Electric Vehicle Data Analysis Project

In [ ]:

```python
# First import all necessary libraries

import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
from scipy.stats import ttest_ind
```

In [ ]:

```python
# Load dataset

EV = pd.read_csv("/content/Electric_Vehicle.csv")
```

In [ ]:

```python
# To check all the columns in the data set
EV.columns
```

Out[ ]:

```
Index(['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]',
       'Wheelbase [cm]', 'Length [cm]', 'Width [cm]', 'Height [cm]',
       'Minimal empty weight [kg]', 'Permissable gross weight [kg]',
       'Maximum load capacity [kg]', 'Number of seats', 'Number of doors',
       'Tire size [in]', 'Maximum speed [kph]', 'Boot capacity (VDA) [l]',
       'Acceleration 0-100 kph [s]', 'Maximum DC charging power [kW]',
       'mean - Energy consumption [kWh/100 km]'],
      dtype='object')
```

In [ ]:

```python
# Filling the empty values with 'zero'
mean_energy = ['mean - Energy consumption [kWh/100 km]']
EV[mean_energy] = EV[mean_energy].fillna(0)
```

In [ ]:

```python
# Seeing the first five rows of the dataset
EV.head()
```

Out[ ]:

	Car full name	Make	Model	Minimal price (gross) [PLN]	Engine power [KM]	Maximum torque [Nm]	Type of brakes	Drive type	Batte capaci [kW
0	Audi e-tron 55 quattro	Audi	e-tron 55 quattro	345700	360	664	disc (front + rear)	4WD	9
1	Audi e-tron 50 quattro	Audi	e-tron 50 quattro	308400	313	540	disc (front + rear)	4WD	7
2	Audi e-tron S quattro	Audi	e-tron S quattro	414900	503	973	disc (front + rear)	4WD	9
3	Audi e-tron Sportback 50 quattro	Audi	e-tron Sportback 50 quattro	319700	313	540	disc (front + rear)	4WD	7
4	Audi e-tron Sportback 55 quattro	Audi	e-tron Sportback 55 quattro	357000	360	664	disc (front + rear)	4WD	9

5 rows × 25 columns

TASK 1

In [ ]:

```
# Task 1: A customer has a budget of 350,000 PLN and
# wants an EV with a minimum range of 400 km.
# a) Your task is to filter out EVs that meet these criteria.(2 Marks)
# b) Group them by the manufacturer (Make).(6 marks)
# c) Calculate the average battery capacity for each manufacturer. (8 Marks)
```

In [ ]:

```
# a) Your task is to filter out EVs that meet these criteria.(2 Marks)

filtered_EV = EV[(EV['Minimal price (gross) [PLN]'] <= 350000) &
                 (EV['Range (WLTP) [km]'] >= 400)]
filtered_EV.head()
```

Out[ ]:

	Car full name	Make	Model	Minimal price (gross) [PLN]	Engine power [KM]	Maximum torque [Nm]	Type of brakes	Drive type	Batte capaci [kW
0	Audi e-tron 55 quattro	Audi	e-tron 55 quattro	345700	360	664	disc (front + rear)	4WD	95
8	BMW iX3	BMW	iX3	282900	286	400	disc (front + rear)	2WD (rear)	80
15	Hyundai Kona electric 64kWh	Hyundai	Kona electric 64kWh	178400	204	395	disc (front + rear)	2WD (front)	64
18	Kia e-Niro 64kWh	Kia	e-Niro 64kWh	167990	204	395	disc (front + rear)	2WD (front)	64
20	Kia e-Soul 64kWh	Kia	e-Soul 64kWh	160990	204	395	disc (front + rear)	2WD (front)	64

5 rows × 25 columns

In [ ]:

```
# b) Group them by the manufacturer (Make).(6 marks)

group_make = filtered_EV.groupby("Make")
group_make.size()
```

Out[ ]:

