electric-vechile-project

October 5, 2024

[ ]:

```
import pandas as pd
```

[ ]:

```
df  = pd.read_csv(r"C:\Users\Srikanth\Downloads\INTERNSHIP FILES\Electric␣
 ↪vechile project\dataset.csv")
df
```

[ ]:

```
        VIN (1-10)     County           City State  Postal Code  Model Year  \
0       JTMEB3FV6N     Monroe       Key West    FL        33040        2022
1       1G1RD6E45D      Clark       Laughlin    NV        89029        2013
2       JN1AZ0CP8B     Yakima         Yakima    WA        98901        2011
3       1G1FW6S08H     Skagit       Concrete    WA        98237        2017
4       3FA6P0SU1K  Snohomish        Everett    WA        98201        2019
…            …        …            …   …          …         …
112629  7SAYGDEF2N       King         Duvall    WA        98019        2022
112630  1N4BZ1CP7K   San Juan  Friday Harbor    WA        98250        2019
112631  1FMCU0KZ4N       King         Vashon    WA        98070        2022
112632  KNDCD3LD4J       King      Covington    WA        98042        2018
112633  YV4BR0CL8N       King      Covington    WA        98042        2022

             Make       Model                 Electric Vehicle Type  \
0          TOYOTA  RAV4 PRIME  Plug-in Hybrid Electric Vehicle (PHEV)
1       CHEVROLET        VOLT  Plug-in Hybrid Electric Vehicle (PHEV)
2          NISSAN        LEAF          Battery Electric Vehicle (BEV)
3       CHEVROLET     BOLT EV          Battery Electric Vehicle (BEV)
4            FORD      FUSION  Plug-in Hybrid Electric Vehicle (PHEV)
…           …         …                                     …
112629      TESLA     MODEL Y          Battery Electric Vehicle (BEV)
112630     NISSAN        LEAF          Battery Electric Vehicle (BEV)
112631       FORD      ESCAPE  Plug-in Hybrid Electric Vehicle (PHEV)
112632        KIA        NIRO  Plug-in Hybrid Electric Vehicle (PHEV)
112633      VOLVO        XC90  Plug-in Hybrid Electric Vehicle (PHEV)

        Clean Alternative Fuel Vehicle (CAFV) Eligibility  Electric Range  \
0                 Clean Alternative Fuel Vehicle Eligible              42
1                 Clean Alternative Fuel Vehicle Eligible              38
2                 Clean Alternative Fuel Vehicle Eligible              73
3                 Clean Alternative Fuel Vehicle Eligible             238
```

```
4                   Not eligible due to low battery range              26
…                                                   …             …
112629  Eligibility unknown as battery range has not b…               0
112630            Clean Alternative Fuel Vehicle Eligible             150
112631            Clean Alternative Fuel Vehicle Eligible              38
112632              Not eligible due to low battery range              26
112633              Not eligible due to low battery range              18

        Base MSRP  Legislative District  DOL Vehicle ID  \
0               0                   NaN       198968248
1               0                   NaN         5204412
2               0                  15.0       218972519
3               0                  39.0       186750406
4               0                  38.0         2006714
…           …                   …             …
112629          0                  45.0       217955265
112630          0                  40.0       103663227
112631          0                  34.0       193878387
112632          0                  47.0       125039043
112633          0                  47.0       194673692

                   Vehicle Location  \
0         POINT (-81.80023 24.5545)
1       POINT (-114.57245 35.16815)
2       POINT (-120.50721 46.60448)
3        POINT (-121.7515 48.53892)
4       POINT (-122.20596 47.97659)
…                             …
112629  POINT (-121.98609 47.74068)
112630  POINT (-123.01648 48.53448)
112631   POINT (-122.4573 47.44929)
112632  POINT (-122.09124 47.33778)
112633  POINT (-122.09124 47.33778)

                                         Electric Utility  2020 Census Tract
0                                                     NaN        12087972100
1                                                     NaN        32003005702
2                                              PACIFICORP        53077001602
3                                  PUGET SOUND ENERGY INC        53057951101
4                                  PUGET SOUND ENERGY INC        53061041500
…                                                   …                …
112629      PUGET SOUND ENERGY INC||CITY OF TACOMA - (WA)        53033032401
112630  BONNEVILLE POWER ADMINISTRATION||ORCAS POWER &…        53055960301
112631      PUGET SOUND ENERGY INC||CITY OF TACOMA - (WA)        53033027702
112632      PUGET SOUND ENERGY INC||CITY OF TACOMA - (WA)        53033032007
112633      PUGET SOUND ENERGY INC||CITY OF TACOMA - (WA)        53033032005
```

```
[112634 rows x 17 columns]
```

