Automobile Dataset EDA

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SEPT 2021

“In God we trust;
all others must bring data.”

- WILLIAM EDWARDS DEMMINGS
  (STATISTICIAN, DATA SCIENTIST)

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Introduction

We are presented with a small automobile dataset with just 205 observations.

Each observation constitutes of 26 features of automobiles such as make, horsepower, price and more.

In this report, we will strive to draw relationships between each feature and present useful inferences.

Features of the Data - Numerical

	symbolling	normalized-losses	wheel-base	length	width	height	curb-weight	engine-size	bore	stroke	compression-ratio	horsepower	peak-rpm	city-mpg	highway-mpg	price
count	205.0	164.0	205.0	205.0	205.0	205.0	205.0	205.0	201.0	201.0	205.0	203.0	203.0	205.0	205.0	201.0
mean	0.8	122.0	98.8	174.0	65.9	53.7	2555.6	126.9	3.3	3.3	10.1	104.3	5125.4	25.2	30.8	13207.1
std	1.2	35.4	6.0	12.3	2.1	2.4	520.7	41.6	0.3	0.3	4.0	39.7	479.3	6.5	6.9	7947.1
min	-2.0	65.0	86.6	141.1	60.3	47.8	1488.0	61.0	2.5	2.1	7.0	48.0	4150.0	13.0	16.0	5118.0
25%	0.0	94.0	94.5	166.3	64.1	52.0	2145.0	97.0	3.2	3.1	8.6	70.0	4800.0	19.0	25.0	7775.0
50%	1.0	115.0	97.0	173.2	65.5	54.1	2414.0	120.0	3.3	3.3	9.0	95.0	5200.0	24.0	30.0	10295.0
75%	2.0	150.0	102.4	183.1	66.9	55.5	2935.0	141.0	3.6	3.4	9.4	116.0	5500.0	30.0	34.0	16500.0
max	3.0	256.0	120.9	208.1	72.3	59.8	4066.0	326.0	3.9	4.2	23.0	288.0	6600.0	49.0	54.0	45400.0

We have 17 numerical features, each with distinct variation.
From the count, we notice that few features have lower count, implying missing values in those columns.

Features of the Data - Categorical

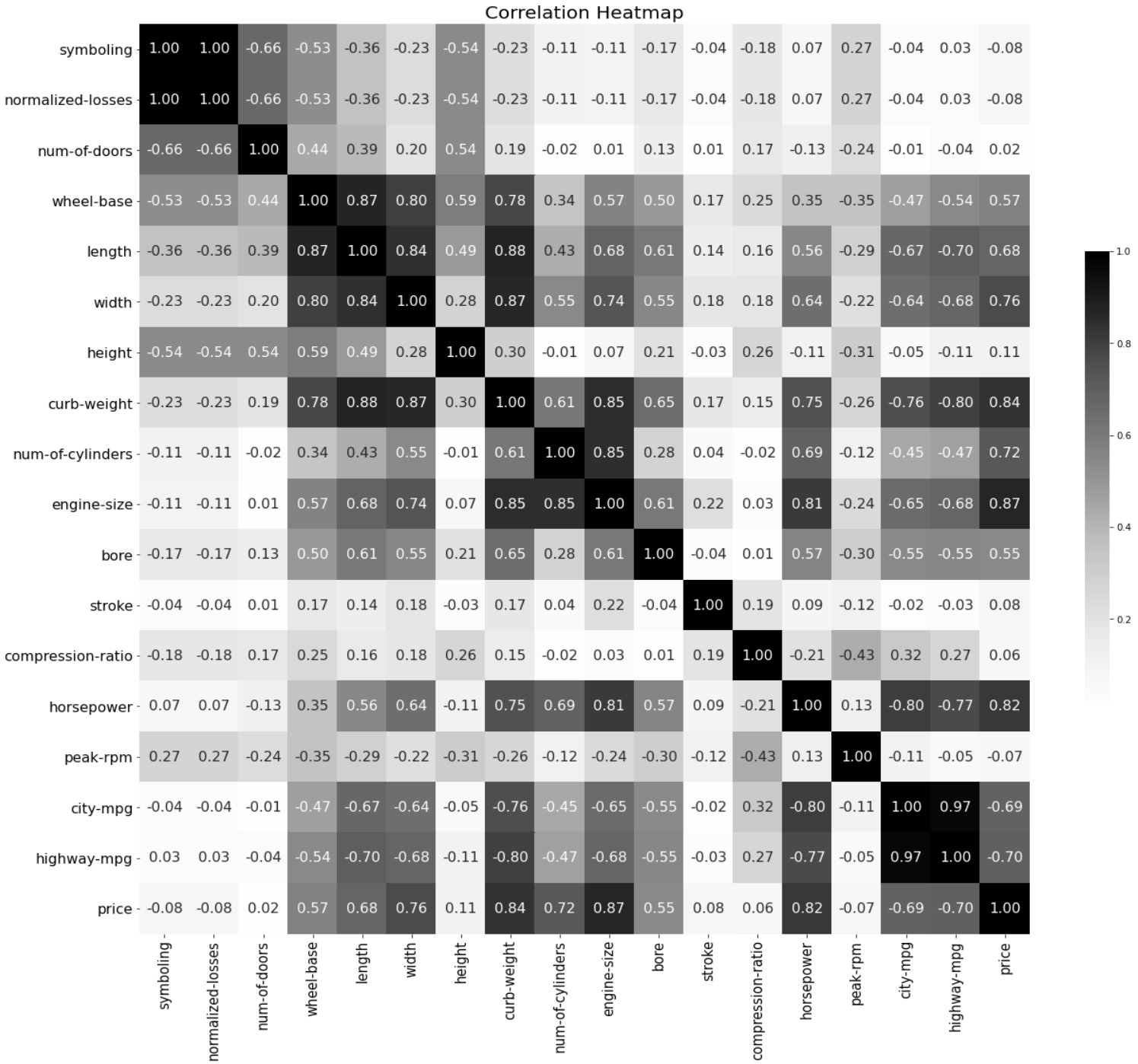
	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels	engine-location	engine-type	num-of-cylinders	fuel-system
count	205	205	205	203	205	205	205	205	205	205
unique	22	2	2	2	5	3	2	7	7	8
top	toyota	gas	std	four	sedan	fwd	front	ohc	four	mpfi
freq	32	185	168	114	96	120	202	148	159	94

