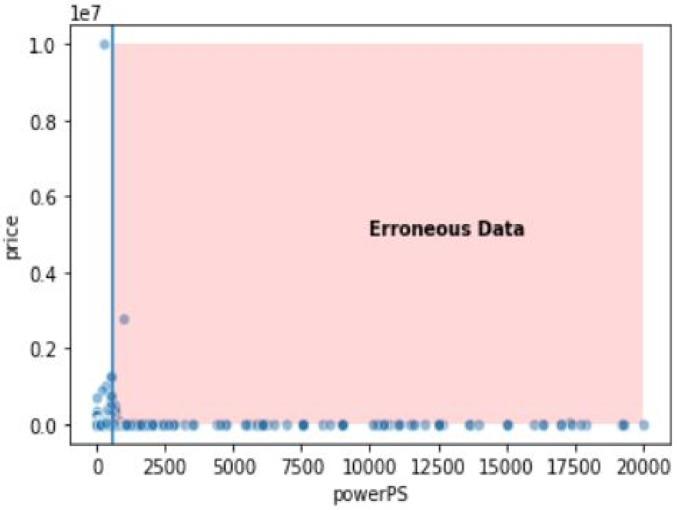
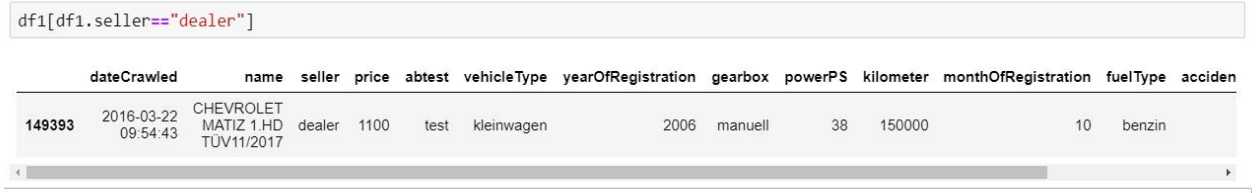
CAPSTONE DATA STORYTELLING

A large data frame consisting of 377 thousand arbitrarily entered car sale advertisements have been processed and cleaned to be used in a value prediction model. Now the dataset looks thinner with 230 thousand data points, but it is sanitized and ready to be used to provide valuable information through data storytelling, EDA and machine learning algorithms.

Having strong confidence of the cleanliness of the data, I started writing code for drawing graphs immediately. The first few graphs drawn immediately revealed I had missed some outliers, as seen on the right, which were removed immediately.
Outliers, once ignored, can cause great problems for basic calculations such as mean, standard deviation and they would have great impact on the correlation coefficients. A prediction model would never work precisely, once error is introduced as input to its mechanism.



After revisiting and cleaning the dataset, I immediately found something interesting to count: of all the ads placed, only 1 out of 233.000 belonged to dealers! It appears like dealers like to advertise as private party sellers. This tendency is very common worldwide, simply because buyers prefer private sellers.



