project

December 19, 2024

video link - https://photos.app.goo.gl/8729ZBuzhP28cNDt9

1 ELECTRIC VEHICLE DATA ANALYSIS PROJECT

In this project, We will analyze a dataset related to electric vehicles (EVs). The dataset contains various features such as electric range, energy consumption, price, and other relevantattributes.Our goal is to conduct a thorough analysis to uncover meaningful insights, tell a compelling story, conduct hypothesis testing.

Importing required libraries for the Project

[4]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import scipy.stats as stats
```

Uploading the data set of the EV vehicles and checking the avialable details using the .head() function to get the overview of the data

[6]:
```
ev_df = pd.read_excel("FEV-data-Excel.xlsx ")
ev_df.head()
```

[6]:

	Car full name	Make	Model	Minimal price (gross) [PLN]	Engine power [KM]	Maximum torque [Nm]	Type of brakes	Drive type	Battery capacity [kWh]	Range (WLTP) [km]
0	Audi e-tron 55 quattro	Audi	e-tron 55 quattro	345700	360	664	disc (front + rear)	4WD	95.0	438
1	Audi e-tron 50 quattro	Audi	e-tron 50 quattro	308400	313	540				
2	Audi e-tron S quattro	Audi	e-tron S quattro	414900	503	973				
3	Audi e-tron Sportback 50 quattro	Audi	e-tron Sportback 50 quattro	319700	313	540				
4	Audi e-tron Sportback 55 quattro	Audi	e-tron Sportback 55 quattro	357000	360	664				

```
1  disc (front + rear)        4WD                    71.0                340
2  disc (front + rear)        4WD                    95.0                364
3  disc (front + rear)        4WD                    71.0                346
4  disc (front + rear)        4WD                    95.0                447

   …  Permissable gross weight [kg]  Maximum load capacity [kg]  \
0  …                         3130.0                      640.0
1  …                         3040.0                      670.0
2  …                         3130.0                      565.0
3  …                         3040.0                      640.0
4  …                         3130.0                      670.0

   Number of seats  Number of doors  Tire size [in]  Maximum speed [kph]  \
0                5                5              19                  200
1                5                5              19                  190
2                5                5              20                  210
3                5                5              19                  190
4                5                5              19                  200

   Boot capacity (VDA) [l]  Acceleration 0-100 kph [s]  \
0                    660.0                         5.7
1                    660.0                         6.8
2                    660.0                         4.5
3                    615.0                         6.8
4                    615.0                         5.7

   Maximum DC charging power [kW]  mean - Energy consumption [kWh/100 km]
0                             150                                   24.45
1                             150                                   23.80
2                             150                                   27.55
3                             150                                   23.30
4                             150                                   23.85

[5 rows x 25 columns]
```

1.1 Task 1 : Filtering EV Dataset Based on Conditions

First lets start by filtering the EVs for a customer who has a budget of 350,000 PLN and he wants a minimum Range of EV to be 400 KM.

[9]:
```
""" Task 1 """
filter_data=ev_df[(ev_df["Minimal price (gross) [PLN]"] <= 350000) &␣
 ↪(ev_df["Range (WLTP) [km]"] >= 400)]
sorted_by_price = filter_data.sort_values(by=["Minimal price (gross)␣
 ↪[PLN]"],ascending = False)
display(sorted_by_price)
```

	Car full name	Make	\
0	Audi e-tron 55 quattro	Audi	
22	Mercedes-Benz EQC	Mercedes-Benz	
8	BMW iX3	BMW	
41	Tesla Model 3 Performance	Tesla	
40	Tesla Model 3 Long Range	Tesla	
49	Volkswagen ID.4 1st	Volkswagen	
39	Tesla Model 3 Standard Range Plus	Tesla	
48	Volkswagen ID.3 Pro S	Volkswagen	
15	Hyundai Kona electric 64kWh	Hyundai	
18	Kia e-Niro 64kWh	Kia	
20	Kia e-Soul 64kWh	Kia	
47	Volkswagen ID.3 Pro Performance	Volkswagen	

	Model	Minimal price (gross) [PLN]	\
0	e-tron 55 quattro	345700	
22	EQC	334700	
8	iX3	282900	
41	Model 3 Performance	260490	
40	Model 3 Long Range	235490	
49	ID.4 1st	202390	
39	Model 3 Standard Range Plus	195490	
48	ID.3 Pro S	179990	
15	Kona electric 64kWh	178400	
18	e-Niro 64kWh	167990	
20	e-Soul 64kWh	160990	
47	ID.3 Pro Performance	155890	

	Engine power [KM]	Maximum torque [Nm]	Type of brakes	\
0	360	664	disc (front + rear)	
22	408	760	disc (front + rear)	
8	286	400	disc (front + rear)	
41	480	639	disc (front + rear)	
40	372	510	disc (front + rear)	
49	204	310	disc (front) + drum (rear)	
39	285	450	disc (front + rear)	
48	204	310	disc (front) + drum (rear)	
15	204	395	disc (front + rear)	
18	204	395	disc (front + rear)	
20	204	395	disc (front + rear)	
47	204	310	disc (front) + drum (rear)	

	Drive type	Battery capacity [kWh]	Range (WLTP) [km]	…	\
0	4WD	95.0	438	…	
22	4WD	80.0	414	…	
8	2WD (rear)	80.0	460	…	
41	4WD	75.0	567	…	
40	4WD	75.0	580	…	

49	2WD (rear)	77.0	500	…
39	2WD (rear)	54.0	430	…
48	2WD (rear)	77.0	549	…
15	2WD (front)	64.0	449	…
18	2WD (front)	64.0	455	…
20	2WD (front)	64.0	452	…
47	2WD (rear)	58.0	425	…

	Permissable gross weight [kg]	Maximum load capacity [kg]	\
0	3130.0	640.0	
22	2940.0	445.0	
8	2725.0	540.0	
41	NaN	NaN	
40	NaN	NaN	
49	2660.0	661.0	
39	NaN	NaN	
48	2280.0	412.0	
15	2170.0	485.0	
18	2230.0	493.0	
20	1682.0	498.0	
47	2270.0	540.0	

	Number of seats	Number of doors	Tire size [in]	Maximum speed [kph]	\
0	5	5	19	200	
22	5	5	19	180	
8	5	5	19	180	
41	5	5	20	261	
40	5	5	18	233	
49	5	5	20	160	
39	5	5	18	225	
48	5	5	19	160	
15	5	5	17	167	
18	5	5	17	167	
20	5	5	17	167	
47	5	5	18	160	

	Boot capacity (VDA) [l]	Acceleration 0-100 kph [s]	\
0	660.0	5.7	
22	500.0	5.1	
8	510.0	6.8	
41	425.0	3.3	
40	425.0	4.4	
49	543.0	8.5	
39	425.0	5.6	
48	385.0	7.9	
15	332.0	7.6	
18	451.0	7.8	
20	315.0	7.9	

```
47                    385.0                          7.3
```

```
    Maximum DC charging power [kW]  mean - Energy consumption [kWh/100 km]
0                              150                                    24.45
22                             110                                    21.85
8                              150                                    18.80
41                             150                                      NaN
40                             150                                      NaN
49                             125                                    18.00
39                             150                                      NaN
48                             125                                    15.90
15                             100                                    15.40
18                             100                                    15.90
20                             100                                    15.70
47                             100                                    15.40

[12 rows x 25 columns]
```

Now we try to group the above filterd data for the customer based on the Manufacturer.

[11]:
```
"""b) Group them by the manufacturer (Make)"""
group_by_make= filter_data.groupby("Make").agg(Cars_available=("Make","count"))
b=group_by_make.sort_values(by=["Cars_available"],ascending=False)
b
```

[11]:
```
              Cars_available
Make
Tesla                      3
Volkswagen                 3
Kia                        2
Audi                       1
BMW                        1
Hyundai                    1
Mercedes-Benz              1
```

From above we can see above customer specification there are 3 Models available from Tesla 3 Models available from Volkswagen 2 models available fromm kia 1 model each from Audi,BMW,Hyundai,Mercedes-Benz

Moving now we will try compare the Average Battery Capacity for above customer Requriments.

[14]:
```
"""c) Calculate the average battery capacity for each manufacturer. """
avg_capacity_by_make = filter_data.groupby("Make").
 ↪agg(Avg_battery_capacity=("Battery capacity [kWh]","mean"))
a=avg_capacity_by_make.sort_values(by=["Avg_battery_capacity"],ascending=False)
a
```

[14]:
```
              Avg_battery_capacity
Make
```

```
Audi                    95.000000
BMW                     80.000000
Mercedes-Benz           80.000000
Volkswagen              70.666667
Tesla                   68.000000
Hyundai                 64.000000
Kia                     64.000000
```

We can see that based on the above cusotmer requirements the maximum battery capacity afforable is around 95 kWh from Audi and minimum of 64 Kwh from kia.

1.2 Task 2:Finding outliers in mean - Energy consumption [kWh/100 km] Column.

Checking for the NUll values in the mean - Energy consumption [kWh/100 km] Column

[18]:
```
null_values = ev_df["mean - Energy consumption [kWh/100 km]"].isnull().sum()
null_values
```

[18]:
```
9
```

From above we can see there 9 Null values in our mean column which may effect the results which we are gettingso we try to remove this null values and use that Dataet for accurate analysis of outliers

[20]:
```
mean_energy = ev_df.dropna()
mean_energy_2 = mean_energy["mean - Energy consumption [kWh/100 km]"]
null_values_1 = mean_energy_2.isnull().sum()
null_values_1
```

[20]:
```
0
```

We can see Null Values Have been removed so we can proceed for our Outlier Detection.

[22]:
```
mean_energy_2.describe()
```

[22]:
```
count    42.000000
mean     18.610714
std       4.134293
min      13.100000
25%      15.600000
50%      16.875000
75%      22.937500
max      27.550000
Name: mean - Energy consumption [kWh/100 km], dtype: float64
```

1.2.1 Finding Outliers using IQR Method

The Interquartile Range (IQR) method is a popular technique for detecting outliers in a dataset.

Calculating q1,q3 and iqr values for outlier detection.

[24]:
```
q1 = np.quantile(mean_energy_2,0.25)
q3 = np.quantile(mean_energy_2,0.75)
iqr=q3-q1
print(f"The q1 quartile range is:{q1}\nThe q3 quartile range is:{q3}\nThe iqr␣
 ↪for the follwing dataset is:{iqr}")
```

```
The q1 quartile range is:15.6
The q3 quartile range is:22.9375
The iqr for the follwing dataset is:7.3375
```

Creating Upper and Lower bonds for outlier detection using q1,q3 and iqr values .

[25]:
```
upper_bound = q3+(1.5*iqr)
lower_bound = q1-(1.5*iqr)
print(f"The iqr of follwing datset is {iqr},\nThe Upper bound of the␣
 ↪dataset{upper_bound},\nThe Lower bound of the dataset{ lower_bound}")
```