	0
Make	
Audi	1
BMW	1
Hyundai	1
Kia	2
Mercedes-Benz	1
Tesla	3
Volkswagen	3

dtype: int64

In [ ]:

```
# c) Calculate the average battery capacity for each manufacturer. (8 Marks)
```

```
avg_battery_capacity = group_make["Battery capacity [kWh]"].mean()
avg_battery_capacity.sort_values(ascending= False)
```

Out[ ]:

	Battery capacity [kWh]
Make	
Audi	95.000000
BMW	80.000000
Mercedes-Benz	80.000000
Volkswagen	70.666667
Tesla	68.000000
Hyundai	64.000000
Kia	64.000000

dtype: float64

In [ ]:

```
```

TASK 2

In [ ]:

```
# Task 2: You suspect some EVs have unusually high or low energy consumption.
# Find the outliers in the mean - Energy consumption [kWh/100 km] column.(16 M
```

In [ ]:

```
# first get the column
energy = EV['mean - Energy consumption [kWh/100 km]']

# finding Q1, Q3, IQR
Q1 = energy.quantile(0.25)
Q3 = energy.quantile(0.75)
IQR = Q3 - Q1

# Defining outliers bound
LowerBound = Q1 - 1.5 * IQR
UpperBound = Q3 + 1.5 * IQR

# Filtering of outliers from datset

answer = EV[(energy < LowerBound) | (energy > UpperBound)]
answer
```

Out[ ]:

	Car full name	Make	Model	Minimal price (gross) [PLN]	Engine power [KM]	Maximum torque [Nm]	Type of brakes	Drive type
9	Citroën ë-C4	Citroën	ë-C4	125000	136	260	disc (front + rear)	2WD (front)
29	Peugeot e-2008	Peugeot	e-2008	149400	136	260	disc (front + rear)	2WD (front)
39	Tesla Model 3 Standard Range Plus	Tesla	Model 3 Standard Range Plus	195490	285	450	disc (front + rear)	2WD (rear)
40	Tesla Model 3 Long Range	Tesla	Model 3 Long Range	235490	372	510	disc (front + rear)	4WD
41	Tesla Model 3 Performance	Tesla	Model 3 Performance	260490	480	639	disc (front + rear)	4WD
42	Tesla Model S Long Range Plus	Tesla	Model S Long Range Plus	368990	525	755	disc (front + rear)	4WD
43	Tesla Model S Performance	Tesla	Model S Performance	443990	772	1140	disc (front + rear)	4WD
44	Tesla Model X Long Range Plus	Tesla	Model X Long Range Plus	407990	525	755	disc (front + rear)	4WD
45	Tesla Model X Performance	Tesla	Model X Performance	482990	772	1140	disc (front + rear)	4WD

