Recap:

- Example of a Linear mixed effects model (lme) to predict breeding values
  - ⇒ Sire model, only sires get breeding values
  - ⇒ Sire effects are considered as random effects

- Model: $y = X\beta + Zs + e$

$$E\begin{bmatrix} e \\ s \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ X\beta \end{bmatrix} \Leftrightarrow \begin{cases} E[e] = 0 \\ E[s] = 0 \\ E[y] = X\beta \end{cases}$$

$$var\begin{bmatrix} y \\ s \\ e \end{bmatrix} = \begin{bmatrix} ZGZ^T + R & ZG & R \\ GZ^T & G & 0 \\ R & 0 & R \end{bmatrix}; \quad \begin{matrix} var(e) = R = I \cdot \sigma_e^2 \\ var(s) = G = I \cdot \sigma_s^2 \end{matrix}$$

- Solution for $\hat{\beta}$ and $\hat{s}$ were obtained by solving the MME:

$$\underbrace{\begin{bmatrix} X^TX & X^TZ \\ Z^TX & Z^TZ + I \cdot \lambda \end{bmatrix}}_{M} \underbrace{\begin{bmatrix} \hat{\beta} \\ \hat{s} \end{bmatrix}}_{b} = \underbrace{\begin{bmatrix} X^Ty \\ Z^Ty \end{bmatrix}}_{r}$$

$$b = M^{-1} r$$