```
The iqr of follwing datset is 7.3375,
The Upper bound of the dataset33.94375,
The Lower bound of the dataset4.593749999999998
```

Checking for outliers values in our mean energy Consumption.

[26]:
```
outliers = mean_energy_2[(mean_energy_2 <= lower_bound) | (mean_energy_2>=␣
 ↪upper_bound)]
print(f'The following are the outliers in the boxplot:\n{outliers}')
```

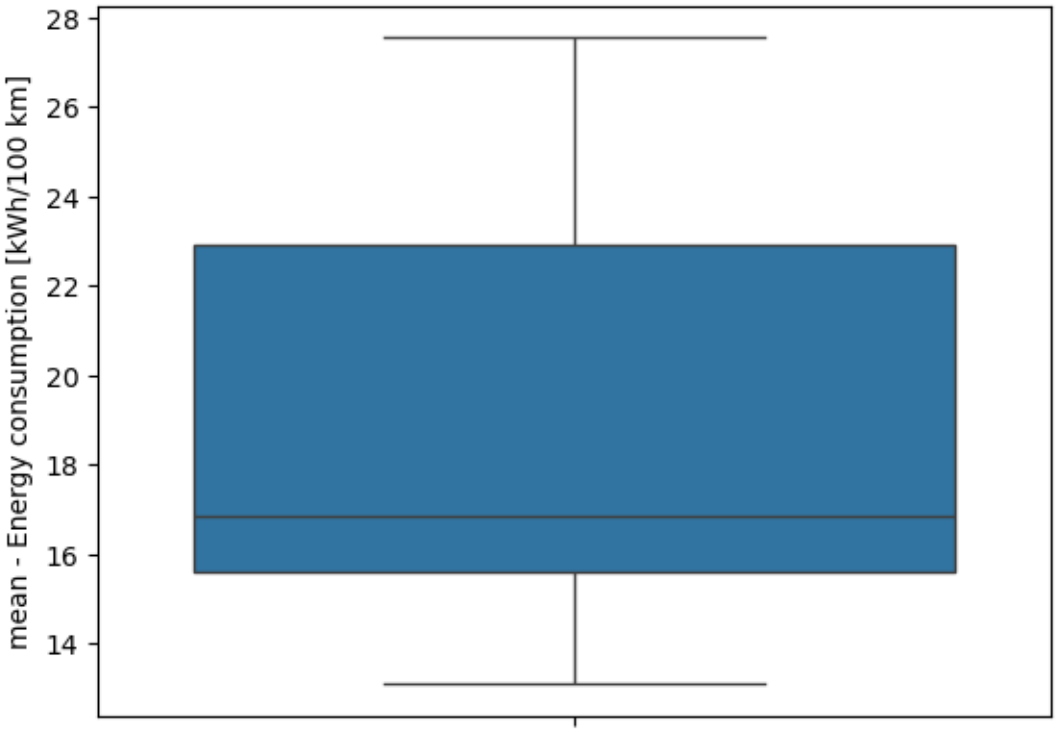
```
The following are the outliers in the boxplot:
Series([], Name: mean - Energy consumption [kWh/100 km], dtype: float64)
```

From the above IQR results we can see that there are no significant Ouliers in our Mean Energy Consumption

1.2.2 Finding Outliers Using Boxplot Visualization

Finding the ouliers in the mean energy compution to double Check our results.For this Task we are choosing the Python in Built visualisation BOXPLOT which is extremely used to find ouliers in an dataset BOXPLOT creates the upper bond and lower bond and point out the data points which are outliers in the dataset

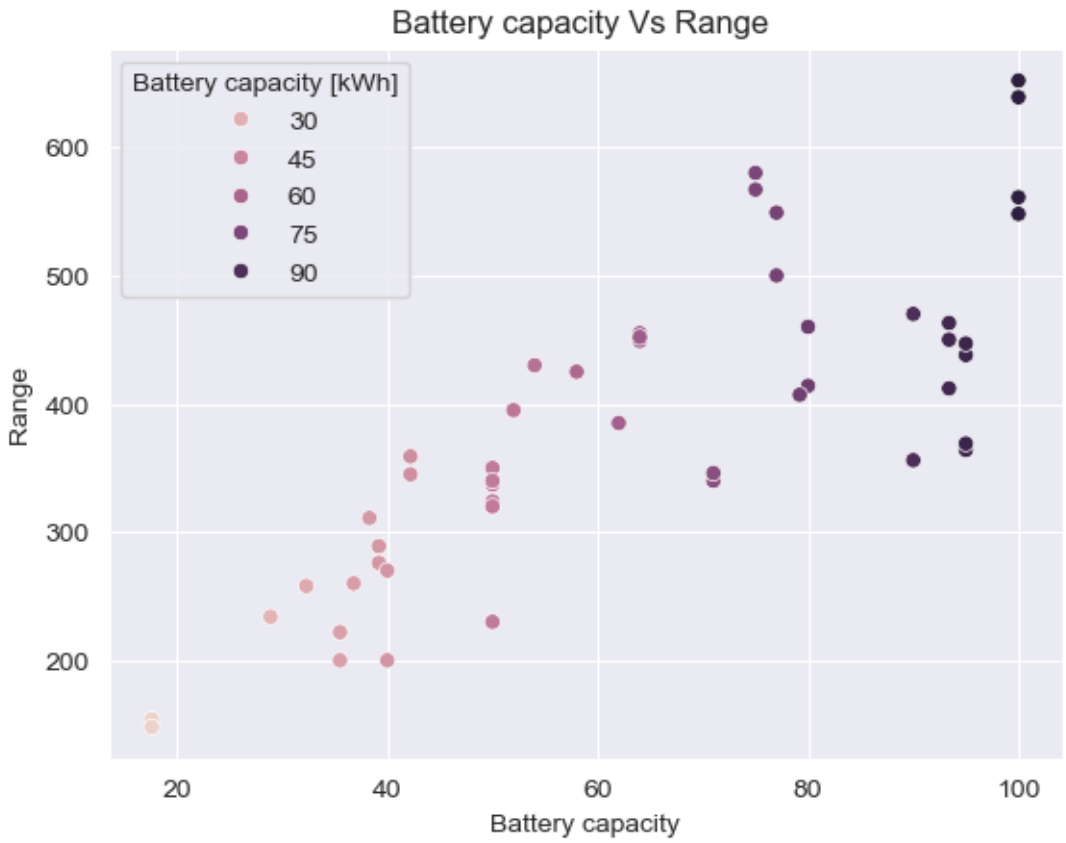
[30]:
```
sns.boxplot(mean_energy_2)
plt.show()
```



From the above Boxplot Visualizationsn we can see that there are no significant Ouliers in our Mean Energy Consumption

1.3 Task 3: Checking For Relationship between Baterry Capacity and Range

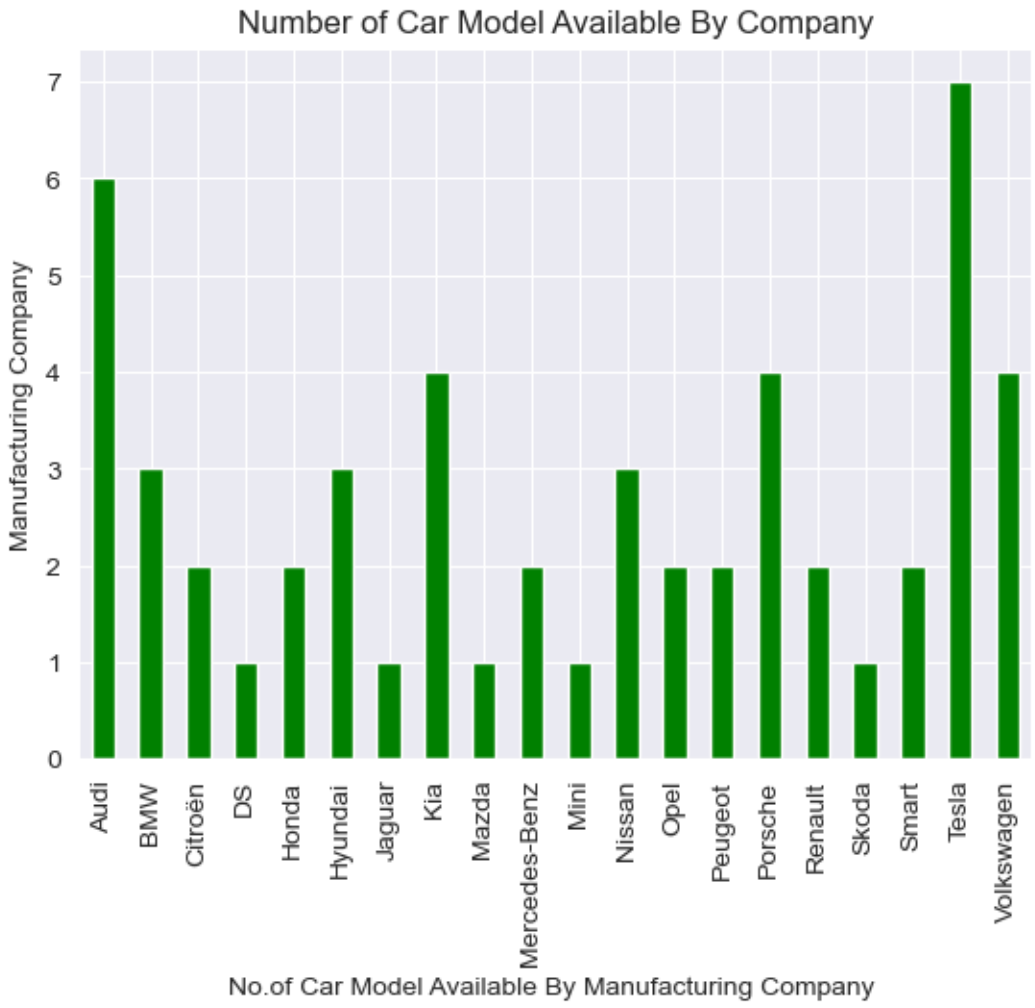
[33]:
```
""" a) Create a suitable plot to visualize."""
sns.set_style("darkgrid")
sns.scatterplot(x="Battery capacity [kWh]",y="Range (WLTP) [km]",data =␣
