Examples

▷ Sire model

LME where only sire get breeding values

→ Model: $y = Xb + Zs + e$

$$\underset{\text{Sire breeding values}}{\Big\uparrow}$$

$$E\begin{bmatrix} y \\ s \\ e \end{bmatrix} = \begin{bmatrix} Xb \\ 0 \\ 0 \end{bmatrix}$$

$$\text{var}\begin{bmatrix} y \\ s \\ e \end{bmatrix} = \begin{bmatrix} V & ZU & R \\ UZ^T & U & 0 \\ R & 0 & R \end{bmatrix}$$

$R = I \cdot \bar{\sigma}_e^e$

$U = A_S * \bar{\sigma}_s^2$; with A_S being the sire relationship matrix and $\bar{\sigma}_s^2$ is the sire variance component.

$V = ZUZ^T + R$

◻ Special case: When sire are unrelated, then
$A_S = I$; identity matrix

◻ Estimates $\hat{b}$ and predictions $\hat{s}$ are obtained via mixed model equations.