In [2]:
```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from scipy.stats import ttest_ind
```

In [15]:
```python
# Load the dataset
df = pd.read_csv(r"electric.csv")

df.head()
```

Out[15]:

	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]	...	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]	Maximu D chargir pow [kV
0	Audi e-tron 55 quattro	Audi	e-tron 55 quattro	345700	360	664	disc (front + rear)	4WD	95.0	438	...	3130.0	640.0	5	5	19	200	660.0	5.7	1!
1	Audi e-tron 50 quattro	Audi	e-tron 50 quattro	308400	313	540	disc (front + rear)	4WD	71.0	340	...	3040.0	670.0	5	5	19	190	660.0	6.8	1!
2	Audi e-tron S quattro	Audi	e-tron S quattro	414900	503	973	disc (front + rear)	4WD	95.0	364	...	3130.0	565.0	5	5	20	210	660.0	4.5	1!
3	Audi e-tron Sportback 50 quattro	Audi	e-tron Sportback 50 quattro	319700	313	540	disc (front + rear)	4WD	71.0	346	...	3040.0	640.0	5	5	19	190	615.0	6.8	1!
4	Audi e-tron Sportback 55 quattro	Audi	e-tron Sportback 55 quattro	357000	360	664	disc (front + rear)	4WD	95.0	447	...	3130.0	670.0	5	5	19	200	615.0	5.7	1!

5 rows × 25 columns

In [20]:
```python
# Filter EVs based on budget and range
filtered_evs = df[(df['Minimal price (gross) [PLN]'] <= 350000) & (df['Range (WLTP) [km]'] >= 400)]
print(filtered_evs)
```

```
                     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]
```

In [24]:
```python
#Group by manufacturer
grouped_by_make = filtered_evs.groupby('Make')
print(grouped_by_make.size())
```

```
Make
Audi             1
BMW              1
Hyundai          1
Kia              2
Mercedes-Benz    1
Tesla            3
Volkswagen       3
dtype: int64
```

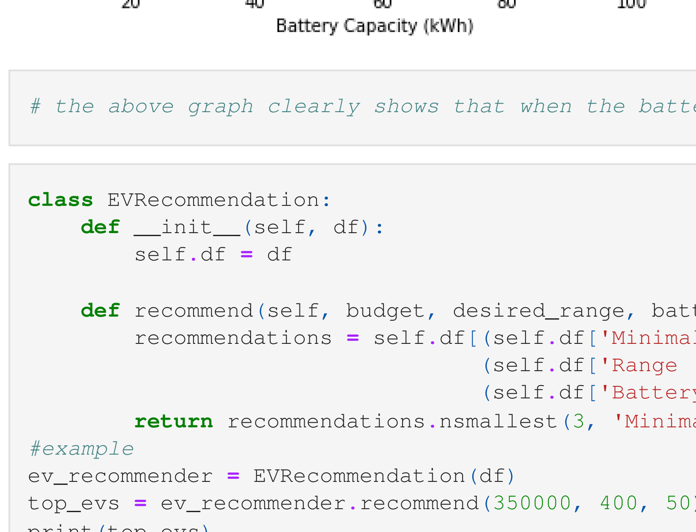
In [29]:
```python
 # Group by manufacturer and calculate average battery capacity
avg_battery_capacity = filtered_evs.groupby('Make')['Battery capacity [kWh]'].mean()


print(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
```

In [42]:
```python
# Calculate the IQR to detect outliers
q1 = df["mean - Energy consumption [kWh/100 km]"].quantile(0.25)
q2 = df["mean - Energy consumption [kWh/100 km]"].quantile(0.75)
iqr = q2 - q1

# Define lower and upper bounds for outliers
lower_bound = q1 - 1.5 * iqr
upper_bound = q2 + 1.5 * iqr

# Filter out the outliers
outliers = df[
    (df["mean - Energy consumption [kWh/100 km]"] < lower_bound) |
    (df["mean - Energy consumption [kWh/100 km]"] > upper_bound)
]

# Check if the DataFrame is empty and display appropriate message
if outliers.empty:
    print("No outliers detected in the 'mean - Energy consumption [kWh/100 km]' column.")
else:
    print("Outliers in mean Energy Consumption [kWh/100 km]:")
    print(outliers[["Make", "Model", "mean - Energy consumption [kWh/100 km]"]])

# Display bounds for reference
print(f"\nLower Bound: {lower_bound:.2f}, Upper Bound: {upper_bound:.2f}")
```

```
No outliers detected in the 'mean - Energy consumption [kWh/100 km]' column.

Lower Bound: 3.75, Upper Bound: 35.35
```

In [35]:
```python
# Task 3: Visualize relationship between battery capacity and range


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.show()
```



In [36]:
```python
# the above graph clearly shows that when the battery capacity increases the range also increases
```

In [37]:
```python
class EVRecommendation:
    def __init__(self, df):
        self.df = df

    def recommend(self, budget, desired_range, battery_capacity):
        recommendations = self.df[(self.df['Minimal price (gross) [PLN]'] <= budget) &
                                  (self.df['Range (WLTP) [km]'] >= desired_range) &
                                  (self.df['Battery capacity [kWh]'] >= battery_capacity)]
        return recommendations.nsmallest(3, 'Minimal price (gross) [PLN]')
#example
ev_recommender = EVRecommendation(df)
top_evs = ev_recommender.recommend(350000, 400, 50)
print(top_evs)
```

```
                     Car full name        Make                 Model  \
47  Volkswagen ID.3 Pro Performance  Volkswagen  ID.3 Pro Performance
20                 Kia e-Soul 64kWh         Kia          e-Soul 64kWh
18                 Kia e-Niro 64kWh         Kia          e-Niro 64kWh

    Minimal price (gross) [PLN]  Engine power [KM]  Maximum torque [Nm]  \
47                       155890                204                  310
20                       160990                204                  395
18                       167990                204                  395

                Type of brakes   Drive type  Battery capacity [kWh]  \
47  disc (front) + drum (rear)   2WD (rear)                    58.0
20         disc (front + rear)  2WD (front)                    64.0
18         disc (front + rear)  2WD (front)                    64.0

    Range (WLTP) [km]  ...  Permissable gross weight [kg]  \
47                425  ...                         2270.0
20                452  ...                         1682.0
18                455  ...                         2230.0

    Maximum load capacity [kg]  Number of seats  Number of doors  \
47                       540.0                5                5
20                       498.0                5                5
18                       493.0                5                5

    Tire size [in]  Maximum speed [kph]  Boot capacity (VDA) [l]  \
47              18                  160                    385.0
20              17                  167                    315.0
18              17                  167                    451.0

    Acceleration 0-100 kph [s]  Maximum DC charging power [kW]  \
47                         7.3                             100
20                         7.9                             100
18                         7.8                             100

    mean - Energy consumption [kWh/100 km]
47                                    15.4
20                                    15.7
18                                    15.9

[3 rows x 25 columns]
```

In [38]:
```python
# Filter data for Tesla and Audi
tesla = df[df['Make'] == 'Tesla']['Engine power [KM]']
audi = df[df['Make'] == 'Audi']['Engine power [KM]']

# Perform t-test
t_stat, p_value = ttest_ind(tesla, audi)

print(f"T-statistic: {t_stat}, P-value: {p_value}")

# Insights
if p_value < 0.05:
    print("There is a significant difference in the average engine power between Tesla and Audi.")
else:
    print("There is no significant difference in the average engine power between Tesla and Audi.")
```

```
T-statistic: 1.7024444538261418, P-value: 0.11672692675082785
There is no significant difference in the average engine power between Tesla and Audi.
```

In [ ]: