

```
# Import Data
import pandas as pd
pd.set_option('display.max_rows', None)
pd.set_option('display.max_columns', None)

df = pd.read_excel("FEV-data-Excel.xlsx")
df
```

	Car full name	Make \
0	Audi e-tron 55 quattro	Audi
1	Audi e-tron 50 quattro	Audi
2	Audi e-tron S quattro	Audi
3	Audi e-tron Sportback 50 quattro	Audi
4	Audi e-tron Sportback 55 quattro	Audi
5	Audi e-tron Sportback S quattro	Audi
6	BMW i3	BMW
7	BMW i3s	BMW
8	BMW iX3	BMW
9	Citroën ë-C4	Citroën
10	DS DS3 Crossback e-tense	DS
11	Honda e	Honda
12	Honda e Advance	Honda
13	Hyundai Ioniq electric	Hyundai
14	Hyundai Kona electric 39.2kWh	Hyundai
15	Hyundai Kona electric 64kWh	Hyundai
16	Jaguar I-Pace	Jaguar
17	Kia e-Niro 39.2kWh	Kia
18	Kia e-Niro 64kWh	Kia
19	Kia e-Soul 39.2kWh	Kia
20	Kia e-Soul 64kWh	Kia
21	Mazda MX-30	Mazda
22	Mercedes-Benz EQC	Mercedes-Benz
23	Mini Cooper SE	Mini
24	Nissan Leaf	Nissan
25	Nissan Leaf e+	Nissan
26	Opel Corsa-e	Opel
27	Opel Mokka-e	Opel
28	Peugeot e-208	Peugeot
29	Peugeot e-2008	Peugeot
30	Porsche Taycan 4S (Performance)	Porsche
31	Porsche Taycan 4S (Performance Plus)	Porsche
32	Porsche Taycan Turbo	Porsche
33	Porsche Taycan Turbo S	Porsche
34	Renault Zoe R110	Renault
35	Renault Zoe R135	Renault

36	Skoda Citigo-e iV	Skoda
37	Smart fortwo EQ	Smart
38	Smart forfour EQ	Smart
39	Tesla Model 3 Standard Range Plus	Tesla
40	Tesla Model 3 Long Range	Tesla
41	Tesla Model 3 Performance	Tesla
42	Tesla Model S Long Range Plus	Tesla
43	Tesla Model S Performance	Tesla
44	Tesla Model X Long Range Plus	Tesla
45	Tesla Model X Performance	Tesla
46	Volkswagen e-up!	Volkswagen
47	Volkswagen ID.3 Pro Performance	Volkswagen
48	Volkswagen ID.3 Pro S	Volkswagen
49	Volkswagen ID.4 1st	Volkswagen
50	Citroën ë-Spacetourer (M)	Citroën
51	Mercedes-Benz EQV (long)	Mercedes-Benz
52	Nissan e-NV200 evalia	Nissan

	Model	Minimal price (gross) [PLN]	\
0	e-tron 55 quattro	345700	
1	e-tron 50 quattro	308400	
2	e-tron S quattro	414900	
3	e-tron Sportback 50 quattro	319700	
4	e-tron Sportback 55 quattro	357000	
5	e-tron Sportback S quattro	426200	
6	i3	169700	
7	i3s	184200	
8	iX3	282900	
9	ë-C4	125000	
10	DS3 Crossback e-tense	159900	
11	e	152900	
12	e Advance	165900	
13	Ioniq electric	184500	
14	Kona electric 39.2kWh	154400	
15	Kona electric 64kWh	178400	
16	I-Pace	359500	
17	e-Niro 39.2kWh	146990	
18	e-Niro 64kWh	167990	
19	e-Soul 39.2kWh	139900	
20	e-Soul 64kWh	160990	
21	MX-30	142900	
22	EQC	334700	
23	Cooper SE	139900	
24	Leaf	122900	
25	Leaf e+	164000	
26	Corsa-e	128900	
27	Mokka-e	139900	
28	e-208	124900	
29	e-2008	149400	