↪ev_df,hue="Battery capacity [kWh]")
plt.title("Battery capacity Vs Range ")
plt.xlabel("Battery capacity")
plt.ylabel(" Range ")
plt.show()
```



From the above visual we can see that there is a linear realtionship betweeen the Batter Capacity of the EV and Range Of the EV which means the EV models with Higher Battery Capcity are providing the higher Ranges and EV models with lower Battery Capacity are Providing Lower Ranges

1.3.1 Models Manufactured by Each Company

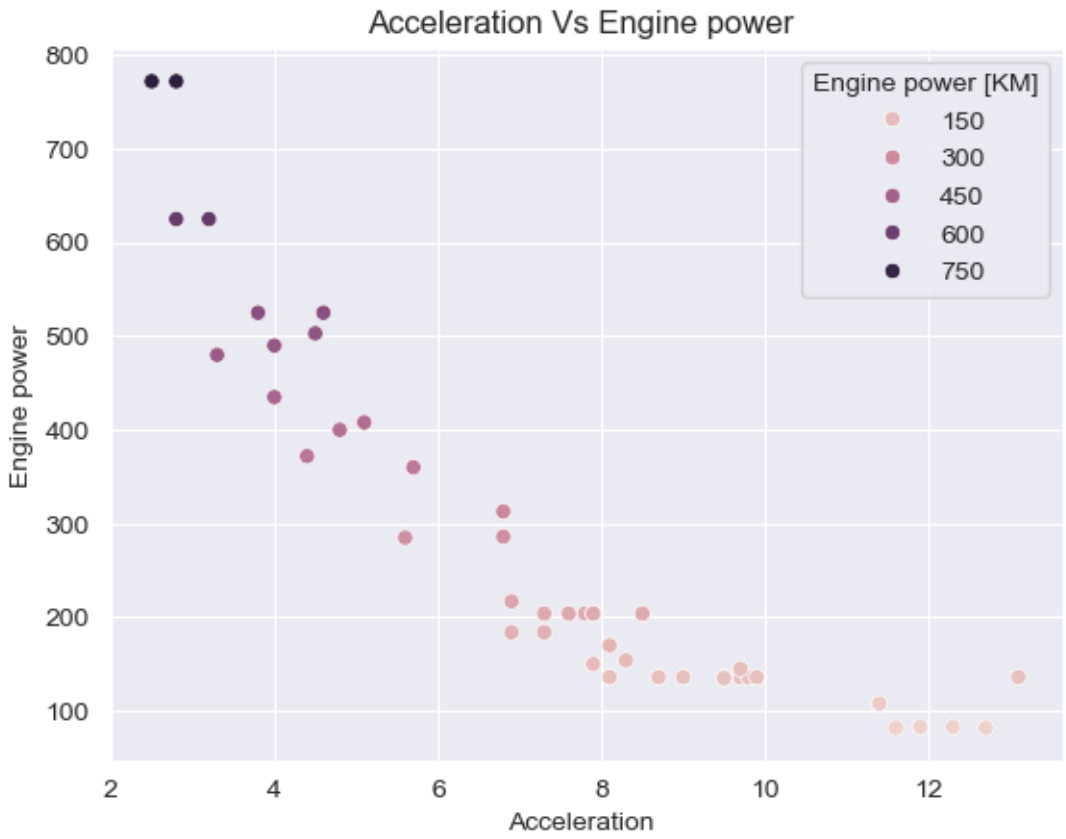
[36]:
```
""" b) Highlight any insights."""
Cars_by_company=ev_df.groupby("Make")["Make"].count()
Cars_by_company
Cars_by_company.plot(kind="bar",color="Green")
plt.title("Number of Car Model Available By Company")
plt.xlabel("No.of Car Model Available By Manufacturing Company ")
plt.ylabel("Manufacturing Company")
plt.show()
```



From the above visual we can see the most number of models from a single company are 7 Models from Tesla 6 Models from Audi 4 Models from 3 Companies -Kia,Porsche,Volkswagen 3 models from 3 MCompanies - BMW,Hyundai,Nissan 2 models from 6 Companies - Citroen,Honda,Opel,Peugeot,Renault,Smart 1 Models from 5 Companies - Skoda,jaguar,Ds,Mini and Mazda

1.3.2 Relationhip Between Acceleration and Engine Power

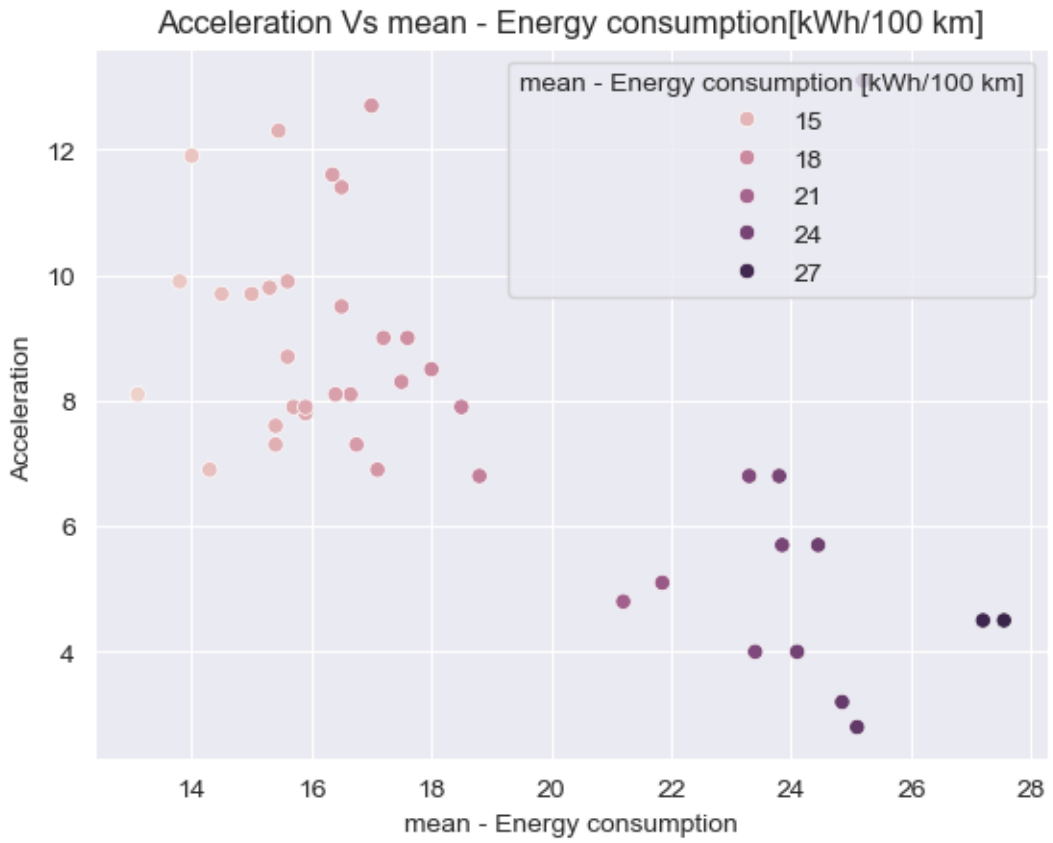
[39]:
```
sns.set_style("darkgrid")
sns.scatterplot(x="Acceleration 0-100 kph [s]",y="Engine power [KM]",data =␣
↪ev_df,hue="Engine power [KM]")
plt.title("Acceleration Vs Engine power ")