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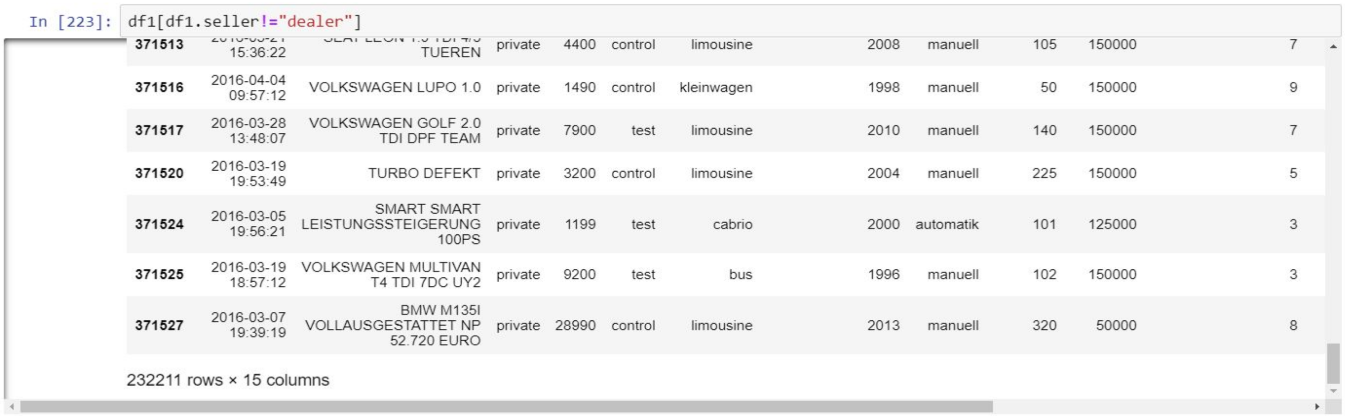
df1[df1.seller=="dealer"]
```

	dateCrawled	name	seller	price	abtest	vehicleType	yearOfRegistration	gearbox	powerPS	kilometer	monthOfRegistration	fuelType	acciden
149393	2016-03-22 09:54:43	CHEVROLET MATIZ 1.HD TÜV11/2017	dealer	1100	test	kleinwagen	2006	manuell	38	150000	10	benzin	



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In [223]: df1[df1.seller!="dealer"]
```
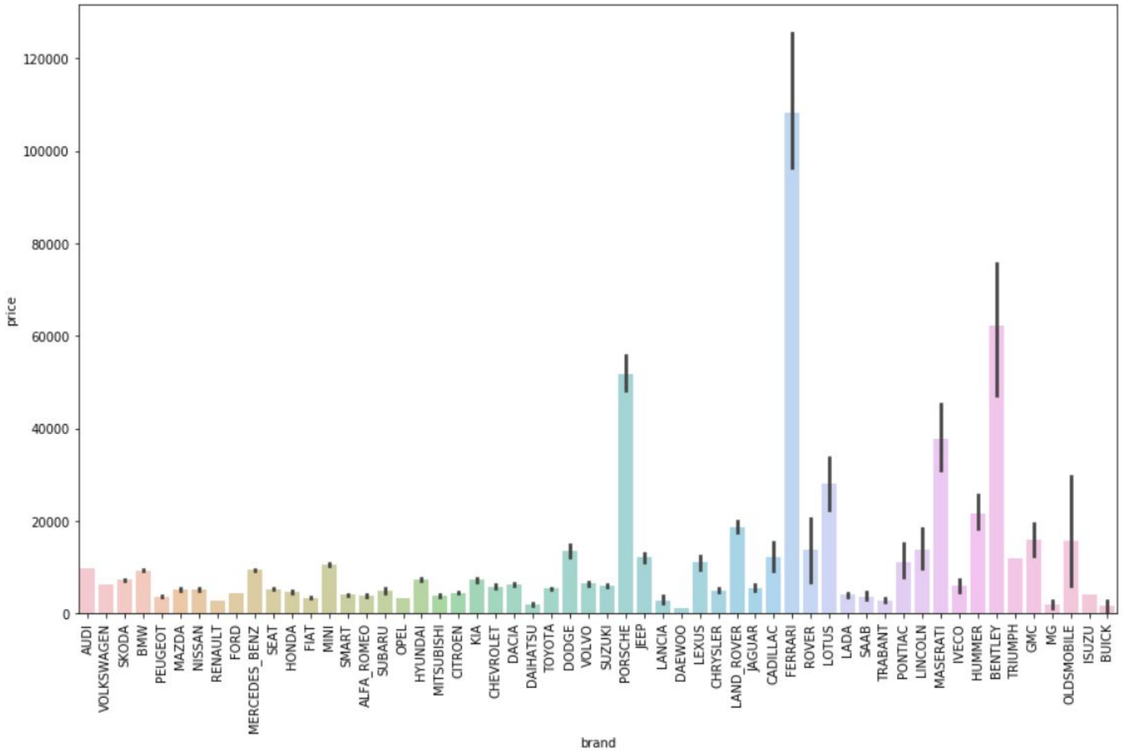
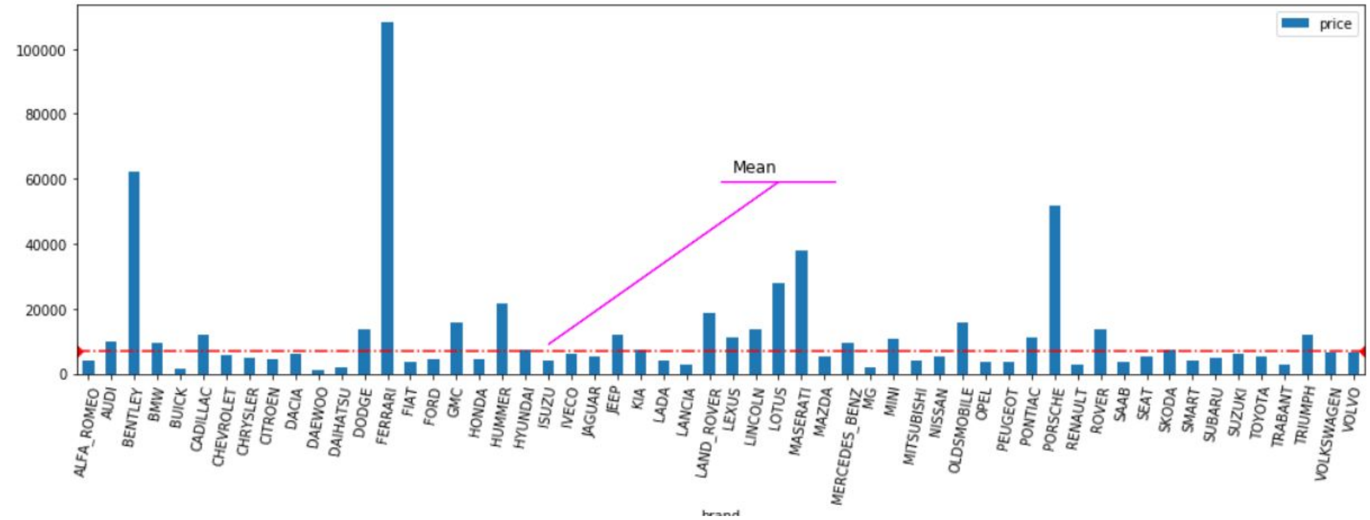