We have 10 categorical features. Some of these features are ordinal and may be converted to numeric. These are num-of-doors and num-of-cylinders.

Correlation among Features

Max correlation:

- city-mpg and highway-mpg - 0.97
- Engine-size and price – 0.87
- Engine-size and price – 0.85
- Curb-weight and price – 0.84
- Wheel-base, length, width, height and crub-weight have high correlation among them as these are dimensions of the car

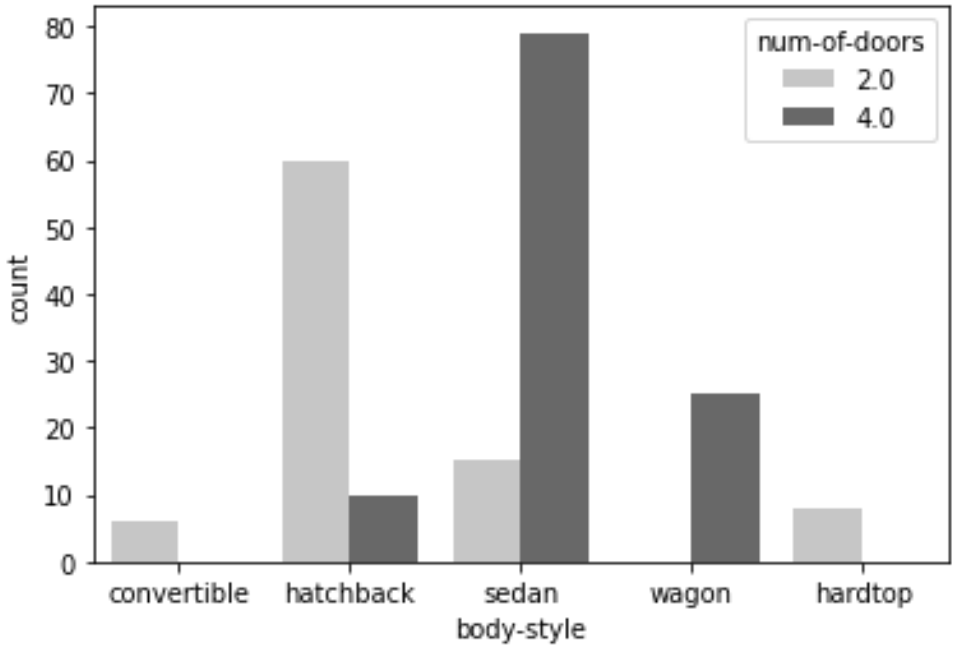


Missing values Imputation

IN THE SUBSEQUENT SLIDES WE WILL IMPUTE THE MISSING VALUES BASED ON INSIGHTS FROM EDA

Imputing num-of-doors

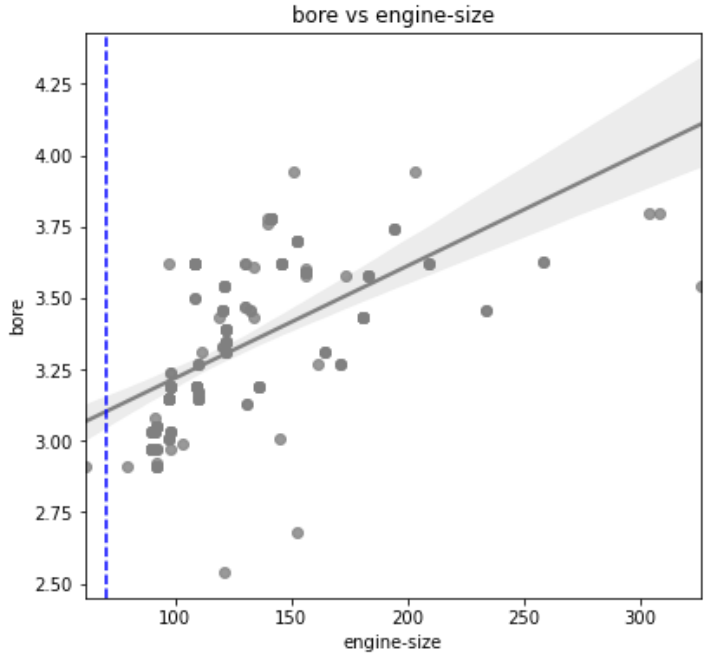
- We know logically that number of doors depends on body-style of car.
- That is, convertible and hardtop have two doors, while rest have 4.
- We see that the null values are for cars with body-style as sedan.
- Hence we may impute num-of-doors to be 4.