plt.xlabel("Acceleration ")
plt.ylabel("Engine power")
plt.show()
```



Now we are trying to see the relationship between the Accerelation and Engine power we can see the the model with the higher engine power are taking less time to accelerate means having Higher acceleration rate we can see the the model with the lower engine power are taking more time to accelerate means having Lower acceleration rate

1.3.3 Relationhip Between Acceleration and Mean Energy Consumption[kWh/100 km]

[42]:
```
sns.set_style("darkgrid")
sns.scatterplot(y="Acceleration 0-100 kph [s]",x="mean - Energy consumption␣
↪[kWh/100 km]",data = ev_df,hue="mean - Energy consumption [kWh/100 km]")
plt.title("Acceleration Vs mean - Energy consumption[kWh/100 km]")
plt.ylabel("Acceleration ")
plt.xlabel("mean - Energy consumption")
plt.show()
```



Now we are trying to see the relationship between the Accerelation and Mean Energy Consumption we can see the the model having Higher acceleration rate means taking less time to reach 0-100kph are consuming more Energy per 100 km we can see the the model having Lower acceleration rate means taking less time to reach 0-100kph are consuming less Energy per 100 km

1.4 Task 4: Build an EV Recommendation Class

For this Task we assigned to make EV Recommendation Class Where the user inputs his specific Budget Allocation, Desired Range, Battery capacity he requires. Then we will Return him the top 3 EV's based on His desired Inputs:

[46]:
```
""" Task 4"""

