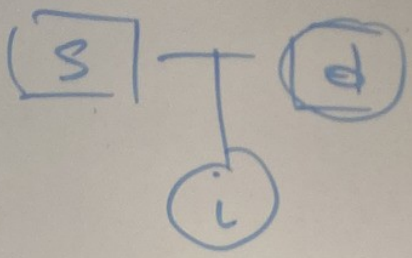
For animal i : $E(u_i) = 0$



$var(u_i) = (1 + F_i)\,\sigma_u^2$

- Inbreeding coefficient of animal i
- $F_i = \frac{1}{2} A_{sd}$ where A_{sd} is the relationship between parents s and d

$G = var(\underline{u})$

$$= \begin{bmatrix} var(u_1) & cov(u_1,u_2) & cov(u_1,u_3) & cov(u_1,u_6) \\ cov(u_2,u_1) & var(u_2) & \cdots & \end{bmatrix}$$

$$= \begin{bmatrix} (1+F_1)\sigma_u^2 & 0 & \frac{1}{2}\sigma_u^2 & \frac{1}{2}\sigma_u^2 \cdots \\ & (1+F_2)\cdot\sigma_u^2 & & \end{bmatrix}$$

$cov(u_1, u_2) = 0$, because animals 1 and 2 do not share common ancestors

$$cov(u_1, u_3) = cov(u_1, \tfrac{1}{2}u_1 + \tfrac{1}{2}u_2 + m_3)$$
$$= cov(u_1, \tfrac{1}{2}u_1) + cov(u_1, \tfrac{1}{2}u_2) + \underbrace{cov(u_1, m_3)}_{=0}$$
$$= \tfrac{1}{2} cov(u_1, u_1) + \tfrac{1}{2} cov(u_1, u_2)$$
$$= \tfrac{1}{2} var(u_1) = \tfrac{1}{2}\sigma_u^2$$