Empirical Methods in Financial Econometrics:Project 4

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Exercise 1

A

The jumps per year of DIS:

years	jumps
2007	16
2008	13
2009	8
2010	14
2011	5
2012	12
2013	14
2014	10
2015	6
2016	12
2017	12

The jumps per year of PG:

years	jumps
2007	19
2008	13
2009	7
2010	12
2011	9
2012	22
2013	15
2014	13
2015	12
2016	11
2017	13

I think jumps are uniformly distributed over the years.

B

The truncated variance of DIS and PG are created by the codes of ex_1 and ex_1_c in the Matlab. Please run the codes and find "TV", which are exactly the truncated variance.

C

The figure is below:

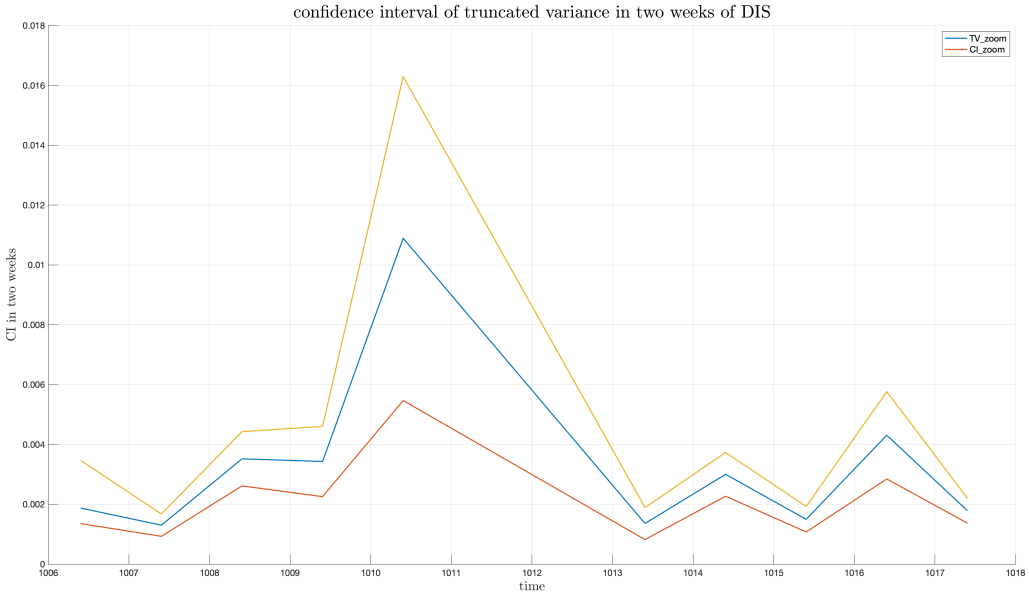

Figure 1: confidence interval of truncated variance in two weeks of DIS.