class ev_recommendation:
    def __init__(self,budget,range_km,battery_capacity):
        self.budget = budget
        self.range_km = range_km
        self.battery_capacity = battery_capacity
        print(f"Your budget Allocation : {self.budget}\nYour Desired Range: ␣
 ↪{self.range_km}\nBattery Capacity Required:  {self.battery_capacity}")
```

```
        if self.budget==0:
             print("Enter Valid Budget")
        elif self.range_km == 0:
            print("Enter Valid Range")
        elif self.battery_capacity == 0:
            print("Enter Valid Battery Capacity")
        else:
            print("The Top Three EV with in given parameters")
            ev_with_in_range=ev_df[(ev_df["Range (WLTP) [km]"]< self.range_km)␣
↪& (ev_df["Battery capacity [kWh]"] < self.battery_capacity) &␣
↪(ev_df["Minimal price (gross) [PLN]"] <=self.budget)]
            top_3_range =ev_with_in_range.nlargest(3,["Range (WLTP) [km]"])
            display("Top 3 Based On Your Desired Range:",top_3_range)
            top_3_battery=ev_with_in_range.nlargest(3,["Minimal price (gross)␣
↪[PLN]"])
            display("Top 3 Based On Your Desired Budget:",top_3_battery)
            top_3_budget=ev_with_in_range.nlargest(3,["Battery capacity [kWh]"])
            display("Top 3 Based On Your Battery Capacity Required:
↪",top_3_budget)
```

1.4.1 User Based Inputs will we given Here

[48]:
```
#first input in budget second input is range third input is Battery Capacity
ev_recommendation(400000,500,80)
```