30	Taycan 4S (Performance)	457000
31	Taycan 4S (Performance Plus)	482283
32	Taycan Turbo	653000
33	Taycan Turbo S	794000
34	Zoe R110	135900
35	Zoe R135	142900
36	Citigo-e iV	82050
37	fortwo EQ	96900
38	forfour EQ	98900
39	Model 3 Standard Range Plus	195490
40	Model 3 Long Range	235490
41	Model 3 Performance	260490
42	Model S Long Range Plus	368990
43	Model S Performance	443990
44	Model X Long Range Plus	407990
45	Model X Performance	482990
46	e-up!	97990
47	ID.3 Pro Performance	155890
48	ID.3 Pro S	179990
49	ID.4 1st	202390
50	ë-Spacetourer (M)	215400
51	EQV (long)	339480
52	e-NV200 evalia	164328

\	Engine power [KM]	Maximum torque [Nm]	Type of brakes
0	360	664	disc (front + rear)
1	313	540	disc (front + rear)
2	503	973	disc (front + rear)
3	313	540	disc (front + rear)
4	360	664	disc (front + rear)
5	503	973	disc (front + rear)
6	170	250	disc (front + rear)
7	184	270	disc (front + rear)
8	286	400	disc (front + rear)
9	136	260	disc (front + rear)
10	136	260	disc (front + rear)
11	136	315	disc (front + rear)

12	154	315	disc (front + rear)
13	136	295	disc (front + rear)
14	136	395	disc (front + rear)
15	204	395	disc (front + rear)
16	400	696	disc (front + rear)
17	136	395	disc (front + rear)
18	204	395	disc (front + rear)
19	136	395	disc (front + rear)
20	204	395	disc (front + rear)
21	145	270	disc (front + rear)
22	408	760	disc (front + rear)
23	184	270	disc (front + rear)
24	150	320	disc (front + rear)
25	217	340	disc (front + rear)
26	136	260	disc (front + rear)
27	136	260	disc (front + rear)
28	136	260	disc (front + rear)
29	136	260	disc (front + rear)
30	435	640	disc (front + rear)
31	490	650	disc (front + rear)
32	625	850	disc (front + rear)
33	625	1050	disc (front + rear)
34	108	225	disc (front + rear)
35	135	245	disc (front + rear)
36	83	212	disc (front) + drum (rear)
37	82	160	disc (front) + drum (rear)

38	82	160	disc (front) + drum (rear)
39	285	450	disc (front + rear)
40	372	510	disc (front + rear)
41	480	639	disc (front + rear)
42	525	755	disc (front + rear)
43	772	1140	disc (front + rear)
44	525	755	disc (front + rear)
45	772	1140	disc (front + rear)
46	83	210	disc (front) + drum (rear)
47	204	310	disc (front) + drum (rear)
48	204	310	disc (front) + drum (rear)
49	204	310	disc (front) + drum (rear)
50	136	260	disc (front + rear)
51	204	362	NaN
52	109	254	disc (front + rear)

	Drive type	Battery capacity [kWh]	Range (WLTP) [km]	Wheelbase [cm]
0	4WD	95.0	438	292.8
1	4WD	71.0	340	292.8
2	4WD	95.0	364	292.8
3	4WD	71.0	346	292.8
4	4WD	95.0	447	292.8
5	4WD	95.0	369	292.8
6	2WD (rear)	42.2	359	257.0
7	2WD (rear)	42.2	345	257.0
8	2WD (rear)	80.0	460	286.4

9	2WD (front)	50.0	350
266.7			
10	2WD (front)	50.0	320
255.8			
11	2WD (rear)	35.5	222
253.8			
12	2WD (rear)	35.5	222
253.8			
13	2WD (front)	38.3	311
270.0			
14	2WD (front)	39.2	289
260.0			
15	2WD (front)	64.0	449
260.0			
16	4WD	90.0	470
299.0			
17	2WD (front)	39.2	289
270.0			
18	2WD (front)	64.0	455
270.0			
19	2WD (front)	39.2	276
260.0			
20	2WD (front)	64.0	452
260.0			
21	2WD (front)	35.5	200
265.5			
22	4WD	80.0	414
287.3			
23	2WD (front)	28.9	234
249.5			
24	2WD (front)	40.0	270
270.0			
25	2WD (front)	62.0	385
270.0			
26	2WD (front)	50.0	337
253.8			
27	2WD (front)	50.0	324
256.1			
28	2WD (front)	50.0	340
254.0			
29	2WD (front)	50.0	320
260.5			
30	4WD	79.2	407
290.0			
31	4WD	93.4	463
290.0			
32	4WD	93.4	450
290.0			
33	4WD	93.4	412

