```
import numpy as np
import pandas as pd
import os
```

```
Adjust Data
 path ="/Users/yifuhe/Desktop/homework7"
 df1=pd.read_excel(path+"/USD_UK.xls")
 df2=pd.read_excel(path+"/USD_EU.xls")
 df3=pd.read_excel(path+"/JP_USD.xls")
 df4=pd.read_excel(path+"/SZ_USD.xls")
 df_uk=pd.DataFrame(df1.iloc[10:,:].values,columns=df1.iloc[9,:].to_list())
 df_eu=pd.DataFrame(df2.iloc[10:,:].values,columns=df2.iloc[9,:].to_list())
 df_jp=pd.DataFrame(df3.iloc[10:,:].values,columns=df3.iloc[9,:].to_list())
 df_sz=pd.DataFrame(df4.iloc[10:,:].values,columns=df4.iloc[9,:].to_list())
 df_uk=df_uk.fillna(method="ffill")
 df_eu=df_eu.fillna(method="ffill")
 df_jp=df_jp.fillna(method="ffill")
 df_sz=df_sz.fillna(method="ffill")
 df_jp["DEXJPUS"]=df_jp["DEXJPUS"]**(-1)
```

```
df_sz["DEXSZUS"]=df_sz["DEXSZUS"]**(-1)
```

Question 1

Calculate rt-rt*

```
rt_uk=(df_uk.iloc[:,1]-df_uk.iloc[:,2])/1200
rt_eu=(df_eu.iloc[:,1]-df_eu.iloc[:,2])/1200
rt_jp=(df_jp.iloc[:,1]-df_jp.iloc[:,2])/1200
rt_sz=(df_sz.iloc[:,1]-df_sz.iloc[:,2])/1200
```

Calculate st

```
st_uk=[]
st_jp=[]
for i in range(8917):
   st_uk.append(np.log(df_uk.iloc[i+21,3])-np.log(df_uk.iloc[i,3]))
   st_jp.append(np.log(df_jp.iloc[i+21,3])-np.log(df_jp.iloc[i,3]))
```

```
st_eu=[]
st_sz=[]
for j in range(5525):
    st_eu.append(np.log(df_eu.iloc[j+21,3])-np.log(df_eu.iloc[j,3]))
for m in range(1281):
    st_sz.append(np.log(df_sz.iloc[m+21,3])-np.log(df_sz.iloc[m,3]))

st_uk=np.array(st_uk)
st_jp=np.array(st_jp)
st_eu=np.array(st_eu)
```

Calculate excess return

st_sz=np.array(st_sz)

```
excess_uk=[]
for i in range(8917):
    if rt_uk[i]>=0:
        excess_uk.append(rt_uk[i]-st_uk[i])
    else:
        excess_uk.append(st_uk[i]-rt_uk[i])
```

```
excess_jp=[]
for i in range(8917):
    if rt_jp[i]>=0:
        excess_jp.append(rt_jp[i]-st_jp[i])
    else:
        excess_jp.append(st_jp[i]-rt_jp[i])
```

```
excess_eu=[]
for i in range(5525):
    if rt_eu[i]>=0:
        excess_eu.append(rt_eu[i]-st_eu[i])
    else:
        excess_eu.append(st_eu[i]-rt_eu[i])
```

```
excess_sz=[]
for i in range(1281):
    if rt_sz[i]>=0:
        excess_sz.append(rt_sz[i]-st_sz[i])
    else:
        excess_sz.append(st_sz[i]-rt_sz[i])
```

```
excess_uk=np.array(excess_uk)
excess_jp=np.array(excess_jp)
excess_eu=np.array(excess_eu)
excess_sz=np.array(excess_sz)
```

```
t_uk=excess_uk.mean()/excess_uk.std()*np.sqrt(8938)
t_jp=excess_jp.mean()/excess_jp.std()*np.sqrt(8938)
t_sz=excess_sz.mean()/excess_sz.std()*np.sqrt(1302)
t_eu=excess_eu.mean()/excess_eu.std()*np.sqrt(5546)
print(t_uk)
print(t_jp)
print(t_sz)
print(t_eu)
```

```
3.9238165738425885
5.2387334329103385
3.7824255210450604
7.442595339750493
```

From the t test value, they all make a significant profit

Question2

```
import statsmodels.api as sm
x=sm.add_constant(rt_uk[21:8938])
lm=sm.OLS(st_uk,x).fit()
print(lm.summary())
t1 = (-0.3758 - 1 )/0.172
```

```
OLS Regression Results
_____
Dep. Variable:
Model:
                          y R-squared:
                                                       0.001
        OLS Adj. R-squared: 0.000
Least Squares F-statistic: 4.793
Wed, 13 May 2020 Prob (F-statistic): 0.0286
Method:
Date:
Time: 03:56:00 Log-Likelihood:
No. Observations: 8917 AIC:
Df Residuals: 8915 BIC:
                                                      19246.
                                                   -3.849e+04
                                                    -3.847e+04
Df Model:
                           1
Covariance Type: nonrobust
_____
           coef std err t P>|t| [0.025 0.975]
const -0.0008 0.000 -2.265 0.024 -0.002
0 -0.3758 0.172 -2.189 0.029 -0.712
                                                      -0.000
                                                      -0.039
Omnibus: 1350.998 Durbin-Watson: 0.091
Prob(Omnibus): 0.000 Jarque-Bera (JB): 4106.495
Skew: -0.792 Prob(JB): 0.00
Kurtosis:
                       5.923 Cond. No.
                                                        580.
Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly
```

/Users/yifuhe/opt/anaconda3/lib/python3.7/sitepackages/numpy/core/fromnumeric.py:2542: FutureWarning: Method .ptp is deprecated and will be removed in a future version. Use numpy.ptp instead. return ptp(axis=axis, out=out, **kwargs)

```
length =np.min([st_jp.shape[0],rt_jp.shape[0]])
x = sm.add_constant(rt_jp[-length:])
lm=sm.OLS(st_jp[-length:],x).fit()
print(lm.summary())
t2= (-1.0400 - 1 )/0.186
```

Dep. Variable	:	}	y I	R-squ	ared:		0.003
Model:		OLS Adj. R-squared:			0.003		
Method:		Least Squares	5 I	F-statistic:			31.18
Date:	W	ed, 13 May 2020) I	Prob	(F-statistic):		2.42e-08
Time:		03:56:00) I	Log-L	ikelihood:		18385.
No. Observati	ons:	8917	7 A	AIC:			-3.677e+04
Df Residuals:		8915	5 E	BIC:			-3.675e+04
<pre>Df Model:</pre>		1	1				
Covariance Ty	pe:	nonrobust	t				
	coef	std err				[0.025	0.975]
const	0.0033	0.000		 116		0.002	0.004
0	-1.0400	0.186	-5.	584			
Omnibus:	=======	435.49	==== :	===== Durbi	======== n-Watson:	======	0.092
Prob(Omnibus)	:	0.000	о :	Jarqu	e-Bera (JB):		815.570
Skew:		0.372	2 1	Prob(JB):		7.97e-178
Kurtosis:		4.282	2 (cond.	No.		571.

```
length =np.min([st_eu.shape[0],rt_eu.shape[0]])
x=sm.add_constant(rt_eu[-length:])
lm=sm.OLS(st_eu[-length:],x).fit()
print(lm.summary())
t3=(-1.7107 -1)/ 0.322
```

Time:		03:56:0)0 Log-	Likelihood:	12027.	
No. Observa	tions:	552	25 AIC:			-2.405e+04
Df Residual	s:	552	23 BIC:			-2.404e+04
Df Model:			1			
Covariance	Туре:	nonrobus	it			
========	coef	std err	t	P> t	[0.025	0.975]
const	0.0005	0.000	1.253	0.210	-0.000	0.001
0	-1.7107	0.322	-5.315	0.000	-2.342	-1.080
Omnibus:		 174.61	====== L5 Durb	======== in-Watson:	=======	 0.093
Prob(Omnibu	ıs):	0.00)O Jarq	ue-Bera (JB):		425.175
skew:		-0.13	30 Prob	(JB):		4.72e-93
Kurtosis:		4.33	34 Cond	. No.		872.

