

$$G = \begin{bmatrix} 1+F_1 & 0 & 1/2 & 1/2 & 1/4 \dots \\ 0 & 1 & 0 & 0 & 0 \dots \\ 1/2 & 0 & 1 & 0 & 0 \dots \\ 1/2 & 0 & 0 & 1 & 0 \dots \\ 1/4 & 0 & 0 & 0 & 1 \dots \end{bmatrix} \quad \sigma_u^2$$

$G = A \cdot \sigma_u^2$  used in animal model

$A \rightarrow$  numerator relationship matrix

For Mixed Model Equations, we need  $G^{-1}$

$$G^{-1} = (A \cdot \sigma_u^2)^{-1} = A^{-1} \cdot \sigma_u^{-2}$$

$$\begin{bmatrix} X^T X & X^T Z \\ Z^T X & Z^T Z + A^{-1} \lambda \end{bmatrix} \begin{bmatrix} \hat{\beta} \\ \hat{u} \end{bmatrix} = \begin{bmatrix} X^T y \\ Z^T y \end{bmatrix}$$

$$\lambda = \sigma_e^2 / \sigma_u^2$$

Compute Numerator Relationship Matrix A

Background:  $\text{var}(y) = G = A \cdot \sigma_u^2$