Electric Vehicle Data Analysis

Name: **Syed Nadeemuddin**

Assignment: **Electric Vehicle Data Analysis**

Date: **27 December 2025**

Introduction

This project focuses on the analysis of electric vehicle (EV) registration data obtained from the Washington State Department of Licensing. The primary objective is to examine patterns of EV adoption, regional distribution, vehicle characteristics, and growth trends over time. The study applies data cleaning, exploratory data analysis, visualization techniques, and basic analytical methods to derive meaningful insights.

Section 1: Data Cleaning

1(a) Identification of Missing Values

Several columns in the dataset contain missing values. These are mainly observed in geographic and utility-related fields such as County, City, Postal Code, Electric Utility, and Vehicle Location. Additionally, the Electric Range column includes zero values, which indicate missing or unverified data rather than an actual zero driving range.

1(b) Handling of Missing Values

Missing values were handled carefully based on their impact on the analysis. Records with zero or missing electric range values were excluded from range-related calculations to avoid misleading results. Other missing categorical values were retained when they did not significantly influence the findings.

1(c) Duplicate Records

Duplicate vehicle records were identified using the VIN (1–10) column, which acts as a unique identifier. Only one record per VIN was retained to ensure an accurate count of registered vehicles.

1(d) VIN Anonymization

To maintain privacy, VIN values can be anonymized using hashing techniques. This approach preserves uniqueness while preventing exposure of sensitive vehicle information.

1(e) Vehicle Location Cleaning

The Vehicle Location column stores GPS coordinates as text strings. These values were cleaned by separating latitude and longitude into individual numeric fields, enabling clearer interpretation and effective geospatial analysis.

Section 2: Data Exploration

Top EV Makes and Models

Tesla dominates the electric vehicle market in the dataset, followed by Chevrolet and Nissan. The most frequently registered models are the Tesla Model Y and Tesla Model 3, indicating strong consumer preference for these vehicles.

Distribution by County

Electric vehicle registrations are highly concentrated in urban counties. King County leads in total registrations, followed by Snohomish and Pierce counties, highlighting greater EV adoption in metropolitan areas.

EV Adoption Over Time

The data shows a steady increase in EV adoption over the years, with noticeable growth after 2018 and a sharp rise after 2020. This trend reflects technological improvements, expanding charging infrastructure, and supportive government policies.

Average Electric Range

After removing missing and zero values, the average electric range of vehicles in the dataset is approximately 109 miles.

CAFV Eligibility

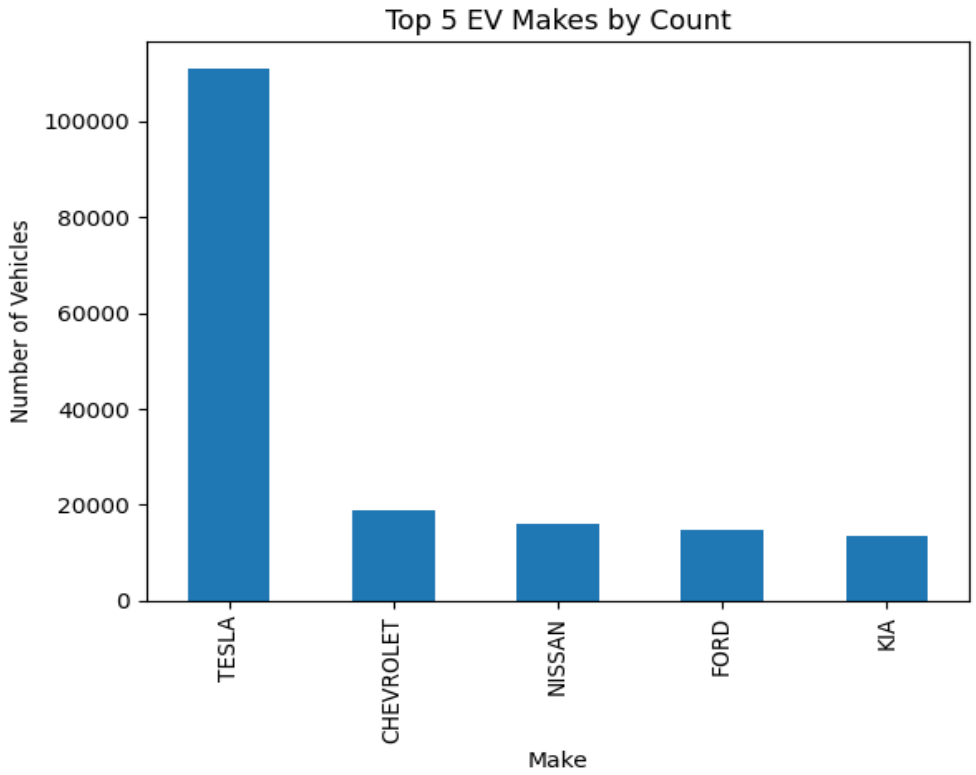
Approximately 28% of vehicles are confirmed to be eligible for Clean Alternative Fuel Vehicle (CAFV) incentives. A significant portion of records have unknown eligibility due to missing battery range data.