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

```
length =np.min([st_sz.shape[0],rt_sz.shape[0]])
x=sm.add_constant(rt_sz[-length:])
lm=sm.OLS(st_sz[-length:],x).fit()
print(lm.summary())
t4 = ( 1.1655 -1)/  0.806
```

Dep. Variabl	le:	у	R-squa	ared:		0.002
Model:		OLS	Adj. F	R-squared:		0.001
Method:		Least Squares	F-stat	tistic:		2.091
Date:	We	ed, 13 May 2020	Prob	(F-statistic):	0.148
Time:		03:56:00	Log-L	ikelihood:		3263.2
No. Observat	tions:	1281	AIC:			-6522.
Df Residuals	5:	1279	BIC:			-6512.
<pre>Df Model:</pre>		1				
Covariance 7	Гуре:	nonrobust				
=========						
	coef	std err	t 		[0.025	0.975]
const	-0.0023	0.002			-0.005	0.001
0		0.806				
======= Omnibus:	========	0.929		======= 1-Watson:	========	 0.124
Prob(Omnibus	s):	0.628	Jarque	e-Bera (JB):		0.819
Skew:		-0.020	Prob(JB):		0.664
Kurtosis:		3.117	Cond.	No.		1.52e+03

[2] The condition number is large, 1.52e+03. This might indicate that there are

strong multicollinearity or other numerical problems.

```
print("Conclusion:")
print(f"t1: {t1}")
print(f"t2: {t2}")
print(f"t3: {t3}")
print(f"t4: {t4}")
print("T1-T3 are all different from 1, t4 cannot reject the null hypothesis")
```

```
Conclusion:

t1: -7.998837209302326

t2: -10.967741935483872

t3: -8.41832298136646

t4: 0.20533498759305208

T1-T3 are all different from 1, t4 cannot reject the null hypothesis
```

Question 3

```
eu = np.array(q3(rt_eu.values,st_eu))
jp = np.array(q3(rt_jp.values,st_jp))
sz = np.array(q3(rt_sz.values,st_sz))
uk = np.array(q3(rt_uk.values,st_uk))
```

all excess return are significant, except sz.

```
print(f"df: {len(eu)}")
print(f"t-stats_eu: {eu.mean()/eu.std()*np.sqrt(eu.shape[0])}")
print(f"df: {len(jp)}")
print(f"t-stats_jp: {jp.mean()/jp.std()*np.sqrt(jp.shape[0])}")
print(f"df: {len(sz)}")
print(f"t-stats_sz: {sz.mean()/sz.std()*np.sqrt(sz.shape[0])}")
print(f"df: {len(uk)}")
print(f"t-stats_uk: {uk.mean()/uk.std()*np.sqrt(uk.shape[0])}")
```

```
df: 5273
t-stats_eu: 7.0755861320934414
df: 8665
t-stats_jp: 10.871171983201158
df: 1029
t-stats_sz: -0.8489514369236427
df: 8665
t-stats_uk: 6.616505541210296
```

```
# load data
data = pd.read_excel(path+"/F-F_Research_Data_Factors_daily.xlsx")
name = data.iloc[3,:]
data = pd.DataFrame(data.iloc[16077:-2,:].values,columns=name)
CAPM = data["Mkt-RF"]
F3 = data.iloc[:,1:4]

data2 = pd.read_excel(path+"/F-F_Research_Data_5_Factors_2x3_daily.xlsx")
name = data2.iloc[2,1:6]
F5 = pd.DataFrame(data2.iloc[5656:,1:6].values,columns = name)
```

```
F3.head()
```

```
.dataframe tbody tr th {
    vertical-align: top;
}
.dataframe thead th {
    text-align: right;
}
```

3	Mkt-RF	SMB	HML
0	-0.63	0.84	0.38
1	0.56	-0.07	0.21
2	-0.04	0.09	0.09
3	1.38	-0.42	0.05
4	-2.16	1.4	0.3

F5.head(10)

```
.dataframe tbody tr th {
    vertical-align: top;
}
.dataframe thead th {
    text-align: right;
}
```

2	Mkt-RF	SMB	HML	RMW	СМА
0	-0.63	0.87	0.38	-0.41	0.33
1	0.56	-0.08	0.21	-0.13	0.27
2	-0.04	0.04	0.09	-0.22	-0.01
3	1.38	-0.48	0.05	-0.28	-0.01
4	-2.16	1.44	0.3	-0.09	0.15
5	-1.17	-0.8	-0.14	0.03	-0.19
6	-0.02	0.2	0.26	-0.3	0.04
7	0.28	-0.08	0.28	-0.16	0.22
8	0.01	0.41	-0.01	-0.06	0.1
9	0.79	-0.09	-0.21	-0.41	-0.54

EU

```
# EU CAPM
#eu = pd.DataFrame(eu,columns=["EU"])
length =np.min([eu.shape[0],CAPM.shape[0]])
x=sm.add_constant(CAPM[-length:])
lm=sm.OLS(eu[-length:],x.astype(float)).fit()
```

```
print(lm.summary())

# EU F3
length =np.min([eu.shape[0],F3.shape[0]])
x=sm.add_constant(F3[-length:])
lm=sm.OLS(eu[-length:],x.astype(float)).fit()
print(lm.summary())

# EU F5
length =np.min([eu.shape[0],F5.shape[0]])
x=sm.add_constant(F5[-length:])
lm=sm.OLS(eu[-length:],x.astype(float)).fit()
print(lm.summary())
OLS Regression Results
```

Dep. Variab	ole:		y R-sq	uared:		0.001
Model:		0	LS Adj.	R-squared:		0.000
Method:		Least Squar	es F-st	atistic:		3.17
Date:	W	ed, 13 May 20	20 Prob	(F-statistic):	0.074
Time:		07:40:	58 Log-	Likelihood:		11460
No. Observa	ations:	52	73 AIC:			-2.292e+0
Df Residual	s:	52	71 BIC:			-2.290e+0
Df Model:			1			
		nonrobu				
	coef	std err	t	P> t	[0.025	0.975
				0.000		
				0.075		
======= Omnibus:				in-Watson:		0.10
Prob(Omnibu	ıs):	0.0	000 Jarq	ue-Bera (JB):		438.09
Skew:		-0.1	.53 Prob	(JB):		7.41e-9
Kurtosis:		4.3	79 Cond	. No.		1.2
======================================	'd Errors as			ce matrix of		
======================================	d Errors as	sume that the	covarian	ce matrix of		
warnings: [1] Standar specified.		sume that the OLS Reg	covarian	ce matrix of [.] esults	the errors	is correc
warnings: [1] Standar specified.		sume that the OLS Reg	covarian pression R ====================================	ce matrix of esults ====================================	the errors	is correc
warnings: [1] Standar specified. ===================================	 ple:	sume that the OLS Reg	e covarian gression R ======= y R-sq OLS Adj.	ce matrix of esults ====================================	the errors	is correc
warnings: [1] Standar specified. ===================================	 ple:	sume that the OLS Reg	e covarian gression R ======= y R-sq OLS Adj.	ce matrix of esults ====================================	the errors	0.00 0.00
warnings: [1] Standar specified. ====== Dep. Variab Model: Method:	 ple:	sume that the OLS Reg OLS Reg COLS Reg	e covarian gression R ====================================	ce matrix of esults ====================================	the errors	is correc 0.00 0.00 1.62
warnings: [1] Standar specified. ======= Dep. Variab Model: Method: Date:	 ple:	Sume that the OLS Reg OLS Reg Column 10	e covarian pression R ======= y R-sq pLS Adj. res F-st	ce matrix of results ====================================	the errors	0.00 0.00 1.62 0.18
Warnings: [1] Standar specified. ======= Dep. Variab Model: Method: Date: Time: No. Observa	ole: wations:	Sume that the OLS Reg O Least Squar ded, 13 May 20 07:40:	e covarian pression R ======= y R-sq pLS Adj. res F-st	ce matrix of esults ====================================	the errors	is correc 0.00 0.00 1.62 0.18 11461 -2.291e+0
warnings: [1] Standar specified.	ole: wations:	Sume that the OLS Reg OLS Reg OLS Reg OOLS	e covarian pression R R==================================	ce matrix of esults ====================================	the errors	0.00 0.00 1.62 0.18 11461 -2.291e+0
Warnings: [1] Standar specified. ======= Dep. Variab Model: Method: Date: Time: No. Observa	ole: wations:	Sume that the OLS Reg OLS Reg OLS Reg OOLS	e covarian pression R y R-sq OLS Adj. res F-st O20 Prob 58 Log-	ce matrix of esults ====================================	the errors	0.000 0.000 1.620 0.180 11461 -2.291e+0
warnings: [1] Standar specified. ======= Dep. Variab Model: Method: Date: Time: No. Observa	ole: Wations:	Sume that the OLS Reg OLS Reg OLS Reg OOLS	ression R y R-sq DLS Adj. Ses F-st 20 Prob 58 Log- 273 AIC: 3	ce matrix of esults ====================================	the errors	is correc
warnings: [1] Standar specified. ========== Dep. Variab Model: Method: Date: Time: No. Observa Df Residual	ations: Type:	Sume that the OLS Reg OLS Reg OLS Reg OCIT OF THE CONTROL OF T	y R-sq DLS Adj. Pes F-st 20 Prob 58 Log- 273 AIC: 3	ce matrix of results ====================================	the errors	0.000 0.000 1.620 0.180 11461 -2.291e+0
Warnings: [1] Standar specified. ======= Dep. Variab Model: Method: Date: Time: No. Observa Df Residual Df Model: Covariance	ations: Type:	Sume that the OLS Reg OLS Reg OCUBE OCUB	y R-sq DLS Adj. Pes F-st 20 Prob 58 Log- 273 AIC: 3	ce matrix of esults ====================================	the errors	0.000 0.000 1.620 0.18 11461 -2.291e+0- -2.289e+0-
warnings: [1] Standar specified. ===================================	ations: Type: coef	Sume that the OLS Reg OLS Reg OLS Reg OCIT OF THE CONTROL OF T	e covarian pression R y R-sq pls Adj. es F-st p20 Prob 58 Log- e73 AIC: e69 BIC: 3 est t	ce matrix of esults ====================================	the errors	0.00 0.00 1.62 0.18 11461 -2.291e+0 -2.289e+0

