Electric Vehicle Population Data Analysis with Structured Query Language(SQL)

Future is more greener...

SAHIL VERMA

Project Overview 📋

- 🚗 **Comprehensive EV Data:** This dataset provides in-depth information on registered electric vehicles across various regions.

- 🔍 **Key Attributes:**
- Make and Model: Brand and specific model of each electric vehicle.
- 🗺️ County: Region where each vehicle is registered.
- 📅 Registration Year: Year of registration, capturing trends over time.
- 💵 Price: Pricing details for analyzing the market value of electric vehicles.

- 📈 **Valuable Insights:** The data helps uncover adoption patterns and market trends of electric vehicles over recent years, providing a foundation for data-driven decisions in the EV market.

Dataset Details:

Here are some key columns likely present, given the objectives outlined for the project:

- **Make:** The brand or manufacturer of the electric vehicle (e.g., Tesla, Nissan).
- **Model:** The specific model name of the electric vehicle (e.g., Model S, Leaf).
- **County:** The administrative region where the vehicle is registered.
- **City:** The city where the electric vehicle is registered.
- **Model Year:** The year the vehicle was registered, which helps in analyzing trends over time.
- **Base MSRP:** The price of the vehicle, useful for analyzing the cost distribution across different models and brands.
- **Legislative District:** District information that can be used for region-based analyses.

🎯Objective:

1. 📊 **Analyze Manufacturer Trends**
   - Identify the top manufacturers, total vehicles by each, and specific manufacturers like Tesla.
2. 🚗 **Explore Unique EV Models**
   - List and categorize all unique models to understand diversity in the EV landscape.
3. 🌍 **City & State Registration Insights**
   - Determine popular EV cities/states and find the top models in each location, highlighting regional trends.
4. 📅 **Yearly Registration Patterns**
   - Track EV registrations year by year and recent trends over the past 5 years.
5. 🔋 **Battery Range Analysis**
   - Calculate average, maximum, and minimum battery ranges, and compare models by range capabilities.
6. 📈 **Evaluate EV Registrations by Model and Make**
   - Rank and find top models registered each year and the overall average registrations per make.
7. 📍 **Geographic Battery Range Insights**
   - Average battery range comparison across different counties to explore regional battery efficiency.
8. 🔝 **Top Models in Major Cities**
   - Discover the most common models in each city, ranking the top three in popularity.
9. 💵 **Market Analysis on MSRP**
   - Identify the most expensive models each year to understand pricing trends.
10. 📉 **Cumulative and Percentage Metrics**
    - Determine cumulative EV count by legislative district and the percentage of total EVs by make.

SQL Queries and Analysis Results:

1. Retrieve all records of electric vehicles from a specific manufacturer (e.g., "Tesla").

Query:

```
select * from ev_dataset
where make = 'Tesla';
```

Output:

VIN (1-10)	County	City	State	Postal Code	Model Year	Make	Model	Electric_Vehicle_Type
5YJ3E1EB0J	Thurston	Olympia	WA	98512	2018	TESLA	MODEL 3	Battery Electric Vehicle (BEV)
5YJ3E1EA2J	Yakima	Yakima	WA	98902	2018	TESLA	MODEL 3	Battery Electric Vehicle (BEV)
5YJ3E1EA4N	Yakima	Yakima	WA	98902	2022	TESLA	MODEL 3	Battery Electric Vehicle (BEV)
7SAYGAEE2P	Snohomish	Bothell	WA	98012	2023	TESLA	MODEL Y	Battery Electric Vehicle (BEV)
5YJSA1DPXC	Thurston	Olympia	WA	98502	2012	TESLA	MODEL S	Battery Electric Vehicle (BEV)
5YJSA1H27F	Yakima	Yakima	WA	98908	2015	TESLA	MODEL S	Battery Electric Vehicle (BEV)
5YJSA1H14E	Snohomish	Snohomish	WA	98296	2014	TESLA	MODEL S	Battery Electric Vehicle (BEV)
5YJYGDEEXL	Snohomish	Everett	WA	98208	2020	TESLA	MODEL Y	Battery Electric Vehicle (BEV)

2. List all unique models of electric vehicles in the dataset.

Query:

```
SELECT DISTINCT model
FROM ev1;
```

Output:

model
MODEL 3
E-TRON
MODEL Y
I3
MODEL S
R1T
500
ESCAPE

3. Count the total number of electric vehicles in the dataset.

Query:

select **electric_vehicle_type,count(*)** as **total_no_of_EV**
from **ev1**
group by **electric_vehicle_type**;