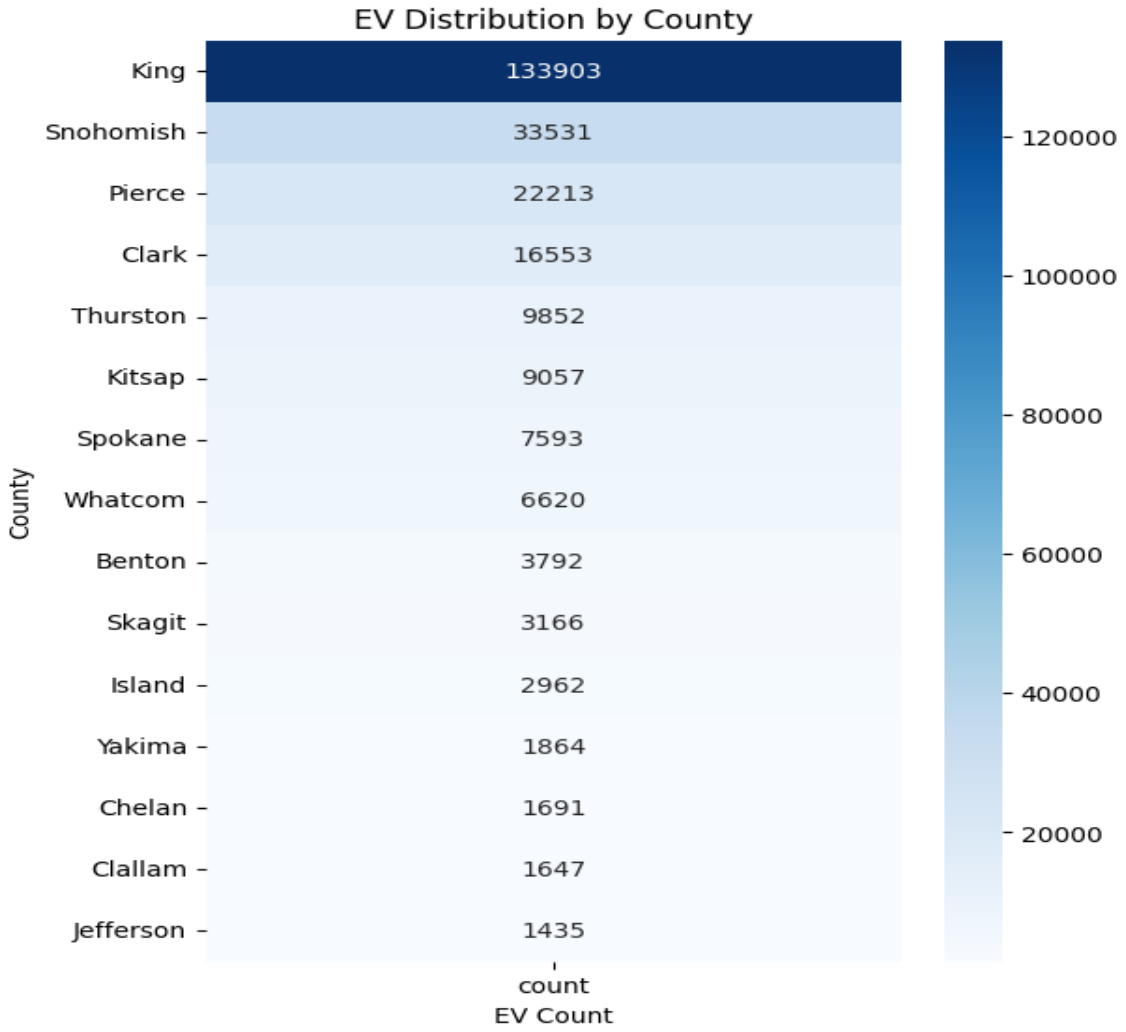
Regional Trends

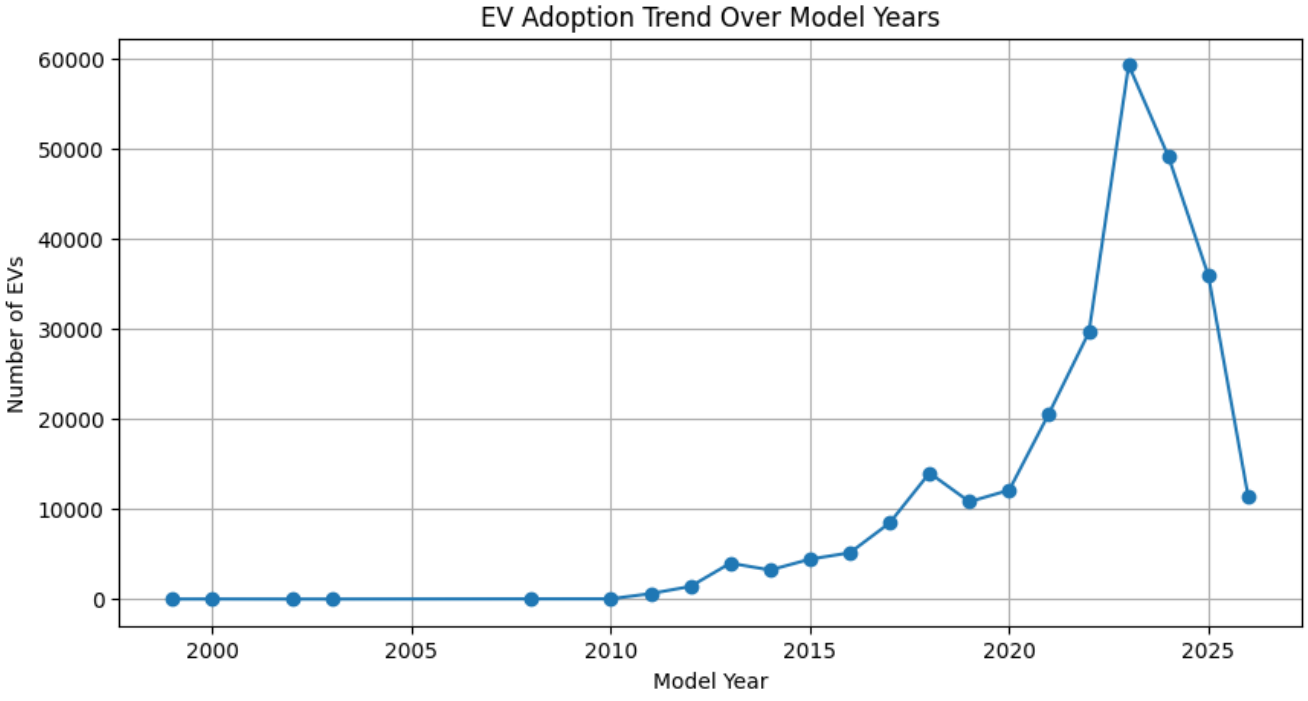
Urban regions exhibit significantly higher EV adoption than rural areas. This difference can be attributed to better charging infrastructure, higher population density, and greater awareness of electric mobility.