				0.306		0.001
Omnibus:		178.9		======================================	=======	0.108
<pre>Prob(Omnibus):</pre>		0.0		e-Bera (JB):		438.454
Skew:		-0.1	L53 Prob(3	-		6.18e-96
Kurtosis: =======			379 Cond. 	No.		2.09
Warnings: [1] Standard E specified.	Errors ass	ume that the	e covariance	matrix of	the errors	is correctl
			gression Res			
======= Dep. Variable:			y R-squa			0.001
Model:		(-	-squared:		0.000
Method:		Least Squai	_			1.097
Date:				(F-statistic)):	0.359
Time:		07:40		kelihood:		11461.
No. Observatio	ns:		273 AIC:			-2.291e+04
of Residuals:		52	267 BIC:			-2.287e+04
Df Model:			5			
Covariance Typ		nonrobu				
		std err	t	P> t	[0.025	0.975]
const	0.0027		7.059	0.000		0.003
Mkt-RF	-0.0005	0.000	-1.380	0.168	-0.001	0.000
MB	0.0006	0.001	0.928	0.353	-0.001	0.002
IML	-0.0008	0.001	-1.197	0.231	-0.002	0.001
RMW	0.0003	0.001	0.358	0.721	-0.001	0.002
CMA				0.804		0.002
======= Omnibus:				======== ı-Watson:		0.108
Prob(Omnibus):		0.0	000 Jarque	e-Bera (JB):		439.557
Skew:		-0.1	L53 Prob(B):		3.56e-96
		4.3	381 Cond.	No.		3.83

JP

```
# jp CAPM

length =np.min([jp.shape[0],CAPM.shape[0]])
x=sm.add_constant(CAPM[-length:])
lm=sm.OLS(jp[-length:],x.astype(float)).fit()
print(lm.summary())

# jp F3
length =np.min([jp.shape[0],F3.shape[0]])
x=sm.add_constant(F3[-length:])
lm=sm.OLS(jp[-length:],x.astype(float)).fit()
print(lm.summary())
```

jp F5

length =np.min([jp.shape[0],F5.shape[0]])

x=sm.add_constant(F5[-length:])

lm=sm.OLS(jp[-length:],x.astype(float)).fit()

print(lm.summary())

======= Dep. Variable:				 R-squa			0.00
Model:		O	-		-squared:		-0.00
Method:		Least Square		_			0.404
Date:		d, 13 May 202					0.404
Time:	we				kelihood:	•	17863
No. Observatio	ncı	861		AIC:	kerinood.		-3.572e+0
Df Residuals:	115.	860		BIC:			-3.572e+0
Df Model:		800	1	BIC.			-3.37 TE+0
Covariance Typ	e:	nonrobus	_				
========	coef	std err		t	P> t	[0.025	0.975
const							
Mkt-RF	0.0002	0.000	0	.636	0.525	-0.000	0.00
======= Omnibus:		281.27				_======	0.10
<pre>Prob(Omnibus):</pre>		0.00	00	Jarque	-Bera (JB):		567.30
skew:		-0.22	28	Prob(J	B):		6.46e-12
Kurtosis:		4.17	72	Cond.	No.		1.1
Warnings: [1] Standard E specified.	rrors ass			ariance	matrix of t	====== he errors	
[1] Standard E		OLS Regi	ressi	ariance ion Res	matrix of t ults	he errors	is correc
[1] Standard E specified.		OLS Regi	ressi	ariance ion Res	matrix of t ults ======	he errors	is correc
[1] Standard E specified.		OLS Regi	ressi =====	ariance ion Res R-squa	matrix of t ults ======	he errors	is correc
[1] Standard E specified. ———————————————————————————————————		OLS Regi	ressi ===== y LS	ariance ion Res ===== R-squa Adj. R	matrix of t ults ====== red: -squared:	he errors	0.00 -0.00
[1] Standard E specified. ===================================	======	OLS Regi	ressi y LS	ariance ion Res ===== R-squa Adj. R F-stat	matrix of t ults ====================================	he errors	0.00 -0.00 0.989
[1] Standard E specified. ======= Dep. Variable: Model: Method:	======	OLS Regi OI OI Least Square	ressi y S S	ariance ion Res ====== R-squa Adj. R F-stat Prob (matrix of t ults ====================================	he errors ======	0.00 -0.00 0.989 0.39
[1] Standard E specified. Dep. Variable: Model: Method: Date:	======= We	OLS Regi	ressi y LS es 20	ariance ion Res ====== R-squa Adj. R F-stat Prob (matrix of t ults ====================================	he errors ======	0.00 -0.00 0.989 0.39
[1] Standard E specified. ===================================	======= We	OLS Regi OI Least Square d, 13 May 202	ress; y _S es 20	ariance ion Res ====== R-squa Adj. R F-stat Prob (Log-Li	matrix of t ults ====================================	he errors ======	0.00 -0.00 0.989 0.39 17865 -3.572e+0
[1] Standard E specified. ===================================	====== We	OLS Regi OI Least Square d, 13 May 202 07:41:5	ress; y _S es 20	ariance ion Res ====== R-squa Adj. R F-stat Prob (Log-Li AIC:	matrix of t ults ====================================	he errors ======	0.00 -0.00 0.989 0.39 17865 -3.572e+0
[1] Standard E specified. ===================================	======= We ns:	OLS Regi OI Least Square od, 13 May 202 07:41: 862 860 nonrobus	ressi y LS es 20 59 10 06 3	ariance ion Res ====== R-squa Adj. R F-stat Prob (Log-Li AIC: BIC:	matrix of t ults ====================================	he errors	0.00 -0.00 0.989 0.39 17865 -3.572e+0
[1] Standard E specified. ===================================	 we ns: e:	OLS Region OI Least Square of 13 May 202 07:41:5 860 860 860 860 850 850 850 850 850 850 850 850 850 85	ressi y s es 20 59 10 06 3	ariance ion Res R-squa Adj. R F-stat Prob (Log-Li AIC: BIC:	matrix of t ults ====================================	he errors	0.00 -0.00 0.989 0.39 17865 -3.572e+0 -3.569e+0
[1] Standard E specified. ===================================	we ns: e: 	OLS Region OI Least Square of 13 May 202 07:41:5 860 860 860 860 850 850 850 850 850 850 850 850 850 85	ressi y _S es 20 59 10 06 3	ariance ion Res R-squa Adj. R F-stat Prob (Log-Li AIC: BIC:	matrix of t ults ====================================	he errors :	0.00 -0.00 0.989 0.39 17865 -3.572e+0 -3.569e+0
[1] Standard E specified. ===================================	we ns: e: 	OLS Region OI Reast Square of 13 May 202 07:41:5 862 860 860 850 850 850 850 850 850 850 850 850 85	ressi y LS es 20 59 10 06 3 st	ariance ion Res ====== R-squa Adj. R F-stat Prob (Log-Li AIC: BIC: ====== t	matrix of t ults ====================================	he errors [0.025 0.003	0.000 -0.000 0.989 0.39 17865 -3.572e+0 -3.569e+0
[1] Standard E specified. ===================================	wens: e:	OLS Region OI Least Square of 13 May 202 07:41:5 860 860 860 860 860 860 860 860 860 860	ressi y Ses 20 59 10 06 3 st	ariance ion Res R-squa Adj. R F-stat Prob (Log-Li AIC: BIC: t .524	matrix of t ults ====================================	he errors : : [0.025 0.003 -0.000	0.00 -0.00 0.989 0.39 17865 -3.572e+0 -3.569e+0
[1] Standard E specified. ===================================	we ns: e: coef 0.0034 0.0002 0.0007 -0.0004	OLS Regination of the control of the	ress: y LS es 20 59 10 06 3 st ===== 10; 0; 1.	ariance ion Res ====== R-squa Adj. R F-stat Prob (Log-Li AIC: BIC: ====== t524 .645 .315	matrix of t ults ====================================	he errors : [0.025 0.003 -0.000 -0.000 -0.002	0.000 -0.000 0.989 0.39 17865 -3.572e+0 -3.569e+0
[1] Standard E specified. ===================================	we ns: e: coef 0.0034 0.0002 0.0007 -0.0004	OLS Region OI Least Square of 13 May 202 07:41:5 862 860 nonrobus std err	ress: y Ses 20 59 10 06 3 st 	ariance ion Res R-squa Adj. R F-stat Prob (Log-Li AIC: BIC: t524 .645 .315	matrix of t ults ====================================	he errors : [0.025 0.003 -0.000 -0.000 -0.002	0.00 -0.00 0.989 0.39 17865 -3.572e+0 -3.569e+0
[1] Standard E specified. ===================================	we ns: e: coef 0.0034 0.0002 0.0007 -0.0004	OLS Region OI Least Square of 13 May 202 07:41:5 862 860 860 860 860 860 860 960 960 960 960 960 960 960 960 960 9	ressi y ses 20 59 10 06 3 st =====	ariance ion Res R-squa Adj. R F-stat Prob (Log-Li AIC: BIC: t524 .645 .315 .746 Durbin	matrix of t ults ====================================	he errors : [0.025 0.003 -0.000 -0.000 -0.002	0.00 -0.00 0.989 0.39 17865 -3.572e+0 -3.569e+0
[1] Standard E specified. ===================================	we ns: e: coef 0.0034 0.0002 0.0007 -0.0004	OLS Region Old Reast Square (d, 13 May 202 07:41:5 862 860	ressi y -S es 20 59 10 06 3 st 10, 01, -0,	ariance ion Res R-squa Adj. R F-stat Prob (Log-Li AIC: BIC: t524 .645 .315 .746 Durbin	matrix of t ults ====================================	he errors : [0.025 0.003 -0.000 -0.000 -0.002	0.00 -0.00 0.989 0.39 17865 -3.572e+0 -3.569e+0