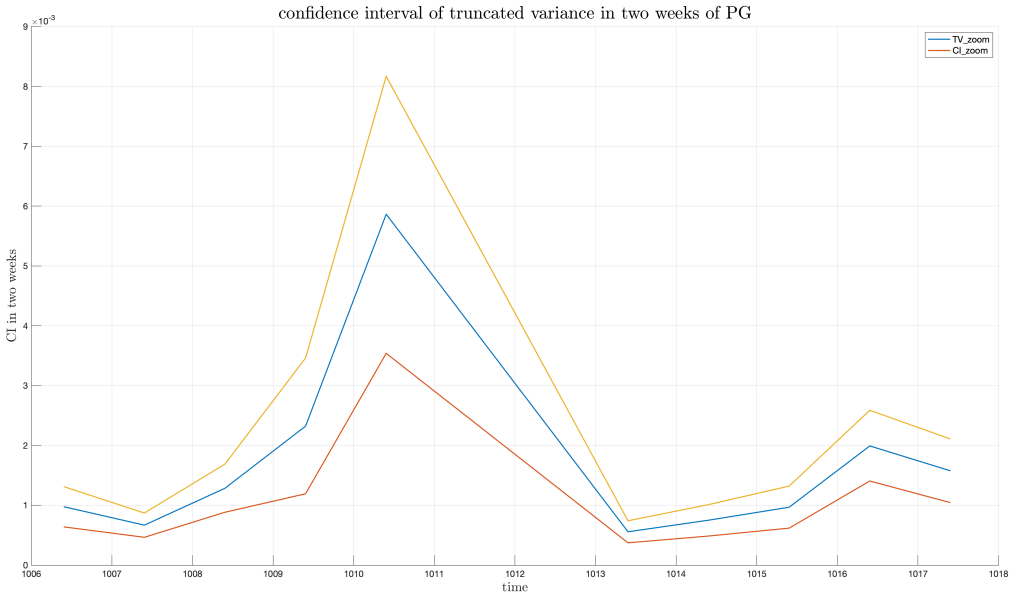

Figure 2: confidence interval of truncated variance in two weeks of PG.

Interpret: The truncated variance of DIS and PG are fluctuated during the two weeks, especially on the 10th October. The confidence intervals of the truncated variance matched the truncated variance very well, and the bigger the volatility of the truncated variance is, the bigger the confidence interval is.

D

No, I do not need to use the Delta-method to create confidence intervals for the annualized integrated variance. Because the reason why I use the Delta-method is the limited sample to use. However, through the bootstrap method, we have created much more samples based the sample we have now.

E

The figure is below:

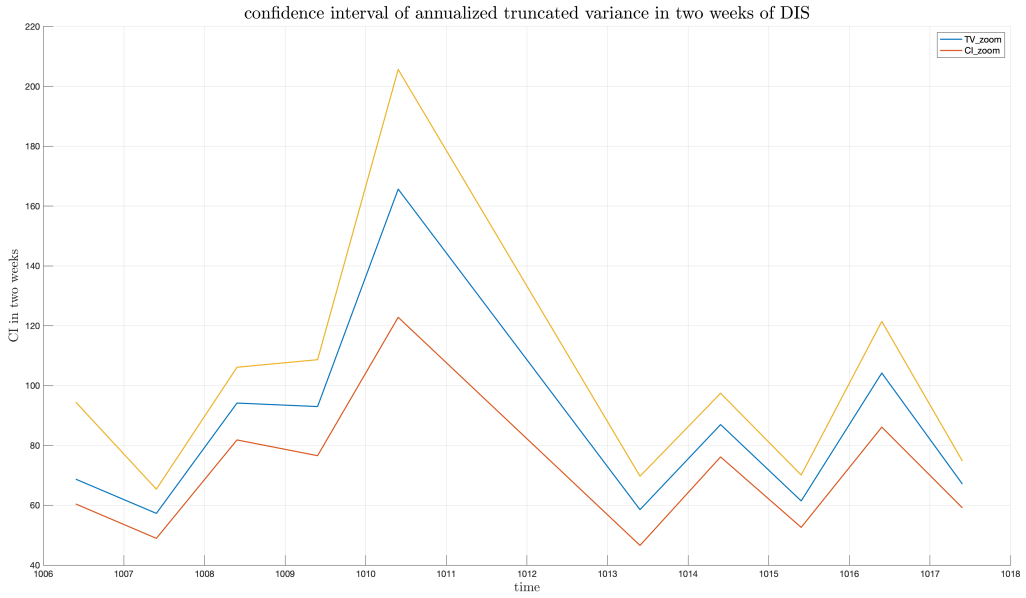

Figure 3: confidence interval of annualized truncated variance in two weeks of DIS.

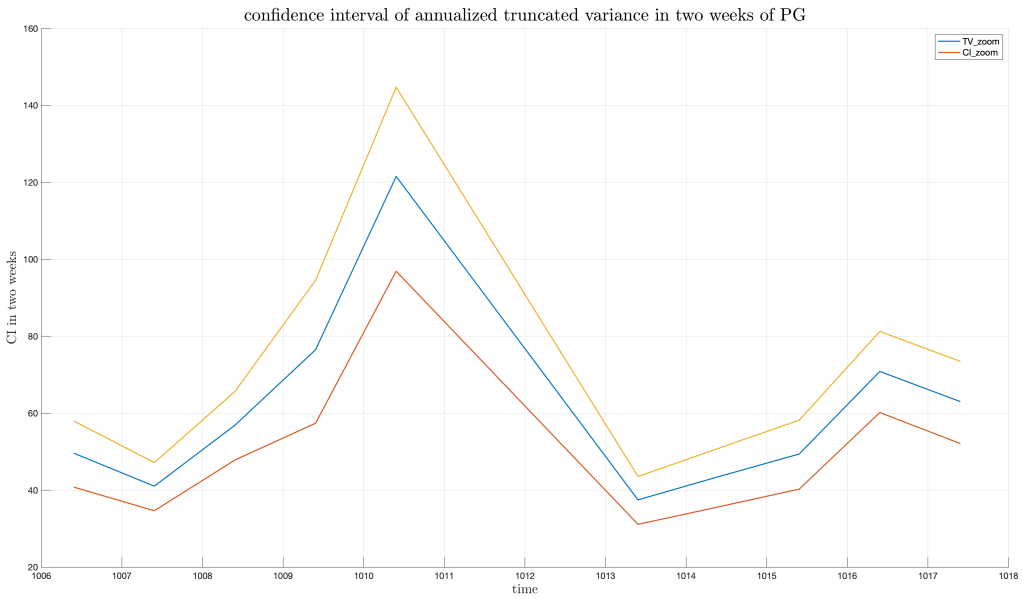

Figure 4: confidence interval of annualized truncated variance in two weeks of PG.

Interpret: Compared to the original truncated variance, the trend of the annualized truncated variance is still the same, because the real value didn't change. The scale of the annualized truncated variance is much bigger and easy to read that the original truncated variance.

Exercise 2

A

The figure is below:

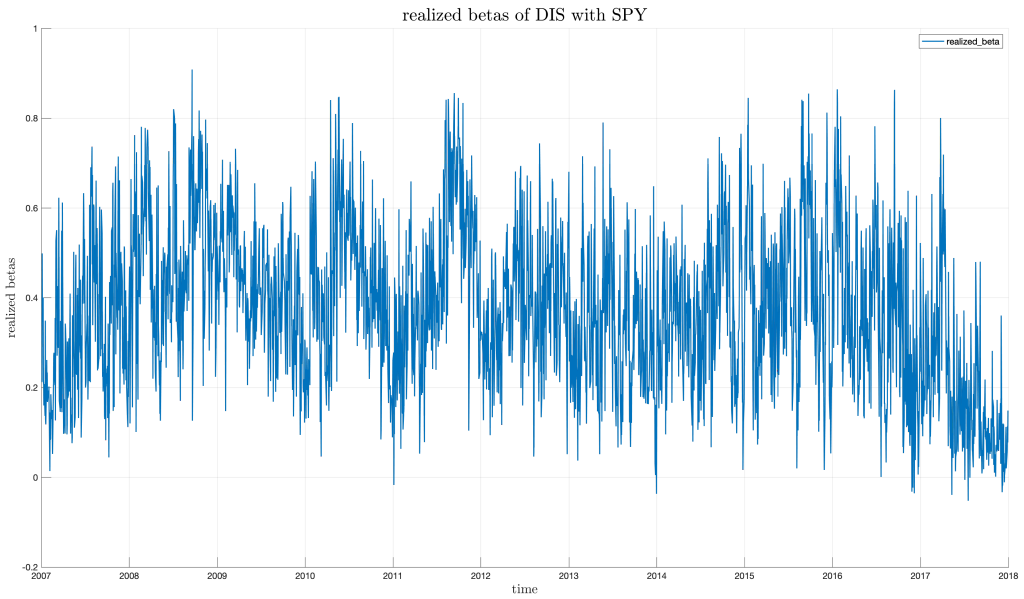

Figure 5: realized betas of DIS with SPY.

