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Evaluating the impact of uncertainty in estimated breeding values on optimal contribution selection

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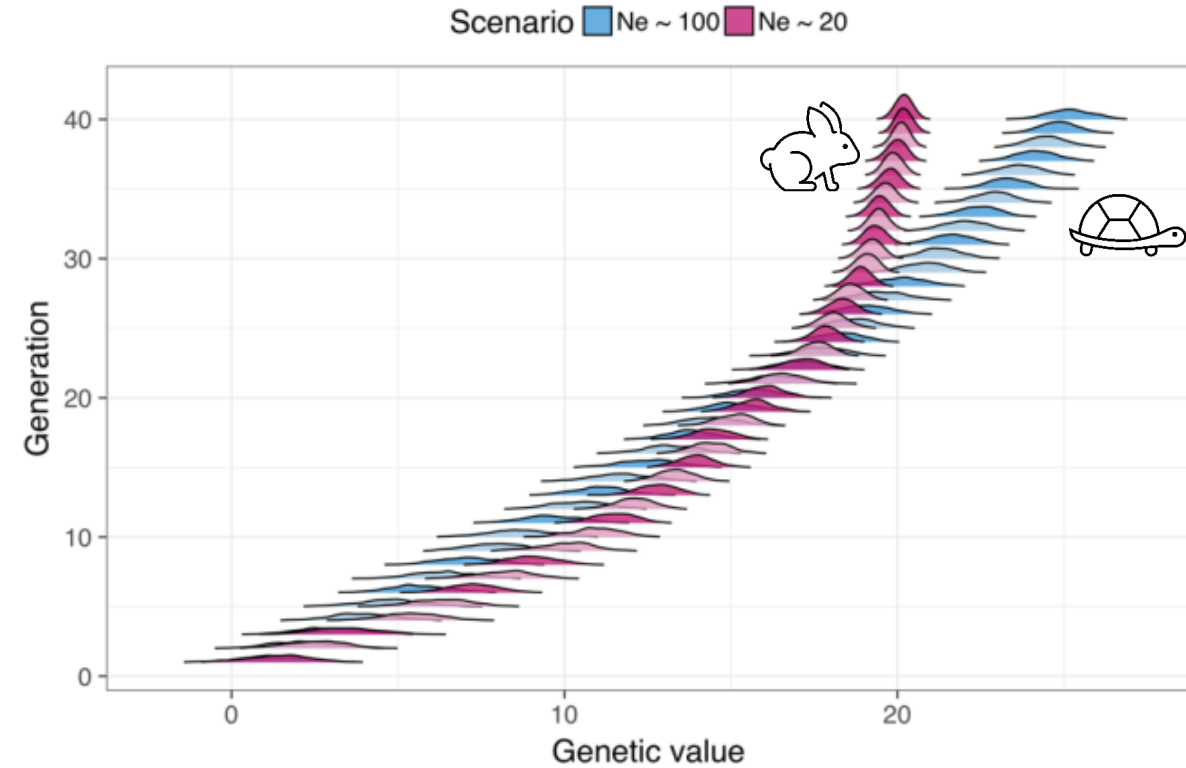
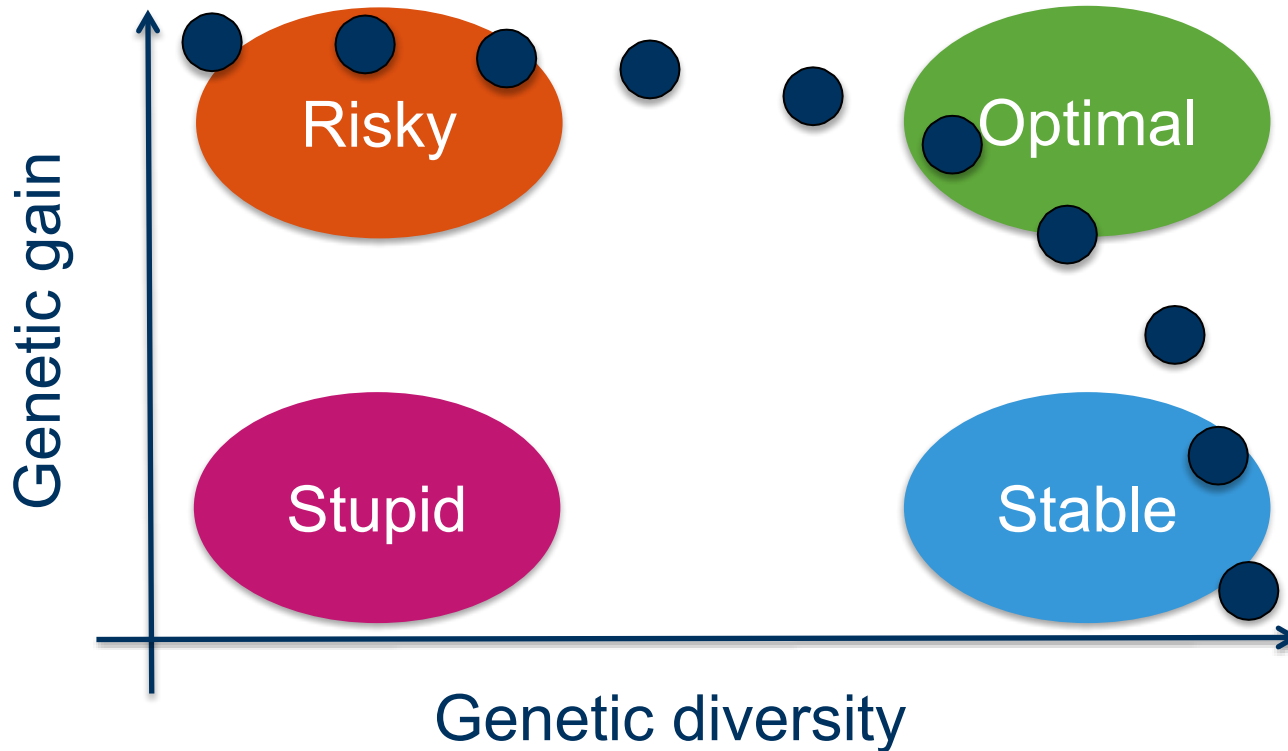
EAAP, Lyon FR, 28.8.2023.



Optimal Contribution Selection

Motivation

$$\text{Response} = \frac{\text{Accuracy} \times \text{Selection intensity} \times \text{Diversity}}{\text{Time}}$$



Optimal Contribution Selection

Theory

$$f(\mathbf{x}) = \mathbf{x}^T \mathbf{a} - \lambda \mathbf{x}^T \mathbf{A} \mathbf{x}$$

