Assignment 3

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Import Modules

In [1]:

```
import pandas            as pd
import numpy             as np
import scipy             as scp
import matplotlib.pyplot as plt
import os                as os

from datetime import date as dd  # for dates

from scipy import optimize
from scipy import stats
import statsmodels.api as sm
```

Part 1

In [2]:

```
merger_data = pd.ExcelFile('Merger data.xls')
sheet_names = merger_data.sheet_names
firm_names = sheet_names[1:len(sheet_names)]
car_all_firm = pd.DataFrame(data=range(-25,26),columns=['Event time']) #store abnorm
```

In [3]:

```
#calculate car
# %%

for i in range(0,len(firm_names)):
    firm_data_i = merger_data.parse(firm_names[i])   # parse
    Event_time = firm_data_i.columns[3]              #'Event time'
    firm_data_i['r'] = firm_data_i.Price.pct_change()                # Obtain retur
    firm_data_i['rm'] = firm_data_i.SP500.pct_change()               # Obtain marke
    pre_event_interval = (firm_data_i[Event_time] <= -26) & (firm_data_i[Event_time]
    pre_event_regression_data = firm_data_i.loc[pre_event_interval,['r','rm']]

    # estimate alpha and beta
    mod = sm.OLS(pre_event_regression_data.r, sm.add_constant(pre_event_regression_d
    res = mod.fit()
    res.summary()
    alpha = res.params[0]
    beta = res.params[1]
    # abnormal return
    firm_data_i['abnormal_r'] = firm_data_i['r'] - alpha - beta*firm_data_i['rm']
    event_window = (firm_data_i[Event_time]<=25)&(firm_data_i[Event_time]>=-25)
    car_i = firm_data_i.loc[event_window,['abnormal_r']].cumsum()
    car_all_firm[firm_names[i]] = car_i.values

car_all_firm.head()
```

Out[3]:

	Event time	TWC	LIFE	Covidien	ForestLabs	PinnacleFoods	Hillshire_brands	Pepco
0	-25	-0.018207	0.010398	0.006880	-0.008557	-0.012511	0.002014	0.003399
1	-24	-0.014846	0.034930	0.002733	-0.021442	-0.003382	-0.000944	-0.003314
2	-23	-0.017012	0.019334	-0.001299	-0.001115	0.007723	-0.003362	0.005722
3	-22	-0.011297	0.036854	0.002184	-0.021881	0.017020	-0.002704	0.005940
4	-21	0.002944	0.028271	-0.006278	-0.036995	0.026462	-0.017832	0.012496

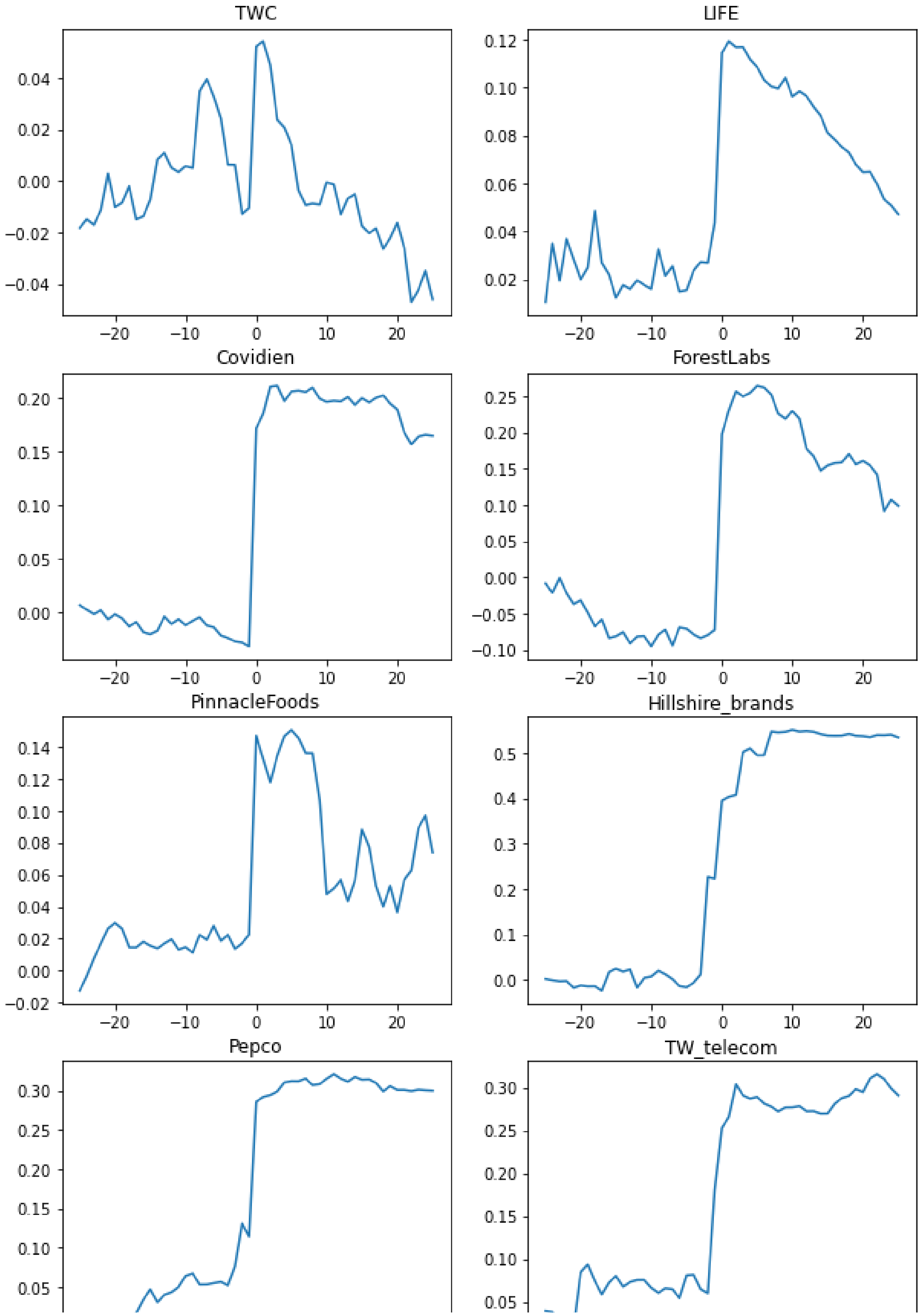
Q 1.1:

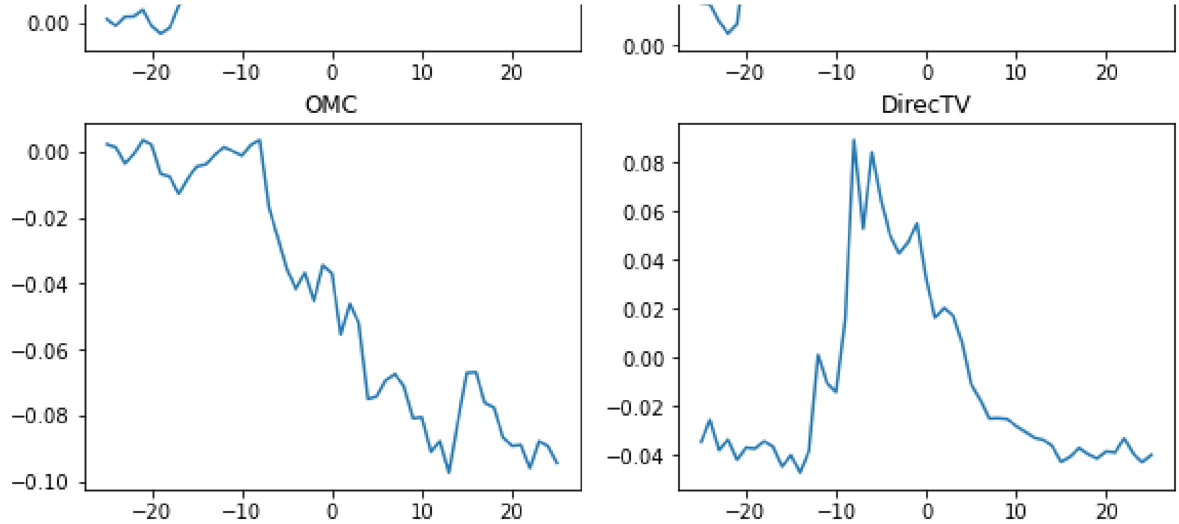
(i) Plot CARit against t for each firm, i. Compute the cross-sectional average of the cumulative abnormal return (CARt):

In [4]:

```
#plot car
fig, axs = plt.subplots(5, 2 ,figsize=(10,20))  # create customized figures
for i in range(0,len(firm_names)):
    yind = i%2                 # odd-1,even-0
    xind = int((i-yind)/2)
    axs[xind,yind].plot(car_all_firm['Event time'],car_all_firm[firm_names[i]])
    axs[xind,yind].set_title(firm_names[i])

plt.savefig('car_all_firm.png',bbox_inches='tight') #save image
```



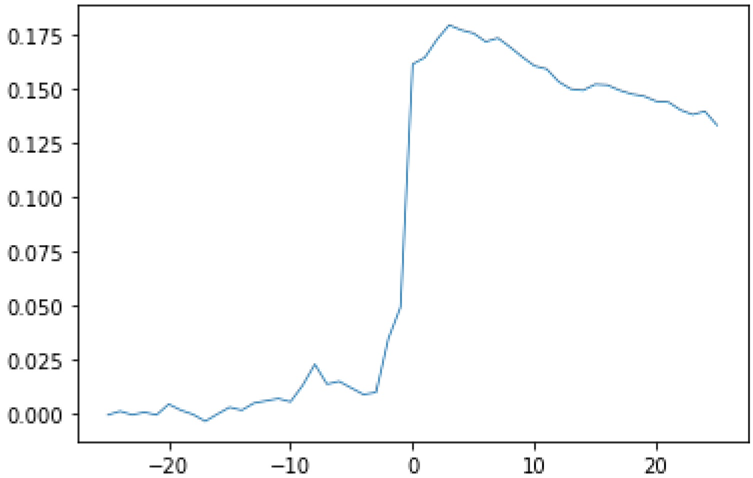


Q 1.2:

(ii) Plot CARt against t. Discuss and interpret your findings in relation to the efficient market hypothesis.

In [5]:

```
#plot average car
car_all_firm['average_car'] = car_all_firm[firm_names].mean(axis=1)
plt.plot(car_all_firm['Event time'], car_all_firm['average_car'] , linewidth = .8)
plt.show()
plt.savefig('car_average_firm.png',bbox_inches='tight') #save image
```



```
<Figure size 432x288 with 0 Axes>
```

There is a leakage of information before the announcement date because there is a sudden incresse in CAR during the event period. The strong form market efficieny hypothesis assumes all public and private information has been refleted by price at time t. If the strong form holds, there would not be any sudden increase in CAR. Hence, the strong form does not hold.

Part 2

Q2.1

(i) Did small value stocks (SMALL, HiBm, column E) earn higher mean returns than large growth stocks (Big LoBm stocks, column F) over the emerging market sample? Comment on the economic size of the differences and the statistical significance of your findings.

In [26]:

```
em_data = pd.read_excel('Emerging markets.xlsx')
df=em_data

small_Hibm_mean = 12*df.iloc[:,4].mean()

big_Lobm_mean = 12*df.iloc[:,5].mean()

print(f'Annualized average return for small value stocks is {small_Hibm_mean:.4} per

print(f'Annualized average return for large growth stocks is {big_Lobm_mean:.4} perc
premium_bm = small_Hibm_mean - big_Lobm_mean

print(f'Annualized average return for the premium is {premium_bm:.4} percent' )

t = df.shape[0]

excess_bm = em_data['SMALL HiBM']- df['BIG LoBM']   #time series
tstats_bm = excess_bm.mean()/np.std(excess_bm)*np.sqrt(t)
print(f'The tstat for the premium is {tstats_bm:.4}' )  #tstat
```

```
Annualized average return for small value stocks is 17.07 percent
Annualized average return for large growth stocks is 8.346 percent
Annualized average return for the premium is 8.726 percent
The tstat for the premium is 4.028
```

The tstat is less than -1.96 which means that the premium is significantly unequal to zero.Hence, the returns for small value stocks and large growth stocks are not equal.

Q2.2

(ii) Did high yield (column F) stocks earn higher mean returns than low yield stocks (column G) over the sample? Comment on the economic and significance of your findings.

In [28]:

```
Hiyield_mean = 12*df.iloc[:,5].mean()

Loyield_mean = 12*df.iloc[:,6].mean()

print(f'Annualized average return for HighYield is {Hiyield_mean:.4} percent' )

print(f'Annualized average return for LowYield is {Loyield_mean:.4} percent' )

premium_yield = Hiyield_mean-Loyield_mean
print(f'Annualized average return for Premium is {premium_yield:.4} percent' )

excess_yield = df['BIG LoBM']-df['BIG HiBM'] #time series
tstats_yield = excess_yield.mean()/np.std(excess_yield)*np.sqrt(t) #tstat of value
print(f'The tstat for the premium is {tstats_yield:.4}' )
```

```
Annualized average return for HighYield is 8.346 percent
Annualized average return for LowYield is 12.55 percent
Annualized average return for Premium is -4.199 percent
The tstat for the premium is -2.252
```

The tstat is less than -1.96 which means that the premium is significantly unequal to zero.Hence, the returns for HighYield stocks and LowYield stocks are not equal.

