```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from scipy import stats
df = pd.read_excel('FEV-data-Excel.xlsx')
df.head()
```

```
                       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

4  Audi e-tron Sportback 55 quattro  Audi  e-tron Sportback 55 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

4                       357000                360                  664


        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
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]

#Task1(a)
filtered_df = df[(df['Minimal price (gross) [PLN]'] <= 350000) &
(df['Range (WLTP) [km]'] >= 400)]
filtered_df

                        Car full name           Make  \
0              Audi e-tron 55 quattro           Audi
8                            BMW iX3            BMW
15         Hyundai Kona electric 64kWh        Hyundai
18                  Kia e-Niro 64kWh            Kia
20                  Kia e-Soul 64kWh            Kia
22                   Mercedes-Benz EQC  Mercedes-Benz
39  Tesla Model 3 Standard Range Plus          Tesla
```

```
40          Tesla Model 3 Long Range          Tesla
41         Tesla Model 3 Performance          Tesla
47   Volkswagen ID.3 Pro Performance     Volkswagen
48             Volkswagen ID.3 Pro S     Volkswagen
49               Volkswagen ID.4 1st     Volkswagen

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

    Engine power [KM]  Maximum torque [Nm]               Type of brakes
\
0                 360                  664         disc (front + rear)

8                 286                  400         disc (front + rear)

15                204                  395         disc (front + rear)

18                204                  395         disc (front + rear)

20                204                  395         disc (front + rear)

22                408                  760         disc (front + rear)

39                285                  450         disc (front + rear)

40                372                  510         disc (front + rear)

41                480                  639         disc (front + rear)

47                204                  310  disc (front) + drum (rear)

48                204                  310  disc (front) + drum (rear)

49                204                  310  disc (front) + drum (rear)


     Drive type  Battery capacity [kWh]  Range (WLTP) [km]  ...  \
0           4WD                    95.0                438  ...
8    2WD (rear)                    80.0                460  ...
15  2WD (front)                    64.0                449  ...
```

```
18  2WD (front)                    64.0                 455  ...
20  2WD (front)                    64.0                 452  ...
22          4WD                    80.0                 414  ...
39   2WD (rear)                    54.0                 430  ...
40          4WD                    75.0                 580  ...
41          4WD                    75.0                 567  ...
47   2WD (rear)                    58.0                 425  ...
48   2WD (rear)                    77.0                 549  ...
49   2WD (rear)                    77.0                 500  ...

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

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

```
160

    Boot capacity (VDA) [l]  Acceleration 0-100 kph [s]  \
0                     660.0                         5.7
8                     510.0                         6.8
15                    332.0                         7.6
18                    451.0                         7.8
20                    315.0                         7.9
22                    500.0                         5.1
39                    425.0                         5.6
40                    425.0                         4.4
41                    425.0                         3.3
47                    385.0                         7.3
48                    385.0                         7.9
49                    543.0                         8.5

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

[12 rows x 25 columns]
```

```
#Task 1(b)
grouped_by_make = filtered_df.groupby('Make')
grouped_by_make
```

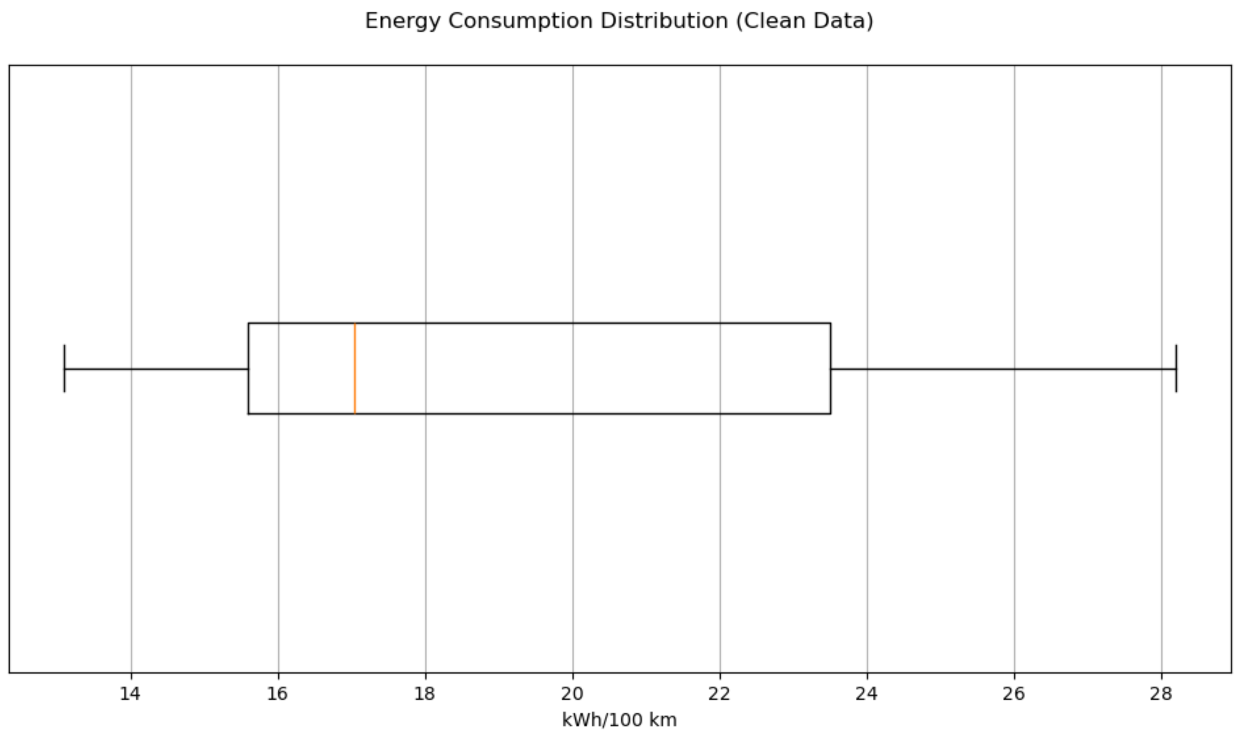
```
<pandas.core.groupby.generic.DataFrameGroupBy object at
0x000001EA1241DD60>
```

