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Exploring dynamics of breeding values under non-random mating and imprinting: A real example with Rubia Gallega breeding program

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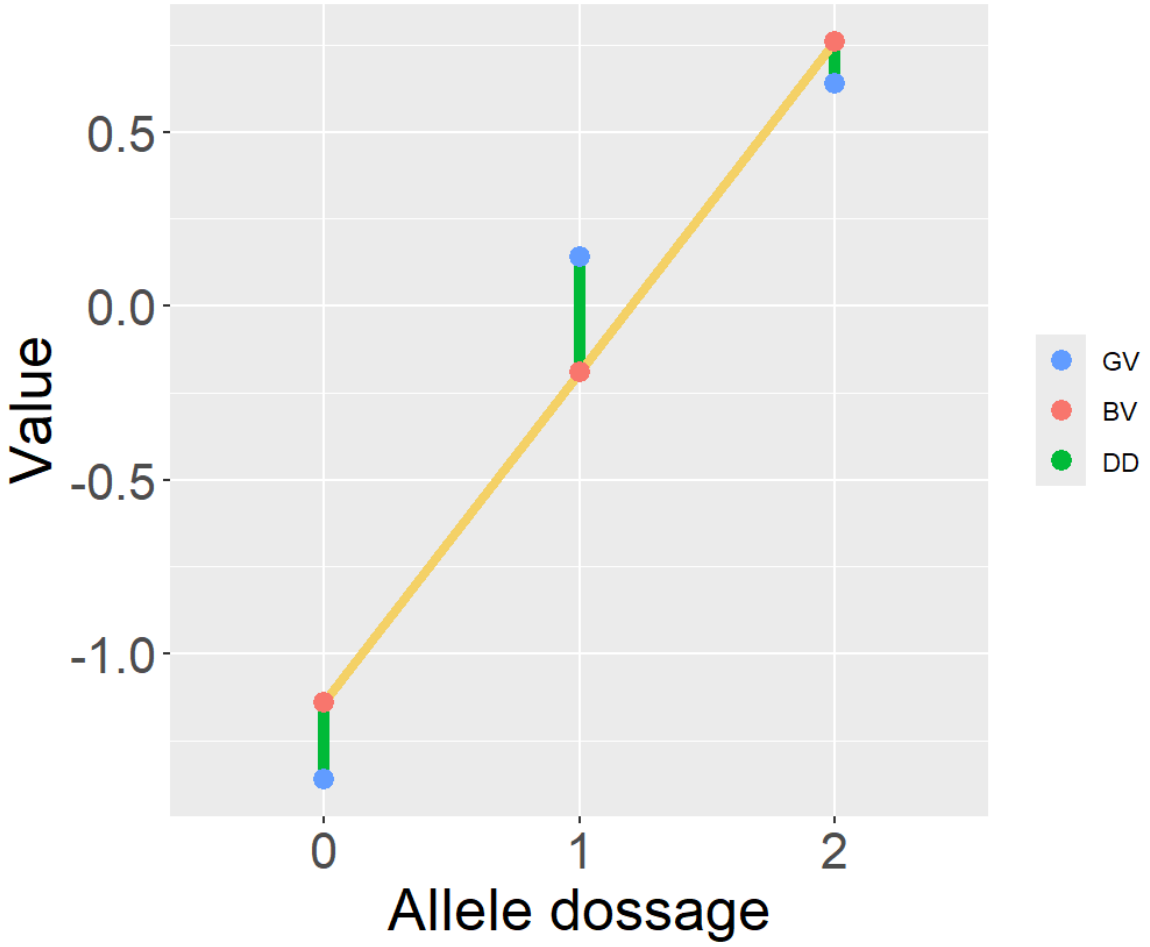
Quantitative Genetics



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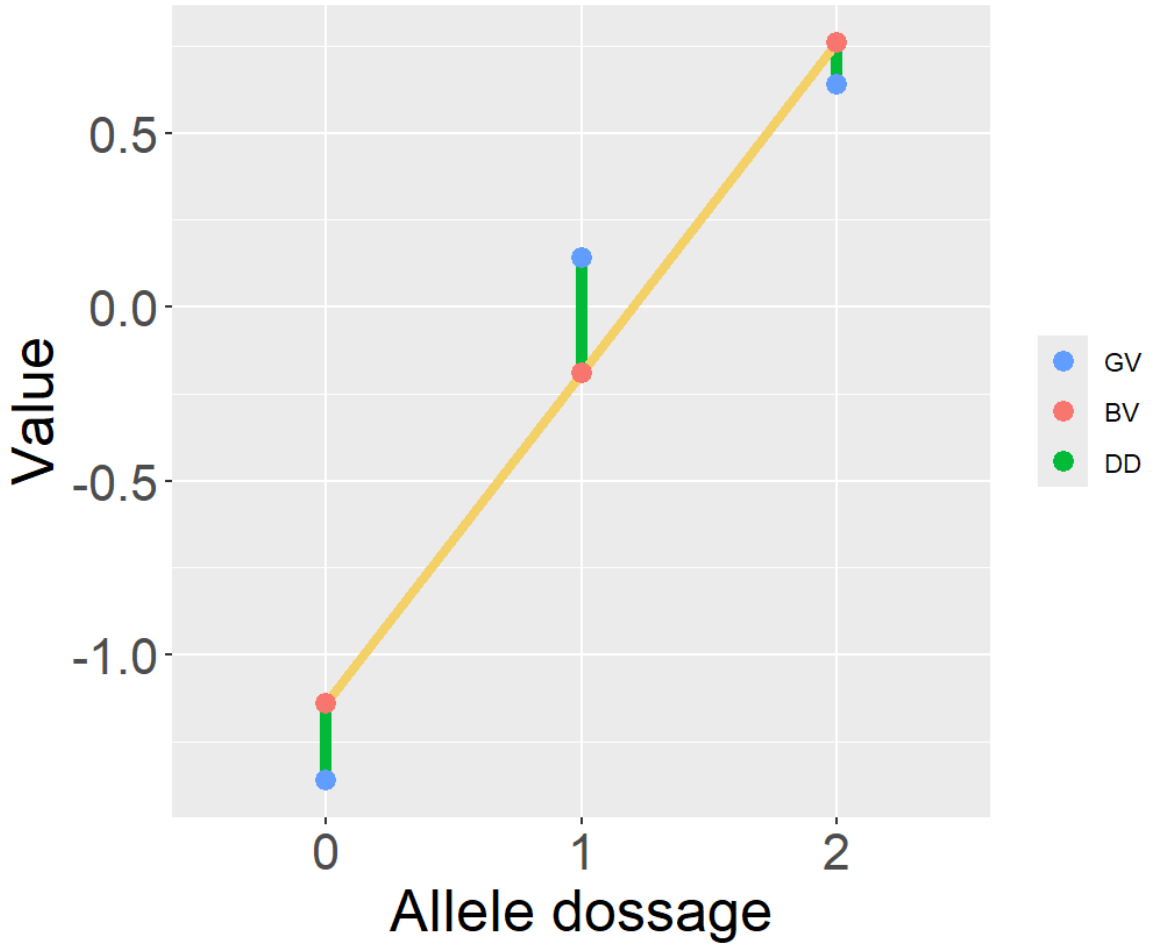
- d = 0.5

