Selection Index

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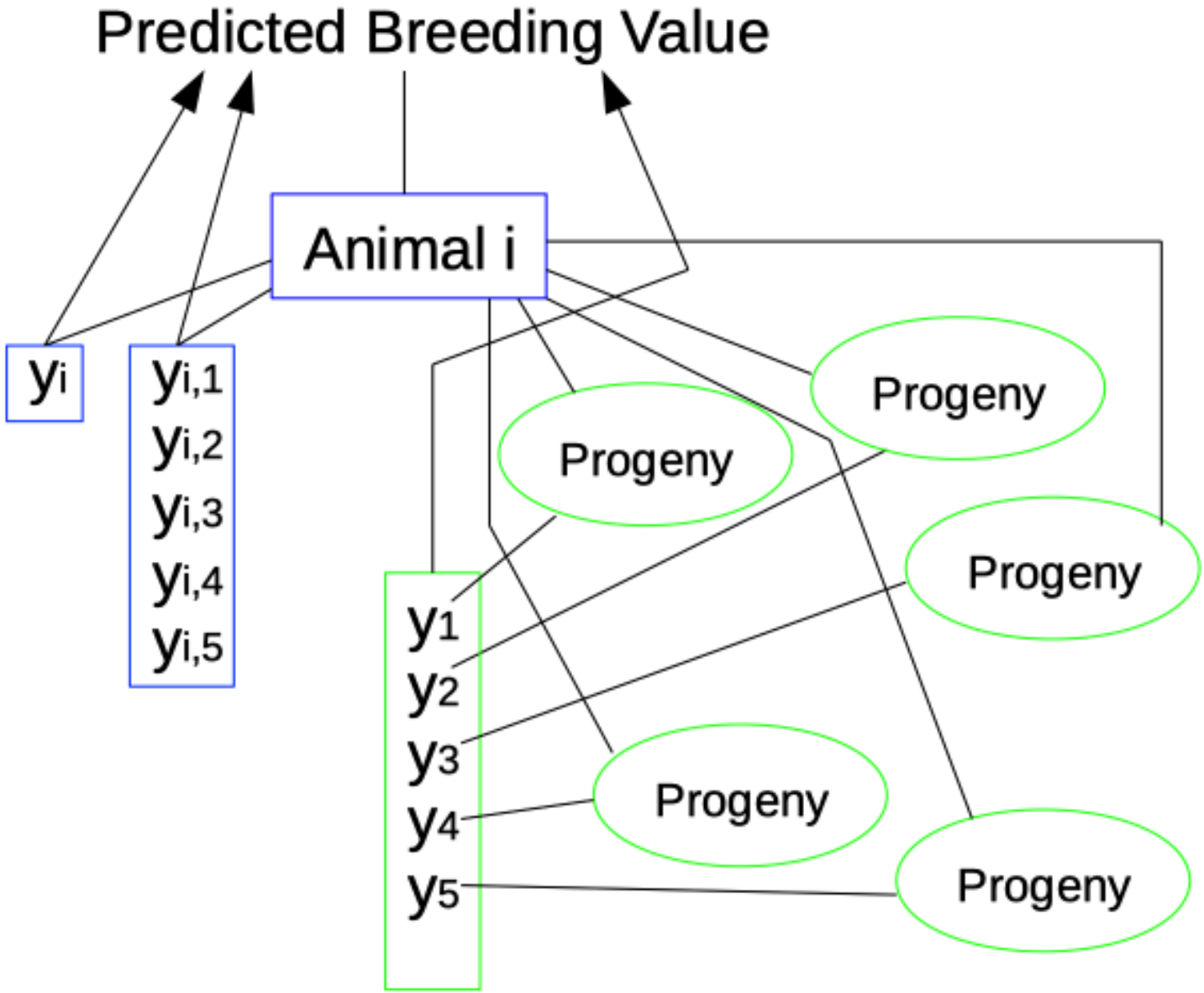
<!– ———————————————————————– – TODO: – – > Slide on “Aggregate Genotype” is not integrated well – – Try to put concept of AG in the center and start with – – The requirement to improve animals with respect to – – several traits simultaneously. – – > Here, we are missing the use of the selection index for – – predicting breeding values of single traits, this was – – done in lbg_fs_2018_slides_pbvsi.Rmd, should be – – integrated here. – – ———————————————————————– –>

So far . . .

