



# Car emission analysis

Using UK car emissions data

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1	file	year	manufact	model	description	euro_stan	tax_band	transmissi	transmissi	engine_ca	fuel_type	urban_me	extra_urbi	combined	urban_im	extra_urbi	combined	noise_level	co2	thc_emiss	co_emiss	nox_emiss	thc_nox_e	particulate	fuel_cost	fuel_cost	standard	standard	first_year	first_year	date_of_change	
2	DatapartC	2000	Alfa Rome	145 Range	1.6 Twin S	2		M5	Manual	1598	Petrol	11.1	6.5	8.2	25.4	43.5	34.4	74	195		980					618						
3	DatapartC	2000	Alfa Rome	145 Range	1.8 Twin S	2		M5	Manual	1747	Petrol	11.5	6.6	8.4	24.6	42.8	33.6	74	200		1105					633						
4	DatapartC	2000	Alfa Rome	145 Range	Cloverleaf	2		M5	Manual	1970	Petrol	12.4	6.6	8.8	22.8	42.8	32.1	74	210		1103					663						
5	DatapartC	2000	Alfa Rome	146 Range	1.6 Twin S	2		M5	Manual	1598	Petrol	11.3	6.6	8.3	25	42.8	34	73	195		980					626						
6	DatapartC	2000	Alfa Rome	146 Range	1.8 Twin S	2		M5	Manual	1747	Petrol	11.5	6.6	8.4	24.6	42.8	33.6	74	200		1105					633						
7	DatapartC	2000	Alfa Rome	146 Range	Ti	2		M5	Manual	1970	Petrol	12.4	6.6	8.8	22.8	42.8	32.1	74	210		1103					663						
8	DatapartC	2000	Alfa Rome	156 Range	1.6 Twin S	2		M5	Manual	1598	Petrol	11.4	6.4	8.2	24.8	44.1	34.4	74	195		919					618						
9	DatapartC	2000	Alfa Rome	156 Range	1.8 Twin S	2		M5	Manual	1747	Petrol	11.4	6.4	8.2	24.8	44.1	34.4	74	195		1069					618						
10	DatapartC	2000	Alfa Rome	156 Range	2.0 Selesp	2		SAT5	Automatic	1970	Petrol	11.7	6.6	8.5	24.1	42.8	33.2	73.5	202		1078					641						
11	DatapartC	2000	Alfa Rome	156 Range	2.0 Twin S	2		M5	Manual	1970	Petrol	11.7	6.6	8.5	24.1	42.8	33.2	73.5	202		1078					641						
12	DatapartC	2000	Alfa Rome	156 Range	2.4 JTD	2		M5	Manual	2387	Diesel	8.9	5.4	6.7	31.7	52.3	42.2	74	178		666		0.062			517						
13	DatapartC	2000	Alfa Rome	156 Range	2.5 V6	2		M6	Manual	2492	Petrol	16.5	8.4	11.4	17.1	33.6	24.8	74	271		1200					858						
14	DatapartC	2000	Alfa Rome	156 Range	2.5 V6 Q-S	2		A4	Automatic	2492	Petrol	17.5	8.6	11.9	16.1	32.8	23.7	71	283		1570					898						
15	DatapartC	2000	Alfa Rome	156 Sport	1.6 Twin S	2		M5	Manual	1598	Petrol	11.5	6.5	8.3	24.6	43.5	34	74	198		1097					626						
16	DatapartC	2000	Alfa Rome	156 Sport	1.8 Twin S	2		M5	Manual	1747	Petrol	11.7	6.4	8.4	24.1	44.1	33.6	74	199		848					633						
17	DatapartC	2000	Alfa Rome	156 Sport	2.0 Selesp	2		SAT5	Automatic	1970	Petrol	12.2	6.8	8.8	23.2	41.5	32.1	73.5	209		1296					663						
18	DatapartC	2000	Alfa Rome	156 Sport	2.0 Twin S	2		M5	Manual	1970	Petrol	12.2	6.8	8.8	23.2	41.5	32.1	73.5	209		1444					663						
19	DatapartC	2000	Alfa Rome	156 Sport	2.4 JTD	2		M5	Manual	2387	Diesel	9	5.6	6.8	31.4	50.4	41.5	74	180		894		0.056			526						
20	DatapartC	2000	Alfa Rome	156 Sport	2.5 V6	2		M6	Manual	2492	Petrol	17.2	8.6	11.7	16.4	32.8	24.1	74	280		1518					883						
21	DatapartC	2000	Alfa Rome	156 Sport	2.5 V6 Q-S	2		A4	Automatic	2492	Petrol	17.7	8.7	12	16	32.5	23.5	71	287		1267					905						
22	DatapartC	2000	Alfa Rome	166 Range	2.0 Twin S	2		M5	Manual	1970	Petrol	13.8	7.3	9.7	20.5	38.7	29.1	73.5	230		1171					731						
23	DatapartC	2000	Alfa Rome	166 Range	2.5 V6 24v	2		M5	Manual	2492	Petrol	16.3	8.6	11.4	17.3	32.8	24.8	73	271		1170					858						
24	DatapartC	2000	Alfa Rome	166 Range	2.5 V6 24v	2		A4	Automatic	2492	Petrol	17.5	9.1	12.2	16.1	31	23.2	72	289		1177					917						
25	DatapartC	2000	Alfa Rome	166 Range	3.0 V6 24v	2		A4	Automatic	2959	Petrol	19.4	9.3	13	14.6	30.4	21.7	72	308		1220					980						
26	DatapartC	2000	Alfa Rome	166 Range	3.0 V6 24v	2		M6	Manual	2959	Petrol	18.3	9.1	12.5	15.4	31	22.6	74	296		1214					941						
27	DatapartC	2000	Alfa Rome	Spider/GT	GTV V6 24	2		M5	Manual	2959	Petrol	16.8	8.7	11.7	16.8	32.5	24.1	75	278		1222					883						
28	DatapartC	2000	Alfa Rome	Spider/GT	GTV V6 24	2		M6	Manual	2959	Petrol	16.8	8.7	11.7	16.8	32.5	24.1	74	278		1256					883						
29	DatapartC	2000	Alfa Rome	Spider/GT	Spider/GT	2		M5	Manual	1970	Petrol	13.3	6.8	9.2	21.2	41.5	30.7	74	220		1292					693						
30	DatapartC	2000	Aston Mar	Aston Mar	DB7 Vanta	2		A5	Automatic	5935	Petrol	31.7	11.9	19.1	8.9	23.8	14.8	74	460		148					1438						
31	DatapartC	2000	Aston Mar	Aston Mar	DB7 Vanta	2		M6	Manual	5935	Petrol	29.2	12.6	18.8	9.7	22.3	15.1	75	450		724					1409						
32	DatapartC	2000	Aston Mar	Aston Mar	V8 CoupÃ	2		A4	Automatic	5340	Petrol	31.2	14	20.2	9	20.2	14	73.9	483		1608					1520						
33	DatapartC	2000	Aston Mar	Aston Mar	V8 Volanté	2		A4	Automatic	5340	Petrol	34.2	13.5	21.1	8.4	20.9	13.3	73.9	503		1459					1600						
34	DatapartC	2000	Aston Mar	Aston Mar	Vantage Pi	2		M6	Manual	5340	Petrol	34.2	14.1	21.5	8.4	20	13.1	74.9	511		960					1624						
35	DatapartC	2000	Audi		Audi 'S' QcS3 1.8 T Q	2		QM6	Manual	1781	Petrol	12.3	7.3	9.2	23	38.7	30.7	74	221		667					693						
36	DatapartC	2000	Audi		Audi 'S' QcS4 2.7 V6	2		QM6	Manual	2671	Petrol	16	8.9	11.5	17.7	31.7	24.6	75	276		698					865						
37	DatapartC	2000	Audi		Audi 'S' QcS6 4.2 V8	2		QA5	Automatic	4172	Petrol	22	10.4	14.6	12.8	27.2	19.3	74	350		234					1102						
38	DatapartC	2000	Audi		Audi 'S' QcS8 4.2 V8	2		QA5	Automatic	4172	Petrol	22	9.8	14.2	12.8	28.8	19.9	74	341		344					1069						
39	DatapartC	2000	Audi		Audi A3 (3 1.6 101bh	2		M5	Manual	1595	Petrol	10.7	6.1	7.8	26.4	46.3	36.2	71	187		680					588						
40	DatapartC	2000	Audi		Audi A3 (3 1.6 101bh	2		A4	Automatic	1595	Petrol	11.5	6.7	8.5	24.6	42.2	33.2	70	204		722					641						
41	DatapartC	2000	Audi		Audi A3 (3 1.8 125bh	2		M5	Manual	1781	Petrol	11.8	6.4	8.4	23.9	44.1	33.6	72	202		656					633						
42	DatapartC	2000	Audi		Audi A3 (3 1.8 125bh	2		A4	Automatic	1781	Petrol	13.4	7	9.3	21.1	40.4	30.4	71	223		665					700						
43	DatapartC	2000	Audi		Audi A3 (3 1.8 T 150b	2		M5	Manual	1781	Petrol	10.8	6.4	8	26.2	44.1	35.3	71	192		124					603						
44	DatapartC	2000	Audi		Audi A3 (3 1.8 T 150b	2		A4	Automatic	1781	Petrol	13.4	6.9	9.3	21.1	40.9	30.4	70	223		203					700						
45	DatapartC	2000	Audi		Audi A3 (3 1.8 T Quatt	2		QM5	Manual	1781	Petrol	13.3	7.5	9.6	21.7	37.7	29.4	74	220		787					774						