- $\alpha = \frac{cov(GV,N)}{var(N)}$ (Fisher, 1918; Lynch & Walsh 1998)

Quantitative Genetics



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- α = Average substitution effect

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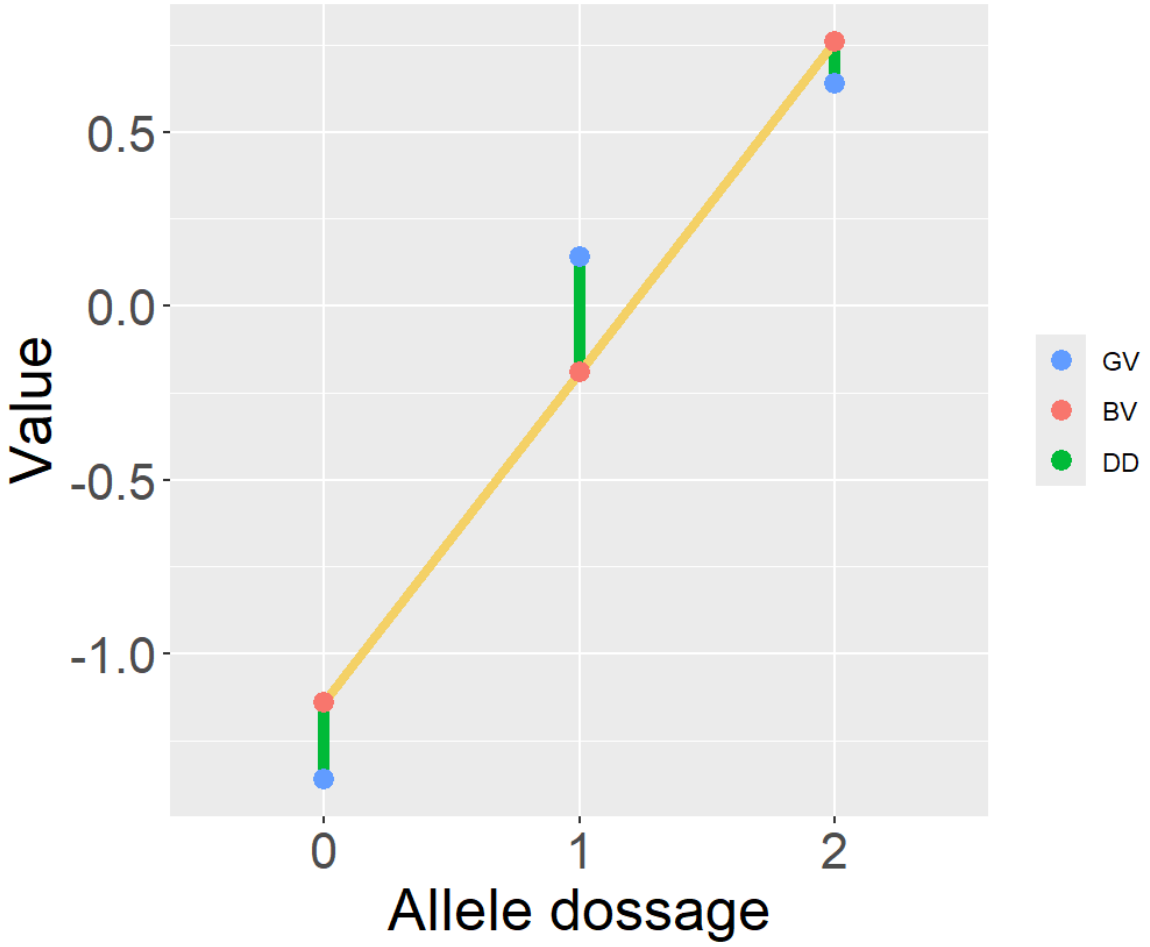

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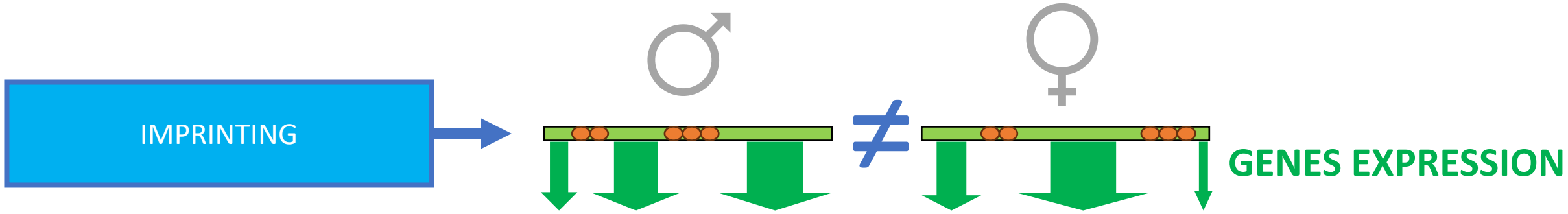
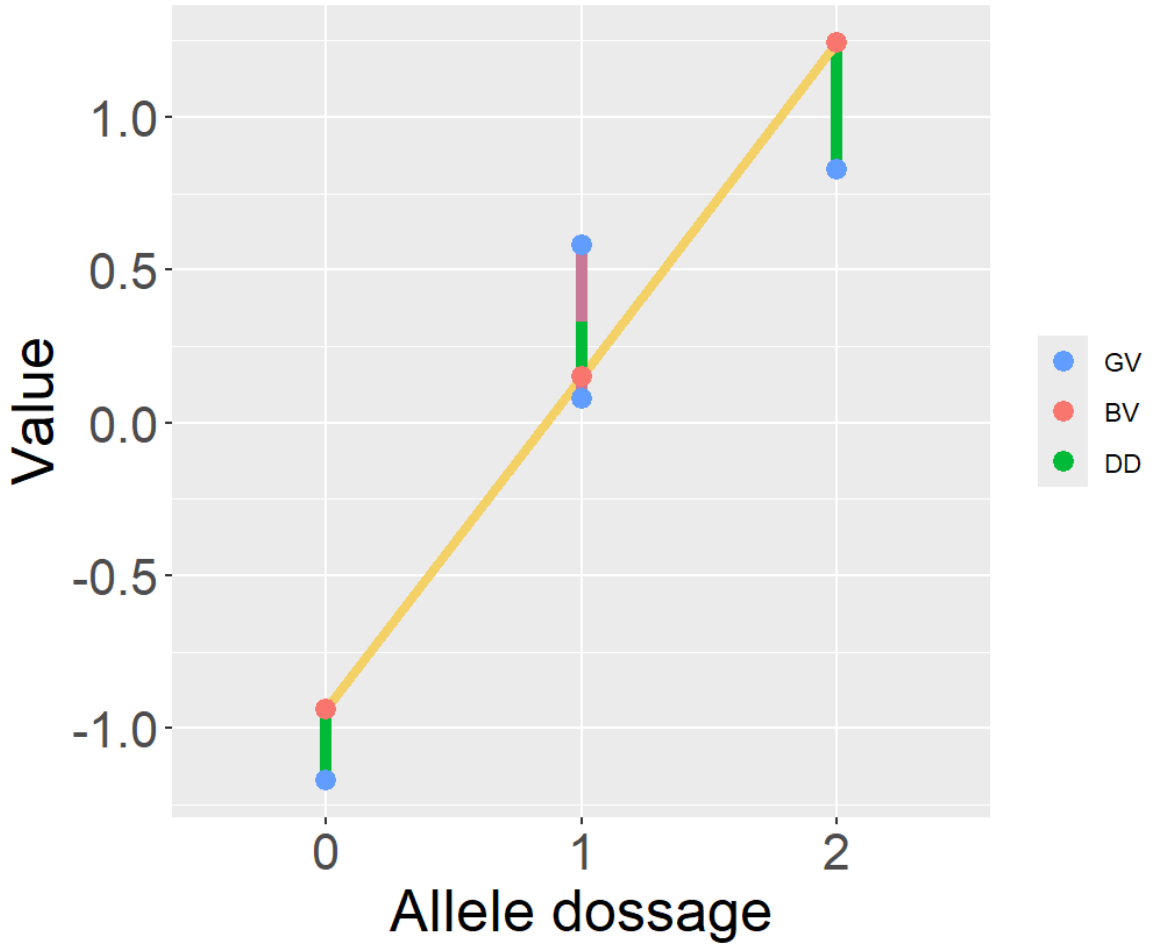
Imprinting

