Smarter

SMAll RuminanTs breeding for Efficiency and Resilience

On the accuracy of resilience parameters

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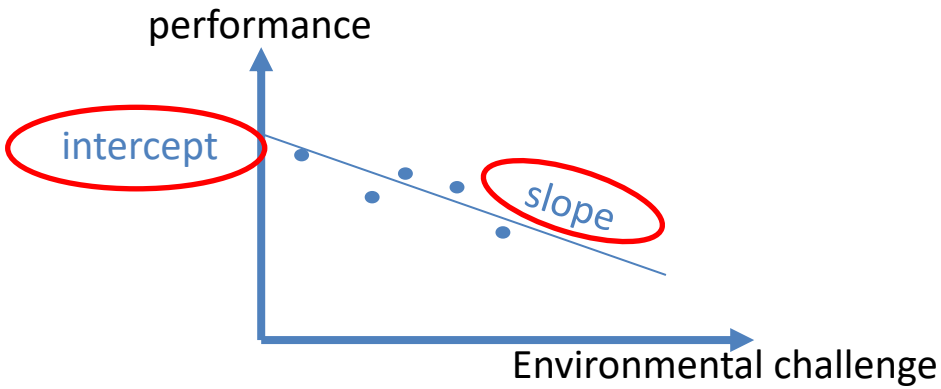
Introduction and objectives

- Resilience (Stay productive under challenged condition)

$$\text{resilience} \propto |\text{slope}|^{-1}$$

$$\text{Performance potential} \propto \text{intercept}$$



Roadblocks

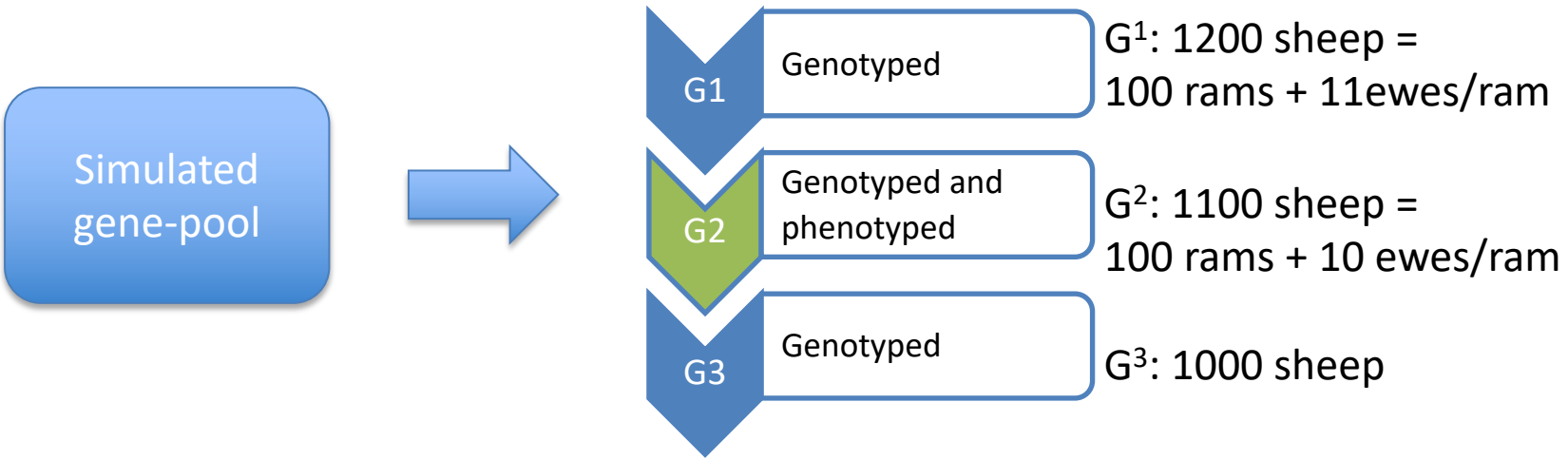
- Sparsity of data
- Unknown environmental challenge level

Accuracy of EBV as a function of:

- Distribution of phenotyped animals
- Genetic architecture
- Not knowing the level of environmental challenge

Method

- Simulation of population



- Simulation of phenotypes (2nd generation)

Phenotype = **intercept** + (challenge level) * **slope**

(parameters) = (population mean) + (genetic deviation) + (environmental deviation)

$$h^2_{slope} = h^2_{intercept} = (0.1 \quad 0.3) \qquad \rho = (-0.5 \quad 0.0 \quad 0.5)$$

Method

Phenotyped animals (2nd generation) are allocated:

Scenario 1: **Random**ly in all environments

Scenario 2: In **Cluster**s (families). Families are randomly allocated

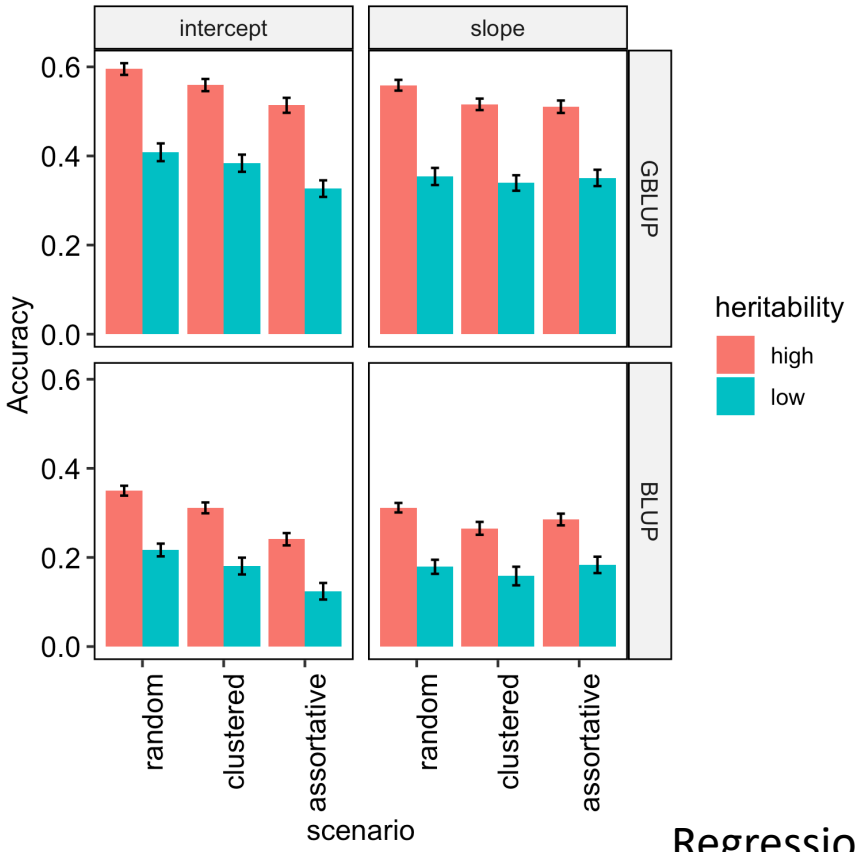
Scenario 3: In **assortative** clusters. Best sire is reared in the best farm. A bad sire in bad farm …

Using pedigree information (BLUP) or genomic information (GBLUP)