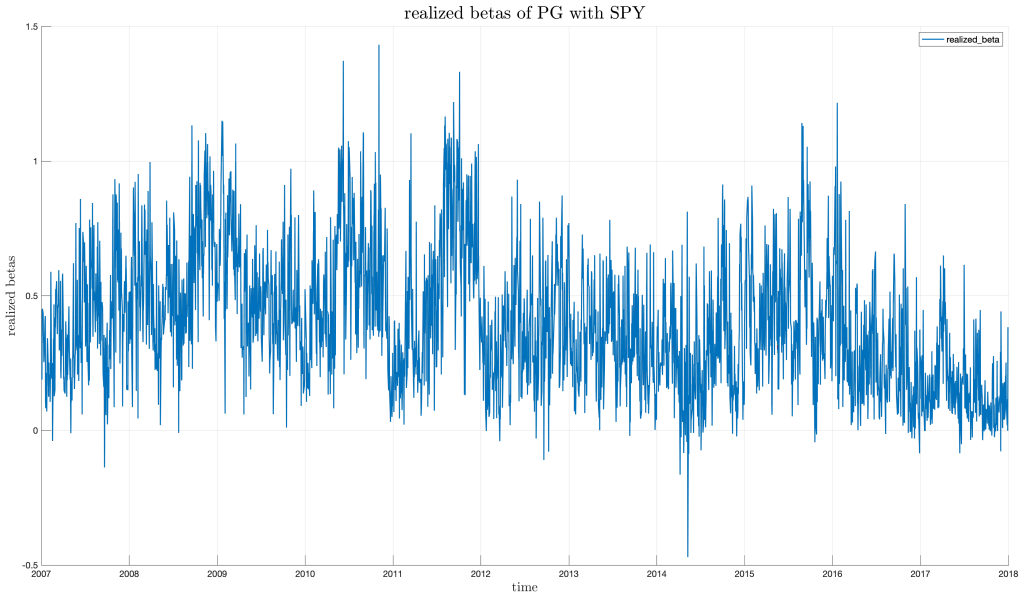

Figure 6: realized betas of PG with SPY.

Interpret: The plots of DIS fluctuated from 0 to 1 and the plots of PG fluctuated from -0.5 to 1.5. Because the stock returns of DIS and PG are not so close to the market return, which is represented by SPY here. In general, when the scale of realized beta is between 0 and 1, it means that the stock return is less than the market income; when it is less than 0, it indicates that the stock not only has no income, but a

loss; when it is greater than 1, it shows that the stock returns are more than the market income.

B

Yes, the realized beta varies over the years which it is shown obviously in the figures. No, it does not seem plausible to assume a fixed beta like in the usual CAPM, because there are other assumptions about CAPM model.

C

The figure is below:

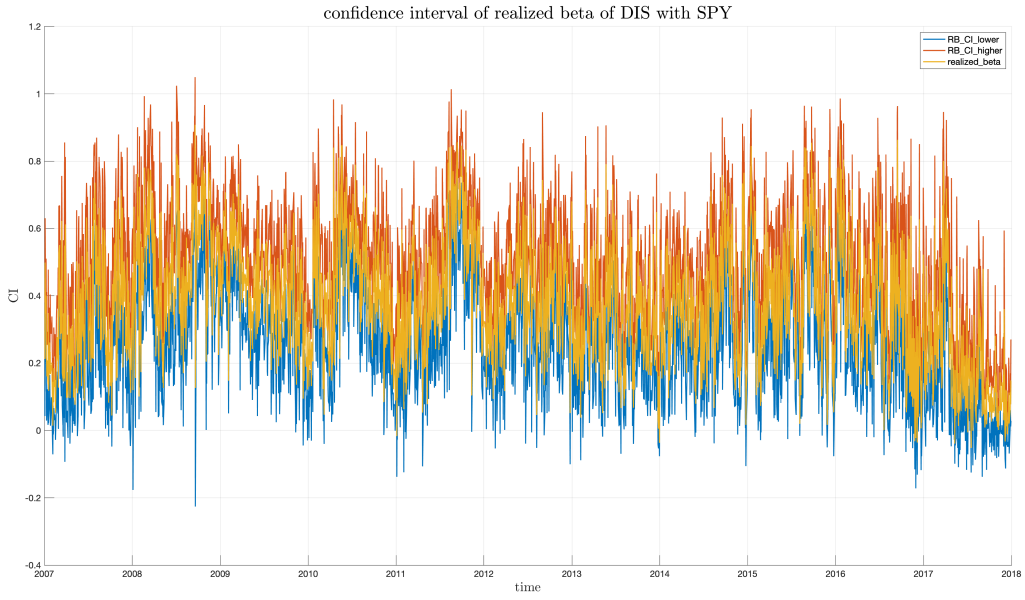

Figure 7: confidence interval of realized betas of DIS with SPY.

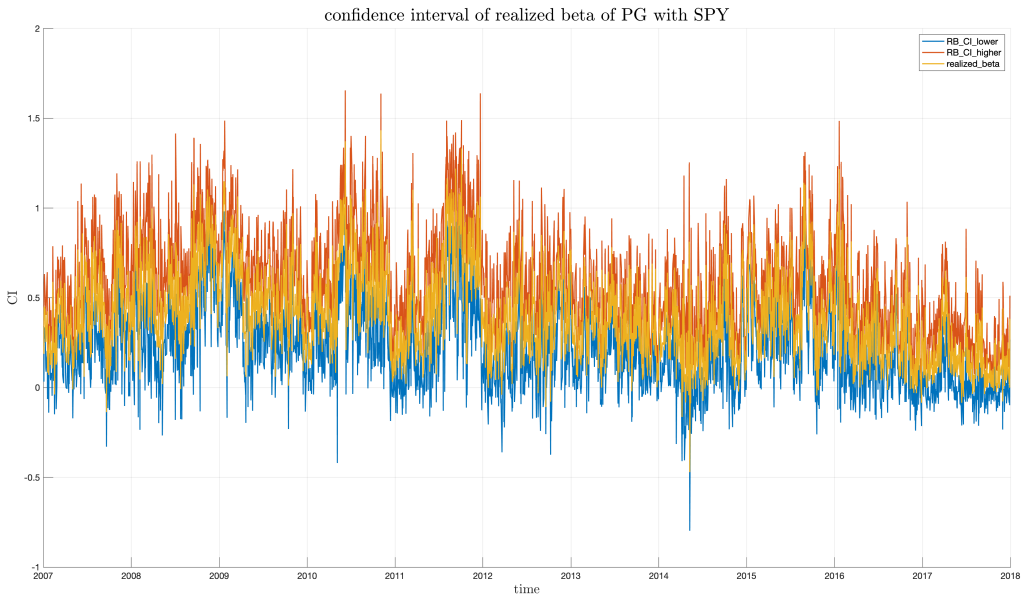

Figure 8: confidence interval of realized betas of PG with SPY.

Comment: From the figures we can see, the yellow line, which is realized beta, is covered by the blue and the red lines which are the confidence intervals. Due to this, I think the accuracy of intervals is pretty good.