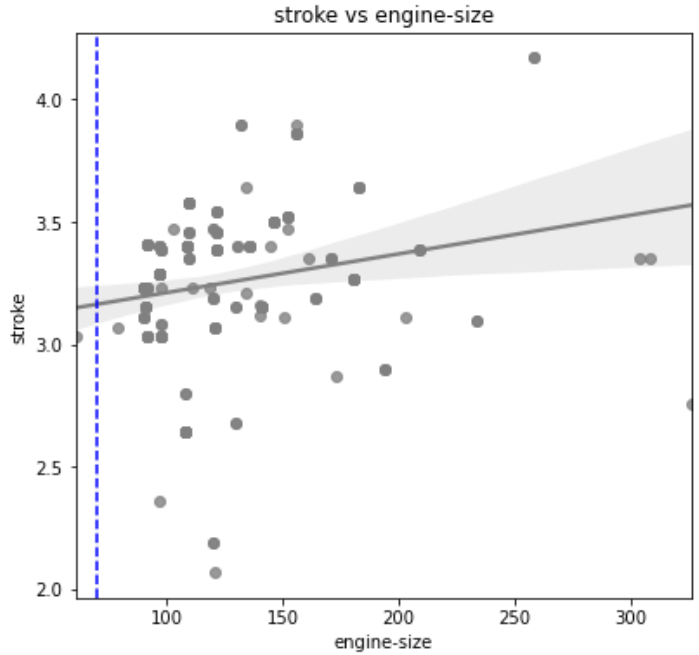


	num-of-doors	body-style
27	NaN	sedan
63	NaN	sedan

Imputing stroke and bore

- 'stroke' and 'bore' are dimensions of the cylinder in an automobile engine.
- That is, we may see some correlation between these variables.
- In our missing data for stroke and bore, the engine size was at 70 and 80 units.
- Ideally we could use OLS to find the intercept and the slope to calculate the missing values.
- But here, as the count of missing values is less, we may eyeball estimate the value.

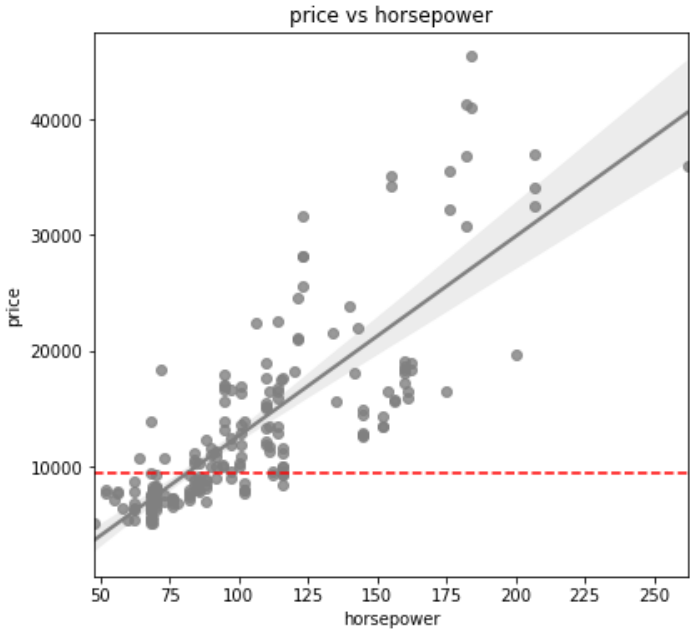




Eyeballing those values in these graphs, it seems that
For engine size = 70, bore = 3.0, stroke = 3.0
For engine size = 80, bore = 3.0, stroke = 3.0

Imputing Horsepower

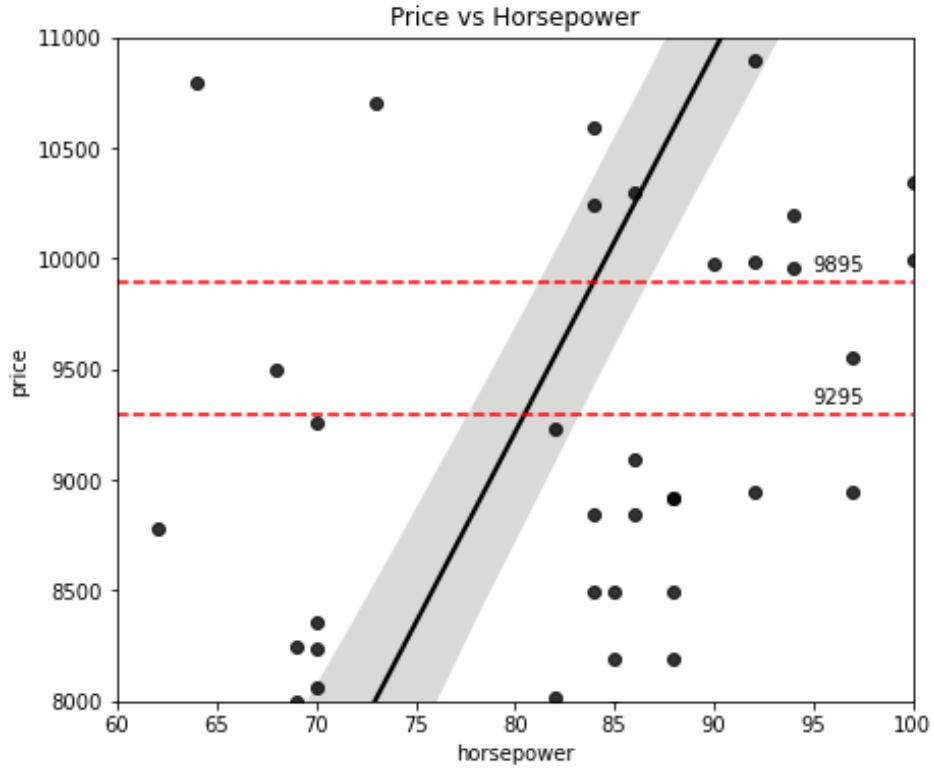
- From the heatmap we created earlier, we see that it correlates most with engine-size and price.
- As engine-size is 132 for both missing values, lets look at price a bit deeper.