predict BV for 3rd generation

Results (1) – distribution of phenotyped animals

Accuracy at low and high heritabilities

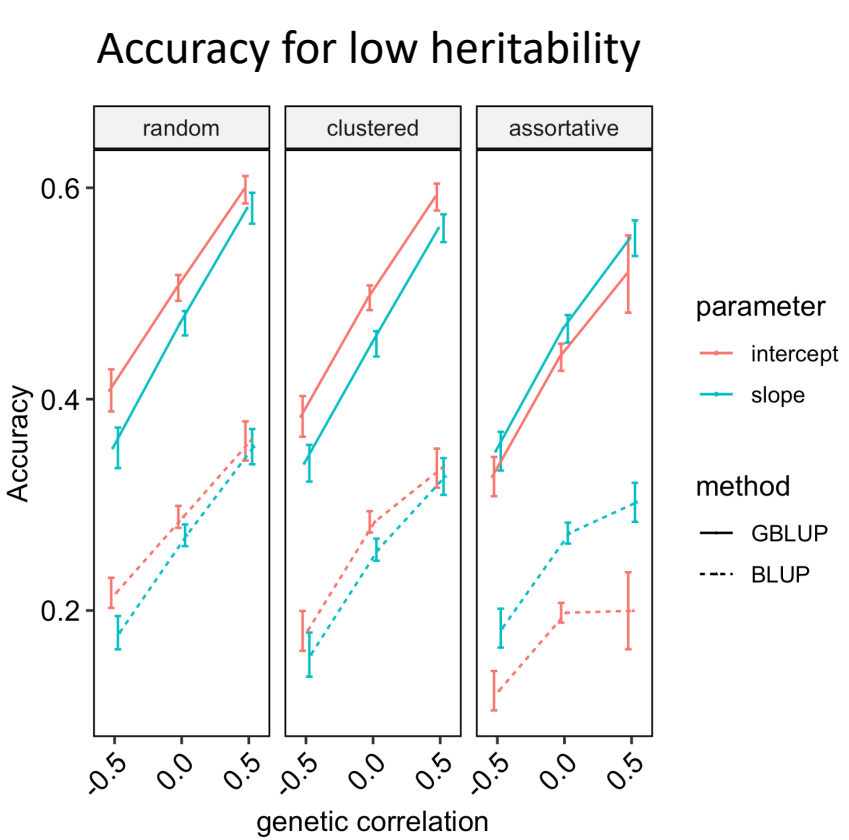


- GBLUP > BLUP
- Intercept > slope
- Intercept is more sensitive to scenarios
- Random allocation gives best accuracy for both intercept and slope

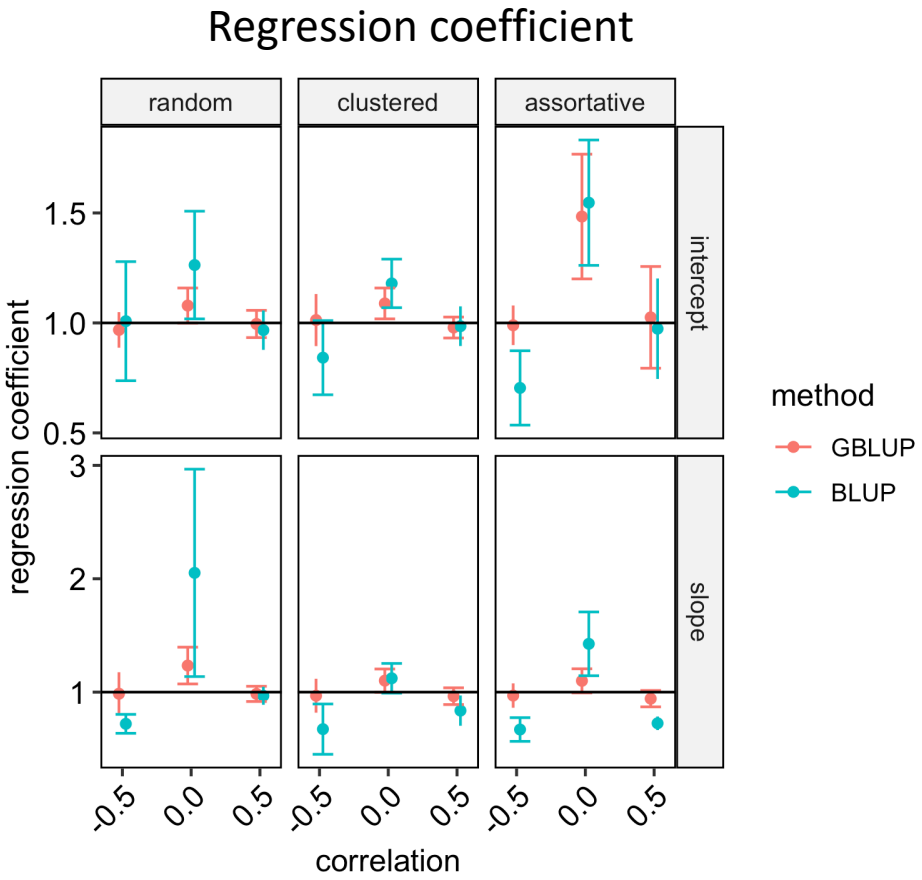
Regression coefficient

- High heritability and GBLUP are less biased.
- No significant difference between scenarios and between parameters (slope and intercept)