D

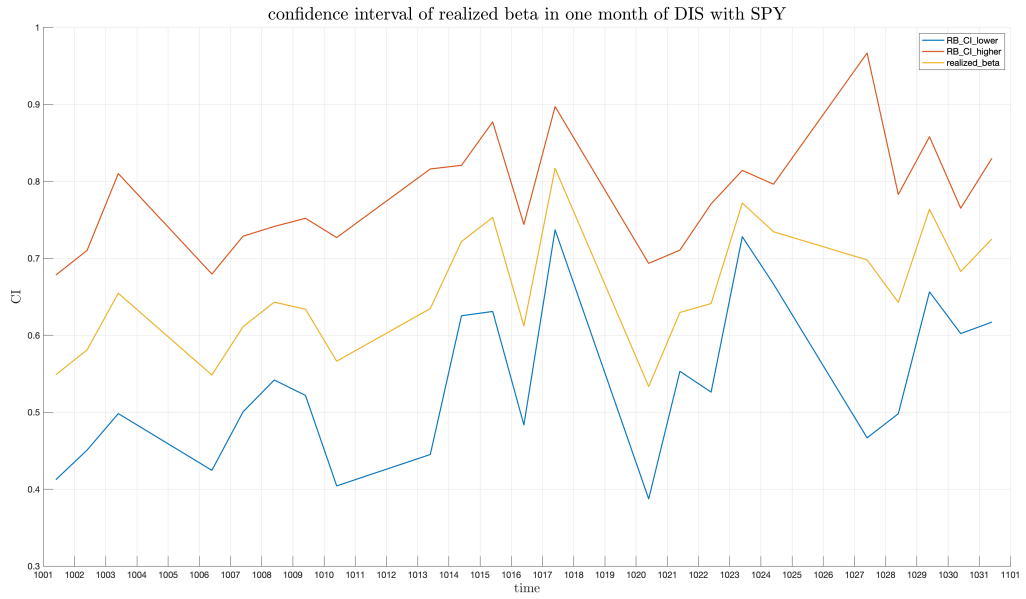

Figure 9: confidence interval of realized betas in one month of DIS with SPY.

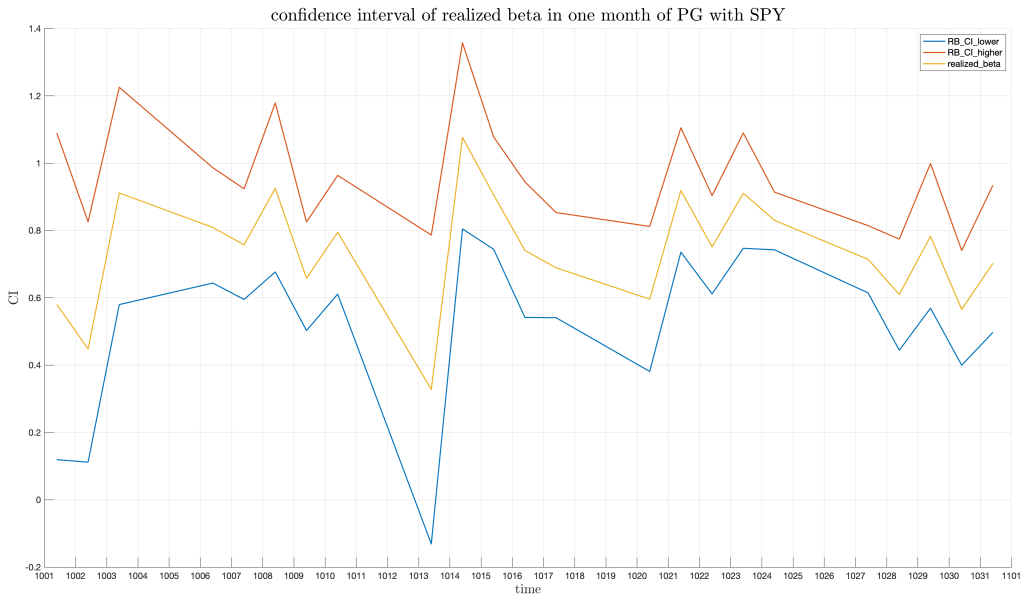

Figure 10: confidence interval of realized betas in one month of PG with SPY.

