```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns


from sklearn.decomposition import PCA
from sklearn.feature_selection import mutual_info_regression

# matplotlib defaults

plt.style.use("seaborn-darkgrid")
plt.rc("figure", autolayout=True)
plt.rc(
    "axes",
    labelweight="bold",
    labelsize="large",
    titleweight="bold",
    titlesize=14,
    titlepad=10,
)

import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))
```

```
<ipython-input-6-8a4e3a410fe5>:6: MatplotlibDeprecationWarning: The seaborn styles shipped by Matplotlib are deprecated since 3.6, as th
  plt.style.use("seaborn-darkgrid")
```

```
data = pd.read_csv('cars.csv')
data
```

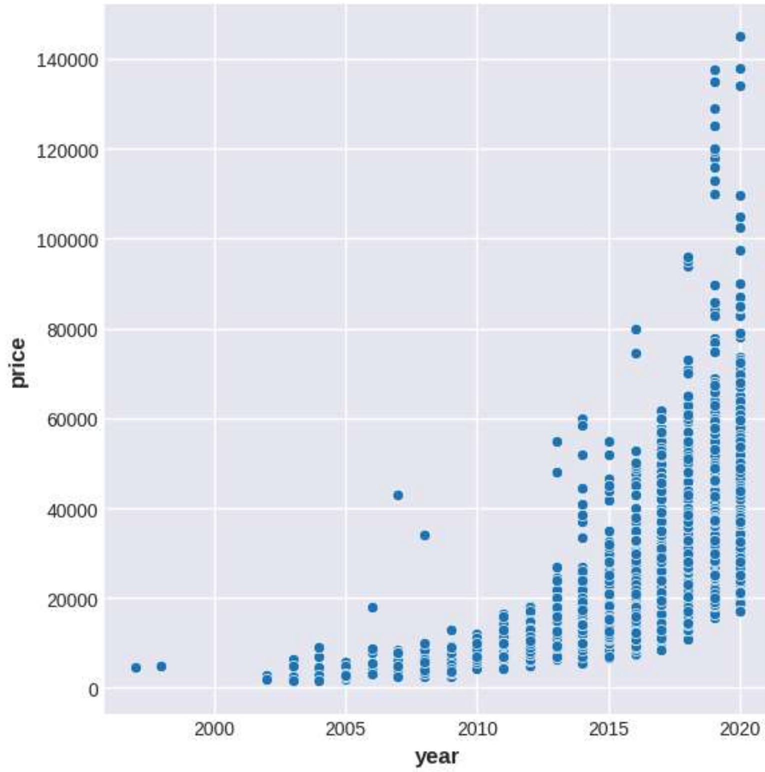
	model	year	price	transmission	mileage	fuelType	tax	mpg	engineSize
0	A1	2017	12500	Manual	15735	Petrol	150	55.4	1.4
1	A6	2016	16500	Automatic	36203	Diesel	20	64.2	2.0
2	A1	2016	11000	Manual	29946	Petrol	30	55.4	1.4
3	A4	2017	16800	Automatic	25952	Diesel	145	67.3	2.0
4	A3	2019	17300	Manual	1998	Petrol	145	49.6	1.0
...	...	...	...	...	...	...	...	...	...
10663	A3	2020	16999	Manual	4018	Petrol	145	49.6	1.0
10664	A3	2020	16999	Manual	1978	Petrol	150	49.6	1.0
10665	A3	2020	17199	Manual	609	Petrol	150	49.6	1.0
10666	Q3	2017	19499	Automatic	8646	Petrol	150	47.9	1.4
10667	Q3	2016	15999	Manual	11855	Petrol	150	47.9	1.4