The Data

The Data

# Missing value percentages

	percent_missing
first_year_6_months	96.882072
standard_6_months	93.570785
first_year_12_months	92.272198
standard_12_months	92.272198
thc_nox_emissions	88.068819
date_of_change	86.346158
tax_band	82.779987
fuel_cost_6000_miles	73.193294
particulates_emissions	67.478192
thc_emissions	49.045286
fuel_cost_12000_miles	27.191228
nox_emissions	11.779570
transmission_type	0.749269
co_emissions	0.700929
extra_urban_imperial	0.028565
urban_imperial	0.028565
extra_urban_metric	0.028565
urban_metric	0.028565
transmission	0.021973
noise_level	0.019775
combined_imperial	0.015381
combined_metric	0.015381
engine_capacity	0.015381
co2	0.000000
manufacturer	0.000000
fuel_type	0.000000
euro_standard	0.000000
description	0.000000
model	0.000000
year	0.000000

# Result of processing the data

	year	manufacturer	co2	urban_metric	extra_urban_metric	combined_metric	model	fuel_type
0	2000	Alfa Romeo	195	11.1	6.5	8.2	145 Range	Petrol
1	2000	Alfa Romeo	200	11.5	6.6	8.4	145 Range	Petrol
2	2000	Alfa Romeo	210	12.4	6.6	8.8	145 Range	Petrol
3	2000	Alfa Romeo	195	11.3	6.6	8.3	146 Range	Petrol
4	2000	Alfa Romeo	200	11.5	6.6	8.4	146 Range	Petrol
...	...	...	...	...	...	...	...	...
45506	2013	Volkswagen	122	5.7	4.1	4.7	New Golf 2013	Diesel
45507	2013	Volkswagen	139	7.5	5.1	6.0	New Golf 2013	Petrol
45508	2013	Volkswagen	139	7.5	5.1	6.0	New Golf 2013	Petrol
45509	2013	Volkswagen	148	8.1	5.3	6.4	New Golf 2013	Petrol
45510	2013	Volkswagen	149	8.1	5.4	6.4	New Golf 2013	Petrol

45511 rows × 8 columns

# Overview of Analysis

Performed exploratory data analysis on the dataset in order to answer the business questions.