- Epigenetic effect
- Difference between maternal and paternal haplotype
- Source of parent-of-origin effect



Quantitative Genetics with imprinting



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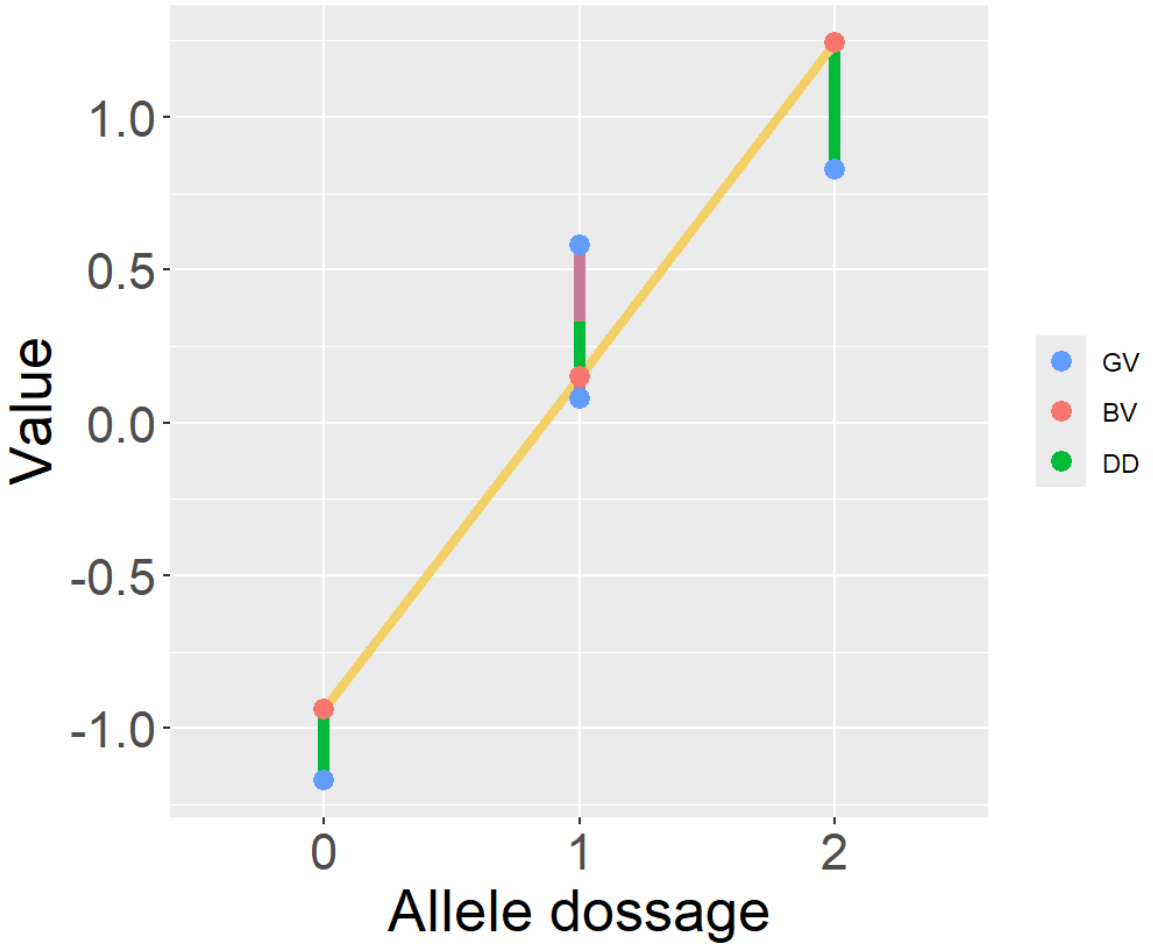

- a = 1
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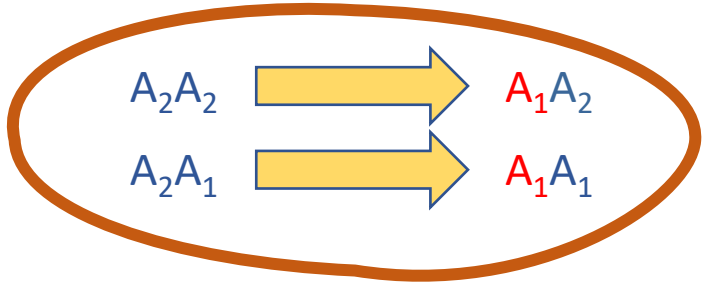
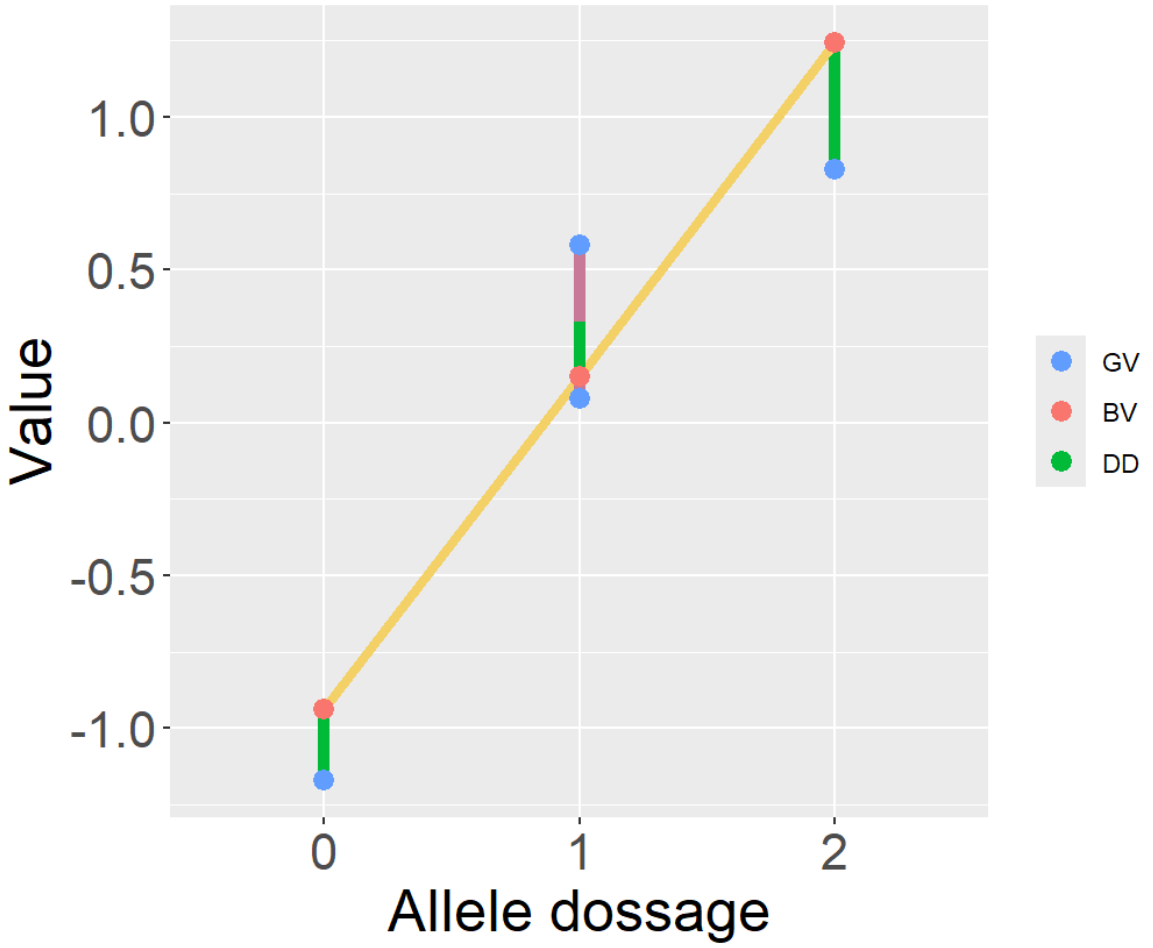
- $\alpha_{male} = \frac{cov(GV,N)}{var(N)}$

- α_{male} = Males average substitution effect



- $\alpha_{male} = \alpha_1 - \alpha_2$ = a + d(q – p) + i

Quantitative Genetics with imprinting



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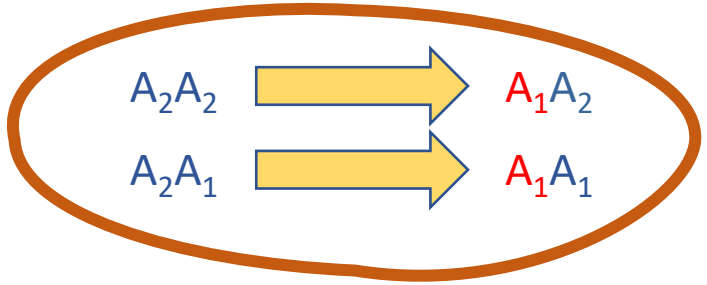

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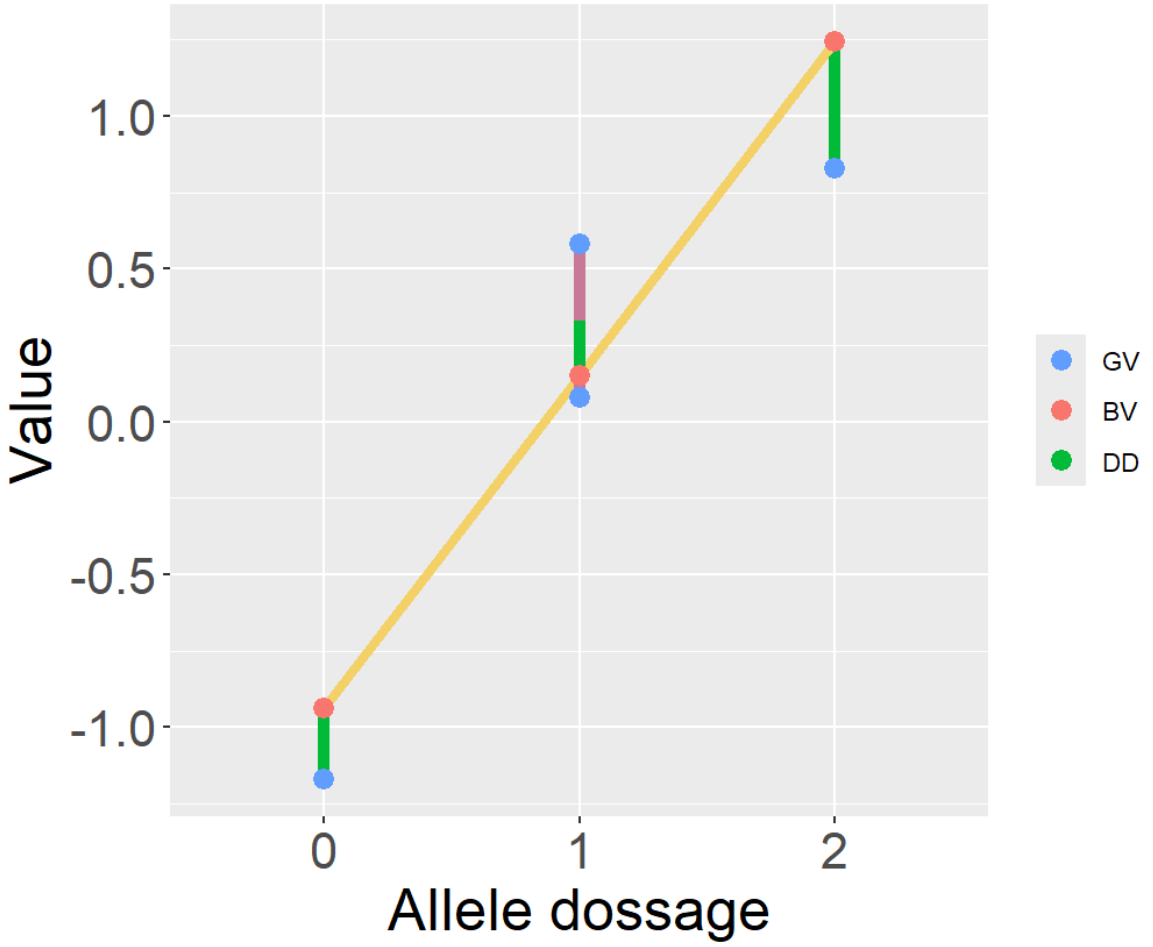

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EBV

$$\alpha_{male} = \frac{cov(GV,N)}{var(N)}$$

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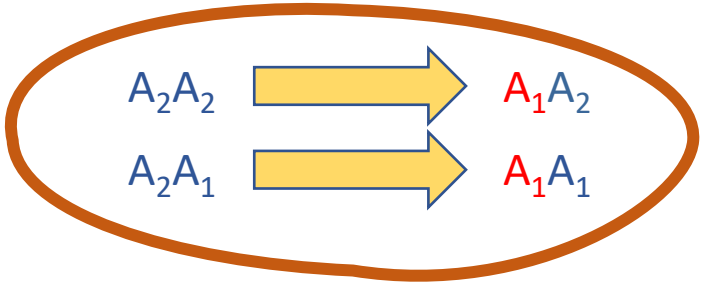


- $\alpha_{male} = \alpha_1 - \alpha_2 = a + d(q - p) + i$

Problems

- Regression coefficient can’t be calculated for each sex with imprinting
- Assuming random mating
- Assuming same allele frequencies on males and females

Our proposal

- $\alpha = \frac{cov(GV,N)}{var(N)} = \frac{2cov(E(GV_{prog}),N)}{var(N)}$ **RM**

- $\alpha = \frac{2cov\left(E\left(GV_{prog}\right),N\right)}{var(N)} = \propto_{Sex}$ **Imprinting**

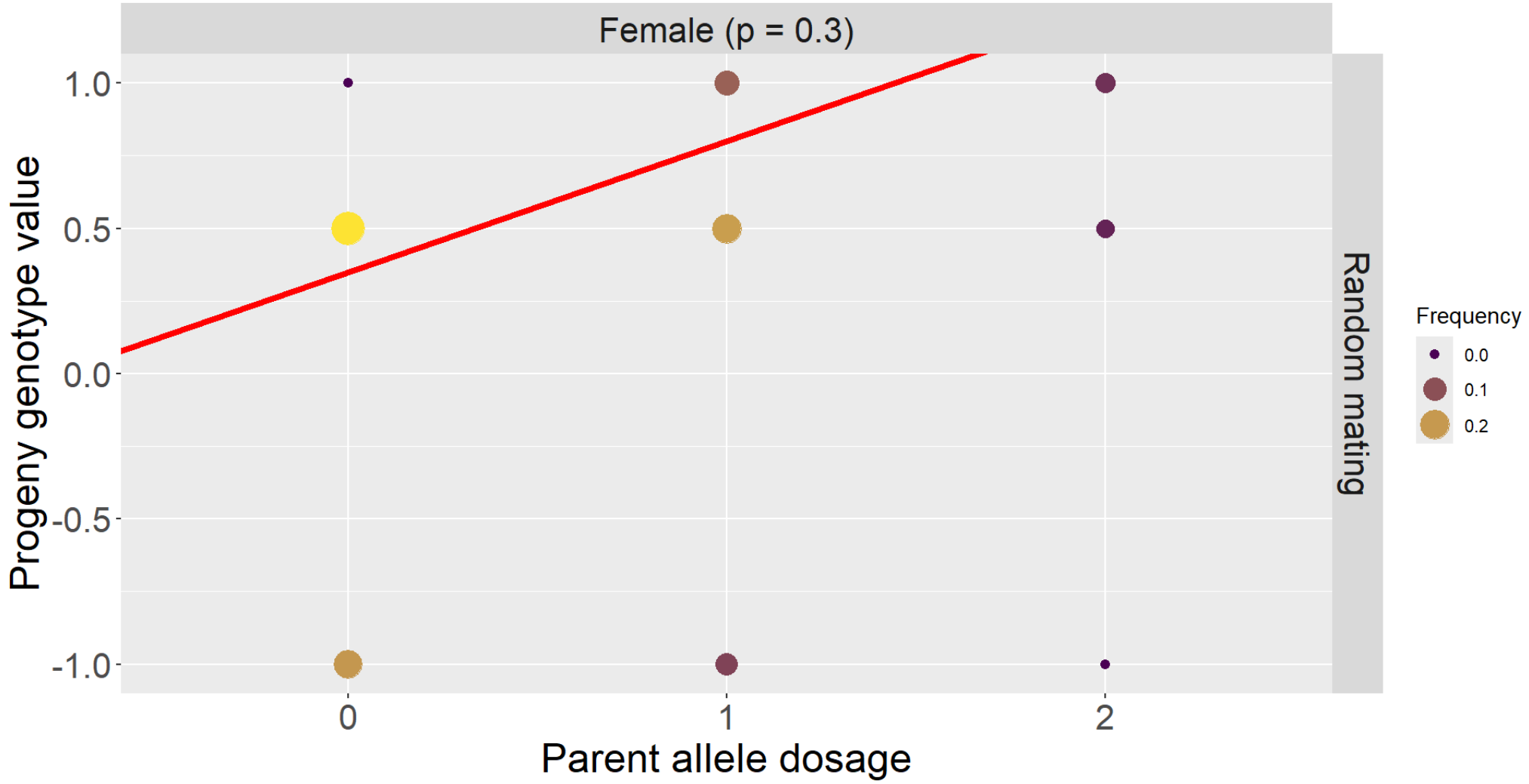
- $\alpha = \frac{2cov\left(E\left(GV_{prog}\right),N\right)}{var(N)} = \propto_{GCA}$ $p_{♂} \neq p_{♀}$

Example: AD

a = 1
d = 0.5

$N_{males} = N_{females}$

$p_{females} = 0.3$
$p_{males} = 0.9$



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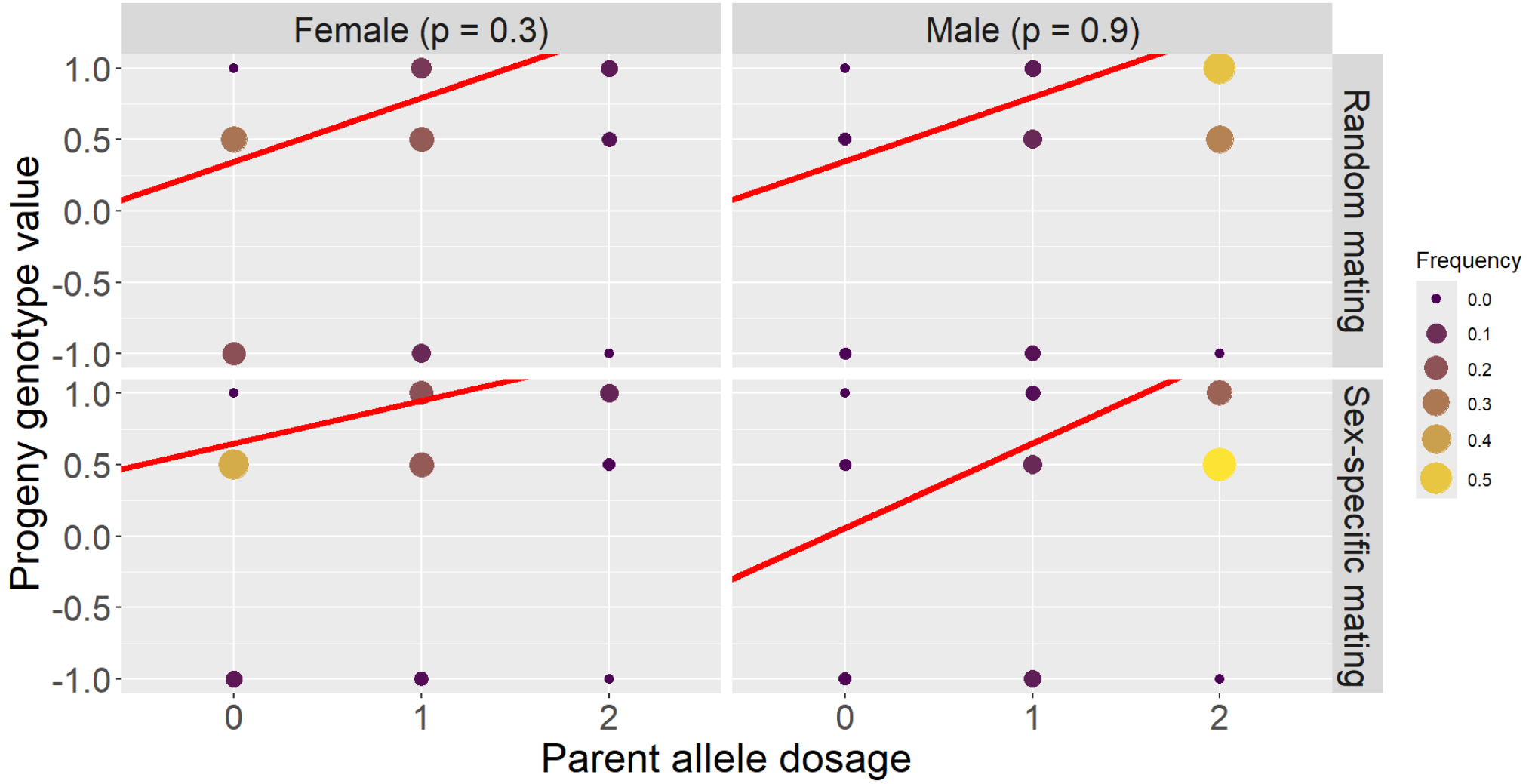

