In [1]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import statsmodels.api as sm
from numpy.polynomial.polynomial import polyfit
from sklearn.linear_model import LinearRegression
import seaborn as sns
import statsmodels.stats.tests.test_influence
from sklearn.feature_selection import RFE
from statsmodels.stats.outliers_influence import variance_inflation_factor
```

executed in 32.2s, finished 18:54:02 2022-01-05

In [2]:

```
df = pd.read_csv("ToyotaCorolla.csv",encoding='latin1')
df1 = df [['Price','Age_08_04','KM','HP','cc','Doors','Gears','Quarterly_Tax','Weight']]
df1
```

executed in 251ms, finished 18:54:07 2022-01-05

Out[2]:

	Price	Age_08_04	KM	HP	cc	Doors	Gears	Quarterly_Tax	Weight
0	13500	23	46986	90	2000	3	5	210	1165
1	13750	23	72937	90	2000	3	5	210	1165
2	13950	24	41711	90	2000	3	5	210	1165
3	14950	26	48000	90	2000	3	5	210	1165
4	13750	30	38500	90	2000	3	5	210	1170
...	...	...	...	...	...	...	...	...	...
1431	7500	69	20544	86	1300	3	5	69	1025
1432	10845	72	19000	86	1300	3	5	69	1015
1433	8500	71	17016	86	1300	3	5	69	1015
1434	7250	70	16916	86	1300	3	5	69	1015
1435	6950	76	1	110	1600	5	5	19	1114

1436 rows × 9 columns

In [5]:

```
df1.describe
```

executed in 24ms, finished 13:53:20 2021-11-27

Out[5]:

```
<bound method NDFrame.describe of       Price  Age_08_04     KM   HP    cc
Doors  Gears  Quarterly_Tax  Weight
0     13500         23  46986   90  2000      3      5           210    116
5
1     13750         23  72937   90  2000      3      5           210    116
5
2     13950         24  41711   90  2000      3      5           210    116
5
3     14950         26  48000   90  2000      3      5           210    116
5
4     13750         30  38500   90  2000      3      5           210    117
0
...     ...        ...    ...   ...   ...    ...    ...           ...
...
1431   7500         69  20544   86  1300      3      5            69    102
5
1432  10845         72  19000   86  1300      3      5            69    101
5
1433   8500         71  17016   86  1300      3      5            69    101
5
1434   7250         70  16916   86  1300      3      5            69    101
5
1435   6950         76      1  110  1600      5      5            19    111
4

