Genetic Relationship

Genotype
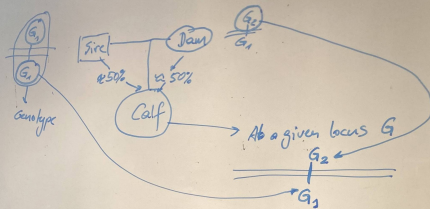
Sire — Dam

σ 50% σ 50%

Calf

G_c
G_1

At a given locus G

G_2

G_1
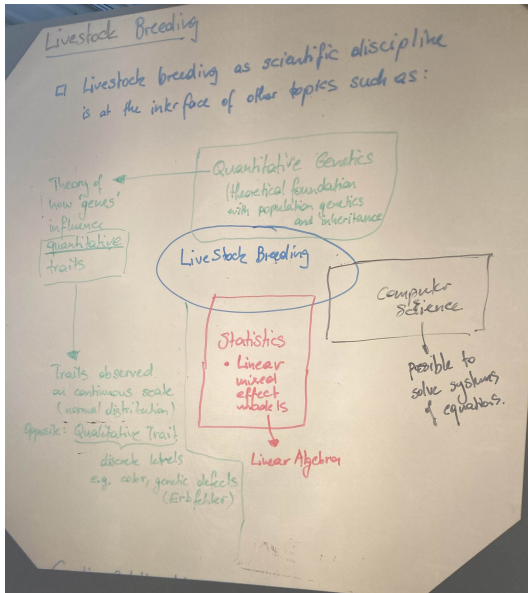
Prediction of Breeding Values

- Solving large systems of Linear equations
  - (Technical)
- Breeding values are unknown
- Observations are known

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Livestock Breeding

☐ Livestock breeding as scientific discipline is at the inter face of other topics such as:

Quantitative Genetics
(theoretical foundation
with population genetics
and inheritance)

Theory of
how 'genes'
influence
quantitative
traits

Live Stock Breeding

Computer
science

Statistics
• Linear
mixed
effect
models

possible to
solve systems
of equations.

Traits observed
on continuous scale
(normal distribution)
Opposite: Qualitative Trait
discrete labels
e.g. color, genetic defects
(Erbfehler)

Linear Algebra

Traditional Breeding

- ☐ Observations on traits
- ☐ Pedigree → relationship between animals

} sources of information to predict breeding values

⇩

Bulls (5-7 years)

Generation Intervals

Genomic Selection

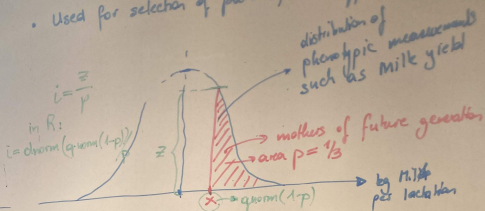- ☐ Observations
- ☐ Pedigree
- ☐ SNP - Marker Information

} sources of information to predict genomic breeding values.

→ Bulls right after birth

↳ GI ≈ 2 years

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- Used for selection of parents, what happens?

distribution of phenotypic measurements such as milk yield

$i = \dfrac{z}{p}$

in R:
$i = \text{dnorm}(\text{qnorm}(1-p))$

→ mothers of future generation

→ area $p = 1/3$

$x \to \text{qnorm}(1-p)$

by M. Thu post lactation

- Select top $\underline{1/3}$ of cows

- How should this strategy of phenotypic selection be used on Bulls?
  ⟹ Wait until bull has daughters and then select based on daughters.

- Selection response (R):

$$R = \dfrac{i \cdot r \cdot \overline{\sigma}_A}{L}$$

i: selection intensity
r: accuracy - for phenotypic selection is equal to the square root of heritability
$\overline{\sigma}_A$: genetic standard deviation
L: Generation interval.

eg. Mother: $R \approx \dfrac{1.02 \cdot 0.5 \cdot 200}{3}$ ≠ 34 kg

Bulls: $R \approx \dfrac{1.02 \cdot 0.5 \cdot 200}{6}$ ≈ 21 kg