Matrix G

- Model definition $var(u) = G = \begin{bmatrix} var(u_1) & cov(u_1, u_2) \cdots \\ cov(u_2, u_1) & var(u_2) \cdots \\ & \end{bmatrix}$

- Depends on relationship between breeding values

- First example: Sire model
  - Breeding values of sires are random effects s
  - ~~Cow~~ Female animals and (male) animals without offspring do not get breeding values.

- Model: $y = X\beta + Zs + e$; $E[e] = 0$, $E[s] = 0$, $E[y] = X\beta$, $var[e] = R = I \cdot \sigma_e^2$, $var[s] = G$, $var[y] = ZGZ^T + R$

- Data: $y = \begin{bmatrix} 2.61 \\ 2.31 \\ \vdots \\ 5.16 \end{bmatrix}$ $s = \begin{bmatrix} s_1 \\ s_2 \\ s_3 \end{bmatrix}$

$\beta = \begin{bmatrix} herd\,1 \\ herd\,2 \end{bmatrix}$ $e = \begin{bmatrix} e_1 \\ \vdots \\ e_{16} \end{bmatrix}$