zad2

December 10, 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]
```

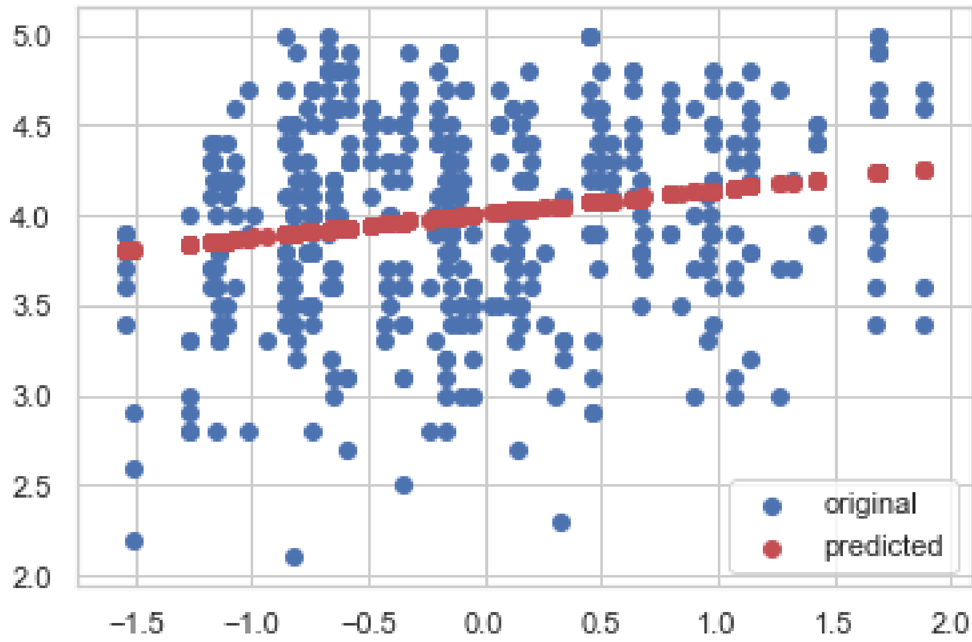
[2]:
```python
#Utwórz regresję przy użyciu piękna (zmienna btystdave), aby przewidzieć oceny␣
 ↪kursu (courseevaluation), kontrolując różne
#inne dane wejściowe.
import statsmodels.api as sm

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:

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.

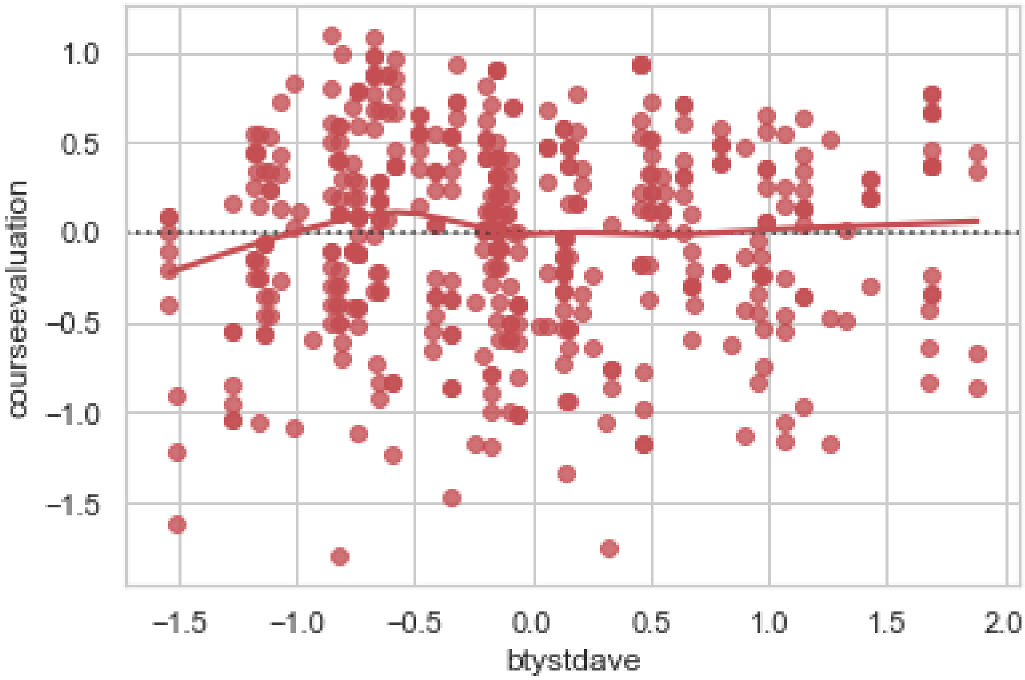
Jarque-Bera (JB)/Prob(JB) – like the Omnibus test in that it tests both skew and kurtosis. We hope to see in this test a confirmation of the Omnibus test.