9 rows × 25 columns

In [ ]:

```
```

TASK 3

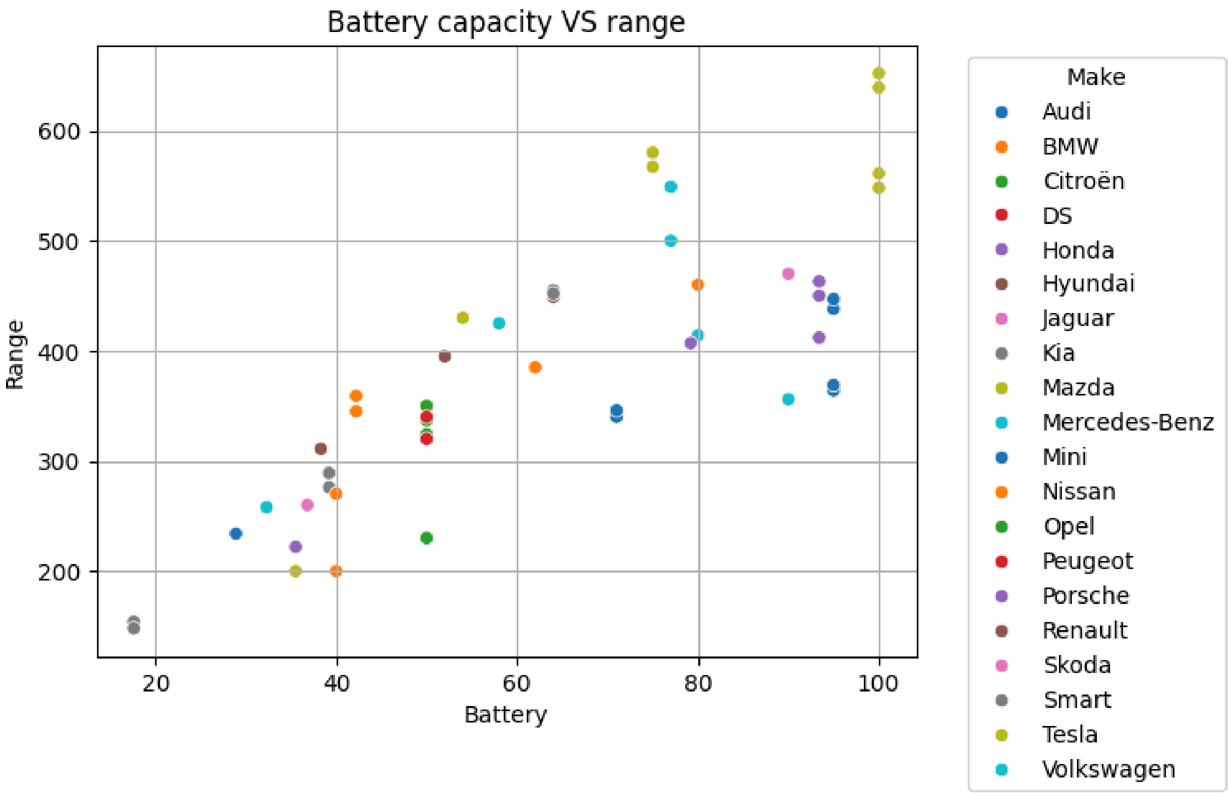
In [ ]:

```
# Task 3: Your manager wants to know if there's a strong relationship
# between battery capacity and range.
# a) Create a suitable plot to visualize.(8 Marks)
# b) Highlight any insights.(8 Marks)
```

In [ ]:

```
# a) Create a suitable plot to visualize.(8 Marks)
```

```
sns.scatterplot(data = EV,
                x = 'Battery capacity [kWh]',
                y = 'Range (WLTP) [km]',
                hue = 'Make',
                palette='tab10')
plt.title("Battery capacity VS range")
plt.xlabel("Battery")
plt.ylabel("Range")
plt.legend(title='Make', bbox_to_anchor=(1.05, 1),loc='upper left')
plt.grid(True)
plt.show()
```



In [ ]:

```
# b) Highlight any insights.(8 Marks)

float(EV['Battery capacity [kWh]'].corr(EV['Range (WLTP) [km]']))
# a positive correlation is observed between battery capacity and vehicle rang
```

Out[ ]:

```
0.8104385771936846
```

TASK 4

In [ ]:

```
# Task 4: Build an EV recommendation class.
# The class should allow users to input their
# budget, desired range, and battery capacity.
# The class should then return the top three EVs
# matching their criteria. (8+8 Marks)
```

In [ ]:

```
class EVRecommend:
  def __init__(self,EV_data):
    self.EV_data = EV_data

  def recommend(self, budget, min_range, minimum_capacity):
    recommendation = self.EV_data[
                    (self.EV_data["Minimal price (gross) [PLN]"] <= budget) &
                    (self.EV_data["Range (WLTP) [km]"] >= min_range) &
                    (self.EV_data["Battery capacity [kWh]"]>= minimum_capacity
    sort_reccommends = recommendation.sort_values(
                        by=["Minimal price (gross) [PLN]",
                            "Range (WLTP) [km]",
                            "Battery capacity [kWh]"],
                        ascending=[True,False,False])
    return sort_reccommends[["Car full name",
                             "Make",
                             "Model",
                             "Minimal price (gross) [PLN]",
                             "Range (WLTP) [km]","Battery capacity [kWh]",
                             "mean - Energy consumption [kWh/100 km]",
                             "Maximum speed [kph]"]
                            ].head(3)

Budget = int(input("Enter your Budget: "))
Desired_range = int(input("Enter minimum range of vehicle: "))
Battery_capacity = int(input("Enter minimum capacity of battery: "))
recommender = EVRecommend(EV)
recommender.recommend(Budget, Desired_range, Battery_capacity)
```

```
Enter your Budget: 200000
Enter minimum range of vehicle: 250
Enter minimum capacity of battery: 60
```