- Prediction of breeding values based on regression approach
- Usage of single class of information
  - own performance on the same trait
  - repeated measures
  - offspring records

$\rightarrow$ How to combine different sources of information

Desired Scenario



Two Approaches

1. Selection Index Theory and
2. Best Linear Unbiased Prediction (BLUP)

- Same genetic model
- Main difference in how identifiable environment is corrected for
- Start with 1. then move to 2.
- Nowadays 2. is most widely used method

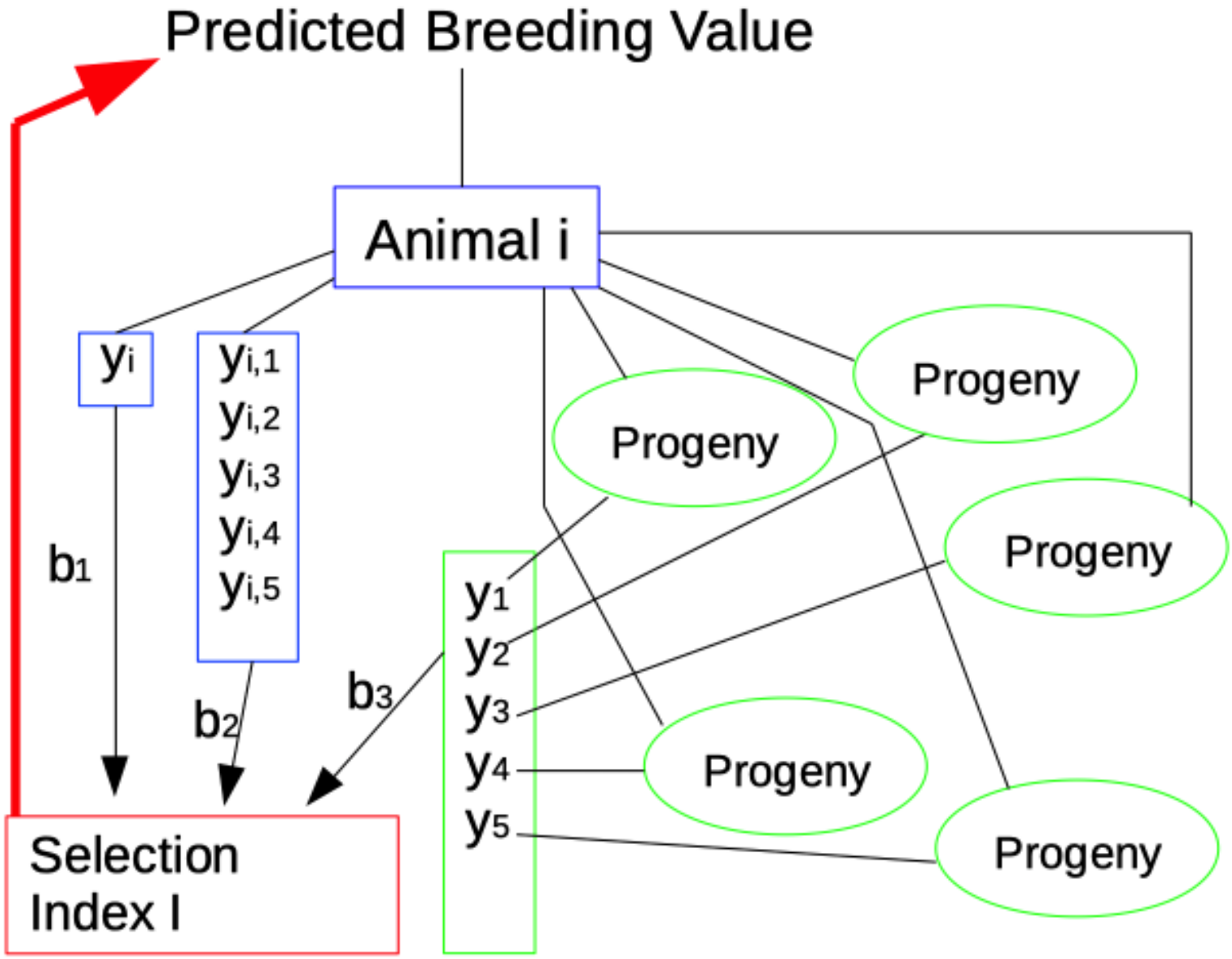
Differentiate between

- **true breeding value**: measures genetic potential, but cannot be observed
- **predicted breeding value**: use information, such as phenotypic observations to predict true breeding value as accurate as possible

Three objectives of predicted breeding values

1. selection criterion for parents of next generation
2. prediction of true breeding value as early as possible
3. predicted breeding values affect price of semen and breeding animals