	horsepower	price	engine-size
130	NaN	9295	132
131	NaN	9895	132

Imputing Horsepower (2)

- Eyeballing the above graph, we can estimate the missing horsepower values
- For observation with price 9295, the horsepower is around 80
- For observation with price 9895, the horsepower is around 83



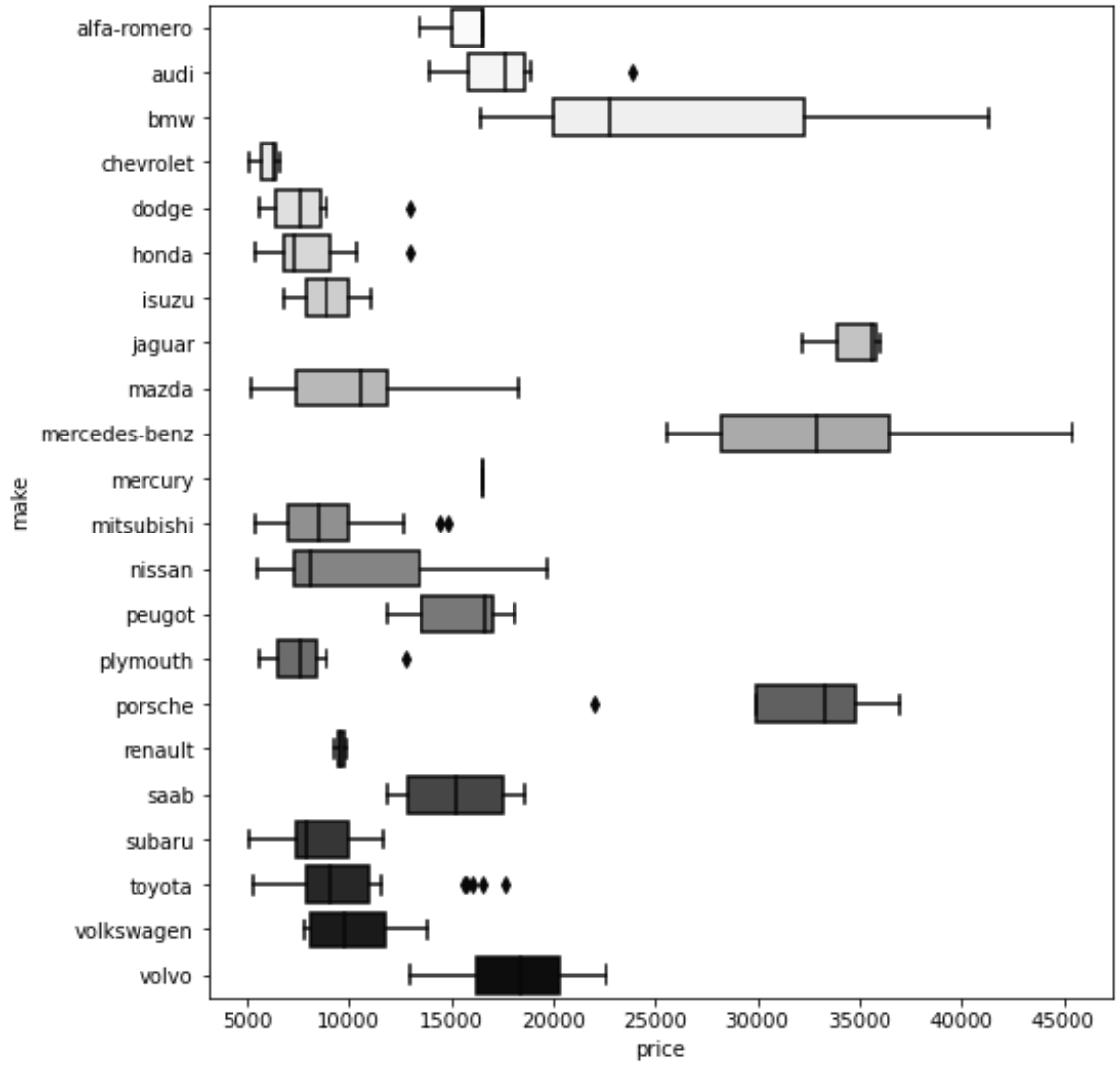
Please note that this eyeballing technique is used only because