Output:

	electric_vehide_type	total_no_of_EV
	Battery Electric Vehide (BEV)	43794
	Plug-in Hybrid Electric Vehide (PHEV)	11176

4. Retrieve all electric vehicles registered in a specific city (e.g., "Seattle").

Query:

```
select city,model
from ev1
where city="Seattle";
```

Output:

city	model
Seattle	500
Seattle	MODEL X
Seattle	LEAF
Seattle	A3
Seattle	LEAF
Seattle	I3
Seattle	MODEL 3
Seattle	500

5. Retrieve the top 5 most number of electric vehicles registered in a specific city (e.g., "Olympia")

Query:

select **city,model, count(*) as no_of_reg_vehicle**
from **ev1** where **city='Olympia'**
group by **city,model**
order by **no_of_reg_vehicle** desc limit **5**;

Output:

city	model	no_of_reg_vehicle
Olympia	MODEL Y	137
Olympia	MODEL 3	116
Olympia	LEAF	107
Olympia	BOLT EV	81
Olympia	VOLT	48

6. Find all vehicles registered after a specific year (e.g., after 2020).

Query:

```
select *
from ev1
where `Model year`>2020;
```

Output:

VIN (1-10)	County	City	State	Postal Code	Model Year	Make	Model	Electric_Vehicle_Type
WA1AAAGE9M	Kitsap	Port Orchard	WA	98367	2021	AUDI	E-TRON	Battery Electric Vehicle (BEV)
5YJ3E1EA4N	Yakima	Yakima	WA	98902	2022	TESLA	MODEL 3	Battery Electric Vehicle (BEV)
7SAYGAEE2P	Snohomish	Bothell	WA	98012	2023	TESLA	MODEL Y	Battery Electric Vehicle (BEV)
7FCTGBAA7P	Kitsap	Poulsbo	WA	98370	2023	RIVIAN	R1T	Battery Electric Vehicle (BEV)
1FMCU0LZ4M	Kitsap	Silverd		98383	2021	FORD	ESCAPE	Plug-in Hybrid Electric Vehicle (PHEV)
5YJ3E1EB3N	Yakima	Yakima	WA	98902	2022	TESLA	MODEL 3	Battery Electric Vehicle (BEV)
WA1LAAGE2P	Thurston	Yelm	WA	98597	2023	AUDI	E-TRON	Battery Electric Vehicle (BEV)
7SAYGAEE5P	Kitsap	Kingston	WA	98346	2023	TESLA	MODEL Y	Battery Electric Vehicle (BEV)

Silverdale

7. List electric vehicles that have a certain battery range or above a specified range. (eg, 150-200)

Query:

```
select make, model, `Electric Range`
from ev1
where `Electric Range` between 150 and 200;
```

Output:

	make	model	Electric Range
	NISSAN	LEAF	151
	NISSAN	LEAF	151
	TESLA	MODEL X	200
	NISSAN	LEAF	150
	TESLA	MODEL X	200
	NISSAN	LEAF	150
	NISSAN	LEAF	151
	NISSAN	LEAF	151
	NISSAN	LEAF	151

8. Count the total number of electric vehicles by each manufacturer.

Query:

```
select make, count(*) as no_of_vehicles
from ev1
group by make
order by no_of_vehicles desc;
```

Output:

make	no_of_vehicles
TESLA	25229
NISSAN	3961
CHEVROLET	3752
BMW	2453
FORD	2445
KIA	2323

9. Calculate the average battery capacity of all electric vehicles in the dataset.

Query:

select **round(avg(`Electric Range`),2) avg_range**
from **ev1**;

Output:

avg_range
53.79

10. Find the maximum and minimum battery range among all electric vehicles.

Query:

select **min(`Electric Range`) min_range**, **max(`Electric Range`) max_range**
from **ev1**;

Output:

min_range	max_range
0	337

11. Count the number of electric vehicles registered in each state.

Query:

select **state, count(*) no_of_vehicles**
from **ev1**
group by state;

Output:

state	no_of_vehides
WA	54970

12. List the top 5 cities with the most electric vehicle registrations.

Query:

select **city, count(*)** as **no_of_reg_vehicle**
from **ev1**
group by **city**
order by **no_of_reg_vehicle** desc limit 5;

