Date Preprocess

```
%  load monthly return information for asset classes in the CAPM model
[blah,blah,rawraw]=xlsread('HW3_20190414.xlsx','FX_Prices');
ac_name=rawraw(1,1:end);
ac_name(cellfun(@(ac_name) any(isnan(ac_name)),ac_name)) = [];
rawraw=rawraw(2:end,[2,5,8,11,14,17,20]);
ac_price=rawraw(2:end,:);
ac_price=cell2mat(ac_price);
ac_mret =zeros(length(ac_price)-1,7);


for i=1:7
   for j =2:length(ac_price)
      ac_mret(j-1,i)=ac_price(j-1,i)/ac_price(j,i)-1;
   end


end


% step 1: monthly return of the 7 currencies:
ac_mret;
ac_mret_rv=flipud(ac_mret);


% seperate the monthly_return by currency
EURUSD= flipud(ac_mret(:,1));
GBPUSD= flipud(ac_mret(:,2));
JPYUSD= flipud(ac_mret(:,3));
AUDUSD= flipud(ac_mret(:,4));
CADUSD= flipud(ac_mret(:,5));
NOKUSD= flipud(ac_mret(:,6));
CHFUSD= flipud(ac_mret(:,7));
```

```
%the asset classes loaded
ac_name=ac_name';

%   number of asset classes
num_ac=length(ac_name);
```

method 1

```
%step 2:
%%%starting from 12/31/1999, at each month-end date, we'll forecast next-month
returns for the seven currencies separately
% 12/31/1999, ROW:232
% N=24




rng(0); % for reproducibility
%

EstMdl1 = arima('ARLags',1);
EstMdl2 = arima('MALags',1);
logL = zeros(2,1);
EURUSD_fst=[];
GBPUSD_fst= [];
JPYUSD_fst=[];
```

```
AUDUSD_fst= [];

CADUSD_fst= [];

NOKUSD_fst= [];

CHFUSD_fst= [];

K=1;

%%EURUSD forcast

for i = 68:287


       arma_ts=EURUSD((i-23):i,1);

   [~,~,logL(1)] = estimate(EstMdl1,arma_ts,'Display','off');

   [~,~,logL(2)] = estimate(EstMdl2,arma_ts,'Display','off');

   [aic,bic] = aicbic(logL, [3;3], length(arma_ts)*ones(2,1));




     if aic(1)<aic(2)

        MyEstMdl= estimate(EstMdl1,arma_ts,'Display','off');

       [Forecast_Vec,MSE_Vec] = forecast(MyEstMdl,K,'Y0',arma_ts);

        EURUSD_fst=[EURUSD_fst,Forecast_Vec];


     else

       MyEstMdl= estimate(EstMdl2,arma_ts,'Display','off');

       [Forecast_Vec,MSE_Vec] = forecast(MyEstMdl,K,'Y0',arma_ts);

       EURUSD_fst=[EURUSD_fst,Forecast_Vec];


     end


end


%% GBPUSD forcast
```

```
for i = 68:287


       arma_ts=GBPUSD((i-23):i,1);
   [~,~,logL(1)] = estimate(EstMdl1,arma_ts,'Display','off');
   [~,~,logL(2)] = estimate(EstMdl2,arma_ts,'Display','off');
   [aic,bic] = aicbic(logL, [3;3], length(arma_ts)*ones(2,1));




    if aic(1)<aic(2)
        MyEstMdl= estimate(EstMdl1,arma_ts,'Display','off');
        [Forecast_Vec,MSE_Vec] = forecast(MyEstMdl,K,'Y0',arma_ts);
        GBPUSD_fst=[GBPUSD_fst,Forecast_Vec];


    else
       MyEstMdl= estimate(EstMdl2,arma_ts,'Display','off');
       [Forecast_Vec,MSE_Vec] = forecast(MyEstMdl,K,'Y0',arma_ts);
       GBPUSD_fst=[GBPUSD_fst,Forecast_Vec];


    end
end


%%JPYUSD forcast
for i = 68:287


       arma_ts=JPYUSD((i-23):i,1);
   [~,~,logL(1)] = estimate(EstMdl1,arma_ts,'Display','off');
   [~,~,logL(2)] = estimate(EstMdl2,arma_ts,'Display','off');
   [aic,bic] = aicbic(logL, [3;3], length(arma_ts)*ones(2,1));
```

```
   if aic(1)<aic(2)
        MyEstMdl= estimate(EstMdl1,arma_ts,'Display','off');
        [Forecast_Vec,MSE_Vec] = forecast(MyEstMdl,K,'Y0',arma_ts);
        JPYUSD_fst=[JPYUSD_fst,Forecast_Vec];

   else
       MyEstMdl= estimate(EstMdl2,arma_ts,'Display','off');
       [Forecast_Vec,MSE_Vec] = forecast(MyEstMdl,K,'Y0',arma_ts);
       JPYUSD_fst=[JPYUSD_fst,Forecast_Vec];

   end
end

%% AUDUSD forcast
for i = 68:287

       arma_ts=AUDUSD((i-23):i,1);
   [~,~,logL(1)] = estimate(EstMdl1,arma_ts,'Display','off');
   [~,~,logL(2)] = estimate(EstMdl2,arma_ts,'Display','off');
   [aic,bic] = aicbic(logL, [3;3], length(arma_ts)*ones(2,1));



   if aic(1)<aic(2)
        MyEstMdl= estimate(EstMdl1,arma_ts,'Display','off');
        [Forecast_Vec,MSE_Vec] = forecast(MyEstMdl,K,'Y0',arma_ts);
        AUDUSD_fst=[AUDUSD_fst,Forecast_Vec];
```

```
    else
        MyEstMdl= estimate(EstMdl2,arma_ts,'Display','off');
        [Forecast_Vec,MSE_Vec] = forecast(MyEstMdl,K,'Y0',arma_ts);
        AUDUSD_fst=[AUDUSD_fst,Forecast_Vec];

    end
end
%% CADUSD forcast
for i = 68:287

        arma_ts=CADUSD((i-23):i,1);
   [~,~,logL(1)] = estimate(EstMdl1,arma_ts,'Display','off');
   [~,~,logL(2)] = estimate(EstMdl2,arma_ts,'Display','off');
   [aic,bic] = aicbic(logL, [3;3], length(arma_ts)*ones(2,1));



    if aic(1)<aic(2)
         MyEstMdl= estimate(EstMdl1,arma_ts,'Display','off');
         [Forecast_Vec,MSE_Vec] = forecast(MyEstMdl,K,'Y0',arma_ts);
         CADUSD_fst=[CADUSD_fst,Forecast_Vec];

    else
        MyEstMdl= estimate(EstMdl2,arma_ts,'Display','off');
        [Forecast_Vec,MSE_Vec] = forecast(MyEstMdl,K,'Y0',arma_ts);
        CADUSD_fst=[CADUSD_fst,Forecast_Vec];

    end
end
%% NOKUSD forcast
```

```
for i = 68:287


      arma_ts=NOKUSD((i-23):i,1);
  [~,~,logL(1)] = estimate(EstMdl1,arma_ts,'Display','off');
  [~,~,logL(2)] = estimate(EstMdl2,arma_ts,'Display','off');
  [aic,bic] = aicbic(logL, [3;3], length(arma_ts)*ones(2,1));




    if aic(1)<aic(2)
       MyEstMdl= estimate(EstMdl1,arma_ts,'Display','off');
      [Forecast_Vec,MSE_Vec] = forecast(MyEstMdl,K,'Y0',arma_ts);
       NOKUSD_fst=[NOKUSD_fst,Forecast_Vec];


    else
      MyEstMdl= estimate(EstMdl2,arma_ts,'Display','off');
      [Forecast_Vec,MSE_Vec] = forecast(MyEstMdl,K,'Y0',arma_ts);
      NOKUSD_fst=[NOKUSD_fst,Forecast_Vec];
    end


end
%%  CHFUSD forcast



for i = 68:287


      arma_ts=CHFUSD((i-23):i,1);
  [~,~,logL(1)] = estimate(EstMdl1,arma_ts,'Display','off');
  [~,~,logL(2)] = estimate(EstMdl2,arma_ts,'Display','off');
  [aic,bic] = aicbic(logL, [3;3], length(arma_ts)*ones(2,1));
```

```
    if aic(1)<aic(2)
       MyEstMdl= estimate(EstMdl1,arma_ts,'Display','off');
      [Forecast_Vec,MSE_Vec] = forecast(MyEstMdl,K,'Y0',arma_ts);
       CHFUSD_fst=[CHFUSD_fst,Forecast_Vec];