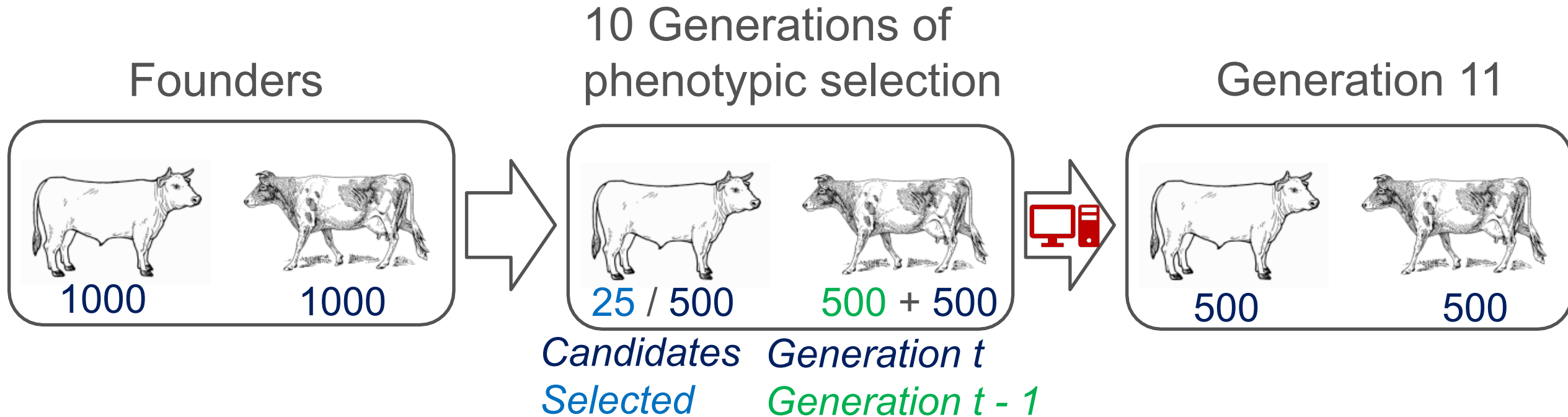
- Solve for \mathbf{x}
- Three main components
 - What measure of **selection criteria**
 - What measure of **coancestry**
 - What constrains

AIM:

Evaluate how uncertainty in EBV impacts optimised contributions and success of OCS

Material and methods

Simulation



Simulation

- **AlphaSimR** (Gaynor et al., 2021)
- Built-in cattle demographics
- $h^2 = 0.3$; 1k QTL/Chr; 2k SNP/Chr; 10 Chr



- (G)BLUP
- OCS **optiSel** (Wellmann, 2023)
- Selection

Scenarios

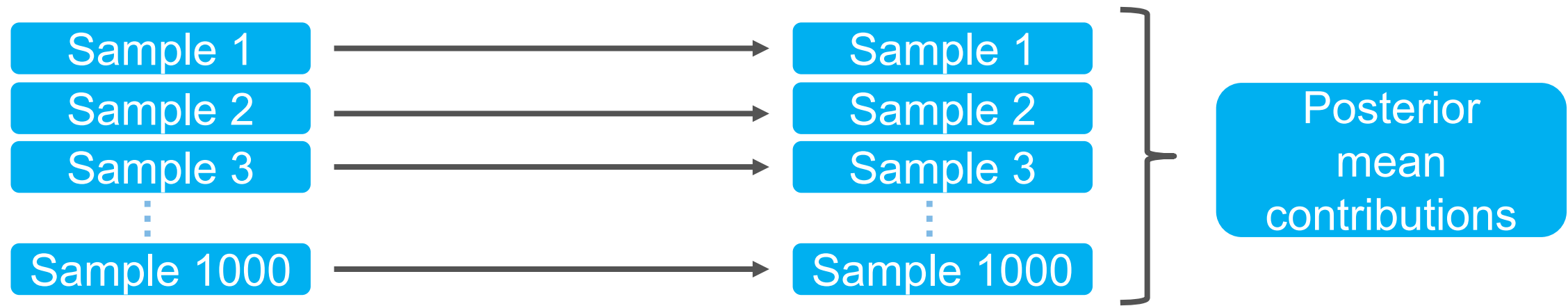
(G)BLUP

OCS
Ne = 50 or 100

NAÏVE



PROBABILISTIC

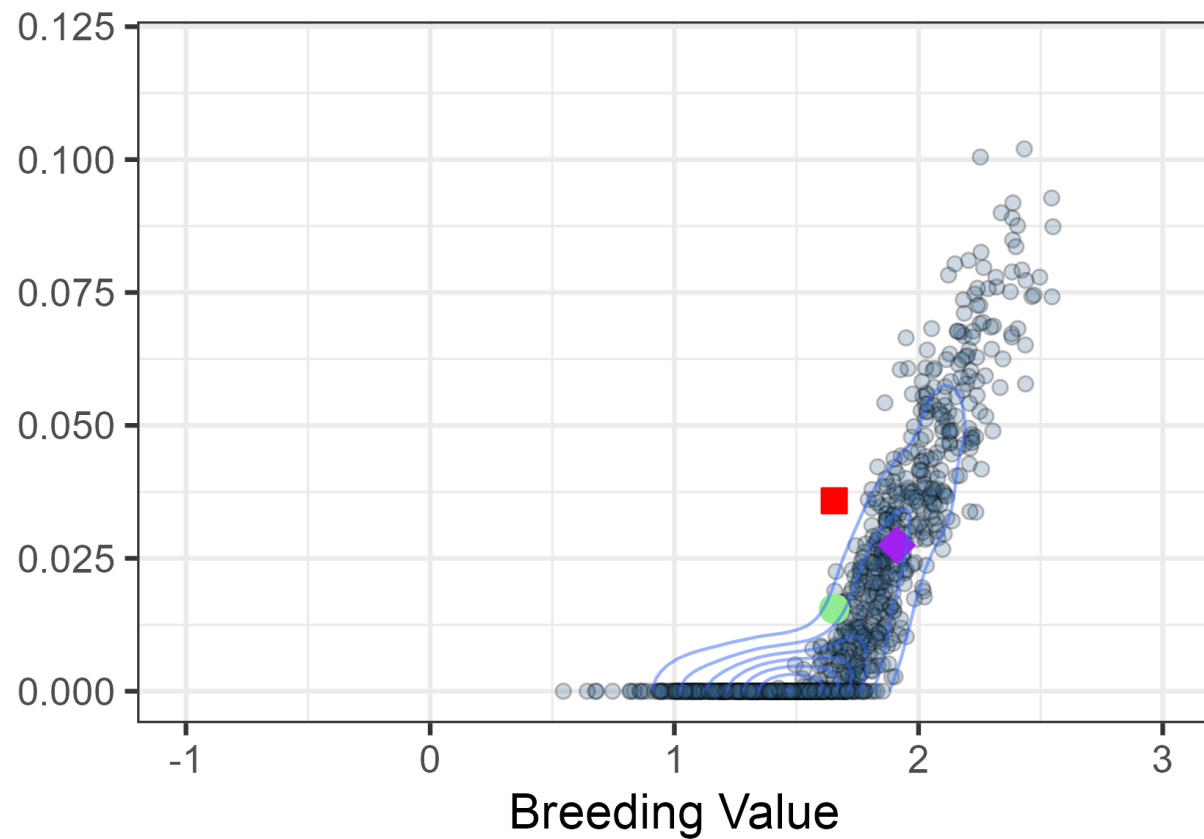
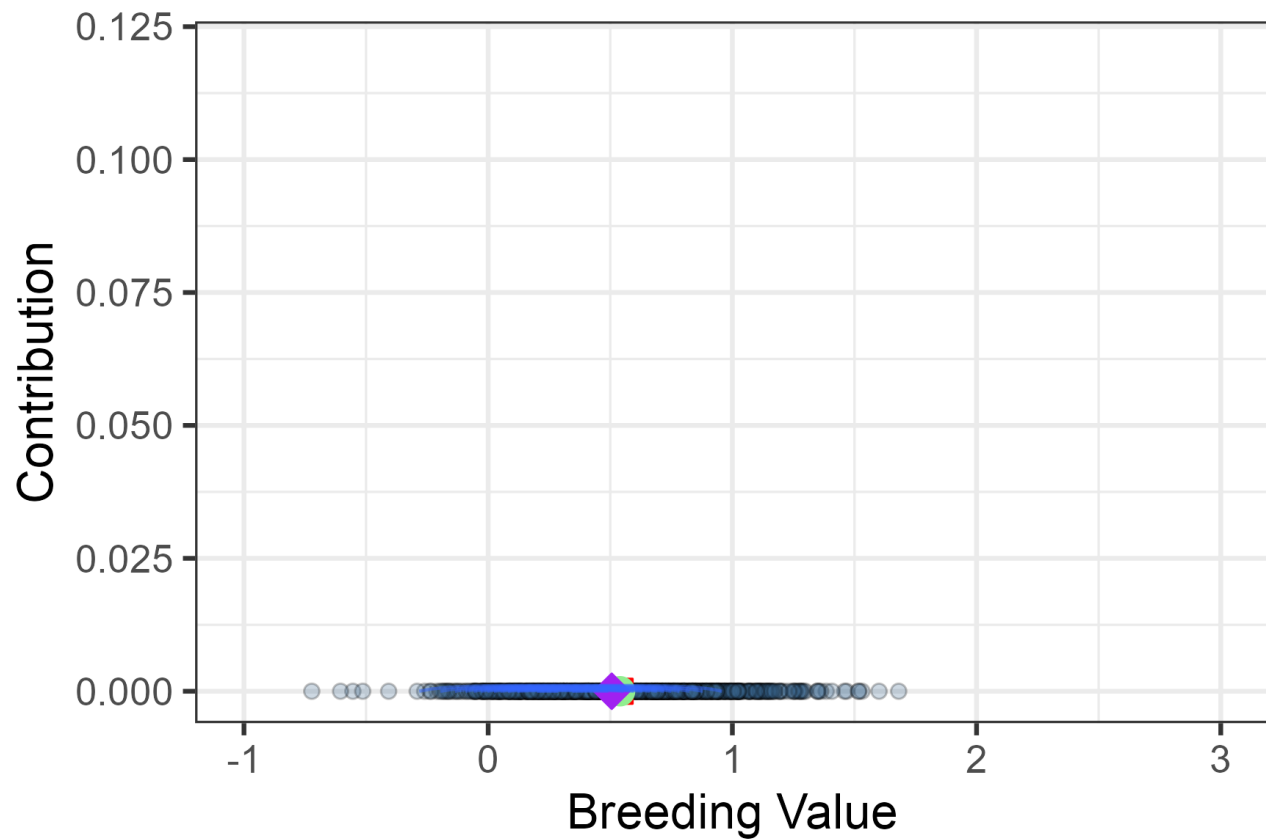


