Simple additive model

Sire model

Animal model

Sire Model

$y = Xb + Zs + e$

$$\begin{bmatrix} X`X & X`Z \\ Z`X & Z`Z+\alpha A^{-} \end{bmatrix} \begin{bmatrix} b \\ s \end{bmatrix} = \begin{bmatrix} X`y \\ Z`y \end{bmatrix}$$

Data Description

Data file:

ID	sex	sire	wwt(kg)
4	M	1	4.5
5	F	2	2.9
6	F	1	3.9
7	M	3	3.5
8	M	2	5.0

Pedigree file:

sire	ss	ds
1	0	0
2	0	0
3	1	0

Vs = 5, Ve = 55

alpha = Ve/Vs

alpha = (1-.25*h2)/.25*h2

Start computing

```
PROC IML;
  X = {1 0,
       0 1,
       0 1,
       1 0,
       1 0};

  Z = {1 0 0,
       0 1 0,
       1 0 0,
       0 0 1,
       0 1 0};

  y = {4.5,2.9,3.9,3.5,5.0};

  A = {1   0   0.5,
       0   1   0,
       0.5 0   1.0};

  Ai = inv(A);

  Vs = 5; Ve = 55;
  alpha = Ve/Vs;
```

MME Setup

```
XPX  = X`*X;
XPZ  = X`*Z;
ZPZ  = Z`*Z;
ZPZ2 = Z`*Z+alpha#Ai;

lhs = (X`*X || X`*Z          )//
      (Z`*X || Z`*Z+alpha#Ai );

rhs = X`*y // Z`*y;
sol = GINV(lhs)*rhs;
```

Compute accuracy

```
Di   = vecdiag(GINV(lhs));
PEV = Di#Ve;
I    = J(5,1,1);
Acc=J(5,1,.);
Acc[3:5,]   = SQRT(I[3:5,]-Di[3:5,]#alpha);
```

Output

SOL		DI	PEV	ACC
b1	4.336	0.374	20.543	.
b2	3.382	0.545	29.982	.
s1	0.022	0.084	4.615	0.278
s2	0.014	0.083	4.554	0.299
s3	-0.043	0.086	4.751	0.223

Animal Model
y = Xb + Zu + e

$$\begin{bmatrix} X`X & X`Z \\ Z`X & Z`Z+\alpha A^{-} \end{bmatrix} \begin{bmatrix} b \\ s \end{bmatrix} = \begin{bmatrix} X`y \\ Z`y \end{bmatrix}$$

Data Description

Data file:

ID	sex	sire	wwt(kg)
4	M	1	4.5
5	F	2	2.9
6	F	1	3.9
7	M	3	3.5
8	M	2	5.0

Pedigree file:

anim	s	d
1	0	0
2	0	0
3	0	0
4	1	0
5	3	2
6	1	2
7	4	5
8	3	6

Va = 20 Ve = 40

alpha = Ve/Va

alpha = (1-h2)/h2

Start computing

```
A = {1   0   0  .5    0   .5  .25 .25,
     0   1   0   0   .5   .5  .25 .25,
     0   0   1   0   .5    0  .25 .5,
    .5   0   0   1    0  .25 .5   .125,
     0  .5  .5   0    1  .25 .5   .375,
    .5  .5   0  .25  .25   1  .25 .5,
    .25 .25 .25 .5   .5   .25  1  .25,
    .25 .25 .5  .125 .375 .5  .25  1};

Ai = inv(A);

Va = 20; Ve = 40;
alpha = Ve/Va;
```

MME Setup

```
XPX  = X`*X;
XPZ  = X`*Z;
ZPZ  = Z`*Z;
ZPZ2 = Z`*Z+alpha#Ai;

lhs = (X`*X || X`*Z          )//
      (Z`*X || Z`*Z+alpha#Ai );

rhs = X`*y // Z`*y;
sol = GINV(lhs)*rhs;
```

Compute accuracy

```
Di  = vecdiag(GINV(lhs));
PEV = Di#Ve;
I   = J(10,1,1);
Acc=J(10,1,.);
Acc[3:10,]  = SQRT(I[3:10,]-Di[3:10,]#alpha);
```

Output

SOL		DI	PEV	ACC
b1	4.359	0.596	23.822	.
b2	3.404	0.802	32.098	.
u1	0.098	0.471	18.844	0.240
u2	-0.019	0.492	19.684	0.126
u3	-0.041	0.456	18.258	0.295
u4	-0.009	0.428	17.107	0.380
u5	-0.186	0.428	17.124	0.379
u6	0.177	0.442	17.691	0.340
u7	-0.249	0.442	17.674	0.341
u8	0.183	0.422	16.895	0.394

Repeatability model

Sire model

with repeated daughter records

Animal model

with repeated records

Sire Model with Repeated records

$y = Xb + Zs + Wp + e$

$$\begin{bmatrix} X`X & X`Z & X`W \\ Z`X & Z`Z+\alpha\#A_i & Z`W \\ W`X & W`Z & W`W+\gamma \#I \end{bmatrix} \begin{bmatrix} b \\ s \\ pe \end{bmatrix} = \begin{bmatrix} X`y \\ Z`y \\ W`y \end{bmatrix}$$

Data Description

Data file:

cow	herd	lact	sire	fat (kg)
11	1	1	1	5
11	1	2	1	6
11	1	3	1	4
12	1	1	1	5
12	1	2	1	8
13	1	2	2	9
13	1	3	2	4
14	2	1	1	7
14	2	2	1	6
15	2	2	2	5
15	2	3	2	4
16	2	4	2	4

Pedigree file:

sire	ss	ds
1	0	0
2	1	0
3	2	0

Vs = 5, Vpe = 15, Ve = 40

alpha = Ve/Vs, gamma = Ve/Vpe

alpha = (1-t)/.25*h2

gamma=(1-t)/(t-.25*h2)

Start computing

```
PROC IML;
 X = {1 0 1 0 0 0,   Z = {1 0 0,   W = {1 0 0 0 0 0,
 y = {5,6,4,5,8,9,4,7,6,5,4,4};

 A = { 1   .50 .25,
       .50  1   .50,
       .25 .50   1};

 Ai = inv(A);

 Vs = 5; Vpe = 15; Ve = 40;
 alpha = Ve/Vs; gamma = Ve/Vpe;
```

MME Setup

```
XPX  = X`*X;
XPZ  = X`*Z;
XPW  = X`*W;
ZPZ  = Z`*Z;
ZPW  = Z`*W;
WPW  = W`*W;
ZPZ2 = Z`*Z+alpha#Ai;
WPW2 = W`*W+gamma#I(6);

lhs = (X`*X || X`*Z          || X`*W           )//
      (Z`*X || Z`*Z+alpha#Ai || Z`*W           )//
      (W`*X || W`*Z          || W`*W+gamma#I(6));
rhs = X`*y // Z`*y // W`*y;
sol = GINV(lhs)*rhs;
```

Compute accuracy

```
Di   = vecdiag(GINV(lhs));
PEV = Di#Ve;
I    = J(15,1,1);
Acc =J(15,1,.);
Acc[7:9,]    = SQRT(I[7:9,]-Di[7:9,]#alpha);
Acc[10:15,] = SQRT(I[10:15,]-Di[10:15,]#gamma);
```

Output

SOL		DI	PEV	ACC
b1	3.716	0.317	12.691	.
b2	3.160	0.286	11.460	.
b3	2.184	0.374	14.951	.
b4	3.309	0.237	9.476	.
b5	0.558	0.361	14.459	.
b6	0.824	1.187	47.480	.
s1	-0.016	0.121	4.848	0.174
s2	0.016	0.121	4.848	0.174
s3	0.008	0.124	4.962	0.087
pe1	-0.380	0.256	10.251	0.563
pe2	0.023	0.274	10.959	0.519
pe3	0.357	0.280	11.196	0.504
pe4	0.261	0.307	12.265	0.427
pe5	-0.261	0.307	12.265	0.427
pe6	0.000	0.375	15.000	0.000

Animal Model with Repeated records

$y = Xb + Zu + Wp + e$

$$\begin{bmatrix} X`X & X`Z & X`W \\ Z`X & Z`Z+\alpha A^{-1} & Z`W \\ W`X & W`Z & W`W+\gamma I \end{bmatrix} \begin{bmatrix} b \\ u \\ pe \end{bmatrix} = \begin{bmatrix} X`y \\ Z`y \\ W`y \end{bmatrix}$$

Data Description

Data file:

cow	lact	hys	fat (kg)
4	1	1	201
4	2	3	280
5	1	1	150
5	2	4	200
6	1	2	160
6	2	3	190
7	1	1	180
7	2	3	250
8	1	2	285
8	2	4	300

Pedigree file:

anim	s	d
1	0	0
2	0	0
3	0	0
4	1	2
5	3	2
6	1	5
7	3	4
8	1	7

Va = 20 Vpe = 12 Ve = 28 alpha = Ve/Va. gamma = Ve/Vpe

alpha = (1-t)/h2, gamma = (1-t)/(t-h2)

```
A = {1    0    0   .5    0   .5   .25  .625,
     0    1    0   .5   .5   .25  .25  .125,
     0   .5    1    0   .5   .25  .5   .25,
    .5   .5    0    1  .25  .375  .5   .5,
     0   .5   .5  .25    1   .5   .375 .188,
    .5  .25  .25 .375  .5    1   .313 .406,
    .25 .25   .5   .5  .375 .313  1   .625,
    .625 .125 .25 .5   .188 .406 .625  1.125}
```

SOL		DI	PEV	ACC
b1	131.670	0.300	8.392	.
b2	161.266	0.298	8.346	.
b3	43.802	0.336	9.416	.
b4	87.869	0.424	11.871	.
b5	80.631	0.334	9.348	.
b6	80.635	0.408	11.424	.
u1	10.149	0.639	17.898	0.324
u2	-3.086	0.679	19.017	0.222
u3	-7.063	0.651	18.238	0.297
u4	13.581	0.609	17.064	0.383
u5	-18.196	0.589	16.486	0.419
u6	-18.394	0.618	17.293	0.368
u7	9.317	0.614	17.180	0.375
u8	24.197	0.660	18.466	0.277
pe1	0.000	0.429	12.000	0.000
pe2	0.000	0.429	12.000	0.000
pe3	0.000	0.429	12.000	0.000
pe4	8.416	0.330	9.235	0.480
pe5	-7.150	0.342	9.579	0.449
pe6	-17.226	0.336	9.416	0.464
pe7	-1.386	0.326	9.130	0.489
pe8	17.346	0.348	9.734	0.435