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***** ANIMAL BREEDING NOTES *****
***** CHAPTER 21 MTM *****
***** MULTIPLE TRAIT MODELS (ANIMAL MODEL) *****
***** Mauricio A. Elzo
***** University of Florida
***** Gainesville, FL 32611-0910
***** Tel: 1-352-392-7564
***** Email: maelzo@ufl.edu
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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;

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

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=====;
*** Write date as Month day, year ***;
*=====
=====;
%macro fdate(fmt);
  %global fdate;
  data _null_;
    call symput("fdate",left(put("&sysdate9'd,&fmt)));
  run;

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%mend fdate;
*=====
=====;
%fdate(worddate.); *** Get today's date ***;
*=====
=====;
*=====
=====;
%let runname=UABM_21_MTAM_Example_February-20-2010_a &fdate; ** Change
once; *Use throughout program **;
title1 &runname;
*=====
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=====;
*** 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 */
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 21 MTM';

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print 'Compute Ainv    = transpose(Tinv)*Dinv*Tinv';
Ainv=(t(Tinv)*Dinv)*Tinv; print Ainv;

print 'Compute Ginv = inv(g0)@Ainv for all animals (@ = direct product)';
Ginv=inv(g0)@Ainv; print Ginv;

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=====
print 'Computation of R inverse for nt traits';

print 'Enter ve = residual covariance matrix';
r0={8 8, 8 88}; print r0;

print 'Compute block-diagonal environmental matrix EN = r0@i(ncafrec)
animals with records (5 animals)';
EN=r0@i(ncafrec); print EN;

print 'Construct R = (DN + EN) = residual covariance matrix for
nonparents';
R=EN; print R;

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

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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;

print 'Add GINV to the appropriate submatrices of xftinvrxf';
lhs=xftinvrxf;
print xftinvrxf ginv ;
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;
  end;
end;
print lhs;
print lhs [format=6.3];

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print 'Compute rhs = xftinvr*y';
rhs=xftinvr*y;
print rhs;
print rhs [format=6.2];

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if restronsol > 0 then do;
   print 'Impose restrictions on solutions';
   print 'Set solution for mean of each trait to zero';
   do i=1 to neq;
      if i=1 then do; *Set solutions for mean of each trait 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;

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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 (Breeding Values)';
sol=ginvlhs*rhs;
print sol;
print sol [format=6.2];

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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];

print 'Check that animal solutions sum to zero, i.e., Ginv*animsol = 0';
print 'Extract animsol from sol: animsol=sol(nf+1, ..., nf+nanim*nt)';
animsol=j(nanim*nt,1,0);
do i=1 to nanim*nt;
  animsol[i]=sol[nf+i];
end;
print sol animsol;

print 'Compute sumanimsol = Ginv*animsol';
sumanimsol=sum(Ginv*animsol);
print sumanimsol;
print sumanimsol [format=6.2];

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finish solve;
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run solve;

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

*%solvemme;
*run;

ods csv close;
ods graphics off;
ods html close;

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*ods listing;  
ods trace off;
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