Econometrics_HW2_2.10

September 7, 2019

1 Question 2.10

1.1 A) The econometric model rj - rf = alpha(j) + beta(j) * (rm - rf) + e is a simple regression model as the equation represents a straight line which has a y- intercept and a slope component. Here, the y-intercept component is alpha which is the expected excess return and beta is a slope which is a risk factor and implies the effect of change in risk premium on returns.

1.2 B) Here we are estimating the CAPM Model for each of the 6 firms and analyzing the estimated beta values

[17]:
```
#importing libraries

import pandas as pd
import numpy as np
import statsmodels.api as sm
import matplotlib.pyplot as plt
%matplotlib inline
```

[18]:
```
#Checking current working directory

import os
os.chdir("C:\\Users\\nishc\\Downloads")
```

[19]:
```
#Loading data set
data= pd.read_stata("capm4.dta")
data.head()
```

[19]:
```
       date       dis        ge        gm       ibm      msft       xom  \
0  19980130  0.080884  0.056218 -0.046296 -0.056153  0.154255 -0.030644
1  19980227  0.047368  0.003226  0.198490  0.059620  0.136154  0.081728
2  19980331 -0.046343  0.112379 -0.017226 -0.005386  0.056047  0.060784
3  19980430  0.168337 -0.011603 -0.005535  0.115523  0.006983  0.080407
4  19980529 -0.090818 -0.021277  0.074212  0.015922 -0.058946 -0.029461

        mkt  riskfree
0  0.004529  0.004188
1  0.073230  0.004268
2  0.051322  0.004358
```

```
3  0.010862  0.003940
4 -0.025755  0.003806
```

[20]:
```python
#checking for NaN values in the Dataset
data.isnull().sum()
```

[20]:
```
date        0
dis         0
ge          0
gm          0
ibm         0
msft        0
xom         0
mkt         0
riskfree    0
dtype: int64
```

[21]:
```python
#Risk Premium for Market Portfolio

RP_mkt= data["mkt"]-data["riskfree"]

# Risk Premium for each Stocks
RP_dis= data["dis"]- data["riskfree"]
RP_ge= data["ge"]- data["riskfree"]
RP_gm= data["gm"]- data["riskfree"]
RP_ibm= data["ibm"]- data["riskfree"]
RP_msft= data["msft"]- data["riskfree"]
RP_xom= data["xom"]- data["riskfree"]
```

[22]:
```python
#CAPM Models



x= sm.add_constant(RP_mkt)


#CAPM Model for Disney

model1= sm.OLS(RP_dis,x)
result1=model1.fit()
print(result1.summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.289
Model:                            OLS   Adj. R-squared:                  0.283
Method:                 Least Squares   F-statistic:                     52.74
Date:                Sat, 07 Sep 2019   Prob (F-statistic):           3.11e-11
Time:                        14:26:07   Log-Likelihood:                 167.72
```

```
No. Observations:                 132   AIC:                            -331.4
Df Residuals:                     130   BIC:                            -325.7
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const         -0.0011      0.006     -0.193      0.847      -0.013       0.011
0              0.8978      0.124      7.262      0.000       0.653       1.142
==============================================================================
Omnibus:                       15.249   Durbin-Watson:                   2.426
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               25.331
Skew:                           0.546   Prob(JB):                     3.16e-06
Kurtosis:                       4.847   Cond. No.                         20.8
==============================================================================

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

C:\Users\nishc\AppData\Local\Continuum\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)
```

1.2.1 The Beta value of Disney's Stock is 0.8978. Therefore, we can say that the stock is DEFENSIVE

[23]:
```python
#CAPM Model for GE

model2= sm.OLS(RP_ge,x)
result2=model2.fit()
print(result2.summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.389
Model:                            OLS   Adj. R-squared:                  0.385
Method:                 Least Squares   F-statistic:                     82.87
Date:                Sat, 07 Sep 2019   Prob (F-statistic):           1.33e-15
Time:                        14:26:07   Log-Likelihood:                 197.34
No. Observations:                 132   AIC:                            -390.7
Df Residuals:                     130   BIC:                            -384.9
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
```

```
const         -0.0012      0.005     -0.245      0.807      -0.011       0.008
0              0.8993      0.099      9.104      0.000       0.704       1.095
==============================================================================
Omnibus:                        3.287   Durbin-Watson:                   2.239
Prob(Omnibus):                  0.193   Jarque-Bera (JB):                2.872
Skew:                           0.238   Prob(JB):                        0.238
Kurtosis:                       3.544   Cond. No.                         20.8
==============================================================================

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

1.2.2 The Beta value of GE's Stock is 0.8993. Therefore, we can say that the stock is DEFENSIVE

[24]:
```python
#CAPM Model for GM

model3= sm.OLS(RP_gm,x)
result3=model3.fit()
print(result3.summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.230
Model:                            OLS   Adj. R-squared:                  0.224
Method:                 Least Squares   F-statistic:                     38.91
Date:                Sat, 07 Sep 2019   Prob (F-statistic):           5.77e-09
Time:                        14:26:08   Log-Likelihood:                 102.76
No. Observations:                 132   AIC:                            -201.5
Df Residuals:                     130   BIC:                            -195.8
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const         -0.0116      0.010     -1.185      0.238      -0.031       0.008
0              1.2614      0.202      6.238      0.000       0.861       1.661
==============================================================================
Omnibus:                        4.443   Durbin-Watson:                   2.063
Prob(Omnibus):                  0.108   Jarque-Bera (JB):                4.999
Skew:                          -0.187   Prob(JB):                       0.0821
Kurtosis:                       3.877   Cond. No.                         20.8
==============================================================================

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

1.2.3 The Beta value of GM's Stock is 1.2614. Therefore, we can say that the stock is AGGRESSIVE

[25]:
```
#CAPM Model for IBM

model4= sm.OLS(RP_ibm,x)
result4=model4.fit()
print(result4.summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.405
Model:                            OLS   Adj. R-squared:                  0.400
Method:                 Least Squares   F-statistic:                     88.32
Date:                Sat, 07 Sep 2019   Prob (F-statistic):           2.52e-16
Time:                        14:26:08   Log-Likelihood:                 164.76
No. Observations:                 132   AIC:                            -325.5
Df Residuals:                     130   BIC:                            -319.8
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.0059      0.006      0.961      0.339      -0.006       0.018
0              1.1882      0.126      9.398      0.000       0.938       1.438
==============================================================================
Omnibus:                       19.729   Durbin-Watson:                   2.172
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               61.477
Skew:                           0.439   Prob(JB):                     4.47e-14
Kurtosis:                       6.226   Cond. No.                         20.8
==============================================================================

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

1.2.4 The Beta value of IBM's Stock is 1.1882. Therefore, we can say that the stock is AGGRESSIVE

[26]:
```
#CAPM Model for Microsoft

model5= sm.OLS(RP_msft,x)
result5=model5.fit()
print(result.summary())
```

```
---------------------------------------------------------------------------
```

```
    NameError                                 Traceback (most recent call
 ↪last)

    <ipython-input-26-08abe29001ef> in <module>
      3 model5= sm.OLS(RP_msft,x)
      4 result5=model5.fit()
----> 5 print(result.summary())


    NameError: name 'result' is not defined
```

1.2.5 The Beta value of Microsoft's Stock is 1.3189. Therefore, we can say that the stock is AGGRESSIVE

[27]:
```
#CAPM Model for Exxon Mobil

model6= sm.OLS(RP_xom,x)
result6=model6.fit()
print(result6.summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.141
Model:                            OLS   Adj. R-squared:                  0.134
Method:                 Least Squares   F-statistic:                     21.29
Date:                Sat, 07 Sep 2019   Prob (F-statistic):           9.33e-06
Time:                        14:26:09   Log-Likelihood:                 210.05
No. Observations:                 132   AIC:                            -416.1
Df Residuals:                     130   BIC:                            -410.3
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.0079      0.004      1.823      0.071      -0.001       0.016
0              0.4140      0.090      4.614      0.000       0.236       0.591
==============================================================================
Omnibus:                       22.128   Durbin-Watson:                   2.348
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               40.767
Skew:                           0.747   Prob(JB):                     1.40e-09
Kurtosis:                       5.276   Cond. No.                         20.8
==============================================================================

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

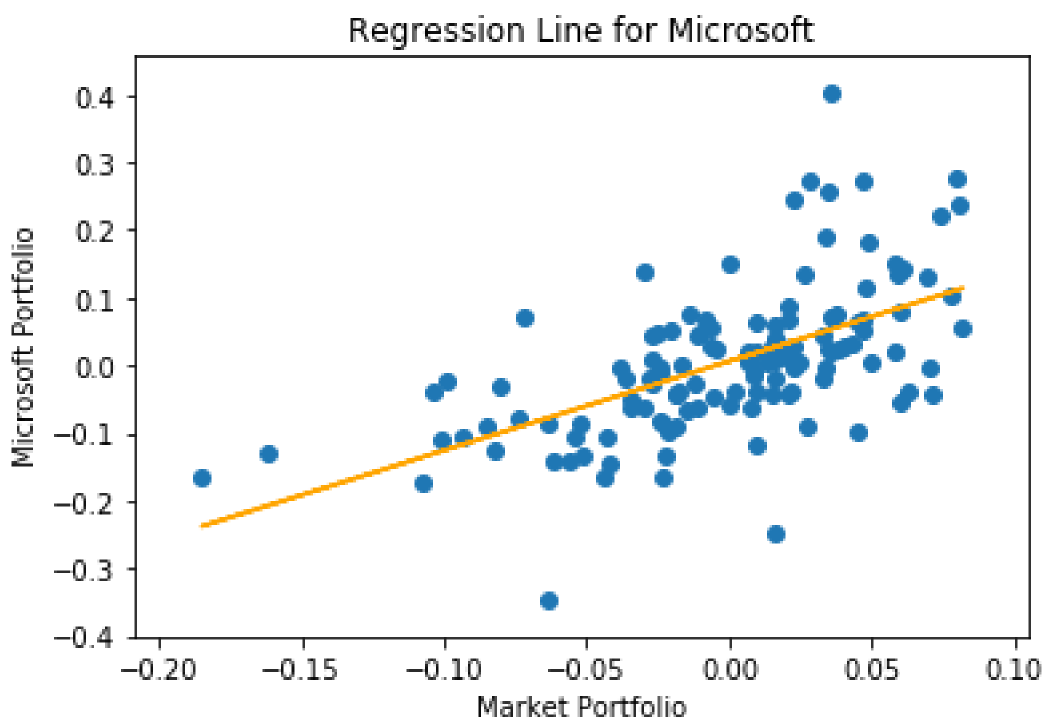
1.2.6 The Beta value of Exxon Mobil's Stock is 0.414. Therefore, we can say that the stock is DEFENSIVE

1.3 From the above analysis of the beta values of different value it is seen that Exxon Mobil has the lowest and most defensive beta value which is 0.4140. Whereas, IBM has the highest and most aggressive beta value which is 1.8820

1.4 C) The obtained alpha values are very close to Zero as stated by the Finance Theory. Thus, the theory seems to be correct as per the given datesets.

1.4.1 Fitted Regression line of Microsoft across the scatter plot

[37]:
```
plt.scatter(RP_mkt, RP_msft)
plt.plot(RP_mkt,result5.predict(x), color='orange')
plt.xlabel("Market Portfolio")
plt.ylabel(" Microsoft Portfolio")
plt.title("Regression Line for Microsoft")
plt.show()
```



1.5 Estimating CAPM Model for alpha=0

[38]:
```
x1= RP_mkt + np.zeros(132)
```

[39]:
```
#CAPM Model for Disney
```

```python
model11= sm.OLS(RP_dis,x1)
result11=model11.fit()
print(result11.summary())
```

```
                            OLS Regression Results
================================================================================
=======
Dep. Variable:                      y   R-squared (uncentered):
0.289
Model:                            OLS   Adj. R-squared (uncentered):
0.283
Method:                 Least Squares   F-statistic:
53.14
Date:                Sat, 07 Sep 2019   Prob (F-statistic):
2.62e-11
Time:                        14:32:14   Log-Likelihood:
167.70
No. Observations:                 132   AIC:
-333.4
Df Residuals:                     131   BIC:
-330.5
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
x1             0.8979      0.123      7.290      0.000       0.654       1.142
==============================================================================
Omnibus:                       15.250   Durbin-Watson:                   2.426
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               25.332
Skew:                           0.547   Prob(JB):                     3.16e-06
Kurtosis:                       4.847   Cond. No.                         1.00
==============================================================================

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

[40]:
```python
#CAPM Model for GE

model22= sm.OLS(RP_ge,x1)
result22=model22.fit()
print(result22.summary())
```

```
                            OLS Regression Results
================================================================================
=======
```

```
Dep. Variable:                      y   R-squared (uncentered):
0.389
Model:                            OLS   Adj. R-squared (uncentered):
0.385
Method:                 Least Squares   F-statistic:
83.49
Date:                Sat, 07 Sep 2019   Prob (F-statistic):
1.04e-15
Time:                        14:32:14   Log-Likelihood:
197.31
No. Observations:                 132   AIC:
-392.6
Df Residuals:                     131   BIC:
-389.7
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
x1             0.8993      0.098      9.137      0.000       0.705       1.094
==============================================================================
Omnibus:                        3.287   Durbin-Watson:                   2.238
Prob(Omnibus):                  0.193   Jarque-Bera (JB):                2.873
Skew:                           0.238   Prob(JB):                        0.238
Kurtosis:                       3.544   Cond. No.                         1.00
==============================================================================

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

[41]:
```python
#CAPM Model for GM

model33= sm.OLS(RP_gm,x1)
result33=model33.fit()
print(result33.summary())
```

```
                                 OLS Regression Results
================================================================================
=======
Dep. Variable:                      y   R-squared (uncentered):
0.229
Model:                            OLS   Adj. R-squared (uncentered):
0.223
Method:                 Least Squares   F-statistic:
38.84
Date:                Sat, 07 Sep 2019   Prob (F-statistic):
```

```
5.84e-09
Time:                        14:32:14   Log-Likelihood:
102.05
No. Observations:                 132   AIC:
-202.1
Df Residuals:                     131   BIC:
-199.2
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
x1             1.2622      0.203      6.232      0.000       0.862       1.663
==============================================================================
Omnibus:                        4.446   Durbin-Watson:                   2.041
Prob(Omnibus):                  0.108   Jarque-Bera (JB):                5.004
Skew:                          -0.187   Prob(JB):                       0.0819
Kurtosis:                       3.878   Cond. No.                         1.00
==============================================================================

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

[42]:
```python
#CAPM Model for IBM

model44= sm.OLS(RP_ibm,x1)
result44=model44.fit()
print(result44.summary())
```

```
                                 OLS Regression Results
================================================================================
=======
Dep. Variable:                      y   R-squared (uncentered):
0.403
Model:                            OLS   Adj. R-squared (uncentered):
0.398
Method:                 Least Squares   F-statistic:
88.31
Date:                Sat, 07 Sep 2019   Prob (F-statistic):
2.38e-16
Time:                        14:32:14   Log-Likelihood:
164.29
No. Observations:                 132   AIC:
-326.6
Df Residuals:                     131   BIC:
-323.7
```

```
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
x1             1.1878      0.126      9.398      0.000       0.938       1.438
==============================================================================
Omnibus:                       19.736   Durbin-Watson:                   2.157
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               61.502
Skew:                           0.439   Prob(JB):                     4.41e-14
Kurtosis:                       6.227   Cond. No.                         1.00
==============================================================================

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

[43]:

```python
#CAPM Model for Microsoft

model55= sm.OLS(RP_msft,x1)
result55=model55.fit()
print(result55.summary())
```

```
                                 OLS Regression Results
================================================================================
=======
Dep. Variable:                      y   R-squared (uncentered):
0.340
Model:                            OLS   Adj. R-squared (uncentered):
0.335
Method:                 Least Squares   F-statistic:
67.44
Date:                Sat, 07 Sep 2019   Prob (F-statistic):
1.81e-13
Time:                        14:32:14   Log-Likelihood:
132.71
No. Observations:                 132   AIC:
-263.4
Df Residuals:                     131   BIC:
-260.5
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
x1             1.3185      0.161      8.212      0.000       1.001       1.636
==============================================================================
```

```
Omnibus:                       16.074   Durbin-Watson:                   2.334
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               34.121
Skew:                           0.473   Prob(JB):                     3.90e-08
Kurtosis:                       5.304   Cond. No.                         1.00
==============================================================================

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

[44]:
```python
#CAPM Model for Exxon-Mobil

model66= sm.OLS(RP_xom,x1)
result66=model66.fit()
print(result66.summary())
```

```
                                 OLS Regression Results
================================================================================
=======
Dep. Variable:                      y   R-squared (uncentered):
0.137
Model:                            OLS   Adj. R-squared (uncentered):
0.131
Method:                 Least Squares   F-statistic:
20.87
Date:                Sat, 07 Sep 2019   Prob (F-statistic):
1.12e-05
Time:                        14:32:15   Log-Likelihood:
208.38
No. Observations:                 132   AIC:
-414.8
Df Residuals:                     131   BIC:
-411.9
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
x1             0.4134      0.091      4.568      0.000       0.234       0.592
==============================================================================
Omnibus:                       22.136   Durbin-Watson:                   2.290
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               40.789
Skew:                           0.747   Prob(JB):                     1.39e-09
Kurtosis:                       5.277   Cond. No.                         1.00
==============================================================================

Warnings:
```

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

1.6 Difference in beta values when alpha=1 and alpha=0

[45]:
```
diff1= result11.params[0]-result1.params[0]
diff2= result22.params[0]-result2.params[0]
diff3= result33.params[0]-result3.params[0]
diff4= result44.params[0]-result4.params[0]
diff5= result55.params[0]-result5.params[0]
diff6= result66.params[0]-result6.params[0]

print(" The Difference in beta value of Disney when alpha=0 is", diff1)
print(" The Difference in beta value of GE when alpha=0 is", diff2)
print(" The Difference in beta value of GM when alpha=0 is", diff3)
print(" The Difference in beta value of IBM when alpha=0 is", diff4)
print(" The Difference in beta value of Microsoft when alpha=0 is", diff5)
print(" The Difference in beta value of Exxon-Mobil when alpha=0 is", diff6)
```

```
 The Difference in beta value of Disney when alpha=0 is 8.118574049187366e-05
 The Difference in beta value of GE when alpha=0 is 8.242353869281072e-05
 The Difference in beta value of GM when alpha=0 is 0.0008158078392714874
 The Difference in beta value of IBM when alpha=0 is -0.00041328961773245965
 The Difference in beta value of Microsoft when alpha=0 is
-0.00043068366582432744
 The Difference in beta value of Exxon-Mobil when alpha=0 is
-0.0005565950793665619
```

1.7 D) As we can observe from the results that there is a negligible difference in the beta values.