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***** ANIMAL BREEDING NOTES *****
***** CHAPTER 19 DMRAM *****
***** DIRECT MATERNAL REDUCED ANIMAL MODEL *****
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=====

dm 'clear log; clear output;';
ods output clear;
=====

libname libiml 'C:\home\pkg\SAS\IML\ANS6386\2010';
=====

*options nodate nocenter ls=150 ps=32767;
options date nocenter ls=150 ps=32767;
=====

*** To print the list of GDEVICES used by PROC GPLOT ***;
=====

/*proc gdevice catalog=sashelp.devices nofs; list; run; quit;*/
=====

ods trace on / label;
ods graphics on;

goptions reset=all
      cback=white noborder
      colors=(black blue green red)
      ftitle=swissb ftext=swissb htitle=6 htext=3; /* ctext=red ctitle=red; */
      *device=gif;
=====

*** Write date as Month day, year ***;
=====

%macro fdate(fmt);
  %global fdate;
  data _null_;
    call symput("fdate",left(put("&sysdate9" d,&fmt)));
  run;
%mend fdate;
=====

%fdate(worddate.); *** Get today's date ***;
=====

%let runname=UABM_19_DMRAM_Example_February-18-2010_a &fdate; ** Change once; *Use throughout
program **;
title1 &runname;
=====

*** Create html files in the directory for outputs ***;
=====

ods listing close;
ods html
style=default      /** [default, d3d, minimal] name the format style of the output **/
=====

*** PATH FOR WORK HTML FILES ***
path="C:\home\pkg\SAS\IML\ANS6386\2010\Outputs\WORK" (url=none) /** location of WORK html files
=====
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**/
gpath="C:\home\pkg\SAS\IML\ANS6386\2010\Outputs\WORK"           /** location of WORK graph files
**/


/* *** NAMES OF html FILES ***
body=&runname._body.html"          /** name of body file */
contents=&runname._contents.html"  /** name of contents file */
page=&runname._page.html"         /** name of page file */
frame=&runname._frame.html";      /** name of frame file */
=====
=====

***** NO INPUT FILE *****;
=====

=====

*%macro solvemme;
proc iml;

start solve;
print 'ANIMAL BREEDING NOTES';
print 'CHAPTER 19 DMRAM';
print 'DIRECT MATERNAL REDUCED ANIMAL MODEL';
print 'Mauricio A. Elzo, University of Florida, maelzo@ufl.edu';

=====
print 'Enter Parameters for Current Run';
print 'Enter restronsol = 1 to impose restrictions on solutions to solve the MME, else = 0 if not';
restronsol=0; print restronsol;
if restronsol > 0 then print 'Restrictions imposed on solutions to solve the mixed model equations (MME)';
else print 'No restrictions imposed on solutions to solve MME';

=====
print 'Dataset = Weaning weight dataset used in Chapter 16 for AM and RAM';
=====

print 'Enter nt = Number of traits';
nt=1; print nt;
print 'Enter nrec = Number of records';
nrec=13; print nrec;
print 'Enter nanim = Number of animals';
nanim=15; print nanim;
print 'Enter nf = Number of fixed effects in the MME';
nf=2; print nf;
print 'Enter nga = Number of random additive direct and maternal genetic effects in the MME';
nga=20; print nga;
print 'npe = Number of random permanent environmental effects in the MME';
npe=6; print npe;
print 'Compute neq = nf+nga+npe = total number of MME';
neq=nf+nga+npe; print neq;

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print 'Enter X = matrix of fixed sex effects';
X={1 0,
   1 0,
   1 0,
   0 1,
   0 1,
   0 1,
   0 1,
   0 1,
   1 0,
   1 0,
   0 1,
   1 0,
   0 1};
print X;

print 'Enter Z = [ZD | 0.5P] = matrix of direct and maternal parental additive genetic effects';
print 'Direct = first 10 columns of Z (animals 1 to 10)';

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.5 0 0 0 1 0 0 0 0 0,
0 .5 .5 0 0 1 0 0 0 0,
0 0 .5 0 0 .5 1 0 0 0,
0 0 0 .5 0 0 .5 1 0 0,
0 0 0 0 .5 0 0 .5 1 0,
0 0 0 0 .5 0 0 0 .5 1;
print T;

print 'Compute TT = transpose of T';
TT=t(T); print TT;

print 'Enter diagonal elements of matrix D';
dvec={1, .75, .5, .75, .75, .4375, .34375, .375, .45703125, .462890625};
print dvec;

print 'Construct diagonal matrix D';
D=diag(dvec); print D;

print 'Compute D inverse';
DINV=inv(D); print DINV;

=====
print 'Compute AINV = TT*DINV*T = inverse of the relationship matrix A';
AINV=TT*DINV*T; print AINV;

print 'Compute GOR = matrix of ratios of direct and maternal covariances to the residual variance';
GOR=G0/ve; print GOR;

print 'Compute vper = ratio of vpe to ve';
vper=vpe/ve; print vper;

print 'Compute IGOR = inverse of GOR';
IGOR=inv(GOR); print IGOR;

print 'Compute ivper = inverse of vper';
ivper=inv(vper); print ivper;

print 'Compute GINV = AINV@IGOR = inverse of matrix G, where @ = direct product';
GINV=AINV@IGOR; print GINV;

=====
print 'Compute PEINV = I*ivper, where I = 6 x 6 identity matrix (6 dams)';
IMAT=i(6); print IMAT;
PEINV=IMAT*ivper; print PEINV;

=====
print 'Enter dnvec = vector containing the diagonal elements of matrix DN';
print 'Notice that the nonzero elements correspond to nonparents';
dnvec={0,0,0,0,0,0,.34375,.375,.45703125,.462890625,.4189453125};
print dnvec;

print 'Compute g011r = g011/ve, i.e., ratio of additive direct variance to residual variance';
g011r=G0[1,1]/ve; print g011r;

print 'Construct DN = diagonal matrix of residual additive direct genetic variances';
DN=diag(dnvec)*g011r; print DN;

print 'Construct R = (I + DN) = residual covariance matrix for the MME';
R=i(13)+DN; print R;

=====
print 'Compute invr = inverse of R';
invr=inv(R); print invr;

=====
print 'Compute lhs = left hand side of the MME';
print 'Compute xft = transpose of xf';
xft=t(xf); print xft;

print 'Compute xftinvr = xf transpose times invr';
xftinvr=xmult(xft,invr); print xftinvr;

print 'Compute xtinvrx = xf transpose times invr times xf';
xftinvrxf=xmult(xftinvr,xf); print xftinvrxf;

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print 'Add GINV and PEINV to the appropriate submatrices of xftinvrxf';
lhs=xftinvrxf;
print xftinvrxf ginv peinv;
do i=nf+1 to neq;
  do j=nf+1 to neq;
    if i <= nf+nga & j <= nf+nga then lhs[i,j]=lhs[i,j]+ginv[i-nf,j-nf]; *Add ginv elements
to lhs;
    else if i > nf+nga & j > nf+nga then lhs[i,j]=lhs[i,j]+peinv[i-nf-nga,j-nf-nga]; *Add
peinv elements to lhs;
  end;
end;
print lhs;
print lhs [format=6.3];
=====
print 'Compute rhs = xftinvr*y';
rhs=xftinvr*y;
print rhs;
print rhs [format=6.2];
=====

if restronsol > 0 then do;
  print 'Impose restrictions on solutions';
  print 'Set solution for mean to zero';
  do i=1 to neq;
    if i=1 then do; *Set solutions for mean to zero;
    rhs[i]=0;
    do j=1 to neq;
      lhs[i,j]=0;
      lhs[j,i]=0;
    end;
    end;
  end;
  print 'lhs after restrictions';
  print lhs [format=6.3];
end;
=====
print 'Compute ginvlhs = generalized inverse of the left hand side of the MME';
ginvlhs=ginv(lhs);
print ginvlhs [format=9.6];
print ginvlhs [format=6.3];

print 'Compute gl = ginvlhs*lhs = matrix of expectations of solutions';
gl=ginvlhs*lhs;
print gl [format=6.3];

print 'Notice that lg = gl (i.e., lhs*ginvlhs = lhs*ginvlhs)';
lg=lhs*ginvlhs;
print lg [format=6.3];

print 'Verify that lgl = lhs (i.e., lhs*ginvlhs*lhs = lhs => generalized inverse is correct)';
lgl=lhs*ginvlhs*lhs;
print lgl [format=6.3];

print 'Compute ranklhs = rank of the MME = trace of ginvlhs*lhs';
ranklhs=round(trace(gl));
print ranklhs;

print 'Compute sol = vector of solutions for the MME';
sol=ginvlhs*rhs;
print sol;
print sol [format=6.2];

print 'Compute sesol = standard error of solutions';
sesol=j(neq,1,0);
do i=1 to neq;
  if lhs[i,i] > 0 then do;
    sesol[i]=sqrt(ginvlhs[i,i]);
  end;
end;
print sesol [format=6.2];

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*=====
finish solve;
*=====

*=====
*=====
*=====

run solve;
*=====

*** Final statements ***;
*=====

quit; *** Must be placed BEFORE the ods statements below !!!! ***;
*%mend solvemme;

*%solvemme;
*run;

ods csv close;
ods graphics off;
ods html close;
*ods listing;
ods trace off;
```