Selection Index Method

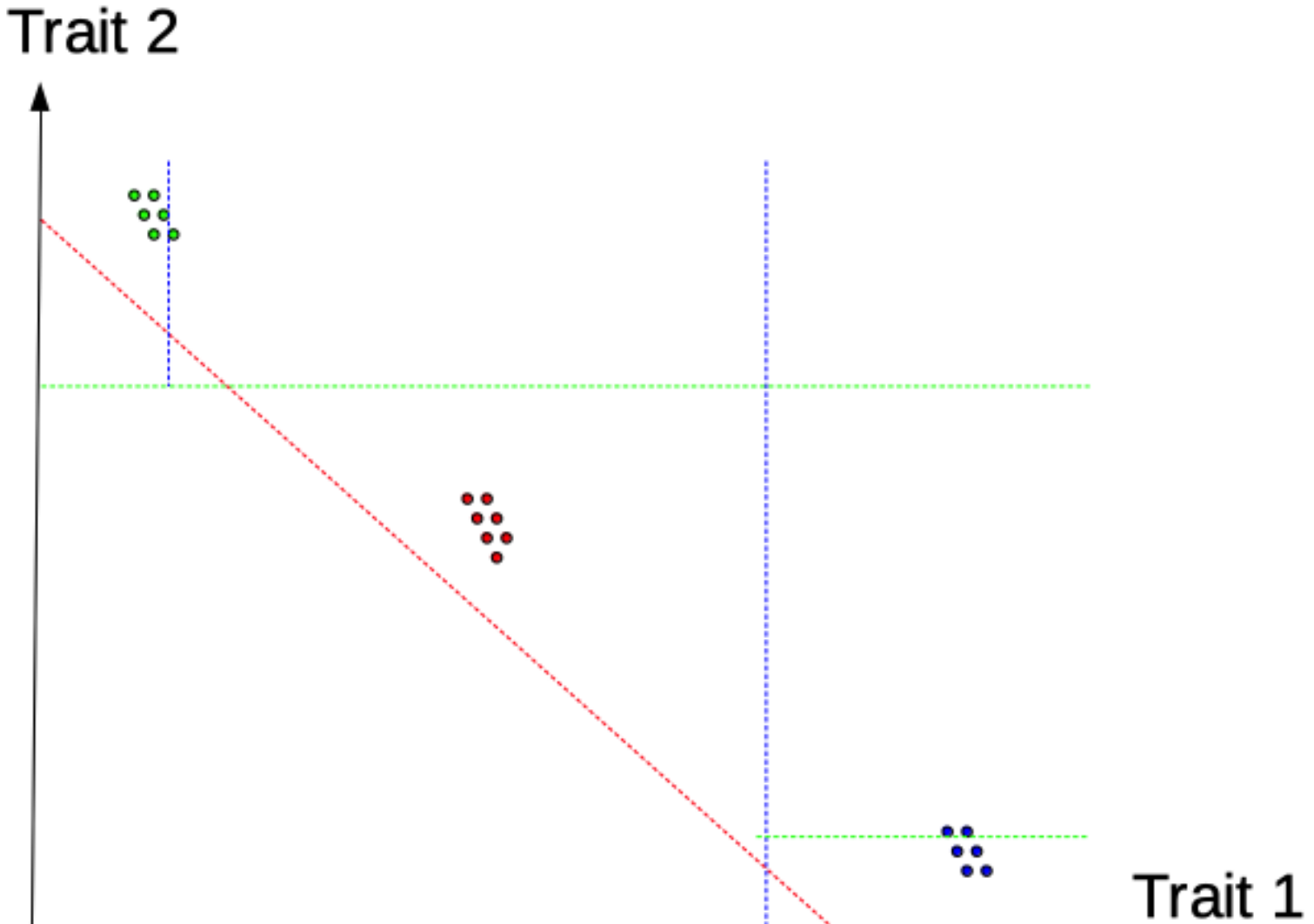


What is the Selection Index

- Combine all available information
- Assign single number I to each animal
- Rank animals according to I
- Use ranking as selection criterion
- Weights b_t for each information
- Determine weights b - How To? Follows

Aggregate Genotype

- Want to improve more than just one trait
- How to select animals?