Warnings: [1] Standard Errors assume that the covariance matrix of the errors is correctly OLS Regression Results ______ y R-squared: Dep. Variable: 0.000 Model: OLS Adj. R-squared: -0.000 Method: Least Squares F-statistic: 0.6604 wed, 13 May 2020 Prob (F-statistic): 07:41:59 Log-Likelihood: Date: 0.654 17865. Time: -3.572e+04 8610 AIC: No. Observations: 8604 BIC: -3.568e+04 Df Residuals: Df Model: 5 Covariance Type: nonrobust ______ coef std err t P>|t| [0.025 0.975] -----0.0034 0.000 10.470 0.000 0.003 const 0.004 0.0003 0.000 0.835 0.404 -0.000 0.001 0.0007 0.001 1.167 0.243 -0.000 0.002 -0.0008 0.001 -1.245 0.213 -0.002 0.000 6.377e-05 0.001 0.074 0.941 -0.002 0.002 0.0008 0.001 0.792 0.429 -0.001 0.003 Mkt-RF SMB HML RMW CMA 279.136 Durbin-Watson: Omnibus: 0.110 561.110 Prob(Omnibus): 0.000 Jarque-Bera (JB): -0.227 Prob(JB): 1.43e-122 skew: Kurtosis: 4.165 Cond. No. 3.84 Warnings: [1] Standard Errors assume that the covariance matrix of the errors is correctly

SZ

specified.

```
# sz CAPM

length =np.min([sz.shape[0],CAPM.shape[0]])
x=sm.add_constant(CAPM[-length:])
lm=sm.OLS(sz[-length:],x.astype(float)).fit()
print(lm.summary())

# sz F3
length =np.min([sz.shape[0],F3.shape[0]])
x=sm.add_constant(F3[-length:])
lm=sm.OLS(sz[-length:],x.astype(float)).fit()
print(lm.summary())

# sz F5
length =np.min([sz.shape[0],F5.shape[0]])
x=sm.add_constant(F5[-length:])
lm=sm.OLS(sz[-length:],x.astype(float)).fit()
print(lm.summary())
```

		OLS PAGE	ession Res	ults		
		OL3 Regi	=========	:========		
Dep. Variab	ole:		y R-squa	red:		0.000
Model:		OL	S Adj. R	-squared:		-0.00
Method:		Least Square	s F-stat	istic:		1.027e-0
Date:	We	ed, 13 May 202	0 Prob ([F-statistic]):	0.99
Time:		07:42:3	39 Log-Li	kelihood:		2712.
No. Observa	ations:	102	9 AIC:			-5421
Df Residual	ls:	102	?7 BIC:			-5411
Df Model:			1			
Covariance		nonrobus				
	coef	std err	t	P> t	[0.025	0.975
const		0.001				
Mkt-RF	-2.063e-06	0.001				0.00
======= Omnibus:	=========	 1.28	======= 37 Durbin	======== 1-Watson:	========	0.17
Prob(Omnibu	ıs):	0.52	25 Jarque	e-Bera (JB):		1.34
skew:			3 Prob(J			0.51
=======		2.93				
warnings: [1] Standar				:=======		
warnings: [1] Standar specified.	rd Errors as:	sume that the	covariance	e matrix of	the errors	is correc
warnings: [1] Standar specified.	rd Errors as:	sume that the	covariance	e matrix of	the errors	is correc
warnings: [1] Standar specified. ======	rd Errors as:	sume that the OLS Regr	covariance	e matrix of sults	the errors	is correc
warnings: [1] Standar specified. Dep. Variab	rd Errors as:	sume that the OLS Regr	covariance ression Resy R-squa	e matrix of sults cults cured:	the errors	is correc 0.00 -0.00
warnings: [1] Standar specified. ======= Dep. Variab Model: Method:	rd Errors as: 	sume that the OLS Regr	covariance ression Res y R-squa S Adj. R	e matrix of sults cults cured: cred: crequared:	the errors	is correc 0.00 -0.00 0.548
Warnings: [1] Standar specified. ======= Dep. Variab Model: Method: Date:	rd Errors as: 	sume that the OLS Regr OL Least Square	covariance ression Res y R-squa S Adj. Res res F-stat	e matrix of sults cults cured: cred: crequared:	the errors	is correc 0.00 -0.00 0.548 0.64
Warnings: [1] Standar specified. ========== Dep. Variab Model: Method: Date: Time:	rd Errors as: ple: Wo	Sume that the OLS Regress OL Least Square	covariance ression Res y R-squa S Adj. R res F-stat O Prob (e matrix of sults red: -squared: -istic: -statistic	the errors	0.00 -0.00 0.548 0.64 2713.
warnings: [1] Standar specified. ======= Dep. Variab Model: Method: Date: Time: No. Observa	ole:	Sume that the OLS Regr OL Least Square ed, 13 May 202 07:42:3	covariance ression Res y R-squa S Adj. R res F-stat O Prob (D Log-Li	e matrix of sults red: -squared: -istic: -statistic	the errors	0.00 -0.00 0.548 0.64 2713.
warnings: [1] Standar specified. ======= Dep. Variab Model: Method: Date: Time: No. Observa	ole:	oume that the OLS Regr OL Least Square ed, 13 May 202 07:42:3	covariance ression Res y R-squa S Adj. R res F-stat O Prob (D Log-Li	e matrix of sults red: -squared: -istic: -statistic	the errors	0.00 -0.00 0.548 0.64 2713.
Warnings: [1] Standar specified. ======= Dep. Variab Model: Method: Date: Time: No. Observa Df Residual	rd Errors as: Die: Wations:	oume that the OLS Regr OL Least Square ed, 13 May 202 07:42:3	covariance ression Res y R-squa S Adj. R res F-stat O Prob (O Log-Li D AIC: S BIC:	e matrix of sults red: -squared: -istic: -statistic	the errors	is correc
warnings: [1] Standar specified. ============ Dep. Variab Model: Method: Date: Time: No. Observa Df Residual	rd Errors as: Die: Wations:	Sume that the OLS Regr OL Least Square ed, 13 May 202 07:42:3 102	covariance ression Res y R-squa S Adj. R res F-stat O Prob (O Log-Li D AIC: S BIC:	e matrix of sults red: -squared: -istic: -statistic	the errors	0.00 -0.00 0.548 0.64 2713.
Warnings: [1] Standar specified. EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE	ole: wations: Is:	Sume that the OLS Regr OL Least Square ed, 13 May 202 07:42:3 102 nonrobus	covariance ression Res y R-squa S Adj. R res F-stat O Prob (D Log-Li R BIC: B BIC: B State	e matrix of sults sults red: c-squared: cistic: (F-statistic) kelihood:	the errors	is correc 0.00 -0.00 0.548 0.64 27135419 -5399
warnings: [1] Standar specified. ======= Dep. Variab Model: Method: Date: Time: No. Observa Df Residual Df Model: Covariance ========	rd Errors associations: Actions: Type: coef	sume that the OLS Regr OL Least Square ed, 13 May 202 07:42:3 102 nonrobus std err	covariance ression Res y R-squa S Adj. R S F-stat O Prob (D Log-Li D AIC: S BIC: S St	e matrix of sults ured: c-squared: cistic: [F-statistic] kelihood:	the errors): [0.025	is correction of the correctio
Warnings: [1] Standar specified.	ole: Wations: Is: Type: coef	oume that the OLS Regreed, 13 May 202 07:42:3 102 nonrobus std err	covariance ression Res y R-squa S Adj. R res F-stat O Prob (R S BIC: S BIC: S T STATE CONTROL OF THE PROPERTY	e matrix of sults ured: c-squared: cistic: (F-statistic) kelihood:	the errors : [0.025 -0.002	0.00 -0.00 0.548 0.64 2713. -5419 -5399

	coef	std err	t	P> t	[0.025	0.975]
const	-0.0005	0.001	-0.879	0.379	-0.002	0.001
Mkt-RF	-0.0001	0.001	-0.186	0.852	-0.001	0.001
SMB	0.0005	0.001	0.405	0.686	-0.002	0.003
HML	-0.0012	0.001	-1.212	0.226	-0.003	0.001
Omnibus:		1.	.115 Durb	======== in-Watson:		0.174
Prob(Omnib	us):	0.	.573 Jarq	ue-Bera (JB)	:	1.176
Skew:		0.	.076 Prob	(JB):		0.556
Kurtosis:		2.	.934 Cond	. No.		2.09