[ ]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 112634 entries, 0 to 112633
Data columns (total 17 columns):
 #   Column                                             Non-Null Count   Dtype
---  ------                                             --------------   -----
 0   VIN (1-10)                                         112634 non-null  object
 1   County                                             112634 non-null  object
 2   City                                               112634 non-null  object
 3   State                                              112634 non-null  object
 4   Postal Code                                        112634 non-null  int64
 5   Model Year                                         112634 non-null  int64
 6   Make                                               112634 non-null  object
 7   Model                                              112614 non-null  object
 8   Electric Vehicle Type                              112634 non-null  object
 9   Clean Alternative Fuel Vehicle (CAFV) Eligibility  112634 non-null  object
 10  Electric Range                                     112634 non-null  int64
 11  Base MSRP                                          112634 non-null  int64
 12  Legislative District                               112348 non-null  float64
 13  DOL Vehicle ID                                     112634 non-null  int64
 14  Vehicle Location                                   112610 non-null  object
 15  Electric Utility                                   112191 non-null  object
 16  2020 Census Tract                                  112634 non-null  int64
dtypes: float64(1), int64(6), object(10)
memory usage: 14.6+ MB
```

[ ]:
```
df.duplicated().sum()
```

[ ]:
```
0
```

[ ]:
```

```

[ ]:
```
df['Model'].value_counts()
```

[ ]:
```
Model
MODEL 3        23135
MODEL Y        17142
LEAF           12880
MODEL S         7377
BOLT EV         4910
               …
745LE              2
S-10 PICKUP        1
SOLTERRA           1
```

```
918                 1
FLYING SPUR         1
Name: count, Length: 114, dtype: int64
```

```
[ ]: df['Model'] = df['Model'].fillna(df['Model'].mode()[0])
```

```
[ ]:
```

```
[ ]: df['Legislative District'].describe()
```

```
[ ]: count    112348.000000
     mean         29.805604
     std          14.700545
     min           1.000000
     25%          18.000000
     50%          34.000000
     75%          43.000000
     max          49.000000
     Name: Legislative District, dtype: float64
```

```
[ ]: df['Legislative District'] = df['Legislative District'].fillna(df['Legislative␣
       ↪District'].mean())
```

```
[ ]:
```

```
[ ]: df['Vehicle Location'].value_counts()
```

```
[ ]: Vehicle Location
     POINT (-122.13158 47.67858)    2916
     POINT (-122.2066 47.67887)     2059
     POINT (-122.1872 47.61001)     2001
     POINT (-122.31765 47.70013)    1880
     POINT (-122.12096 47.55584)    1852
                                    …
     POINT (-124.33152 48.05431)       1
     POINT (-77.41203 39.41574)        1
     POINT (-123.61022 46.35588)       1
     POINT (-112.04165 40.68741)       1
     POINT (-116.91895 47.40077)       1
     Name: count, Length: 758, dtype: int64
```

```
[ ]: df['Vehicle Location'] = df['Vehicle Location'].fillna(df['Vehicle Location'].
       ↪mode()[0])
```

```
[ ]:
```

```
[ ]: df['Electric Utility'].value_counts()
[ ]: Electric Utility
     PUGET SOUND ENERGY INC||CITY OF TACOMA - (WA)
     40247
     PUGET SOUND ENERGY INC
     22172
     CITY OF SEATTLE - (WA)|CITY OF TACOMA - (WA)
     21447
     BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF CLARK COUNTY - (WA)
     6522
     BONNEVILLE POWER ADMINISTRATION||CITY OF TACOMA - (WA)||PENINSULA LIGHT COMPANY
     5053
                 …
     BONNEVILLE POWER ADMINISTRATION||PENINSULA LIGHT COMPANY
     1
     BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF ASOTIN COUNTY
     1
     CITY OF SEATTLE - (WA)
     1
     BONNEVILLE POWER ADMINISTRATION||NESPELEM VALLEY ELEC COOP, INC
     1
     BONNEVILLE POWER ADMINISTRATION||PUD NO 1 OF CLALLAM COUNTY|PUD NO 1 OF
     JEFFERSON COUNTY        1
     Name: count, Length: 73, dtype: int64
```

```
[ ]: df['Electric Utility'] = df['Electric Utility'].fillna(df['Electric Utility'].
      ↪mode()[0])
```

