LME in Matrix - Vector Notation

Instead of writing the model for each observation:

$$y_{ijk} = \mu + \beta_j + u_i + e_{ijk}$$

we group all observations into vector y

$$y = \begin{bmatrix} y_{12} \\ y_{13} \\ \vdots \\ y_{627} \end{bmatrix} = \begin{bmatrix} 2.61 \\ 2.51 \\ \vdots \\ 3.16 \end{bmatrix}$$

Group all fixed effects into vector β

$$\beta = \begin{bmatrix} \mu \\ \text{herd} \end{bmatrix}$$

Group all breeding values into vector u

$$u = \begin{bmatrix} u_1 \\ u_2 \\ \vdots \\ u_{27} \end{bmatrix}$$

; vector of random residuals

$$e = \begin{bmatrix} e_{12} \\ e_{13} \\ \vdots \\ e_{27} \end{bmatrix}$$

Matrices X and Z are design matrices.