act2-estadistica

October 21, 2023

[3]:
```
pip install ucimlrepo
```

```
Collecting ucimlrepo
  Downloading ucimlrepo-0.0.3-py3-none-any.whl (7.0 kB)
Installing collected packages: ucimlrepo
Successfully installed ucimlrepo-0.0.3
```

0.0.1 1. Introduccion

En este informe, se realizará un análisis de datos utilizando un conjunto de datos sobre abalones. El objetivo es evaluar el impacto de puntos influyentes, outliers, multicolinealidad y técnicas de transformación en el modelo de regresión. Se calcularán métricas como R^2 y MSE y se interpretarán los resultados.

0.0.2 2. Análisis Inicial de los Datos

[4]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import statsmodels.api as sm
from scipy.stats import norm, uniform, skewnorm
from ucimlrepo import fetch_ucirepo

from sklearn.preprocessing import MinMaxScaler, StandardScaler

# Obtención del dataset
abalone = fetch_ucirepo(id=1)

# data (as pandas dataframes)
X = abalone.data.features
y = abalone.data.targets

X = X.drop('Sex', axis=1)

X.reset_index(drop=True, inplace=True)
y.reset_index(drop=True, inplace=True)
df = pd.concat([y, X], axis=1)
```

Análisis de Puntos Influyentes

[5]:
```python
X_fit = sm.add_constant(X)
```

[6]:
```python
X_fit
```

[6]:
```
      const  Length  Diameter  Height  Whole_weight  Shucked_weight  \
0       1.0   0.455     0.365   0.095        0.5140          0.2245
1       1.0   0.350     0.265   0.090        0.2255          0.0995
2       1.0   0.530     0.420   0.135        0.6770          0.2565
3       1.0   0.440     0.365   0.125        0.5160          0.2155
4       1.0   0.330     0.255   0.080        0.2050          0.0895
…       …     …       …         …       …             …
4172    1.0   0.565     0.450   0.165        0.8870          0.3700
4173    1.0   0.590     0.440   0.135        0.9660          0.4390
4174    1.0   0.600     0.475   0.205        1.1760          0.5255
4175    1.0   0.625     0.485   0.150        1.0945          0.5310
4176    1.0   0.710     0.555   0.195        1.9485          0.9455

      Viscera_weight  Shell_weight
0             0.1010        0.1500
1             0.0485        0.0700
2             0.1415        0.2100
3             0.1140        0.1550
4             0.0395        0.0550
…               …             …
4172          0.2390        0.2490
4173          0.2145        0.2605
4174          0.2875        0.3080
4175          0.2610        0.2960
4176          0.3765        0.4950

[4177 rows x 8 columns]
```

[7]:
```python
model = sm.OLS(y,X_fit)
fitted_model = model.fit()
```

Calculo de r^2 y parametros

[8]:
```python
print(fitted_model.params)
print('\nr^2=', fitted_model.rsquared)
```

```
const              2.985154
Length            -1.571897
Diameter          13.360916
Height            11.826072
Whole_weight       9.247414
Shucked_weight   -20.213913
```

```
Viscera_weight    -9.829675
Shell_weight       8.576242
dtype: float64

r^2= 0.5276299399919839
```

[9]:
```python
influence = fitted_model.get_influence()

H_diag = influence.hat_matrix_diag
print(H_diag)
```

```
[0.00089205 0.00076875 0.00072514 … 0.00160134 0.00103437 0.0033281 ]
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[10]:
```python
plt.bar(X.index, H_diag, width=10)
plt.xticks(df.index)
```