Warnings:

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

Regress		

Dep. Variable:	У	R-squared:	0.004
Model:	01.5	Adi. R-squared:	-0.000

Method: Date:		Least Squa Wed, 13 May 20		tistic: (F-statistic)	:	0.9216 0.466
Time:		07:42	:39 Log-L	ikelihood:		2714.8
No. Observat	ions:	10	029 AIC:			-5418.
Df Residuals	S:	10	023 BIC:			-5388.
Df Model:			5			
Covariance T						
========		std err	t	P> t	[0.025	0.975]
const	-0.0005	0.001		0.359		0.001
Mkt-RF	0.0001	0.001	0.211	0.833	-0.001	0.002
SMB	0.0007	0.001	0.645	0.519	-0.001	0.003
HML	-0.0018	0.001	-1.507	0.132	-0.004	0.001
RMW	0.0024	0.002	1.519	0.129	-0.001	0.006
CMA	0.0016	0.002	0.777	0.438	-0.002	0.006
======= Omnibus:		 !.!	======= 524 Durbir	======== 1-Watson:	=======	0.179
Prob(Omnibus	s):	0.4	467 Jarque	e-Bera (JB):		1.599
skew:		0.0	083 Prob(JB):		0.449
Kurtosis:		2.9	903 Cond.	No.		4.08

UK

```
# UK CAPM

length =np.min([uk.shape[0],CAPM.shape[0]])
x=sm.add_constant(CAPM[-length:])
lm=sm.oLS(uk[-length:],x.astype(float)).fit()
print(lm.summary())

# UK F3
length =np.min([uk.shape[0],F3.shape[0]])
x=sm.add_constant(F3[-length:])
lm=sm.oLS(uk[-length:],x.astype(float)).fit()
print(lm.summary())

# UK F5
length =np.min([uk.shape[0],F5.shape[0]])
x=sm.add_constant(F5[-length:])
lm=sm.oLS(uk[-length:],x.astype(float)).fit()
print(lm.summary())
```

```
OLS Regression Results
                                                                       0.000
Dep. Variable:
                                     R-squared:
                                                                       0.000
Model:
                                 OLS Adj. R-squared:
Method:
                      Least Squares F-statistic:
                                                                       1.040
Date:
                    Wed, 13 May 2020 Prob (F-statistic):
                                                                       0.308
Time:
                            07:49:00
                                     Log-Likelihood:
                                                                      18782.
```

		8610 8608				-3.756e+04 -3.755e+04
Df Model:			1			
Covariance Ty	pe:	nonrobust	t			
========	coef	std err	======= t	P> t	 [0.025	0.975]
 const	0 0063	0.000	21 541	0 000	0 006	0.007
Mkt-RF	0.0003	0.000	1.020	0.308	-0.000	0.001
======= Omnibus:	=======	919.546		======== n-Watson:	=======	0.170
Prob(Omnibus)	:	0.000) Jarque	e-Bera (JB):		2356.989
skew:		0.614	4 Prob(IB):		0.00
Kurtosis: 		5.249	9 Cond.	No.		1.11
Warnings: [1] Standard specified. =======	Errors ass	OLS Regre	covariance ession Res		he errors	is correctly
Dep. Variable	:)	y R-squa			0.000
Model:		OLS	_	R-squared:		-0.000
Method:		Least Squares				0.3595
Date:	We	ed, 13 May 2020			:	0.782
Time:			_	kelihood:		18782.
No. Observati		8610				-3.756e+04
Df Residuals:		8606				-3.753e+04
Df Model:			3			
Covariance Ty =======	•	nonrobus 	_		=======	
	coef	std err	t 	P> t	[0.025 	0.975]
		0.000				
Mkt-RF	0.0003	0.000	0.983	0.326	-0.000	0.001
MKC-KF	6410 OF	0.001				0.001
	.641e-05		0 105	0 846		
SMB -2 HML	-0.0001	0.001				
SMB -2 HML	-0.0001	0.001 ==================================				
SMB -2 HML =========== Omnibus: Prob(Omnibus)	-0.0001 	919.17	Durbir Jarque		======	0.170
SMB -2 HML ======= Omnibus:	-0.0001 	919.17	====== 1 Durbir		======	0.170
SMB -2 HML =======	-0.0001					
SMB -2 HML ======== Omnibus: Prob(Omnibus) Skew: Kurtosis: =========	-0.0001	919.177 0.000 0.614	Durbir Durbir Prob(3 Cond.	n-Watson: e-Bera (JB): B): No.	=======	0.170 2355.085 0.00 2.05
SMB -2 HML ===================================	-0.0001 :: :	919.17: 0.000 0.614 5.248 	Durbir Durbir Prob(3 Cond.	n-Watson: e-Bera (JB): No. e-matrix of t	=======	0.170 2355.085 0.00 2.05
SMB -2 HML ===================================	-0.0001 :: Errors ass	919.173 0.000 0.614 5.248 	Durbir Jarque Prob() Cond. Covariance	n-Watson: P-Bera (JB): No. P-Bera (JB):	======= he errors	0.170 2355.085 0.00 2.05
SMB -2 HML ===================================	-0.0001 :: Errors ass	919.173 0.000 0.614 5.248 	Durbin Darque Prob() Covariance ession Res	an-watson: a-Bera (JB): NO. amatrix of the sults ared: R-squared:	======= he errors	0.170 2355.085 0.00 2.05 is correctly 0.000 -0.000
SMB -2 HML ===================================	-0.0001 :: :: Errors ass	919.173 0.000 0.614 5.248 sume that the of	Durbin Darque Prob() Covariance ession Res Res Res Adj. F	m-Watson: P-Bera (JB): No. P-Bera (JB):	====== he errors	0.170 2355.085 0.00 2.05 ======= is correctly -0.000 -0.000 0.6663
SMB -2 HML ===================================	-0.0001 :: :: Errors ass	919.173 0.000 0.614 5.248 sume that the of OLS Regressive Cols Least Squares	Durbin Darque Prob() Covariance ession Res R-squa Adj. F S F-stat	m-watson: P-Bera (JB): No. P-Bera (JB):	====== he errors	0.170 2355.085 0.00 2.05 is correctly 0.000 -0.000 0.6663 0.649
SMB -2 HML ===================================	-0.0001 :: Errors ass	919.173 0.000 0.614 5.248 sume that the of OLS Regres OLS Least Squares ed, 13 May 2020 07:49:00	Durbin Darque Prob() Covariance ession Res Resque Adj. F F F S F-Stat D Prob () Log-Li	m-Watson: P-Bera (JB): No. P-Bera (JB):	====== he errors	0.170 2355.085 0.00 2.05 is correctly 0.000 -0.000 0.6663 0.649 18783.
SMB -2 HML ===================================	-0.0001 :: Errors ass	919.17: 0.000 0.614 5.248 5.248 6 OLS Regree OLS Regree OLS August Squares 20, 13 May 2020 07:49:00 8610	Durbin Darque Prob(2 Covariance ession Res Res Adj. F F F S F-stat D Prob (2 COVARIANCE COVARIANCE AND	m-watson: P-Bera (JB): No. P-Bera (JB):	====== he errors	0.170 2355.085 0.00 2.05 is correctly 0.000 -0.000 0.6663 0.649 187833.755e+04
SMB -2 HML ===================================	-0.0001 :: Errors ass	919.173 0.000 0.614 5.248 sume that the of OLS Regres OLS Least Squares ed, 13 May 2020 07:49:00	Durbin Darque Prob(2 Covariance ession Res Res Adj. F F F S F-stat D Prob (2 COVARIANCE COVARIANCE AND	m-watson: P-Bera (JB): No. P-Bera (JB):	====== he errors	0.170 2355.085 0.00 2.05 is correctly 0.000 -0.000 0.6663 0.649 18783.
SMB -2 HML ===================================	-0.0001 :: Errors ass :: We	919.17: 0.000 0.614 5.248 5.248 60.000 0.614 5.248 60.000 0.614 60.000 0.614 60.000 0.614 60.000 0.614 60.000 0.614 60.000 0.614 60.000 0.614 60.000 0.614 60.000 0.614 60.000 0.614 60.000 0.616 60.0000 60.00000 60.0000 60.0000 60.00000 60.0000 60.00000 60.00000 60.0000 60.00000 60.00000 60.0000	Durbin Darque Prob() Covariance ession Res Res Res Res Covariance Adj. F S F-stat D Prob () Log-Li D AIC: BIC:	m-watson: P-Bera (JB): No. P-Bera (JB):	====== he errors	0.170 2355.085 0.00 2.05 is correctly 0.000 -0.000 0.6663 0.649 187833.755e+04

	coef	std err	 t	P> t	======= [0.025	0.975]
const	0.0063	0.000	21.510	0.000	0.006	0.007
Mkt-RF	0.0002	0.000	0.658	0.511	-0.000	0.001
SMB	9.454e-05	0.001	0.175	0.861	-0.001	0.001
HML	0.0003	0.001	0.543	0.587	-0.001	0.002
RMW	0.0005	0.001	0.679	0.497	-0.001	0.002
CMA	-0.0013	0.001	-1.402	0.161	-0.003	0.001
omnibus:	========	015	720 Dunhin		=======	0.171
		915.7				
Prob(Omnib	us):			-Bera (JB):		2339.835
Skew:			513 Prob(J			0.00
Kurtosis:		5.2	240 Cond.	No.		3.84