```
[ ]: df.isna().sum()
```

```
[ ]: VIN (1-10)                                           0
     County                                               0
     City                                                 0
     State                                                0
     Postal Code                                          0
     Model Year                                           0
     Make                                                 0
     Model                                                0
     Electric Vehicle Type                                0
     Clean Alternative Fuel Vehicle (CAFV) Eligibility    0
     Electric Range                                       0
     Base MSRP                                            0
     Legislative District                                 0
     DOL Vehicle ID                                       0
     Vehicle Location                                     0
     Electric Utility                                     0
     2020 Census Tract                                    0
     dtype: int64
```

[ ]:
```
df.to_csv('Electric Vechile data')
```

[ ]:
```
import os
os.getcwd()
```

[ ]:
```
'C:\\Users\\Srikanth\\INNOMATICS FILES\\INTERNSHIP'
```

1 Task 1: This is an open ended problem. Apply Exploratory Data Analysis (Univariate and Bivariate) on the dataset available above.

[ ]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 112634 entries, 0 to 112633
Data columns (total 17 columns):
 #   Column                                             Non-Null Count   Dtype
---  ------                                             --------------   -----
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 1   County                                             112634 non-null  object
 2   City                                               112634 non-null  object
 3   State                                              112634 non-null  object
 4   Postal Code                                        112634 non-null  int64
 5   Model Year                                         112634 non-null  int64
 6   Make                                               112634 non-null  object
 7   Model                                              112634 non-null  object
 8   Electric Vehicle Type                              112634 non-null  object
 9   Clean Alternative Fuel Vehicle (CAFV) Eligibility  112634 non-null  object
 10  Electric Range                                     112634 non-null  int64
 11  Base MSRP                                          112634 non-null  int64
 12  Legislative District                               112634 non-null  float64
 13  DOL Vehicle ID                                     112634 non-null  int64
 14  Vehicle Location                                   112634 non-null  object
 15  Electric Utility                                   112634 non-null  object
 16  2020 Census Tract                                  112634 non-null  int64
dtypes: float64(1), int64(6), object(10)
memory usage: 14.6+ MB
```
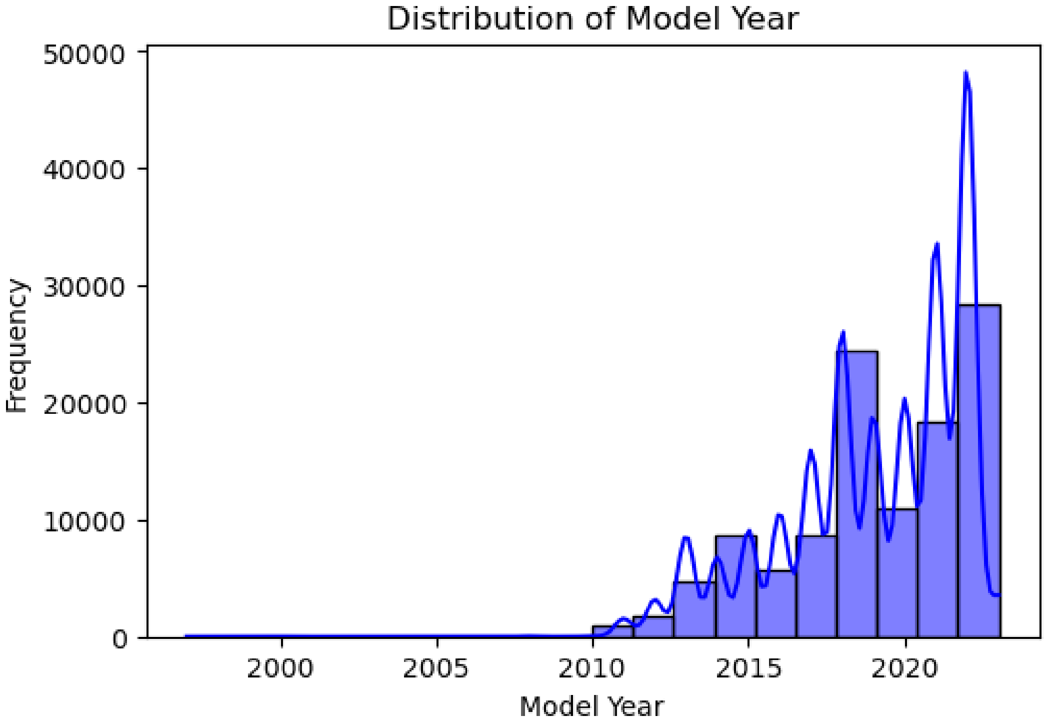