TBV

True contributions

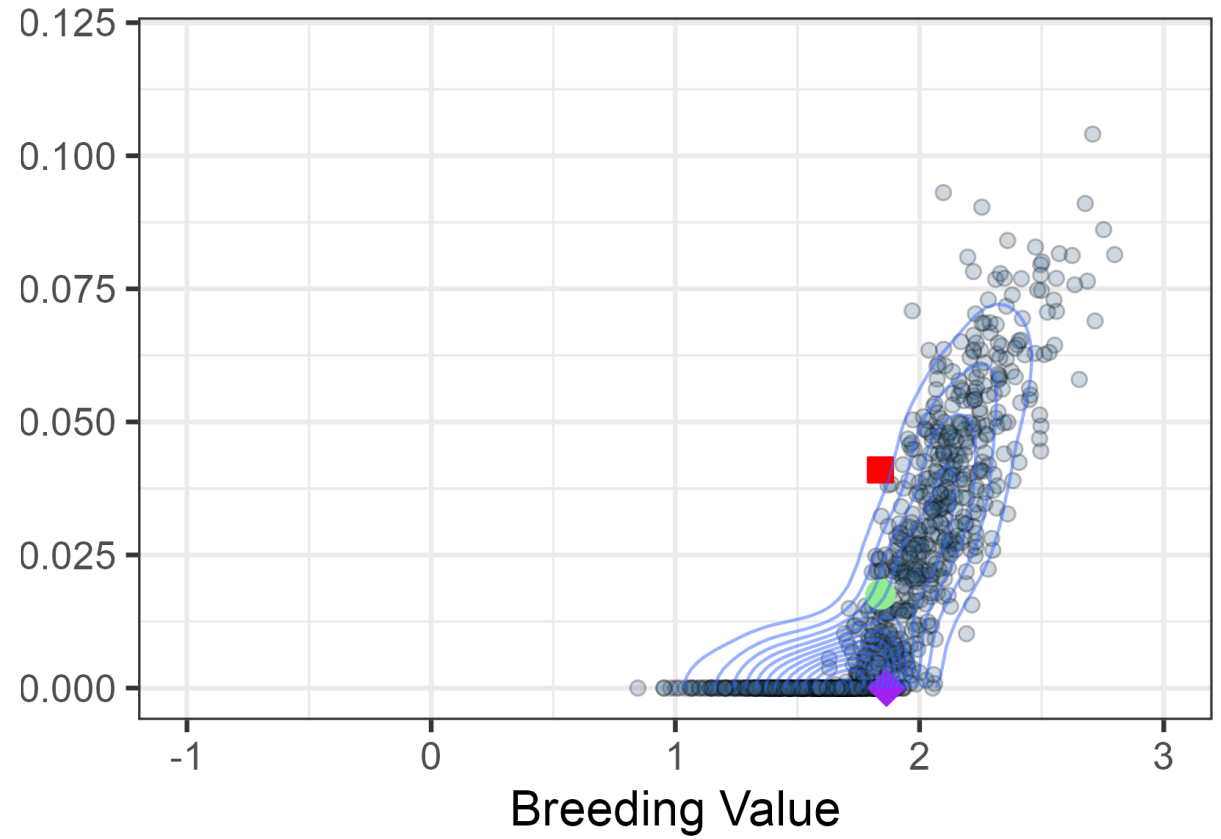
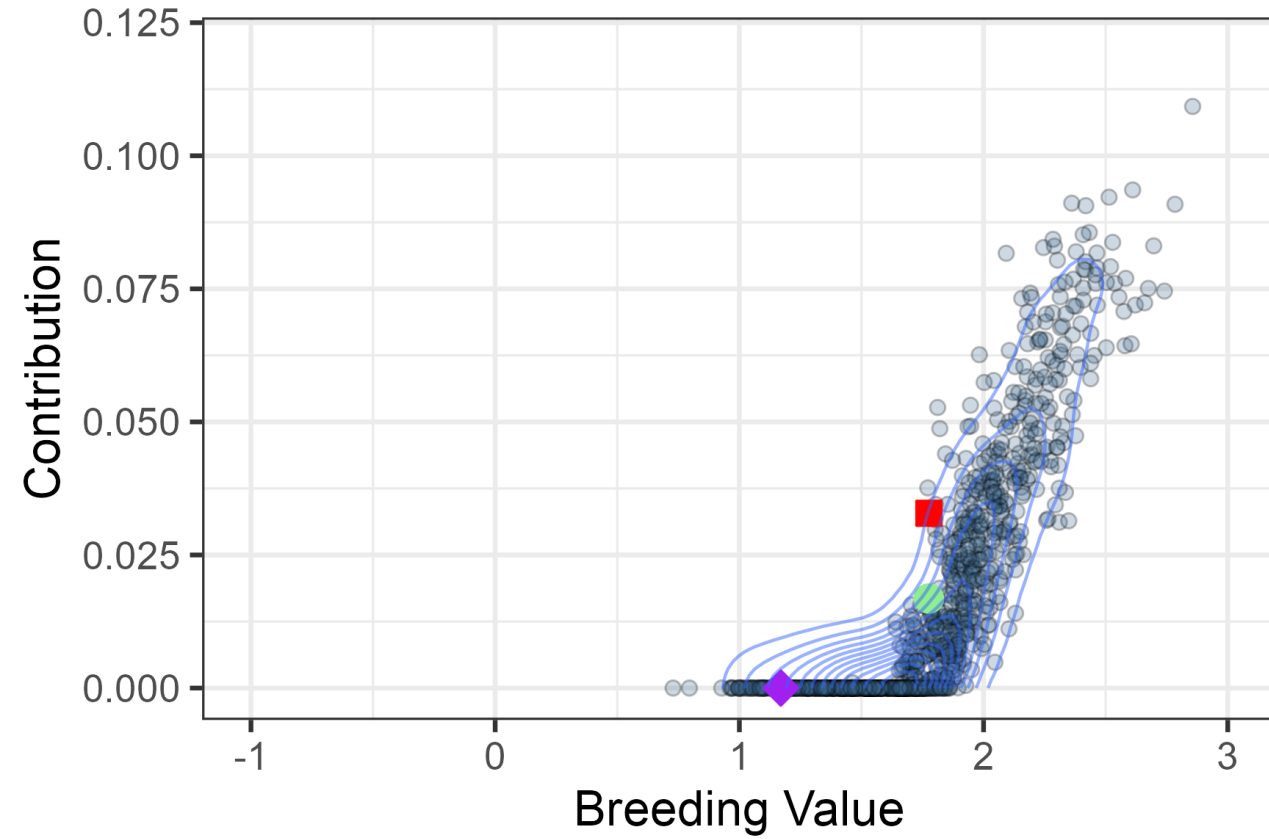
Results

