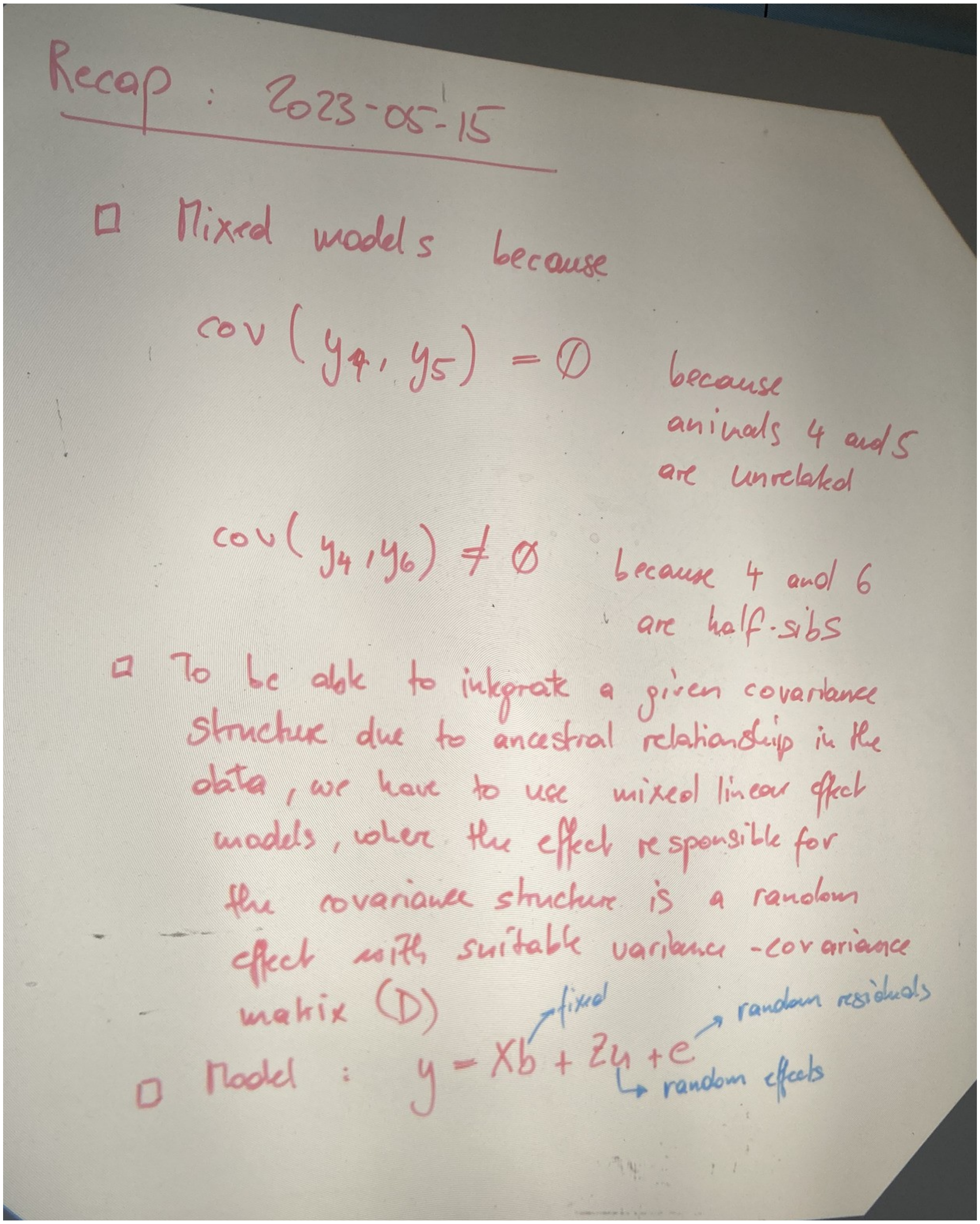
OHP Picture 1



Recap: 2023-05-15

- Mixed models because

  $\mathrm{cov}(y_4, y_5) = 0$ because animals 4 and 5 are unrelated

  $\mathrm{cov}(y_4, y_6) \neq 0$ because 4 and 6 are half-sibs

- To be able to integrate a given covariance structure due to ancestral relationship in the data, we have to use mixed linear effect models, where the effect responsible for the covariance structure is a random effect with suitable variance-covariance matrix (D)

- Model: $y = X\overbrace{b}^{\text{fixed}} + \underbrace{Zu}_{\text{random effects}} + \overbrace{e}^{\text{random residuals}}$

OHP Picture 2

- First example: Sire Model

$$y = Xb + Zs + e$$

vector random sire effects

- Example data: 3 Sires: 1, 3, 4

$\Rightarrow$ s has 3 elements $s^T = [s_1, s_3, s_4]$

- Put information from data into model:

$$y = \begin{bmatrix} 4.5 \\ 2.9 \\ 3.9 \\ 3.5 \\ 5.0 \end{bmatrix} \; ; \quad b = \begin{bmatrix} b_M \\ b_F \end{bmatrix} \; ; \quad s = \begin{bmatrix} s_1 \\ s_3 \\ s_4 \end{bmatrix}, \quad e = \begin{bmatrix} e_1 \\ e_2 \\ \vdots \\ e_5 \end{bmatrix}$$

$4.5 \Rightarrow M$

X and Z are design matrices

$$X = \begin{array}{c} \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 0 & 1 \\ 1 & 0 \end{bmatrix} \\ \begin{matrix} b_M & b_F \end{matrix} \end{array} \qquad Z = \begin{array}{c} \begin{matrix} s_1 & s_3 & s_4 \end{matrix} \\ \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix} \end{array}$$

OHP Picture 3

- First example: Sire Model

$$y = Xb + \underbrace{Zs}_{\text{vector random sire effects}} + e$$

- Example data: 3 Sires : 1, 3, 4

$\Rightarrow$ s has 3 elements $s^T = [s_1, s_3, s_4]$

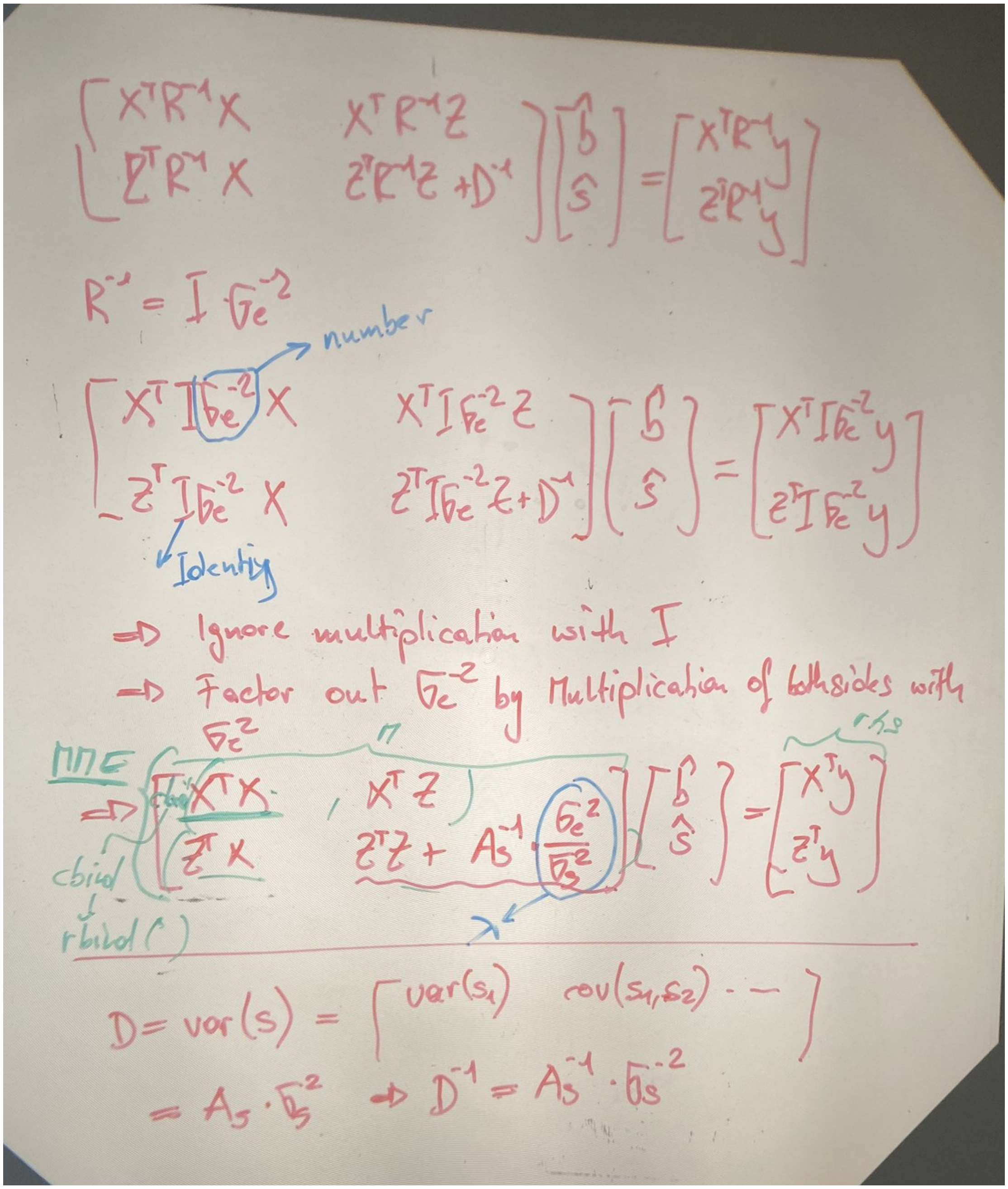
- Put information from data into model:

