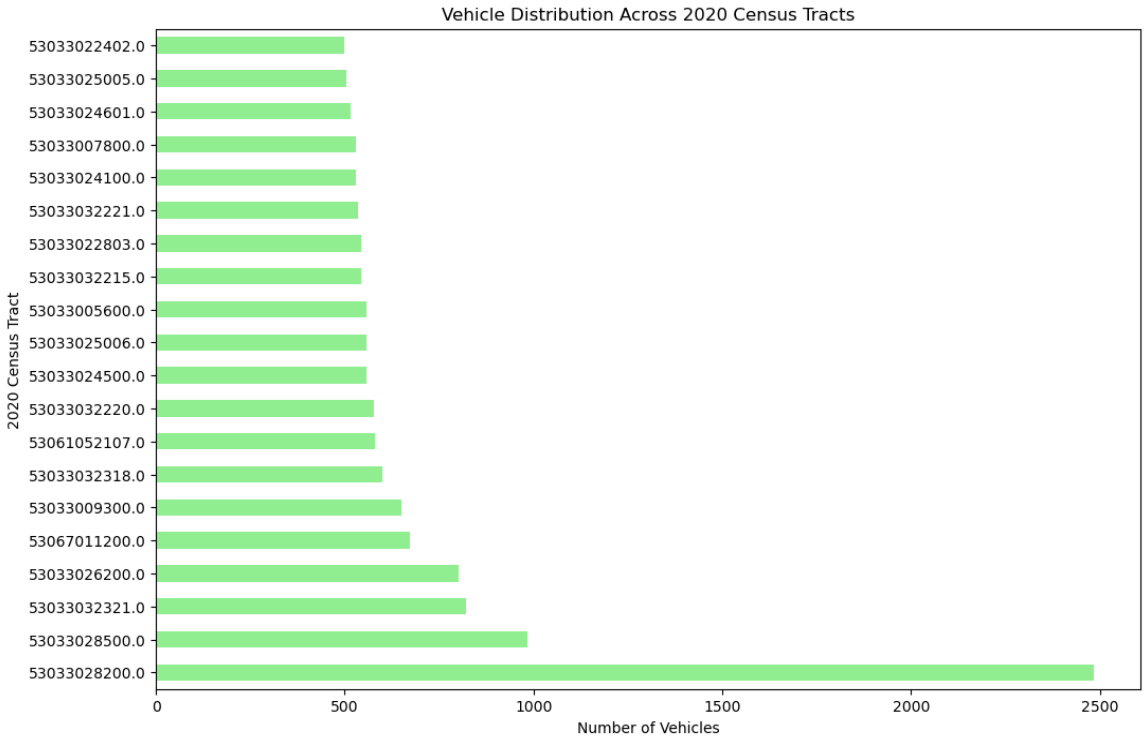
10. Electric Utility Providers:

• What is the distribution of electric utility service providers for the vehicles in the dataset?



11. Census Tract Analysis:

• How are vehicles distributed across different 2020 Census Tracts? Provide insights based on vehicle counts per tract.



12. Electric Range Correlation:

• Is there a correlation between the electric range and the base MSRP of the vehicles? Provide the correlation coefficient and interpret the result.

Observation

- `Correlation Coefficient between Electric Range and Base MSRP: nan`
- `Correlation Coefficient (r):`
  `1: Perfect positive correlation.`
  `0.7 to 0.9: Strong positive correlation.`
  `0.4 to 0.6: Moderate positive correlation.`
  `0.1 to 0.3: Weak positive correlation.`
  `0: No correlation.`
  `-0.1 to -0.3: Weak negative correlation.`
  `-0.4 to -0.6: Moderate negative correlation.`
  `-0.7 to -0.9: Strong negative correlation.`
  `-1: Perfect negative correlation`
- `There cannot be a Correlation between Electric Range and Base MSRP`

13. VIN Analysis:

• Identify any patterns or commonalities in the VIN (1-10) for the vehicles. Are there any frequent prefixes or suffixes