1. Which manufacturer had the worst co2 emissions?
2. Did emissions go down over the years?
3. Which car should you own based on emissions?

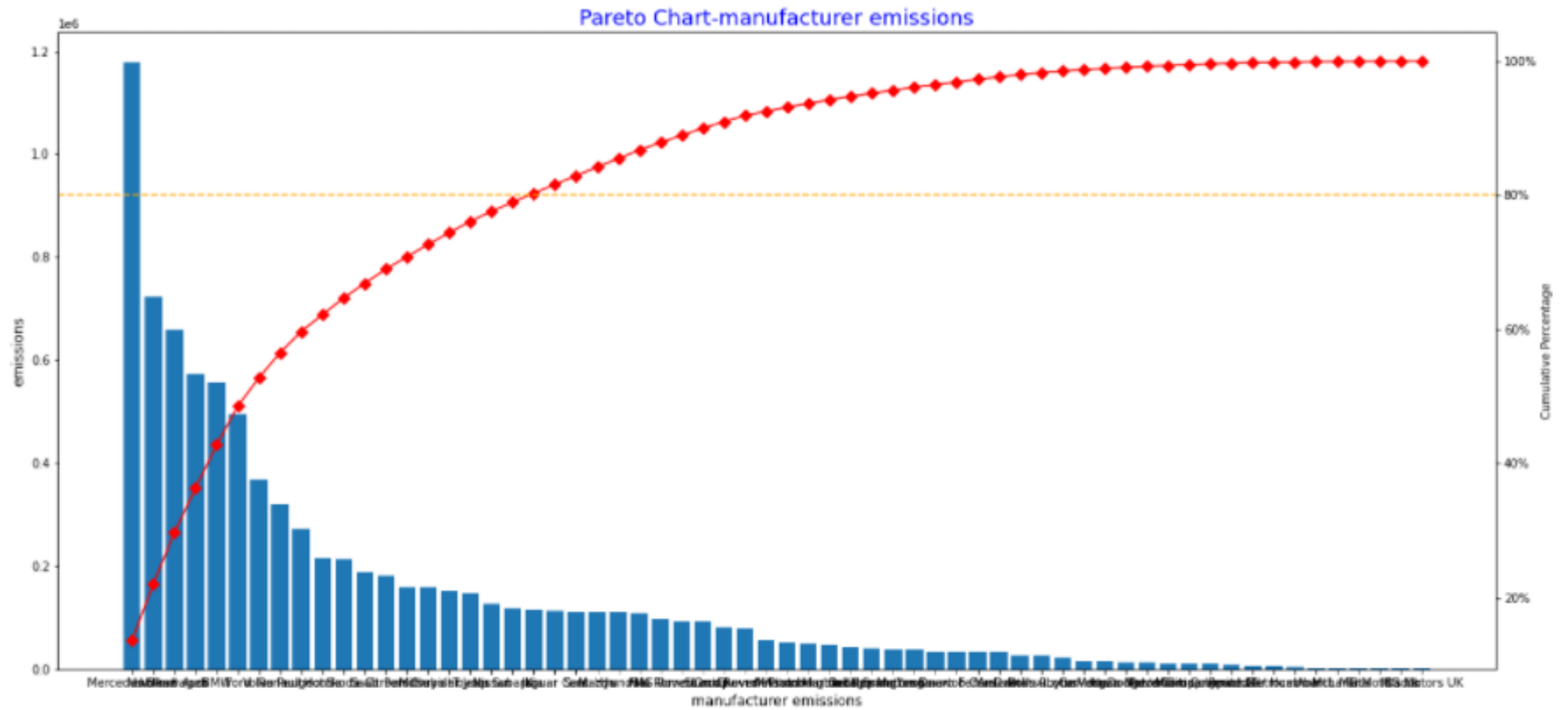
## Top 10 by co2

- Those responsible for 80% of the total

manufacturer	co2
Mercedes-Benz	1178426
Vauxhall	722466
Volkswagen	659921
Audi	573583
BMW	558210
Ford	496182
Volvo	367334
Renault	320410
Peugeot	273557
Honda	215824