Results (2) – genetic correlation



$$\text{Accuracy} \propto (1 + \rho)$$

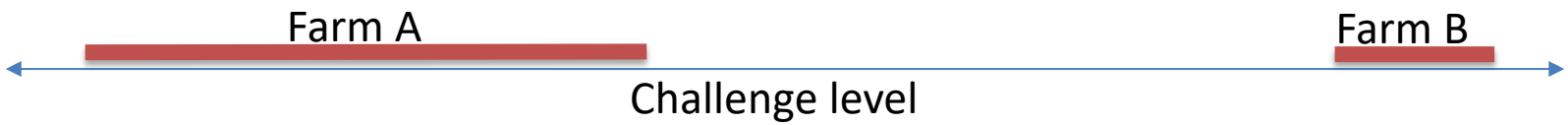


Uncorrelated data are biased

Results (3) – Unknown environmental challenge – 1

- 2-stage reaction norm:
  1. Farms are fitted as fixed effect
  2. Farm effects are used as challenge level for all animals within that farm

- Diversity of farms

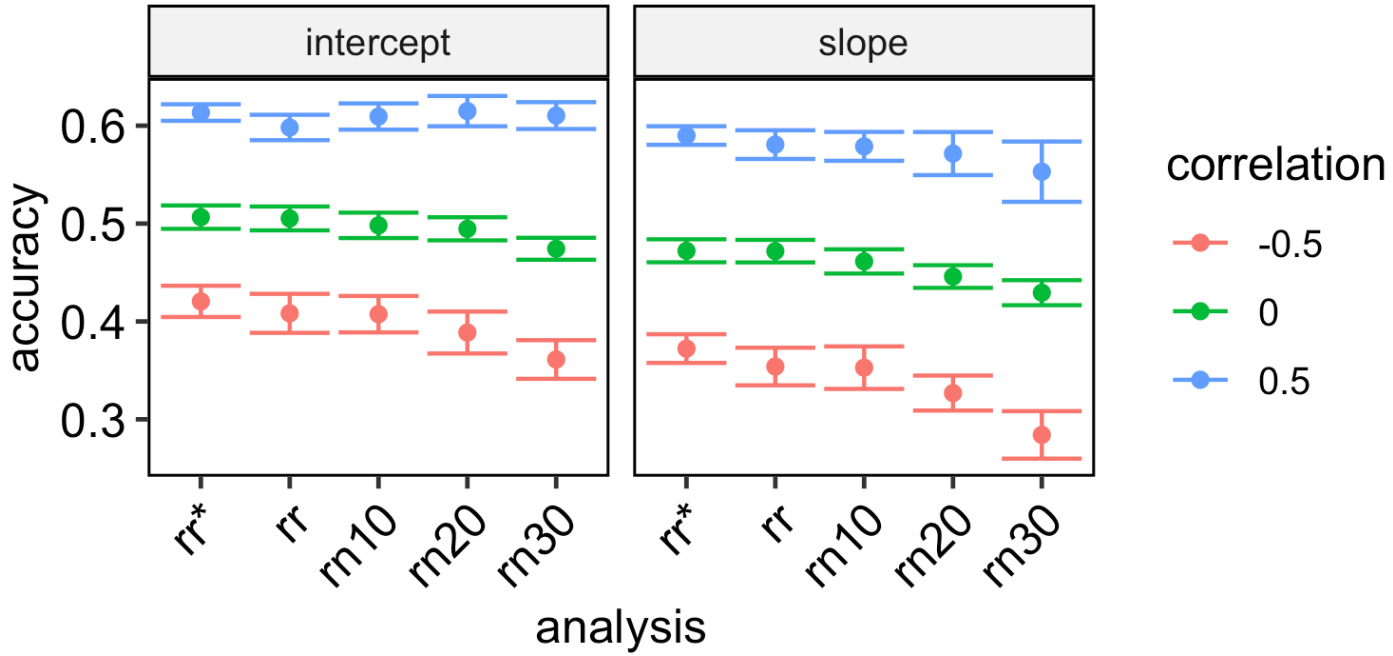


Hypothesis:
- Unknown challenge level for each individual reduces accuracy
- The larger the farms (groups) are the poorer the accuracy is

Results (3) – unknown environmental challenge – 2

Impact of genetic correlation

Accuracy with known X, and unknown X with farms having different range (10% , 20% and 30% of total environment)