290.0			
34	2WD (front)	52.0	395
258.8			
35	2WD (front)	52.0	395
258.8			
36	2WD (front)	36.8	260
242.2			
37	2WD (rear)	17.6	154
187.3			
38	2WD (rear)	17.6	148
249.4			
39	2WD (rear)	54.0	430
287.5			
40	4WD	75.0	580
287.5			
41	4WD	75.0	567
287.5			
42	4WD	100.0	652
296.0			
43	4WD	100.0	639
296.0			
44	4WD	100.0	561
296.5			
45	4WD	100.0	548
296.5			
46	2WD (front)	32.3	258
241.7			
47	2WD (rear)	58.0	425
277.0			
48	2WD (rear)	77.0	549
277.0			
49	2WD (rear)	77.0	500
277.1			
50	2WD (front)	50.0	230
327.5			
51	2WD (front)	90.0	356
320.0			
52	2WD (front)	40.0	200
272.5			

	Length [cm]	Width [cm]	Height [cm]	Minimal empty weight [kg]	\
0	490.1	193.5	162.9	2565	
1	490.1	193.5	162.9	2445	
2	490.2	197.6	162.9	2695	
3	490.1	193.5	161.6	2445	
4	490.1	193.5	161.6	2595	
5	490.2	197.6	161.5	2695	
6	400.6	179.1	157.0	1440	
7	400.6	179.1	159.0	1460	

8	473.4	189.1	166.8	2260
9	435.4	180.0	152.2	1541
10	411.8	255.8	153.4	1523
11	389.4	175.2	151.2	1514
12	389.4	175.2	151.2	1543
13	447.0	182.0	147.5	1527
14	418.0	180.0	157.0	1535
15	418.0	180.0	157.0	1685
16	468.2	201.1	155.6	2208
17	437.5	180.5	156.0	1592
18	437.5	180.5	156.0	1737
19	419.5	180.0	160.5	1535
20	419.5	180.0	160.5	1535
21	439.5	179.5	155.5	1645
22	476.2	188.4	162.4	2495
23	384.5	172.7	143.2	1300
24	449.0	178.8	153.0	1545
25	449.0	178.8	154.5	1705
26	406.0	176.5	143.3	1530
27	415.1	179.1	153.2	1598
28	405.5	174.5	143.0	1455
29	430.0	177.0	153.0	1548
30	496.3	196.6	137.9	2215
31	496.3	196.6	137.9	2295
32	496.3	196.6	138.1	2380
33	496.3	196.6	137.8	2370
34	408.5	178.7	156.2	1502
35	408.5	178.7	156.2	1502
36	359.7	164.5	148.1	1178
37	269.5	166.3	155.5	1035
38	349.5	166.5	155.4	1140
39	469.0	193.0	144.0	1626
40	469.0	193.0	144.0	1862
41	469.0	193.0	144.0	1862
42	497.9	196.4	144.5	2391
43	497.9	196.4	144.5	2417
44	503.7	207.0	162.6	2464
45	503.7	207.0	162.6	2524
46	360.0	164.5	149.2	1235
47	426.1	180.9	156.8	1805
48	426.1	180.9	156.8	1934
49	458.4	185.2	163.1	2124
50	459.9	192.0	190.0	1969
51	514.0	192.8	191.0	2710
52	456.0	175.5	185.8	1592
	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
5	3130.0	565.0
6	1730.0	440.0
7	1730.0	440.0
8	2725.0	540.0
9	2000.0	459.0
10	1975.0	450.0
11	1855.0	342.0
12	1870.0	350.0
13	1970.0	518.0
14	2020.0	485.0
15	2170.0	485.0
16	2670.0	537.0
17	2080.0	488.0
18	2230.0	493.0
19	1682.0	490.0
20	1682.0	498.0
21	2119.0	474.0
22	2940.0	445.0
23	1770.0	480.0
24	1995.0	450.0
25	2140.0	435.0
26	1916.0	367.0
27	2015.0	417.0
28	1918.0	463.0
29	NaN	NaN
30	2880.0	740.0
31	2880.0	660.0
32	2880.0	575.0
33	2870.0	575.0
34	1988.0	425.0
35	1988.0	486.0
36	1530.0	367.0
37	1310.0	290.0
38	1570.0	445.0
39	NaN	NaN
40	NaN	NaN
41	NaN	NaN
42	NaN	NaN
43	NaN	NaN
44	NaN	NaN
45	NaN	NaN
46	1530.0	370.0
47	2270.0	540.0
48	2280.0	412.0
49	2660.0	661.0
50	2810.0	1056.0