371513	15:36:22	TUEREN	private	4400	control	limousine	2008	manuell	105	150000	7
371516	2016-04-04 09:57:12	VOLKSWAGEN LUPO 1.0	private	1490	control	kleinwagen	1998	manuell	50	150000	9
371517	2016-03-28 13:48:07	VOLKSWAGEN GOLF 2.0 TDI DPF TEAM	private	7900	test	limousine	2010	manuell	140	150000	7
371520	2016-03-19 19:53:49	TURBO DEFEKT	private	3200	control	limousine	2004	manuell	225	150000	5
371524	2016-03-05 19:56:21	SMART SMART LEISTUNGSSTEIGERUNG 100PS	private	1199	test	cabrio	2000	automatik	101	125000	3
371525	2016-03-19 18:57:12	VOLKSWAGEN MULTIVAN T4 TDI 7DC UY2	private	9200	test	bus	1996	manuell	102	150000	3
371527	2016-03-07 19:39:19	BMW M135I VOLLAUSGESTATTET NP 52.720 EURO	private	28990	control	limousine	2013	manuell	320	50000	8

232211 rows × 15 columns

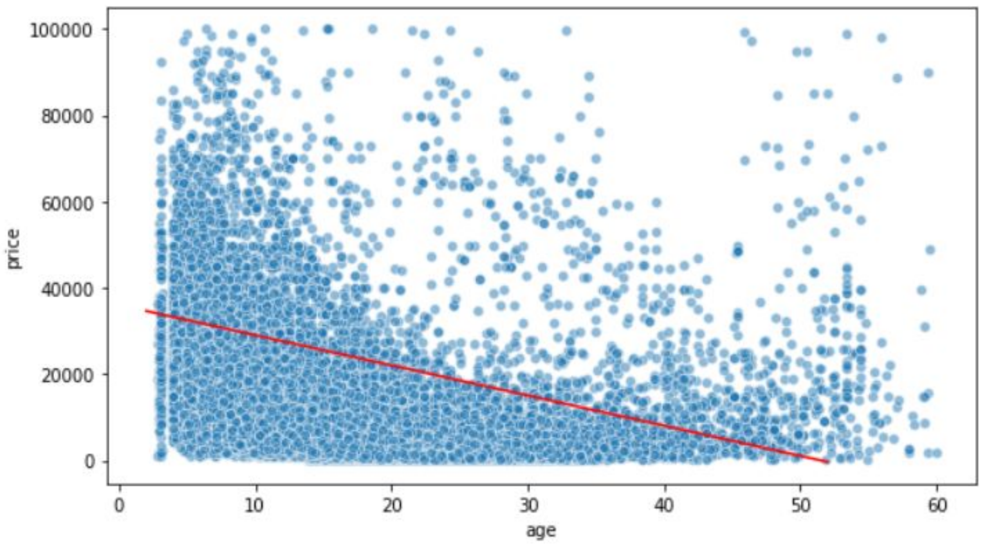
The graph below shows all brands and their mean prices as well as interquartile ranges. Ferrari, Porsche, Bentley and Maserati are the most expensive brands.