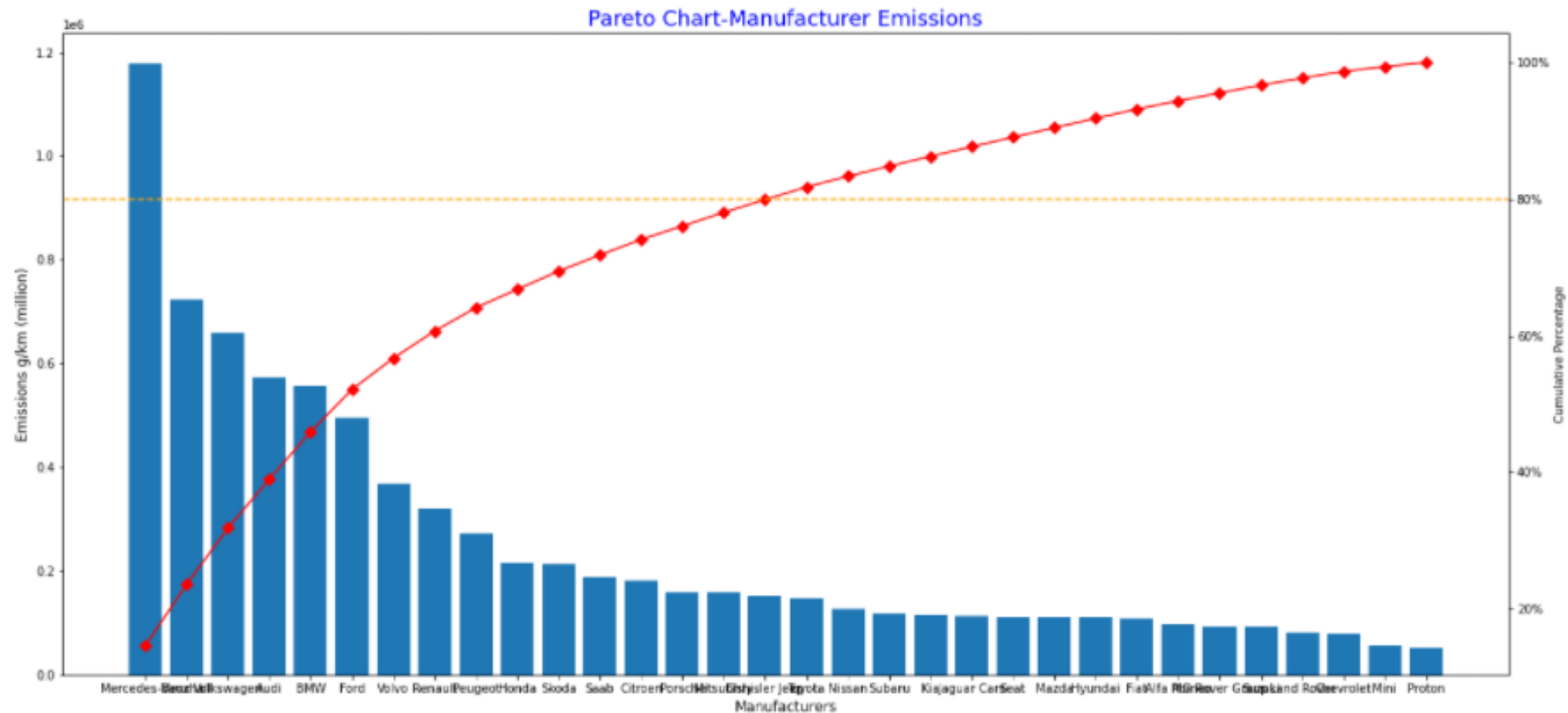
manufacturer	co2	cum_percentage
Mercedes-Benz	1178426	13.66
Vauxhall	722466	22.03
Volkswagen	659921	29.68
Audi	573583	36.33
BMW	558210	42.80
Ford	496182	48.55
Volvo	367334	52.80
Renault	320410	56.52
Peugeot	273557	59.69
Honda	215824	62.19
Skoda	214415	64.67
Saab	189607	66.87
Citroen	182374	68.98
Porsche	159145	70.83
Mitsubishi	158845	72.67
Chrysler Jeep	151394	74.42
Toyota	147388	76.13
Nissan	126315	77.60
Subaru	118647	78.97
Kia	115487	80.31

