Livestock Breeding and Genomics - Exercise 12

Peter von Rohr

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Problem 1 Marker Effect Model

We are given the dataset that is shown in the table below. This dataset contains gentyping results of 10 for 2 SNP loci.

Animal	SNP A	SNP B	Observation
1	0	0	156
2	1	0	168
3	0	1	161
4	1	0	164
5	-1	0	128
6	-1	1	124
7	0	-1	143
8	1	1	178
9	1	0	163
10	0	0	151

Your Task

- The goal of this problem is to estimate SNP marker effects using a `marker effect model`. Because we have just 2 SNP loci, you can use a fixed effects linear model with the 2 loci as fixed effects. Furthermore you can also include a fixed intercept into the model.
- Specify all the model components including the vector of observations, the design matrix X, the vector of unknowns and the vector of residuals.
- You can use the R-function `lm()` to get the solutions for estimates of the unknown SNP effects.

Your Solution

Problem 2 Breeding Value Model

Use the same data as in Problem 1 to estimate genomic breeding values using a `breeding value model`.

Hints

- The only fixed effect in this model is the mean μ which is the same for all observations.
- You can use the following matrix as the genomic relationship matrix

$$G = \begin{bmatrix} 0.141 & -0.124 & -0.123 & -0.124 & 0.288 & 0.083 & 0.287 & -0.329 & -0.124 & 0.082 \\ -0.124 & 0.760 & -0.330 & 0.701 & -0.949 & -1.155 & 0.082 & 0.495 & 0.701 & -0.124 \\ -0.123 & -0.330 & 0.757 & -0.330 & 0.085 & 0.905 & -0.943 & 0.491 & -0.330 & -0.123 \\ -0.124 & 0.701 & -0.330 & 0.760 & -0.949 & -1.155 & 0.082 & 0.495 & 0.701 & -0.124 \\ 0.288 & -0.949 & 0.085 & -0.949 & 1.584 & 1.322 & 0.492 & -1.152 & -0.949 & 0.288 \\ 0.083 & -1.155 & 0.905 & -1.155 & 1.322 & 2.202 & -0.738 & -0.333 & -1.155 & 0.083 \\ 0.287 & 0.082 & -0.943 & 0.082 & 0.492 & -0.738 & 1.576 & -1.148 & 0.082 & 0.287 \\ -0.329 & 0.495 & 0.491 & 0.495 & -1.152 & -0.333 & -1.148 & 1.374 & 0.495 & -0.329 \\ -0.124 & 0.701 & -0.330 & 0.701 & -0.949 & -1.155 & 0.082 & 0.495 & 0.760 & -0.124 \\ 0.082 & -0.124 & -0.123 & -0.124 & 0.288 & 0.083 & 0.287 & -0.329 & -0.124 & 0.141 \end{bmatrix}$$

Your Tasks

- Specify all model components of the linear mixed model, including the expected values and the variance-covariance matrix of the random effects.

Your Solution