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. source: www.accelebrate.com/blog/interpreting-results-from-linear-regression-is-the-data-appropriate

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

[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]:
```
# 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.
```

```python
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:
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"""
```

[12]:
```python
from mpl_toolkits.mplot3d import Axes3D
import matplotlib.pyplot as plt
import numpy as np
```

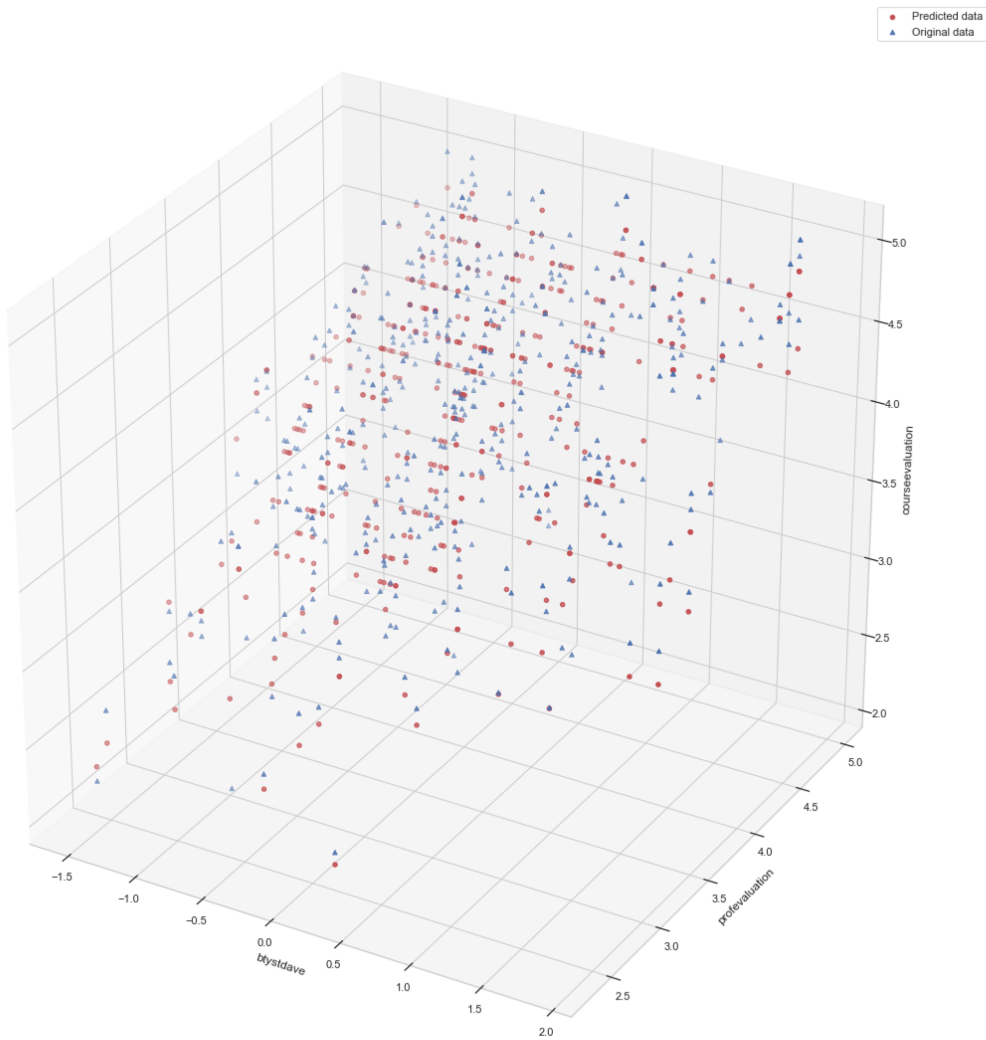
```
fig = plt.figure(figsize=(20,20))
ax = fig.add_subplot(111, projection='3d')

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
```

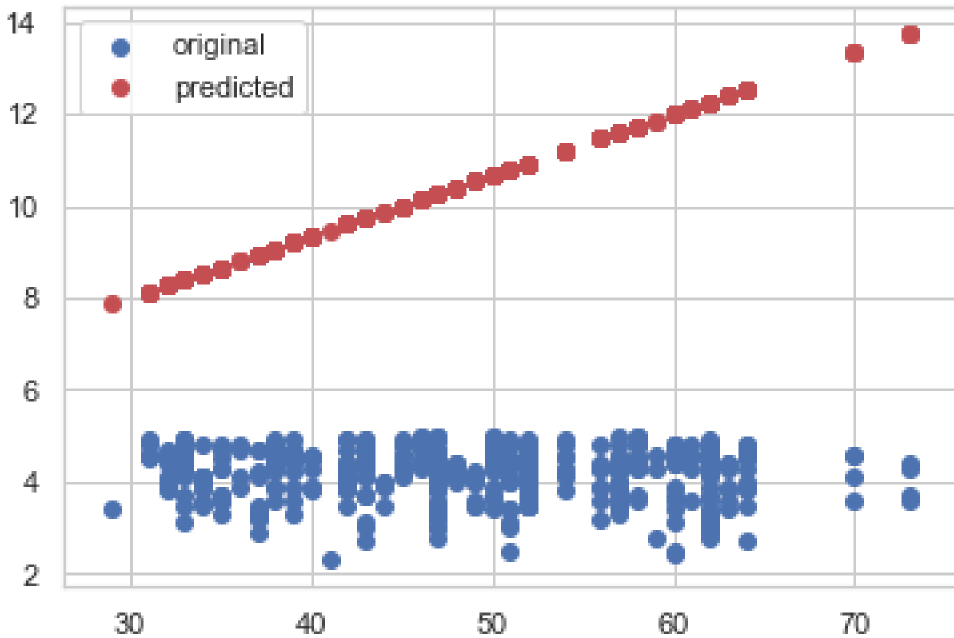
```
==============================================================================
Dep. Variable:      courseevaluation   R-squared:                       0.036
Model:                           OLS   Adj. R-squared:                  0.034
Method:                Least Squares   F-statistic:                     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

```
[ ]:
```