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%this is the code to do xx

%load data
clear;
load stockdata;

%calculate daily return
applereturn=log(appleprice(1:end-1,6))-log(appleprice(2:end,6));
ibmreturn=log(ibmprice(1:end-1,6))-log(ibmprice(2:end,6));
stockreturn=[applereturn ibmreturn];


%% show efficient frontier through simulation
%generate random weights
stocknumber=size(stockreturn,2);
trialnumber=10000;
mat = rand(trialnumber, stocknumber);
rowsum = sum(mat,2);
matnorm=repmat(rowsum,1,stocknumber);
mat=mat./matnorm;

%calculate return and risk for each combination
portreturn=stockreturn*mat';%calculate portfolio return
meanportreturn=mean(portreturn);%mean return
stdportreturn=std(portreturn);%portfolio standard deviation
figure(1); scatter(stdportreturn,meanportreturn);%plot
xlim([0,0.03]);ylim([0,0.0025]);

sharperatio=meanportreturn./stdportreturn;
mat(find(sharperatio==max(sharperatio)));


%% efficient frontier analytical solution
clear;
load stockdata;

%calculate daily return
applereturn=log(appleprice(1:end-1,6))-log(appleprice(2:end,6));
ibmreturn=log(ibmprice(1:end-1,6))-log(ibmprice(2:end,6));
stockreturn=[applereturn ibmreturn];
stocknumber=size(stockreturn,2);

returndata=stockreturn;%daily return
returnvector=mean(returndata)';%expected return for each stock
varmatrix=cov(returndata); %covariance matrix

%LHS matrix
A=[2*varmatrix returnvector ones(stocknumber,1);
    returnvector' 0 0;
    ones(stocknumber,1)' 0 0];
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%range of portfolio return
maxreturn=max(returnvector);
minreturn=min(returnvector);

%simulate targeted returns
interval=(0:0.01:1);
portreturn=zeros(size(interval));
portrisk=zeros(size(interval));
for i=1:length(interval)
targetreturn=minreturn+interval(i)*(maxreturn-minreturn);
RHS=[zeros(stocknumber,1);targetreturn;1];
OW=inv(A)*RHS;
weights=OW(1:stocknumber);
portreturn(i)=targetreturn;
portrisk(i)=sqrt(weights'*varmatrix*weights);
end

figure(2);scatter(portrisk,portreturn);
xlim([0,0.03]);ylim([0,0.0025]);


%% portfolio with highest Sharpe Ratio
%long only constraint:   Aw ? b   where A=-eye(3), b=zeros(3,1) which becomes w ? 0
% budget constraint: Aw=b  where A=[1 1 ... 1], b=1 which becomes ?wi = 1
n=stocknumber; %number of stocks
A=zeros(n+1,n);
A(1,:)=1;
A(2:end,:)=-eye(n);
b = zeros(n+1,1);
b(1,1)=1;

%Supply a starting point and invoke an optimization routine:
      W0 = 1/n*ones(n,1);    % Starting guess at the solution
      f1 = @(W)sharperatio(W, returnvector,varmatrix);
      [opw,fval] = fmincon(f1,W0,A,b);


figure(1); scatter(stdportreturn,meanportreturn), hold on;
xlim([0.008,0.02]);
scatter(opw'*varmatrix*opw,opw'*returnvector,'x','r'),hold off;
```