[ ]:
```
import matplotlib.pyplot as plt
import seaborn as sns
```

2 Univariate Analysis

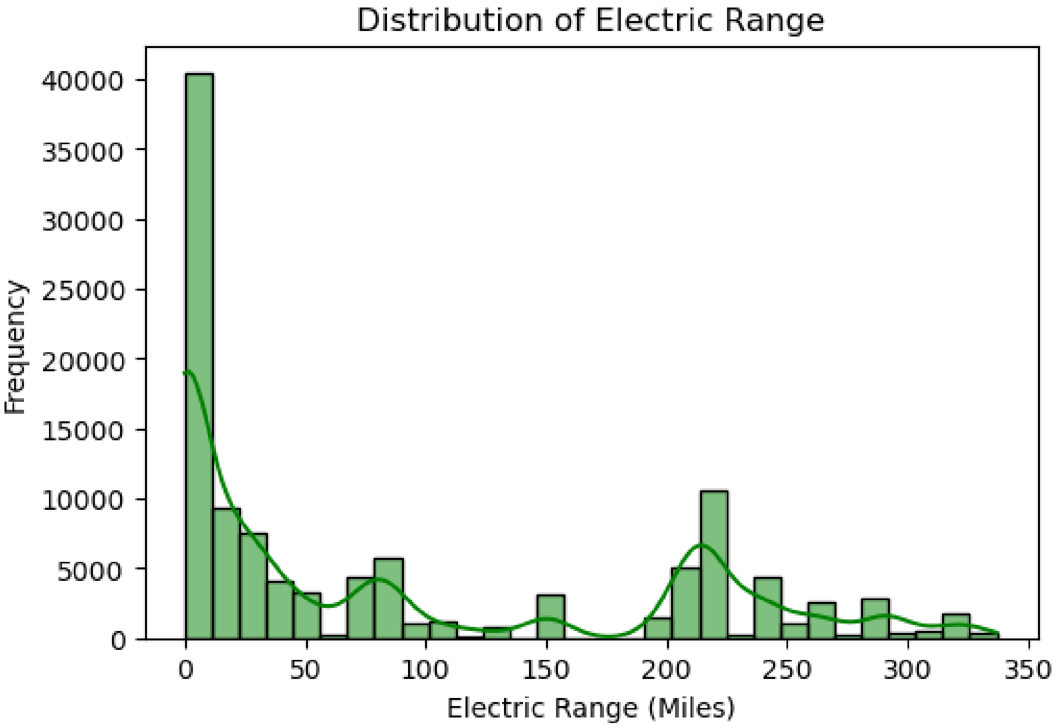
[ ]:

```
#Distribution of Model Year
plt.figure(figsize=(6,4))
sns.histplot(df['Model Year'], bins=20, kde=True, color='blue')
plt.title('Distribution of Model Year')
plt.xlabel('Model Year')
plt.ylabel('Frequency')
plt.show()
```

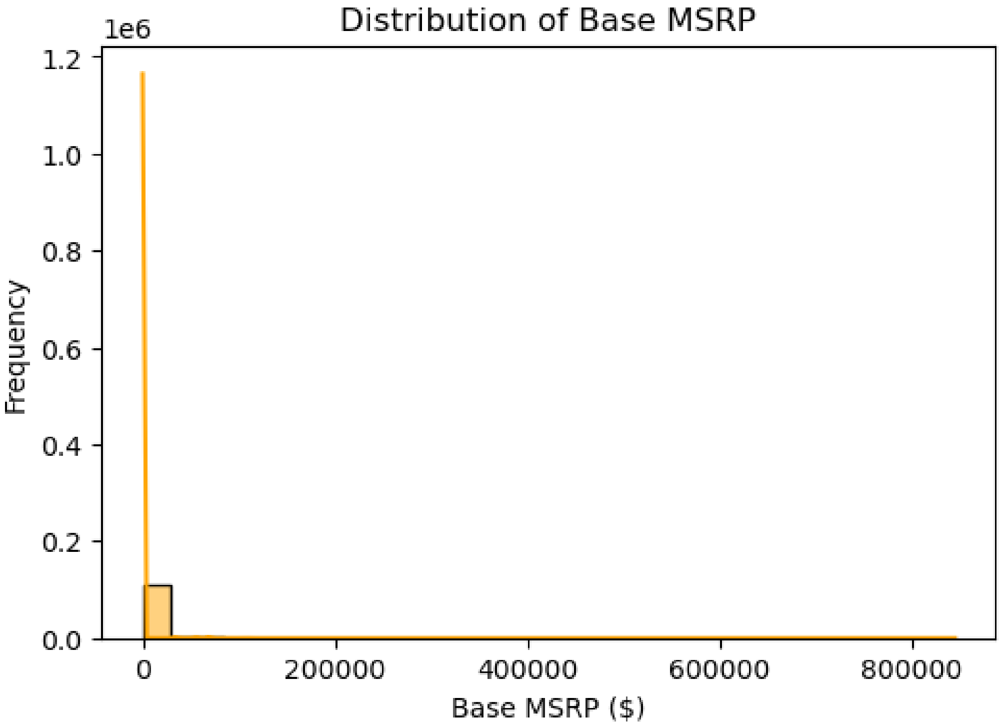


[ ]:

```
#Distribution of Electric Range
plt.figure(figsize=(6,4))
sns.histplot(df['Electric Range'], bins=30, kde=True, color='green')
plt.title('Distribution of Electric Range')
plt.xlabel('Electric Range (Miles)')
plt.ylabel('Frequency')
plt.show()
```



