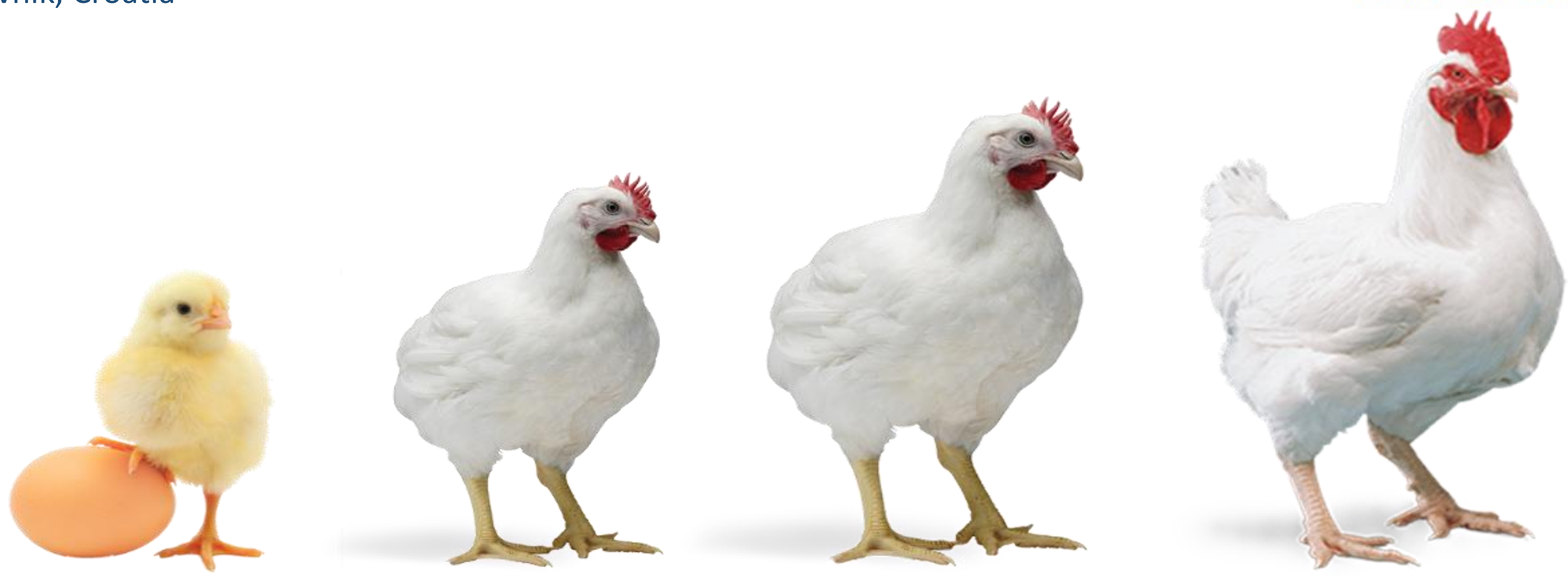
EAAP 2018

Dubrovnik, Croatia



Influence of age on variance components for body weight in commercial male and female broiler chicken

Thinh T. Chu*, Per Madsen, Lei Wang, John Henshall, Rachel Hawken, Just Jensen*

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Alternative title:

To develop statistical model to estimate genetic parameters for body weight of broiler chicken at weeks 1-6 of age

Thinh T. Chu, *Per Madsen, Lei Wang, John Henshall, Rachel Hawken, Just Jensen*

1. Introduction

- Commercial environment
- BW over weeks of age
- Different factors modelled for body-weight (BW)
- What is the right model?
  - Cross-validation preferred
  to improve predictability of breeding values

Objectives

- Develop a model to improve predictability of breeding values
- Genetic parameters for BW at different ages

2. Materials & Methods

- Longitudinal dataset:
  - Weekly BW records at week of age 1-6.
  - About 17,000 birds

- Pedigree (not genomic) information

2. M & M (conts)

Develop models:

- Subset the data into 12 datasets by week (6) and sex (2)
- Univariate models - starting model:
  - All fixed factors & possible interaction factors
  - Random factors (*a, ma, c, p*)
- Drop out/remove factor

- Bivariate models for 2 sexes (sex by genotype interaction)

- Multivariate model & random regression model

2. M & M (conts)

- Criteria for dropping factors:
  - Convergence of the models (REML-AI using DMU software)
  - Likelihood ratio tests: test for significance of random effects
  - Predictability = cor(y.c1, a.r2)/sqrt(h^2/0.25)

- <u>Cross-validation based on half-sibs</u>

2. M & M (cont')

Multivariate reduced rank model:

DMUAI (REML-AI) to estimate variance components.

$$\mathbf{y}_1 = \mathbf{X}_1\,\mathbf{b}_1 + \mathbf{Z}_1\,\mathbf{a}_1 + \mathbf{W}_1\mathbf{c}_1 + \mathbf{e}_1$$

$$\begin{bmatrix}\mathbf{y}_{2-5}^{m}\\ \mathbf{y}_{2-5}^{f}\end{bmatrix} = \begin{bmatrix}\mathbf{X}_{2-5}^{m} & 0\\ 0 & \mathbf{X}_{2-5}^{f}\end{bmatrix}\begin{bmatrix}\mathbf{b}_{2-5}^{m}\\ \mathbf{b}_{2-5}^{f}\end{bmatrix} + \begin{bmatrix}\mathbf{Z}_{2-5}^{m} & 0\\ 0 & \mathbf{Z}_{2-5}^{f}\end{bmatrix} a_{2-5} + \begin{bmatrix}\mathbf{W}_{2-5}^{m} & 0\\ 0 & \mathbf{W}_{2-5}^{f}\end{bmatrix} c_{2-5} + \begin{bmatrix}\mathbf{e}_{2-5}^{m}\\ \mathbf{e}_{2-5}^{f}\end{bmatrix}$$

$$\begin{bmatrix}\mathbf{y}_{6}^{m}\\ \mathbf{y}_{6}^{f}\end{bmatrix} = \begin{bmatrix}\mathbf{X}_{6}^{m} & 0\\ 0 & \mathbf{X}_{6}^{f}\end{bmatrix}\begin{bmatrix}\mathbf{b}_{6}^{m}\\ \mathbf{b}_{6}^{f}\end{bmatrix} + \begin{bmatrix}\mathbf{Z}_{6}^{m} & 0\\ 0 & \mathbf{Z}_{6}^{f}\end{bmatrix} a_{6} + \begin{bmatrix}\mathbf{e}_{6}^{m}\\ \mathbf{e}_{6}^{f}\end{bmatrix}$$

Covariance matrices: Va (6x6), Vc (5x5) and Ve (11x11)

3. Results

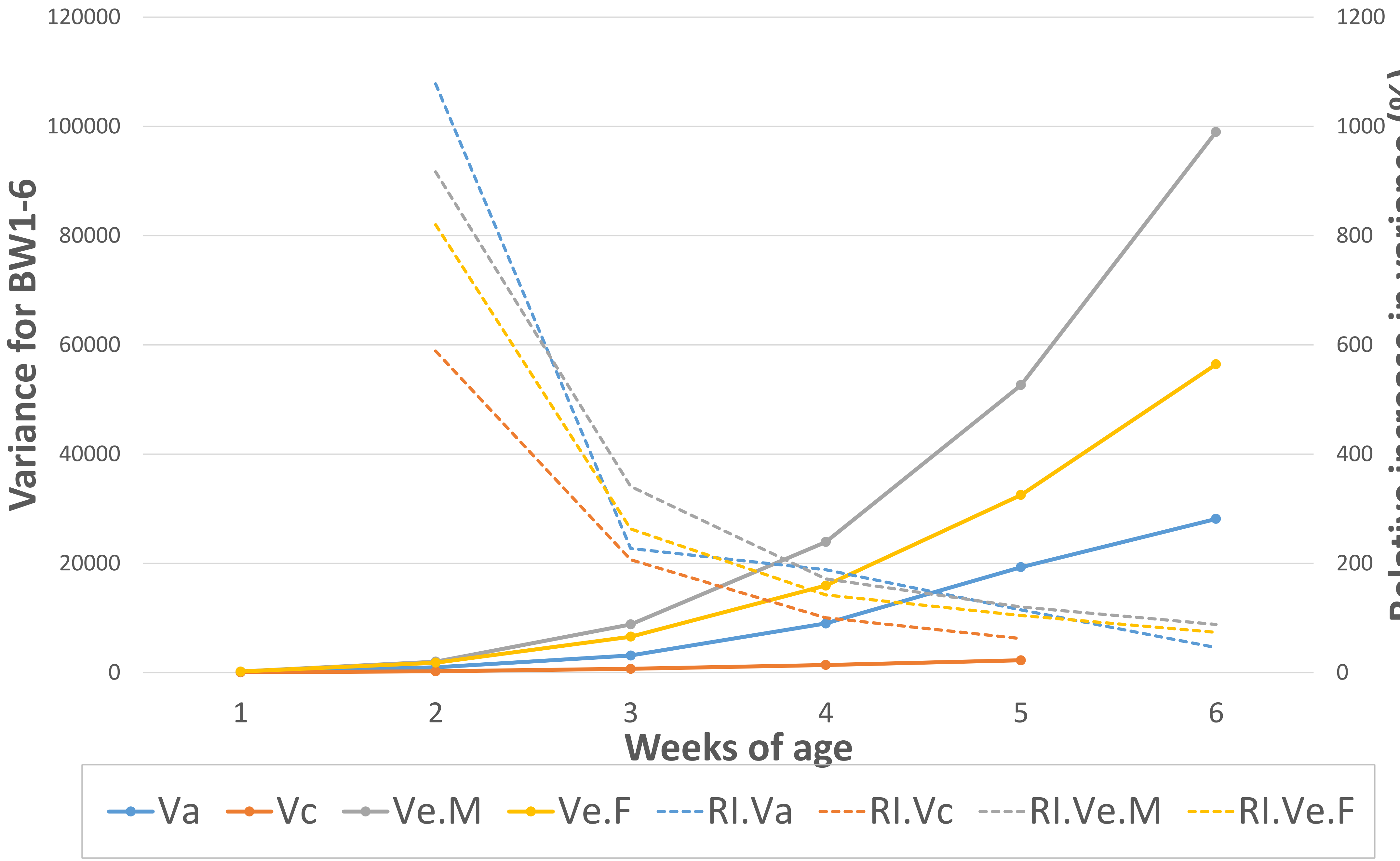


Fig. 1: Variance components at 1-6 weeks

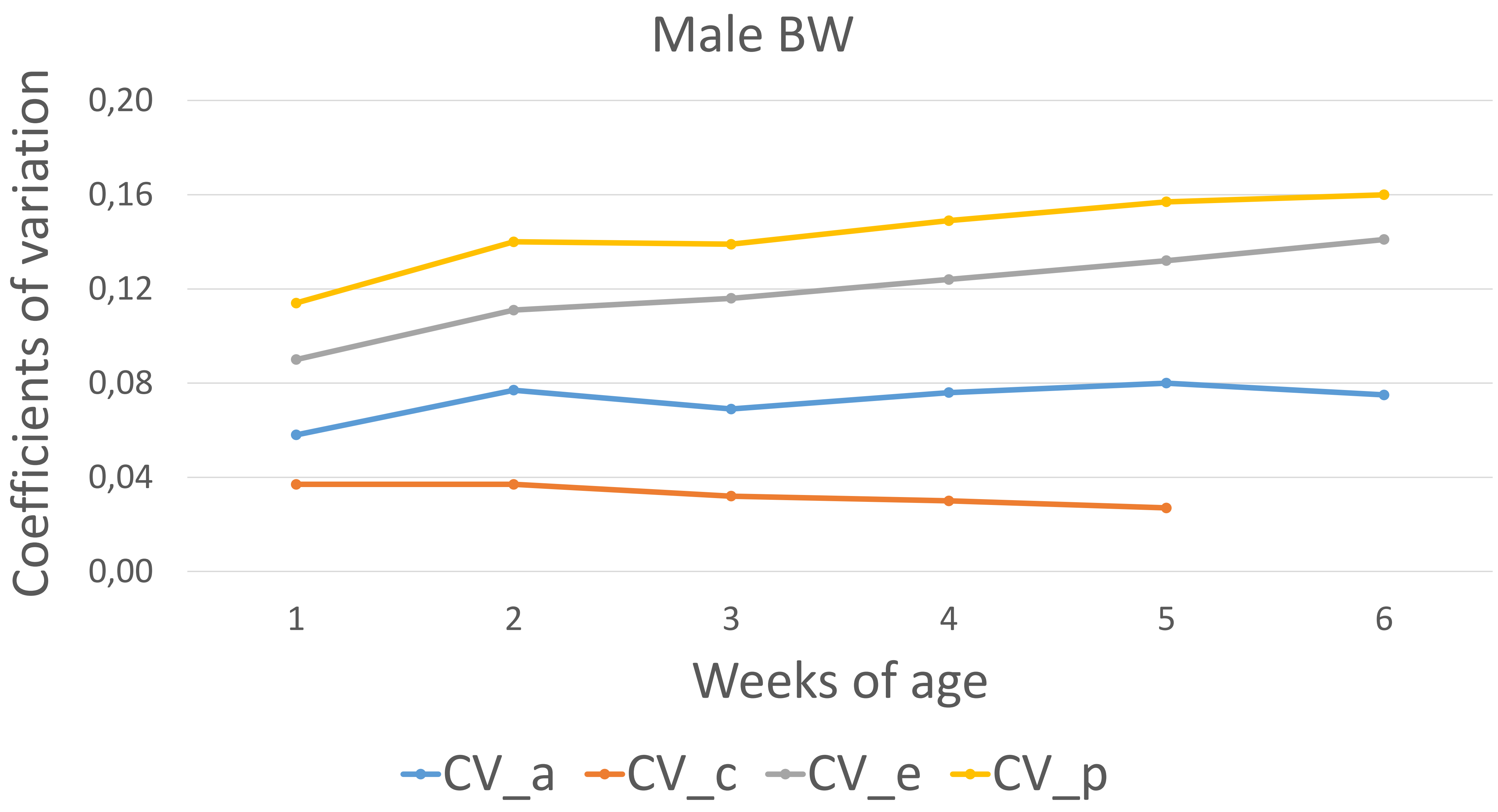


Fig. 2: Coefficients of variation for effects at 1-6 weeks

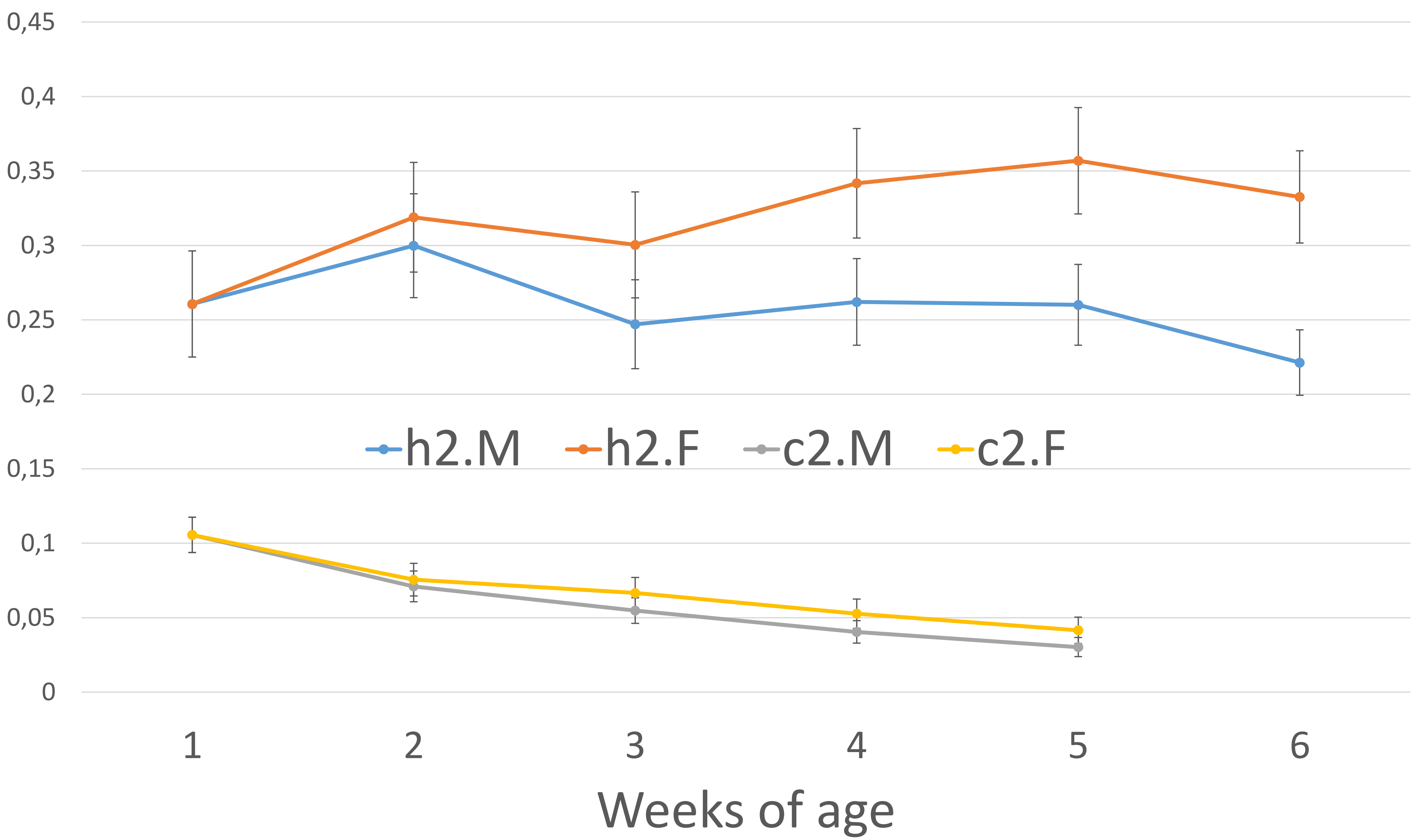


Fig. 3: Heritability and maternal effect at 1-6 weeks

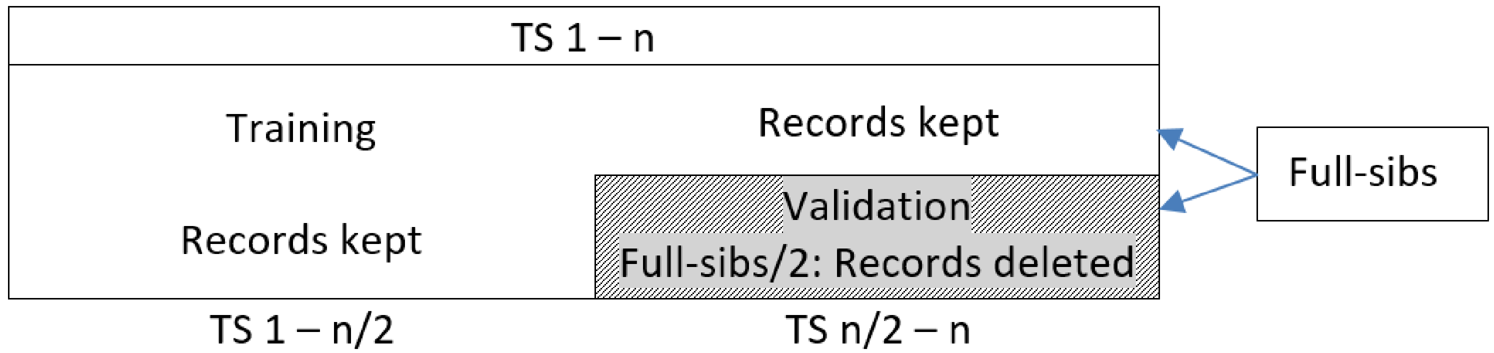
Tab 1: Genetic correlation for BW1-6

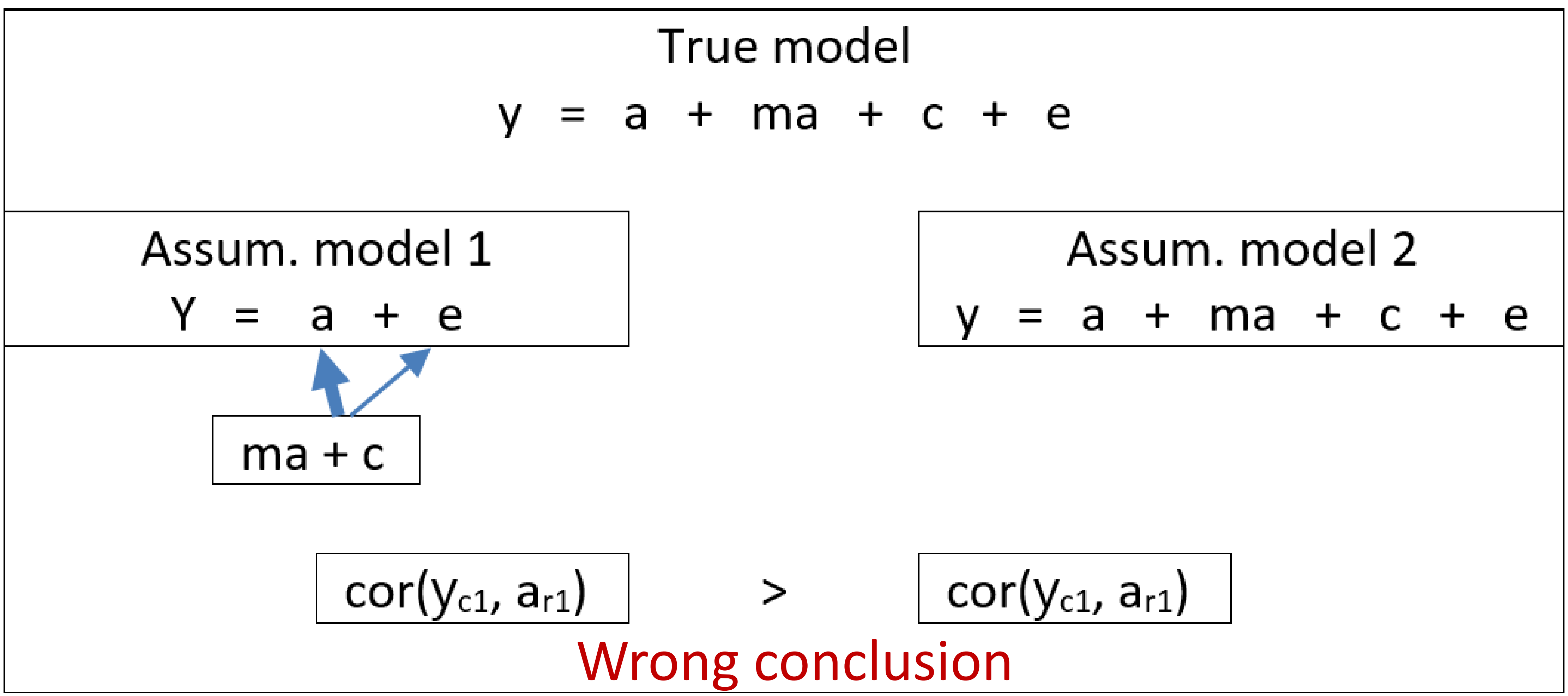
Week	1	2	3	4	5	6
1	1					
2	0.84	1				
3	0.74	0.93	1			
4	0.55	0.71	0.90	1		
5	0.43	0.56	0.77	0.96	1	
6	0.35	0.45	0.67	0.91	0.99	1

5. Discussion

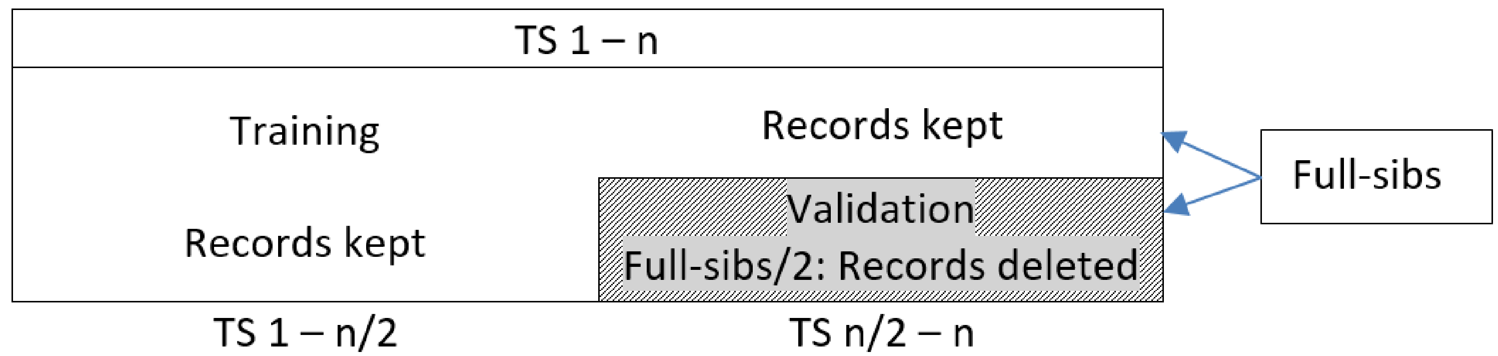
- Cross-validation based on half-sib birds used in developing model
- Conventional cross-validation 😑🔫 Maternal effects

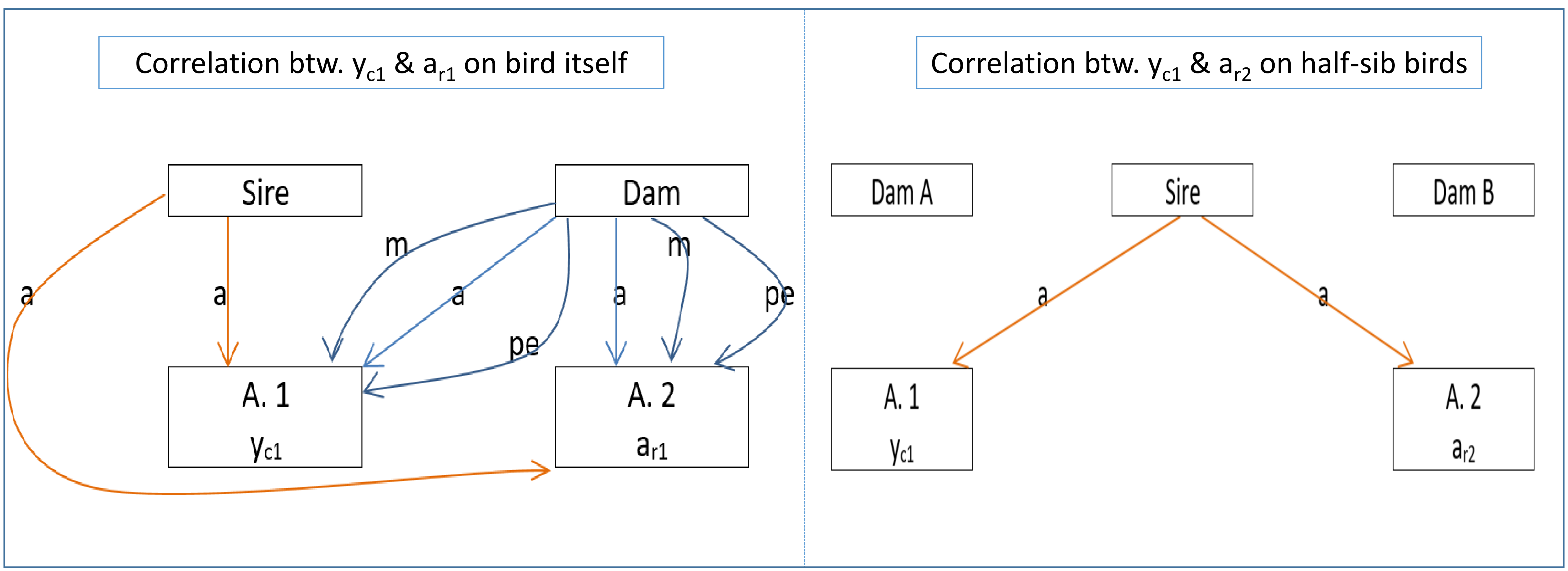
Conventional cross-validation with maternal effects





Cross-validation based on half-sibs





4. Conclusions

- Cross-validation based on half-sibs helps when maternal effects present
- Variance components increased sharply as age increased. But mainly due to scaling effect, high genetic correlation between two consecutive weekly BWs (>0.9)
- Maternal effect reduced gradually & disappeared at week 6
- No sex by genotype interaction. But heterogeneous residual variances for male and female BW in 2-6 weeks