Few examples (1)

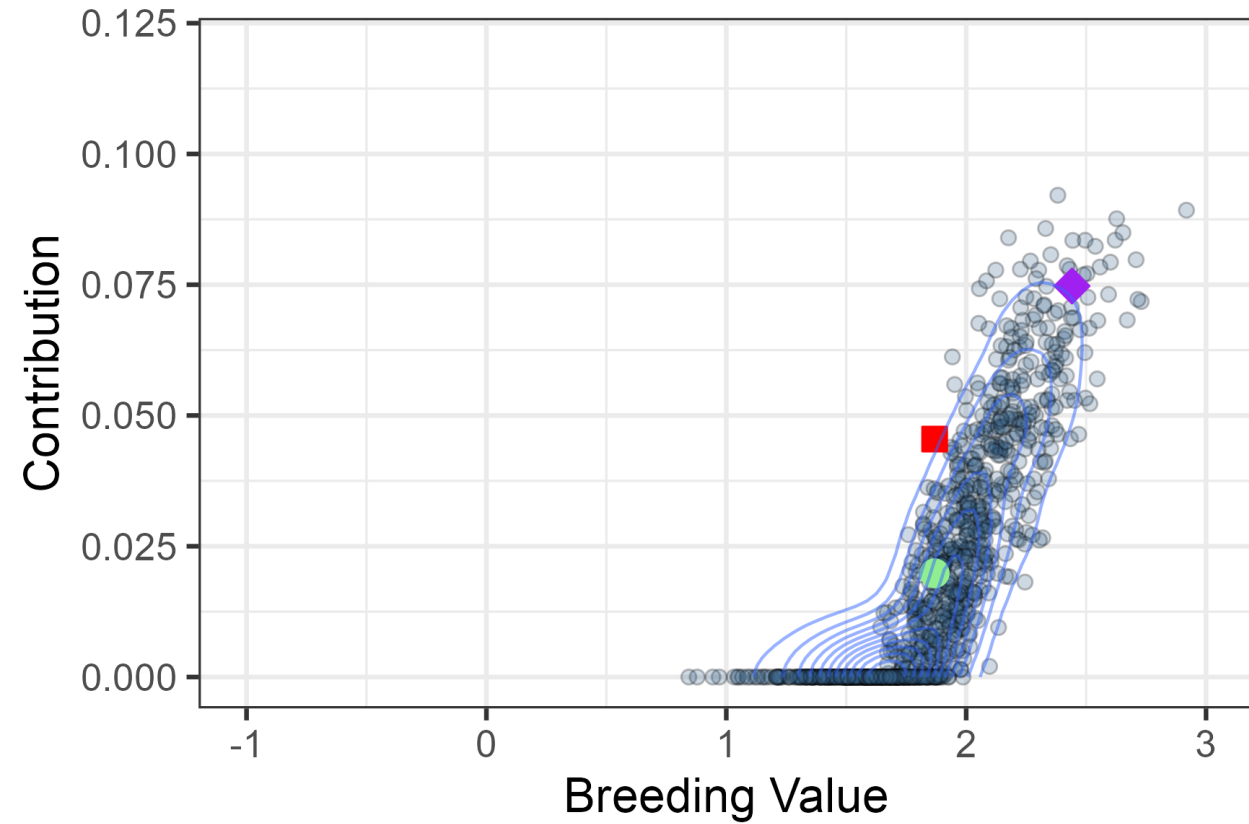


Results

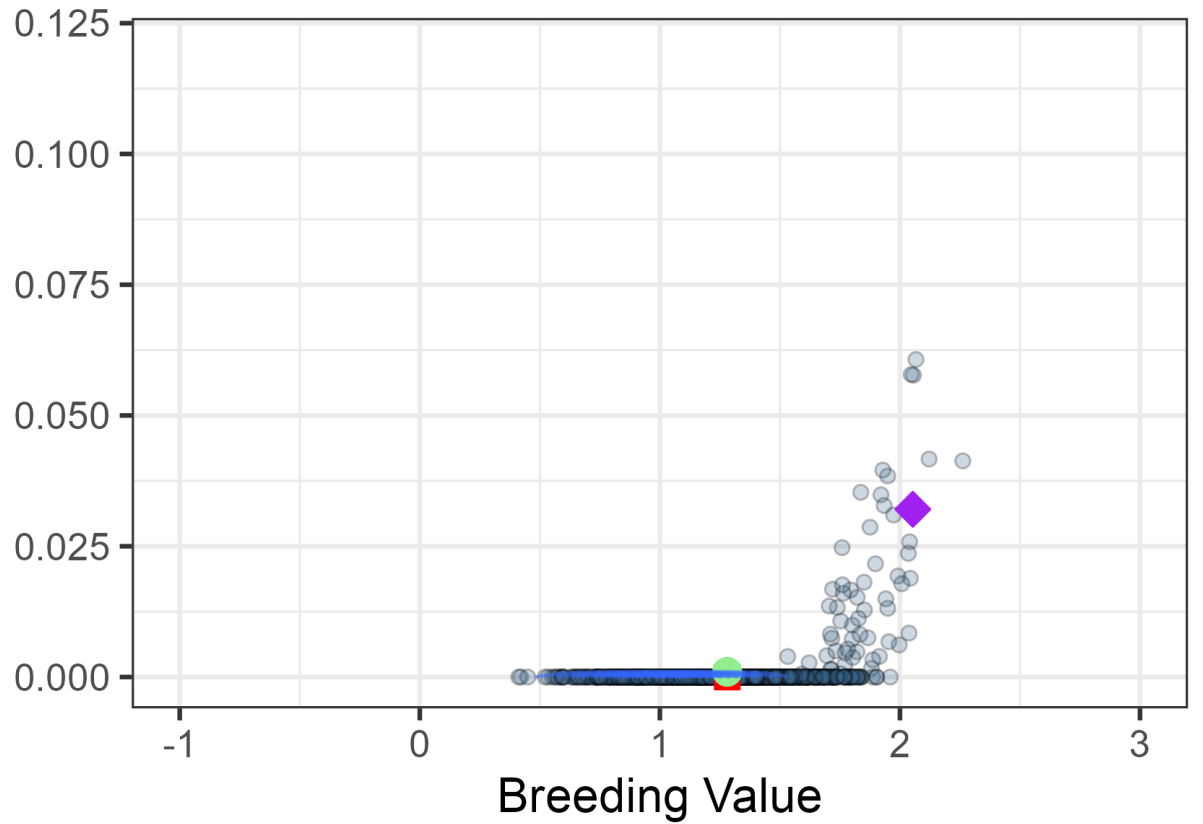
Few examples (2)



Results



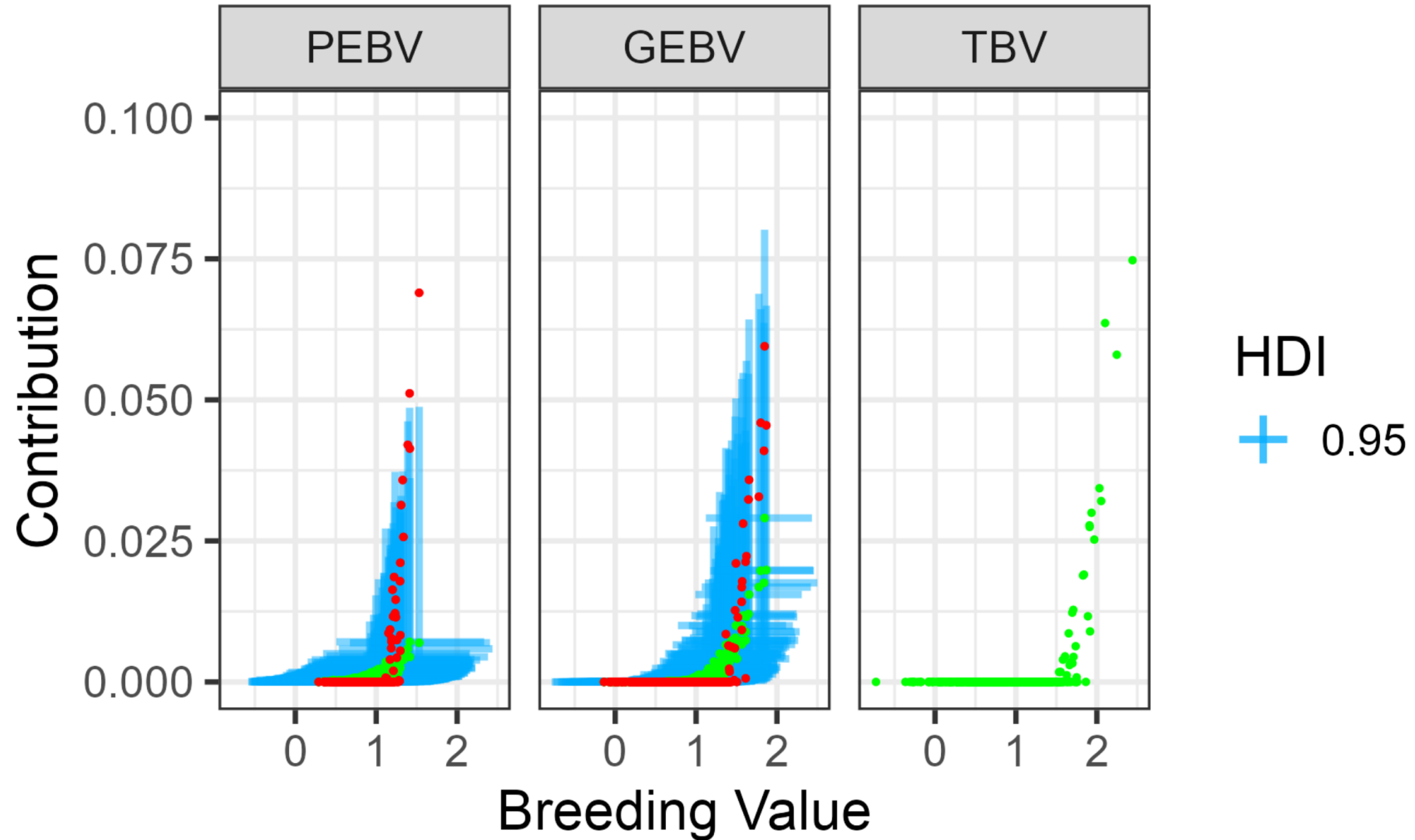
Few examples (3)