```
Your budget Allocation : 400000
Your Desired Range:  500
Battery Capacity Required:  80
The Top Three EV with in given parameters
```

```
'Top 3 Based On Your Desired Range:'
```

	Car full name	Make	Model	\
18	Kia e-Niro 64kWh	Kia	e-Niro 64kWh	
20	Kia e-Soul 64kWh	Kia	e-Soul 64kWh	
15	Hyundai Kona electric 64kWh	Hyundai	Kona electric 64kWh	

	Minimal price (gross) [PLN]	Engine power [KM]	Maximum torque [Nm]	\
18	167990	204	395	
20	160990	204	395	
15	178400	204	395	

	Type of brakes	Drive type	Battery capacity [kWh]	\
18	disc (front + rear)	2WD (front)	64.0	
20	disc (front + rear)	2WD (front)	64.0	
15	disc (front + rear)	2WD (front)	64.0	

	Range (WLTP) [km]	…	Permissable gross weight [kg]	\

```
18                455  …                          2230.0
20                452  …                          1682.0
15                449  …                          2170.0

    Maximum load capacity [kg]  Number of seats  Number of doors  \
18                       493.0                5                5
20                       498.0                5                5
15                       485.0                5                5

    Tire size [in]  Maximum speed [kph]  Boot capacity (VDA) [l]  \
18              17                  167                     451.0
20              17                  167                     315.0
15              17                  167                     332.0

    Acceleration 0-100 kph [s]  Maximum DC charging power [kW]  \
18                         7.8                             100
20                         7.9                             100
15                         7.6                             100

    mean - Energy consumption [kWh/100 km]
18                                    15.9
20                                    15.7
15                                    15.4

[3 rows x 25 columns]
'Top 3 Based On Your Desired Budget:'
                        Car full name     Make                          Model  \
3   Audi e-tron Sportback 50 quattro     Audi  e-tron Sportback 50 quattro
1             Audi e-tron 50 quattro     Audi             e-tron 50 quattro
50         Citroën ë-Spacetourer (M)  Citroën             ë-Spacetourer (M)

    Minimal price (gross) [PLN]  Engine power [KM]  Maximum torque [Nm]  \
3                        319700               313                  540
1                        308400               313                  540
50                       215400               136                  260

         Type of brakes   Drive type  Battery capacity [kWh]  \
3   disc (front + rear)          4WD                    71.0
1   disc (front + rear)          4WD                    71.0
50  disc (front + rear)  2WD (front)                    50.0

    Range (WLTP) [km]  …  Permissable gross weight [kg]  \
3                 346  …                         3040.0
1                 340  …                         3040.0
50                230  …                         2810.0

    Maximum load capacity [kg]  Number of seats  Number of doors  \
```

```
3                       640.0                5                5
1                       670.0                5                5
50                     1056.0                8                5

    Tire size [in]  Maximum speed [kph]  Boot capacity (VDA) [l]  \
3               19                  190                    615.0
1               19                  190                    660.0
50              16                  130                    603.0

    Acceleration 0-100 kph [s]  Maximum DC charging power [kW]  \
3                          6.8                             150
1                          6.8                             150
50                        13.1                             100

    mean - Energy consumption [kWh/100 km]
3                                     23.3
1                                     23.8
50                                    25.2

[3 rows x 25 columns]
'Top 3 Based On Your Battery Capacity Required:'
                       Car full name     Make                          Model  \
1              Audi e-tron 50 quattro     Audi             e-tron 50 quattro
3   Audi e-tron Sportback 50 quattro     Audi  e-tron Sportback 50 quattro
15       Hyundai Kona electric 64kWh  Hyundai           Kona electric 64kWh

    Minimal price (gross) [PLN]  Engine power [KM]  Maximum torque [Nm]  \
1                        308400                313                  540
3                        319700                313                  540
15                       178400                204                  395

         Type of brakes   Drive type  Battery capacity [kWh]  \
1   disc (front + rear)          4WD                    71.0
3   disc (front + rear)          4WD                    71.0
15  disc (front + rear)  2WD (front)                    64.0

    Range (WLTP) [km]  …  Permissable gross weight [kg]  \
1                 340  …                         3040.0
3                 346  …                         3040.0
15                449  …                         2170.0

    Maximum load capacity [kg]  Number of seats  Number of doors  \
1                        670.0                5                5
3                        640.0                5                5
15                       485.0                5                5

    Tire size [in]  Maximum speed [kph]  Boot capacity (VDA) [l]  \
```

```
1                19                    190                      660.0
3                19                    190                      615.0
15               17                    167                      332.0

    Acceleration 0-100 kph [s]  Maximum DC charging power [kW]  \
1                          6.8                              150
3                          6.8                              150
15                         7.6                              100

    mean - Energy consumption [kWh/100 km]
1                                     23.8
3                                     23.3
15                                    15.4

[3 rows x 25 columns]
```

[48]:
```
<__main__.ev_recommendation at 0x22d698efb90>
```

1.5 Task 5: Inferential Statistics

We are assigned to test whether there is significant difference between the average Engine power [KM] of vehicles manufactured by two leading manufacturers i.e.Tesla and Audi. For testing we are going to use hypothese testing first lets start with our Null Hypothesis (H0) = There is no siginificant Relationship between the mean engine power of two manufacturers Tesla andd Audi. ALternate Hypothesis(H1) = There is a significant relationship between the mean engine power of two manufacturers Tesla andd Audi. Lets start with preparing our Two sample datasets consisting of engine power of Tesla and Audi

1.5.1 Preparation our Two sample datasets consisting of engine power of Tesla and Audi

Filtering the two datasets of Tesla and Audi from EV dataset.

[53]:
```
"""Task 5: """

tesla = ev_df[ev_df["Make"] == "Tesla"]
display(tesla.head(4))

audi= ev_df[ev_df["Make"] == "Audi"]
display(audi.head(4))
```

```
                        Car full name   Make                          Model  \
39  Tesla Model 3 Standard Range Plus  Tesla  Model 3 Standard Range Plus
40           Tesla Model 3 Long Range  Tesla           Model 3 Long Range
41          Tesla Model 3 Performance  Tesla          Model 3 Performance
42      Tesla Model S Long Range Plus  Tesla      Model S Long Range Plus

    Minimal price (gross) [PLN]  Engine power [KM]  Maximum torque [Nm]  \
39                       195490                285                  450
```

```
40                      235490                372                  510
41                      260490                480                  639
42                      368990                525                  755

         Type of brakes  Drive type  Battery capacity [kWh]  \
39  disc (front + rear)  2WD (rear)                    54.0
40  disc (front + rear)         4WD                    75.0
41  disc (front + rear)         4WD                    75.0
42  disc (front + rear)         4WD                   100.0