- Most common VIN prefixes (first 10 characters):

```
VIN (1-10)
7SAYGDEE6P    1239
7SAYGDEE7P    1235
7SAYGDEE8P    1197
7SAYGDEEXP    1191
7SAYGDEE5P    1177
Name: count, dtype: int64
```

- Most common VIN suffixes (last 10 characters):

```
VIN (1-10)
7SAYGDEE6P    1239
7SAYGDEE7P    1235
7SAYGDEE8P    1197
7SAYGDEEXP    1191
7SAYGDEE5P    1177
Name: count, dtype: int64
```

14. Eligibility Status:

• What percentage of vehicles are eligible for the Clean Alternative Fuel Vehicle (CAFV) program

Observation

- Percentage of vehicles eligible for CAFV: 37.29%

15. Model Popularity:

• Which vehicle models are the most popular in the dataset? Provide a frequency table of the top 10 models

Observation

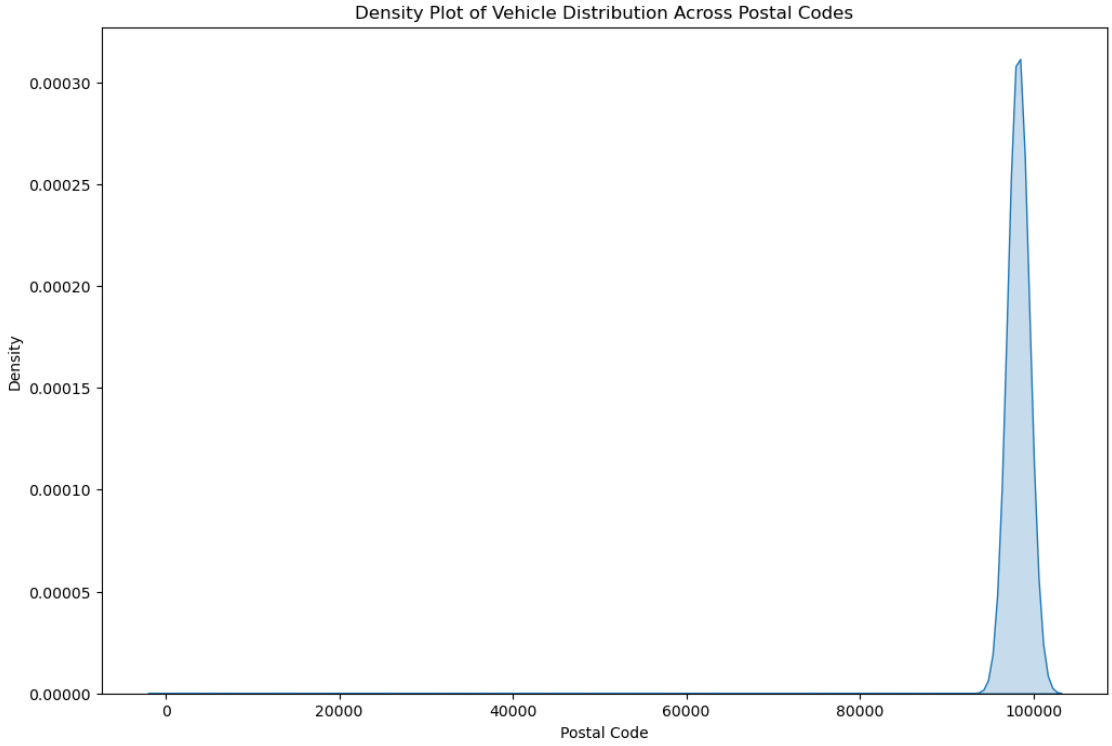
- Frequency Table of top 10 Models:

```
Model
MODEL Y           35993
MODEL 3           30091
LEAF              13365
MODEL S            7734
BOLT EV            6821
MODEL X            5796
VOLT               4796
ID.4               3937
WRANGLER           3392
MUSTANG MACH-E     3322
Name: count, dtype: int64
```

- MODEL Y is most popular in the dataset

16. Postal Code Distribution:

• How are vehicles distributed across different postal codes? Provide a heatmap or density plot