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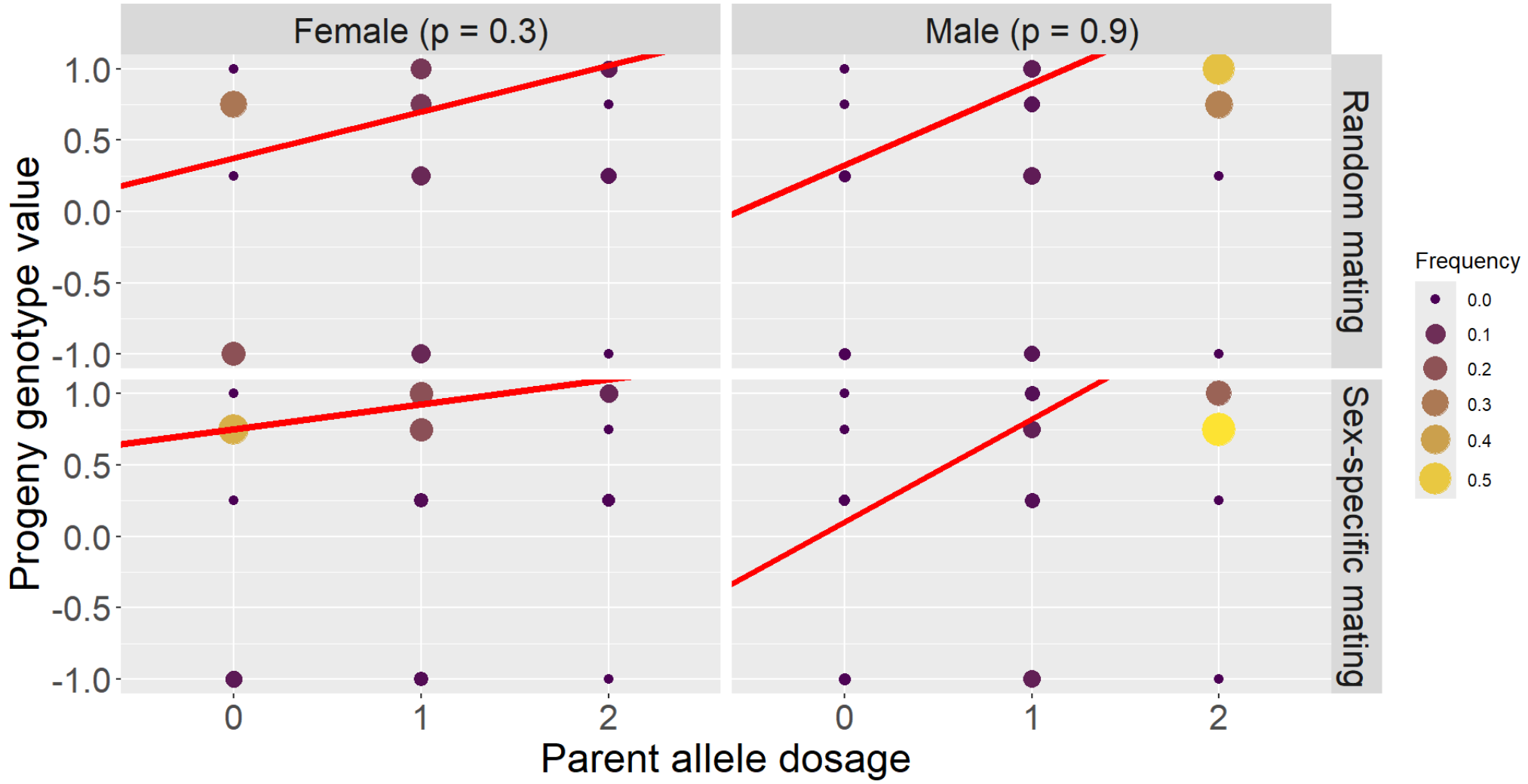