[ ]:
```
#Distribution of Base MSRP
plt.figure(figsize=(6,4))
sns.histplot(df['Base MSRP'], bins=30, kde=True, color='orange')
plt.title('Distribution of Base MSRP')
plt.xlabel('Base MSRP ($)')
plt.ylabel('Frequency')
plt.show()
```



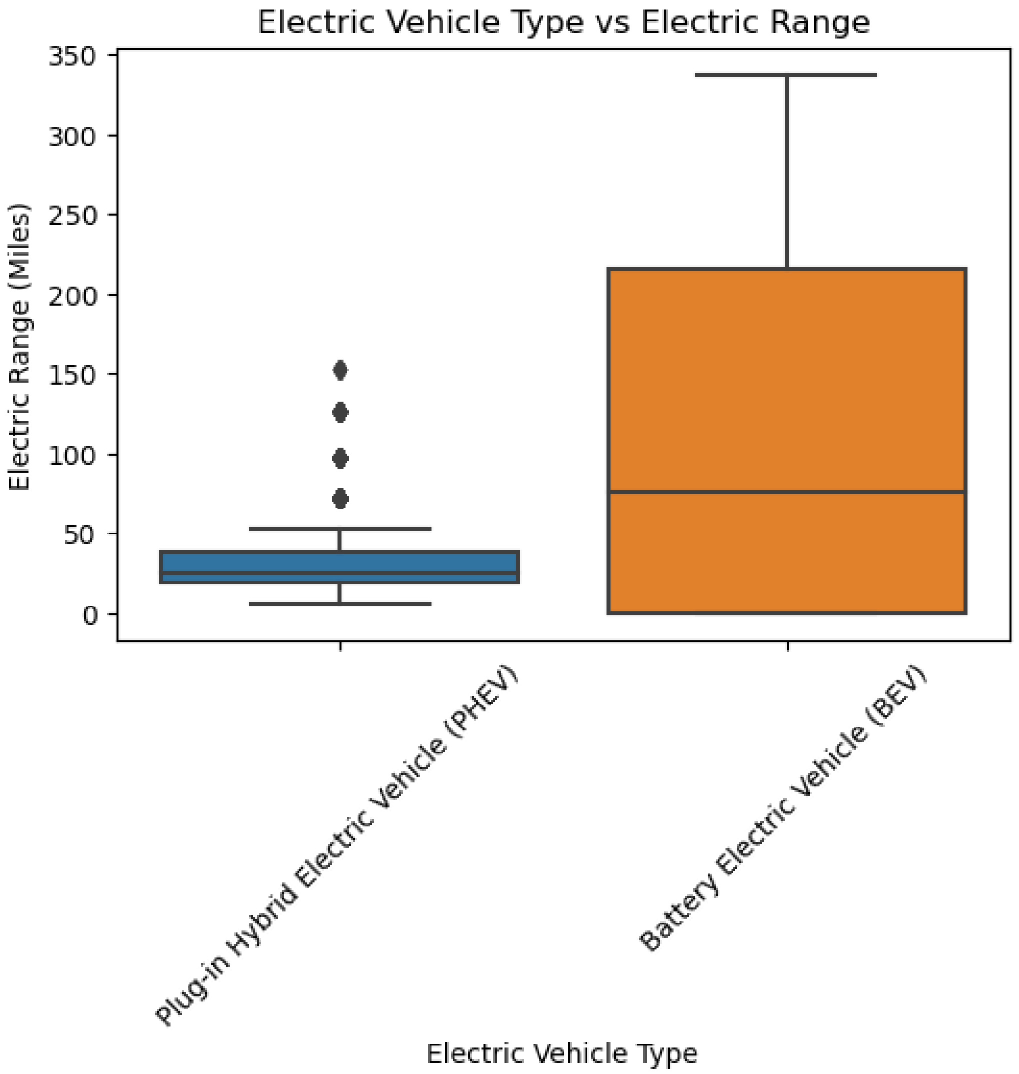
[ ]:

```

```

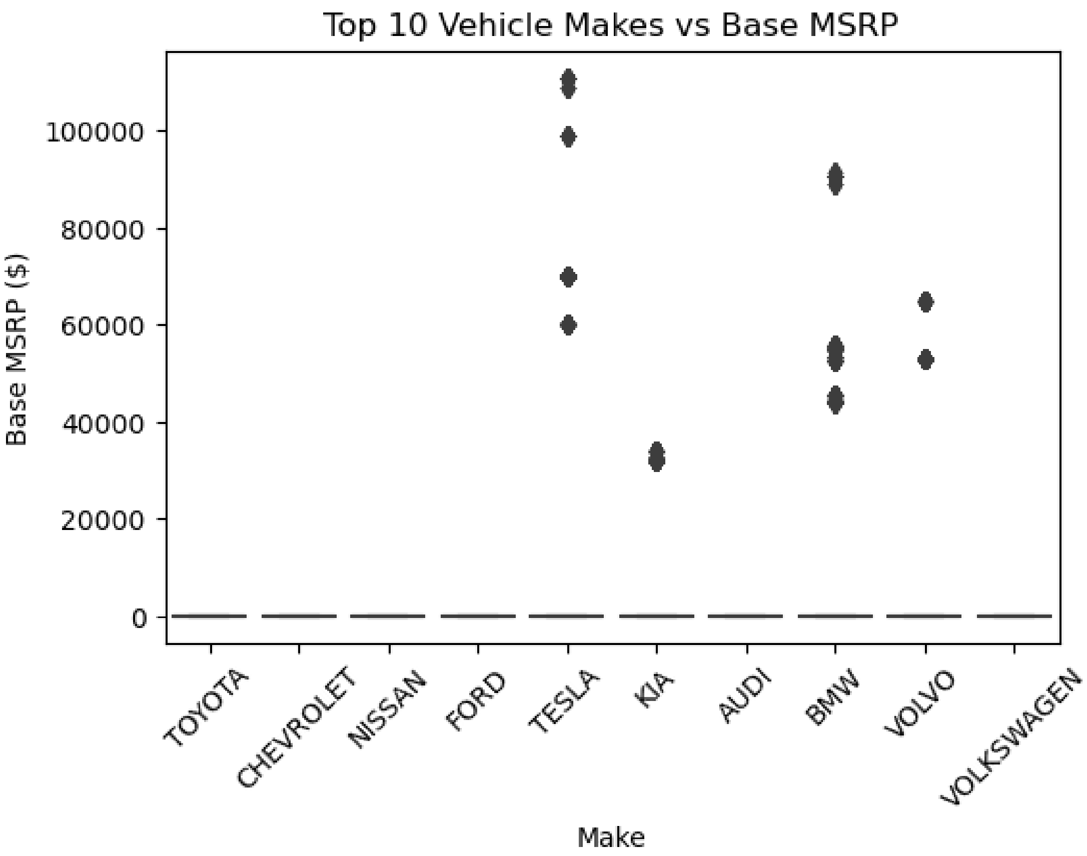
3 Bivariate Analysis

[ ]:

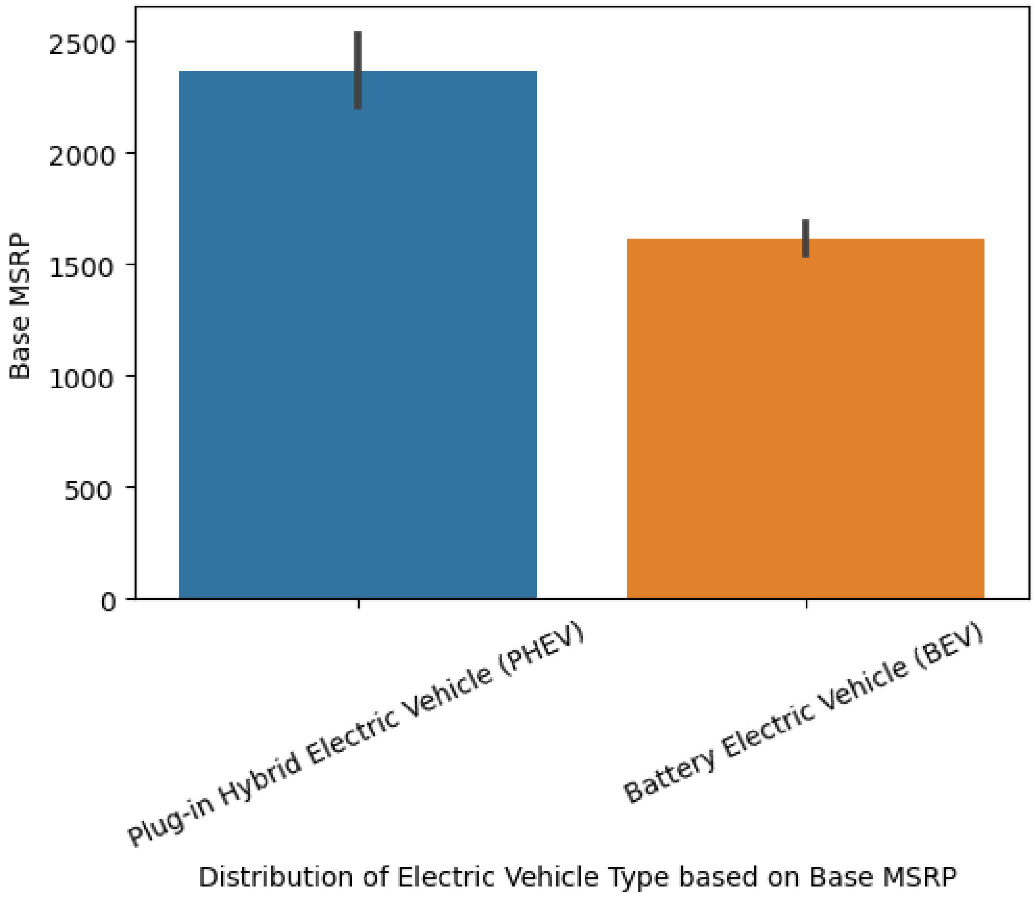
```
# Electric Vehicle Type vs Electric Range
plt.figure(figsize=(6,4))
sns.boxplot(x='Electric Vehicle Type', y='Electric Range', data=df)
plt.title('Electric Vehicle Type vs Electric Range')
plt.xticks(rotation=45)
plt.ylabel('Electric Range (Miles)')
plt.show()
```



```
[ ]: #Make vs Base MSRP
     plt.figure(figsize=(6,4))
     top_makes = df['Make'].value_counts().nlargest(10).index
     sns.boxplot(x='Make', y='Base MSRP', data=df[df['Make'].isin(top_makes)])
     plt.title('Top 10 Vehicle Makes vs Base MSRP')
     plt.xticks(rotation=45)
     plt.ylabel('Base MSRP ($)')
     plt.show()
```



```
[ ]: plt.figure(figsize=(6,4))
     sns.barplot(x='Electric Vehicle Type', y='Base MSRP',data=df)
     plt.xticks(rotation = 25)
     plt.xlabel('Distribution of Electric Vehicle Type based on Base MSRP ')
     plt.ylabel('Base MSRP')
     plt.show()
```



[ ]:

```
```

4 Task 2: Create a Choropleth using plotly.express to display the number of EV vehicles based on location.

[ ]:

```
!pip install plotly
```

```
Requirement already satisfied: plotly in c:\users\srikanth\anaconda3\lib\site-
packages (5.9.0)
Requirement already satisfied: tenacity>=6.2.0 in
c:\users\srikanth\anaconda3\lib\site-packages (from plotly) (8.2.2)
```

[ ]:

```
import plotly.express as px
```

[ ]:

```
state_data = df.groupby('State')['VIN (1-10)'].count().reset_index()
state_data.columns = ['State', 'EV Count']
```

```
fig = px.choropleth(state_data,
                    locations='State',
                    locationmode='USA-states',
                    color='EV Count',
                    color_continuous_scale='Blues',
                    scope='usa',
                    labels={'EV Count': 'Number of EV Vehicles'},
                    title='Number of Electric Vehicles by State')


fig.show()
```

5 Scatter Plot using plotly.express

Note - Scatter Plot is a bivariate plot. Bivariate means it requires two variables / features / columns. You should make a note that both the variables should be real numerical valued.

```
[ ]: fig = px.scatter(df,
                      x='Base MSRP',
                      y='Electric Range',
                      color='Electric Vehicle Type',
                      title='Scatter Plot of Electric Range vs Base MSRP',
                      labels={'Base MSRP': 'Base MSRP ($)', 'Electric Range':␣
       ↪'Electric Range (Miles)'},
                      hover_data=['Make', 'Model'])

     fig.show()
```

6 Box Plot using plotly.express

Note - Box Plot can be used to create a univariate or bivariate plot. For a univariate box plot, the column type should be real numerical. For a bivariate box plot, one column should be categorical and another column should be real numerical. Below is an example of code for bivariate box plot.

```
[ ]: fig = px.box(df,
                  x='Electric Vehicle Type',
                  y='Base MSRP',
                  title='Box Plot of Base MSRP by Electric Vehicle Type',
                  labels={'Base MSRP': 'Base MSRP ($)', 'Electric Vehicle Type': 'EV␣
       ↪Type'},
                  hover_data=['Make', 'Model'])

     fig.show()
```

