Multiple Regression

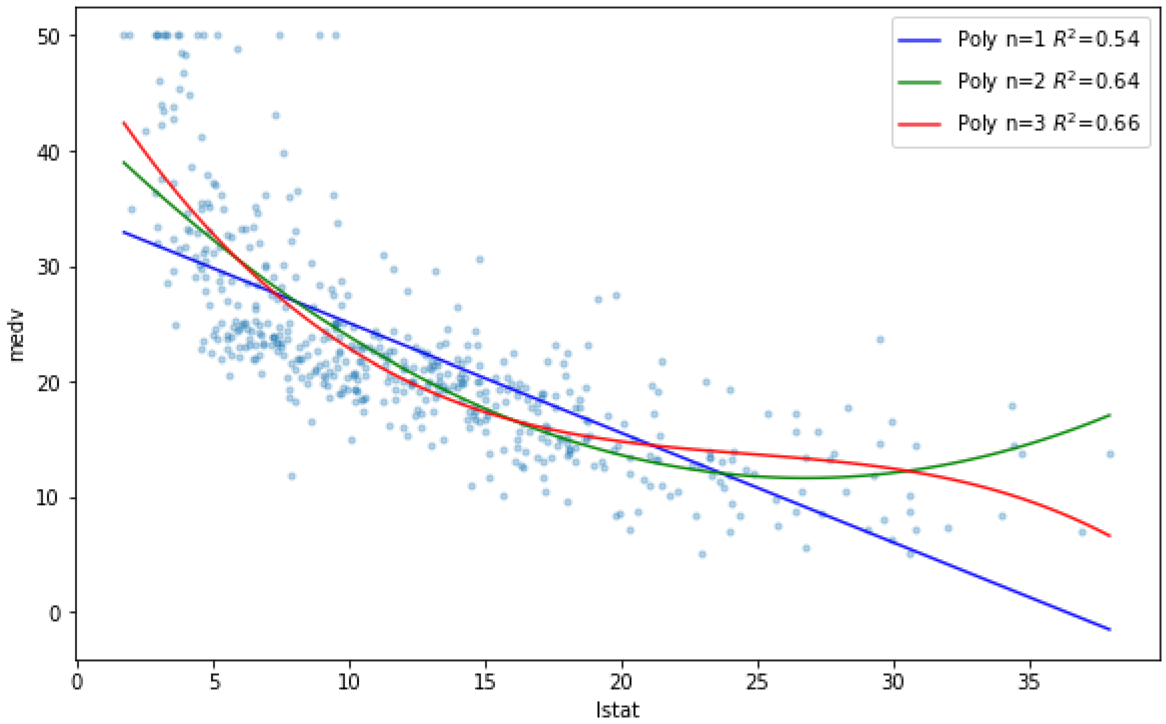
```
from pandas import DataFrame
import statsmodels.api as sm

Stock_Market = {'Year': [2017,2017,2017,2017,2017,2017,2017,2017,2017,2017,2017,2017,2016,2016,2016,2016,2016,2016,2016,2016,2016,2016,201
                'Month': [12, 11,10,9,8,7,6,5,4,3,2,1,12,11,10,9,8,7,6,5,4,3,2,1],
                'Interest_Rate': [2.75,2.5,2.5,2.5,2.5,2.5,2.5,2.25,2.25,2.25,2,2,2,1.75,1.75,1.75,1.75,1.75,1.75,1.75,1.75,1.75,1.75,1.75],
                'Unemployment_Rate': [5.3,5.3,5.3,5.3,5.4,5.6,5.5,5.5,5.5,5.6,5.7,5.9,6,5.9,5.8,6.1,6.2,6.1,6.1,6.1,5.9,6.2,6.2,6.1],
                'Stock_Index_Price': [1464,1394,1357,1293,1256,1254,1234,1195,1159,1167,1130,1075,1047,965,943,958,971,949,884,866,876,822,704,719]
                }

df = DataFrame(Stock_Market,columns=['Year','Month','Interest_Rate','Unemployment_Rate','Stock_Index_Price'])

X = df[['Interest_Rate','Unemployment_Rate']] # here we have 2 variables for the multiple linear regression. If you just want to use one variable for simple linear
Y = df['Stock_Index_Price']

X = sm.add_constant(X) # adding a constant

model = sm.OLS(Y, X).fit()
predictions = model.predict(X)

print_model = model.summary()
print(print_model)
```

```
/usr/local/lib/python3.7/dist-packages/statsmodels/tools/_testing.py:19: FutureWarning: pandas.util.testing is deprecated. Use the functions in the public API at
  import pandas.util.testing as tm
                            OLS Regression Results
==============================================================================
Dep. Variable:      Stock_Index_Price   R-squared:                       0.898
Model:                            OLS   Adj. R-squared:                  0.888
Method:                 Least Squares   F-statistic:                     92.07
Date:                Thu, 25 Feb 2021   Prob (F-statistic):           4.04e-11
Time:                        11:00:01   Log-Likelihood:                -134.61
No. Observations:                  24   AIC:                             275.2
Df Residuals:                      21   BIC:                             278.8
Df Model:                           2
Covariance Type:            nonrobust
=====================================================================================
                        coef    std err          t      P>|t|      [0.025      0.975]
-------------------------------------------------------------------------------------
const              1798.4040    899.248      2.000      0.059     -71.685    3668.493
Interest_Rate       345.5401    111.367      3.103      0.005     113.940     577.140
Unemployment_Rate  -250.1466    117.950     -2.121      0.046    -495.437      -4.856
==============================================================================
Omnibus:                        2.691   Durbin-Watson:                   0.530
Prob(Omnibus):                  0.260   Jarque-Bera (JB):                1.551
Skew:                          -0.612   Prob(JB):                        0.461
Kurtosis:                       3.226   Cond. No.                         394.
==============================================================================

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

Polynomial Regression