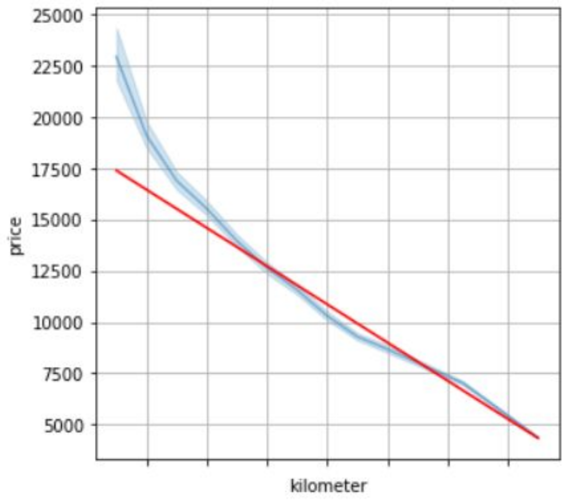


Compared to the database mean, the top three brands are clearly seen to be dwarfing others.

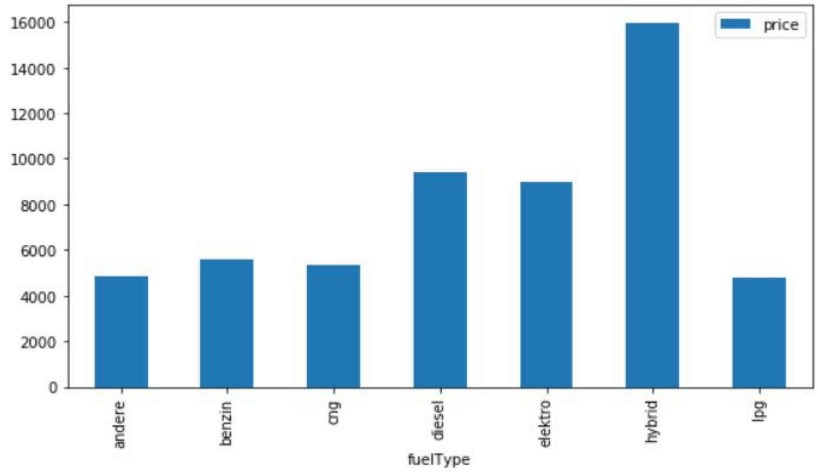


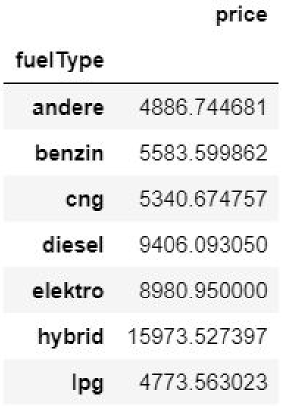
The red line represents the regression, in this (age,price) graph below. The regression line was shifted upwards in order to overlay. The trend is clearly visible, the age and price are negatively correlated.





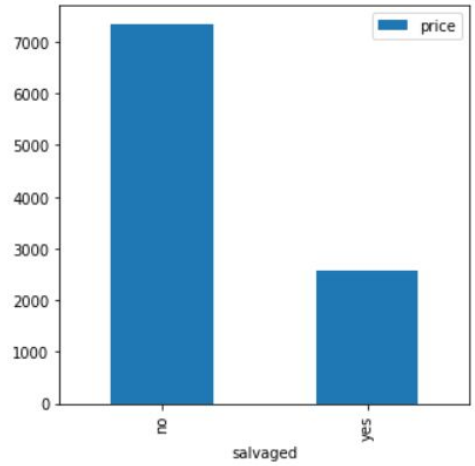
The (kilometer,price) graph on the left reveals that the price is inversely proportional to the mileage. This information is also backed by the regression line, depicted in red, and the negative sign of the Pearson coefficient, which has been calculated as -0.37.

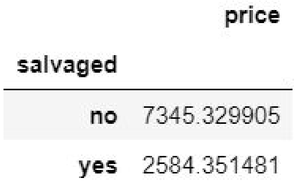




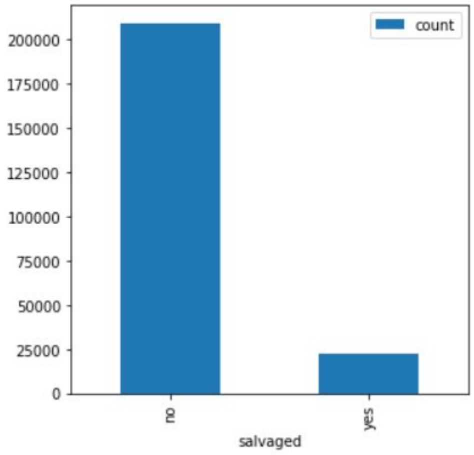
	price
fuelType	
andere	4886.744681
benzin	5583.599862
cng	5340.674757
diesel	9406.093050
elektro	8980.950000
hybrid	15973.527397
lpg	4773.563023