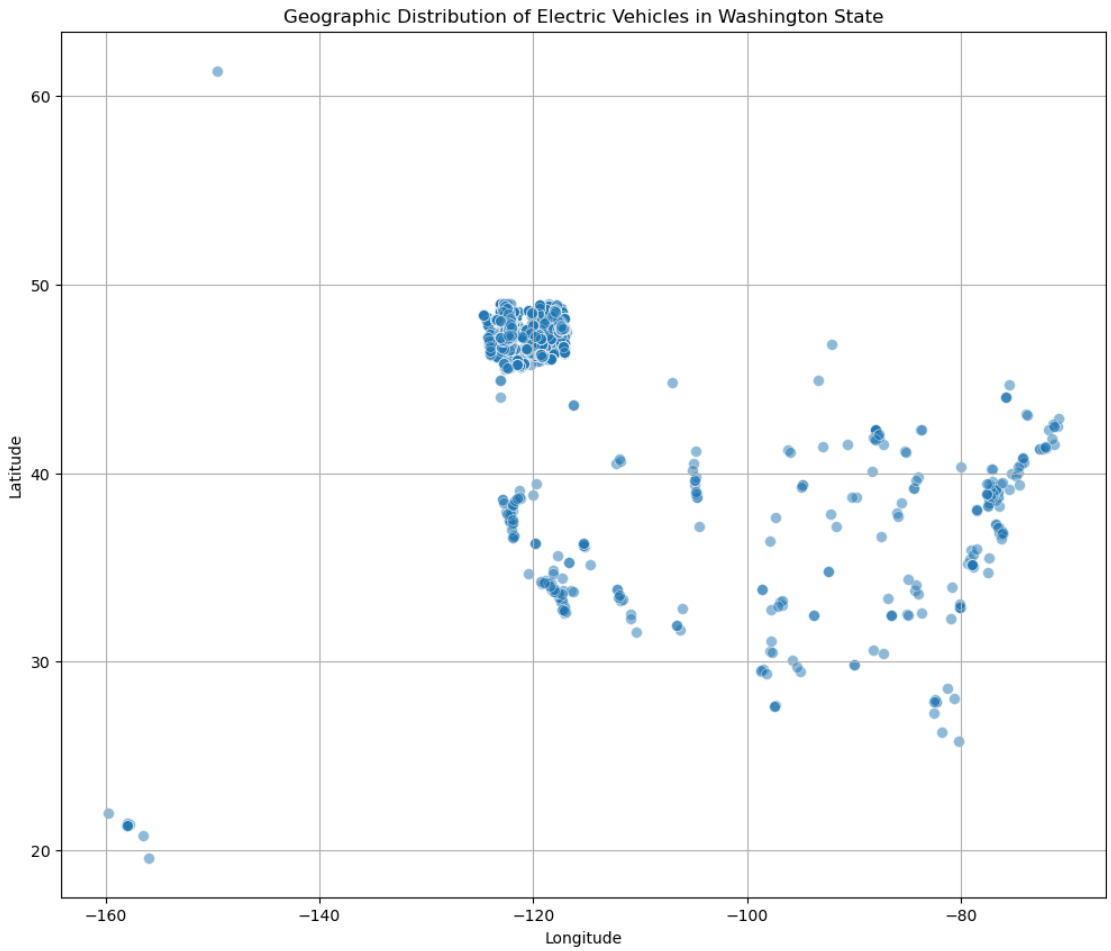


Observation

- `Density Plot of Vehicle Distribution Across Postal Codes shows postal code at 100000 is maximum`

17. Vehicle Location Analysis:

• Analyze the geographic coordinates to determine any clusters of electric vehicles in certain areas of Washington state.