# First pareto chart





# Second pareto chart



# Third pareto chart

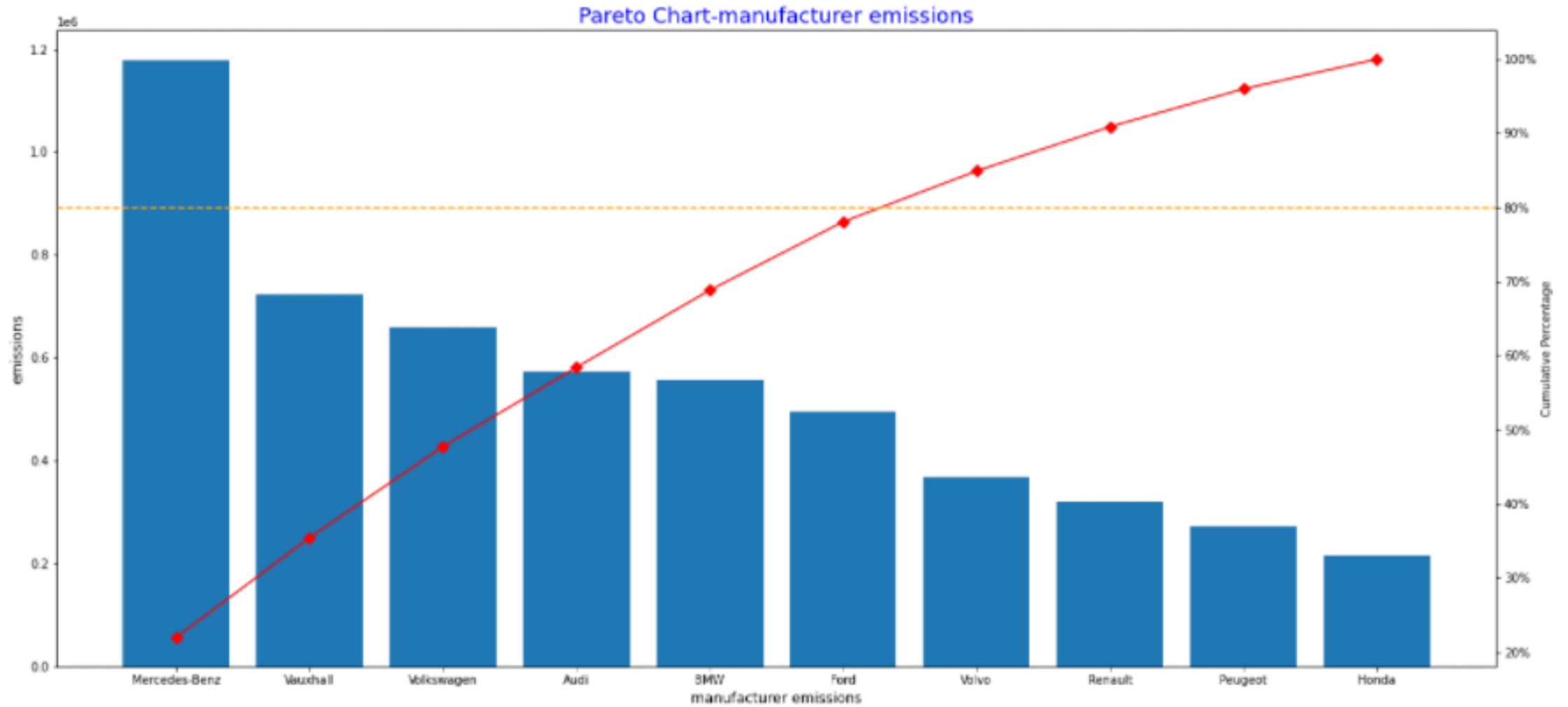
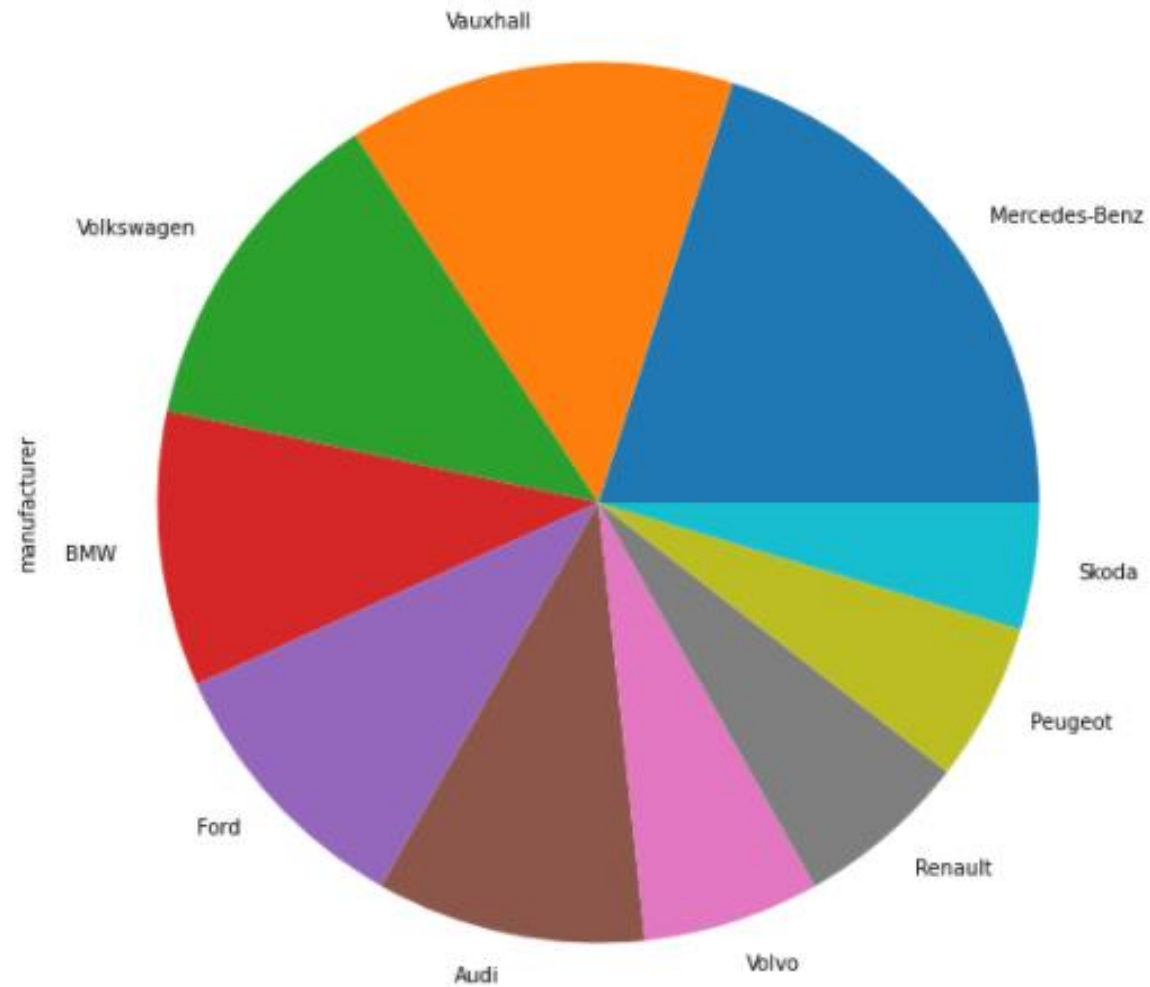