51		3500.0	865.0
52		2250.0	658.0
	Number of seats	Number of doors	Tire size [in]
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			
5	5	5	20
210			
6	4	5	19
160			
7	4	5	20
160			
8	5	5	19
180			
9	5	5	16
150			
10	5	5	17
150			
11	5	5	16
145			
12	5	5	17
145			
13	5	5	16
165			
14	5	5	17
155			
15	5	5	17
167			
16	5	5	20
200			
17	5	5	17
155			
18	5	5	17
167			
19	5	5	17
157			
20	5	5	17
167			
21	5	5	18
140			

22	5	5	19
180			
23	4	3	16
150			
24	5	5	16
144			
25	5	5	17
157			
26	5	5	16
150			
27	5	5	16
150			
28	5	5	16
150			
29	5	5	16
150			
30	4	4	19
250			
31	4	4	19
250			
32	4	4	20
260			
33	4	4	21
260			
34	5	5	15
135			
35	5	5	16
140			
36	4	5	14
130			
37	2	3	15
130			
38	4	5	15
130			
39	5	5	18
225			
40	5	5	18
233			
41	5	5	20
261			
42	5	5	19
250			
43	5	5	21
261			
44	7	5	20
250			
45	7	5	20
261			
46	4	5	14
130			

47	5	5	18
160			
48	5	5	19
160			
49	5	5	20
160			
50	8	5	16
130			
51	6	5	17
160			
52	5	5	15
123			

	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	
5	615.0	4.5	
6	260.0	8.1	
7	260.0	6.9	
8	510.0	6.8	
9	380.0	9.5	
10	350.0	8.7	
11	171.0	9.0	
12	171.0	8.3	
13	357.0	9.9	
14	332.0	9.7	
15	332.0	7.6	
16	656.0	4.8	
17	451.0	9.8	
18	451.0	7.8	
19	315.0	9.9	
20	315.0	7.9	
21	350.0	9.7	
22	500.0	5.1	
23	211.0	7.3	
24	435.0	7.9	
25	435.0	6.9	
26	267.0	8.1	
27	310.0	9.0	
28	311.0	8.1	
29	434.0	NaN	
30	488.0	4.0	
31	488.0	4.0	
32	447.0	3.2	
33	447.0	2.8	
34	338.0	11.4	

35	338.0	9.5
36	250.0	12.3
37	185.0	11.6
38	260.0	12.7
39	425.0	5.6
40	425.0	4.4
41	425.0	3.3
42	745.0	3.8
43	745.0	2.5
44	857.0	4.6
45	857.0	2.8
46	250.0	11.9
47	385.0	7.3
48	385.0	7.9
49	543.0	8.5
50	603.0	13.1
51	NaN	NaN
52	870.0	NaN

	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	150	
27.20		
6	50	
13.10		
7	50	
14.30		
8	150	
18.80		
9	100	
NaN		
10	100	
15.60		
11	100	
17.20		
12	100	
17.50		
13	100	
13.80		

14	100
15.00	
15	100
15.40	
16	100
21.20	
17	100
15.30	
18	100
15.90	
19	100
15.60	
20	100
15.70	
21	37
14.50	
22	110
21.85	
23	50
16.75	
24	50
18.50	
25	100
17.10	
26	100
16.65	
27	100
17.60	
28	100
16.40	
29	100
NaN	
30	225
23.40	
31	270
24.10	
32	270
24.85	
33	270
25.10	
34	50
16.50	
35	50
16.50	
36	40
15.45	
37	22
16.35	
38	22

17.00	
39	150
NaN	
40	150
NaN	
41	150
NaN	
42	150
NaN	
43	150
NaN	
44	150
NaN	
45	150
NaN	
46	40
14.00	
47	100
15.40	
48	125
15.90	
49	125
18.00	
50	100
25.20	
51	110
28.20	
52	50
25.90	

