zad2

December 11, 2019

[1]:
```python
import pandas as pd
data = pd.read_csv("beauty.csv")
data
```

[1]:
```
     tenured  profnumber  minority  age  beautyf2upper  beautyflowerdiv  \
0          0           1         1   36              6                5
1          1           2         0   59              2                4
2          1           3         0   51              5                5
3          1           4         0   40              4                2
4          0           5         0   31              9                7
..       …           …         …  …            …              …
458        0          93         0   32              9                6
459        0          93         0   32              9                6
460        0          94         1   42              7                3
461        0          94         1   42              7                3
462        0          94         1   42              7                3

     beautyfupperdiv  beautym2upper  beautymlowerdiv  beautymupperdiv  …  \
0                  7              6                2                4  …
1                  4              3                2                3  …
2                  2              3                2                3  …
3                  5              2                3                3  …
4                  9              6                7                6  …
..               …            …              …              …  …
458                6              5                7                8  …
459                6              5                7                8  …
460                8              4                4                6  …
461                8              4                4                6  …
462                8              4                4                6  …

     nonenglish  onecredit  percentevaluating  profevaluation  students  \
0             0          0           55.81395             4.7        43
1             0          0           85.00000             4.6        20
2             0          0          100.00000             4.1        55
3             0          0           86.95652             4.5        46
4             0          0           87.50000             4.8        48
..          …        …                …             …       …
```

```
458           0          0        42.85714          4.1        21
459           0          0        60.46511          4.5        86
460           1          0        77.61194          4.4        67
461           1          0        81.81818          4.4        66
462           1          1        80.00000          4.1        35

     tenuretrack  blkandwhite  btystdvariance  btystdavepos  btystdaveneg
0              1            0        2.129806      0.201567      0.000000
1              1            0        1.386081      0.000000     -0.826081
2              1            0        2.537435      0.000000     -0.660333
3              1            0        1.760577      0.000000     -0.766312
4              1            0        1.693100      1.421450      0.000000
..           …          …             …           …            …
458            1            0        3.107088      1.143040      0.000000
459            1            0        3.107088      1.143040      0.000000
460            1            0        3.018447      0.332051      0.000000
461            1            0        3.018447      0.332051      0.000000
462            1            0        3.018447      0.332051      0.000000

[463 rows x 64 columns]
```

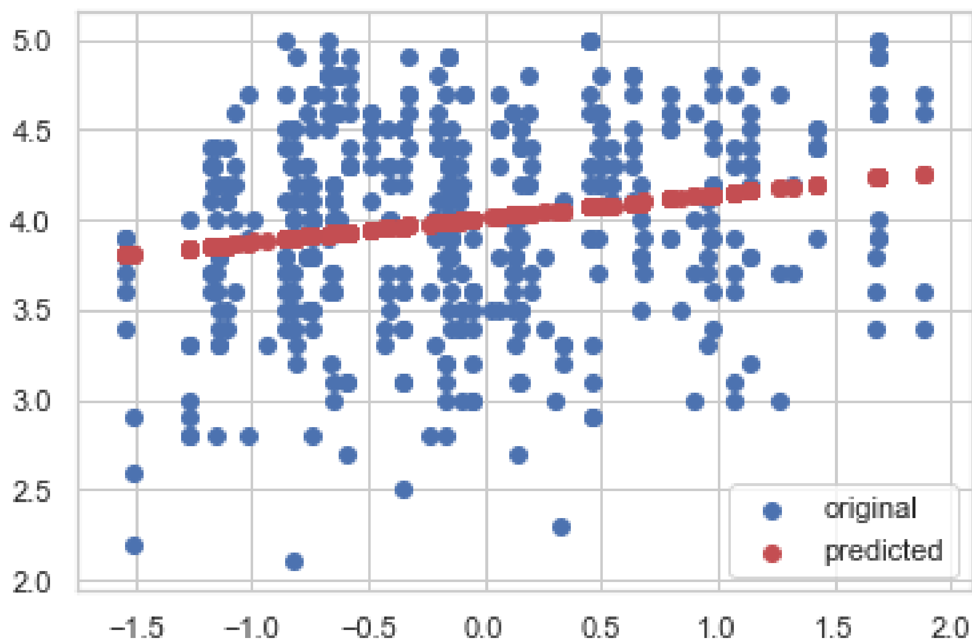
[2]:
```python
#Utwórz regresję przy użyciu piękna (zmienna btystdave), aby przewidzieć oceny␣
 ↪kursu (courseevaluation), kontrolując różne
#inne dane wejściowe.
import statsmodels.api as sm

X = data['btystdave']
Y = data['courseevaluation']
X = sm.add_constant(X)
model = sm.OLS(Y, X).fit()
predictions = model.predict(X)

model.summary()
```

```
C:\ProgramData\Anaconda3\lib\site-packages\numpy\core\fromnumeric.py:2389:
FutureWarning: Method .ptp is deprecated and will be removed in a future
version. Use numpy.ptp instead.
  return ptp(axis=axis, out=out, **kwargs)
```

[2]:
```
<class 'statsmodels.iolib.summary.Summary'>
"""
                            OLS Regression Results
==============================================================================
Dep. Variable:       courseevaluation   R-squared:                       0.036
Model:                            OLS   Adj. R-squared:                  0.034
Method:                 Least Squares   F-statistic:                     17.08
Date:                Mon, 09 Dec 2019   Prob (F-statistic):           4.25e-05
```

```
Time:                        23:34:56   Log-Likelihood:                -375.32
No. Observations:                 463   AIC:                             754.6
Df Residuals:                     461   BIC:                             762.9
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          4.0100      0.026    157.205      0.000       3.960       4.060
btystdave      0.1330      0.032      4.133      0.000       0.070       0.196
==============================================================================
Omnibus:                       15.399   Durbin-Watson:                   1.410
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               16.405
Skew:                          -0.453   Prob(JB):                     0.000274
Kurtosis:                       2.831   Cond. No.                         1.29
==============================================================================

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

[7]:
```python
# Wyświetl dopasowany model graficznie i objaśnij znaczenie każdego ze␣
↪współczynników wraz z pozostałym odchyleniem standardowym

import matplotlib.pyplot as plt
import numpy as np

fig, ax = plt.subplots()
scatter=ax.scatter(y=data['courseevaluation'], x=data['btystdave'],c='b',␣
↪label='original')
scatter=ax.scatter(y=predictions, x=data['btystdave'],c='r', label='predicted')

ax.legend()
plt.show()
```



Coeffitients explanation:

[0.025 - 0,975] - Confidence interval - is a type of interval estimate, computed from the statistics of the observed data, that might contain the true value of an unknown population parameter. The interval has an associated confidence level, or coverage that, loosely speaking, quantifies the level of confidence that the deterministic parameter is captured by the interval. More strictly speaking, the confidence level represents the frequency (i.e. the proportion) of possible confidence intervals that contain the true value of the unknown population parameter.

Omnibus/Prob(Omnibus) – a test of the skewness and kurtosis of the residual . We hope to see a value close to zero which would indicate normalcy. The Prob (Omnibus) performs a statistical test indicating the probability that the residuals are normally distributed. We hope to see something close to 1 here.

Skew – a measure of data symmetry. We want to see something close to zero, indicating the residual distribution is normal. Note that this value also drives the Omnibus.

Kurtosis – a measure of "peakiness", or curvature of the data. Higher peaks lead to greater Kurtosis. Greater Kurtosis can be interpreted as a tighter clustering of residuals around zero, implying a better model with few outliers.

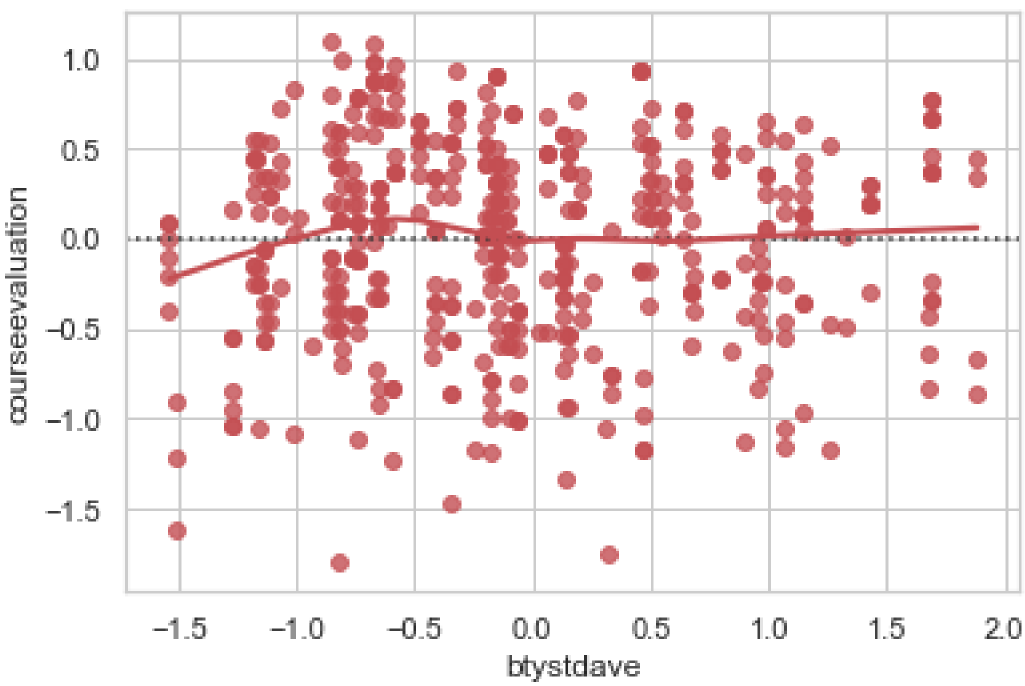
Durbin-Watson – tests for homoscedasticity. We hope to have a value between 1 and 2.

Jarque-Bera (JB)/Prob(JB) – like the Omnibus test in that it tests both skew and kurtosis. We hope to see in this test a confirmation of the Omnibus test.

Condition Number – This test measures the sensitivity of a function's output as compared to its input. When we have multicollinearity, we can expect much higher fluctuations to small changes in the data, hence, we hope to see a relatively small number, something below 30.

In statistics, the standard deviation (SD, also represented by the lower case Greek letter sigma for the population standard deviation or the Latin letter s for the sample standard deviation) is a measure of the amount of variation or dispersion of a set of values.[1] A low standard deviation indicates that the values tend to be close to the mean (also called the expected value) of the set, while a high standard deviation indicates that the values are spread out over a wider range. source: https://en.wikipedia.org/wiki/Standard_deviation www.accelebrate.com/blog/interpreting-results-from-linear-regression-is-the-data-appropriate https://en.wikipedia.org/wiki/Confidence_interval

[4]:
```
#Wykreślić residua względem dopasowanych wartości.

#Przypadek jet dwuwymiarowy więc użyję gotowej funkcji:
#Residua

import seaborn as sns

sns.set(style="whitegrid")

# Plot the residuals after fitting a linear model
sns.residplot(data['btystdave'], data['courseevaluation'], lowess=True,␣
↪color="r")
plt.show()
```



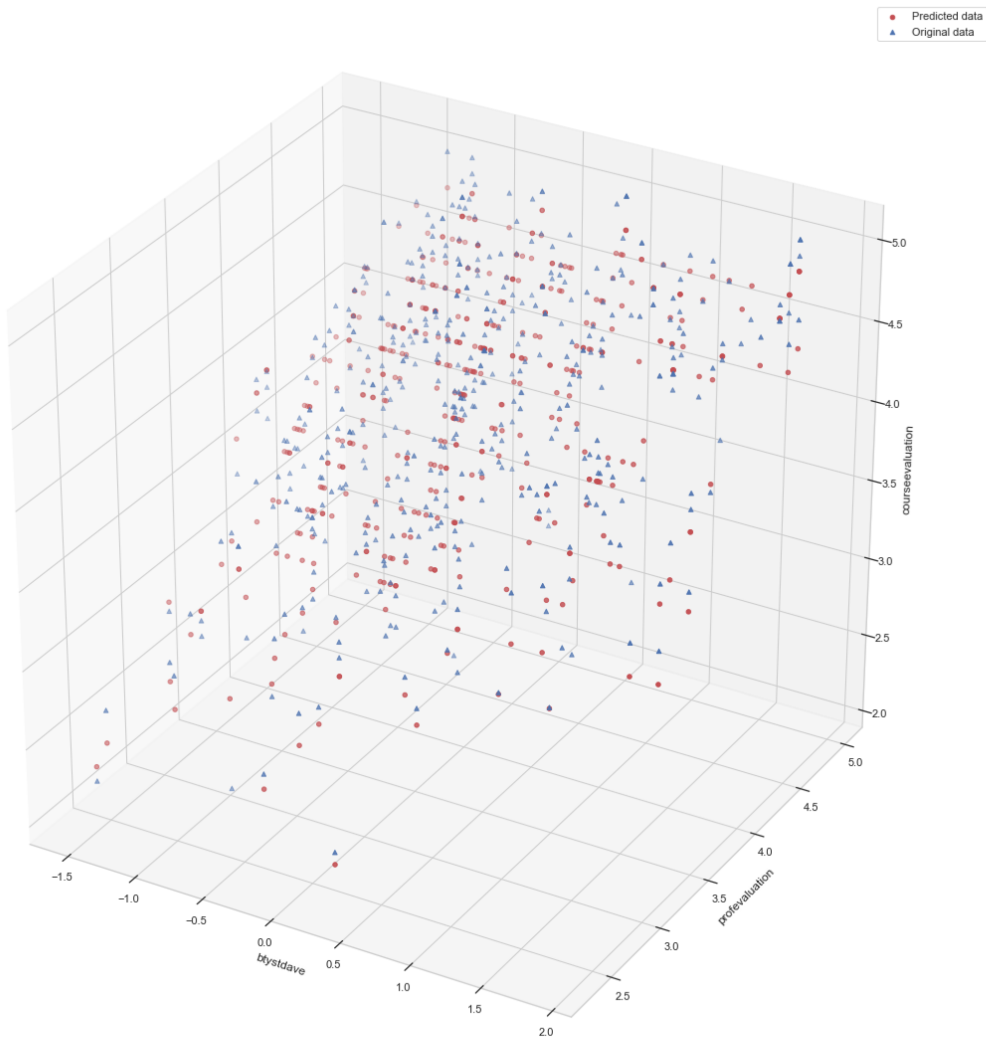
[11]:
```python
# Dopasuj niektóre inne modele, w tym piękno, a także inne zmienne wejściowe.␣
↪Dla każdego modelu określ, jakie są predyktory
# i jakie są dane wejściowe i wyjaśnij znaczenie każdego z jego współczynników.

#Model 2
#Predicting course-evaluation from beauty and professor-evaluation. Coeffitiens␣
↪have been explained above.


X = data[['btystdave', 'profevaluation']]
Y = data['courseevaluation']
X = sm.add_constant(X)
model2 = sm.OLS(Y, X).fit()
predictions2 = model2.predict(X)
model2.summary()
```

[11]:
```
<class 'statsmodels.iolib.summary.Summary'>
"""
                            OLS Regression Results
==============================================================================
Dep. Variable:       courseevaluation   R-squared:                       0.875
Model:                            OLS   Adj. R-squared:                  0.874
Method:                 Least Squares   F-statistic:                     1606.
Date:                Tue, 10 Dec 2019   Prob (F-statistic):          3.22e-208
Time:                        00:12:19   Log-Likelihood:                 97.136
No. Observations:                 463   AIC:                            -188.3
Df Residuals:                     460   BIC:                            -175.9
Df Model:                           2
Covariance Type:            nonrobust
================================================================================
==
                     coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
--
const              0.0309      0.072      0.427      0.669      -0.111
0.173
btystdave          0.0128      0.012      1.084      0.279      -0.010
0.036
profevaluation     0.9506      0.017     55.504      0.000       0.917
0.984
==============================================================================
Omnibus:                      103.892   Durbin-Watson:                   1.792
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              358.857
Skew:                          -0.996   Prob(JB):                     1.19e-78
Kurtosis:                       6.826   Cond. No.                         35.1
==============================================================================
```

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

[12]:

```python
from mpl_toolkits.mplot3d import Axes3D
import matplotlib.pyplot as plt
import numpy as np

fig = plt.figure(figsize=(20,20))
ax = fig.add_subplot(111, projection='3d')

xs = data['btystdave']
ys = data['profevaluation']
zs = predictions2
ax.scatter(xs, ys, zs, c='r', marker='o', label='Predicted data')


xs = data['btystdave']
ys = data['profevaluation']
zs = data['courseevaluation']
ax.scatter(xs, ys, zs, c='b', marker='^', label='Original data')


ax.set_xlabel('btystdave')
ax.set_ylabel('profevaluation')
ax.set_zlabel('courseevaluation')

plt.legend()
plt.show()
```



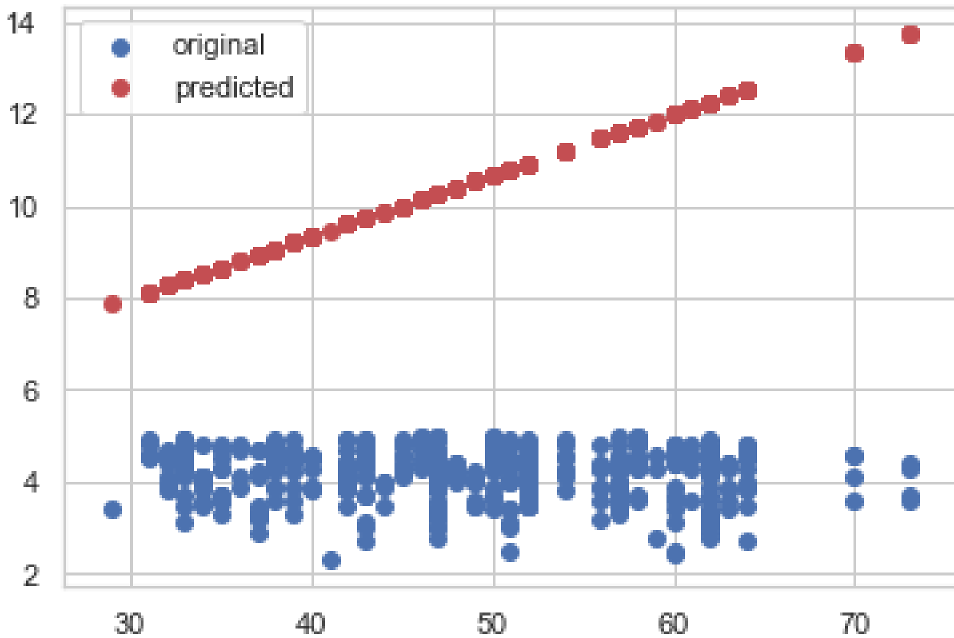

```
[19]: #Model 3
      #Predicting professor-evaluation from age

      X = data['age']
      Y = data['profevaluation']
      X = sm.add_constant(X)
      model3 = sm.OLS(Y, X).fit()
      predictions3 = model.predict(X)

      model.summary()
```

```
[19]: <class 'statsmodels.iolib.summary.Summary'>
      """
                                  OLS Regression Results
```

```
==============================================================================
Dep. Variable:       courseevaluation   R-squared:                       0.036
Model:                            OLS   Adj. R-squared:                  0.034
Method:                 Least Squares   F-statistic:                     17.08
Date:                Tue, 10 Dec 2019   Prob (F-statistic):           4.25e-05
Time:                        00:23:29   Log-Likelihood:                -375.32
No. Observations:                 463   AIC:                             754.6
Df Residuals:                     461   BIC:                             762.9
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          4.0100      0.026    157.205      0.000       3.960       4.060
btystdave      0.1330      0.032      4.133      0.000       0.070       0.196
==============================================================================
Omnibus:                       15.399   Durbin-Watson:                   1.410
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               16.405
Skew:                          -0.453   Prob(JB):                     0.000274
Kurtosis:                       2.831   Cond. No.                         1.29
==============================================================================

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

[20]:

```
fig, ax = plt.subplots()
scatter=ax.scatter(y=data['profevaluation'], x=data['age'],c='b',␣
 ↪label='original')
scatter=ax.scatter(y=predictions3, x=data['age'],c='r', label='predicted')

ax.legend()
plt.show()
```


original
predicted
14
12
10
8
6
4
2
30
40
50
60
70

```
[ ]:
```