    Range (WLTP) [km]  …  Permissable gross weight [kg]  \
39                430  …                           NaN
40                580  …                           NaN
41                567  …                           NaN
42                652  …                           NaN

    Maximum load capacity [kg]  Number of seats  Number of doors  \
39                         NaN                5                5
40                         NaN                5                5
41                         NaN                5                5
42                         NaN                5                5

    Tire size [in]  Maximum speed [kph]  Boot capacity (VDA) [l]  \
39              18                  225                    425.0
40              18                  233                    425.0
41              20                  261                    425.0
42              19                  250                    745.0

    Acceleration 0-100 kph [s]  Maximum DC charging power [kW]  \
39                         5.6                             150
40                         4.4                             150
41                         3.3                             150
42                         3.8                             150

    mean - Energy consumption [kWh/100 km]
39                                     NaN
40                                     NaN
41                                     NaN
42                                     NaN

[4 rows x 25 columns]

                      Car full name  Make                          Model  \
0            Audi e-tron 55 quattro  Audi             e-tron 55 quattro
1            Audi e-tron 50 quattro  Audi             e-tron 50 quattro
2             Audi e-tron S quattro  Audi              e-tron S quattro
3  Audi e-tron Sportback 50 quattro  Audi  e-tron Sportback 50 quattro
```

```
   Minimal price (gross) [PLN]  Engine power [KM]  Maximum torque [Nm]  \
0                       345700               360                  664
1                       308400               313                  540
2                       414900               503                  973
3                       319700               313                  540

        Type of brakes Drive type  Battery capacity [kWh]  Range (WLTP) [km]  \
0  disc (front + rear)        4WD                    95.0                438
1  disc (front + rear)        4WD                    71.0                340
2  disc (front + rear)        4WD                    95.0                364
3  disc (front + rear)        4WD                    71.0                346

   …  Permissable gross weight [kg]  Maximum load capacity [kg]  \
0  …                         3130.0                       640.0
1  …                         3040.0                       670.0
2  …                         3130.0                       565.0
3  …                         3040.0                       640.0

   Number of seats  Number of doors  Tire size [in]  Maximum speed [kph]  \
0                5                5              19                  200
1                5                5              19                  190
2                5                5              20                  210
3                5                5              19                  190

   Boot capacity (VDA) [l]  Acceleration 0-100 kph [s]  \
0                    660.0                         5.7
1                    660.0                         6.8
2                    660.0                         4.5
3                    615.0                         6.8

   Maximum DC charging power [kW]  mean - Energy consumption [kWh/100 km]
0                             150                                   24.45
1                             150                                   23.80
2                             150                                   27.55
3                             150                                   23.30

[4 rows x 25 columns]
```

1.5.2 Creating and Checking The Two Sample Datasets for any error and null values

In this phase we try to create the sample datasets For Hypothesis Testing for Engine Power

[56]:
```
tesla_engine=tesla[["Engine power [KM]"]]
display(tesla_engine)
audi_engine = audi[["Engine power [KM]"]]
display(audi_engine)
```

```
    Engine power [KM]
39                285
40                372
41                480
42                525
43                772
44                525
45                772
```

```
   Engine power [KM]
0                360
1                313
2                503
3                313
4                360
5                503
```

We can see there are no null values and erroe so we can proceed with this data for Hypothesis testing. The two sample datasets are small and independent datasets so we can go ahead with the Two Sample T Test

1.5.3 Checking the Variences Of the Sample Datasets

To Conduct Two sample T test First of all we have check the varience of the Two Sample datasets

[60]:
```
tesla_var = np.var(tesla["Engine power [KM]"])
audi_var = np.var(audi["Engine power [KM]"])
print("The Varience of Tesla Dataset:",tesla_var,"\nThe Varience of Audi␣
 ↪Dataset:",audi_var)
```

```
The Varience of Tesla Dataset: 29229.14285714286
The Varience of Audi Dataset: 6528.666666666667
```

We can see ther differene between ratio of the two datasets is Greater than 4:1

1.5.4 Performing Two Sample T Test

Now with the Sample datasts ready and variences is known we conduct the Two Sample T test

[64]:
```
statistic,p_value=stats.
 ↪ttest_ind(tesla_engine,audi_engine,equal_var=False)#varience not in raio of␣
 ↪4:1
print("The Two Sample T test Results:")
print(f"T Statistic:{statistic}")
print(f"P-Value:{p_value}")
```

```
The Two Sample T test Results:
T Statistic:[1.79399518]
P-Value:[0.10684105]
```

1.5.5 Interpreting the T- Test Results

Based on the P value of 0.10684105 from the Two Sample T-Tet we can verifying the Hyothesis we made. we are Taking Significance level(alpha) =0.05(confidence level of 95%)

[67]:
```
alpha = 0.05
if p_value < 0.05:
    print("We Reject The Null Hypothesis.There is a signigicant Difference␣
 ↪between both Tesla and Audi Mean Energy Power")
else:
    print("We Fail to Reject the NUll Hypotheses Means\nWe do not have␣
 ↪sufficient evidence to say that the mean Engine Power between the two data␣
 ↪groups Tesla and Audi is different.")
```

```
We Fail to Reject the NUll Hypotheses Means
We do not have sufficient evidence to say that the mean Engine Power between the
two data groups Tesla and Audi is different.
```

Here, since the p-value (0.10684105) is greater than alpha = 0.05 so we cannot reject the null hypothesis of the test. We do not have sufficient evidence to say that the mean Engine Power between the two data groups Tesla and Audi is different.

[ ]:

[ ]: