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/* MSBA 5511 Financial Analytics */
/* Prof. Tina Zhang */
/* Jackie Ocaña */


PROC IMPORT OUT=stockdata
            DATAFILE= "/home/u63343340/HW/Final_optimization_bac_msft_student.xlsx"
            DBMS=XLSX REPLACE;
     GETNAMES=YES;
     DATAROW=2;
RUN;

data sd1;
set stockdata;
rename "BAC_Adj Close"n=bac_adj_close;
rename "MSFT_Adj Close"n=msft_adj_close;
run;

proc sort data=sd1;
by date;
run;

data sd1;
set sd1;
ret1bac=bac_adj_close/lag(bac_adj_close)-1;
ret2msft=msft_adj_close/lag(msft_adj_close)-1;
run;

/*matrix*/
ods select Cov PearsonCorr;
proc corr data=work.sd1 noprob outp=OutCorr
          nomiss
          cov;

var ret1bac ret2msft;
run;

proc contents data=outcorr;
run;

/* part 3a */
proc optmodel;

 num dsid = open('OutCorr');
 num ncol = attrn(dsid,'nvar');/* the attrn function: NVARS-specifies the number of variables in the data set.*/

 set ASSETS = setof {j in 3..ncol} varname(dsid,j);

 num coeff{ASSETS,ASSETS};

 num r{ASSETS};

 read data OutCorr(where=(_TYPE_='COV')) into [_NAME_]
  {j in ASSETS} <coeff[_NAME_,j] = col(j)>;

 read data OutCorr(where=(_TYPE_='MEAN')) into [_NAME_]
   {j in ASSETS} <r[j] = col(j)>;

 print coeff;
 print r;


 var x{ASSETS};
 /*no shorts*/

 /* low variance */
 minimize f = sum{i in ASSETS, j in ASSETS}coeff[i,j]*x[i]*x[j];

/* contraints */
 con weights: sum{i in ASSETS}x[i] =1;/*x1+x2+...+xn=1*/
 con targetr: sum{i in ASSETS}r[i]*x[i] =0.001;
/*  the value mentioned gets changed multiple times */

 solve with qp;
 print x;


/* std dev */
data null;
  my_value = 0.0001674922;
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   my_sqrt_value = sqrt(my_value);
   put my_sqrt_value=;
 run;

 /* part 3b-1 */

 proc optmodel;

  num dsid = open('OutCorr');
  num ncol = attrn(dsid,'nvar');

  set ASSETS = setof {j in 3..ncol} varname(dsid,j);

  num coeff{ASSETS,ASSETS};

  num r{ASSETS};

  read data OutCorr(where=(_TYPE_='COV')) into [_NAME_]
   {j in ASSETS} <coeff[_NAME_,j] = col(j)>;

  read data OutCorr(where=(_TYPE_='MEAN')) into [_NAME_]
    {j in ASSETS} <r[j] = col(j)>;

  print coeff;
  print r;

  var x{ASSETS};

  minimize f = sum{i in ASSETS, j in ASSETS}coeff[i,j]*x[i]*x[j];

  con weights: sum{i in ASSETS}x[i] =1;

 /*  change number here */
  con targetr: sum{i in ASSETS}r[i]*x[i] =0.0001;

  solve with qp;
  print x;


 /* 3b-1 std dev */
 data null;

 /* this is objective value */
   my_value = 0.0004743726;
   my_sqrt_value = sqrt(my_value);
   put my_sqrt_value=;
 run;

 /* part 3b-2 */

 proc optmodel;

  num dsid = open('OutCorr');
  num ncol = attrn(dsid,'nvar');

  set ASSETS = setof {j in 3..ncol} varname(dsid,j);

  num coeff{ASSETS,ASSETS};

  num r{ASSETS};

  read data OutCorr(where=(_TYPE_='COV')) into [_NAME_]
   {j in ASSETS} <coeff[_NAME_,j] = col(j)>;

  read data OutCorr(where=(_TYPE_='MEAN')) into [_NAME_]
    {j in ASSETS} <r[j] = col(j)>;

  print coeff;
  print r;


  var x{ASSETS};

  minimize f = sum{i in ASSETS, j in ASSETS}coeff[i,j]*x[i]*x[j];

  con weights: sum{i in ASSETS}x[i] =1;

 /*  change number here */
  con targetr: sum{i in ASSETS}r[i]*x[i] =0.00001;

  solve with qp;
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  print x;


 /* 3b-2 std dev */
 data null;

 /* this is objective value */
   my_value = 0.0005437955;
   my_sqrt_value = sqrt(my_value);
   put my_sqrt_value=;
 run;

 /* part 3b-3 */

 proc optmodel;

  num dsid = open('OutCorr');
  num ncol = attrn(dsid,'nvar');

  set ASSETS = setof {j in 3..ncol} varname(dsid,j);

  num coeff{ASSETS,ASSETS};

  num r{ASSETS};

  read data OutCorr(where=(_TYPE_='COV')) into [_NAME_]
   {j in ASSETS} <coeff[_NAME_,j] = col(j)>;

  read data OutCorr(where=(_TYPE_='MEAN')) into [_NAME_]
    {j in ASSETS} <r[j] = col(j)>;

  print coeff;
  print r;


  var x{ASSETS};

  minimize f = sum{i in ASSETS, j in ASSETS}coeff[i,j]*x[i]*x[j];

  con weights: sum{i in ASSETS}x[i] =1;

 /*  change number here */
  con targetr: sum{i in ASSETS}r[i]*x[i] =0.00009;

  solve with qp;
  print x;


 /* 3b-3 std dev */
 data null;

 /* this is objective value */
   my_value = 0.0005437955;
   my_sqrt_value = sqrt(my_value);
   put my_sqrt_value=;
 run;

 /* part 3b-4 */

 proc optmodel;

  num dsid = open('OutCorr');
  num ncol = attrn(dsid,'nvar');

  set ASSETS = setof {j in 3..ncol} varname(dsid,j);

  num coeff{ASSETS,ASSETS};

  num r{ASSETS};

  read data OutCorr(where=(_TYPE_='COV')) into [_NAME_]
   {j in ASSETS} <coeff[_NAME_,j] = col(j)>;

  read data OutCorr(where=(_TYPE_='MEAN')) into [_NAME_]
    {j in ASSETS} <r[j] = col(j)>;

  print coeff;
  print r;


  var x{ASSETS};
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 minimize f = sum{i in ASSETS, j in ASSETS}coeff[i,j]*x[i]*x[j];


 con weights: sum{i in ASSETS}x[i] =1;/*x1+x2+...+xn=1*/

/*  change number here */
 con targetr: sum{i in ASSETS}r[i]*x[i] =0.0002;

 solve with qp;

 print x;


/* 3b-4 std dev */
data null;

/* this is objective value */
  my_value = 0.000405496;
  my_sqrt_value = sqrt(my_value);
  put my_sqrt_value=;
run;

/* PART 2 */
/* opening Fama-French data */
PROC IMPORT OUT= work.riskfree
            DATAFILE= "/home/u63343340/HW/F-F_Research_Data_Factors_Daily_CVS.csv"
            DBMS=CSV REPLACE;
     GETNAMES=YES;
     DATAROW=2;
RUN;

data work.riskfree;
set work.riskfree;
rename "Mkt-RF"n=mkt_rf;
run;

PROC CONTENTS DATA=work.RISKFREE;
RUN;

/*narrow down fama french's data to 2016*/
DATA work.riskfree1;
  SET work.riskfree;
  DATE1 = INPUT(PUT(var1,8.),YYMMDD8.);
  FORMAT DATE1 YYMMDD8.;
RUN;

data work.riskfree1;
set work.riskfree1;
year=year(date1);
run;

/*get the risk free data in 2016.*/
data temp;
set work.riskfree1;
where year =2016;
run;

/*fama french data omits the percentage. we convert the data to decimals*/
data temp;
set temp;
rename date=origdate;
mkt_rf_d=mkt_rf/100;
SMB_d=smb/100;
HML_d=hml/100;
RF_d=rf/100;
run;

data work.riskfree2016;
set temp;
drop mkt_rf;
drop smb;
drop hml;
drop rf;
run;

data msft;
set work.sd1;
drop bac_adj_close;
drop ret1bac;
drop msft_adj_close;
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run;

/*sas merge many to many*/
proc sql;
  create table work.msftriskfree2016 as
  select  *
  from work.msft c, work.riskfree2016 r
  where c.date=r.date1
  order by c.date, r.date1;
quit;

/*test print the merged dataset, just take a look*/
proc print data=work.msftriskfree2016 (obs=100);
run;

/*APT regression*/
data work.aptmodel;
set work.msftriskfree2016;
rp=ret2msft-RF_d;/*y variable*/
mrp=mkt_rf_d;/*x variable in CAPM*/
run;

proc reg data=work.aptmodel;
capm: model rp = mrp;
FF_3Factor: model rp=mrp smb_d hml_d;
run;
```