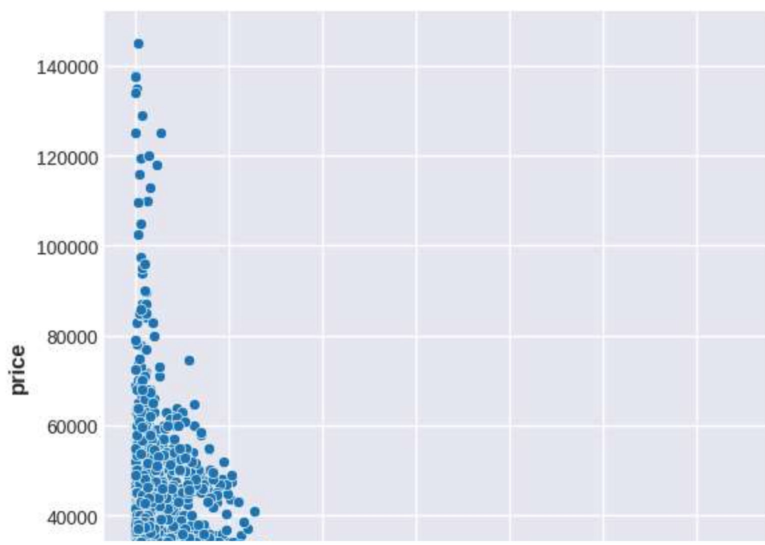
10668 rows × 9 columns

```
data.var()
```

```
<ipython-input-9-6bf595b3cfe5>:1: FutureWarning: The default value of numeric_only in DataFrame.var is deprecated. In a future version,
  data.var()
year          4.698029e+00
price         1.372375e+08
mileage       5.524971e+08
tax           4.511848e+03
mpg           1.676968e+02
engineSize    3.635567e-01
dtype: float64
```

```
y = data['price']
dataa = data.drop('price', axis=1)

cols = [col for col in dataa.columns if dataa[col].dtype in ['int64','float64']]

for idx, col in enumerate(cols):
    plt.figure(idx, figsize=(6,6))
    sns.scatterplot(x=col, y=y, data=dataa)
    plt.show
```


price
year
0
20000
40000
60000
80000
100000
120000
140000
2000
2005
2010
2015
2020


price
40000
60000
80000
100000
120000
140000

```
features = ['mileage','year','mpg','tax','engineSize']

X = dataa[features]

# normalizing features
X_norm = (X - X.mean(axis=0))/X.std(axis=0)

# principal component analysis on features
pca = PCA()

# fit and transform X_norm to PCA dataframe
X_pca = pca.fit_transform(X_norm)

# converting to dataframe
names = [f"PC{i+1}" for i in range(X_pca.shape[1])]
X_pcadf = pd.DataFrame(X_pca, columns=names)


print(X_pcadf.head())
X_pcadf.shape
```

```
        PC1       PC2       PC3       PC4       PC5
0  0.090760 -0.570609  0.764235  0.477724 -0.189107
1  1.695531 -0.392693 -0.959671 -0.290391 -0.193339
2  1.372958 -0.846314  0.045635 -0.757974 -0.270327
3  0.594204 -0.060592 -0.251248  1.143175  0.014687
4 -0.671744 -1.585431  1.074037  0.237700  0.083554
(10668, 5)
```

```
pca.singular_values_
```

```
array([157.07494624, 128.5707558 ,  81.32535378,  58.01448569,
        46.39534781])
```

```
cov_matrix = np.cov(X_norm.T)
print("Convariance matrix: ", cov_matrix)
```

```
Convariance matrix:  [[ 1.         -0.78966699  0.39510337 -0.16654715  0.07071017]
 [-0.78966699  1.         -0.35128087  0.09306616 -0.0315823 ]
 [ 0.39510337 -0.35128087  1.         -0.63590853 -0.36562073]
 [-0.16654715  0.09306616 -0.63590853  1.          0.39307544]
 [ 0.07071017 -0.0315823  -0.36562073  0.39307544  1.        ]]
```

```
eigenvalues, eigenvectors = np.linalg.eig(cov_matrix)
print("Eigenvectors:", eigenvectors)
print("Eigenvalues:", eigenvalues)
```

```
Eigenvectors: [[-0.48575669  0.46716498 -0.0732536  -0.7130325   0.17892982]
 [ 0.46373634 -0.48249022  0.26369364 -0.68624992 -0.10806712]
 [-0.5485194  -0.22908421  0.24802587  0.00616002 -0.76491314]
 [ 0.43356476  0.43702648 -0.49512711 -0.10954391 -0.60322362]
 [ 0.24522869  0.55271001  0.7864044   0.09277865 -0.08564328]]
Eigenvalues: [2.31297823 1.54968025 0.62002561 0.20179322 0.31552269]
```

```
eig_pairs = [(eigenvalues[index],eigenvectors[:,index]) for index in range(len(eigenvalues))]

# sort the pairs
eig_pairs.sort()

# reverse to make it in correct order
eig_pairs.reverse()
print(eig_pairs)

# extract the sorted eiganvalues and eiganvectors
eigenvalues_sorted = [eig_pairs[index][0] for index in range(len(eigenvalues))]
eigenvectors_sorted = [eig_pairs[index][1] for index in range(len(eigenvalues))]

# print sorted eigan values
print("Sorted eigan values:", eigenvalues_sorted)
```

```
[(2.3129782260606886, array([-0.48575669,  0.46373634, -0.5485194 ,  0.43356476,  0.24522869])), (1.5496802518372197, array([ 0.4671649
Sorted eigan values: [2.3129782260606886, 1.5496802518372197, 0.6200256087189561, 0.31552269142829453, 0.20179322195483534]
```

```
total = sum(eigenvalues_sorted)
var_explained = [(i/total) for i in eigenvalues_sorted]

# calculate cumulative variance
cum_var_exp = np.cumsum(var_explained)


vect = np.array(eigenvectors_sorted)

# dot product to create principal components analysis
X_vect_pca = np.dot(X_norm,vect.T)

pd.DataFrame(X_vect_pca)
```