The price according to fuel types have been depicted below. The fact that hybrid vehicles are the most expensive proves to be because of this reason: the only electric cars available at second hand market -thus this database- were “Smart fourtwo” ultra compact city cars that has front row of seats only. Those vehicles are very small, therefore not so expensive. Many brands have hybrid models, that have cutting age technology to curb down fuel consumption, making them considerably higher priced. Diesel vehicles burn less amount of fuel and diesel is considerably cheaper than gasoline in Europe, therefore these cars are preferred over gasoline ones and they are more expensive.

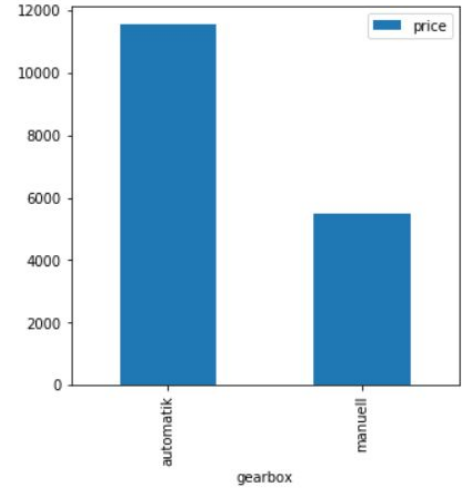


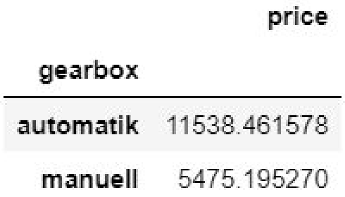


	price
salvaged	
no	7345.329905
yes	2584.351481



The average price of a salvaged vehicle is almost three times lower than an accident free vehicle, which is quite obvious, since salvaged vehicles are less preferred. The actual wording in the original data frame is not provided, however, I believe it is “nicht unfall frei” which means not accident free.It was originally translated as not repaired damage which I believe is wrong. Some information may be lost in translation, because people tend to sell damaged vehicles, even totaled ones.