$$y = \begin{bmatrix} 4.5 \Rightarrow M \\ 2.9 \\ 3.9 \\ 3.5 \\ 5.0 \end{bmatrix}; \quad b = \begin{bmatrix} b_M \\ b_F \end{bmatrix}; \quad s = \begin{bmatrix} s_1 \\ s_3 \\ s_4 \end{bmatrix}, \quad e = \begin{bmatrix} e_1 \\ e_2 \\ \vdots \\ e_5 \end{bmatrix}$$

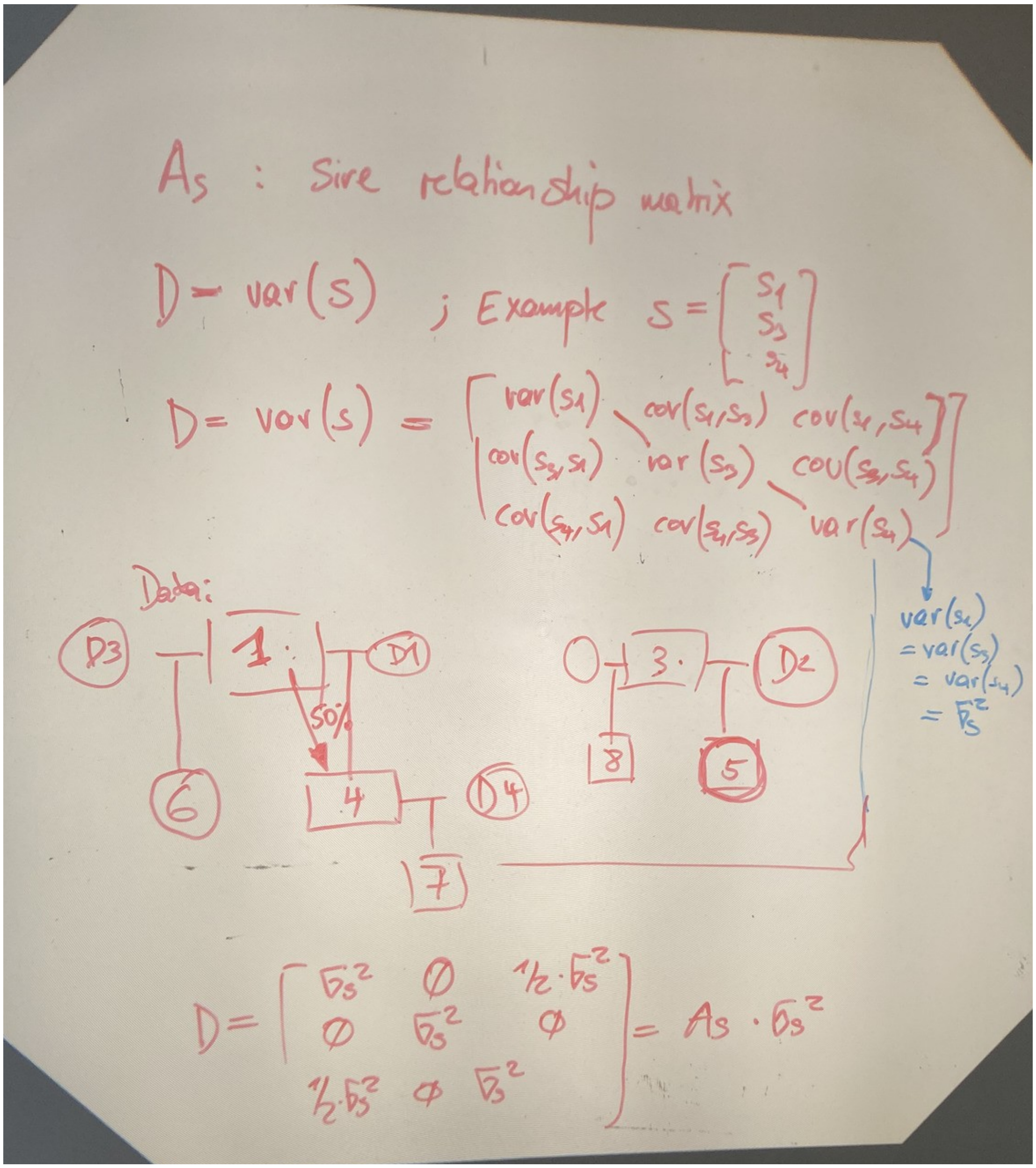
X and Z are design matrices

$$X = \begin{array}{c} \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 0 & 1 \\ 1 & 0 \end{bmatrix} \\ \begin{matrix} b_M & b_F \end{matrix} \end{array} \qquad Z = \begin{array}{c} \begin{matrix} s_1 & s_3 & s_4 \end{matrix} \\ \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix} \end{array}$$