Output:

city	no_of_reg_vehide
Seattle	10614
Bellevue	5035
Vancouver	3247
Sammamish	3032
Kirkland	3003

13. Find the average battery range for each vehicle model.

Query:

```
select model, round(avg(`Electric Range`),2) avg_e_range
from ev1
group by model;
```

Output:

model	avg_e_range
MODEL 3	104.55
E-TRON	144.92
MODEL Y	15.72
I3	89.16
MODEL S	172.38
R1T	0.00
500	85.62
ESCAPE	37.66

14. List all vehicles registered in cities with more than a 250 of total electric vehicle registrations.

Query:

```
select city,make,model, count(*) as no_of_vehicle
from ev1
group by city, make,model
having no_of_vehicle>250;
```

Output:

city	make	model	no_of_vehicle
Bothell	TESLA	MODEL Y	697
Renton	TESLA	MODEL 3	277
Bothell	TESLA	MODEL 3	321
Seattle	NISSAN	LEAF	889
Seattle	TESLA	MODEL 3	1784
Redmond	TESLA	MODEL 3	462
Sammamish	TESLA	MODEL 3	598
Bellevue	TESLA	MODEL 3	934

15. Find the most recent year in which a new electric vehicle model was registered.

Query:

```
select MAX(`Model Year`) most_recent_year
from ev1;
```

Output:

most_recent_year
2025

16. List vehicles registered within the last 5 years.

Query:

```
select `model year`,model
from ev1
where `model year`>= year(current_date) - 4
order by `model year` desc;
```

Output:

model year	model
2025	X5
2025	NX
2025	IX
2025	X5
2025	SORENTO

Note - This output image is only of top rows but query was giving the desired output

17. Find the total number of unique makes and models in the dataset.

Query:

```
select count(distinct make) as unique_no_make, count(distinct model) as unique_no_model
from ev1;
```

Output:

unique_no_make	unique_no_model
40	143

18. Count how many vehicles were registered each year.

Query:

```
select `model year`, count(model) as no_of_vehicle
from ev1
group by `model year`;
```

Output:

model year	no_of_vehicle
2018	4043
2021	5408
2022	7824
2023	17010
2014	902
2012	373
2015	1228

19. Calculate the average number of registrations for each vehicle make.

Query:

select **make, round(count(*)/count(distinct model),2) as avg_no_of_vehicle**
from **ev1**
group by **make**
order by **avg_no_of_vehicle** desc;

Output:

make	avg_no_of_vehicle
TESLA	4204.83
NISSAN	1980.50
JEEP	819.00
CHRYSLER	806.00
VOLKSWAGEN	721.00
CHEVROLET	536.00
RIVIAN	435.67
TOYOTA	391.80

20. List the top 5 most frequently registered models for each year.

Query:

```
select `model year`,model,no_of_vehicles
from (select `model year`,model,count(*) as no_of_vehicles,
row_number() over(partition by `model year`) as most_freq_vehicles
from ev1
group by `model year`, model
order by `model year` desc,no_of_vehicles desc) t5
where most_freq_vehicles<=5;
```

Output:

model year	model	no_of_vehicles
2025	X5	16
2025	NX	14
2025	CX-70	4
2025	SORENTO	4
2025	I5	1
2024	MODEL Y	1885
2024	IONIQ 5	180

Note - This output image is only of top rows but query was giving the desired output

21. Find the total count of electric vehicles in each city, sorted in descending order.

Query:

```
select city, count(model) as no_of_vehicle
from ev1
group by city
order by no_of_vehicle desc;
```

Output:

city	no_of_vehicle
Seattle	10614
Bellevue	5035
Vancouver	3247
Sammamish	3032
Kirkland	3003
Redmond	2462
Bothell	1953
Tukwila	1615

22. For each model, retrieve the most recent registration date.

Query:

```
select model, Most_Recent_Registration_Date from (select Model, MAX(`model year`)
as Most_Recent_Registration_Date,
row_number() over(partition by model order by MAX(`model year`) desc) as row_no
from ev1
group by Model) recent_year
where row_no=1;
```

Output:

model	Most_Recent_Registration_Date
330E	2024
500	2019
500E	2024
530E	2023
740E	2019
745E	2020
918	2015
A3	2018

