3.4 Challenge

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3.4 CHALLENGE: Run and interpret a market regression model

Download monthly prices for Alfa (ALFAA.MX) and the Mexican market index IPCyC (^MXX) from Yahoo Finance from January 2018 to July 2022.

```
import pandas_datareader as pdr
import pandas as pd
import numpy as np
import matplotlib
import matplotlib.pyplot as plt
```

Calculating the cc returns of both stocks and drop NA values

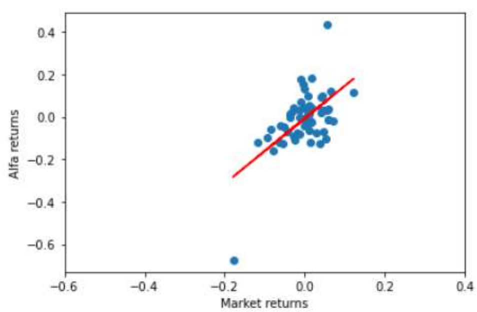
```
# Getting price data and selecting adjusted price columns:
sprices = pdr.get_data_yahoo(['ALFAA.MX','^MXX'],start="01/01/2018", end="07/31/2022",interval="m")
sprices = sprices['Adj Close']
```

```
# Calculating the cc returns
sr = np.log(sprices) - np.log(sprices.shift(1))
```

```
# Deleting NAs
sr=sr.dropna()
sr.columns=['ALFAA','MXX']
```

Do a scatter plot including the regression line and interpret the plot

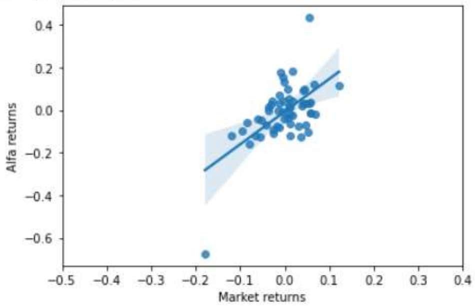
```
# Plotting CC returns of MMX and ALFAA
plt.scatter(sr['MXX'], sr['ALFAA'])

# Adding the regression line (degree 1)
b1, b0 = np.polyfit(sr["MXX"], sr["ALFAA"], 1)

# y = b + mx
y = b0 + b1 * sr["MXX"]

# Plotting the regression line
plt.plot(sr["MXX"], y, c = "red")

# Making the x-axis ranges correct (to coincide with the y's)
plt.xticks(np.arange(-0.60,0.5,0.2))

plt.xlabel("Market returns")
plt.ylabel("Alfa returns")

plt.show()
```



AFTER PLOTTING THE REGRESSION LINE, WE CAN OBSERVE THAT THIS MODEL FITS PROPERLY TO THE CC RETURNS OF MXX AND ALFAA (DISCARDING THE OUTLAYERS), MEANING THAT THE X (MARKET RETURNS) CAN EXPLAIN THE MOVEMENT OF Y (ALFA RETURNS). BY LOOKING AT THE GRAPH, WE COULD CALCULATE THAT THE SLOPE (HOW MANY UNITS CHANGE IN Y PER A UNIT IN X) IS AROUND 2, SO EVERY TIME THE MARKET RETURNS INCREASE, THE ALFA'S INCREASE TIMES 2.

```python
# Another way of plotting the regression line would be:
import seaborn as sns

sns.regplot(sr["MXX"], sr["ALFAA"],)
plt.xticks(np.arange(-0.50,0.5,0.1))
plt.xlabel("Market returns")
plt.ylabel("Alfa returns")

plt.show()
```

```
C:\Users\myros\anaconda3\envs\Statistics\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variables as keyword args: x, y. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```



Run the market regression model (the Y=stock return, the X=market return). You can use the function OLS from the statsmodels.api library.