Chart showing top 10 manufacturer by number of cars in the data



## Top ten emitters

	manufacturer	co2	model
695	Lamborghini	575	Diablo Model Year 1997
698	Lamborghini	575	Diablo Model Year 1998/1999
13348	Maserati	545	MC12
702	Lamborghini	539	Diablo Model Year 2000
2561	Lamborghini	520	Diablo Model Year 2001
4619	Lamborghini	520	Diablo Model Year 2002
4620	Lamborghini	520	Diablo Model Year 2003
6957	Lamborghini	500	Murcielgo Model Year 2002/3
6958	Lamborghini	500	Murcielgo Model Year 2004
17062	Lamborghini	500	Murcielago Model Year 2004

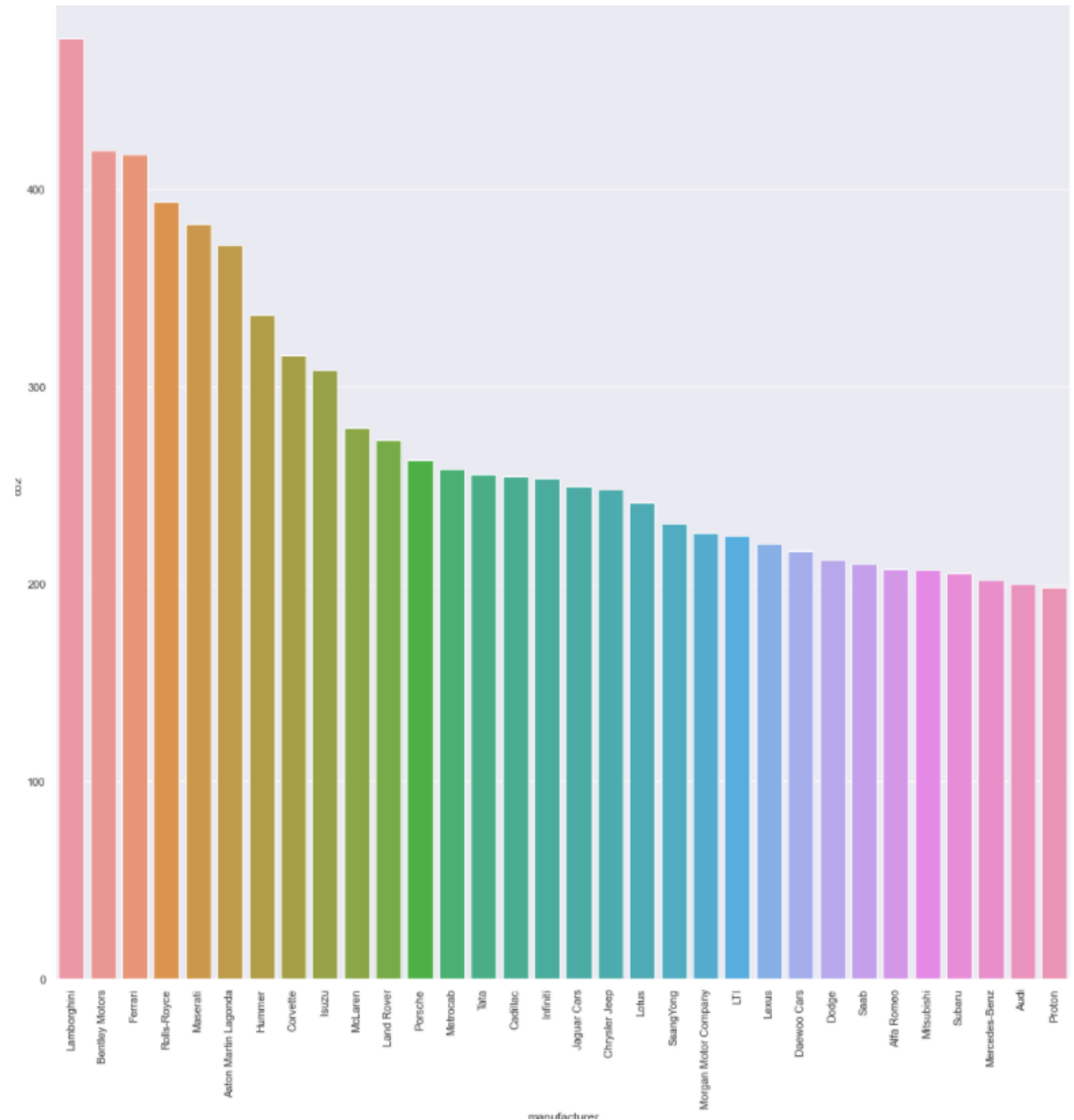
# Top 30 manufacturers by avg emissions

	manufacturer	co2
0	Lamborghini	476.213592
1	Bentley Motors	419.500000
2	Ferrari	417.456790
3	Rolls-Royce	393.731343
4	Maserati	382.206897
5	Aston Martin Lagonda	371.619048
6	Hummer	336.500000
7	Corvette	316.096154
8	Isuzu	308.423077
9	McLaren	279.000000
10	Land Rover	273.066225
11	Porsche	262.615512
12	Metrocab	258.090909
13	Tata	255.571429
14	Cadillac	254.779070

15	Infiniti	253.574468
16	Jaguar Cars	249.273731
17	Chrysler Jeep	248.186885
18	Lotus	241.224719
19	SsangYong	230.648810
20	Morgan Motor Company	225.727273
21	LTi	224.566667
22	Lexus	220.564706
23	Daewoo Cars	216.935897
24	Dodge	212.365079
25	Saab	210.207317
26	Alfa Romeo	207.606452
27	Mitsubishi	207.099087
28	Subaru	205.627383
29	Mercedes-Benz	201.923578
30	Audi	199.646015
31	Proton	198.525097