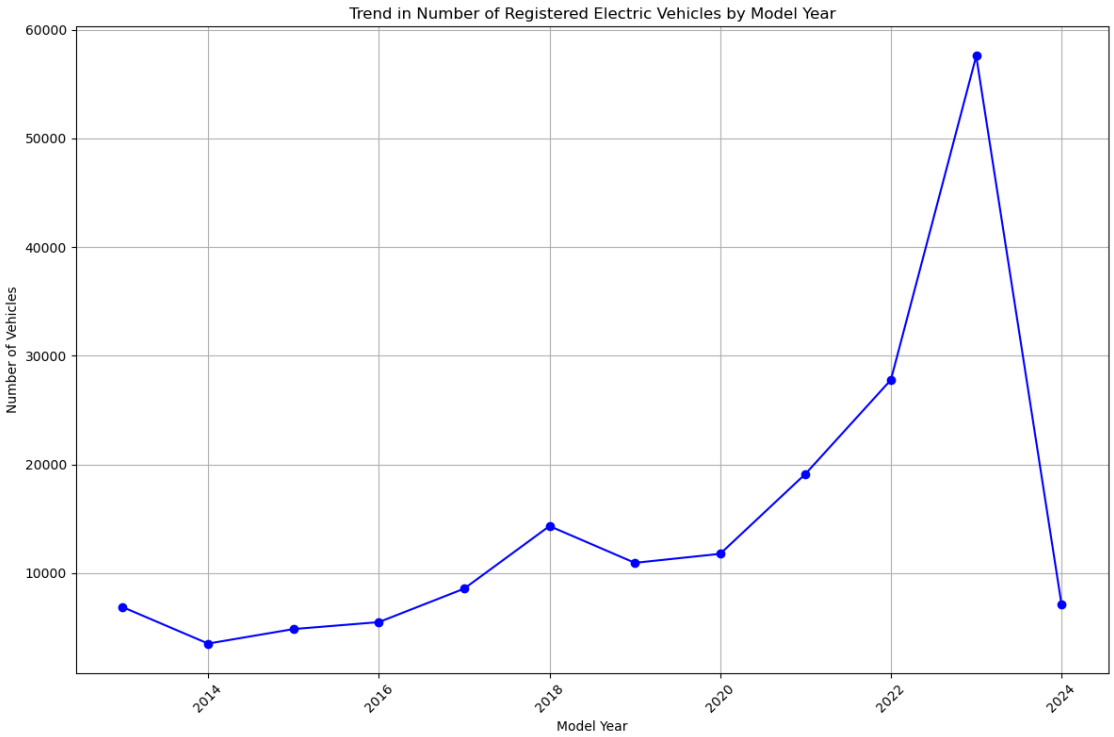


Observation

- At longitude 49 and Longitude -120 the distribution is maximum

18. Model Year Trend:

• Analyze the trend in the number of registered electric vehicles by model year. Provide a line chart to show any increase or decrease over the years.