Question 4

```
eu = np.array(q4(rt_eu.values,st_eu))
jp = np.array(q4(rt_jp.values,st_jp))
sz = np.array(q4(rt_sz.values,st_sz))
uk = np.array(q4(rt_uk.values,st_uk))
```

```
print(f"df: {len(eu)}")
print(f"t-stats_eu: {eu.mean()/eu.std()*np.sqrt(eu.shape[0])}")
print(f"df: {len(jp)}")
print(f"t-stats_jp: {jp.mean()/jp.std()*np.sqrt(jp.shape[0])}")
print(f"df: {len(sz)}")
print(f"t-stats_sz: {sz.mean()/sz.std()*np.sqrt(sz.shape[0])}")
print(f"df: {len(uk)}")
print(f"t-stats_uk: {uk.mean()/uk.std()*np.sqrt(uk.shape[0])}")
print("all excess return are significant!")
```

```
df: 5273
t-stats_eu: 19.33244918864757
df: 8665
t-stats_jp: 23.95469734654302
df: 1029
t-stats_sz: 6.302818243479613
df: 8665
t-stats_uk: 21.869808734119164
all excess return are significant!
```

use the same data for CAPM, F3, F5

EU

```
# EU CAPM
#eu = pd.DataFrame(eu,columns=["EU"])
length =np.min([eu.shape[0],CAPM.shape[0]])
x=sm.add_constant(CAPM[-length:])
lm=sm.OLS(eu[-length:],x.astype(float)).fit()
print(lm.summary())
# EU F3
length =np.min([eu.shape[0],F3.shape[0]])
x=sm.add_constant(F3[-length:])
lm=sm.OLS(eu[-length:],x.astype(float)).fit()
print(lm.summary())
# EU F5
length =np.min([eu.shape[0],F5.shape[0]])
x=sm.add_constant(F5[-length:])
lm=sm.OLS(eu[-length:],x.astype(float)).fit()
print(lm.summary())
```

```
OLS Regression Results
                                   y R-squared:
Dep. Variable:
                                                                       0.000
                                 OLS Adj. R-squared:
Model:
                                                                       0.000
                      Least Squares F-statistic:
Method:
                                                                       1.082
Date:
                    Wed, 13 May 2020 Prob (F-statistic):
                                                                       0.298
                            07:47:40
                                     Log-Likelihood:
Time:
                                                                      11528.
No. Observations:
                                5273
                                      AIC:
                                                                  -2.305e+04
Df Residuals:
                                       BIC:
                                                                  -2.304e+04
                                5271
Df Model:
                                   1
Covariance Type:
                           nonrobust
```

	coef	std err		t	P> t	[0.025	0.975
const	0.0072	0.000	19.30)4	0.000	0.006	0.00
Mkt-RF	0.0003		1.04		0.298		0.00
======= Omnibus:		======================================			======= Watson:		0.16
Prob(Omnibus):		0.0	00 ја	rque-	Bera (JB):		516.25
Skew:		-0.1	.99 Pr	ob(JB):		7.90e-11
Kurtosis:				ond. N			1.20
Warnings: [1] Standard E specified.	rrors as					the errors	is correc
		OLS Reg		1 Resu =====	TS =======		=======
Dep. Variable:			y R-				0.00
Model:				-	squared:		-0.00
Method:		Least Squar					0.704
Date:	W	ed, 13 May 20				:	0.54
Time:		07:47:		_	elihood:		11528
No. Observatio	ns:			C:			-2.305e+0
Df Residuals:		52		C:			-2.302e+0
Df Model:			3				
Covariance Type		nonrobu ======					
		std err			P> t		
const	0.0072	0.000	19.31	L5	0.000	0.007	0.00
Mkt-RF	0.0004	0.000	1.12	26	0.260	-0.000	0.00
SMB -	-0.0006	0.001	-0.97	1	0.332	-0.002	0.00
HML 8.3					0.887		0.00
omnibus:		 205.7			watson:		0.16
Prob(Omnibus):		0.0	000 ја	rque-	Bera (JB):		510.40
Skew:		-0.1	.97 Pr	ob(JB):		1.47e-11
Kurtosis:		4.4	.72 Co	ond. N	0.		2.0
Warnings: [1] Standard E specified.	rrors as	sume that the OLS Reg				the errors	is correc
	======	========	======				
			-	squar			0.00
•			LS Ad	lj. R-	squared:		0.00
Model:							
Model: Method:		Least Squar	es F-				
Model: Method: Date:	W	Least Squar ed, 13 May 20	es F- 20 Pr	ob (F	-statistic)	:	0.18
Model: Method: Date: Time:		Least Squar ed, 13 May 20 07:47:	es F- 20 Pr 40 Lo	ob (F g-Lik		:	0.18 11531
Model: Method: Date: Time: No. Observation		Least Squar ed, 13 May 20 07:47: 52	res F- 20 Pr 40 Lo 273 AI	ob (F g-Lik IC:	-statistic)	:	0.18 11531 -2.305e+0
Model: Method: Date: Time: No. Observation Df Residuals:		Least Squar ed, 13 May 20 07:47: 52	es F- 20 Pr 40 Lo 273 AI	ob (F g-Lik	-statistic)	:	0.18 11531 -2.305e+0
Dep. Variable: Model: Method: Date: Time: No. Observation Df Residuals: Df Model:	ns:	Least Squar ed, 13 May 20 07:47: 52	res F- 220 Pr 40 Lo 273 AI 667 BI	ob (F g-Lik IC:	-statistic)	:	1.50 0.18 11531 -2.305e+0 -2.301e+0
Model: Method: Date: Time: No. Observation Df Residuals:	ns:	Least Squar ed, 13 May 20 07:47: 52	res F- 220 Pr 40 Lo 273 AI 667 BI	ob (F g-Lik IC:	-statistic)	:	0.18 11531 -2.305e+0

const 0.0072 0.000 19.322 0.000 0.007 0.008

```
0.001
Mkt-RF
          0.0003
                     0.000
                              0.927
                                       0.354
                                               -0.000
                             -1.637
SMB
           -0.0011
                     0.001
                                       0.102
                                               -0.002
                                                          0.000
           -0.0003
                     0.001
                             -0.399
                                       0.690
                                               -0.002
                                                          0.001
HML
RMW
           -0.0014
                     0.001
                             -1.675
                                       0.094
                                               -0.003
                                                          0.000
           0.0019
                     0.001
                              1.801
                                       0.072
                                               -0.000
                                                          0.004
CMA
_____
Omnibus:
                        203.612
                               Durbin-Watson:
                                                          0.171
Prob(Omnibus):
                         0.000
                               Jarque-Bera (JB):
                                                        500.740
skew:
                        -0.197
                               Prob(JB):
                                                      1.84e-109
Kurtosis:
                         4.457
                               Cond. No.
                                                           3.83
______
Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly
specified.
```

```
/Users/yifuhe/opt/anaconda3/lib/python3.7/site-packages/numpy/core/fromnumeric.py:2542:
FutureWarning: Method .ptp is deprecated and will be removed in a future version. Use numpy.ptp instead.
return ptp(axis=axis, out=out, **kwargs)
```

jp

```
# jp CAPM

length =np.min([jp.shape[0],CAPM.shape[0]])
x=sm.add_constant(CAPM[-length:])
lm=sm.OLS(jp[-length:],x.astype(float)).fit()
print(lm.summary())

# jp F3
length =np.min([jp.shape[0],F3.shape[0]])
x=sm.add_constant(F3[-length:])
lm=sm.OLS(jp[-length:],x.astype(float)).fit()
print(lm.summary())

# jp F5
length =np.min([jp.shape[0],F5.shape[0]])
x=sm.add_constant(F5[-length:])
lm=sm.OLS(jp[-length:],x.astype(float)).fit()
print(lm.summary())
```

```
OLS Regression Results
Dep. Variable:
                                                                            0.000
                                     У
                                          R-squared:
Model:
                                          Adj. R-squared:
                                                                           -0.000
                                   OLS
                                          F-statistic:
                                                                           0.5975
Method:
                         Least Squares
Date:
                      Wed, 13 May 2020
                                          Prob (F-statistic):
                                                                            0.440
                              07:48:07
                                          Log-Likelihood:
Time:
                                                                           17923.
                                          AIC:
No. Observations:
                                   8610
                                                                       -3.584e+04
Df Residuals:
                                   8608
                                          BIC:
                                                                       -3.583e+04
Df Model:
                                     1
Covariance Type:
                             nonrobust
                                                               [0.025
                                                                           0.975]
                  coef
                          std err
                                                   P>|t|
```