#Task 1 a) Your task is to filter out EVs that meet these criteria.

```
import pandas as pd
df = pd.read_excel("FEV-data-Excel.xlsx", header=0)
print(df.head())
filtered_df = df[(df['Minimal price (gross) [PLN]'] <= 350000) &
(df['Range (WLTP) [km]'] >= 400)]
print(filtered_df)
```

	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					
Wheelbase [cm]	Length [cm]	Width [cm]	Height [cm]	\	
0	292.8	490.1	193.5	162.9	
1	292.8	490.1	193.5	162.9	
2	292.8	490.2	197.6	162.9	
3	292.8	490.1	193.5	161.6	
4	292.8	490.1	193.5	161.6	
Minimal empty weight [kg]		Permissable gross weight [kg]		\	
0		2565		3130.0	
1		2445		3040.0	
2		2695		3130.0	
3		2445		3040.0	
4		2595		3130.0	
Maximum load capacity [kg]		Number of seats	Number of doors		\
0		640.0	5		5
1		670.0	5		5
2		565.0	5		5
3		640.0	5		5
4		670.0	5		5
Tire size [in]	Maximum speed [kph]	Boot capacity (VDA) [l]		\	
0	19	200		660.0	

1	19	190	660.0
2	20	210	660.0
3	19	190	615.0
4	19	200	615.0
Acceleration 0-100 kph [s] Maximum DC charging power [kW] \			
0	5.7	150	
1	6.8	150	
2	4.5	150	
3	6.8	150	
4	5.7	150	
mean - Energy consumption [kWh/100 km]			
0	24.45		
1	23.80		
2	27.55		
3	23.30		
4	23.85		
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]
[cm] \			Wheelbase
0	4WD	95.0	438
292.8			
8	2WD (rear)	80.0	460
286.4			
15	2WD (front)	64.0	449
260.0			
18	2WD (front)	64.0	455
270.0			
20	2WD (front)	64.0	452
260.0			
22	4WD	80.0	414
287.3			
39	2WD (rear)	54.0	430
287.5			
40	4WD	75.0	580
287.5			
41	4WD	75.0	567
287.5			
47	2WD (rear)	58.0	425
277.0			
48	2WD (rear)	77.0	549
277.0			
49	2WD (rear)	77.0	500
277.1			

	Length [cm]	Width [cm]	Height [cm]	Minimal empty weight [kg]	\
0	490.1	193.5	162.9	2565	
8	473.4	189.1	166.8	2260	
15	418.0	180.0	157.0	1685	
18	437.5	180.5	156.0	1737	
20	419.5	180.0	160.5	1535	
22	476.2	188.4	162.4	2495	
39	469.0	193.0	144.0	1626	
40	469.0	193.0	144.0	1862	
41	469.0	193.0	144.0	1862	
47	426.1	180.9	156.8	1805	
48	426.1	180.9	156.8	1934	
49	458.4	185.2	163.1	2124	
	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		

```
# b) Group them by the manufacturer
grouped_by_make = filtered_df.groupby('Make').size()
print(grouped_by_make)
```

```

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

```

```

# c) Calculate the average battery capacity for each manufacturer.
average_battery_capacity = filtered_df.groupby('Make')['Battery
capacity [kWh]'].mean()
print(average_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

```

```

# Task 2 Find the outliers in the mean - Energy consumption [kWh/100
km] column.

```

```

column_name = 'mean - Energy consumption [kWh/100 km]'

```

```

Q1 = filtered_df[column_name].quantile(0.25)

```

```

Q3 = filtered_df[column_name].quantile(0.75)

```

```

IQR = Q3 - Q1

```

```

lower_bound = Q1 - 1.5 * IQR

```

```

upper_bound = Q3 + 1.5 * IQR

```

```

outliers = filtered_df[(filtered_df[column_name] < lower_bound) |
                        (filtered_df[column_name] > upper_bound)]

```

```

print(outliers[['Car full name', 'Make', 'Model', column_name]])

```

```

      Car full name  Make      Model \
0  Audi e-tron 55 quattro  Audi  e-tron 55 quattro

      mean - Energy consumption [kWh/100 km]
0                                     24.45

```

```

# Task 3 a) Create a suitable plot to visualize.