# Bar chart of top 30 average emissions by manufacturer



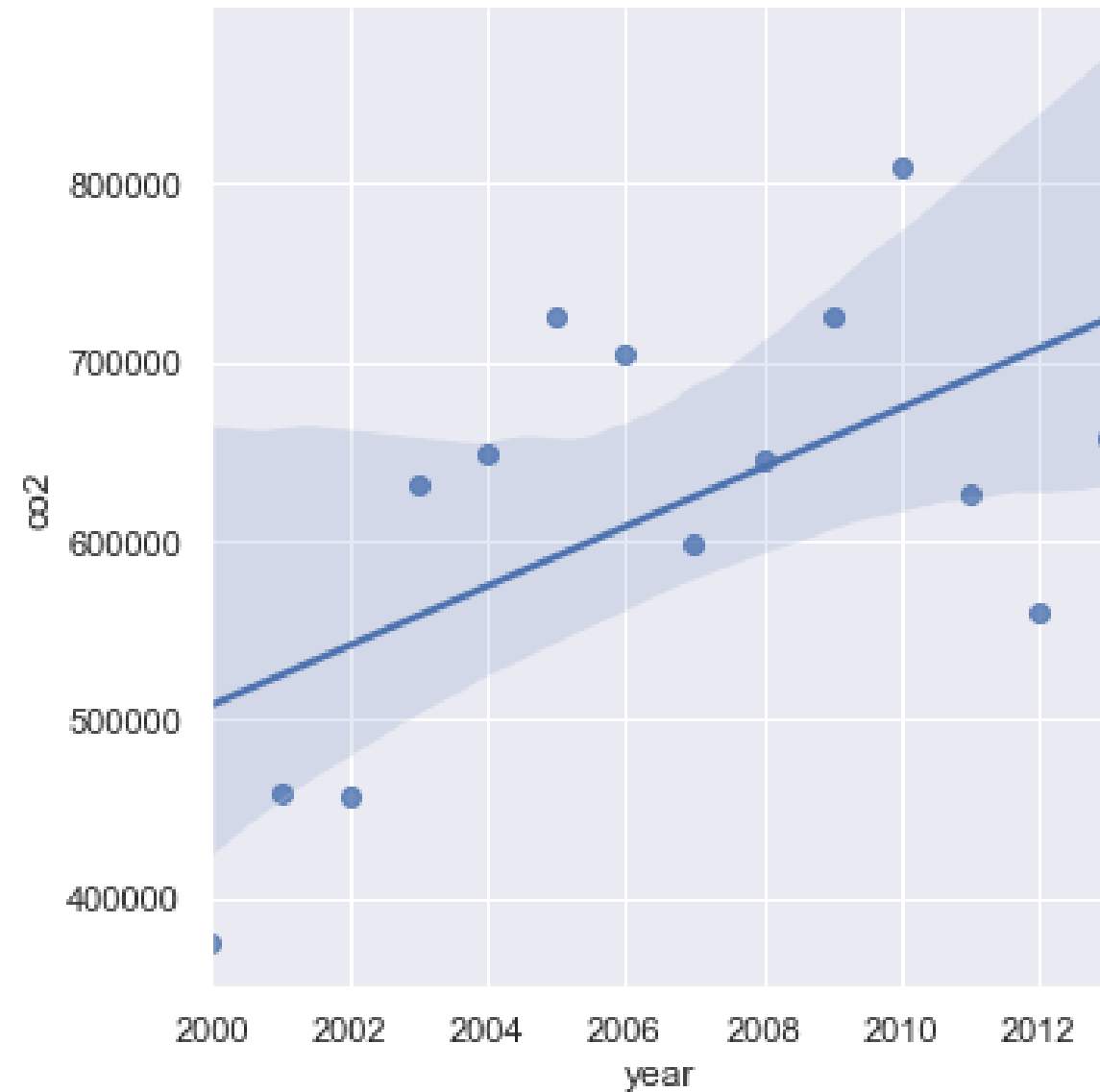
	year	co2
0	2000	375346
1	2001	459372
2	2002	457444
3	2003	631680
4	2004	649745
5	2005	726535
6	2006	705207
7	2007	598146
8	2008	645990
9	2009	726281
10	2010	808554
11	2011	626208
12	2012	560007
13	2013	658045

	year	co2
0	2000	216.088659
1	2001	213.860335
2	2002	214.560976
3	2003	205.290868
4	2004	207.123047
5	2005	197.642818
6	2006	200.799260
7	2007	201.463793
8	2008	196.409243
9	2009	189.431664
10	2010	182.106757
11	2011	168.199839
12	2012	159.228604
13	2013	152.325231