	0	1	2	3	4
0	-0.090760	-0.570609	-0.764235	-0.477724	0.189107
1	-1.695531	-0.392693	0.959671	0.290391	0.193339
2	-1.372958	-0.846314	-0.045635	0.757974	0.270327
3	-0.594204	-0.060592	0.251248	-1.143175	-0.014687
4	0.671744	-1.585431	-1.074037	-0.237700	-0.083554
...	...	...	...	...	...
10663	0.843949	-1.767887	-0.958674	-0.272181	-0.461441
10664	0.918381	-1.775900	-0.989172	-0.332613	-0.407711
10665	0.946673	-1.803109	-0.984906	-0.343034	-0.366183
10666	0.373421	-0.578826	-0.885789	-0.088680	0.400585
10667	0.093154	-0.292445	-1.017448	-0.014394	0.619850

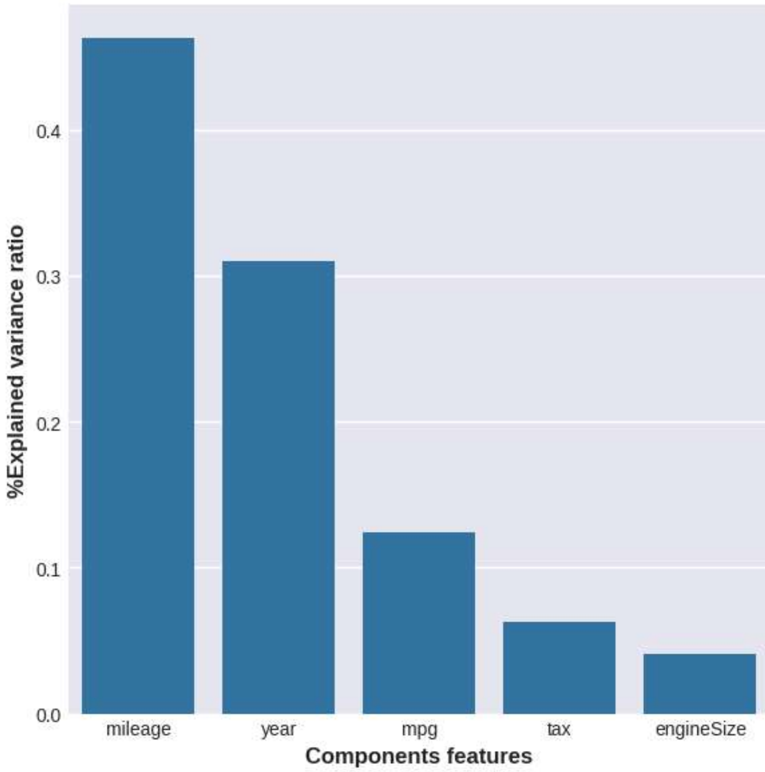
10668 rows × 5 columns

```
evr = pca.explained_variance_ratio_
print(evr)
features = ['mileage','year','mpg','tax','engineSize']

# plot the EVR using matplotlib pyplot
plt.figure(figsize=(6,6))
sns.barplot(x=np.array(features), y=evr)
plt.xlabel("Components features")
plt.ylabel("%Explained variance ratio")
plt.show
```

```
[0.46259565 0.30993605 0.12400512 0.06310454 0.04035864]
```

```
matplotlib.pyplot.show
def show(*args, **kwargs)
```

```
Display all open figures.

Parameters
----------
block : bool, optional
    Whether to wait for all figures to be closed before returning.
```




```
ev = pca.explained_variance_
print(ev)

features = ['mileage','year','mpg','tax','engineSize']


plt.figure(figsize=(6,6))
sns.lineplot(x=np.array(features), y=ev)
plt.xlabel("Components features")
plt.ylabel("%Explained variance")
plt.ylim(0,2)
plt.show
```