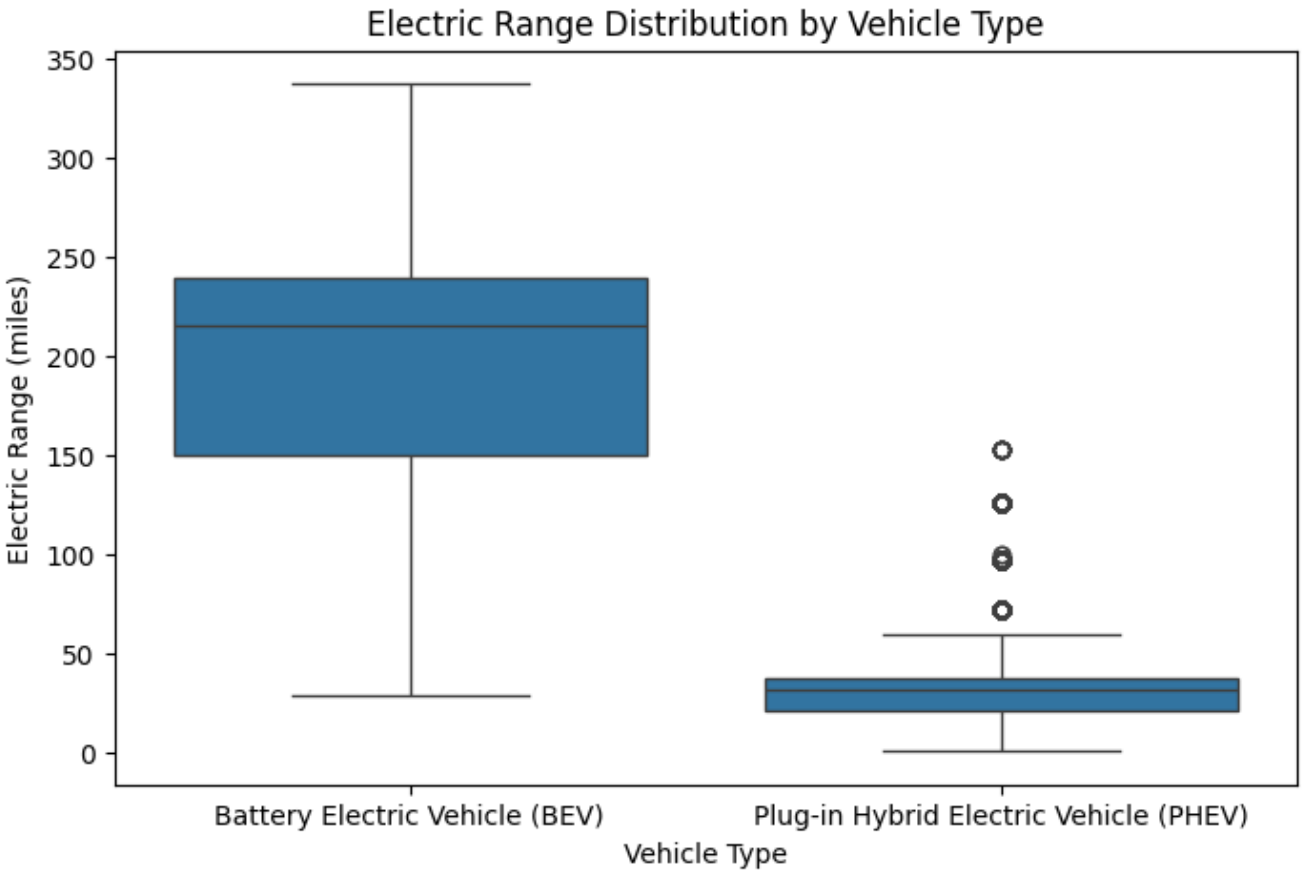
Section 3: Data Visualization

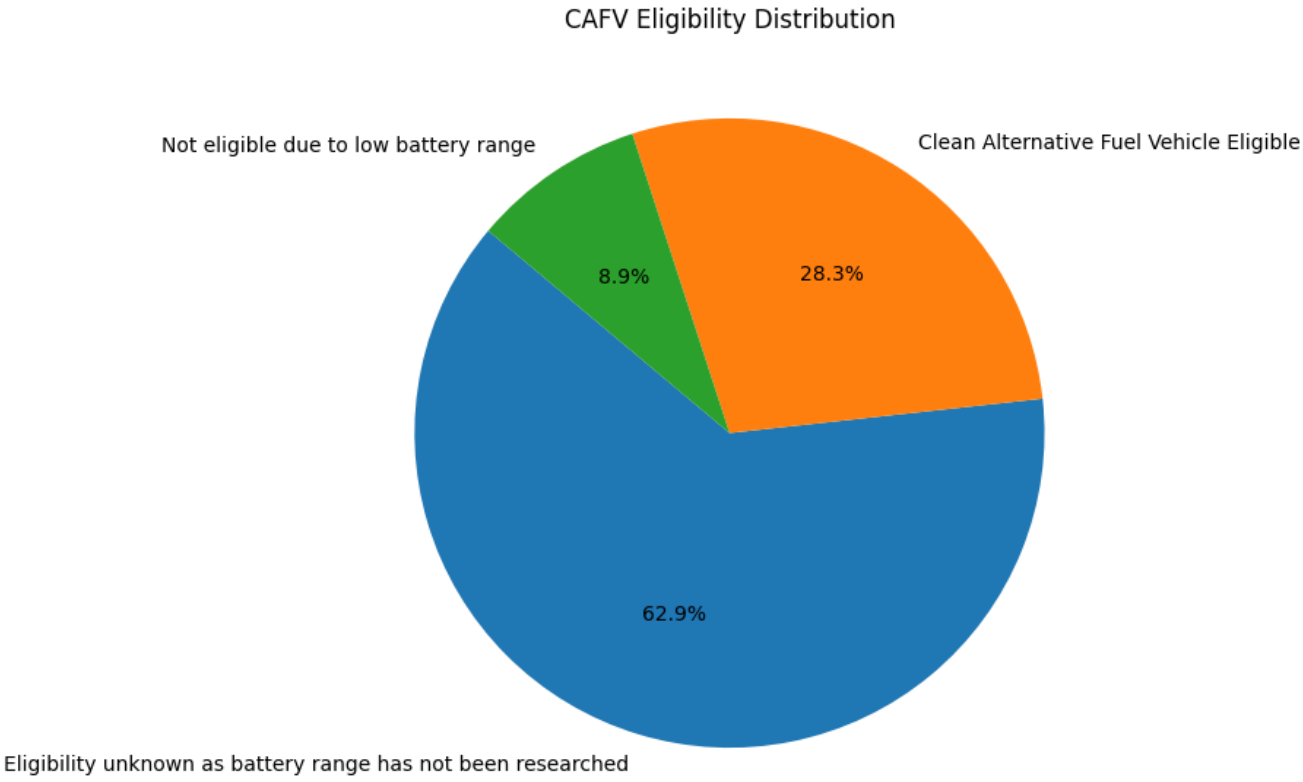
Various visualizations were used to communicate insights effectively, including bar charts, heatmaps, line charts, pie charts, and geospatial maps. These visuals clearly present manufacturer dominance, regional differences, and growth trends in electric vehicle adoption.