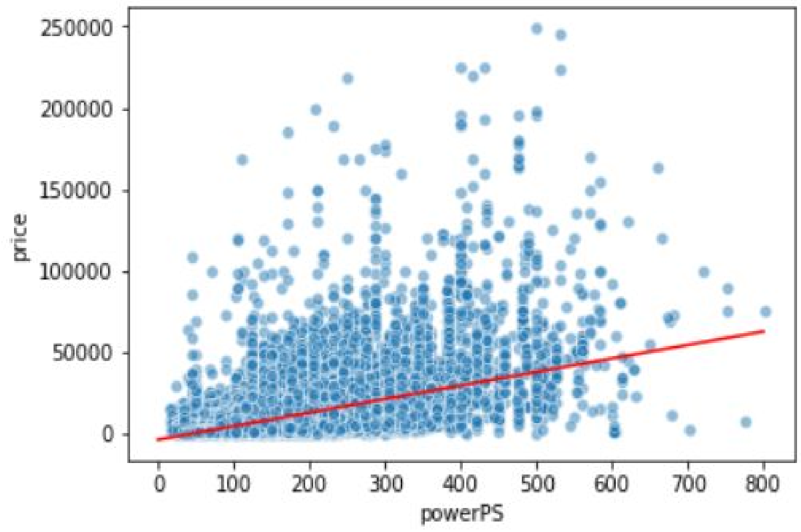


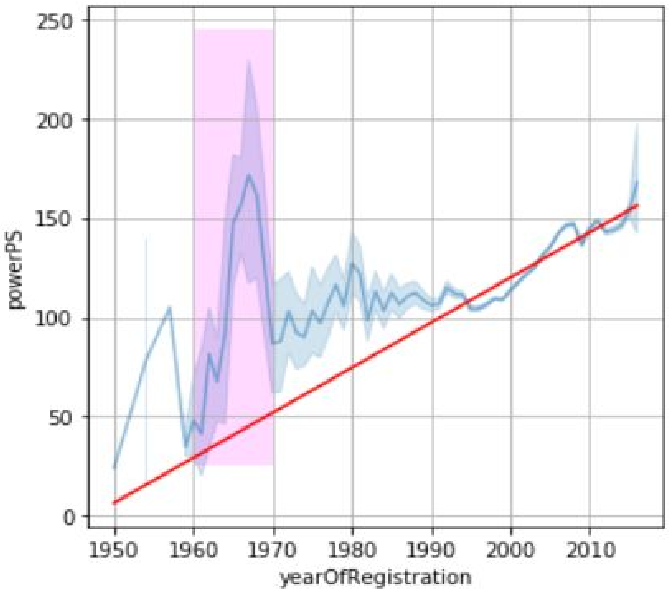


	price
gearbox	
automatik	11538.461578
manuell	5475.195270

Automatic transmission vehicles are twice as expensive as manual transmission vehicles. Automatic transmission is more sophisticated, therefore it is more expensive. Moreover, some luxurious models only come in automatic transmission.

Correlation Calculations

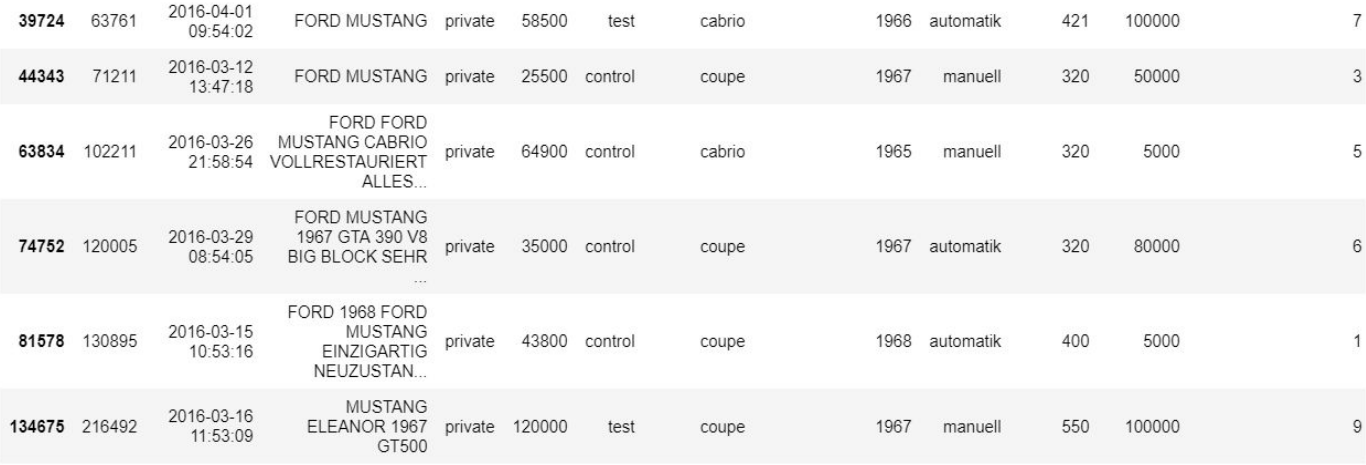




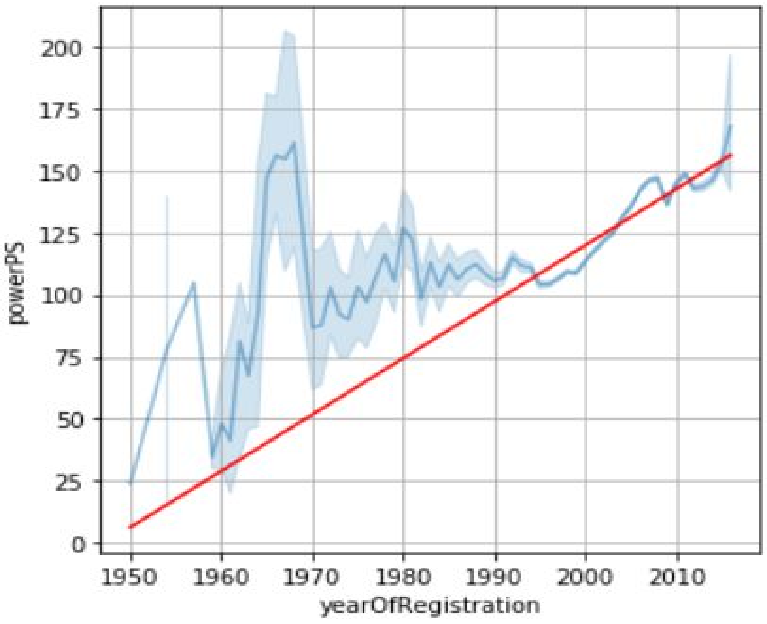
In this project, correlation was measured by pearson coefficient r, which shows strong correlation between continuous numeric variables if r = 1, no correlation if r=0, and strong negative correlation if r=-1.