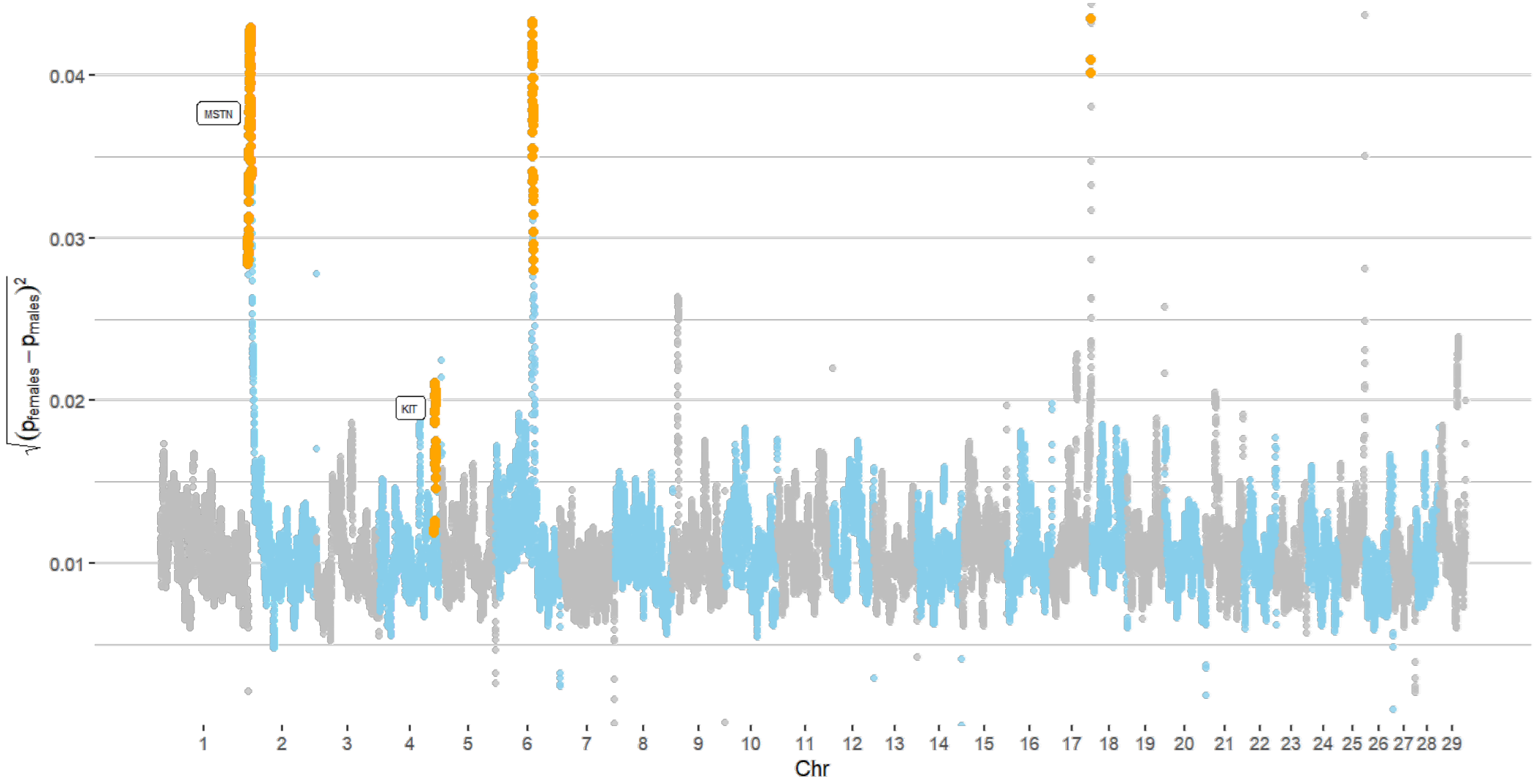
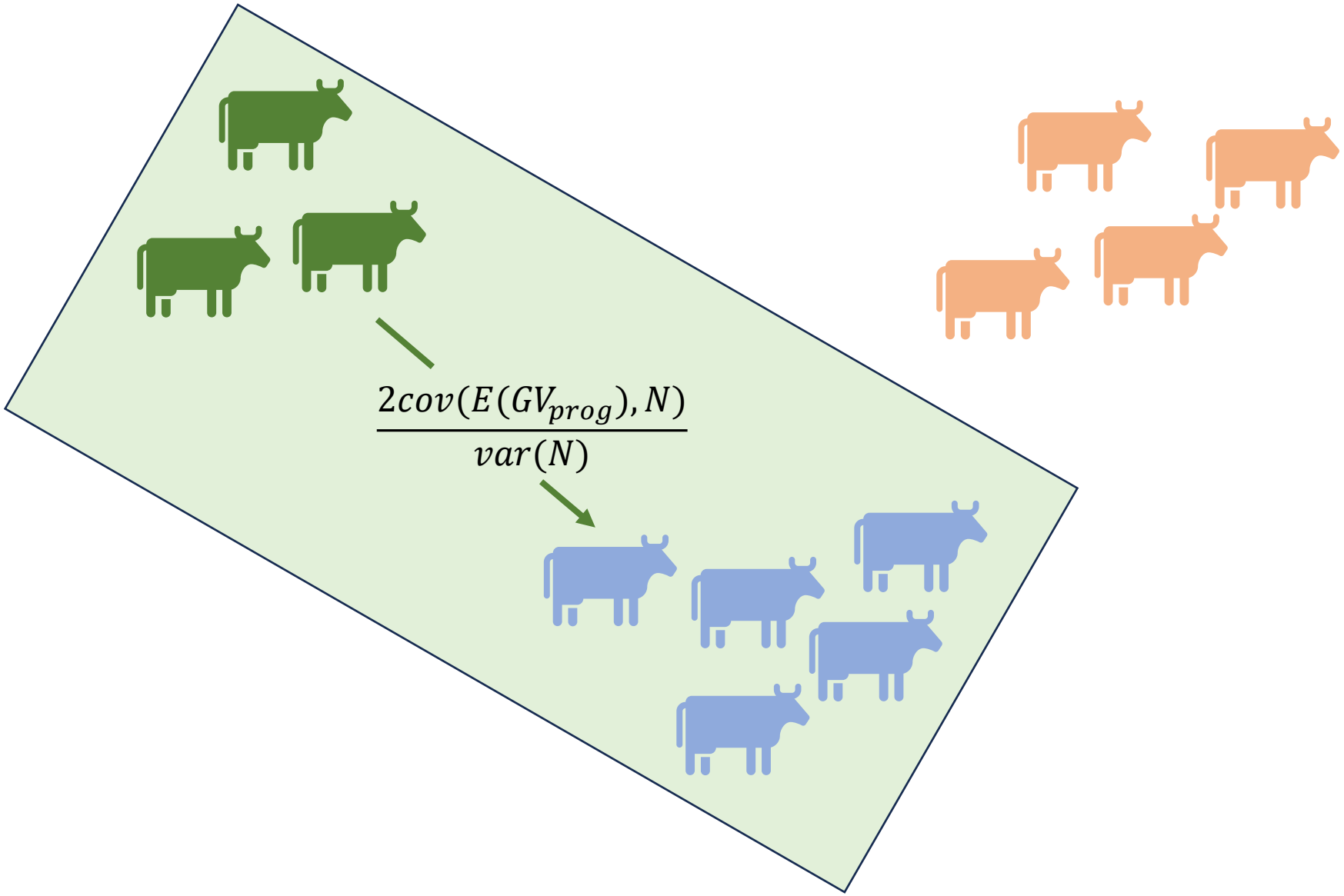