	0.0076	0.000	23.316	0.000	0.007	0.008
Mkt-RF ========	0.0002	0.000	0.773	0.440	-0.000 =====	0.001
Omnibus:		179.52	3 Durbi	n-Watson:		0.176
<pre>Prob(Omnibus):</pre>		0.00	0 Jarqu	e-Bera (JB):		323.890
Skew:		0.15	9 Prob(JB):		4.66e-71
Kurtosis:		3.89	6 Cond.	No.		1.11
warnings: [1] Standard Er specified.	rors ass		covariance		he errors	is correct
Dep. Variable:			y R-squ	======== ared:		0.000
Model:		OL		R-squared:		-0.000
Method:		Least Square	_			0.9302
Date:	We			(F-statistic)	:	0.425
Time:		07:48:0	7 Log-L	ikelihood:		17924.
No. Observation	ıs:	861	_			-3.584e+04
Df Residuals:		860	6 BIC:			-3.581e+04
Df Model:			3			
Covariance Type		nonrobus				
	coef	std err	t	P> t	[0.025	0.975]
const	0.0076	0.000	23.290	0.000	0.007	0.008
Mkt-RF	0.0003	0.000	0.909	0.363	-0.000	0.001
SMB -	-0.0001	0.001	-0.224	0.823	-0.001	0.001
HML	0.0008	0.001	1.425	0.154	-0.000	0.002
Omnibus:		 181.12				0.176
<pre>Prob(Omnibus):</pre>		0.00	0 Jarqu	e-Bera (JB):		328.733
Skew:		0.15	8 Prob(JB):		4.13e-72
Kurtosis:		3.90	3 Cond.	No.		2.05
Warnings: [1] Standard Er		ume that the		e matrix of t		
Dep. Variable:			y R-squ	======== ared:	======	0.000
Model:		OL		R-squared:		-0.000
Method:		Least Square	_			0.8289
Date:	We			(F-statistic)	:	0.529
Time:		07:48:0	7 Log-L	ikelihood:		17925.
No. Observation	ns:	861	.0 AIC:			-3.584e+04
Df Residuals:		860	4 BIC:			-3.580e+04
Df Model:			5			
Covariance Type		nonrobus				
		std err	t	P> t	[0.025	0.975]
const	0.0076		23.168	0.000	0.007	

Mkt-RF

SMB

0.0004

0.0002

0.000

0.001

1.320

0.343

0.187

0.732

-0.000

-0.001

0.001

0.001

Omnibus:	181.318	Durbin	-Watson:	0.176
Prob(Omnibus):	0.000	Jarque	-Bera (JB):	328.919
Skew:	0.159	Prob(J	B):	3.77e-72
Kurtosis:	3.903	Cond. I	No.	3.84

SZ

```
# sz CAPM

length =np.min([sz.shape[0],CAPM.shape[0]])
x=sm.add_constant(CAPM[-length:])
lm=sm.OLS(sz[-length:],x.astype(float)).fit()
print(lm.summary())

# SZ F3
length =np.min([sz.shape[0],F3.shape[0]])
x=sm.add_constant(F3[-length:])
lm=sm.OLS(sz[-length:],x.astype(float)).fit()
print(lm.summary())

# SZ F5
length =np.min([sz.shape[0],F5.shape[0]])
x=sm.add_constant(F5[-length:])
lm=sm.OLS(sz[-length:],x.astype(float)).fit()
print(lm.summary())
```

		OLS Reg	ress	sion Re	sults		
Dep. Variable:			у	R-squ	ared:		0.001
Model:		0	LS	Adj.	R-squared:		-0.000
Method:	L	east Squar	es	F-statistic:			0.5636
Date:	wed,	13 May 20	20	Prob	(F-statistic):		0.453
Time:		07:48:	43	Log-L	ikelihood:		2587.8
No. Observations:		10	29	AIC:			-5172.
Df Residuals:		10	27	BIC:			-5162.
<pre>Df Model:</pre>			1				
Covariance Type:							
		std err		t	P> t		0.975]
const 0.00	 38				0.000	0.003	0.005
Mkt-RF 0.00	05	0.001	C	751	0.453	-0.001	0.002
Omnibus:	=====	1.4	==== 52	 Durbi	n-Watson:		0.211
<pre>Prob(Omnibus):</pre>		0.4	84	Jarqu	e-Bera (JB):		1.343
Skew:		-0.0	83	Prob(JB):		0.511

Kurtosis:		3.06	62 Cond.	No.		1.20
Warnings:						
[1] Standard E	Errors ass	ume that the	covariance	e matrix of	the errors	is correct
specified.		01.5.8		7		
		_	ession Res			
Dep. Variable:			y R-squa			0.001
Model:		OL	.S Adj. I	R-squared:		-0.002
Method:		Least Square	s F-sta	tistic:		0.3822
Date:	We	d, 13 May 202	0 Prob	(F-statistic):	0.766
Time:		07:48:4	3 Log-L	ikelihood:		2588.1
No. Observatio	ons:	102				-5168
Df Residuals:		102				-5148
Df Model:			3			
Covariance Typ ======	oe: 	nonrobus 	it :======			
	coef	std err	t	P> t	[0.025	0.975
const	0.0038	0.001	6.259	0.000	0.003	0.00
Mkt-RF	0.0005	0.001	0.660	0.510	-0.001	0.002
SMB	0.0008	0.001	0.622	0.534	-0.002	0.003
HML	0.0005	0.001	0.451	0.652	-0.002	0.003
======= Omnibus:		1.48		======= 1-Watson:	========	 0.212
Ommibus. Prob(Omnibus):		0.47		e-Bera (JB):		1.372
skew:	•					
				IR) •		0 507
(urtosis:		3.06	34 Prob(3 33 Cond.			0.504 2.09
Kurtosis: ======== warnings: [1] Standard E	Errors ass	3.06	3 Cond.	No.	the errors	2.09
Kurtosis: ===================================		3.06 ume that the OLS Regr	covariance	No. matrix of sults		2.09
Kurtosis: ======== warnings: [1] Standard E		3.06 ume that the OLS Regr	covariance	No. matrix of sults		2.09
Kurtosis: Warnings: [1] Standard E specified. Dep. Variable:		3.06 ume that the OLS Regr	covariance ression Reserved y R-square	No. matrix of sults		2.09
Kurtosis: ==================================	 :	3.06 ume that the OLS Regr	covariance ression Res y R-squa	No. matrix of sults ared: R-squared:		2.09 is correct 0.002
Kurtosis: Warnings: [1] Standard Especified. Dep. Variable: Model: Method:	 :	3.06 ume that the OLS Regr	covariance ression Res y R-squa s Adj. I	No. matrix of sults ared: R-squared: tistic:		2.09 is correct 0.002 -0.003
Kurtosis:	 :	3.06 ume that the OLS Regr OL Least Square d, 13 May 202	covariance ression Res y R-squa s Adj. I	No. matrix of sults ared: R-squared: tistic: (F-statistic		2.09 is correct 0.002 -0.003 0.4379 0.822
Warnings: [1] Standard Especified. Dep. Variable: Model: Method: Date: Time: No. Observation	 : We	3.06 ume that the OLS Regr OL Least Square d, 13 May 202 07:48:4 102	covariance ression Res y R-squa s Adj. I	No. matrix of sults ared: R-squared: tistic: (F-statistic		2.09 is correct 0.002 -0.003 0.4379 0.822 2588.6 -5165
Warnings: [1] Standard Especified. ===================================	 : We	3.06 ====================================	covariance ression Res y R-squa S Adj. I S F-star O Prob J Log-L S BIC:	No. matrix of sults ared: R-squared: tistic: (F-statistic		2.09 is correct 0.002 -0.003 0.4379 0.822 2588.6 -5165
Warnings: [1] Standard Especified. ===================================	 : We ons:	3.06 ume that the OLS Regr OL Least Square d, 13 May 202 07:48:4 102	covariance ression Res y R-squa S Adj. I S F-sta O Prob J Log-L S BIC:	No. matrix of sults ared: R-squared: tistic: (F-statistic		2.09 is correct 0.002 -0.003 0.4379 0.822 2588.6 -5165
Warnings: [1] Standard E specified. ===================================	 : We ons:	3.06 ume that the OLS Regr OL Least Square d, 13 May 202 07:48:4 102	covariance ression Res y R-squa S Adj. I S F-sta O Prob J Log-L S BIC:	No. matrix of sults ared: R-squared: tistic: (F-statistic		2.09 is correct 0.002 -0.003 0.4375
Warnings: [1] Standard Especified. Ender Variable: Model: Method: Date: Time: No. Observation Of Residuals: Dof Model:	we ons:	3.06 ume that the OLS Regr OL Least Square d, 13 May 202 07:48:4 102	covariance ression Res y R-squa S Adj. It s F-star O Prob A Log-L B BIC:	No. matrix of sults ared: R-squared: tistic: (F-statistic ikelihood:	·································	2.09 is correct 0.002 -0.003 0.4379 0.822 2588.6 -5165 -5136
Warnings: [1] Standard Especified. ===================================	we ons: coef	3.06 ====================================	covariance ression Res y R-squa s Adj. I s F-sta 0 Prob 3 Log-L 3 BIC: 5	No. matrix of sults ared: R-squared: tistic: (F-statistic ikelihood:]: 0.025	2.09
Warnings: [1] Standard Especified. ===================================	we ons: coef 0.0038	3.06 ====================================	covariance ression Res y R-squa S Adj. I S F-sta O Prob A Log-L B BIC: B BIC: C C C C C C C C C C C C C C C C C C C	No. matrix of sults ared: R-squared: tistic: (F-statistic ikelihood:	[0.025 	2.09 is correct 0.002 -0.003 0.4373 0.822 2588.0 -5165 -5136
Warnings: [1] Standard Especified. ===================================	we ons: coef 0.0038 0.0003	3.06 ====================================	covariance ression Res y R-squa S Adj. I S F-star O Prob S Log-L S BIC: S t C C C C C C C C C C C C C C C C C C C	No. matrix of sults ared: R-squared: tistic: (F-statistic ikelihood: P> t 0.000 0.748	[0.025 0.003 -0.001	2.09 is correct 0.00 -0.00 0.437 0.82 2588.0 -5165 -5136
Kurtosis: ==================================	we ons: coef 0.0038 0.0003 0.0008	3.06 ====================================	covariance ression Res y R-squa S Adj. I S F-sta O Prob S Log-L S BIC: S t t 6.275 0.321 0.671	No. e matrix of sults ared: R-squared: tistic: (F-statistic ikelihood: P> t 0.000 0.748 0.503	[0.025 0.001 -0.002	2.09 is correct 0.002 -0.003 0.4379 0.822 2588.6 -5165 -5136 0.9753 0.002 0.003
Warnings: [1] Standard Especified. ===================================	we ons: coef 0.0038 0.0003 0.0008 0.0009	3.06 ====================================	covariance ression Res y R-squa s Adj. II s F-sta 0 Prob 3 Log-L 29 AIC: 3 BIC: 5 t 6.275 0.321 0.671 0.681	No. matrix of sults ared: R-squared: tistic: (F-statistic) ikelihood: P> t 0.000 0.748 0.503 0.496	[0.025 0.003 -0.001 -0.002 -0.002	2.09 is correct 0.002 -0.003 0.4379 0.822 2588.6 -51365 -51365 -0.002 0.003 0.003 0.004
Warnings: [1] Standard Especified. Dep. Variable: Method: Date: Time: No. Observation Of Residuals: Of Model: Covariance Type Const Mkt-RF SMB HML RRMW	we ons: coef 0.0038 0.0003 0.0008 0.0009 -0.0012	3.06 ====================================	covariance ression Res y R-squa S Adj. It S F-star O Prob B Log-L B BIC: B BIC: C C C C C C C C C C C C C C C C C C C	No. matrix of matrix of sults ared: R-squared: tistic: (F-statistic) ikelihood: P> t 0.000 0.748 0.503 0.496 0.521	[0.025 	2.09 is correct 0.002 -0.003 0.4379 0.822 2588.6 -5165 -5136. 0.975] 0.009 0.002 0.002 0.002 0.002
Warnings: [1] Standard Especified. Dep. Variable: Method: Date: Time: No. Observation Of Residuals: Covariance Type Const Mkt-RF SMB HML RMW CMA	we cons: coef 0.0038 0.0003 0.0008 0.0009 -0.0012 -0.0016	3.06 ====================================	covariance ression Res y R-squa s Adj. II s F-sta 0 Prob 3 Log-L 29 AIC: 3 BIC: 5 t 6.275 0.321 0.671 0.681 -0.642 -0.692	No. matrix of sults ared: R-squared: tistic: (F-statistic) ikelihood: P> t 0.000 0.748 0.503 0.496 0.521 0.489	[0.025 -0.003 -0.001 -0.002 -0.002 -0.005 -0.006	2.09 is correct 0.002 -0.003 0.437 0.822 2588.0 -5165 -5136 0.975 0.002 0.003 0.003 0.003 0.003
Warnings: [1] Standard Especified. ===================================	we ons: coef 0.0038 0.0003 0.0008 0.0009 -0.0012 -0.0016	3.06 ====================================	covariance ression Res y R-sque S Adj. I S F-sta O Prob S Log-L S BIC: 5 t 6.275 0.321 0.671 0.681 -0.642 -0.692	No. matrix of sults ared: R-squared: tistic: (F-statistic) ikelihood: P> t 0.000 0.748 0.503 0.496 0.521 0.489	[0.025 	2.09 is correct 0.002 -0.003 0.437 0.822 2588.6 -5165 -5136 0.975 0.003 0.003 0.003 0.003 0.003 0.003