```python
#Task 1(c)
avg_battery_capacity = grouped_by_make['Battery capacity
[kWh]'].mean()
avg_battery_capacity
```

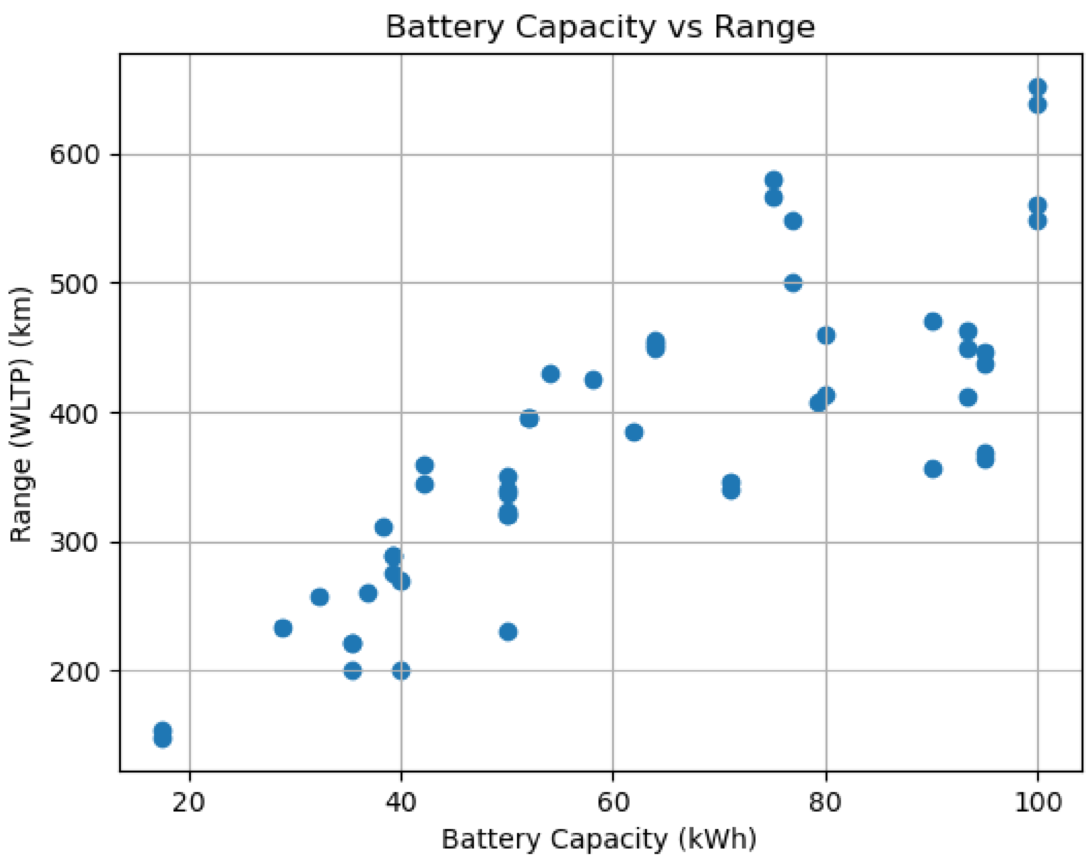
```
Make
Audi             95.000000
BMW              80.000000
Hyundai          64.000000
Kia              64.000000
Mercedes-Benz    80.000000
Tesla            68.000000
Volkswagen       70.666667
Name: Battery capacity [kWh], dtype: float64
```