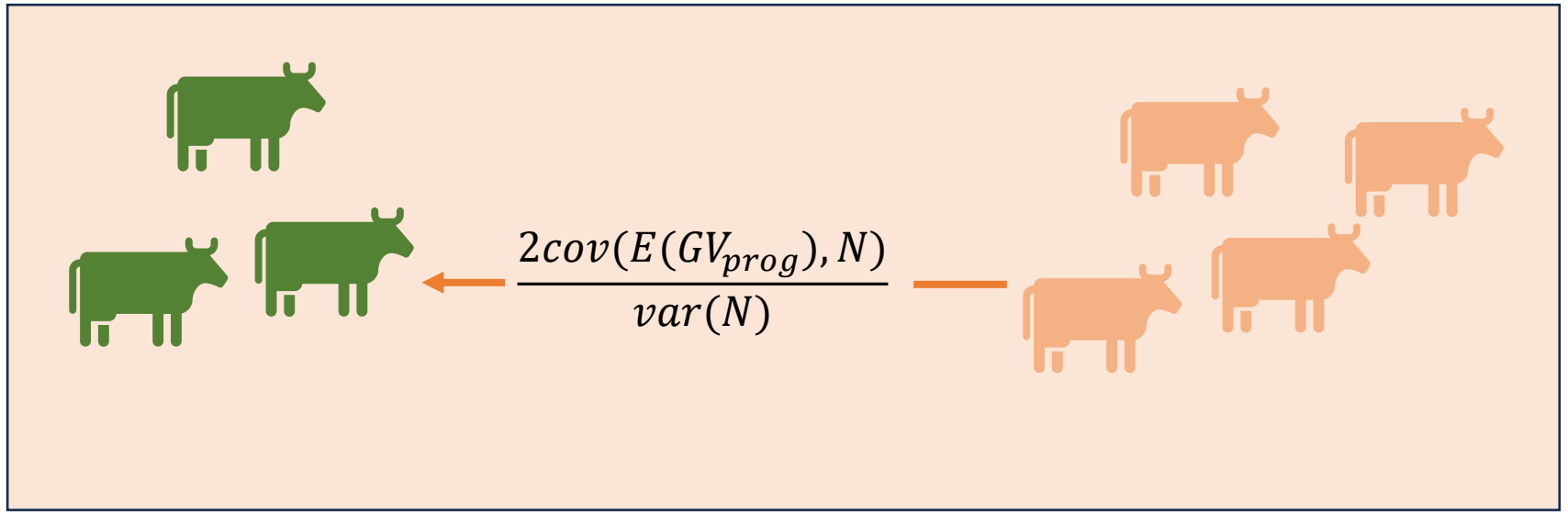
Real example: Rubia Gallega beef cattle

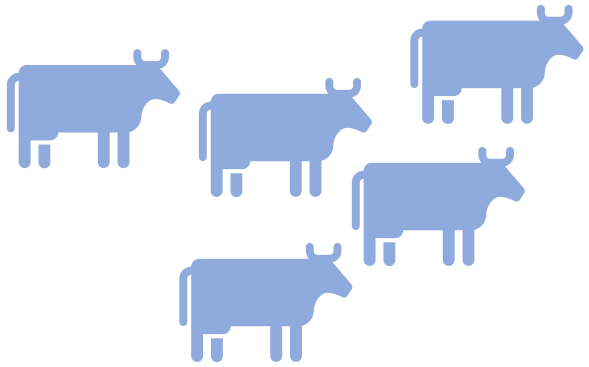


Conclusions



Conclusions





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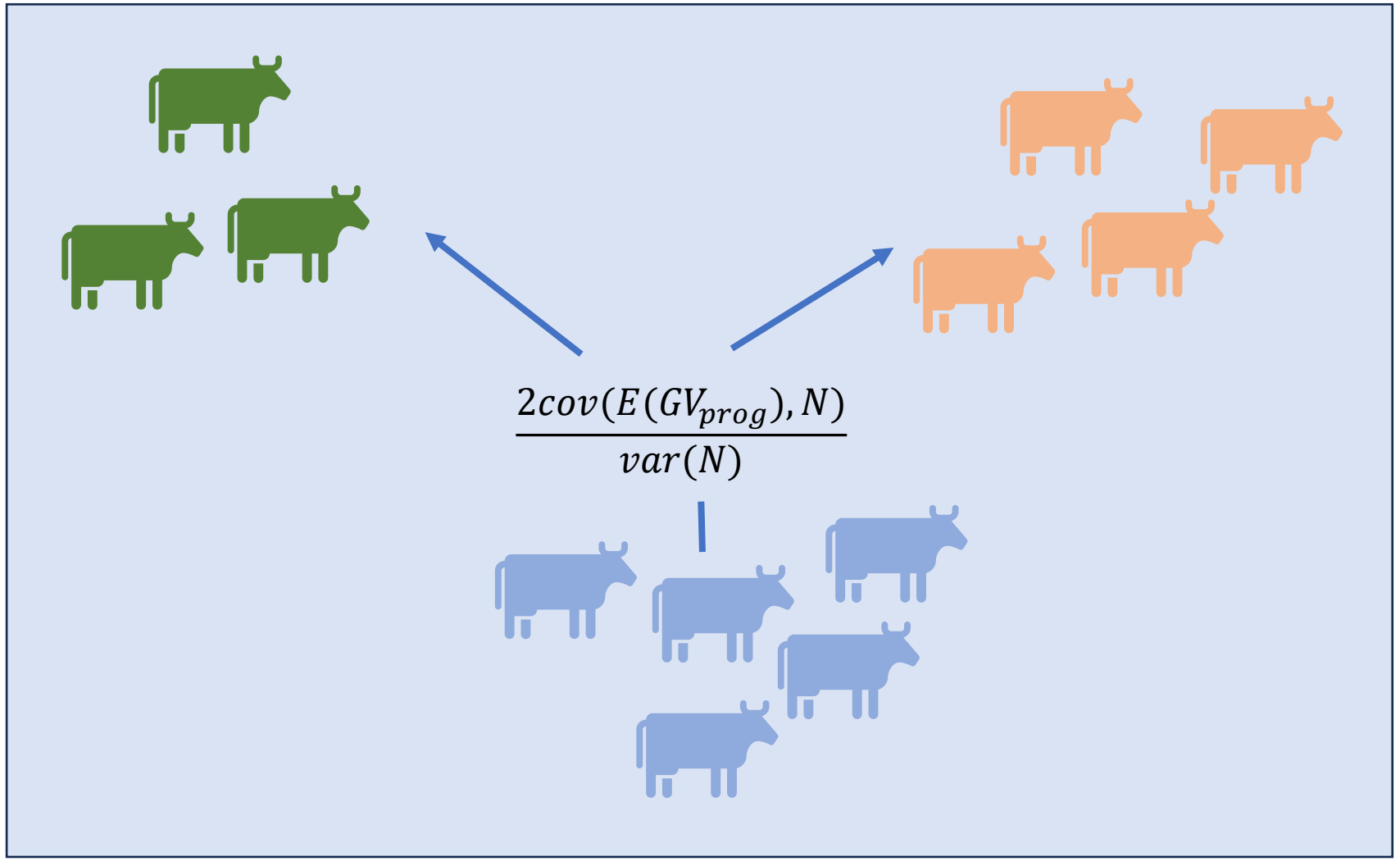


Conclusions

- Random mating is an exception to the norm in animal populations
- Assortative mating is also common (morphological restrictions, location, …)
- Allele frequencies can differ between sexes (and groups)
- This method generalizes the TBV calculation

Final remarks

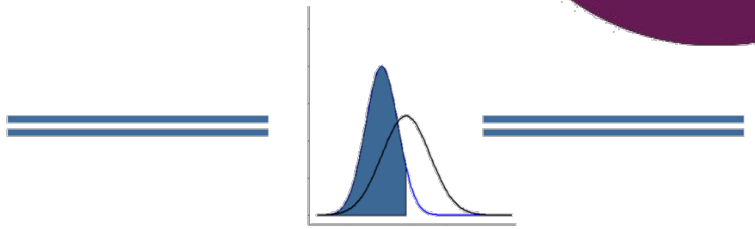
- From this generalization other potential parameters can be derived:
  - Individual mating allocation term
  - Inbreeding depression generated from each group of individuals (from Vitezica et al., 2024)

- Spurious imprinting signals can be detected if random mating is assumed

Thanks for your attention.

David López-Carbonell

davidlc@unizar.es



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