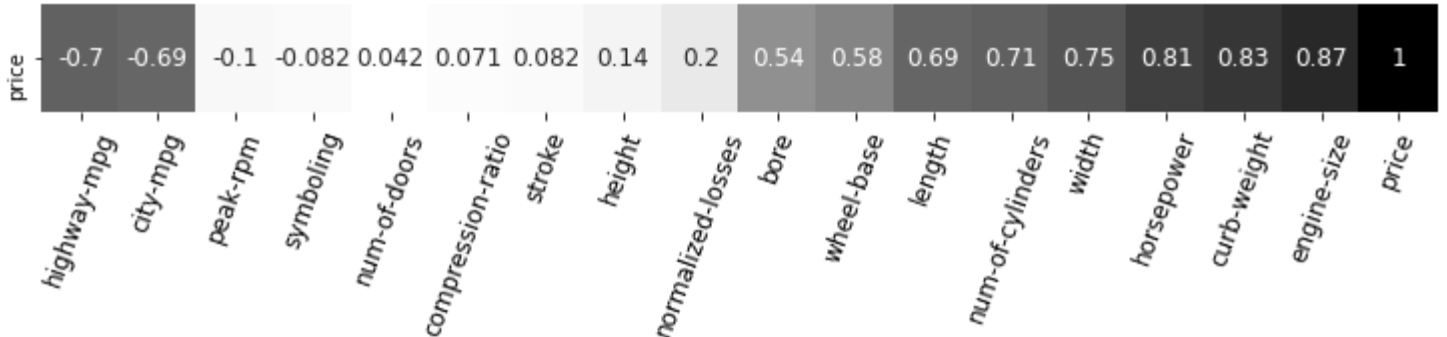
- we have just 205 observations
- the number of missing values are very low (2 here)

When observations are much larger, we may use mode or median instead

Imputing Price

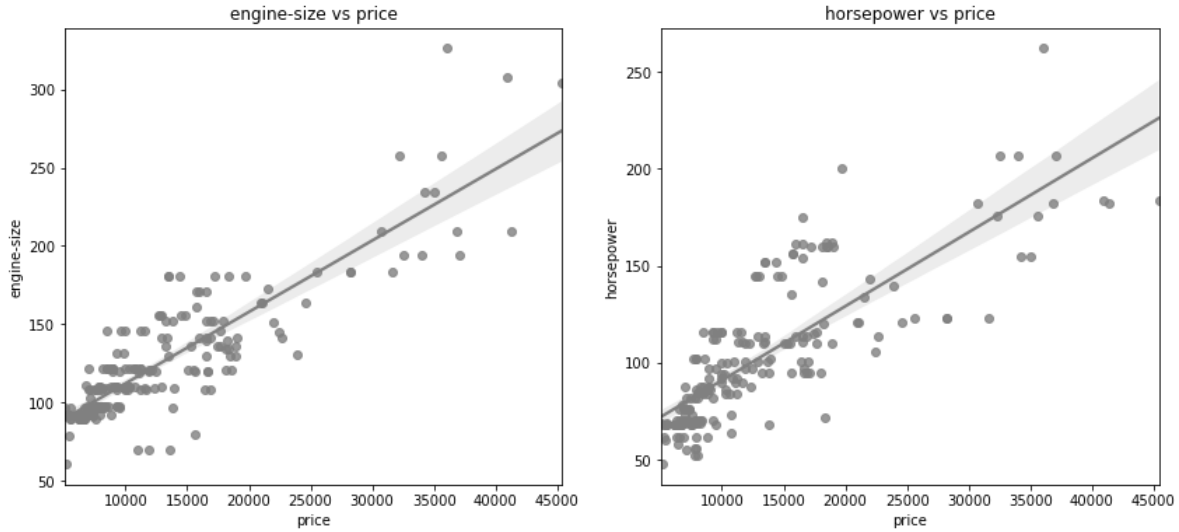
- We know from our understanding that price of a car depends on two major factors.
- First, the brand (make). Second, the performance (engine).
- Checking our assumption using heatmap, We see that engine-size, curb-weight and horsepower are the highest impactors of Price.



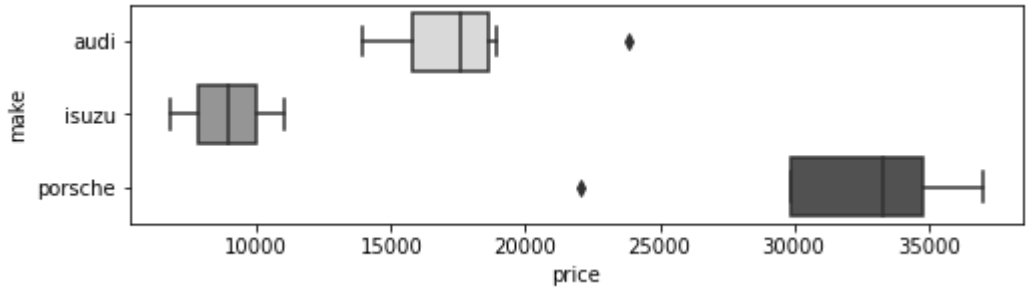


Imputing Price (2)