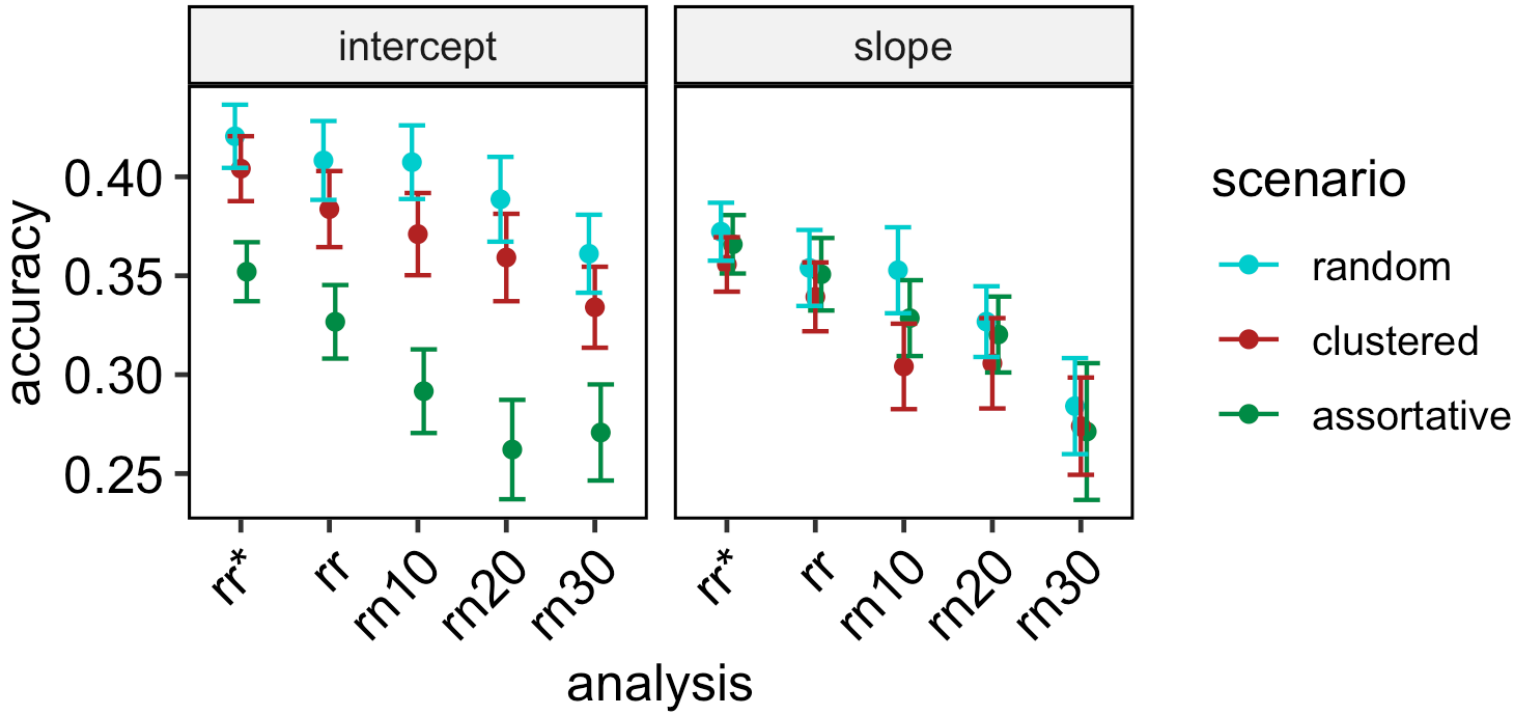


rr*: known X, known variance component
rr: known X
rn20: Unknown X, farms covering 20% of total environment

Results (3) – unknown environmental challenge – 3

Impact of distribution of phenotyped individuals

Accuracy for known X, and unknown X with farms having different range (10% , 20% and 30% of total environment)



rr*: known X, known variance component

rr: known X

rn20: Unknown X, farms covering 20% of total environment

Conclusions - 1

- GBLUP > BLUP

  performance potential (45% ~ 166%)

  resilience (47% ~ 114%)

- Random allocation gives the best accuracy

  For intercept: Random > Random cluster > assortative cluster

  For slope : Random > assortative cluster $\geq^{*}$ Random cluster (* not significantly different)

- Intercept (Performance potential) is more sensitive to allocation of phenotyped individuals

- Intercept > slope

Conclusions - 2

- Trade-off reduces the accuracy

  Accuracy $\propto$ (1 + genetic correlation)

- Diversity of farms has less effect on accuracy when using GBLUP

- If genetic correlation > 0 ➔ unknown environmental challenge does NOT reduce accuracy

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Thank you for your attention

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