Emitted  
carbon per  
year and avg  
emitted  
carbon per  
year

Total  
emissions per  
year

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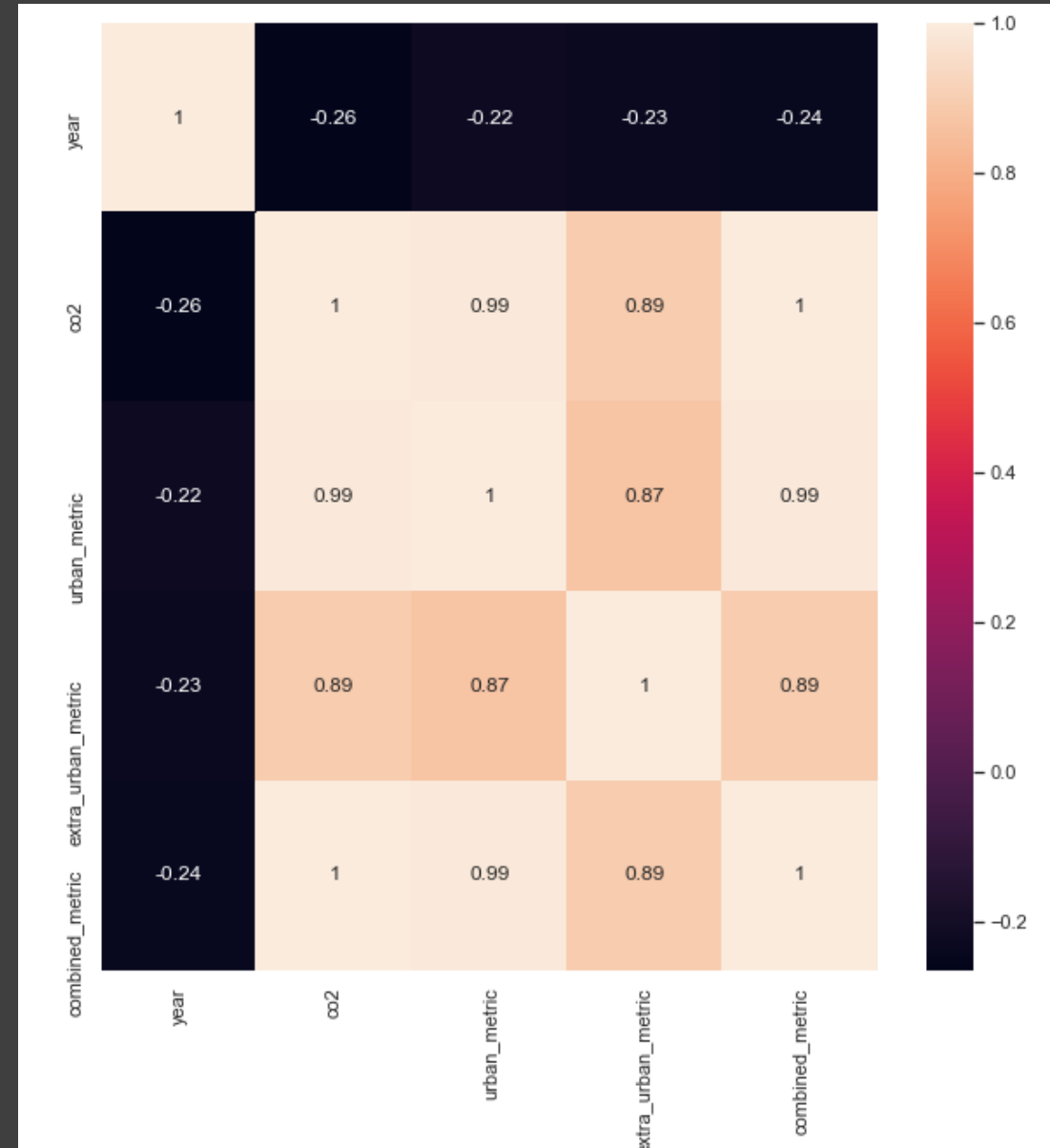


Avg emissions  
per year

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# Heatmap showing correlations





# Cars sorted by lowest fuel consumption

	year	manufacturer	co2	urban_metric	extra_urban_metric	combined_metric	model	fuel_type
44000	2013	Smart	0	0.0	0.0	0.0	fortwo coupé, Model Year 2013	Electricity
42064	2013	Citroen	0	0.0	0.0	0.0	C-Zero	Electricity
43987	2013	Smart	0	0.0	0.0	0.0	fortwo cabrio, Model Year 2013	Electricity
43718	2013	Renault	0	0.0	0.0	0.0	Zoe	Electricity
43661	2013	Renault	0	0.0	0.0	0.0	Fluence Z.E.	Electricity
45493	2013	Mitsubishi	0	0.0	0.0	0.0	i-MiEV	Electricity
45494	2013	Nissan	0	0.0	0.0	0.0	Leaf	Electricity
41951	2013	Chevrolet	27	0.0	0.0	1.2	Volt	Electricity/Petrol
44210	2013	Vauxhall	27	0.0	0.0	1.2	Ampera, Model Year 2012	Electricity/Petrol
44209	2013	Vauxhall	27	0.0	0.0	1.2	Ampera, Model Year 2012	Electricity/Petrol

# Cars sorted by lowest fuel consumption without electric cars

	year	manufacturer	co2	urban_metric	extra_urban_metric	combined_metric	model	fuel_type
2448	2001	Honda	80	4.1	3.0	3.4	Insight (2001 YM)	Petrol
599	2000	Honda	80	4.1	3.0	3.4	Insight (2000 YM)	Petrol
6853	2003	Honda	80	4.1	3.0	3.4	Insight	Petrol
42143	2013	Fiat	90	4.4	3.6	3.9	500 and 500C	Petrol
38355	2012	Chrysler Jeep	97	4.9	3.7	4.1	Chrysler Ypsilon MY2012	Petrol
43366	2013	Nissan	95	5.0	3.6	4.1	Micra	Petrol
43322	2013	Mitsubishi	96	4.8	3.7	4.1	Mirage, 2013	Petrol
43797	2013	Seat	96	5.0	3.6	4.1	Mii	Petrol
42169	2013	Fiat	95	4.8	3.7	4.1	New Panda	Petrol
40099	2012	Skoda	96	5.0	3.6	4.1	Citigo	Petrol

# Conclusion

- From the total amount of emissions, Mercedes Benz is overrepresented in their total emissions.
- Looking at the per car emissions, however, shows that Mercedes Benz is average.
- Emissions in total increased, but average emissions went down.
- Using the specified criteria, the Honda Insight is the best car to own.

# References

- <https://data.world/amercader/car-fuel-emissions-2000-2013>