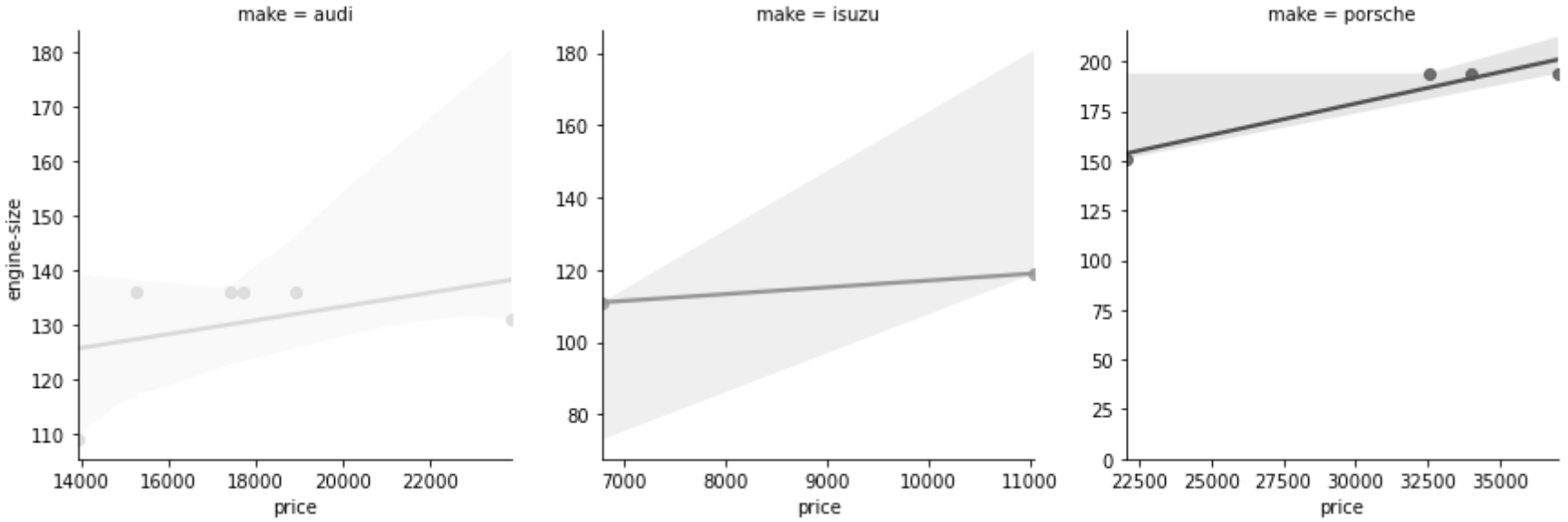
- In line with our assumption, Price is dependent on engine-size, horsepower and the make of the vehicle.
- Lets look at this deeper.



	make	horsepower	price	engine-size
9	audi	160.0	NaN	131
44	isuzu	70.0	NaN	90
45	isuzu	70.0	NaN	90
129	porsche	288.0	NaN	203



Imputing Price (3)

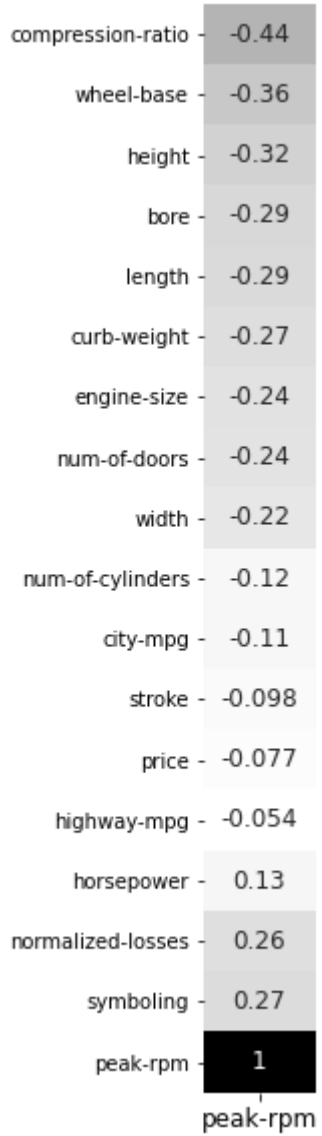


From above we can estimate,

- for an Audi with engine-size 131, the price can be around 22000
- for an isuzu with engine-size 90, the price can be around 7000
- for a porsche with engine-size 203, the price can be around 37500

Imputing Peak-rpm

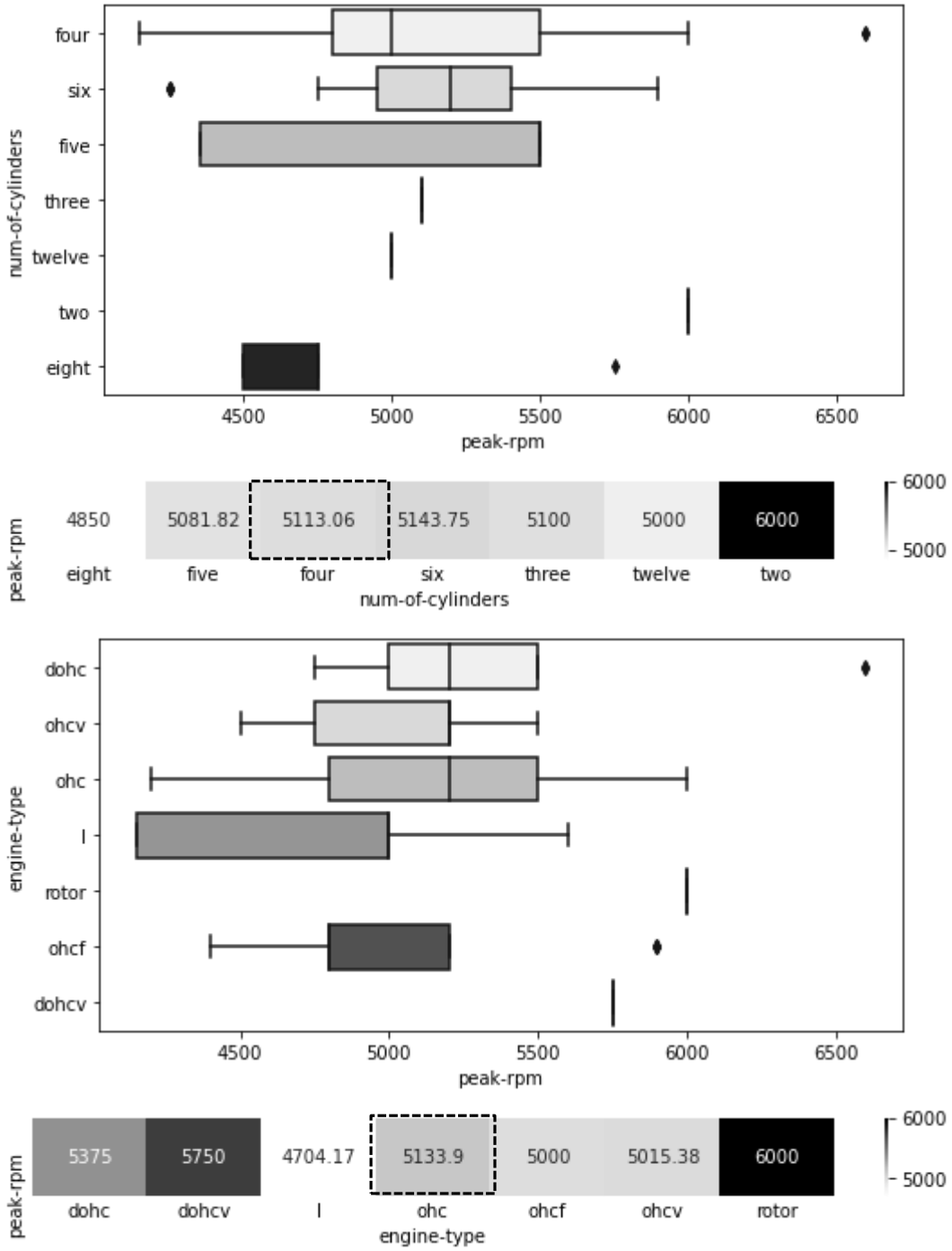
- We see that there are no features that are highly correlated with peak-rpm.
- Hence we look at categorical features instead.
- As engine-type and num-of-cylinders have 7 unique variations, we will use that to impute value for peak-rpm.