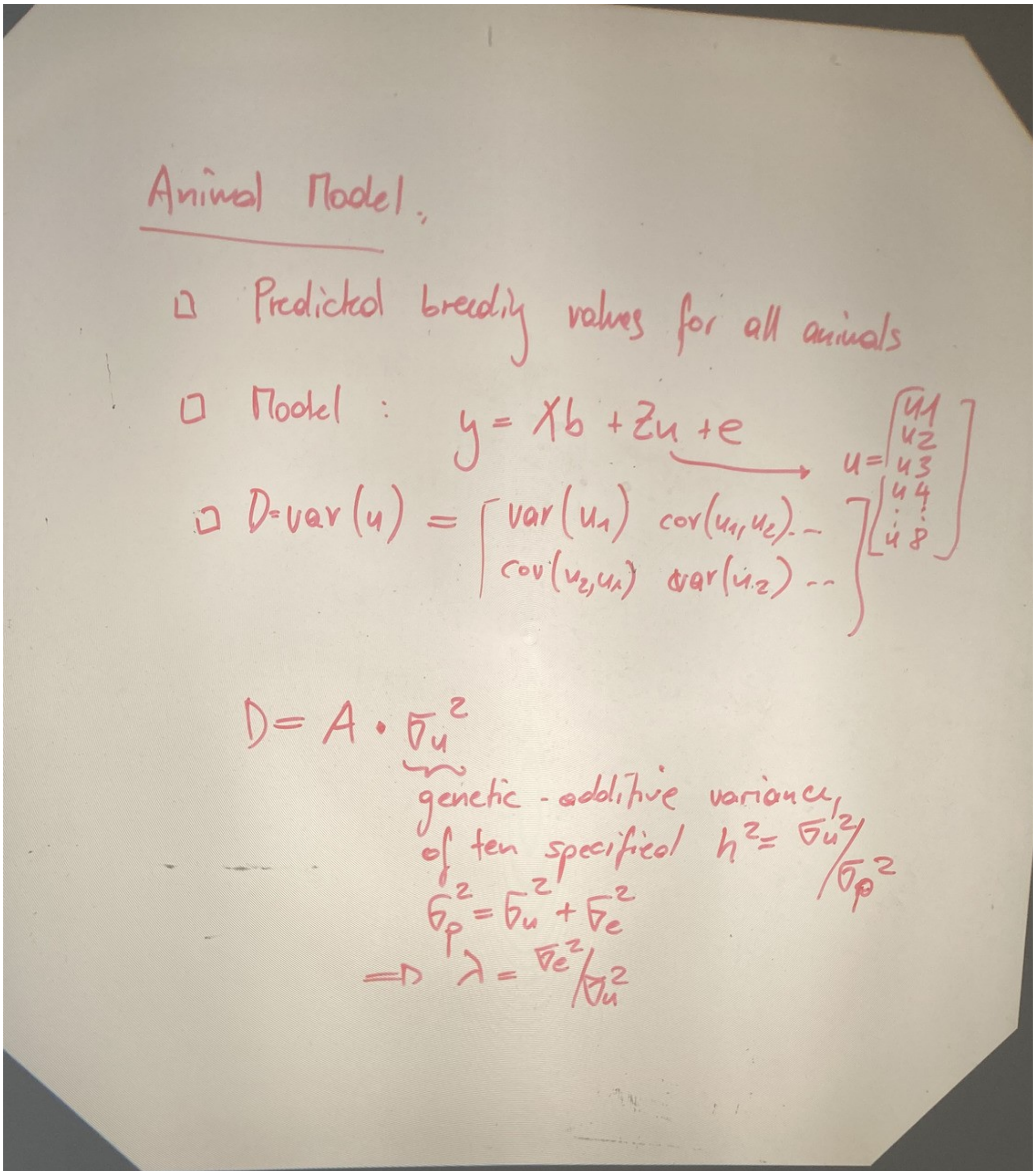
OHP Picture 4



OHP Picture 5



OHP Picture 6



OHP Picture 7