Initial r for the horsepower - price correlation was as low as 0.2. This number seemed to be too small for me, and then after performing another check, I noticed that I failed to realize PS outliers with extremely high values. These were removed and then another pearson correlation value calculation revealed the actual r value is 0.5. The removal of only 130 rows out of 232 thousand changed the correlation coefficient dramatically.

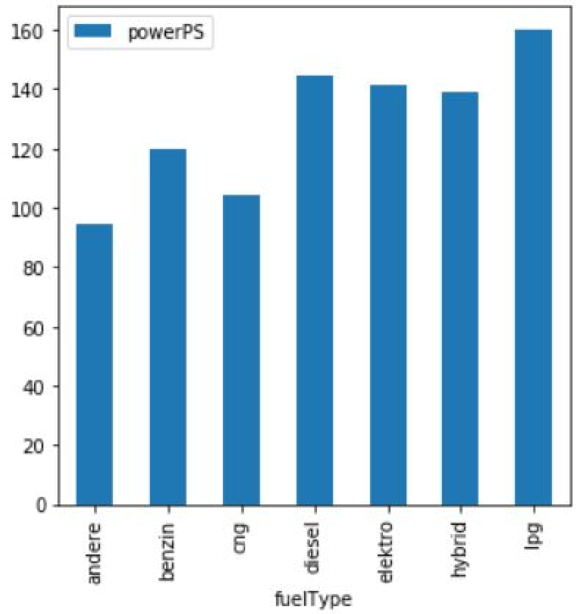
The year vs power chart drew my attention immediately. The power of the vehicles registered in 1960-1970 era create a very noticeable bump in the graph. The data seemed to be wrong, and needed an examination, which revealed only a limited number of data points that were off. The Fiat 500, which is a compact car, has engine volume of 598cc, and this number was entered in the HP column. However, after removing these data points, the shape of the graph did not change. This was due to the increasing role of the American muscle cars in European market! The mean horsepower in 50’s was 50.8, and with the introduction of the American vehicles, the mean increased to 132 in just a decade. In fact, there are only two vehicles in the database in the 50's that are more powerful than 100 PS. The American invasion of the German car market with hot rods can be clearly seen below. A decade ago, 2 vehicles in this DB exceeded two digit horsepower values, but just in a few years, export vehicles as powerful as 550 hp were introduced. The graph on the left was created after removal of erroneous Fiat 500 values.

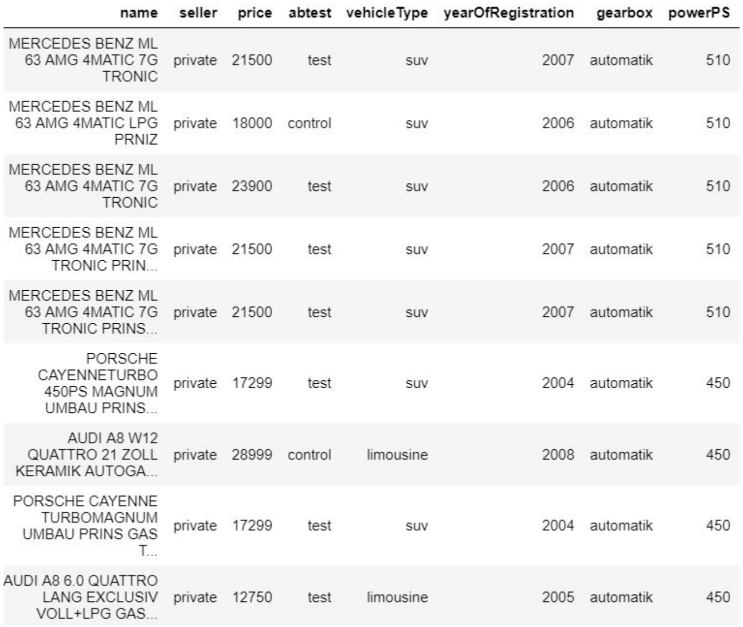


39724	63761	2016-04-01 09:54:02	FORD MUSTANG	private	58500	test	cabrio	1966	automatik	421	100000	7
44343	71211	2016-03-12 13:47:18	FORD MUSTANG	private	25500	control	coupe	1967	manuell	320	50000	3
63834	102211	2016-03-26 21:58:54	FORD FORD MUSTANG CABRIO VOLLRESTAURIERT ALLES...	private	64900	control	cabrio	1965	manuell	320	5000	5
74752	120005	2016-03-29 08:54:05	FORD MUSTANG 1967 GTA 390 V8 BIG BLOCK SEHR ...	private	35000	control	coupe	1967	automatik	320	80000	6
81578	130895	2016-03-15 10:53:16	FORD 1968 FORD MUSTANG EINZIGARTIG NEUZUSTAN...	private	43800	control	coupe	1968	automatik	400	5000	1
134675	216492	2016-03-16 11:53:09	MUSTANG ELEANOR 1967 GT500	private	120000	test	coupe	1967	manuell	550	100000	9