[1436 rows x 9 columns]>
```

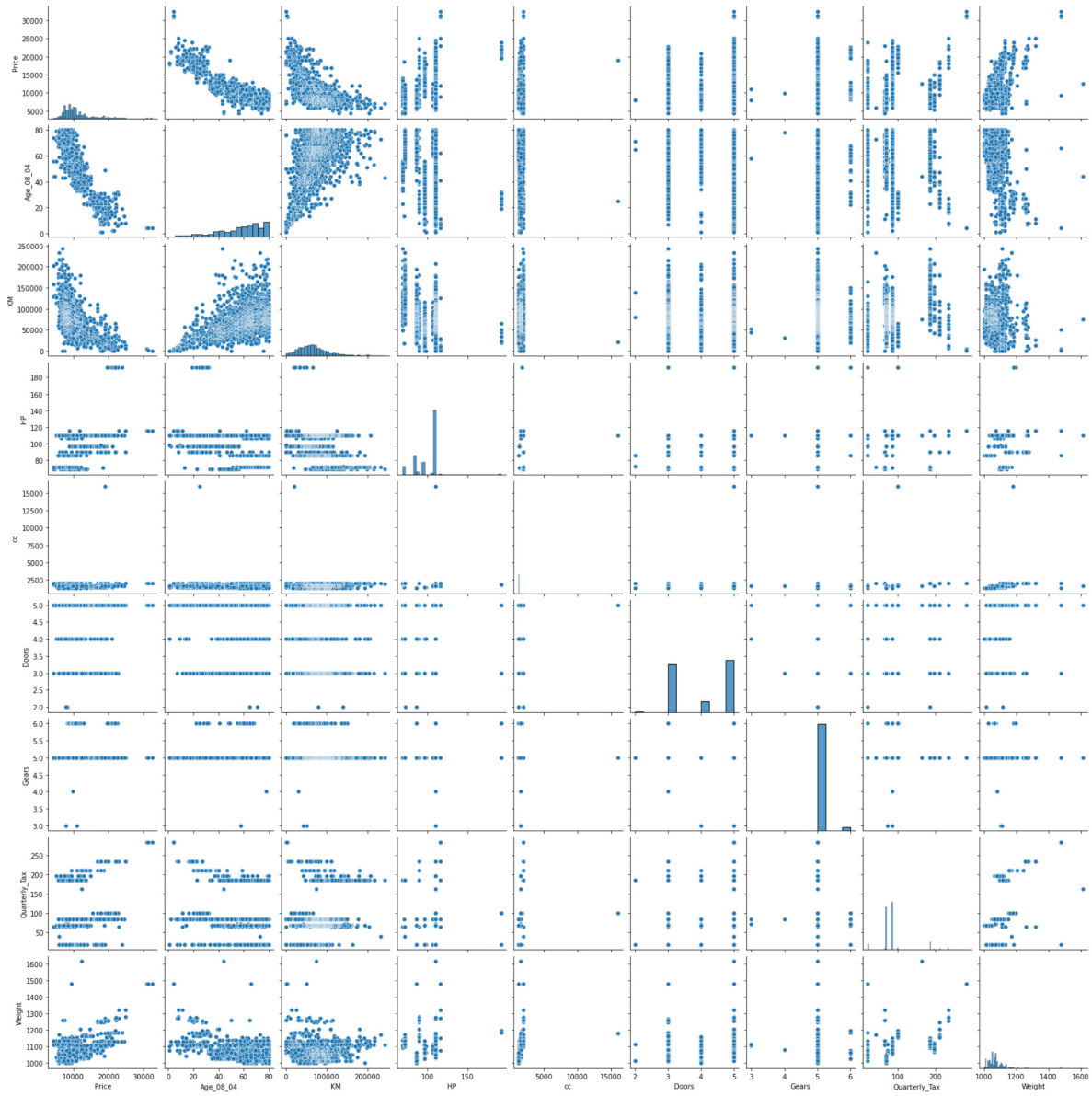
In [6]:

```
sns.pairplot(df1)
```

executed in 27.5s, finished 13:54:03 2021-11-27

Out[6]:

```
<seaborn.axisgrid.PairGrid at 0x2d407fa1c70>
```



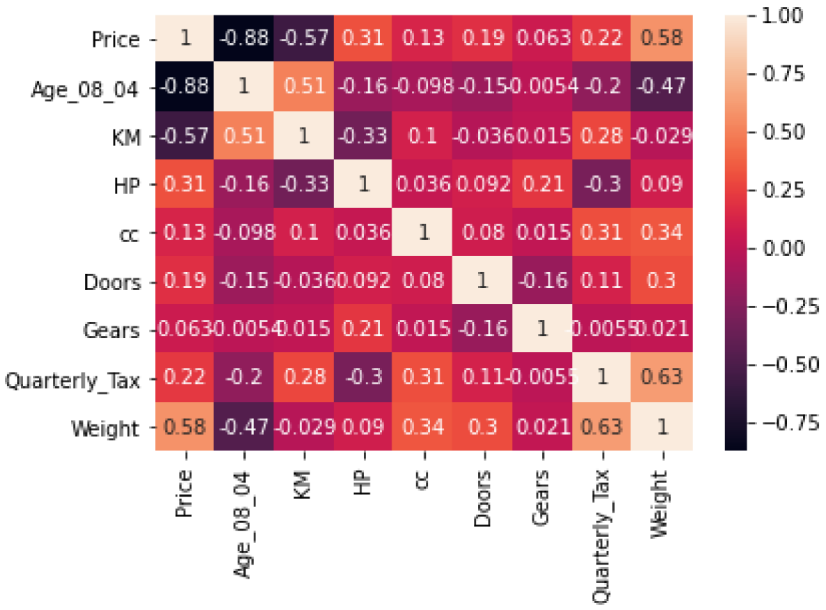
In [7]:

```
corrMatrix = df1.corr()
sns.heatmap(corrMatrix, annot=True)
```

executed in 2.31s, finished 13:55:12 2021-11-27

Out[7]:

<AxesSubplot:>



In [8]:

```
X = df1[['Age_08_04','KM','HP','cc','Doors','Gears','Quarterly_Tax','Weight']]
Y = df1[['Price']]
model = sm.OLS(Y, X).fit()
predictions = model.predict(X)
model.summary()
```

executed in 89ms, finished 13:55:53 2021-11-27

Out[8]:

OLS Regression Results

Dep. Variable:	Price	**R-squared (uncentered):**	0.986
Model:	OLS	**Adj. R-squared (uncentered):**	0.986
Method:	Least Squares	**F-statistic:**	1.247e+04
Date:	Sat, 27 Nov 2021	**Prob (F-statistic):**	0.00
Time:	13:55:53	**Log-Likelihood:**	-12383.
No. Observations:	1436	**AIC:**	2.478e+04
Df Residuals:	1428	**BIC:**	2.482e+04
Df Model:	8		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Age_08_04	-125.4510	2.445	-51.303	0.000	-130.248	-120.654
KM	-0.0205	0.001	-16.305	0.000	-0.023	-0.018
HP	33.4737	2.796	11.973	0.000	27.990	38.958
cc	-0.1032	0.090	-1.141	0.254	-0.281	0.074
Doors	-7.2494	40.184	-0.180	0.857	-86.075	71.576
Gears	78.3780	148.258	0.529	0.597	-212.449	369.205
Quarterly_Tax	5.8258	1.227	4.748	0.000	3.419	8.233
Weight	14.0322	0.773	18.157	0.000	12.516	15.548

Omnibus:	108.641	**Durbin-Watson:**	1.509
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	562.996
Skew:	0.019	**Prob(JB):**	5.59e-123
Kurtosis:	6.067	**Cond. No.**	3.26e+05

Notes:
[1] R^2 is computed without centering (uncentered) since the model does not contain a constant.
[2] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[3] The condition number is large, 3.26e+05. This might indicate that there are
strong multicollinearity or other numerical problems.

In [9]:

```
infl = model.get_influence()
summ_df = infl.summary_frame()
summ_df.sort_values('cooks_d', ascending=False)
```

executed in 3.58s, finished 13:56:18 2021-11-27

Out[9]:

	dfb_Age_08_04	dfb_KM	dfb_HP	dfb_cc	dfb_Doors	dfb_Gears	dfb_Quart
80	-0.289686	-2.363023e+00	-2.781734	2.615263e+01	0.645518	0.905398	-
221	-0.255051	-2.607849e-02	0.174427	4.179288e-01	0.553762	1.572311	
960	-0.208597	3.740370e-02	0.443719	1.977218e-01	0.539659	0.995730	
109	0.104572	-2.934313e-01	0.114571	-1.902240e-01	-0.220145	-0.606577	
601	-0.213100	3.186680e-01	0.385097	-1.107466e-01	0.404397	0.551158	
...	...	...	...	...	...	...	
1167	-0.000069	-5.512316e-05	0.000142	6.568459e-05	0.000134	-0.000053	
482	-0.000005	2.712110e-08	-0.000085	2.916558e-07	-0.000162	0.000013	-
1433	-0.000136	1.856487e-04	0.000104	1.209905e-05	0.000052	-0.000037	-
397	-0.000015	4.001993e-05	0.000028	1.344847e-06	-0.000098	-0.000034	
922	-0.000027	1.632787e-05	-0.000027	-8.283992e-06	0.000052	0.000017	

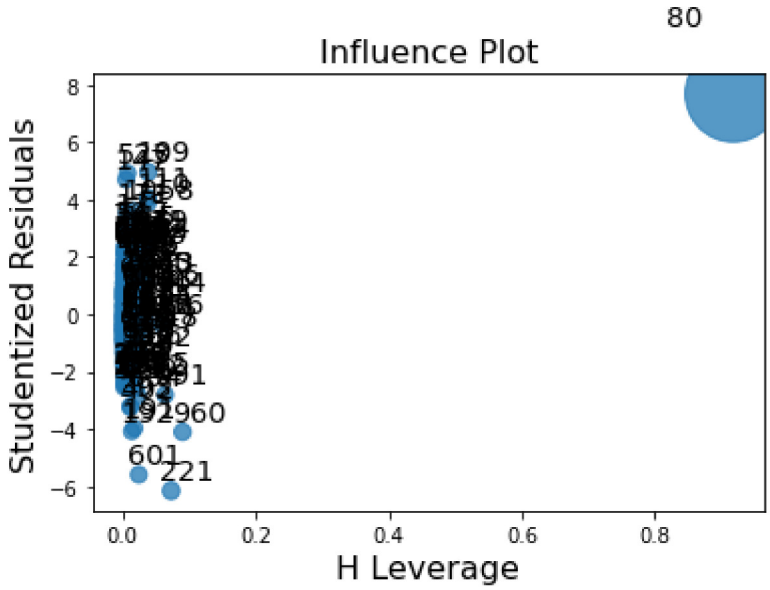
1436 rows × 14 columns

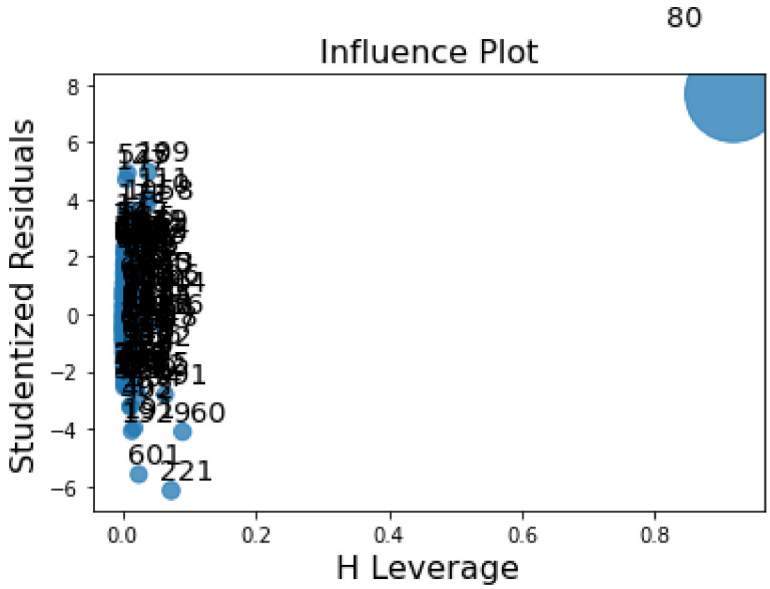
In [10]:

```
infl.plot_influence()
```

executed in 4.73s, finished 13:56:51 2021-11-27

Out[10]:





In [11]:

```
vif = pd.DataFrame()
vif["VIF Factor"] = [variance_inflation_factor(X.values, i) for i in range(X.shape[1])]
vif["features"] = X.columns
vif.round(1)
```

executed in 64ms, finished 13:57:16 2021-11-27

Out[11]:

	VIF Factor	features
0	16.4	Age_08_04
1	7.6	KM
2	64.9	HP
3	17.2	cc
4	21.9	Doors
5	438.6	Gears
6	11.0	Quarterly_Tax
7	543.1	Weight

In [12]:

```
# Removed Weight fron the dataframe and Tested the model
new_X = df1[['Age_08_04','KM','HP','cc','Doors','Gears','Quarterly_Tax']]
new_model = sm.OLS(Y, new_X).fit()
new_predictions = new_model.predict(new_X)
new_model.summary()
```

executed in 72ms, finished 13:57:32 2021-11-27

Out[12]:

OLS Regression Results

Dep. Variable:	Price	**R-squared (uncentered):**	0.983
Model:	OLS	**Adj. R-squared (uncentered):**	0.983
Method:	Least Squares	**F-statistic:**	1.155e+04
Date:	Sat, 27 Nov 2021	**Prob (F-statistic):**	0.00
Time:	13:57:32	**Log-Likelihood:**	-12532.
No. Observations:	1436	**AIC:**	2.508e+04
Df Residuals:	1429	**BIC:**	2.512e+04
Df Model:	7		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Age_08_04	-132.0628	2.682	-49.245	0.000	-137.323	-126.802
KM	-0.0208	0.001	-14.947	0.000	-0.024	-0.018
HP	44.4711	3.027	14.692	0.000	38.533	50.409
cc	0.1805	0.099	1.827	0.068	-0.013	0.374
Doors	272.5298	41.159	6.621	0.000	191.791	353.269
Gears	2417.9083	81.331	29.729	0.000	2258.368	2577.449
Quarterly_Tax	17.0169	1.177	14.462	0.000	14.709	19.325

Omnibus:	184.883	**Durbin-Watson:**	1.396
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	583.580
Skew:	0.640	**Prob(JB):**	1.89e-127
Kurtosis:	5.849	**Cond. No.**	1.63e+05

Notes:
[1] R^2 is computed without centering (uncentered) since the model does not contain a constant.
[2] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[3] The condition number is large, 1.63e+05. This might indicate that there are
strong multicollinearity or other numerical problems.

In [13]:

```
# Removed Index with highest Cook's distance to remove the hightest influencial ROW
new_df = df1.drop(df1.index[80])
new_X = new_df[['Age_08_04','KM','HP','cc','Doors','Gears','Quarterly_Tax']]
new_Y = new_df[['Price']]
final_model = sm.OLS(new_Y, new_X).fit()
predictions = final_model.predict(new_X)
final_model.summary()
```

executed in 80ms, finished 13:57:52 2021-11-27

Out[13]:

OLS Regression Results

Dep. Variable:	Price	**R-squared (uncentered):**	0.983
Model:	OLS	**Adj. R-squared (uncentered):**	0.983
Method:	Least Squares	**F-statistic:**	1.152e+04
Date:	Sat, 27 Nov 2021	**Prob (F-statistic):**	0.00
Time:	13:57:52	**Log-Likelihood:**	-12524.
No. Observations:	1435	**AIC:**	2.506e+04
Df Residuals:	1428	**BIC:**	2.510e+04
Df Model:	7		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Age_08_04	-132.0191	2.684	-49.196	0.000	-137.283	-126.755
KM	-0.0210	0.001	-14.581	0.000	-0.024	-0.018
HP	43.7530	3.287	13.310	0.000	37.304	50.202
cc	0.3468	0.313	1.109	0.268	-0.267	0.960
Doors	270.3889	41.346	6.540	0.000	189.284	351.494
Gears	2394.0486	91.807	26.077	0.000	2213.957	2574.140
Quarterly_Tax	16.4778	1.520	10.843	0.000	13.497	19.459

Omnibus:	183.937	**Durbin-Watson:**	1.393
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	582.178
Skew:	0.636	**Prob(JB):**	3.82e-127
Kurtosis:	5.849	**Cond. No.**	1.82e+05

Notes:
[1] R^2 is computed without centering (uncentered) since the model does not contain a constant.
[2] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[3] The condition number is large, 1.82e+05. This might indicate that there are
strong multicollinearity or other numerical problems.