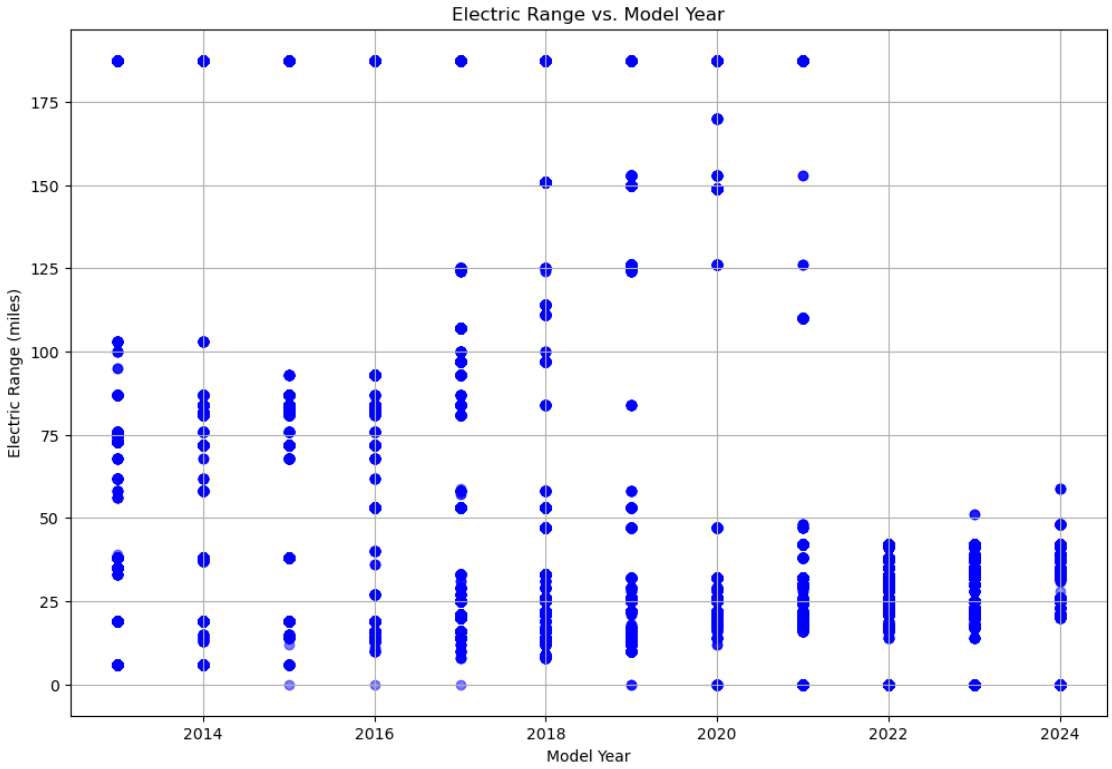


Observation

- The was a steady growth in between year 2014 and 2020
- 2020 to 2023 saw a skyroketting growth in the number of vehicle registered
- After mid of 2023 there was a drastic fall in number of registrations in 2024

19. Range vs. Year:

• Is there a trend between the model year and the electric range of the vehicles? Provide a scatter plot and analyze the trend.



Observation

- The correlation coefficient is -0.55
- This negative correlation indicates that newer model years generally have lower electric ranges compared to older model years.

20. Legislative District and MSRP:

• How does the average base MSRP vary across different legislative districts

Observation

- Legislative District
  1.0 0.0
  24 0.0
  23 0.0
  22 0.0
  21 0.0
  Name: Base MSRP, dtype: float64
- The Base MSRP remains the same for every Legislative District
- There seems to be no connection between Legislative District and Base MSRP

Conclusion

The Electric Vehicle Population report provides a detailed analysis of the current state and future prospects of the electric vehicle (EV) market in the United States, focusing specifically on the state of Washington. The study leverages historical EV registration data to evaluate market penetration, forecast growth trends, and identify key factors influencing the market.

Key findings include:

- A steady increase in EV registrations, driven by technological advancements and favorable policies.
- Identification of the most common EV models and manufacturers.
- The influence of legislative districts on EV distribution patterns.

The report emphasizes the need for continuous support of clean alternative fuel vehicle programs and the development of robust charging infrastructure to sustain market growth. These insights are crucial for policymakers, manufacturers, and other stakeholders aiming to foster a sustainable transportation ecosystem.

Uber Data Analysis Report

The Uber Data Analysis report explores the impact of weather conditions on Uber ride patterns across different boroughs in New York City. The dataset includes hourly Uber pickup data and weather attributes such as temperature, visibility, wind speed, and precipitation.

Key findings include:

- A comprehensive understanding of the total number of Uber pickups, hourly and daily trends, and the correlation between weather variables and ride demand.
- Identification of peak ride-sharing times and the variation of pickups across different boroughs and weather conditions.
- Recommendations for Uber to optimize driver availability and improve service efficiency, such as implementing targeted promotions during low-demand periods and strategic driver incentives during extreme weather conditions.

The report provides actionable insights that can help Uber enhance its operational strategies, ensuring better service reliability and growth. These strategies aim to improve user experience and optimize driver availability during different weather scenarios.

Overall, both reports offer valuable insights and practical recommendations for enhancing the respective fields of electric vehicle market analysis and ride-sharing service optimization, contributing to the broader goals of sustainable transportation and efficient urban mobility.

Faculty Signature