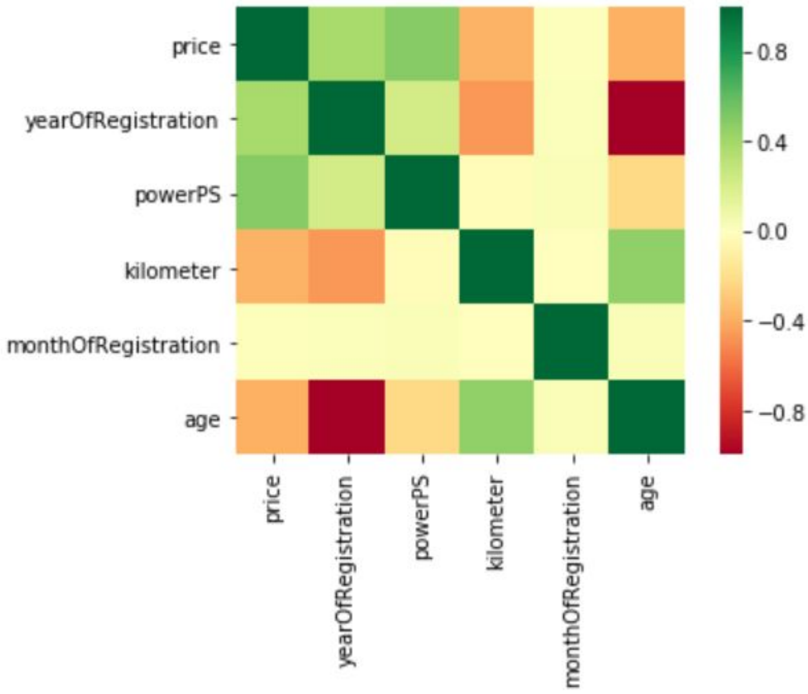
It is really interesting to see that the most powerful vehicles are LPG powered. This data seems erroneous at first glance, but a brief look at the vehicle brands and models reveals that the data is right. LPG conversion kits are very common in Europe, and when people buy vehicles that have low gas mileage, they tend to have the vehicles converted to LPG, which cuts down the fuel costs. It is quite obvious that this conversion would be more prevalently visible in bigger engine cars: small engine burns less fuel and kit price is comparable to the savings that would have been





name	seller	price	abtest	vehicleType	yearOfRegistration	gearbox	powerPS
MERCEDES BENZ ML 63 AMG 4MATIC 7G TRONIC	private	21500	test	suv	2007	automatik	510
MERCEDES BENZ ML 63 AMG 4MATIC LPG PRNIZ	private	18000	control	suv	2006	automatik	510
MERCEDES BENZ ML 63 AMG 4MATIC 7G TRONIC	private	23900	test	suv	2006	automatik	510
MERCEDES BENZ ML 63 AMG 4MATIC 7G TRONIC PRIN...	private	21500	test	suv	2007	automatik	510
MERCEDES BENZ ML 63 AMG 4MATIC 7G TRONIC PRINS...	private	21500	test	suv	2007	automatik	510
PORSCHE CAYENNETURBO 450PS MAGNUM UMBAU PRINS...	private	17299	test	suv	2004	automatik	450
AUDI A8 W12 QUATTRO 21 ZOLL KERAMIK AUTOGA...	private	28999	control	limousine	2008	automatik	450
PORSCHE CAYENNE TURBOMAGNUM UMBAU PRINS GAS T...	private	17299	test	suv	2004	automatik	450
AUDI A8 6.0 QUATTRO LANG EXCLUSIV VOLL+LPG GAS...	private	12750	test	limousine	2005	automatik	450

made after the conversion. However, it is a must to convert powerful vehicles to LPG, since conversion cost would be negligible in the long run. Actually some people prefer to have their vehicles converted as soon as they buy them, even if it is brand new.



The heat map generated to display the correlation coefficients can be seen on the left. An internal algorithm coded into Pandas automatically blocks out columns that are not continuous numeric variables, leaving out transmission type, fuel type etc. These will be handled as a part of the classification problem in the machine learning phase.