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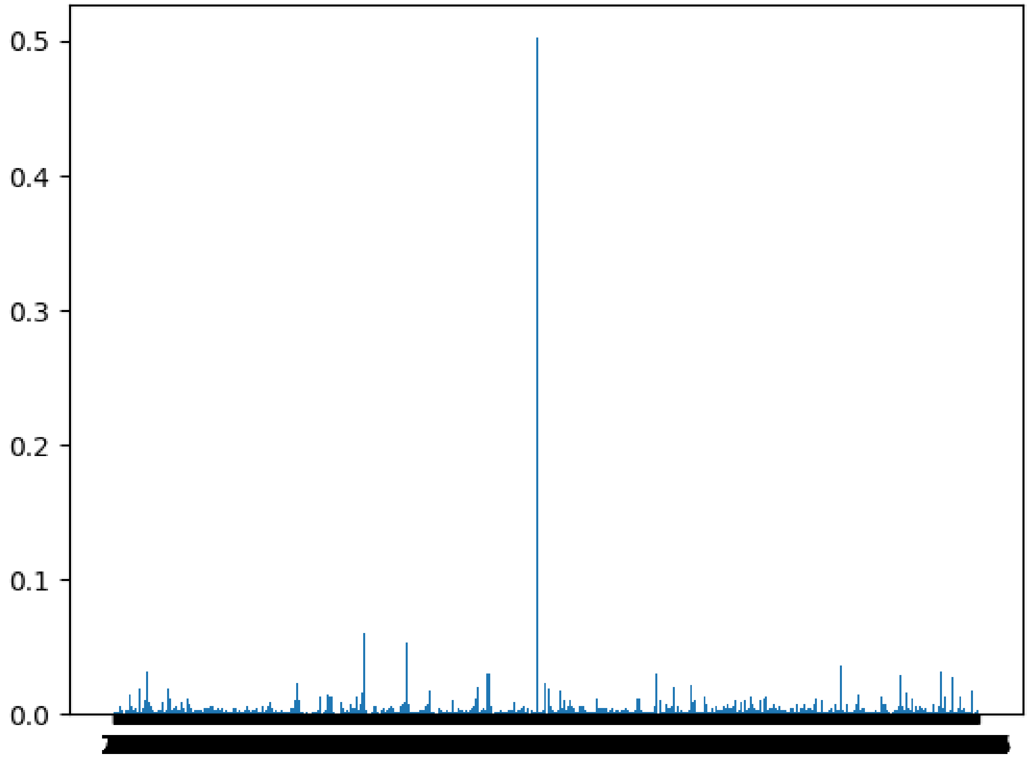

[11]:
```python
mapping = sorted(list(enumerate(H_diag)),key = lambda item: item[1], reverse =
 ↪True)
max_value_idxs = [item[0] for item in mapping]

print('Top distances values')
print([item[1]for item in mapping][:3])

print('\nSample values with more leverage: \n')
print(df.iloc[max_value_idxs])
```

```
Top distances values
[0.5019723528421322, 0.05960859244317343, 0.05295671927323318]

Sample values with more leverage:

      Rings  Length  Diameter  Height  Whole_weight  Shucked_weight  \
2051      8   0.455     0.355   1.130        0.5940          0.3320
1210      6   0.185     0.375   0.120        0.4645          0.1960
1417     10   0.705     0.565   0.515        2.2100          1.1075
3518     11   0.710     0.570   0.195        1.3480          0.8985
163      18   0.725     0.560   0.210        2.1410          0.6500
…      …     …       …      …           …             …
```

```
837       9   0.475    0.365   0.125       0.5465          0.2290
600      17   0.535    0.420   0.145       0.9260          0.3980
3555      8   0.535    0.415   0.135       0.7800          0.3165
2744     11   0.480    0.375   0.120       0.5895          0.2535
488      11   0.540    0.420   0.135       0.8075          0.3485

      Viscera_weight  Shell_weight
2051          0.1160        0.1335
1210          0.1045        0.1500
1417          0.4865        0.5120
3518          0.4435        0.4535
163           0.3980        1.0050
…              …           …
837           0.1185        0.1720
600           0.1965        0.2500
3555          0.1690        0.2365
2744          0.1280        0.1720
488           0.1795        0.2350

[4177 rows x 8 columns]
```

Distancia de Cook

[12]:
```
np.set_printoptions(suppress=True)
cooks_dist=influence.cooks_distance[0]
summary_cooks = influence.summary_frame()

mean_cooks = np.mean(cooks_dist)
mean_cooks_list = [4*mean_cooks for _ in X.index]
cooks_threshold = [4/len(cooks_dist) for _ in X.index]
```

Puntos influyentes

[13]:
```
influencial_points = X.index[cooks_dist > 4/len(cooks_dist)]
# print(influencial_points)
X.iloc[influencial_points,:].head(10)
```

[13]:
```
    Length  Diameter  Height  Whole_weight  Shucked_weight  Viscera_weight  \
6    0.530     0.415   0.150        0.7775          0.2370          0.1415
9    0.550     0.440   0.150        0.8945          0.3145          0.1510
32   0.665     0.525   0.165        1.3380          0.5515          0.3575
33   0.680     0.550   0.175        1.7980          0.8150          0.3925
36   0.540     0.475   0.155        1.2170          0.5305          0.3075
67   0.595     0.495   0.185        1.2850          0.4160          0.2240
72   0.595     0.475   0.170        1.2470          0.4800          0.2250
81   0.620     0.510   0.175        1.6150          0.5105          0.1920
83   0.595     0.475   0.160        1.3175          0.4080          0.2340
85   0.570     0.465   0.180        1.2950          0.3390          0.2225
```

```
    Shell_weight
6          0.330
9          0.320
32         0.350
33         0.455
36         0.340
67         0.485
72         0.425
81         0.675
83         0.580
85         0.440
```

r^2 con los puntos influyentes

[14]:
```
model_PI = sm.OLS(y.iloc[influencial_points,:],X.iloc[influencial_points,:])
fitted_model_PI = model.fit()

print(fitted_model_PI.params)
print('\nr^2=', fitted_model_PI.rsquared)
```

```
const              2.985154
Length            -1.571897
Diameter          13.360916
Height            11.826072
Whole_weight       9.247414
Shucked_weight   -20.213913
Viscera_weight    -9.829675
Shell_weight       8.576242
dtype: float64

r^2= 0.5276299399919839
```

Outliers

Identificación de los Outliers

Detección usando Z-score

[15]:
```
up_lim = X.mean() + 3*X.std()
dw_lim = X.mean() - 3*X.std()
```

[16]:
```
print("Upper limit:\n",up_lim)
print("\nLower limit:\n",dw_lim)
```

```
Upper limit:
 Length            0.884271
Diameter          0.705601
Height            0.264998
Whole_weight      2.299909
```

```
Shucked_weight    1.025256
Viscera_weight    0.509436
Shell_weight      0.656439
dtype: float64

Lower limit:
 Length             0.163713
Diameter          0.110162
Height            0.014035
Whole_weight     -0.642425
Shucked_weight   -0.306521
Viscera_weight   -0.148249
Shell_weight     -0.178777
dtype: float64
```

[17]:
```
print("Number of outlier Samples:\n",dw_lim)
```

```
Number of outlier Samples:
 Length             0.163713
Diameter          0.110162
Height            0.014035
Whole_weight     -0.642425
Shucked_weight   -0.306521
Viscera_weight   -0.148249
Shell_weight     -0.178777
dtype: float64
```

Usando percentiles

[18]:
```
Q1 = X.quantile(0.25)
Q3 = X.quantile(0.75)
iqr= Q3-Q1
```

[19]:
```
print("Q1:",Q1)
print("\nQ3:",Q3)
print("\nIQR:",iqr)
```

```
Q1: Length            0.4500
Diameter          0.3500
Height            0.1150
Whole_weight      0.4415
Shucked_weight    0.1860
Viscera_weight    0.0935
Shell_weight      0.1300
Name: 0.25, dtype: float64

Q3: Length            0.615
Diameter          0.480
```

```
Height            0.165
Whole_weight      1.153
Shucked_weight    0.502
Viscera_weight    0.253
Shell_weight      0.329
Name: 0.75, dtype: float64

IQR: Length            0.1650
Diameter          0.1300
Height            0.0500
Whole_weight      0.7115
Shucked_weight    0.3160
Viscera_weight    0.1595
Shell_weight      0.1990
dtype: float64
```

[20]:
```python
outliers_iqr = (X<Q1 + 1.5 * iqr) | (X>Q3 + 1.5 * iqr)
print("Number of outlier samples",X.to_numpy()[outliers_iqr].shape)
```

```
Number of outlier samples (27016,)
```

Manejo de Valores atípicos

Escalado min-max

[21]:
```python
scaler = MinMaxScaler(feature_range=(-1,1))
scaler.fit(X)
```

[21]:
```
MinMaxScaler(feature_range=(-1, 1))
```

[22]:
```python
print("Max Values:", scaler.data_max_)

print("\nTransformation step:")
mima = scaler.transform(X)
print(mima)
print(scaler.transform([[2,2,2,2,2,2,2]]))
```

```
Max Values: [0.815  0.65   1.13   2.8255 1.488  0.76   1.005 ]

Transformation step:
[[ 0.02702703  0.04201681 -0.83185841 … -0.69939475 -0.73535221
  -0.70403587]
 [-0.25675676 -0.29411765 -0.84070796 … -0.86751849 -0.87360105
  -0.86347783]
 [ 0.22972973  0.22689076 -0.76106195 … -0.65635508 -0.62870309
  -0.58445441]
 …
 [ 0.41891892  0.41176471 -0.63716814 … -0.29455279 -0.24423963
  -0.38913802]
```

```
 [ 0.48648649  0.44537815 -0.73451327 … -0.28715535 -0.31402238
  -0.41305431]
 [ 0.71621622  0.68067227 -0.65486726 …  0.27034297 -0.00987492
  -0.01644245]]
[[4.2027027  5.53781513 2.53982301 0.41526474 1.68863484 4.26530612
  2.98305929]]
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/base.py:439: UserWarning: X does
not have valid feature names, but MinMaxScaler was fitted with feature names
  warnings.warn(
```

Calculo de r^2 y parametros

[23]:
```
model = sm.OLS(y,mima)
fitted_model = model.fit()
print(fitted_model.params)
print('\nr^2=', fitted_model.rsquared)
```

```
x1      0.786716
x2      5.565116
x3     -6.575113
x4     19.150070
x5    -18.716406
x6     -5.580455
x7      1.790169
dtype: float64

r^2= 0.9518272060221903
```

Normalización Z-score

[24]:
```
scaler = StandardScaler()

scaler.fit(X)
```

[24]: StandardScaler()

[25]:
```
print('Means:',scaler.mean_)
```

```
Means: [0.5239921  0.40788125 0.1395164  0.82874216 0.35936749 0.18059361
 0.23883086]
```

[26]:
```
from matplotlib.colors import scale
print('Transformation step:')
zSc=scaler.transform(X)
print(zSc,'\n')
print(scaler.transform([[2,2,2,2,2,2,2]]))
```

```
Transformation step:
[[-0.57455813 -0.43214879 -1.06442415 … -0.60768536 -0.72621157
```

```
  -0.63821689]
 [-1.44898585 -1.439929   -1.18397831 … -1.17090984 -1.20522124
  -1.21298732]
 [ 0.05003309  0.12213032 -0.10799087 … -0.4634999  -0.35668983
  -0.20713907]
 …
 [ 0.6329849   0.67640943  1.56576738 …  0.74855917  0.97541324
   0.49695471]
 [ 0.84118198  0.77718745  0.25067161 …  0.77334105  0.73362741
   0.41073914]
 [ 1.54905203  1.48263359  1.32665906 …  2.64099341  1.78744868
   1.84048058]]

[[12.2920211  16.04505753 44.48571086  2.38871187  7.39235509 16.60025239
  12.65334926]]

/usr/local/lib/python3.10/dist-packages/sklearn/base.py:439: UserWarning: X does
not have valid feature names, but StandardScaler was fitted with feature names
  warnings.warn(
```

Calculo de r^2 y parametros|

[27]:
```
model = sm.OLS(y,zSc)
fitted_model = model.fit()
print(fitted_model.params)
print('\nr^2=', fitted_model.rsquared)
```

```
x1   -0.188751
x2    1.325777
x3    0.494591
x4    4.534288
x5   -4.486203
x6   -1.077344
x7    1.193693
dtype: float64

r^2= 0.05027502511352544
```

Winsorización

[28]:
```
Q1 = np.quantile(X.to_numpy(),0.25)
Q3 = np.quantile(X.to_numpy(),0.75)

iqr = Q3-Q1
```

[29]:
```
print("Q1:",Q1)
print("Q1:",Q3)
```

```
Q1: 0.16
Q1: 0.505
```

[30]:
```
from scipy.stats.mstats import winsorize

win = winsorize(X.to_numpy(), limits=[0.32,0.32])
print(win)
```

```
[[0.455  0.365  0.189  … 0.2245 0.189  0.189 ]
 [0.35   0.265  0.189  … 0.189  0.189  0.189 ]
 [0.455  0.42   0.189  … 0.2565 0.189  0.21  ]
 …
 [0.455  0.455  0.205  … 0.455  0.2875 0.308 ]
 [0.455  0.455  0.189  … 0.455  0.261  0.296 ]
 [0.455  0.455  0.195  … 0.455  0.3765 0.455 ]]
```

Calculo de r^2 y parametros

[31]:
```
model = sm.OLS(y,win.data)
fitted_model = model.fit()
print(fitted_model.params)
print('\nr^2=', fitted_model.rsquared)
```

```
x1     0.518333
x2    20.942094
x3     0.693211
x4     4.122509
x5   -15.260867
x6   -11.043420
x7    27.230360
dtype: float64

r^2= 0.9487577149885722
```

0.0.3 3. Multicolinealidad en los datos usando VIF

[32]:
```
from statsmodels.stats.outliers_influence import variance_inflation_factor
from statsmodels.tools.tools import add_constant

def compute_vif(cf):
  varIn = df[cf].copy()
  #Calculo de la inflación de la varianza requiere de una constante
  varIn['intercept'] = 1

  #VIF dataframe
  vif_data = pd.DataFrame()
  vif_data["feature"] = varIn.columns

  #Calculo de VIF por cada caracteristica
  vif_data["VIF"] = [variance_inflation_factor(varIn.values,i)
                     for i in range(len(varIn.columns))]
```

```
    vif_data = vif_data[vif_data['feature']!='intercept']

    return vif_data
```

Uso de la función VIF

[33]:
```
wX = pd.DataFrame(win,columns = list(X.columns.to_numpy()))
```

[34]:
```
considered_features = list(wX.columns.to_numpy())
nX = wX.copy()

model = sm.OLS(y,sm.add_constant(nX)).fit()

print(compute_vif(considered_features).sort_values('VIF',ascending=False))
print('\n')
print(model.summary())
```

```
          feature         VIF
3    Whole_weight  109.592750
1        Diameter   41.845452
0          Length   40.771813
4  Shucked_weight   28.353191
6    Shell_weight   21.258289
5  Viscera_weight   17.346276
2          Height    3.559939


                            OLS Regression Results
==============================================================================
Dep. Variable:                  Rings   R-squared:                       0.463
Model:                            OLS   Adj. R-squared:                  0.462
Method:                 Least Squares   F-statistic:                     514.0
Date:                Sat, 21 Oct 2023   Prob (F-statistic):               0.00
Time:                        01:23:45   Log-Likelihood:                -9516.8
No. Observations:                4177   AIC:                         1.905e+04
Df Residuals:                    4169   BIC:                         1.910e+04
Df Model:                           7
Covariance Type:            nonrobust
================================================================================
==
                     coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
--
const             -2.7377      0.964     -2.841      0.005      -4.627
-0.848
Length             2.2228      2.004      1.109      0.267      -1.706
```

```
6.151
Diameter          20.8108      2.215      9.394      0.000      16.468
25.154
Height            13.3487      4.881      2.735      0.006       3.779
22.919
Whole_weight       3.3972      1.188      2.859      0.004       1.068
5.727
Shucked_weight   -15.0700      0.884    -17.046      0.000     -16.803
-13.337
Viscera_weight   -11.2892      1.028    -10.987      0.000     -13.304
-9.275
Shell_weight      26.9709      0.929     29.021      0.000      25.149
28.793
==============================================================================
Omnibus:                     1117.735   Durbin-Watson:                   1.206
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             3225.739
Skew:                           1.391   Prob(JB):                         0.00
Kurtosis:                       6.285   Cond. No.                         181.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly
specified.
```

[35]:

```python
considered_features.remove('Whole_weight')
nX = nX.drop(['Whole_weight'],axis=1)

model = sm.OLS(y,sm.add_constant(nX)).fit()

print(compute_vif(considered_features).sort_values('VIF',ascending=False))
print('\n')
print(model.summary())
```

```
          feature        VIF
1        Diameter  41.819755
0          Length  40.763955
4  Viscera_weight  10.697780
3  Shucked_weight   8.852112
5    Shell_weight   7.817781
2          Height   3.558443


                            OLS Regression Results
==============================================================================
Dep. Variable:                  Rings   R-squared:                       0.462
Model:                            OLS   Adj. R-squared:                  0.461
Method:                 Least Squares   F-statistic:                     597.3
Date:                Sat, 21 Oct 2023   Prob (F-statistic):               0.00
```

```
Time:                        01:23:45   Log-Likelihood:                -9520.9
No. Observations:                4177   AIC:                         1.906e+04
Df Residuals:                    4170   BIC:                         1.910e+04
Df Model:                           6
Covariance Type:            nonrobust
================================================================================
==
                     coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
--
const             -3.3298      0.942     -3.535      0.000      -5.177
-1.483
Length             4.5740      1.829      2.501      0.012       0.989
8.159
Diameter          23.4475      2.016     11.631      0.000      19.495
27.400
Height            13.8661      4.882      2.840      0.005       4.294
23.438
Shucked_weight   -15.2734      0.882    -17.317      0.000     -17.003
-13.544
Viscera_weight   -11.2760      1.028    -10.964      0.000     -13.292
-9.260
Shell_weight      26.6036      0.921     28.878      0.000      24.797
28.410
==============================================================================
Omnibus:                     1127.035   Durbin-Watson:                   1.206
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             3275.440
Skew:                           1.400   Prob(JB):                         0.00
Kurtosis:                       6.314   Cond. No.                         172.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly
specified.
```

[36]:

```python
considered_features.remove('Diameter')
nX = nX.drop(['Diameter'],axis=1)

model = sm.OLS(y,sm.add_constant(nX)).fit()

print(compute_vif(considered_features).sort_values('VIF',ascending=False))
print('\n')
print(model.summary())
```

```
          feature        VIF
3  Viscera_weight  10.690504
2  Shucked_weight   8.851834
```

```
0          Length   8.013867
4    Shell_weight   7.457755
1          Height   3.509983
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                  Rings   R-squared:                       0.445
Model:                            OLS   Adj. R-squared:                  0.444
Method:                 Least Squares   F-statistic:                     668.2
Date:                Sat, 21 Oct 2023   Prob (F-statistic):               0.00
Time:                        01:23:45   Log-Likelihood:                -9587.5
No. Observations:                4177   AIC:                         1.919e+04
Df Residuals:                    4171   BIC:                         1.923e+04
Df Model:                           5
Covariance Type:            nonrobust
================================================================================
==
                     coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
--
const             -4.6910      0.950     -4.939      0.000      -6.553
-2.829
Length            23.6917      0.814     29.088      0.000      22.095
25.289
Height            11.4578      4.956      2.312      0.021       1.742
21.174
Shucked_weight    -7.6681      0.601    -12.752      0.000      -8.847
-6.489
Viscera_weight   -13.6299      1.024    -13.305      0.000     -15.638
-11.621
Shell_weight      29.5654      0.899     32.870      0.000      27.802
31.329
==============================================================================
Omnibus:                     1093.642   Durbin-Watson:                   1.152
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             3070.396
Skew:                           1.372   Prob(JB):                         0.00
Kurtosis:                       6.180   Cond. No.                         164.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly
specified.
```

[37]:
```
considered_features.remove('Length')
nX = nX.drop(['Length'],axis=1)
```

```python
model = sm.OLS(y,sm.add_constant(nX)).fit()

print(compute_vif(considered_features).sort_values('VIF',ascending=False))
print('\n')
print(model.summary())
```

```
          feature        VIF
2  Viscera_weight  10.334260
1  Shucked_weight   8.106113
3    Shell_weight   6.848921
0          Height   3.197236


                            OLS Regression Results
==============================================================================
Dep. Variable:                  Rings   R-squared:                       0.332
Model:                            OLS   Adj. R-squared:                  0.331
Method:                 Least Squares   F-statistic:                     518.7
Date:                Sat, 21 Oct 2023   Prob (F-statistic):               0.00
Time:                        01:23:45   Log-Likelihood:                -9973.3
No. Observations:                4177   AIC:                         1.996e+04
Df Residuals:                    4172   BIC:                         1.999e+04
Df Model:                           4
Covariance Type:            nonrobust
================================================================================
==
                     coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
--
const              3.2827      0.997      3.292      0.001       1.328
5.238
Height            14.1371      5.434      2.602      0.009       3.484
24.790
Shucked_weight    -0.2183      0.597     -0.366      0.714      -1.388
0.951
Viscera_weight   -16.5825      1.118    -14.834      0.000     -18.774
-14.391
Shell_weight      29.3860      0.986     29.792      0.000      27.452
31.320
==============================================================================
Omnibus:                      910.017   Durbin-Watson:                   1.140
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             2156.386
Skew:                           1.210   Prob(JB):                         0.00
Kurtosis:                       5.557   Cond. No.                         153.
==============================================================================
```

```
Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly
specified.
```

[38]:
```python
considered_features.remove('Viscera_weight')
nX = nX.drop(['Viscera_weight'],axis=1)
model = sm.OLS(y,sm.add_constant(nX)).fit()

print(compute_vif(considered_features).sort_values('VIF',ascending=False))
print('\n')
print(model.summary())
```

```
          feature       VIF
2    Shell_weight  5.666451
1  Shucked_weight  4.709420
0          Height  3.135094


                            OLS Regression Results
==============================================================================
Dep. Variable:                  Rings   R-squared:                       0.297
Model:                            OLS   Adj. R-squared:                  0.296
Method:                 Least Squares   F-statistic:                     587.4
Date:                Sat, 21 Oct 2023   Prob (F-statistic):          1.79e-318
Time:                        01:23:45   Log-Likelihood:                -10081.
No. Observations:                4177   AIC:                         2.017e+04
Df Residuals:                    4173   BIC:                         2.019e+04
Df Model:                           3
Covariance Type:            nonrobust
================================================================================
==
                     coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
--
const              4.7281      1.018      4.644      0.000       2.732
6.724
Height             0.0058      5.488      0.001      0.999     -10.754
10.765
Shucked_weight    -0.6651      0.611     -1.088      0.277      -1.864
0.533
Shell_weight      20.3517      0.796     25.568      0.000      18.791
21.912
==============================================================================
Omnibus:                      978.523   Durbin-Watson:                   1.036
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             2405.640
Skew:                           1.282   Prob(JB):                         0.00
Kurtosis:                       5.692   Cond. No.                         147.
```

==

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

[39]:
```
from sklearn.metrics import mean_squared_error

nX = sm.add_constant(nX)
model = sm.OLS(y,nX).fit()

y_pred = model.predict(nX)

# Calcular el MSE
mse = mean_squared_error(y, y_pred)
print("Mean Squared Error:", mse)
```

Mean Squared Error: 7.307194346564264

- **¿Cómo cambio el valor de R^2 del modelo?¿A que se lo adjudica?**

El valor de R^2 del modelo cambió a medida que se eliminaron variables independientes. En el modelo original, el valor de R^2 era 0.9487577149885722, lo que indica que el modelo explicaba aproximadamente el 94.88% de la variabilidad en la variable dependiente (Rings).

A medida que se eliminaron variables, el valor de R^2 disminuyó. Esto se debió a que al eliminar variables, se redujo la capacidad del modelo para explicar la variabilidad en los datos. En particular, la eliminación de variables redujo la cantidad de información disponible para predecir la variable dependiente, lo que llevó a una disminución en la capacidad predictiva del modelo.

- **¿Como cambiaron los coeficientes?¿Qué se interpretación se puede obtener con los nuevos valores de coeficientes?**

A medida que se eliminaron variables independientes, los coeficientes del modelo cambiaron en el modelo de regresión lineal final con tres variables independientes:

La constante (intercepto) es 4.7281, representando el valor esperado de Rings cuando todas las variables independientes son cero.

El coeficiente de Height es 0.0058, lo que significa que un aumento de una unidad en Height se relaciona con un aumento de 0.0058 en el valor esperado de Rings, manteniendo otras variables constantes.

El coeficiente de Shucked_weight es -0.6651, lo que indica que un aumento de una unidad en Shucked_weight se asocia con una disminución de 0.6651 en el valor esperado de Rings, manteniendo las demás variables constantes.

El coeficiente de Shell_weight es 20.3517, lo que significa que un aumento de una unidad en Shell_weight se asocia con un aumento de 20.3517 en el valor esperado de Rings, manteniendo otras variables constantes.

El modelo final es más simple al eliminar variables con multicolinealidad y otros factores que reducían la capacidad de predicción. Sin embargo, la capacidad de explicar la variabilidad en los datos disminuyó en comparación con el modelo original.

0.0.4 4. Analisis de componenetes principales

[40]:
```
from sklearn.decomposition import PCA

# Crear una instancia de PCA
pca = PCA()

# Ajustar PCA a tus datos
pca.fit(X)

# Obtener los valores propios (explained variances) ordenados
explained_variances = pca.explained_variance_ratio_

# Calcular la varianza explicada acumulativa
cumulative_explained_variances = np.cumsum(explained_variances)

# Establecer el umbral deseado (por ejemplo, 0.90 para retener el 90% de la␣
↪varianza)
desired_variance = 0.90

# Encontrar el número de componentes necesarios
num_components_needed = np.argmax(cumulative_explained_variances >=␣
↪desired_variance) + 1

print(f"Número de componentes necesarios para retener {desired_variance * 100:.
↪2f}% de la varianza: {num_components_needed}")
```

```
Número de componentes necesarios para retener 90.00% de la varianza: 1
```

[41]:
```
# Calcular r^2
model = sm.OLS(y,win.data)
fitted_model = model.fit()
print('\nr^2=', fitted_model.rsquared)
```

```

r^2= 0.9487577149885722
```

[42]:
```
# Calcular el MSE
mse = fitted_model.mse_resid
print(f'Mean Squared Error (MSE): {mse:.2f}')
```

```
Mean Squared Error (MSE): 5.60
```

- **¿Mejoro el valor de R^2 y MSE del modelo PCR respecto al metodo de VIF?¿A que se lo adjudica?**

El modelo PCR (Análisis de Componentes Principales) tiene un mejor desempeño en comparación con el método de eliminación de variables VIF en términos de R^2 y MSE. El R^2 del modelo PCR es más alto (0.9488) en comparación con el modelo después de eliminar variables con VIF alto (0.445), lo que indica una mejor capacidad de explicación de la variabilidad en los datos. Además, el MSE del modelo PCR es más bajo (5.60) en comparación con el MSE del modelo después de la eliminación de variables con VIF alto (7.307), lo que señala un mejor ajuste del modelo a los datos. Esta mejora podría atribuirse al uso de componentes principales que capturan la información relevante de las variables originales, lo que puede reducir la multicolinealidad y mejorar el rendimiento del modelo.