7 Pie Chart Plot using plotly.express

Note - Pie Chart Plot can be used to create a bivariate plot. For a bivariate pie chart plot, one column should be categorical and another column should be real numerical. Below is an example of code for the plot. names: It should be categorical column values: It should be numeric column

[ ]:

```
vehicle_type_count = df.groupby('Electric Vehicle Type')['VIN (1-10)'].count().
  ↪reset_index()
vehicle_type_count.columns = ['Electric Vehicle Type', 'Count']

# Create a pie chart
fig = px.pie(vehicle_type_count,
             names='Electric Vehicle Type',
             values='Count',
             title='Distribution of Electric Vehicles by Type',
             labels={'Electric Vehicle Type': 'EV Type', 'Count': 'Number of␣
  ↪Vehicles'})

# Show the pie chart
fig.show()
```

[ ]:

```

```

8 Task 3: Create a Racing Bar Plot to display the animation of EV Make and its count each year.

[ ]:

```
!pip install bar-chart-race
```

```
Requirement already satisfied: bar-chart-race in
c:\users\srikanth\anaconda3\lib\site-packages (0.1.0)
Requirement already satisfied: pandas>=0.24 in
c:\users\srikanth\anaconda3\lib\site-packages (from bar-chart-race) (2.0.3)
Requirement already satisfied: matplotlib>=3.1 in
c:\users\srikanth\anaconda3\lib\site-packages (from bar-chart-race) (3.7.2)
Requirement already satisfied: contourpy>=1.0.1 in
c:\users\srikanth\anaconda3\lib\site-packages (from matplotlib>=3.1->bar-chart-
race) (1.0.5)
Requirement already satisfied: cycler>=0.10 in
c:\users\srikanth\anaconda3\lib\site-packages (from matplotlib>=3.1->bar-chart-
race) (0.11.0)
Requirement already satisfied: fonttools>=4.22.0 in
c:\users\srikanth\anaconda3\lib\site-packages (from matplotlib>=3.1->bar-chart-
race) (4.25.0)
Requirement already satisfied: kiwisolver>=1.0.1 in
c:\users\srikanth\anaconda3\lib\site-packages (from matplotlib>=3.1->bar-chart-
race) (1.4.4)
```

```
Requirement already satisfied: numpy>=1.20 in
c:\users\srikanth\anaconda3\lib\site-packages (from matplotlib>=3.1->bar-chart-
race) (1.24.3)
Requirement already satisfied: packaging>=20.0 in
c:\users\srikanth\anaconda3\lib\site-packages (from matplotlib>=3.1->bar-chart-
race) (23.1)
Requirement already satisfied: pillow>=6.2.0 in
c:\users\srikanth\anaconda3\lib\site-packages (from matplotlib>=3.1->bar-chart-
race) (9.4.0)
Requirement already satisfied: pyparsing<3.1,>=2.3.1 in
c:\users\srikanth\anaconda3\lib\site-packages (from matplotlib>=3.1->bar-chart-
race) (3.0.9)
Requirement already satisfied: python-dateutil>=2.7 in
c:\users\srikanth\anaconda3\lib\site-packages (from matplotlib>=3.1->bar-chart-
race) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in
c:\users\srikanth\anaconda3\lib\site-packages (from pandas>=0.24->bar-chart-
race) (2023.3.post1)
Requirement already satisfied: tzdata>=2022.1 in
c:\users\srikanth\anaconda3\lib\site-packages (from pandas>=0.24->bar-chart-
race) (2023.3)
Requirement already satisfied: six>=1.5 in c:\users\srikanth\anaconda3\lib\site-
packages (from python-dateutil>=2.7->matplotlib>=3.1->bar-chart-race) (1.16.0)
```

[ ]:

```python
import bar_chart_race as bcr
```

[ ]:

```python
import plotly.express as px
import pandas as pd

# Group the data by 'Model Year' and 'Make' to get the count of vehicles each␣
 ↪year
make_year_data = df.groupby(['Model Year', 'Make'])['VIN (1-10)'].count().
 ↪reset_index()
make_year_data.columns = ['Model Year', 'Make', 'Count']

# Create an animated bar chart using Plotly
fig = px.bar(make_year_data,
             x='Make',
             y='Count',
             color='Make',
             animation_frame='Model Year',
             animation_group='Make',
             range_y=[0, make_year_data['Count'].max() + 100],
             title='Electric Vehicle Makes Over Time',
             labels={'Count': 'Number of Vehicles', 'Make': 'EV Make'})

# Show the animated bar chart
```

```
fig.show()
```

[ ]:

```
```

[ ]:

```
```

[ ]:

```
```