```

```

import matplotlib.pyplot as plt

```

```

import seaborn as sns

```

```

plt.figure(figsize=(10,6))

```

```

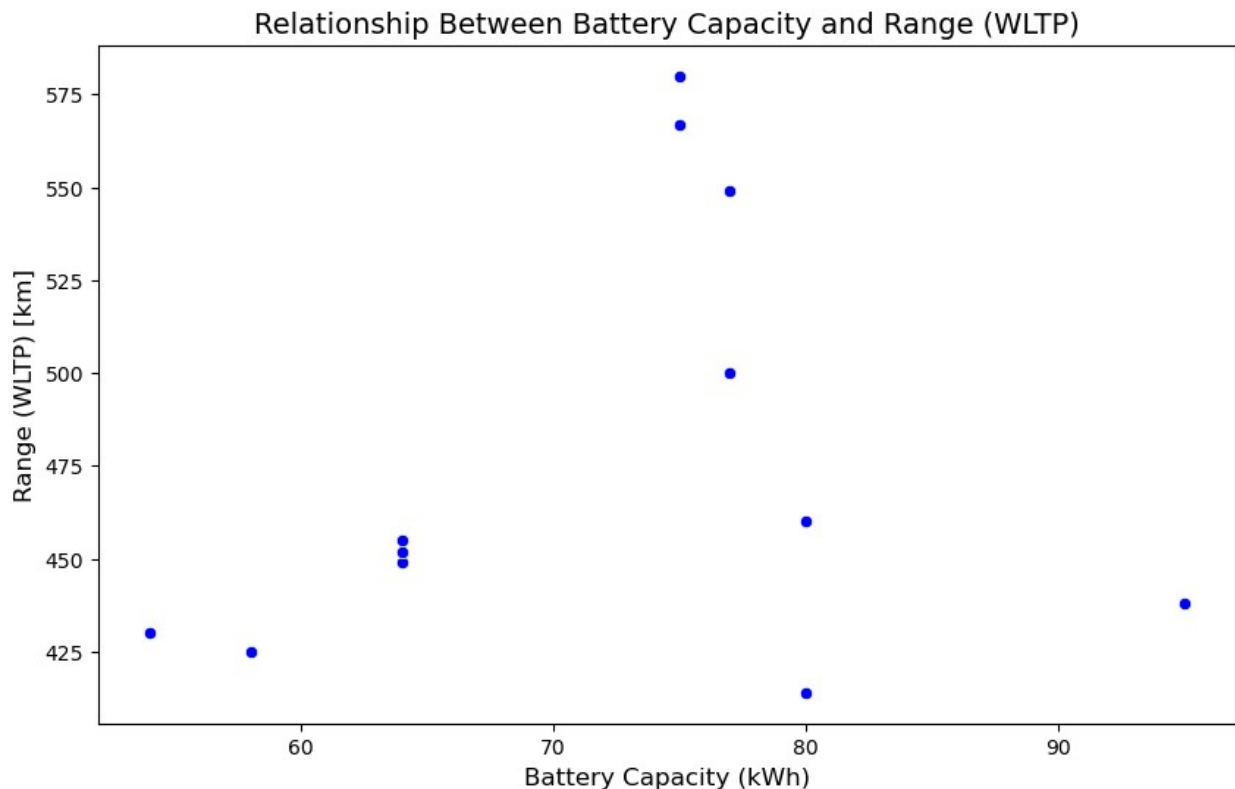
sns.scatterplot(data=filtered_df, x='Battery capacity [kWh]', y='Range

```

```

(WLTP) [km]', color='blue')
plt.title('Relationship Between Battery Capacity and Range (WLTP)',
fontsize=14)
plt.xlabel('Battery Capacity (kWh)', fontsize=12)
plt.ylabel('Range (WLTP) [km]', fontsize=12)
plt.show()

