Parallel processing

Model description

This example is given by Schaeffer & Dekkers: Random regressions in animal models for test-day production in dairy cattle (Proc. 5th WCGALP, 18:443-446, 1994).

The single trait random regression animal model has the form:

$$\mathbf{y} = f_1(\mathbf{p}, \mathbf{DIM}) + \mathbf{Xb} + f_2(\mathbf{a}, \mathbf{DIM}) + \mathbf{e},$$

where,

$\mathbf{y}$ is vector of milk yield observations,
$f_1(\mathbf{p}, \mathbf{DIM})$ is fixed general regression function,
$\mathbf{b}$ is vector of fixed herd times test-day interaction effects,
$\mathbf{X}$ is design matrix to link observations to appropriate fixed effects,
$f_2(\mathbf{a}, \mathbf{DIM})$ is random additive genetic regression function, and
$\mathbf{e}$ is random residual vector.

The fixed regression function has form

$$f_1(\mathbf{p}, DIM) = DIM \cdot p_1 + \ln(305/DIM) \cdot p_2$$

and the random regression function f for animal i has form

$$f_2(\mathbf{a}_i, DIM) = a_{i,1} + DIM \cdot a_{i,2} + \ln(305/DIM) \cdot a_{i,3}.$$

It is assumed that $\mathrm{var}(\mathbf{a}) = \mathbf{A} \otimes \mathbf{G}_0 = \mathbf{G}$, $\mathrm{var}(\mathbf{e}) = \mathbf{I}\sigma_e^2 = \mathbf{R}$ and $\mathrm{cov}(\mathbf{a}, \mathbf{e}) = \mathrm{cov}(\mathbf{e}, \mathbf{a}) = \mathbf{0}$, where $\mathbf{G}_0$ is 3×3 -matrix of variance and covariance components for random animal effects and $\mathbf{A}$ is the numerator relationship matrix.

The variance components are

$$\mathbf{G}_0 = \begin{bmatrix} 44.791 & -0.133 & 0.351 \\ -0.133 & 0.073 & -0.010 \\ 0.351 & -0.010 & 1.068 \end{bmatrix}$$

and $\sigma_e^2 = 100$.

Input files

Datafile:

The data file contains information on the data to be analyzed together with class and regression variables for the model. The data file can be in free format (columns are separated by at least one space) or in binary format.

Each record, i.e., line in a free format file, has been divided to two parts: 1) Integer number columns and 2) real number columns. Columns of real numbers are always after the integer number columns.

RRM.dat

```
1     1     1      73.0      1.4298500      26.0
2     1     1     123.0      0.9081270      23.0
3     1     1     178.0      0.5385280      21.0
1     2     1      34.0      2.1939499      29.0
2     2     1      84.0      1.2894900      18.0
3     2     1     139.0      0.7858380       8.0
4     2     1     184.0      0.5053760       1.0
1     3     2       8.0      3.6408701      37.0
2     3     2      58.0      1.6598700      25.0
3     3     2     113.0      0.9929240      19.0
4     3     2     158.0      0.6577170      15.0
5     3     2     218.0      0.3358170      11.0
2     4     3       5.0      4.1108699      44.0
3     4     3      60.0      1.6259700      29.0
4     4     3     105.0      1.0663500      22.0
5     4     3     165.0      0.6143660      14.0
6     4     3     215.0      0.3496740       8.0
4     5     3      14.0      3.0812500      35.0
5     5     3      74.0      1.4162500      23.0
6     5     3     124.0      0.9000300      17.0
5     6     4      31.0      2.2863200      28.0
6     6     4      81.0      1.3258600      22.0
6     3     4     268.0      0.1293250       7.0
```

Column 1: Herd x Test-day (integer)
Column 2: Animal ID (integer)
Column 3: Block code (integer)
Column 4: Covariable for regression effect, days in milk (real)
Column 5: Covariable for regression effect, ln(305/days in milk) (real)
Column 6: Milk yield (real)

Pedigree file:

All the pedigree information must be given in the pedigree file. Each animal in the pedigree must have a record with four integers of which the forth integer is optional.

RRM.ped

```
1     9     7     1
2    10     8     1
3     9     2     2
4    10     8     3
5    11     7     3
6    11     1     4
7     0     0     8
8     0     0     8
9     0     0     8
10    0     0     8
11    0     0     8
```

Column 1: Animal ID
Column 2: Sire ID
Column 3: Dam ID
Column 4: Block code

Variance component file:

The variance components file has variances and covariances for all the random effects in the model. The variance component file has a line for each (co)variance. Order of lines in the file is irrelevant.

RRM.var

```
1    1    1       44.791
1    2    1       -0.133
1    3    1        0.351
1    2    2        0.073
1    2    3       -0.010
1    3    3        1.068
2    1    1      100.000
```

Column 1: Random effect number (integer)
Column 2: Row index (integer)
Column 3: Column index (integer)
Column 4: (Co)variance value (real)

Command file:

Number of processors should be given for parallel runs. This can be given only using the old directive method; this cannot be given using CLIM instructions. Everything beyond '#' sign is considered as a comment.

RRMparallel.dir

```
# TITLE:
          RANDOM REGRESSION, L. Schaeffer & J. Dekkers (1994)
# INT-VAR:
          HTD ANIMAL BLOCKVAR
# REAL-VAR:
          COVAR_1 COVAR_2 MILK_YD
# TRAITS:
          1
# TRGRP:
          1 -
# SORT_R: Block_code, Relationship_code
          3 2
# FIXRAN: Number of different fixed and random effect
          1 3
# MODEL:  Subgrp. Trait Weight Herd_Test_Day, Animal, Gamma1, Gamma2
            1        3     -          1          2        2       2
# BLKORD: Order of effects within herd
                                      -          1        1       1
# RANDOM: Animal, Gamma1, Gamma2
            1        1       1
# PEDIGR: Number: Animal, Gamma1, Gamma2
            3        1       1       1
# REGRES: Number Beta1, Beta2, Herd_Test_Day, Animal, Gamma1, Gamma2
            6      1      2         cl          cl       1       2
# COMBINE:
          n
# RELMET:
          am
# INPFIL:
          RRM.dat
# VAR:
          3 3 f
# MISSVA:
          0.0
# SCALE:
          n
# PEDFIL:
          RRM.ped
# PARFIL:
          RRM.var
# TMPDIR:
          .
# SOLFOR: Animal effects
          y
# SOLUNF:
          n
# PRECON: WpW, XpX
          b    f
# NPROC:  Number of processors used by the sover program
          2
# COMBLK  Number of blocks in common area when using parallel processing
          1
```

Solver option file:

Everything beyond '#' sign is considered as a comment.

RRM.stop

```
# RAM: RAM demand: H=high, M=medium, L=low
   H
# STOP: Maximum_number_of_iterations, Stopping_criterion, Criterion (A/R/D)
   2000                              1.0e-4                 D     F
# RESID: Calculate residuals? (Y/N)
   N
# VALID: N=no, P=prediction, S=sum of effects, Y=YD, D=DYD, I=IDD, G=generate
   n
# HETVAR: adjust for HV? (N)o, (S)tart, (C)ontinue), (F)inale iterations.
   N
# TYPSOL: Solution files? (N)o, (Y)es, (A)itken, (H)alf-Chebychev
   Y
```

Solution files

Structure of the formatted solution files depends on the model. Therefore, explanation of the content of those files is given in the printout of the particular run of the program.

Solver option file for MiX99 parallel program has been given in 'Input files for Example 9'.

"Solreg"-file contains solutions for general regressions.

```
Trt Reg-No  Solution     Trait  Covariable
  1    1 -.49839E-01   MILK_YD    COVAR_1
  1    2 5.2910        MILK_YD    COVAR_2
```

Column 1: Trait number
Column 2: Regression number within trait
Column 3: Solution
Column 4: Name of trait
Column 5: Name of covarible

"Solfix"-file contains solutions for fixed effects.

```
Fact. Trt      Level    N-Obs  Solution              Factor Trait
  1    1          1          3  19.950                   HTD MILK_YD
  1    1          2          4  20.374                   HTD MILK_YD
  1    1          3          4  20.610                   HTD MILK_YD
  1    1          4          4  19.728                   HTD MILK_YD
  1    1          5          4  18.605                   HTD MILK_YD
  1    1          6          4  17.852                   HTD MILK_YD
```

Column 1: Factor number
Column 2: Trait number
Column 3: Level code
Column 4: Number of observations
Column 5: Solution
Column 6: Name of factor
Column 7: Name of trait

"Solani"-file contains solutions for genetic animal effect.

1	1	3	-0.44285	0.36871E-01	-0.36877E-01
2	1	4	0.26991	-0.66036E-01	0.32241E-01
3	0	6	-0.72850	0.68307E-02	-0.47932E-01
4	0	5	1.1019	-0.53647E-02	0.76715E-01
5	0	3	-0.16244	0.69341E-02	-0.14868E-01
6	0	2	-0.48281	0.16645E-01	-0.37722E-01
7	2	0	-0.98762E-01	0.13324E-01	-0.10292E-01
8	2	0	0.45726	-0.23798E-01	0.36320E-01
9	2	0	-0.62844	0.35033E-01	-0.47903E-01
10	2	0	0.45726	-0.23798E-01	0.36320E-01
11	2	0	-0.18712	-0.75122E-03	-0.14515E-01

Column 1: Animal ID
Column 2: Number of descendants
Column 3: Number of observations
Column 4: Solution for Trait 1 MILK_YD and Factor ANIMAL
Column 5: Solution for Trait 1 MILK_YD and Factor COVAR_1(ANIMAL)
Column 6: Solution for Trait 1 MILK_YD and Factor COVAR_2(ANIMAL)