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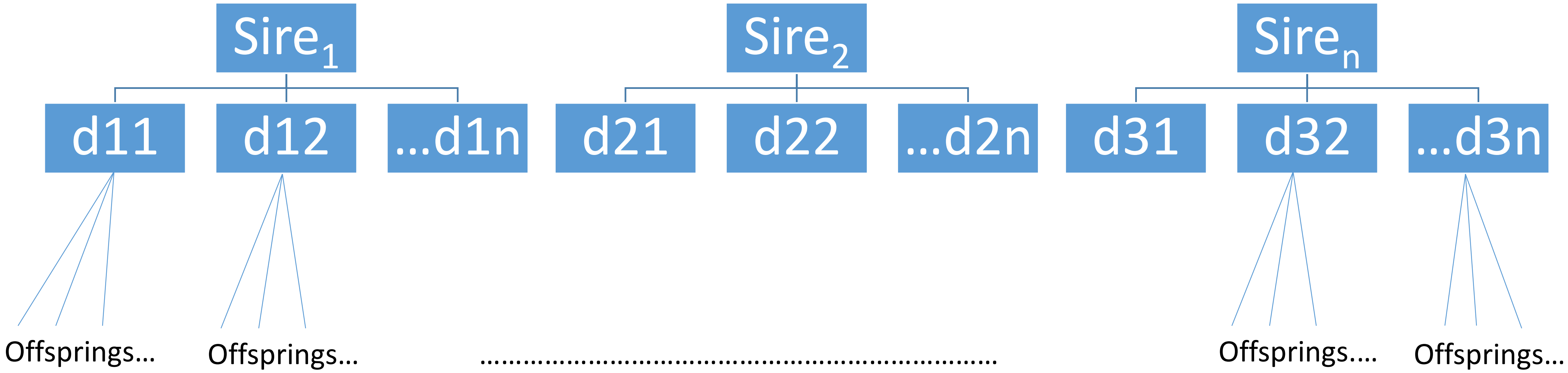
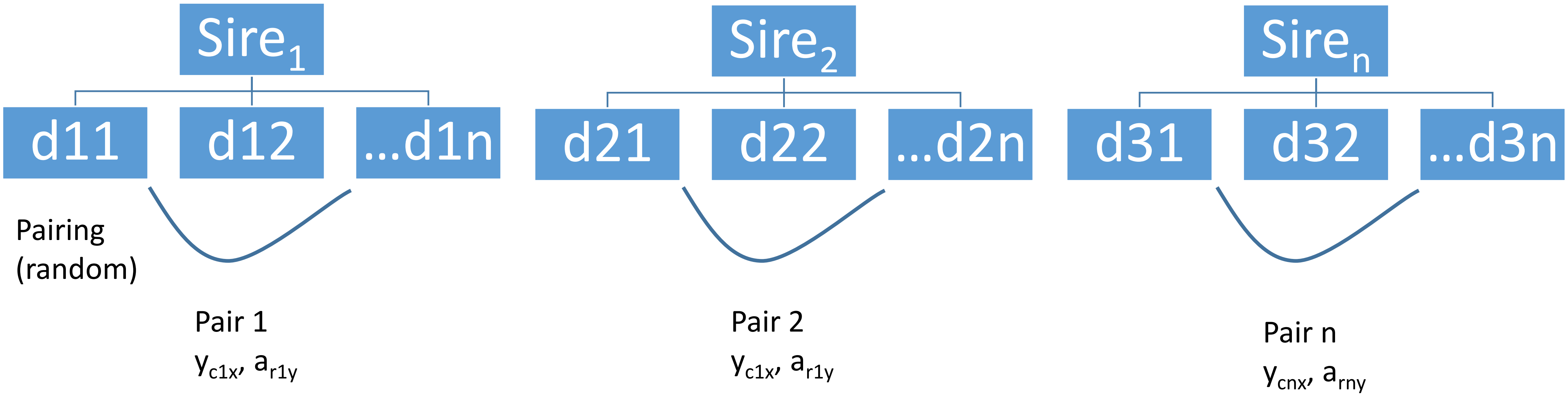
Appendix

- Fixed factors: TS, H, So, dH, Sex & DA
- Breeding structures





Pairing replicate 1: $cor_1(y_{cx}, a_{ry})$

Pairing replicate n: $cor_n(y_{cx}, a_{ry})$

$Cor(y_{cx}, a_{ry}) = mean(cor_1 \ldots cor_n)$

Note: x and y are half-sibs

Tab. 1: Genetic correlation (below diag.) & perm. env. correlation (above diag.) for BW

Week	1	2	3	4	5	6
1	1	0.87	0.85	0.77	0.70	
2	0.84	1	0.98	0.92	0.86	
3	0.74	0.93	1	0.96	0.91	
4	0.55	0.71	0.90	1	0.98	
5	0.43	0.56	0.77	0.96	1	
6	0.35	0.45	0.67	0.91	0.99	1

Tab. 2: Phenotypic correlation for male (above diag.) and female (below diag.) BW

Week	1	2	3	4	5	6
1	1	0.75	0.63	0.50	0.40	0.28
2	0.77	1	0.87	0.69	0.55	0.41
3	0.67	0.89	1	0.87	0.73	0.58
4	0.53	0.71	0.87	1	0.92	0.78
5	0.43	0.58	0.74	0.93	1	0.91
6	0.33	0.45	0.61	0.81	0.92	1