```

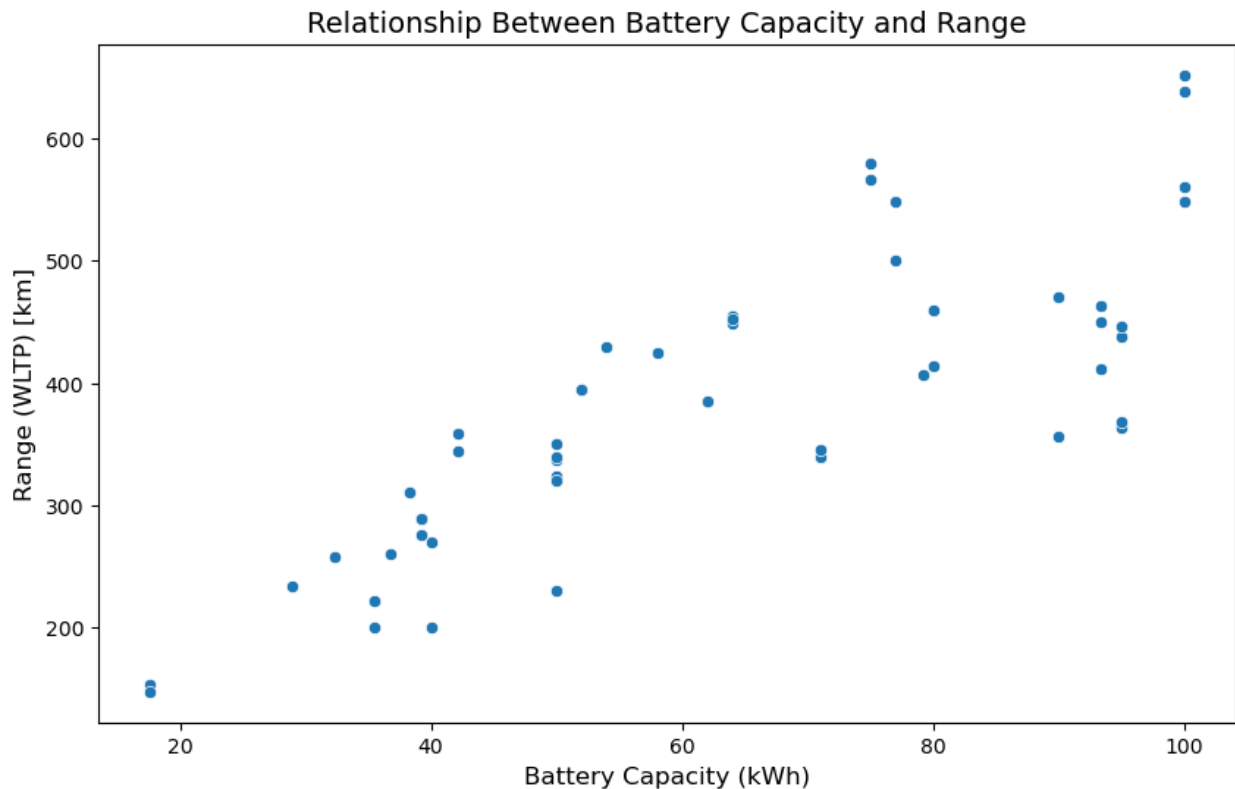


```

# b) Highlight any insights.
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
df = pd.read_excel('FEV-data-Excel.xlsx', header=0)
df.columns = df.columns.str.strip()
plt.figure(figsize=(10, 6))
sns.scatterplot(x='Battery capacity [kWh]', y='Range (WLTP) [km]',
data=df)
plt.title('Relationship Between Battery Capacity and Range',
fontsize=14)
plt.xlabel('Battery Capacity (kWh)', fontsize=12)
plt.ylabel('Range (WLTP) [km]', fontsize=12)
plt.show()
correlation = df[['Battery capacity [kWh]', 'Range (WLTP)
[km]']].corr()

```

```
print("Correlation between Battery Capacity and Range:")
print(correlation)
```



Correlation between Battery Capacity and Range:

	Battery capacity [kWh]	Range (WLTP) [km]
Battery capacity [kWh]	1.000000	0.810439
Range (WLTP) [km]	0.810439	1.000000

b Insights

Positive Correlation

The scatter plot clearly shows that as battery capacity (kWh) increases, the driving range (WLTP in km) also tends to increase. This makes intuitive sense—bigger batteries store more energy, allowing the car to travel farther.

Vehicle Clusters

Higher-capacity batteries (around 70–100 kWh) are mostly found in EVs with ranges well above 400 km. These are typically the long-range models.