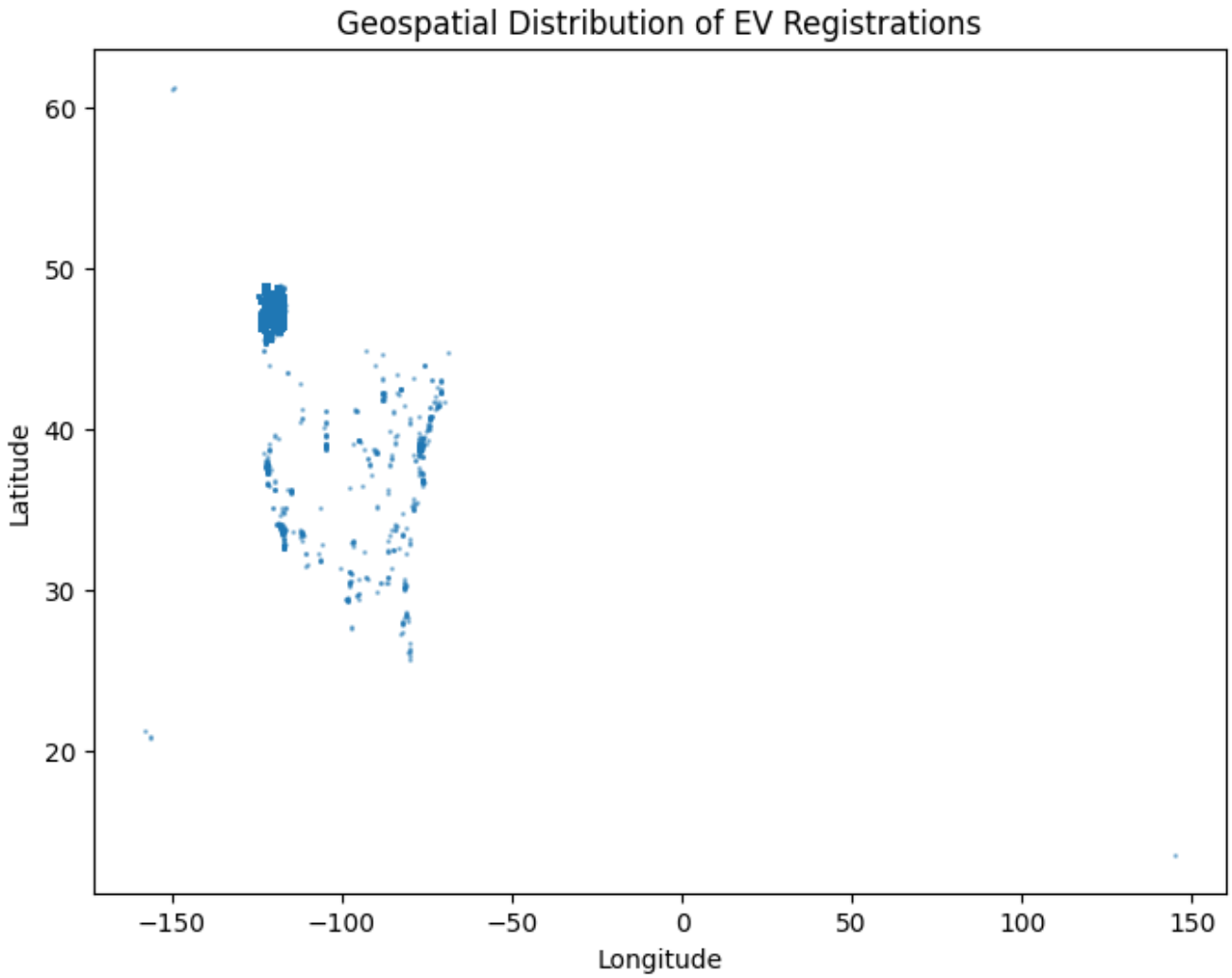



EV Distribution by County
King
Snohomish
Pierce
Clark
Thurston
Kitsap
Spokane
Whatcom
Benton
Skagit
Island
Yakima
Chelan
Clallam
Jefferson
133903
33531
22213
16553
9852
9057
7593
6620
3792
3166
2962
1864
1691
1647
1435
County
120000
100000
80000
60000
40000
20000
count
EV Count


EV Adoption Trend Over Model Years
Number of EVs
60000
50000
40000
30000
20000
10000
0
2000
2005
2010
2015
2020
2025
Model Year


Electric Range Distribution by Vehicle Type
Electric Range (miles)
350
300
250
200
150
100
50
0
Battery Electric Vehicle (BEV)
Plug-in Hybrid Electric Vehicle (PHEV)
Vehicle Type


CAFV Eligibility Distribution
Not eligible due to low battery range
Clean Alternative Fuel Vehicle Eligible
8.9%
28.3%
62.9%
Eligibility unknown as battery range has not been researched



Section 4: Linear Regression Analysis

Linear regression was applied to model the relationship between electric range and vehicle characteristics such as model year, vehicle type, manufacturer, and CAFV eligibility. Categorical variables were converted into numerical form using one-hot encoding. Due to limited available features, the model provides moderate explanatory power.

Model accuracy can be improved by including additional features such as battery capacity, vehicle weight, pricing information, and by applying advanced regression techniques.

Conclusion

This study highlights the rapid growth of electric vehicle adoption, strong dominance of Tesla in the EV market, and clear urban–rural disparities in adoption levels. The findings emphasize the influence of vehicle characteristics, infrastructure availability, and regional factors on electric vehicle growth.