    else
      MyEstMdl= estimate(EstMdl2,arma_ts,'Display','off');
      [Forecast_Vec,MSE_Vec] = forecast(MyEstMdl,K,'Y0',arma_ts);
      CHFUSD_fst=[CHFUSD_fst,Forecast_Vec];
    end
end
% form the forcast return matrix
ret1=[EURUSD_fst;GBPUSD_fst;JPYUSD_fst;AUDUSD_fst;CADUSD_fst;NOKUSD_fst;CHFUSD_
fst];

% last 60 months covariance matrix and Sigma



Total_w_new=[];
for i =68:287
   for j=1:60
      for x=1:7
       temp=ac_mret_rv(i-59:i,:);
        if sign(temp(j,x))==-1
            temp(j,x)=-temp(j,x);
        else
             temp(j,x)=temp(j,x);
```

```
       end



      end
   end


         Sigma=nancov(temp);
         obj_func2=@(w) sqrt(w'*Sigma*w);
         A=[-eye(num_ac)];
         b=[zeros(num_ac,1)];
         Aeq=[];
         beq=[];
         const=1;
         num_ac=length(ac_name);
         b_erc=ones(num_ac,1);
         b_erc=b_erc/sum(b_erc);

         w0=ones(num_ac,1)/num_ac;



      [w_rp,fval]=fmincon(obj_func2,w0,A,b,Aeq,beq,[],[],@(w)
nonlcon(w,b_erc,const));
      %   remember to normalize the weight vector
         w_rp=w_rp/sum(w_rp);

       vola=sqrt(w_rp'*Sigma*w_rp)*sqrt(12);
       factor =0.05/vola;

   Total_w_new=[Total_w_new,factor*w_rp];
```

```
end


Total_w_new
% from here, we can get the Total_w_new(the futuere weight forcast based on
risk-parity)
% make the long-short decision of forcast return
forcast_sig= sign(ret1);


for i =1:7
    for j =1:220


    if forcast_sig(i,j)==-1
          ret1(i,j)=-ret1(i,j);
    else
        ret1(i,j)=ret1(i,j);
    end
    end
end
% get the returned ret
ret1=ret1';


% get the portfolio return for method 1
port_ret_1=[]
for i =1:220
    temp=ret1(i,:)*Total_w_new(:,i);
    port_ret_1=[port_ret_1;temp];
end


% the all portfolios' weight we can get fromt he method 1
```

```
port_ret_1
% plot the future portfolio return from method 1
```

method 2

```
EURUSD_fst2=[];
GBPUSD_fst2= [];
JPYUSD_fst2=[];
AUDUSD_fst2= [];
CADUSD_fst2= [];
NOKUSD_fst2= [];
CHFUSD_fst2= [];
% %%EURUSD forcast



for v=68:287
    mse1=0;
    mse2=0;

   for i= 0:11



          arma_ts=EURUSD(v-i-24:v-i-1);

      MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
      [Forecast_Vec1,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);

      MyEstMdl2= estimate(EstMdl2,arma_ts,'Display','off');
      [Forecast_Vec2,MSE_Vec] = forecast(MyEstMdl2,K,'Y0',arma_ts);
```

```
            a1=(Forecast_Vec1-EURUSD(v-i))^2;
            a2=(Forecast_Vec2-EURUSD(v-i))^2;
            mse1=a1+mse1;
            mse2=a2+mse2;
    end



            arma_ts=EURUSD(v-23:v);
        MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
        [Forecast_1,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);

        MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
        [Forecast_2,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);

         if mse1<mse2


          EURUSD_fst2=[EURUSD_fst2,Forecast_1];
         else
          EURUSD_fst2=[EURUSD_fst2,Forecast_2];
         end


 end


% %%GBPUSD forcast
```

```
for v=68:287
    mse1=0;
    mse2=0;
   for i= 0:11



         arma_ts=GBPUSD(v-i-24:v-i-1);


      MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
      [Forecast_Vec1,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);


      MyEstMdl2= estimate(EstMdl2,arma_ts,'Display','off');
      [Forecast_Vec2,MSE_Vec] = forecast(MyEstMdl2,K,'Y0',arma_ts);



          a1=(Forecast_Vec1-GBPUSD(v-i))^2;
          a2=(Forecast_Vec2-GBPUSD(v-i))^2;
          mse1=a1+mse1;
          mse2=a2+mse2;
   end



          arma_ts=GBPUSD(v-23:v);
      MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
      [Forecast_1,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);
```

```
      MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
      [Forecast_2,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);

       if mse1<mse2
        GBPUSD_fst2=[GBPUSD_fst2,Forecast_1];
       else
        GBPUSD_fst2=[GBPUSD_fst2,Forecast_2];
       end


 end

 % %%JPYUSD forcast


for v=68:287
    mse1=0;
    mse2=0;
   for i= 0:11


         arma_ts=JPYUSD(v-i-24:v-i-1);

      MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
      [Forecast_Vec1,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);

      MyEstMdl2= estimate(EstMdl2,arma_ts,'Display','off');
      [Forecast_Vec2,MSE_Vec] = forecast(MyEstMdl2,K,'Y0',arma_ts);
```

```
            a1=(Forecast_Vec1-JPYUSD(v-i))^2;
            a2=(Forecast_Vec2-JPYUSD(v-i))^2;
            mse1=a1+mse1;
            mse2=a2+mse2;
    end



            arma_ts=JPYUSD(v-23:v);
        MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
        [Forecast_1,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);

        MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
        [Forecast_2,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);

         if mse1<mse2


          JPYUSD_fst2=[JPYUSD_fst2,Forecast_1];
         else
          JPYUSD_fst2=[JPYUSD_fst2,Forecast_2];
         end


 end

% %%AUDUSD forcast
```

```
for v=68:287
     mse1=0;
     mse2=0;
   for i= 0:11



          arma_ts=AUDUSD(v-i-24:v-i-1);


       MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
       [Forecast_Vec1,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);


       MyEstMdl2= estimate(EstMdl2,arma_ts,'Display','off');
       [Forecast_Vec2,MSE_Vec] = forecast(MyEstMdl2,K,'Y0',arma_ts);



            a1=(Forecast_Vec1-AUDUSD(v-i))^2;
            a2=(Forecast_Vec2-AUDUSD(v-i))^2;
            mse1=a1+mse1;
            mse2=a2+mse2;
   end



            arma_ts=AUDUSD(v-23:v);
       MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
       [Forecast_1,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);


       MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
       [Forecast_2,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);
```

```
       if mse1<mse2



        AUDUSD_fst2=[AUDUSD_fst2,Forecast_1];
       else
        AUDUSD_fst2=[AUDUSD_fst2,Forecast_2];
       end


 end

% %%CADUSD forcast

for v=68:287

     mse1=0;
     mse2=0;

   for i= 0:11



          arma_ts=CADUSD(v-i-24:v-i-1);

       MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
       [Forecast_Vec1,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);

       MyEstMdl2= estimate(EstMdl2,arma_ts,'Display','off');
       [Forecast_Vec2,MSE_Vec] = forecast(MyEstMdl2,K,'Y0',arma_ts);
```

```
            a1=(Forecast_Vec1-CADUSD(v-i))^2;
            a2=(Forecast_Vec2-CADUSD(v-i))^2;
            mse1=a1+mse1;
            mse2=a2+mse2;
    end



            arma_ts=CADUSD(v-23:v);
        MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
        [Forecast_1,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);

        MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
        [Forecast_2,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);

         if mse1<mse2


          CADUSD_fst2=[CADUSD_fst2,Forecast_1];
         else
          CADUSD_fst2=[CADUSD_fst2,Forecast_2];
         end


 end

% %%NOKUSD forcast
```

```
for v=68:287

      mse1=0;
      mse2=0;
   for i= 0:11



         arma_ts=NOKUSD(v-i-24:v-i-1);

       MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
       [Forecast_Vec1,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);

       MyEstMdl2= estimate(EstMdl2,arma_ts,'Display','off');
       [Forecast_Vec2,MSE_Vec] = forecast(MyEstMdl2,K,'Y0',arma_ts);



           a1=(Forecast_Vec1-NOKUSD(v-i))^2;
           a2=(Forecast_Vec2-NOKUSD(v-i))^2;
           mse1=a1+mse1;
           mse2=a2+mse2;
   end



           arma_ts=NOKUSD(v-23:v);
       MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
       [Forecast_1,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);
```

```
      MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
      [Forecast_2,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);


       if mse1<mse2



        NOKUSD_fst2=[NOKUSD_fst2,Forecast_1];
       else
        NOKUSD_fst2=[NOKUSD_fst2,Forecast_2];
       end



 end

 % %%CHFUSD forcast



for v=68:287
     mse1=0;
     mse2=0;

   for i= 0:11



          arma_ts=CHFUSD(v-i-24:v-i-1);

      MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
      [Forecast_Vec1,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);
```

```
      MyEstMdl2= estimate(EstMdl2,arma_ts,'Display','off');
      [Forecast_Vec2,MSE_Vec] = forecast(MyEstMdl2,K,'Y0',arma_ts);



           a1=(Forecast_Vec1-CHFUSD(v-i))^2;
           a2=(Forecast_Vec2-CHFUSD(v-i))^2;
           mse1=a1+mse1;
           mse2=a2+mse2;
   end



           arma_ts=CHFUSD(v-23:v);
      MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
      [Forecast_1,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);

      MyEstMdl1= estimate(EstMdl1,arma_ts,'Display','off');
      [Forecast_2,MSE_Vec] = forecast(MyEstMdl1,K,'Y0',arma_ts);

       if mse1<mse2



        CHFUSD_fst2=[CHFUSD_fst2,Forecast_1];
       else
        CHFUSD_fst2=[CHFUSD_fst2,Forecast_2];
       end


end
```

```
%%%_____
_____%%%%%

% form the forcast return matrix
ret2=[EURUSD_fst2;GBPUSD_fst2;JPYUSD_fst2;AUDUSD_fst2;CADUSD_fst2;NOKUSD_fst2;C
HFUSD_fst2];
 % last 60 months covariance matrix and Sigma

% from here, we can get the Total_w_new(the futuere weight forcast based on
risk-parity)
Total_w_new;
% make the long-short decision of forcast return
forcast_sig= sign(ret2);
[m,n]=size(ret2)

for i =1:7
   for j =1:220

   if forcast_sig(i,j)==-1
         ret2(i,j)=-ret2(i,j);
   else
        ret2(i,j)=ret2(i,j);
   end
   end
end
% get the returned ret
ret2=ret2';

% get the portfolio return for method 2
```

```
port_ret_2=[];
for i =1:220
    temp=ret2(i,:)*Total_w_new(:,i);
    port_ret_2=[port_ret_2;temp];
end

% the all portfolios' weight we can get fromt he method 2
port_ret_2
```

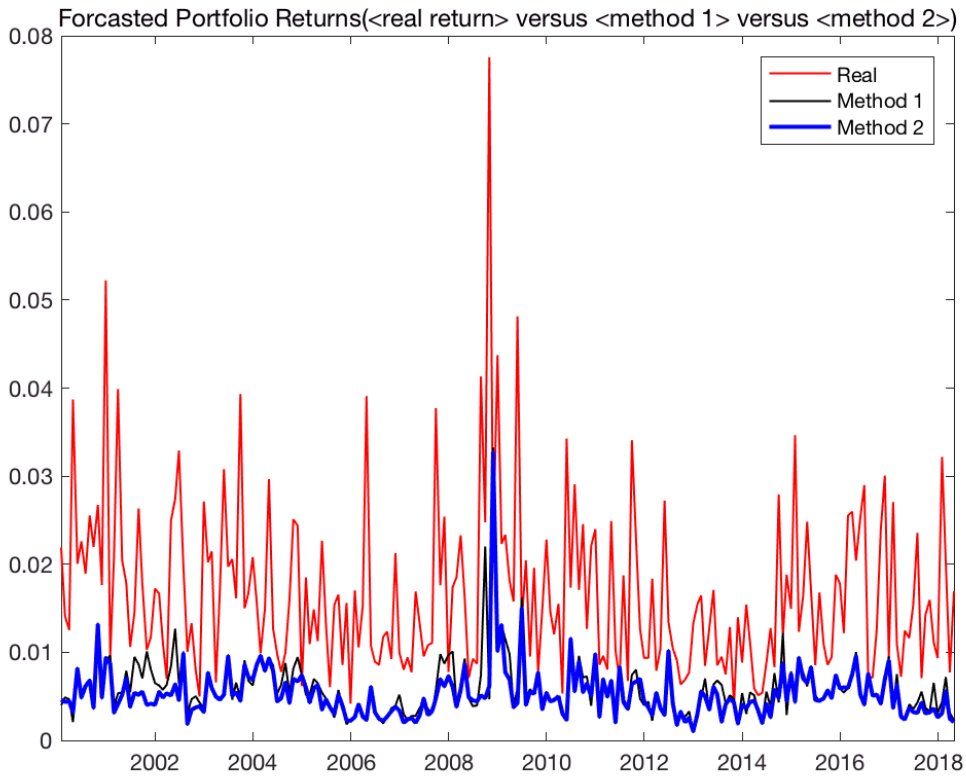
Performance Analysis for Method 1 and Method 2

```
% real portfolio return
ret_real=(ac_mret_rv(69:288,:))';
sig_real= sign(ret_real);
for i =1:7
    for j =1:220

    if sig_real(i,j)==-1
          ret_real(i,j)=-ret_real(i,j);
    else
        ret_real(i,j)=ret_real(i,j);
    end
    end
end
% get the real portfolio return
ret_real=ret_real';
port_ret_real=[];
for i =1:220
    temp=ret_real(i,:)*Total_w_new(:,i);
    port_ret_real=[port_ret_real;temp];
end
% real portfolio return
```

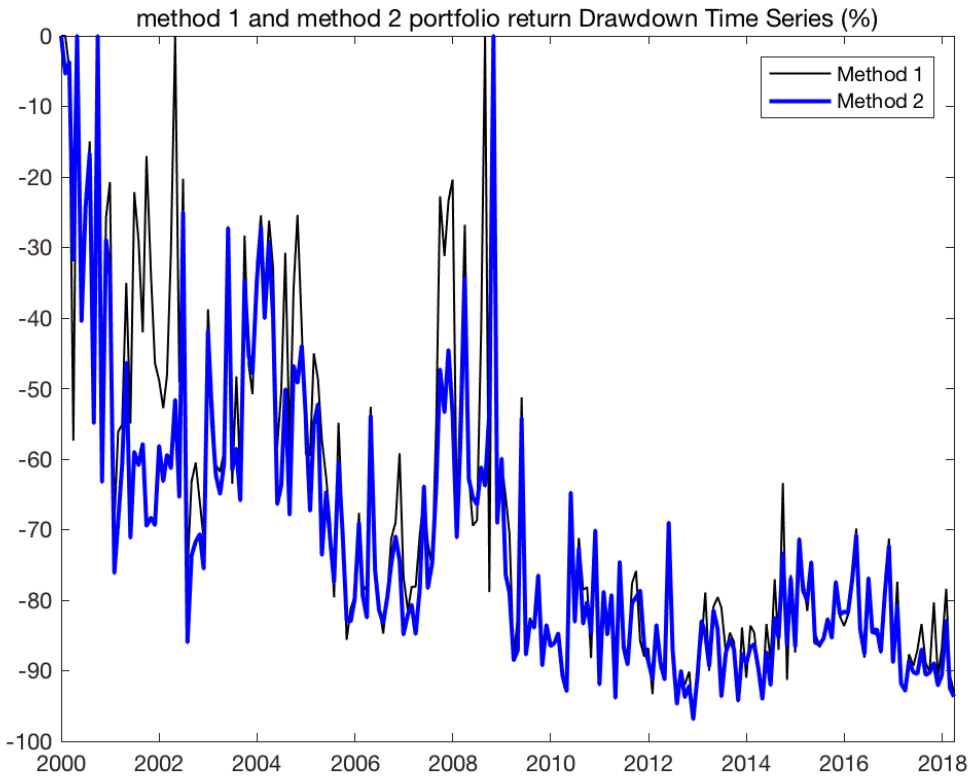
```
 port_ret_real
% plot the future portfolio returns(method 1 versus method2)
traday=xlsread('HW3_20190414.xlsx','FX_Prices');
traday=traday(13:232,1);
traday=flipud(traday);
traday=traday+693960;
traday=datetime(traday,'ConvertFrom','datenum');


figure
h=plot(traday,port_ret_real,'r','LineWidth',1);
hold on;
h1 = plot(traday,port_ret_1,'k','LineWidth',1);
hold on;
h2=plot(traday,port_ret_2,'b','LineWidth',2);
legend([h h1 h2],'Real','Method 1','Method 2');
title('Forcasted Portfolio Returns(<real return> versus <method 1> versus
<method 2>)');
hold off;
% mean and variance of method 1 and method 2
fprintf('portfolio (annualized) mean return of method 1' )
(mean(port_ret_1))*12
fprintf('portfolio (annualized) mean return of method 2' )
(mean(port_ret_2))*12
fprintf('portfolio (annualized) volatility of method 1' )
(std(port_ret_1))*sqrt(12)
fprintf('portfolio (annualized) volatility of method 2' )
(std(port_ret_2))*sqrt(12)
fprintf('portfolio Shape Ratio of method 1' )
((mean(port_ret_1))*12)/((std(port_ret_1))*sqrt(12))