```
# load the boston housing dataset - median house values in the Boston area
import pandas as pd
from pandas import DataFrame
import statsmodels.api as sm
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline

df = pd.read_csv('http://vincentarelbundock.github.io/Rdatasets/csv/MASS/Boston.csv')
# plot lstat (% lower status of the population) against median value
plt.figure(figsize=(6 * 1.618, 6))
plt.scatter(df.lstat, df.medv, s=10, alpha=0.3)
plt.xlabel('lstat')
plt.ylabel('medv')
# points linearlyd space on lstats
x = pd.DataFrame({'lstat': np.linspace(df.lstat.min(), df.lstat.max(), 100)})

# 1-st order polynomial
poly_1 = smf.ols(formula='medv ~ 1 + lstat', data=df).fit()
plt.plot(x.lstat, poly_1.predict(x), 'b-', label='Poly n=1 $R^2$=%.2f' % poly_1.rsquared,
alpha=0.9)

# 2-nd order polynomial
# 2-nd order polynomial
poly_2 = smf.ols(formula='medv ~ 1 + lstat + I(lstat ** 2.0)', data=df).fit()
plt.plot(x.lstat, poly_2.predict(x), 'g-', label='Poly n=2 $R^2$=%.2f' % poly_2.rsquared,
alpha=0.9)

# 3-rd order polynomial
poly_3 = smf.ols(formula='medv ~ 1 + lstat + I(lstat ** 2.0) + I(lstat ** 3.0)', data=df).fit()
plt.plot(x.lstat, poly_3.predict(x), 'r-', alpha=0.9,
label='Poly n=3 $R^2$=%.2f' % poly_3.rsquared)

plt.legend()
```

```
<matplotlib.legend.Legend at 0x7f5f53dad150>
```



```
print_model1 = poly_1.summary()
print_model2 = poly_2.summary()
print_model3= poly_3.summary()
print(("Model 1 Summary: ", print_model1), ("Model 2 Summary: ", print_model2 ), ("Model 3 Summary: ",print_model3))
```

```
('Model 1 Summary: ', <class 'statsmodels.iolib.summary.Summary'>
"""
                            OLS Regression Results
==============================================================================
Dep. Variable:                   medv   R-squared:                       0.544
Model:                            OLS   Adj. R-squared:                  0.543
Method:                 Least Squares   F-statistic:                     601.6
Date:                Thu, 25 Feb 2021   Prob (F-statistic):           5.08e-88
Time:                        11:18:21   Log-Likelihood:                -1641.5
No. Observations:                 506   AIC:                             3287.
Df Residuals:                     504   BIC:                             3295.
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept     34.5538      0.563     61.415      0.000      33.448      35.659
lstat         -0.9500      0.039    -24.528      0.000      -1.026      -0.874
==============================================================================
Omnibus:                      137.043   Durbin-Watson:                   0.892
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              291.373
Skew:                           1.453   Prob(JB):                     5.36e-64
Kurtosis:                       5.319   Cond. No.                         29.7
==============================================================================

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
""") ('Model 2 Summary: ', <class 'statsmodels.iolib.summary.Summary'>
"""
                            OLS Regression Results
==============================================================================
Dep. Variable:                   medv   R-squared:                       0.641
Model:                            OLS   Adj. R-squared:                  0.639
Method:                 Least Squares   F-statistic:                     448.5
Date:                Thu, 25 Feb 2021   Prob (F-statistic):          1.56e-112
Time:                        11:18:21   Log-Likelihood:                -1581.3
No. Observations:                 506   AIC:                             3169.
Df Residuals:                     503   BIC:                             3181.
Df Model:                           2
Covariance Type:            nonrobust
===================================================================================
                      coef    std err          t      P>|t|      [0.025      0.975]
-----------------------------------------------------------------------------------
Intercept          42.8620      0.872     49.149      0.000      41.149      44.575
lstat              -2.3328      0.124    -18.843      0.000      -2.576      -2.090
I(lstat ** 2.0)     0.0435      0.004     11.628      0.000       0.036       0.051
```

```
==============================================================================
Omnibus:                      107.006   Durbin-Watson:                   0.921
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              228.388
Skew:                           1.128   Prob(JB):                     2.55e-50
Kurtosis:                       5.397   Cond. No.                     1.13e+03
==============================================================================

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 1.13e+03. This might indicate that there are
strong multicollinearity or other numerical problems.
""") ('Model 3 Summary: ', <class 'statsmodels.iolib.summary.Summary'>
"""
                            OLS Regression Results
```