```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from scipy import stats
df = pd.read_excel("FEV-data-Excel.xlsx")
column_name = 'Mean - Energy consumption [kWh/100 km]'
if 'mean - Energy consumption [kWh/100 km]' in df.columns:
    column_name = 'mean - Energy consumption [kWh/100 km]'
iqr_outliers = df[
    (df[column_name] < (df[column_name].quantile(0.25) -
1.5*(df[column_name].quantile(0.75)-df[column_name].quantile(0.25))))
|
    (df[column_name] > (df[column_name].quantile(0.75) +
1.5*(df[column_name].quantile(0.75)-df[column_name].quantile(0.25))))
].dropna(subset=[column_name])

clean_df = df.dropna(subset=[column_name]).copy()
z_scores = np.abs(stats.zscore(clean_df[column_name]))
z_outliers = clean_df[z_scores > 3]

plt.figure(figsize=(12, 6))
plt.boxplot(clean_df[column_name], vert=False)
plt.title("Energy Consumption Distribution (Clean Data)", pad=20)
plt.xlabel("kWh/100 km")
plt.yticks([])
plt.grid(True)

for i, x in enumerate(z_outliers[column_name]):
    plt.plot(x, 1, 'ro', alpha=0.5)
    plt.text(x, 1.1, f"{x:.1f}", ha='center')

plt.show()
```

```
final_outliers = pd.concat([iqr_outliers,
z_outliers]).drop_duplicates()
print(f"Total outliers found: {len(final_outliers)}")
```




```
Total outliers found: 0

#Task 3
import matplotlib.pyplot as plt

plt.scatter(df['Battery capacity [kWh]'], df['Range (WLTP) [km]'])
plt.xlabel('Battery Capacity (kWh)')
plt.ylabel('Range (WLTP) (km)')
plt.title('Battery Capacity vs Range')
plt.grid(True)
plt.show()
```




```
"""
Task 3 Insights :
This is being clear from the chart that the battery capacity is
directly correalted by the Range of the EV but after 80 KWh Capacity
the range is more or less stangnent in under 500 Kilometers.
"""

#Task 4
class EVRecommendation:
    def __init__(self, data):
        self.data = data

    def recommend(self, budget, min_range, min_battery):
        filtered = self.data[(self.data['Minimal price (gross) [PLN]']
<= budget) &
                             (self.data['Range (WLTP) [km]'] >=
min_range) &
                             (self.data['Battery capacity [kWh]'] >=
min_battery)]
        return filtered.sort_values('Minimal price (gross)
[PLN]').head(3)
```

```
recommender = EVRecommendation(df)
recommender.recommend(300000, 350, 50)

       Car full name     Make     Model  Minimal price (gross)
[PLN]  \
9       Citroën ë-C4  Citroën      ë-C4                         125000

34  Renault Zoe R110  Renault  Zoe R110                         135900

35  Renault Zoe R135  Renault  Zoe R135                         142900


    Engine power [KM]  Maximum torque [Nm]       Type of brakes
Drive type  \
9                 136                  260  disc (front + rear)  2WD
(front)
34                108                  225  disc (front + rear)  2WD
(front)
35                135                  245  disc (front + rear)  2WD
(front)

    Battery capacity [kWh]  Range (WLTP) [km]  ...  \
9                     50.0                350  ...
34                    52.0                395  ...
35                    52.0                395  ...

    Permissable gross weight [kg]  Maximum load capacity [kg]  \
9                          2000.0                       459.0
34                         1988.0                       425.0
35                         1988.0                       486.0

    Number of seats  Number of doors  Tire size [in]  Maximum speed
[kph]  \
9                 5                5              16
150
34                5                5              15
135
35                5                5              16
140

    Boot capacity (VDA) [l]  Acceleration 0-100 kph [s]  \
9                     380.0                         9.5
34                    338.0                        11.4
35                    338.0                         9.5

    Maximum DC charging power [kW]  mean - Energy consumption [kWh/100
km]
9                              100
NaN
34                              50
```

```
16.5
35                                50
16.5

[3 rows x 25 columns]

#Task 5
from scipy.stats import ttest_ind

tesla = df[df['Make'] == 'Tesla']['Engine power [KM]']
audi = df[df['Make'] == 'Audi']['Engine power [KM]']

t_stat, p_value = ttest_ind(tesla, audi, equal_var=False)
print('t-statistic:', t_stat)
print('p-value:', p_value)


t-statistic: 1.7939951827297178
p-value: 0.10684105068839565

"""
KEY INSIGHTS :
Based on a two-sample t-test (p = 0.1068 > 0.05), there is no
significant difference in engine power between Tesla and Audi vehicles
in the dataset.
Although Tesla may appear to have slightly higher engine power on
average,the difference is not statistically significant.
"""
```