	130	131	count	unique	top	freq
make	renault	renault	205	22	toyota	32
fuel-type	gas	gas	205	2	gas	185
aspiration	std	std	205	2	std	168
num-of-doors	four	two	205	3	four	114
body-style	wagon	hatchback	205	5	sedan	96
drive-wheels	fwd	fwd	205	3	fwd	120
engine-location	front	front	205	2	front	202
engine-type	ohc	ohc	205	7	ohc	148
num-of-cylinders	four	four	205	7	four	159
fuel-system	mpfi	mpfi	205	8	mpfi	94
peak-rpm	NaN	NaN	-	-	-	-

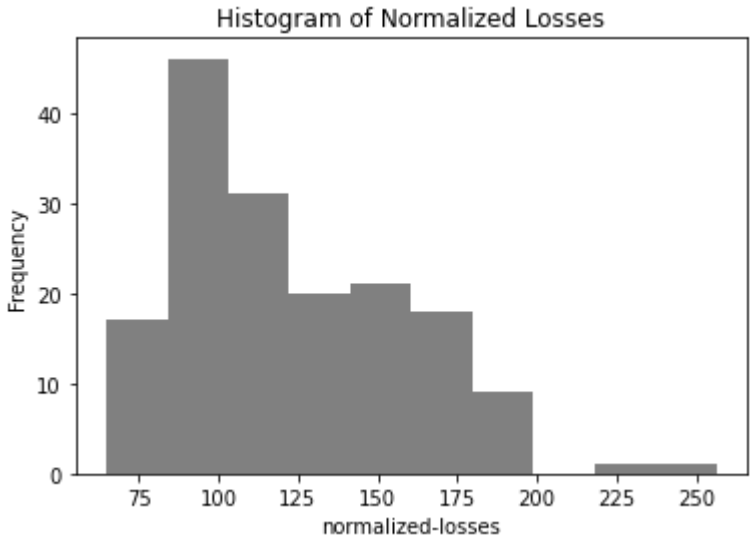
Imputing Peak-rpm (2)

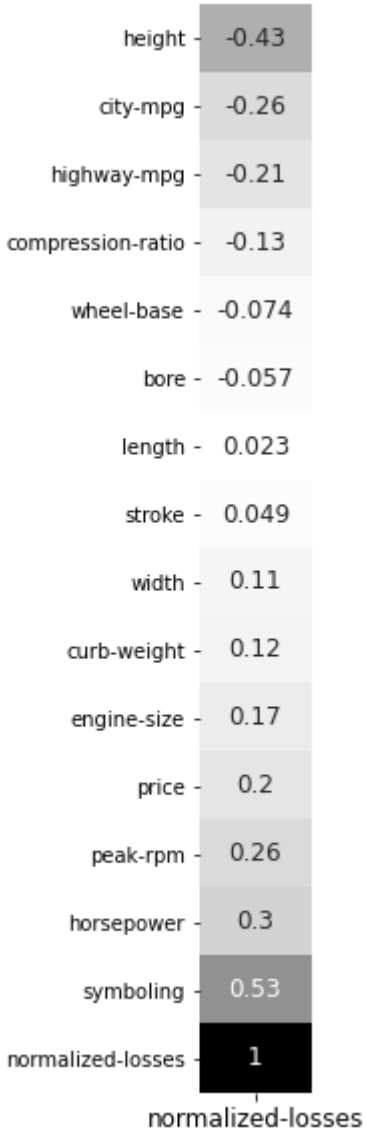
- For vehicles with num-of-cylinders as four, the mean peak-rpm is around 5113.
- For vehicles with engine-type ohc, the mean peak-rpm is around 5134
- Hence, we may impute a value between 5113 and 5134, say 5120.