fprintf('portfolio Shape Ratio of method 2' )
```

```
((mean(port_ret_2))*12)/((std(port_ret_2))*sqrt(12))
%   we need to calculate the drawdown time series for method 1
drawdown_ts1=nan(size(port_ret_1));
drawdown_ts2=nan(size(port_ret_2));
for t=1:length(port_ret_1)

    %   the high-watermark before the date
    tmp_max=max(port_ret_1(1:t));

    %   skip if it's nan
    if isnan(tmp_max)
        continue;
    end

    %   drawdown from high-watermark to the current price
    drawdown_ts1(t)=port_ret_1(t)/tmp_max*100-100;

end
%   we need to calculate the drawdown time series for method 2
for t=1:length(port_ret_2)

    %   the high-watermark before the date
    tmp_max=max(port_ret_2(1:t));

    %   skip if it's nan
    if isnan(tmp_max)
        continue;
    end
    %   drawdown from high-watermark to the current price
    drawdown_ts2(t)=port_ret_2(t)/tmp_max*100-100;
```

```
end


%  plot the drawdown time series
figure
h3=plot(traday,drawdown_ts1,'k','LineWidth',1);
hold on;
h4=plot(traday,drawdown_ts2,'b','LineWidth',2);
legend([h3 h4],'Method 1','Method 2');
title('method 1 and method 2 portfolio return Drawdown Time Series (%)');
hold off;


%  let's locate the max-drawdown period
[maxdd,t_end]=min(drawdown_ts1);
[blah,t_start]=max(port_ret_1(1:t_end));
fprintf('MaxDD of method 1 %.2f%% starts at %s, ends
at %s.\n',maxdd,datetime(traday(t_start)),datetime(traday(t_end)));
[maxdd,t_end]=min(drawdown_ts2);
[blah,t_start]=max(port_ret_2(1:t_end));
fprintf('MaxDD of method 2 %.2f%% starts at %s, ends
at %s.\n',maxdd,datetime(traday(t_start)),datetime(traday(t_end)));
```




```
portfolio (annualized) mean return of method 1

ans = 0.0708

portfolio (annualized) mean return of method 2

ans = 0.0632

portfolio (annualized) volatility of method 1

ans = 0.0115

portfolio (annualized) volatility of method 2

ans = 0.0102

portfolio Shape Ratio of method 1

ans = 6.1396

portfolio Shape Ratio of method 2

ans = 6.2082
```



MaxDD of method 1: -96.70% starts at 10/31/2008, ends at 11/30/2012.

MaxDD of method 2: -96.86% starts at 10/31/2008, ends at 11/30/2012.

```
%%Performance Analysis
% The forcasted portfolio returns are trying to approaching the real portfolio
return values, there are some similar properties between real values and
forcasted values but are still some differences.
% These two methods have it's own advantages by using risk parity method to
form portfolios. Method 1 has higher annual return 7.08% but higher volatility.
% However, by combining risk and mean return, the Sharpe ratio of method 2 is
higher, which implies the method 2 has better performance.
% According to the maximum dropdown analysis, the dropdown periods for both
methods are the same(10/31/2008 to 11/30/2012) but the method 1 has a lower max
```

```
dropdown value.

% So from the maximum dropdown analysis, the method 1 has its own superiority.
```