Q2.3

(iii) Can the performance of small value and big growth stocks be explained by the CAPM? To answer this, subtract the risk-free rate (column C) from the returns on small value (column E) and the returns on big growth (column F) stocks. Then regress their excess returns on the excess return on the local market (column B) and an intercept:

In [29]:

```
mod = sm.OLS(df['SMALL HiBM']-df['RF'],sm.add_constant(df['Mkt-RF']))

res = mod.fit()
res.summary()

talpha =res.tvalues[0]
beta=res.params[1]
tbeta =res.tvalues[1]

print(f'The tstat for the alpha is {talpha:.4}' )
print(f'The value of beta is {beta:.4}' )
print(f'The tstat for the beta is {tbeta:.4}' )
```

```
The tstat for the alpha is 4.322
The value of beta is 0.9357
The tstat for the beta is 40.29
```

In [30]:

```
mod = sm.OLS(df['BIG LoBM']-df['RF'],sm.add_constant(df['Mkt-RF']))

res = mod.fit()
res.summary()

talpha =res.tvalues[0]
beta =res.params[1]
tbeta =res.tvalues[1]

print(f'The tstat for the alpha is {talpha:.4}' )
print(f'The value of beta is {beta:.4}' )
print(f'The tstat for the beta is {tbeta:.4}' )
```

```
The tstat for the alpha is -1.692
The value of beta is 0.9522
The tstat for the beta is 74.23
```

The returns of small value stocks can be observed to be better than the big growth stocks. The inference ws dervied previosuly by a Annualized average return for the premium is 8.726 percent.

CAPM will to be true, the following implication are necesary: 1.The stocks with the highest mean returns should have a higher beta. 2.Alpha value should be insignificantly different from zero.

Inference: 1.The beta vlaue of small value stocks is not higher than big growth stocks as 0.9357 < 0.9522. 2.The alpha value is significantly different from 0 for small value stocks, while that for big growth stocks is not significant. 3.The tstat values for beta of both stocks are also higher than the t critical value.Hence, the result is statistically significant and the null hypothesis is rejected.

In conlusion,the CAPM model in this dataset is rejected due to the violation of the implication above.

Q2.4

(vi) the exercise in (iii), but now use the three-factor Fama-French model that includes the market excess return (column B) in addition to the SMB and HML factors from columns I and J as risk factors. Report on any important differences from the results based on the single-factor CAPM in question (iii).

In [23]:

```
mod = sm.OLS(df['SMALL HiBM']-df['RF'],sm.add_constant(df[['Mkt-RF','SMB','HML']]))

res = mod.fit()
res.summary()
res = mod.fit()
res.summary()

alpha =res.params[0]
beta =res.params[1]

talpha =res.tvalues[0]
tbeta =res.tvalues[1]

print(f'The tstat for the alpha is {talpha:.4}' )
print(f'The value of beta is {beta:.4}' )
print(f'The tstat for the beta is {tbeta:.4}' )
```

```
The tstat for the alpha is 0.4906
The value of beta is 0.9715
The tstat for the beta is 86.26
```

In [25]:

```
mod = sm.OLS(df['BIG LoBM']-df['RF'],sm.add_constant(df[['Mkt-RF','SMB','HML']]))

res = mod.fit()
res.summary()
res = mod.fit()
res.summary()

alpha =res.params[0]
beta =res.params[1]

talpha =res.tvalues[0]
tbeta =res.tvalues[1]

print(f'The tstat for the alpha is {talpha:.4}' )
print(f'The value of beta is {beta:.4}' )
print(f'The tstat for the beta is {tbeta:.4}' )
```

```
The tstat for the alpha is 2.118
The value of beta is 0.9622
The tstat for the beta is 100.4
```

```
Inference:
1.The beta vlaue of small value stocks is higher than big growth stocks as 0.9715 >
0.9622.
2.The alpha value is not significantly different from 0 for small value stocks,
while that for big growth stocks is significant.

Important Differences:
The CAPM does not meet the beta value criteria(The stocks with the highest mean
returns should have a higher beta), however the Fama French Model does.

As a result, the Fama French Model offers a more accurate estimate of excess market
return.
```