Results

HDI Ne=50

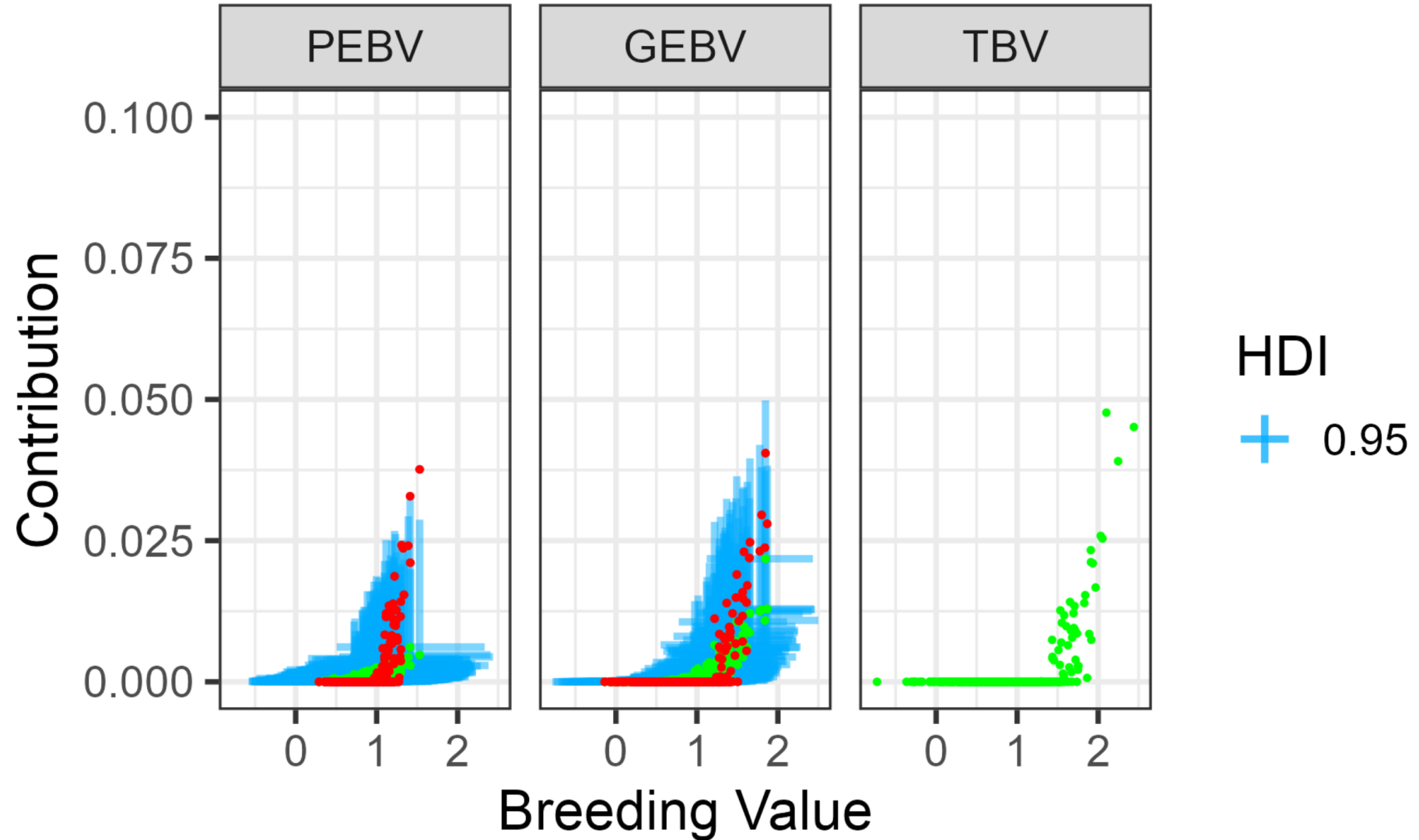
Ne = 50



Results

HDI Ne=100

Ne = 100



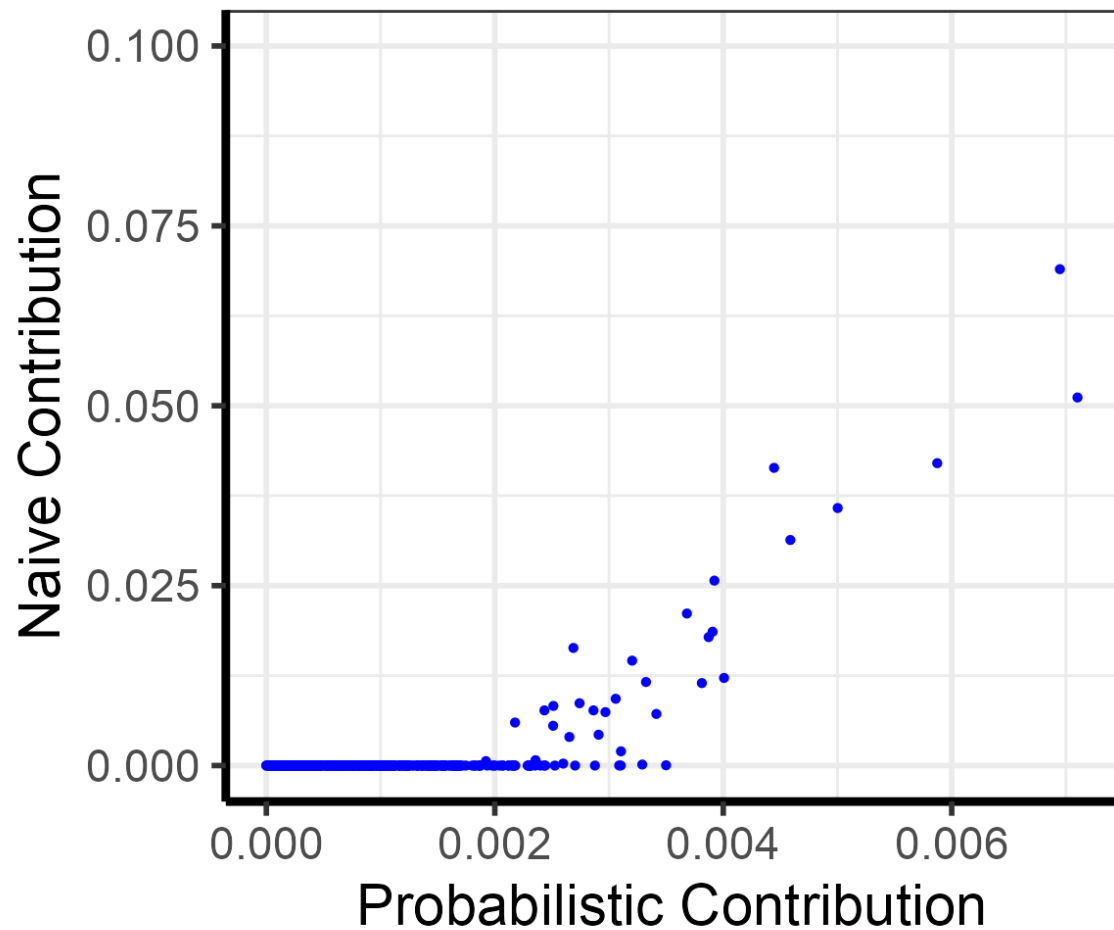
Results

Naïve vs. Probabilistic OC

Ne = 50

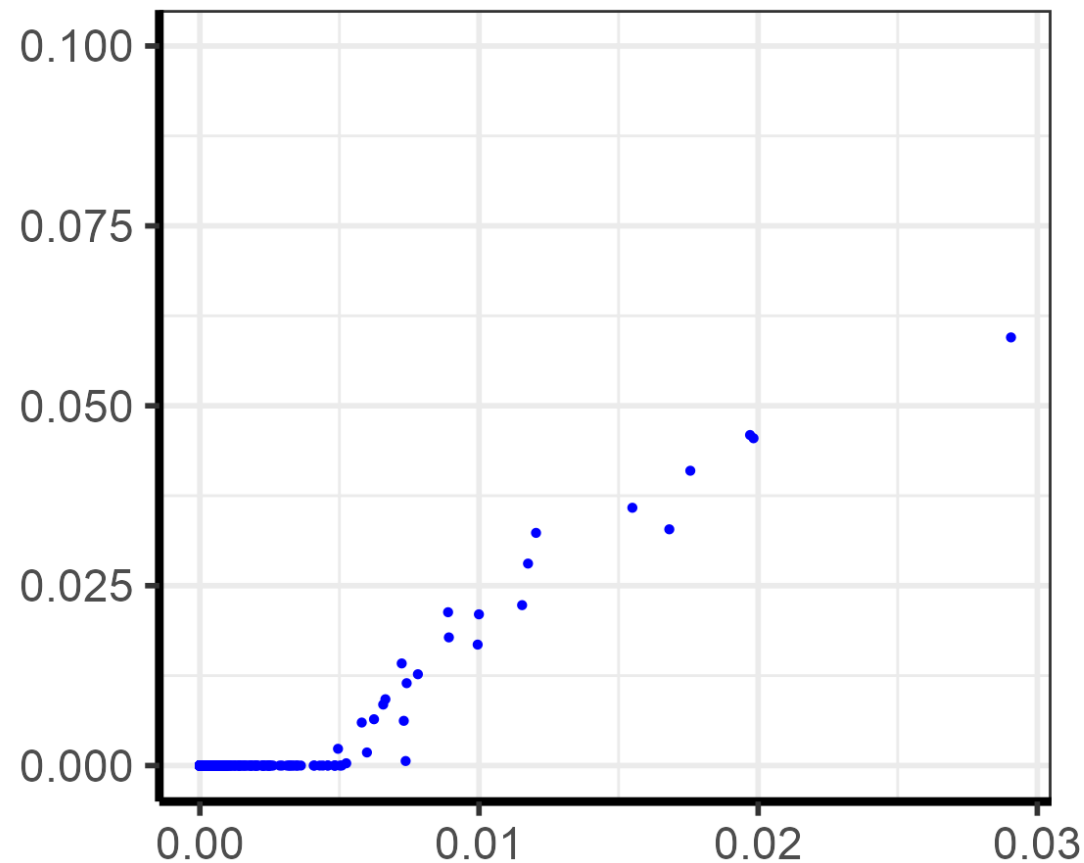
PEBV

cor = 0.70



GEBV

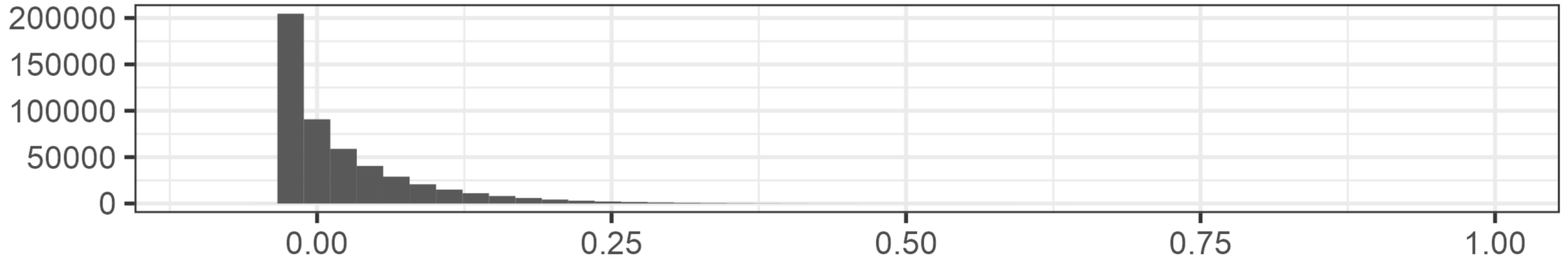
cor = 0.92



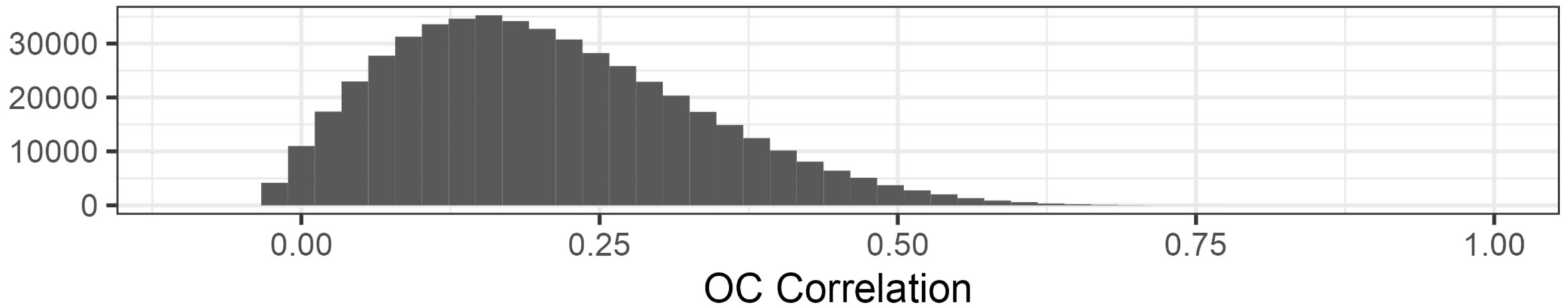
Results

OC samples correlations (Ne = 50)

PEBV