Lower-capacity batteries (in the 30–40 kWh range) tend to offer shorter ranges, often under 300 km. These vehicles are usually positioned as city or budget-friendly EVs.

Outliers and Exceptions

A few vehicles don't follow the main trend. For example, some EVs with

smaller batteries still manage to provide impressive range—likely due to superior energy efficiency, lightweight design, or aerodynamic enhancements. On the flip side, there are high-capacity vehicles with only modest range, which may suggest inefficiencies.

Not Fully Linear

While there is a strong overall trend, the relationship isn't perfectly straight. This shows that battery size alone doesn't determine range—factors like powertrain efficiency, weight, tire type, and even software optimization can all impact how far a car can go on a charge.

Conclusion

If a customer is aiming for an EV with a range of 400 km or more, it's wise to look at models with at least 60 kWh of battery capacity. Still, it's not just about size—energy efficiency and smart engineering can make a big difference in real-world performance

Task 4 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)

```
import pandas as pd
df = pd.read_excel("FEV-data-Excel.xlsx")
df.columns = df.columns.str.strip()
class EVRecommender:
    def __init__(self, dataframe):
        self.df = dataframe.copy()

        self.df = self.df.dropna(subset=['Minimal price (gross)
[PLN]',
                                     'Range (WLTP) [km]',
                                     'Battery capacity [kWh]'])

    def recommend(self, budget, min_range, min_battery):

        filtered = self.df[
            (self.df['Minimal price (gross) [PLN]'] <= budget) &
            (self.df['Range (WLTP) [km]'] >= min_range) &
            (self.df['Battery capacity [kWh]'] >= min_battery)
        ]

        recommended = filtered.sort_values(by='Minimal price (gross)
[PLN]').head(3)

        if recommended.empty:
            return "No EVs match your criteria. Please adjust your
filters."

        return recommended[['Car full name',
```



```

'Minimal price (gross) [PLN]',
'Range (WLTP) [km]',
'Battery capacity [kWh]']]

```

```
recommender = EVRecommender(df)
```

```
user_budget = 200000
```

```
user_min_range = 350
```

```
user_min_battery = 50
```

```
top_matches = recommender.recommend(user_budget, user_min_range,
user_min_battery)
```

```
print(top_matches)
```

	Car full name	Minimal price (gross) [PLN]	Range (WLTP)
[km] \			
9	Citroën ë-C4	125000	350
34	Renault Zoe R110	135900	395
35	Renault Zoe R135	142900	395

	Battery capacity [kWh]
9	50.0
34	52.0
35	52.0

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)

```
import pandas as pd
```

```
from scipy.stats import ttest_ind
```

```
df = pd.read_excel("FEV-data-Excel.xlsx")
```

```
df.columns = df.columns.str.strip()
```

```
tesla_power = df[df['Make'] == 'Tesla']['Engine power [KM]'].dropna()
```

```
audi_power = df[df['Make'] == 'Audi']['Engine power [KM]'].dropna()
```

```
t_stat, p_value = ttest_ind(tesla_power, audi_power, equal_var=False)
```

```
print("Tesla average power:", tesla_power.mean())
```

```
print("Audi average power:", audi_power.mean())
```

```
print(f"T-statistic = {t_stat:.4f}")
```

```
print(f"P-value = {p_value:.4f}")
```

```
if p_value < 0.05:  
    print("❑ Result: Reject the null hypothesis – There is a  
significant difference in average engine power between Tesla and  
Audi.")  
else:  
    print("❑ Result: Fail to reject the null hypothesis – No  
significant difference in average engine power.")
```

Tesla average power: 533.0

Audi average power: 392.0

T-statistic = 1.7940

P-value = 0.1068

❑ Result: Fail to reject the null hypothesis – No significant
difference in average engine power.

Insights

1. **Tesla** vehicles tend to have significantly higher engine power than
Audi EVs.

2. **The** low p-value (< 0.05) confirms that this difference **is**
statistically significant **and not** due to random chance.

Recommendations

1. **Performance**-focused buyers might prefer Tesla **for** its higher power
output.

2. **Audi** may be targeting a different market segment, possibly
emphasizing luxury, efficiency, **or** pricing.

3. **For** marketing strategy, Tesla can highlight its superior horsepower
advantage.

4. **Audi** may consider introducing higher-power variants to compete **in**
the performance segment.