Random regression test-day model

Classical model

(Schaeffer and Dekkers)

LeGendre model

```
Animal Model with Random Regression Testday

y = HTD + Xibi + Ziui + Wp + e

Classical model: Schaeffer and Dekkers
f(dim)=1+dim+ln(305/dim)


[X`*Ri*X  X`*Ri*Z        X`*Ri*W        ][b ]   [X`*Ri*y]
[Z`*Ri*X  Z`*Ri*Z+Gi@Ai  Z`*Ri*W        ][u ] = [Z`*Ri*y]
[W`*Ri*X  W`*Ri*Z        W`*Ri*W+1/Vpe#I][pe]   [W`*Ri*y]
```

Data Description

Data file:

cow	htd	dim	ln(305/dim)	milk (kg/d)
1	1	10	3.42	14
1	3	40	2.03	20
1	5	70	1.47	18
2	2	12	3.24	18
2	4	42	1.98	23
2	6	72	1.44	19
3	2	60	1.63	16
3	4	120	0.93	16
3	6	150	0.71	15

Pedigree file:

anim	s	d
1	0	0
2	1	0
3	1	0

```
Va = { 280 -1.8  4.5,
       -1.8  0.5 -0.2,
        4.5 -0.2  5.0}

Ve = 500, Vpe = 300;
```

Start computing

Fixed effects for HTD

```
X1 = {1 0 0 0 0 0,
      0 0 1 0 0 0,
      0 0 0 0 1 0,
      0 1 0 0 0 0,
      0 0 0 1 0 0,
      0 0 0 0 0 1,
      0 1 0 0 0 0,
      0 0 0 1 0 0,
      0 0 0 0 0 1};
```

Fixed effects for DIM

```
X2 = {1  10 3.42,
      1  40 2.03,
      1  70 1.47,
      1  12 3.24,
      1  42 1.98,
      1  72 1.44,
      1  60 1.63,
      1 120 0.93,
      1 150 0.71};
```

Combined fixed effects

```
X  = X1 || X2;
```

```
Z1 = {1 0 0,
      1 0 0,
      1 0 0,
      0 1 0,
      0 1 0,
      0 1 0,
      0 0 1,
      0 0 1,
      0 0 1};
```

Kronecor product Z with dim function which has 3 column of parameters

```
Z = (X2#Z1[,1])||(X2#Z1[,2])||(X2#Z1[,3])
```

No random regression on PE effects

```
W = Z1;

y = {14,20,18,18,23,19,16,16,15};

A = { 1  .5   .5 ,
     .5   1   .25,
     .5  .25   1};

Ai = inv(A);
```

```
G = { 280 -1.8  4.5,
     -1.8  0.5 -0.2,
      4.5 -0.2  5.0};
Ve  = 500;
Vpe = 300;

Gi = INV(G);
Ri = 1/Ve;
```

MME Setup

```
XPX  = X`*Ri*X;
XPZ  = X`*Ri*Z;
XPW  = X`*Ri*W;
ZPZ  = Z`*Ri*Z;
ZPW  = Z`*Ri*W;
WPW  = W`*Ri*W;
ZPZ2 = Z`*Ri*Z+Gi@Ai;
WPW2 = W`*Ri*W+1/Vpe#I(3);

lhs = (X`*Ri*X || X`*Ri*Z       || X`*Ri*W           )//
      (Z`*Ri*X || Z`*Ri*Z+Gi@Ai || Z`*Ri*W           )//
      (W`*Ri*X || W`*Ri*Z       || W`*Ri*W+1/Vpe#I(3));

rhs = X`*Ri*y // Z`*Ri*y // W`*Ri*y;

sol = GINV(lhs)*rhs;
```

Calculate total EBV and Persistency

```
Point1  = 1 || 60  || LOG(305/60);
Point2  = 1 || 280 || LOG(305/280);
```

first animal start at row 10 of sol
Initialize EBVt, 3 rows, 1 col with zero value
Initialize Persistency, 3 rows, 1 col with zero value

```
init    = 10;
EBVt    = J(3,1,0);
Persist = J(3,1,0); Persist2 = J(3,1,0);
```

```
DO j = 1 TO 3;                    j for number of animals
  DO i = 1 TO 305;                  i for dim
    dim  = i;
    DVEC = 1 || dim || LOG(305/dim);
    UVEC = sol[init:init+2,]; 2 is number of function parameters-1
    EBVt[j,] = EBVt[j,]+DVEC*UVEC;
  END;
```

Aproximate Persistency calculated area under curve or slope where: triangle area (P1) = 1/2 x base x height, slope (P2) = height/base, base = 220 d different from 280-60, height = different value from EBV280-EBV60

```
  Persist[j,]  = 1/2*220*(ABS(Point2*UVEC-Point1*UVEC));
  Persist2[j,] = (ABS(Point2*UVEC)-ABS(Point1*UVEC))/220;
  init = init+3;
END;
```

Analysis of genetic lactation curve

Create SAS dataset

```
CREATE GMdata VAR{mean dim};
DO i = 1 TO 300 BY 10;              i for dim
  dim  = i;
  DVEC = 1 || dim || LOG(305/dim);
  BVEC = sol[7:9,];  b1,b2,b3 for dim is row 7-9 of sol
  MEAN = DVEC*BVEC;  predict milk for each testday
  APPEND;
END;
```

Create SAS dataset

```
CREATE ANIMdata VAR{anim dim EBV PROD};
init = 10;        first animal start at row 10 of sol
DO j = 1 TO 3;        j for number of animals
  anim = j;
  DO i = 1 TO 300 BY 10;  i for dim
    dim  = i;
    DVEC = 1 || dim || LOG(305/dim);
    BVEC = sol[7:9,];  b1,b2,b3 for dim is row 7-9 of sol
    UVEC = sol[init:init+2,];
    MEAN = DVEC*BVEC;     2 is function parameters-1
    EBV  = DVEC*UVEC;
    PROD = MEAN+EBV;
    APPEND;
  END;
  init = init+3;
END;
```

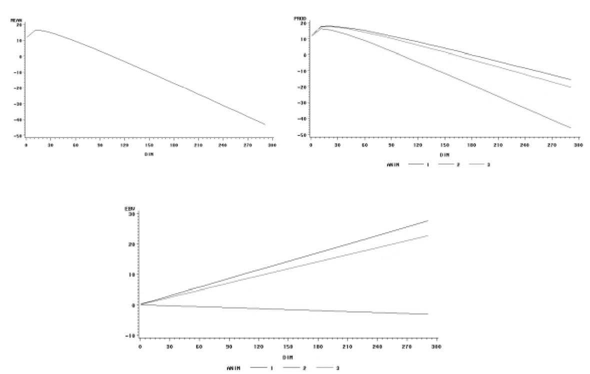
PLOT Genetic Lactation Curve

```
PROC GPLOT DATA=GMdata;
  SYMBOL1 I=JOIN;
  PLOT MEAN*dim /HAXIS = 0 TO 300 BY 30;

PROC GPLOT DATA=ANIMdata;
  SYMBOL1 I=JOIN;
  PLOT EBV*dim = anim /HAXIS = 0 TO 300 BY 30;

PROC GPLOT DATA=ANIMdata;
  SYMBOL1 I=JOIN;
  PLOT PROD*dim = anim /HAXIS = 0 TO 300 BY 30;
RUN;
```

Output

SOL	
htd1	-3.478
htd2	1.821
htd3	3.047
htd4	10.388
htd5	3.998
htd6	13.179
b1	28.955
b2	-0.247
b3	-2.947
u11	0.048
u12	0.094
u13	0.024
u21	-0.005
u22	-0.010
u23	-0.003
u31	0.039
u32	0.078
u33	0.020
pe1	-0.000
pe2	-0.023
pe3	0.023

	EBVT	PERSIST	PERSIST2
a1	4428.545	2281.152	0.094
a2	-492.061	253.461	0.010
a3	3655.307	1882.855	0.078



```
Animal Model with Random Regression Testday

y = HTD + Xibi + Ziui + Wipi + e

LeGendre Model: f(dim) = L1 + L2 + L3
L1 = 1, L2 = 1+sqrt(3)*L,L3 = +sqrt(5/4)*(3*L^2-1)
L = -1+2*(dim-1)/(305-1)

[X`*Ri*X  X`*Ri*Z        X`*Ri*W     ][b ]   [X`*Ri*y]
[Z`*Ri*X  Z`*Ri*Z+Gi@Ai  Z`*Ri*W     ][u ] = [Z`*Ri*y]
[W`*Ri*X  W`*Ri*Z        W`*Ri*W+Pi@I][pe]   [W`*Ri*y]
```

Data Description

Data file:

cow	htd	dim	L	L2	L3	milk (kg/d)
1	1	10	-0.94	-1.63	1.85	14
1	3	40	-0.74	-1.29	0.74	20
1	5	70	-0.55	-0.95	-0.12	18
2	2	12	-0.93	-1.61	1.77	18
2	4	42	-0.73	-1.26	0.67	23
2	6	72	-0.53	-0.92	-0.17	19
3	2	60	-0.61	-1.06	0.14	16
3	4	120	-0.22	-0.38	-0.96	16
3	6	150	-0.02	-0.03	-1.12	15

Pedigree file:

anim	s	d
1	0	0
2	1	0
3	1	0

```
Va  = {130  2.5    -5,
        2.5   32  -4.5,
         -5 -4.5    35}
Vpe = {520  -40     3,
        -40  110 -0.5,
          3 -0.5   30},
Ve = 500;
```

Start computing

Fixed effects for HTD

```
X1 = {1 0 0 0 0 0,
      0 0 1 0 0 0,
      0 0 0 0 1 0,
      0 1 0 0 0 0,
      0 0 0 1 0 0,
      0 0 0 0 0 1,
      0 1 0 0 0 0,
      0 0 0 1 0 0,
      0 0 0 0 0 1};
```

Fixed effects for DIM

```
X2 = {1  10 3.42,
      1  40 2.03,
      1  70 1.47,
      1  12 3.24,
      1  42 1.98,
      1  72 1.44,
      1  60 1.63,
      1 120 0.93,
      1 150 0.71};
```

Combined fixed effects

```
X  = X1 || X2;
```

```
Z1 = {1 0 0,
      1 0 0,
      1 0 0,
      0 1 0,
      0 1 0,
      0 1 0,
      0 0 1,
      0 0 1,
      0 0 1};
```

Kronecor product Z with dim function which has 3 column of parameters

```
Z = (X2#Z1[,1])||(X2#Z1[,2])||(X2#Z1[,3])
```

Include random regression on PE effects

```
W = Z1;

y = {14,20,18,18,23,19,16,16,15};

A = { 1  .5   .5 ,
     .5   1  .25,
     .5 .25    1};

Ai = inv(A);
```

```
G  = {130  2.5    -5,
      2.5   32  -4.5,
       -5 -4.5    35};
Pe = {520  -40     3,
      -40  110 -0.5,
        3 -0.5    30};
Ve  = 500;

Gi = INV(G);
Pei = INV(Pe);
Ri = 1/Ve;
```

MME Setup

```
XPX  = X`*Ri*X;
XPZ  = X`*Ri*Z;
XPW  = X`*Ri*W;
ZPZ  = Z`*Ri*Z;
ZPW  = Z`*Ri*W;
WPW  = W`*Ri*W;
ZPZ2 = Z`*Ri*Z+Gi@Ai;
WPW2 = W`*Ri*W+Pei@I(3);

lhs = (X`*Ri*X || X`*Ri*Z       || X`*Ri*W         )//
      (Z`*Ri*X || Z`*Ri*Z+Gi@Ai || Z`*Ri*W         )//
      (W`*Ri*X || W`*Ri*Z       || W`*Ri*W+Pei@I(3));

rhs = X`*Ri*y // Z`*Ri*y // W`*Ri*y;

sol = GINV(lhs)*rhs;
```

Calculate total EBV and Persistency

```
Point1  = 1 || 60  || LOG(305/60);
Point2  = 1 || 280 || LOG(305/280);
```

first animal start at row 10 of sol
Initialize EBVt, 3 rows, 1 col with zero value
Initialize Persistency, 3 rows, 1 col with zero value

```
init    = 10;
EBVt    = J(3,1,0);
Persist = J(3,1,0); Persist2 = J(3,1,0);
```

```
DO j = 1 TO 3;                    j for number of animals
  DO i = 1 TO 305;                  i for dim
    dim  = i;
    DVEC = 1 || dim || LOG(305/dim);
    UVEC = sol[init:init+2,];  2 is number of function parameters-1
    EBVt[j,] = EBVt[j,]+DVEC*UVEC;
  END;
```

Aproximate Persistency calculated area under curve or slope where: triangle area (P1) = 1/2 x base x height, slope (P2) = height/base, base = 220 d different from 280-60, height = different value from EBV280-EBV60

```
  Persist[j,]  = 1/2*220*(ABS(Point2*UVEC-Point1*UVEC));
  Persist2[j,] = (ABS(Point2*UVEC)-ABS(Point1*UVEC))/220;
  init = init+3;
END;
```

Analysis of genetic lactation curve

Create SAS dataset

```
CREATE GMdata VAR{mean dim};
DO i = 1 TO 300 BY 10;                 i for dim
  dim  = i;
  DVEC = 1 || dim || LOG(305/dim);
  BVEC = sol[7:9,];  b1,b2,b3 for dim is row 7-9 of sol
  MEAN = DVEC*BVEC;  predict milk for each testday
  APPEND;
END;
```

Create SAS dataset

```
CREATE ANIMdata VAR{anim dim EBV PROD};
init = 10;      first animal start at row 10 of sol
DO j = 1 TO 3;      j for number of animals
  anim = j;
  DO i = 1 TO 300 BY 10;  i for dim
    dim  = i;
    DVEC = 1 || dim || LOG(305/dim);
    BVEC = sol[7:9,];  b1,b2,b3 for dim is row 7-9 of sol
    UVEC = sol[init:init+2,];
    MEAN = DVEC*BVEC;    2 is function parameters-1
    EBV  = DVEC*UVEC;
    PROD = MEAN+EBV;
    APPEND;
  END;
  init = init+3;
END;
```

PLOT Genetic Lactation Curve

```
PROC GPLOT DATA=GMdata;
  SYMBOL1 I=JOIN;
  PLOT MEAN*dim /HAXIS = 0 TO 300 BY 30;

PROC GPLOT DATA=ANIMdata;
  SYMBOL1 I=JOIN;
  PLOT EBV*dim = anim /HAXIS = 0 TO 300 BY 30;

PROC GPLOT DATA=ANIMdata;
  SYMBOL1 I=JOIN;
  PLOT PROD*dim = anim /HAXIS = 0 TO 300 BY 30;
RUN;
```

Output

SOL	
htd1	-3.973
htd2	1.232
htd3	3.408
htd4	11.826
htd5	6.459
htd6	16.658
b1	35.610
b2	-0.275
b3	-4.422
u11	-0.003
u12	-0.005
u13	-0.001
u21	-0.012
u22	-0.025
u23	-0.006
u31	0.013
u32	0.027
u33	0.007
pe11	0.000
pe12	0.029
pe13	0.000
pe21	-0.000
pe22	-0.074
pe23	-0.000
pe31	0.000
pe32	0.020
pe33	0.000

	EBVT	PERSIST	PERSIST2
a1	-236.251	121.693	0.005
a2	-1149.76	592.242	0.024
a3	1244.257	640.919	0.026