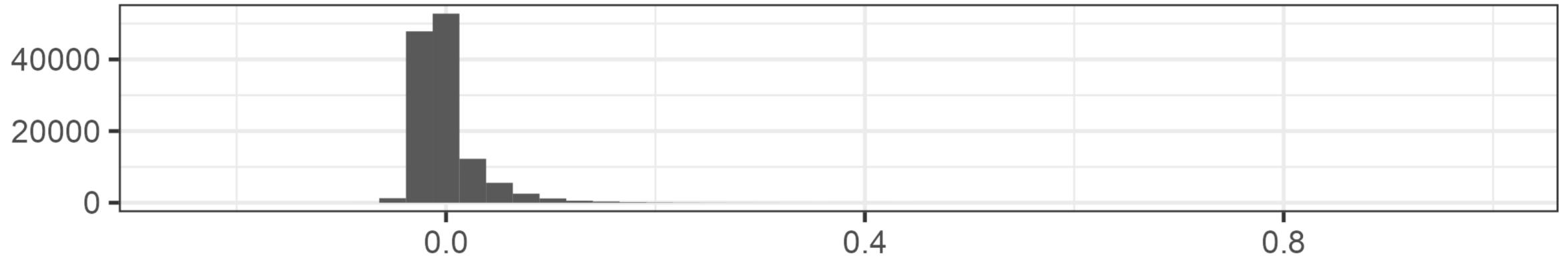
GEBV



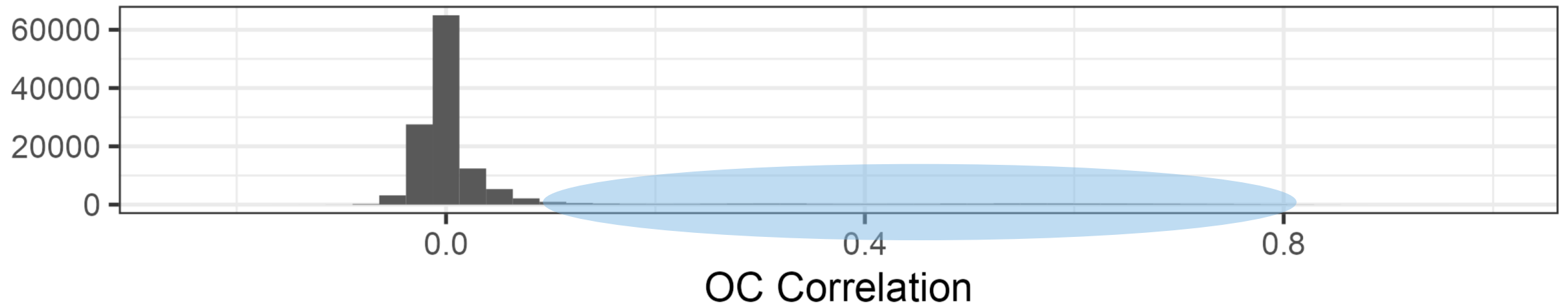
Results

OC correlations among animals (Ne = 50)

PEBV



GEBV



Results

Number of candidates

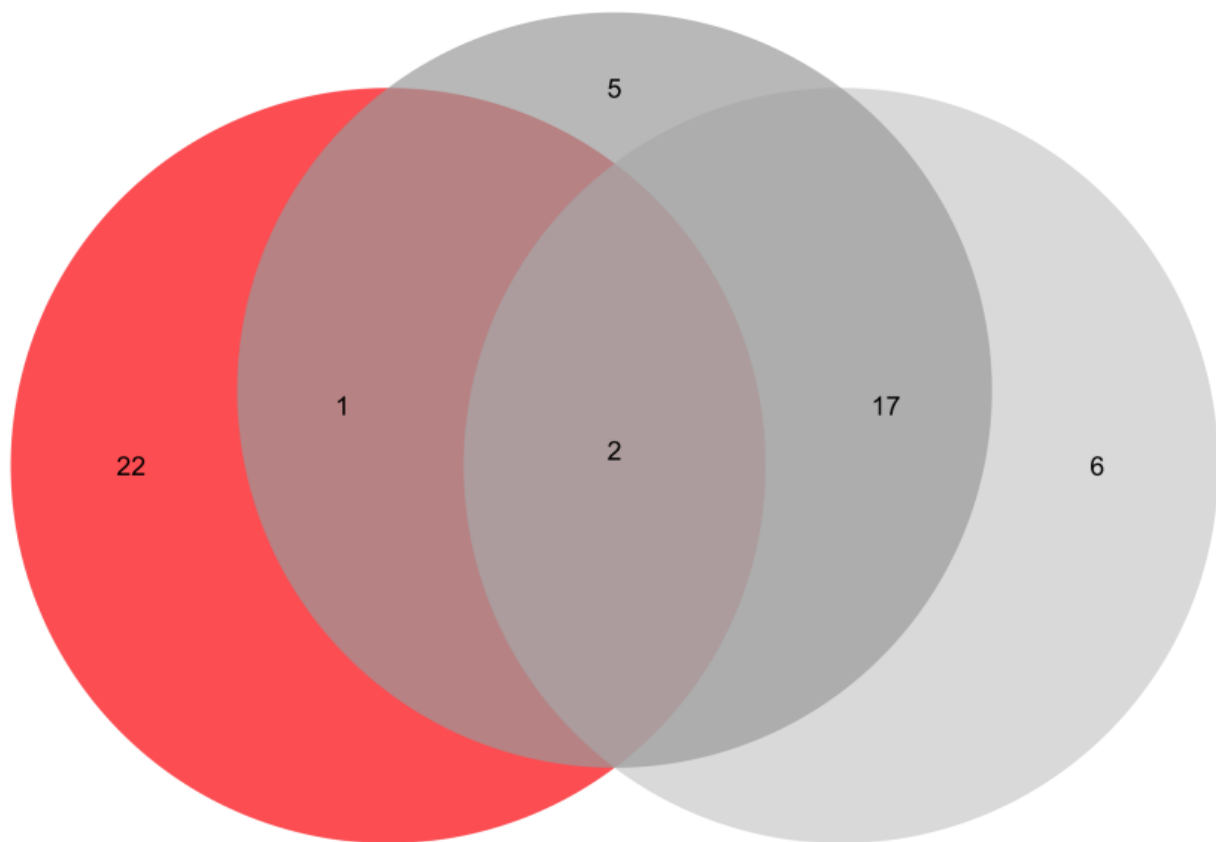
OCS		Number of candidates ($c > 0.001$)	
		<i>Ne = 50</i>	<i>Ne = 100</i>
Naïve	<i>PEBV</i>	27	52
	<i>GEBV</i>	23	39
Probabilistic	<i>PEBV</i>	181	193
	<i>GEBV</i>	94	111
True	<i>TBV</i>	26	40

