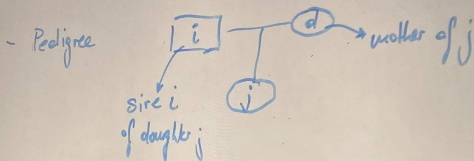Decomposition of $\bar{y}_i = \frac{1}{k} \sum_{j=1}^{k} y_{ij}$

- Genetic model: $y_{ij} = \mu + u_j + e_j$

- Pedigree

sire i
of daughter j

mother of j

- Breeding value u_j of daughter j:
$$u_j = \frac{1}{2} u_i + \frac{1}{2} u_d + m_j$$

$\Rightarrow$ Insert into genetic model:

$y_{ij} = \mu + \frac{1}{2} u_i + \frac{1}{2} u_d + m_j + e_j$; do that for all daughters of sire i

$\Rightarrow \bar{y}_i = \frac{1}{k} \sum_{j=1}^{k} \left[\mu + \frac{1}{2} u_i + \frac{1}{2} u_{dj} + m_j + e_j \right]$

$= \mu + \frac{1}{2} u_i + \frac{1}{2} \frac{1}{k} \sum_{j=1}^{k} u_{dj} + \frac{1}{k} \sum_{j=1}^{k} m_j + \frac{1}{k} \sum_{j=1}^{k} e_j$