Selection Methods

- Tandem selection: First improve only trait 1, then improve only trait 2
- Independent selection boundaries: select for trait 1, among selected look at trait 2
- Combine traits into aggregate genotype H

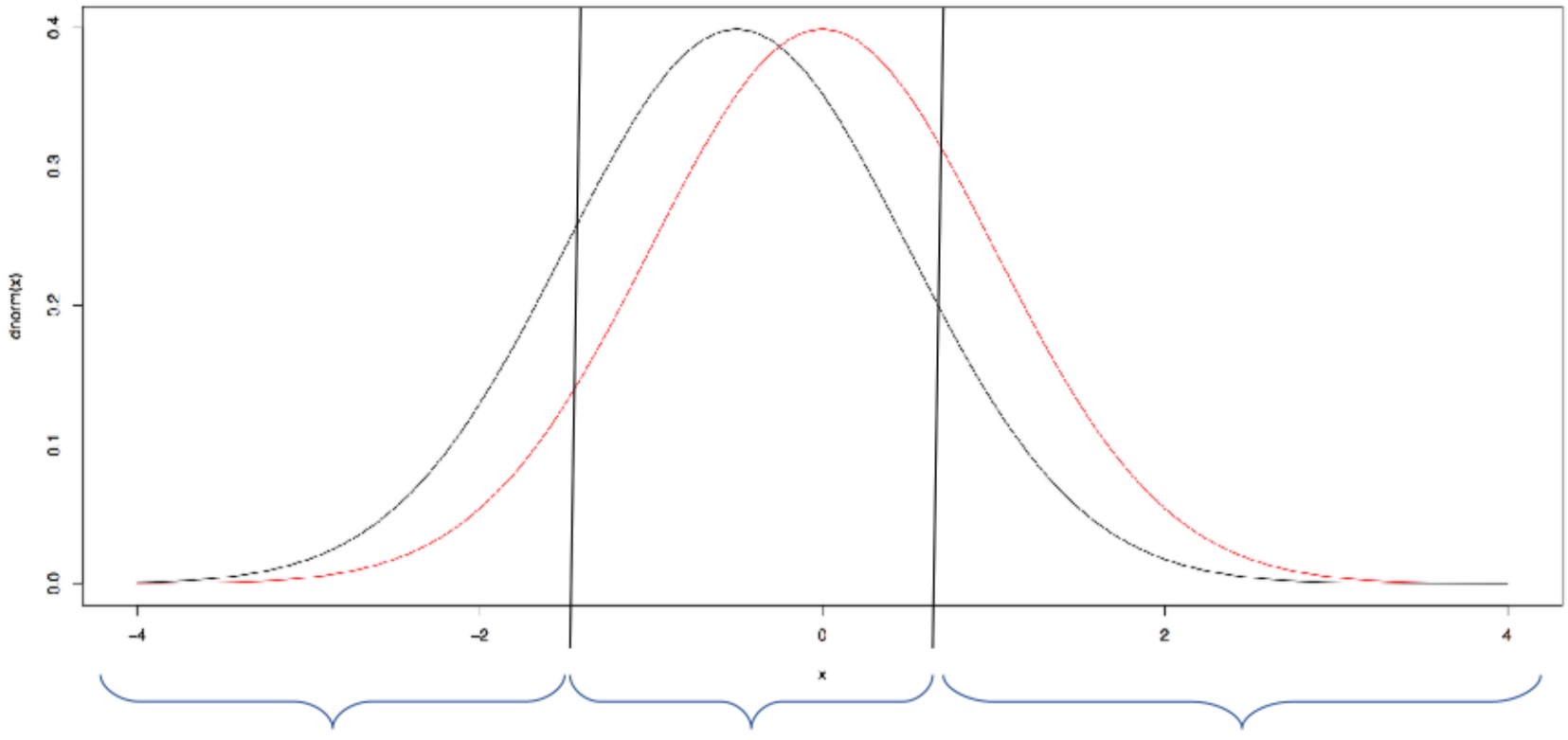
$$H = w_1 a_1 + w_2 a_2 + \cdots + w_m a_m = w^T a$$

where a vector of true breeding values
w vector of economic values

Economic Values

- Change in profit when trait changes
- How does the profit change when animals
  - are healthier or
  - produce more or
  - reduce environmental impact

Change in Profit



$G_1=E_1-K_1$ $G_2=E_2-K_2$ $G_3=E_3-K_3$

Selection Index Construction

- Index Construction means: finding unknown vector of weights b in I
- Objective: I has to approximate H as good as possible
- Criterion:

$$E(H - I)^2 \rightarrow \text{ min}$$

- Result: Index normal equations

$$Pb = Gw$$

Solution

- Compute b from index normal equation

$$\begin{aligned} Pb &= Gw \\ P^{-1}Pb &= P^{-1}Gw \\ b &= P^{-1}Gw \end{aligned}$$

- Accuracy of index I

$$r_{HI} = \frac{cov(H, I)}{\sigma_H \sigma_I} = \frac{\sigma_I}{\sigma_H}$$