

$$(G)_{13} = \text{cov}(u_1, u_3) = \text{cov}\left(u_1, \left[\frac{1}{2}(u_1 + u_2) + m_3\right]\right)$$

decomposition of
 u_3 into breeding
values of parents

$$= \text{cov}\left(u_1, \frac{1}{2}u_1\right)$$

$$+ \text{cov}\left(u_1, \frac{1}{2}u_2\right) \rightarrow = 0$$

$$+ \text{cov}\left(u_1, \frac{1}{2}m_3\right) \rightarrow = 0$$

$$= \frac{1}{2} \cdot \text{cov}(u_1, u_1) = \frac{1}{2} \text{var}(u_1)$$

$$= \frac{1}{2} \sigma_u^2$$

$$G = \begin{bmatrix} \sigma_u^2 & 0 & \frac{1}{2}\sigma_u^2 & \frac{1}{2}\sigma_u^2 & \frac{1}{2}\sigma_u^2 \\ 0 & \sigma_u^2 & \frac{1}{2}\sigma_u^2 & \frac{1}{2}\sigma_u^2 & \frac{1}{2}\sigma_u^2 \\ \frac{1}{2}\sigma_u^2 & \frac{1}{2}\sigma_u^2 & \sigma_u^2 & \frac{1}{2}\sigma_u^2 & \frac{1}{2}\sigma_u^2 \\ \frac{1}{2}\sigma_u^2 & \frac{1}{2}\sigma_u^2 & \frac{1}{2}\sigma_u^2 & \sigma_u^2 & \frac{1}{2}\sigma_u^2 \\ \frac{1}{2}\sigma_u^2 & \frac{1}{2}\sigma_u^2 & \frac{1}{2}\sigma_u^2 & \frac{1}{2}\sigma_u^2 & \sigma_u^2 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ 0 & 1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & 1 & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 1 & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 1 \end{bmatrix} \cdot \sigma_u^2$$

A

$$\text{cov}(u_3, u_4) = \text{cov}\left(\left[\frac{1}{2}u_1 + \frac{1}{2}u_2 + m_3\right], \left[\frac{1}{2}u_1 + \frac{1}{2}u_2 + m_4\right]\right)$$