Normalized Losses

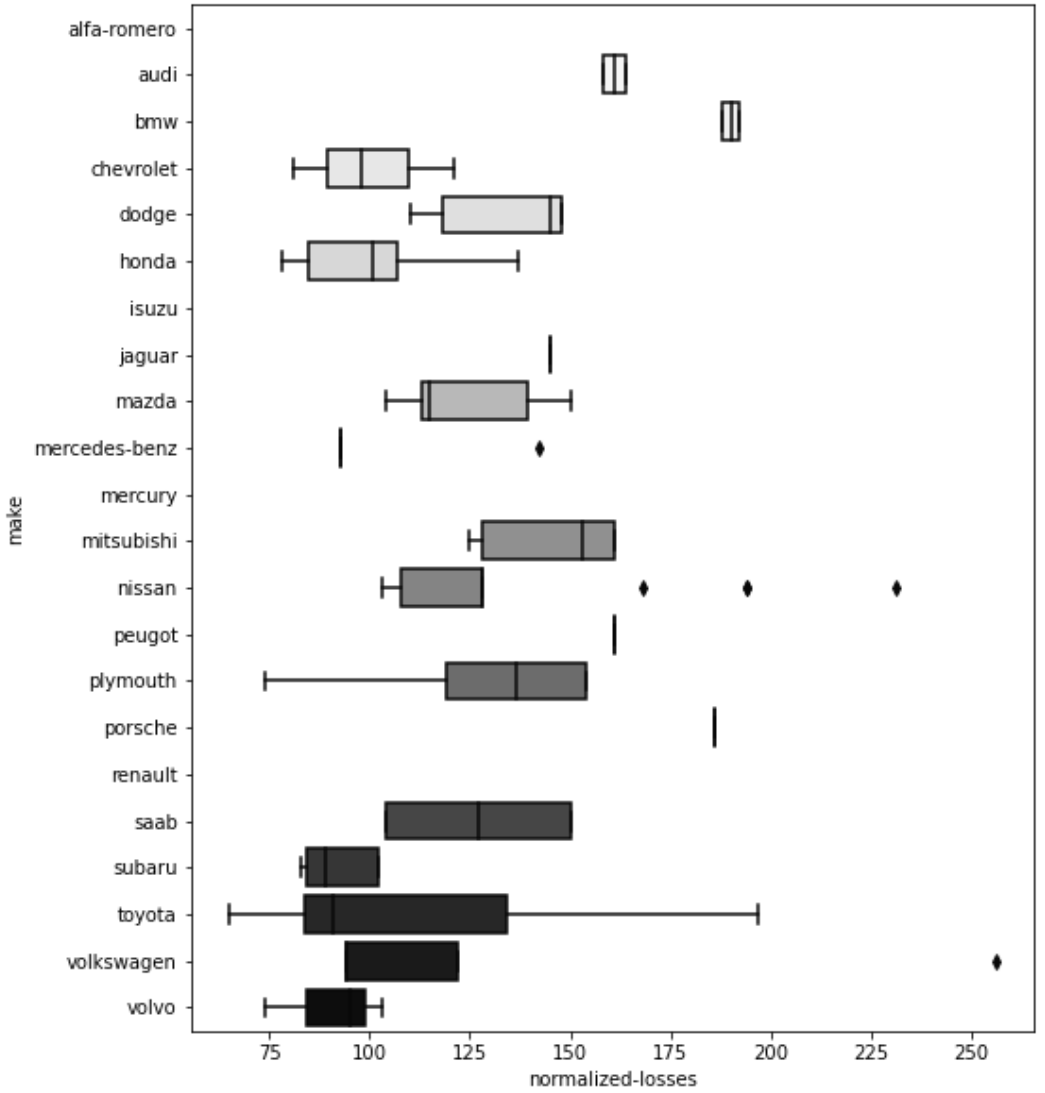
- There are 41 missing field in normalized losses column.
- Clearly we cannot eyeball for each value.
- We also see that no feature is highly correlated with normalized losses.





Normalized Losses (2)

- We see that each make has distinct mean normalized loss.
- We will impute this value in the missing field.



make	normalized-losses (mean)
alfa-romero	NaN
audi	161.0
bmw	190.0
chevrolet	100.0
dodge	133.4
honda	103.0
isuzu	NaN
jaguar	145.0
mazda	123.9
mercedes-benz	102.8
mercury	NaN
mitsubishi	146.2
nissan	135.2
peugot	161.0
plymouth	129.0
porsche	186.0
renault	NaN
saab	127.0
subaru	92.2
toyota	110.3
volkswagen	121.2
volvo	91.5

Conclusion

- In this project, we have analysed the data between multiple features of automobiles to establish each's relationship with the other and impute the missing fields within the dataset.
- We have successfully imputed all missing values with appropriate metrics.
- While doing so, we have uncovered several insights from the data which we present in the subsequent slide.

Inferences

1. Contrary to popular belief that hatchbacks have 4 doors, in this dataset we see about 60 observations (85% of all hatchbacks) to have 2 doors.
2. Price of a vehicle is mostly influenced by the make, engine-size, curb-weight, horsepower in that order.
3. Also we see a negative correlation between mileage and Price.
4. Vehicles with make such as Audi, BMR, Porsche, Alfa Romeo, Jaguar, Mercedes, seem to better manage their losses compared to vehicles of other makes.


THANK YOU