```python
import statsmodels.api as sm
X = sm.add_constant(x)

mkmodel = sm.OLS( sr['ALFAA'], X).fit()

print(mkmodel.summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                  ALFAA   R-squared:                       0.350
Model:                            OLS   Adj. R-squared:                  0.338
Method:                 Least Squares   F-statistic:                     28.59
Date:                Thu, 25 Aug 2022   Prob (F-statistic):           1.94e-06
Time:                        16:01:45   Log-Likelihood:                 43.896
No. Observations:                  55   AIC:                            -83.79
Df Residuals:                      53   BIC:                            -79.78
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const         -0.0075      0.015     -0.498      0.620      -0.037       0.023
MXX            1.5362      0.287      5.347      0.000       0.960       2.113
==============================================================================
Omnibus:                        9.510   Durbin-Watson:                   2.206
Prob(Omnibus):                  0.009   Jarque-Bera (JB):               22.533
Skew:                          -0.150   Prob(JB):                     1.28e-05
Kurtosis:                       6.121   Cond. No.                         19.2
==============================================================================

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

```python
# Using matrix algebra to estimate the beta coefficients:
sr['constant'] = 1
selcols = ['constant','MXX']
x = sr[selcols].values
y = sr['ALFAA'].values

xtx = np.matmul(x.transpose(),x)
xty = np.matmul(x.transpose(),y)
invtxt = np.linalg.inv(xtx)

betas = np.matmul(invtxt,xty)
betas
```

```
array([-0.00745576,  1.53623423])
```

Regression equation:

E[ALFAret]= -0.00745576 + 1.53623423*MXXret

Interpret the beta coefficients and their corresponding t and p values, and their 95% confidence intervals

THE BETA 0 IS THE VALUE OF Y WHEN X = 0, IN THIS CASE WHEN THE MARKET RETURNS ARE 0, THE ALFAS RETURNS ARE -0.0074. BETA 1, IS THE SLOPE (DERIVATIVE) => THE UNITS THE ALFAS RETURNS CHANGES PER A UNIT IN THE MARKET RETURNS, WHICH IS ACTUALLY 1.536 (AROUND WHAT WE CALCULATED IN THE ANSWER ABOVE).

T-VALUE B1 => SINCE IT IS GREATER THAN 3, MEANS THAT THE DIFFERENCE BETWEEN THE COEFFICIENT OF MXX AND THE H0 (MEAN = 0) IS 5.347 STANDARD DEVIATIONS, WHICH IMPLIES THAT WE CAN DECLINE THE NULL HYPOTHESIS. P-VALUE B1 => SINCE THE T-VALUE IS ACTUALLY GREATER THAN 3, MEANS THAT ALMOST A 100% OF THE TIMES WE CAN ENSURE THAT THE COEFFICIENT OF MXX WILL NOT BE 0, THUS THE P-VALUE IS BASICALLY 0.00%. 95% C.I. B1 => THERE IS A 95% OF PROBABILITY THAT THE MXX COEFFICIENT WILL BE BETWEEN 0.960 AND 2.113.

T-VALUE B0 => SINCE IT IS NEGATIVE, MEANS THAT THE DIFFERENCE BETWEEN THE INTERCEPT AND THE H0 (MEAN = 0) IS -0.498 STANDARD DEVIATIONS, WHICH IMPLIES THAT WE CANNOT DECLINE THE NULL HYPOTHESIS, IT ACTUALLY MEANS THAT 0 > THAN THE INTERCEPT. P-VALUE B0 => SINCE THE T-VALUE IS ACTUALLY -0.498, MEANS THAT ALMOST THERE IS A REALLY HIGH POSIBILITY THAT THE INCERCEPT WILL BE 0 (NULL HYPOTHESIS), ACTUALLY 62% OF PROBABILITY. 95% C.I. B0 => THERE IS A 95% OF PROBABILITY THAT THE INTERCEPT COEFFICIENT WILL BE BETWEEN -0.037 AND 0.023.