Comment: Compared to the whole year figures, we can more easily see the yellow line, which is realized beta, is covered by the blue and the red lines which are the confidence intervals from the one month figures. Due to this, I think the accuracy of intervals is pretty good.

E

DIS:

The confidence interval contains 1 : 3

The confidence interval is below 1 : 2766

The confidence interval is above 1 : 0

PG:

The confidence interval contains 1 : 242

The confidence interval is below 1 : 2523

The confidence interval is above 1 : 4

From the numbers I get, the number that the confidence interval is below than1 is the most, so I think the stock I have is less risky than the market, because the market has less impact on them.

Code

The code is below:

Listing 1: ex_1.m

```
[dates, prices] = load_stock('DIS.csv');
% question A
[dates_return,deltax] = log_returns(dates, prices);
[n,T] = size(deltax);
deltan = 1/n;
tau = tau_f(deltax);

BV = bipower_var(deltax);
alpha = 4.5;
cutoff = alpha*deltan^0.49*sqrt(tau*BV);
rd = deltax;
rd(abs(deltax)<=cutoff)=0;

jumps = sum(rd~=0);
y = zeros(12,1);
[yyyy,mm,dd]= ymd_f('DIS.csv');
for i = 1:11
    y(i+1) = sum(ismember(yyyy,2006+i));
end
jumps_y = zeros(11,1);
for i = 1:11
    jumps_y(i) = sum(jumps(1,(sum(y(1:i))+1):sum(y(1:i+1))));
end

% question B
rc = deltax;
rc(abs(deltax)>cutoff)=0;

TV = sum((rc).^2);

% question C
returns = deltax;
kn = 7;
M = 11;

```

```
J = 10000;
statistics = zeros(J,T);
parfor j = 1:J
    new_returns = bootstrap_stock(returns,n,T,kn,M);
    statistics(j,:) = sum(new_returns.^2);
end

% ci of statistics
CI_statistics = ci_f(0.05,mean(statistics),std(statistics));

zoom_start = find(dates_return==datenum(2008,10,6,16,0,0))/n;
zoom_end = find(dates_return==datenum(2008,10,17,16,0,0))/n;
TV_zoom = TV(zoom_start:zoom_end);
CI_zoom = CI_statistics(:,zoom_start:zoom_end);
dates_zoom = dates_return(1,zoom_start:zoom_end);

f = figure(1);
set(f,'units','normalized','outerposition',[0 0 1 1]);
plot(dates_zoom,TV_zoom)
hold on
plot(dates_zoom,CI_zoom)
hold off
datetick('x','mmdd');
legend('TV_zoom','CI_zoom');
title('confidence interval of truncated variance in two weeks of DIS');
box off; grid on;
xlabel('time');
ylabel('CI in two weeks');
print(f,'-dpng','-r200','figures/1C1');
close(f);

% question E
CI_statistics_a = ci_f(0.05,mean(100*sqrt(statistics*252)),std(100*sqrt(
    statistics*252)));
TV_a =100*sqrt(TV*252);

```

```
zoom_start = find(dates_return==datenum(2008,10,6,16,0,0))/n;
zoom_end = find(dates_return==datenum(2008,10,17,16,0,0))/n;
TV_zoom_a = TV_a(zoom_start:zoom_end);
CI_zoom_a = CI_statistics_a(:,zoom_start:zoom_end);
dates_zoom_a = dates_return(1,zoom_start:zoom_end);

f = figure(2);
set(f,'units','normalized','outerposition',[0 0 1 1]);
plot(dates_zoom_a,TV_zoom_a)
hold on
plot(dates_zoom_a,CI_zoom_a)
hold off
datetick('x','mmdd');
legend('TV_zoom','CI_zoom');
title('confidence interval of annualized truncated variance in two weeks
    of DIS');
box off; grid on;
xlabel('time');
ylabel('CI in two weeks');
print(f,'-dpng','-r200','figures/1E1');
close(f);
```