Results

Selected 25 sires (Ne = 50)

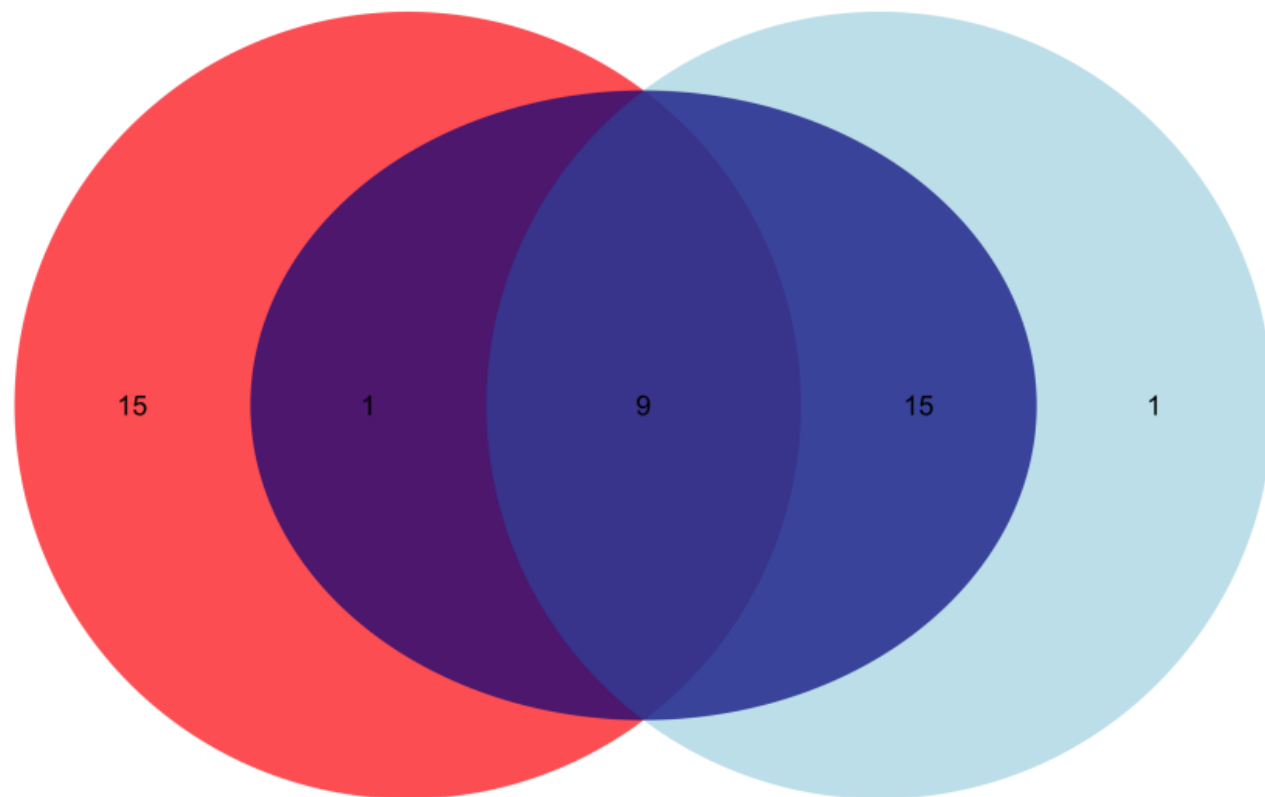
PEBV

True OC *Prob OC* *Naïve OC*



GEBV

True OC *Prob OC* *Naïve OC*



Conclusions

- Ongoing work
- Naïve OC overconfident
 - Results in sub-optimal selection and mating plans
- Probabilistic OC is closer to True OC
 - Especially in the case of non-genomic estimates (capturing Mendelian sampling!)
- Challenging to use Probabilistic OC in practice
- Future directions:
 - Test methods that work with full posterior of BV (e.g., robust optimisation) to enable routine probabilistic OC



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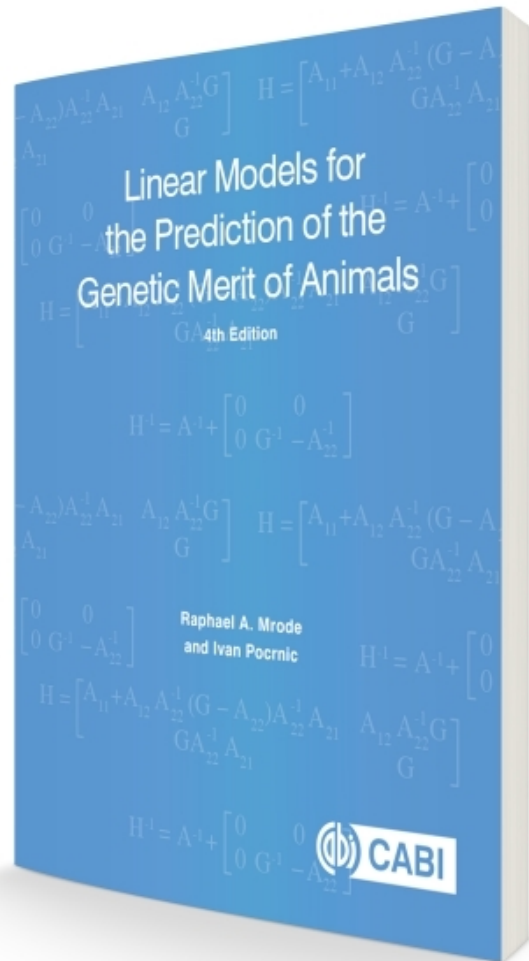


Thanks !!!

Acknowledgements

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- Edinburgh Compute and Data Facility (ECDF)





Linear Models for the Prediction of the Genetic Merit of Animals

CABI Biotechnology Series

September 2023 | 412pp

Authored by **Raphael A Mrode & Ivan Pocrnic**

Fundamental to any livestock improvement programme by animal scientists, is the prediction of genetic merit in the offspring generation for desirable production traits such as increased growth rate, or superior meat, milk and wool production.

The book covers:

- The relationship between the genome and the phenotype.
- BLUP models for various livestock data and structure.
- Incorporation of related ancestral parents and metafounders in prediction models.
- Models for survival analysis and social interaction.

Suitable for graduate and postgraduate students, researchers and lecturers of animal breeding, genetics and genomics, this established textbook provides a thorough grounding in both the basics and in new developments of linear models and animal genetics.

<https://www.cabidigitallibrary.org/doi/book/10.1079/9781800620506.0000>