23. Rank each vehicle make by the total number of registrations within each year.

Query:

```
select make,`model year`, count(model) as no_of_vehicle,
dense_rank() over(partition by `model year` order by count(model) desc) as ranking
from ev1
group by make,`model year`
order by `model year`;
```

Output:

make	model year	no_of_vehicle	ranking
FORD	1999	2	1
FORD	2000	1	1
TOYOTA	2002	1	1
TESLA	2008	8	1
TESLA	2010	9	1
WHEEGO ELECTRIC CARS	2010	1	2
NISSAN	2011	173	1

24. Find the Most Expensive Model in Each Year.

Query:

```
select * from (select model, base_msrp,`model year`,
row_number() over(partition by `model year` order by base_msrp desc) as ranking
from ev1) as ranked_price
where ranking =1
order by base_msrp desc;
```

Output:

model	base_msrp	model year	ranking
918	845000	2015	1
PANAMERA	184400	2018	1
ROADSTER	110950	2010	1
ROADSTER	109000	2011	1
KARMA	102000	2012	1
ROADSTER	98950	2008	1
740E	91250	2019	1

25. Calculate the Average Electric Range by County.

Query:

```
select county,round(avg(`electric range`),2)
avg_erange
from ev1
group by County;
```

Output:

county	avg_erange
Thurston	59.88
Kitsap	56.21
Yakima	55.42
Snohomish	46.00
King	53.81
Island	49.96
Grant	60.75
Whitman	34.63

26. Determine the Cumulative Sum of EVs by Legislative District.

Query:

```
select `Legislative district`,model,count(*) as no_of_vehicles,
sum(count(*)) over(partition by `Legislative district` order by model rows between UNBOUNDED PRECEDING AND CURRENT ROW) as cum_sum
from ev1
group by `Legislative district`, model
order by `Legislative district`, model;
```

Output:

Legislative district	model	no_of_vehicles	cum_sum
1	330E	6	6
1	500	7	13
1	530E	3	16
1	A3	5	21
1	AIR	6	27
1	ARIYA	10	37
1	AVIATOR	1	38

Note - This output image is only of top rows but query was giving the desired output

27. Calculate the Percentage of Total EVs per Make.

Query:

```
select make,  count(*) as vehicle_count,
round((count(*) * 100/sum(count(*)) over()),2) as percentage_ofvehicle
from ev1
group by make;
```

Output:

make	vehicle_count	percentage_ofvehicle
TESLA	25229	45.90
AUDI	1189	2.16
BMW	2453	4.46
RIVIAN	1307	2.38
FIAT	230	0.42
FORD	2445	4.45
CHEVROLET	3752	6.83
NISSAN	3961	7.21

28. Identify the Top 3 Most Common Electric Vehicle Models in Each City.

Query:

```
select * from (select city, model,count(*) no_of_vehicle,
row_number() over(partition by city order by count(*) desc) model_rank
from ev1
group by model, city) as ranked_models
where model_rank<=3
order by city,model_rank;
```

Output:

city	model	no_of_vehicle	model_rank
Aberdeen	MODEL 3	2	1
Aberdeen	FUSION	2	2
Aberdeen	500	1	3
Airway Heights	VOLT	1	1
Airway Heights	FUSION	1	2
Algona	MODEL Y	6	1
Algona	LEAF	3	2
Algona	PRIUS PRIME	2	3

⚖️Conclusion:

- **Top Brands Lead:** Tesla and other major brands dominate registrations, showing strong consumer preference.
- **Geographic Hotspots:** Cities like Olympia and Seattle show high EV concentration, indicating regional interest.
- **Diverse Model Range:** High model variety reveals diverse consumer needs in the EV market.
- **Steady Growth:** Increasing recent registrations point to rapid EV adoption.
- Battery Range Preference: Popular ranges (150–200 miles) suggest consumer expectations for daily use vehicles.
- **Model Demand by Location:** Specific models are more popular in certain cities, useful for targeted marketing.
- **Policy and Market Insights**: Data by legislative district and city helps inform policy and market strategies for infrastructure and resource allocation.

These insights highlight key market trends, consumer preferences, and potential areas for strategic focus in the EV market.

THANK YOU!!!

This journey through data brings us one step closer to understanding the path toward sustainable transportation and a cleaner world.

"Green world, green future – let's drive the change toward sustainability, one electric mile at a time."