-0.087

skew:

Prob(JB):

0.487

UK

```
# UK CAPM

length =np.min([uk.shape[0],CAPM.shape[0]])
x=sm.add_constant(CAPM[-length:])
lm=sm.OLS(uk[-length:],x.astype(float)).fit()
print(lm.summary())

# UK F3
length =np.min([uk.shape[0],F3.shape[0]])
x=sm.add_constant(F3[-length:])
lm=sm.OLS(uk[-length:],x.astype(float)).fit()
print(lm.summary())

# UK F5
length =np.min([uk.shape[0],F5.shape[0]])
x=sm.add_constant(F5[-length:])
lm=sm.OLS(uk[-length:],x.astype(float)).fit()
print(lm.summary())
```

Dep. Variable:			y R-	squared:		0.000
Model:		C	LS Ad	j. R-squared:		0.000
Method:		Least Squar	es F-	statistic:		1.040
Date:	We	d, 13 May 20	20 Pr	ob (F-statist	ic):	0.308
Time:		07:49:	22 Lo	g-Likelihood:		18782.
No. Observatio	ns:	86	510 AI	C:		-3.756e+04
Df Residuals:		86	08 BI	C:		-3.755e+04
Df Model:			1			
Covariance Typ	e:	nonrobu	ıst			
				t P> t	-	-
 const	0.0063			1 0.000		
Mkt-RF				0.308		
======= mnibus:	=======			======== rbin-Watson:	========	 0.170
Prob(Omnibus):		0.0	000 Ja	rque-Bera (JB)):	2356.989
Skew:		0.6	514 Pr	ob(JB):		0.00
<pre><urtosis:< pre=""></urtosis:<></pre>		5.2	49 Co	nd. No.		1.11

- ' ' 17	=======	========						
Dep. Variable	e:		У		uared:		0.000	
Model:			OLS	_	R-squared:		-0.000	
Method:		Least Squ	ares	F-sta	atistic:		0.3595	
Date:		Wed, 13 May	2020	Prob	(F-statistic):		0.782	
Time: No. Observations:		07:49:22 8610		Log-I	_ikelihood:		18782. -3.756e+04	
				AIC:				
Df Residuals	:		8606	BIC:			-3.753e+04	
Df Model:			3					
Covariance Ty	/pe:	nonro	_					
==========	, pc. =======		======					
	coef	std err		t	P> t	[0.025	0.975]	
const	0.0063	3 0.000	21	.539	0.000	0.006	0.007	
Mkt-RF	0.0003	0.000	0	.983	0.326	-0.000	0.001	
SMB -2	2.641e-05	0.001	-0	.052	0.958	-0.001	0.001	
HML	-0.0001	0.001	-0	.195	0.846	-0.001	0.001	
Omnibus:		 919	.171	Durb	======== in-Watson:		0.170	
Prob(Omnibus)):	0	.000	Jarqı	ue-Bera (JB):		2355.085	
Skew:		0	.614	Prob	(JB):		0.00	
Kurtosis:		5	.248	Cond	. No.		2.05	

Warnings:

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

OLS Regression Results

Dep. Varia	able:		у Г	R-squa	ared:		0.000	
Model:			OLS A	Adj. F	R-squared:		-0.000	
Method:		Least Squa	res I	F-sta1	istic:		0.6663	
Date: Time: No. Observations:		ved, 13 May 2	020 I	<pre>Prob (F-statistic):</pre>			0.64	
		07:49	:22 I	Log-Li		18783		
		8610		AIC:			-3.755e+04	
Df Residua	als:	8	604 г	BIC:			-3.751e+04	
<pre>Df Model:</pre>			5					
Covariance	e Type:	nonrob	ust					
	coef	std err		t	P> t	[0.025	0.975]	
const	0.0063	0.000	21.	510	0.000	0.006	0.007	
Mkt-RF	0.0002	0.000	0.0	658	0.511	-0.000	0.001	
SMB	9.454e-05	0.001	0.3	175	0.861	-0.001	0.001	
HML	0.0003	0.001	0.!	543	0.587	-0.001	0.002	
RMW	0.0005	0.001	0.0	679	0.497	-0.001	0.002	
CMA	-0.0013	0.001	-1.4	402	0.161	-0.003	0.001	
Omnibus:		915.	===== 730 լ	 Durbir	 1-Watson:		0.171	
Prob(Omnil	bus):	0.	000	Jarque	e-Bera (JB):		2339.835	
skew:		0.	613 i	Prob(JB):		0.00	
Kurtosis:		5.	240 (cond.	No.		3.84	

Warnings:

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