Out[ ]:

	Car full name	Make	Model	Minimal price (gross) [PLN]	Range (WLTP) [km]	Battery capacity [kWh]	mean - Energy consumption [kWh/100 km]	Maximum speed [kph]
20	Kia e-Soul 64kWh	Kia	e-Soul 64kWh	160990	452	64.0	15.7	167
25	Nissan Leaf e+	Nissan	Leaf e+	164000	385	62.0	17.1	157
18	Kia e-Niro 64kWh	Kia	e-Niro 64kWh	167990	455	64.0	15.9	167

In [ ]:

TASK 5

In [ ]:
```
# Task 5: Inferential Statistics – Hypothesis Testing:
# Test whether there is a significant
# difference in the average Engine power [KM] of vehicles manufactured
# by two leading manufacturers i.e. Tesla and Audi.
# What insights can you draw from the test results?
# Recommendations and Conclusion:
# Provide actionable insights based on your analysis.
# Conduct a two sample t-test using ttest_ind from scipy.stats module(16 Marks
```

In [ ]:
```
# H0 --> There is no significant difference in average engine power
#         between two leading manufactures "Tesla" and "Audi"

# H1 --> There is a significant difference in average engine power
#         between two leading manufactures "Tesla" and "Audi"
```

In [ ]:
```
# storing tesla and audi average engine power

tesla_power = EV[EV['Make'] == "Tesla"]["Engine power [KM]"]
audi_power = EV[EV['Make'] == "Audi"]["Engine power [KM]"]

# mean engine power of tesla and audi
tesla_power_mean = tesla_power.mean()
audi_power_mean = audi_power.mean()

# T-Test
t_stat, p_value = ttest_ind(tesla_power,audi_power,equal_var= False)

print("Tesla mean engine power: {:.2f} [KM]".format(tesla_power_mean))
print("Audi mean engine power: {:.2f} [KM]".format(audi_power_mean))
print("T-statistic: {:.2f}".format(t_stat))
print("P_Value: {:.4f}".format(p_value))
```

```
Tesla mean engine power: 533.00 [KM]
Audi mean engine power: 392.00 [KM]
T-statistic: 1.79
P_Value: 0.1068
```

In [ ]:
```
# Significance level

alpha = 0.05
if (p_value < alpha):
  print("We reject null hypothesis.There is a significant difference in averag
else:
  print("We fail to reject null hypothesis. There is no significant difference
```

```
We fail to reject null hypothesis. There is no significant difference in averag
e engine power between two leading manufactures Tesla and Audi
```

In [ ]:
```
# INTERPRETATION :
```

```
# Although Tesla’s vehicles have a higher average engine power compared to Auc
# the t-test results show a p-value of 0.1068, which is greater than the
# 0.05 significance level.
# This means that the observed difference is not statistically significant
# at the 5% level.
```

In [ ]:

```
# CONCLUSION:

# Based on the available data, we do not have enough evidence to claim
# a significant difference in average engine power between Tesla and Audi EVs.
# While Tesla tends to have higher power on average,
# this difference could be due to sample variability.
```

TASK 6

In [ ]:

```
# Task 6: Project Video Explanation (20 Marks)
# Record a brief video explaining your project,
# covering its objectives, methods, and outcomes.
# The evaluation will focus on clarity of
# explanation, communication skills, and demonstration of
# problem understanding.
```

Video Submission

In [ ]:

```
```