Listing 2: ex_2.m

```
[dates_1, prices_1] = load_stock('DIS.csv');
[dates_2, prices_2] = load_stock('SPY.csv');
% question A
[dates_return_1,deltax_1] = log_returns(dates_1, prices_1);
[dates_return_2,deltax_2] = log_returns(dates_2, prices_2);
[n,T] = size(deltax_1);
deltan = 1/n;
tau_1 = tau_f(deltax_1);
tau_2 = tau_f(deltax_2);

BV_1 = bipower_var(deltax_1);
BV_2 = bipower_var(deltax_2);

```

```
alpha = 4.5;
cutoff_1 = alpha*deltan^0.49*sqrt(tau_1*BV_1);
cutoff_2 = alpha*deltan^0.49*sqrt(tau_2*BV_2);

rc_1 = deltax_1;
rc_1(abs(deltax_1)>cutoff_1)=0;

rc_2 = deltax_2;
rc_2(abs(deltax_2)>cutoff_2)=0;

realized_beta = sum((rc_1.*rc_2))./sum(rc_1.^2);

f = figure(5);
set(f,'units','normalized','outerposition',[0 0 1 1]);
plot(dates_1,realized_beta)
datetick('x','yyyy');
legend('realized_beta');
title('realized betas of DIS with SPY');
box off; grid on;
xlabel('time');
ylabel('realized betas');
print(f,'-dpng','-r200','figures/2A1');
close(f);

% question C
kn = 11;
M = 7;

J = 10000;
booRB = boost_realized_beta(J,T,n,kn,M,rc_1,rc_2);

RB_CI = ci_f(0.05,mean(booRB),std(booRB));

f = figure(6);
set(f,'units','normalized','outerposition',[0 0 1 1]);
plot(dates_1(1,:),RB_CI(1,:))
```

```
hold on
plot(dates_1(1,:),RB_CI(2,:))
plot(dates_1(1,:),realized_beta)
hold off
datetick('x','yyyy');
legend('RB_CI_lower','RB_CI_higher','realized_beta');
title('confidence interval of realized beta of DIS with SPY');
box off; grid on;
xlabel('time');
ylabel('CI');
print(f,'-dpng','-r200','figures/2C1');
close(f);

% question D
zoom_start = find(dates_return_1==datenum(2008,10,1,16,0,0))/n;
zoom_end = find(dates_return_1==datenum(2008,10,31,16,0,0))/n;
realized_beta_zoom = realized_beta(zoom_start:zoom_end);
RB_CI_zoom = RB_CI(:,zoom_start:zoom_end);
dates_zoom = dates_return_1(1,zoom_start:zoom_end);

f = figure(7);
set(f,'units','normalized','outerposition',[0 0 1 1]);
plot(dates_zoom(1,:),RB_CI_zoom(1,:))
hold on
plot(dates_zoom(1,:),RB_CI_zoom(2,:))
plot(dates_zoom(1,:),realized_beta_zoom)
hold off
datetick('x','mmdd');
legend('RB_CI_lower','RB_CI_higher','realized_beta');
title('confidence interval of realized beta in one month of DIS with SPY')
   ;
box off; grid on;
xlabel('time');
ylabel('CI');
print(f,'-dpng','-r200','figures/2D1');
close(f);
```

```
85
86 % question E
87 % confidence interval is below 1
88 beta_2 = length(find(RB_CI(2,:)<1));
89 % confidence interval is above 1
90 beta_3 = length(find(RB_CI(1,:)>1));
91 % confidence interval contains 1
92 beta_1 = T-beta_2-beta_3;
```