

Donagh Berry
Teagasc



From Spectrum to Selection: A Critical Review and Where to from Here ?





Moo-tivation

- **Help in decision making**

- Breeding
 - Management
- } **Animal & herd**

1. Where are the pinch-points?
2. Is this really needed? Who said?
3. What currently exists and how much better is this?
 - What new variability is it capturing?
4. What is the minimum accuracy – sensitivity v specificity?
5. Will predictions be available in right time?
6. What is the return on investment? Cost of reliance?

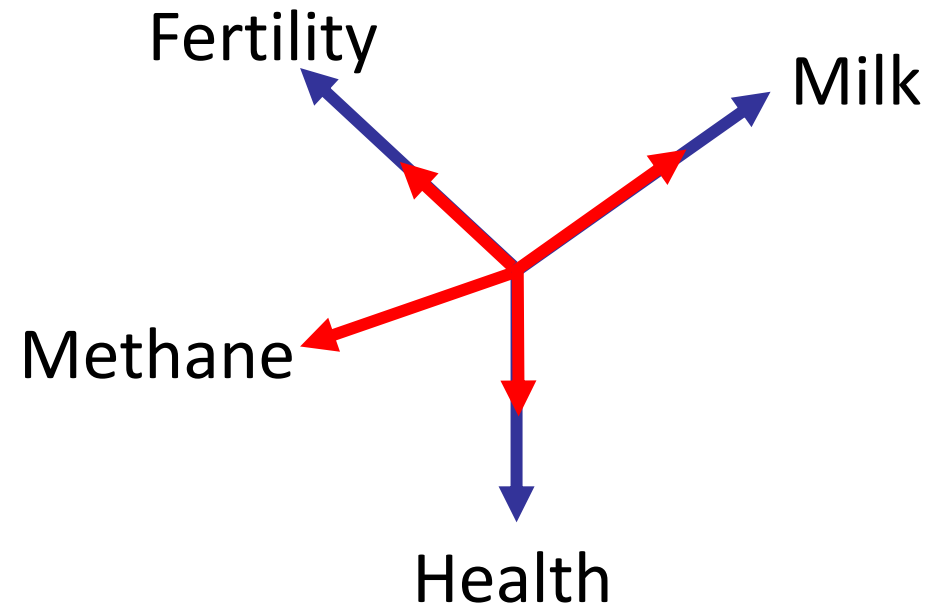
Pinch points?



“ IF I HAD ASKED PEOPLE
WHAT THEY WANTED,
THEY WOULD HAVE SAID:
FASTER HORSES... ”

Henry Ford

Should we actually select for (daily) methane



Lazyfication



ChatGPT

- If you need a proxy then is it really that important?
- Are you not confident enough it is important?

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Incremental value

....the use of a lightweight image-based deep learning model to classify dairy cows into low-, medium-, and high-milk-yield categories by automatically detecting the udder region of the cow



- Where is the actual pinch point?
- What currently exists?
- How good is it?
- Why not being used
Why will yours be different?

Incremental value

$$\text{Accuracy} = \int (\text{Milk} + \dots + \text{MIR})$$

Accuracy(MIR|already available information) ← **What I want**



v

Accuracy(already available information|MIR) ← **What I (usually) get**

Present the improvement in prediction over and above the status quo

Not MIR +.....+ milk **but** milk + ... + MIR

Associated string



Contents lists available at [ScienceDirect](#)

Livestock Science

journal homepage: www.elsevier.com/locate/livsci



Short communication

Methane and carbon dioxide ratio in excreted air for quantification of the methane production from ruminants

J. Madsen ^{a,*}, B.S. Bjerg ^a, T. Hvelplund ^b, M.R. Weisbjerg ^b, P. Lund ^b

$$\begin{aligned} \text{Heat produced in Watt} &= 5.6 * \text{kg body mass}^{0.75} \\ &+ 22 * \text{kg energy corrected milk produced per day} \\ &+ 1.6 * 10^{-5} * \text{number of days in pregnancy}^3. \end{aligned}$$

How will the prediction actually be used?

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Accuracy (& reward)



- Cost €3 to €4
- Ovarian activity status
- Uterine information
- Huge amount of pregnancy info

What currently exists?

How good is it?

What is the minimum sensitivity and specificity?

Which is more important?

Back of the envelope calculations

Daily cost per dry cow €3

Dry period 6 weeks

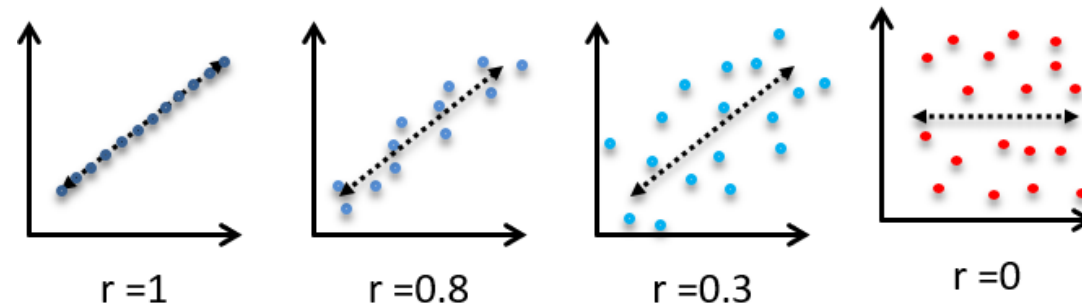
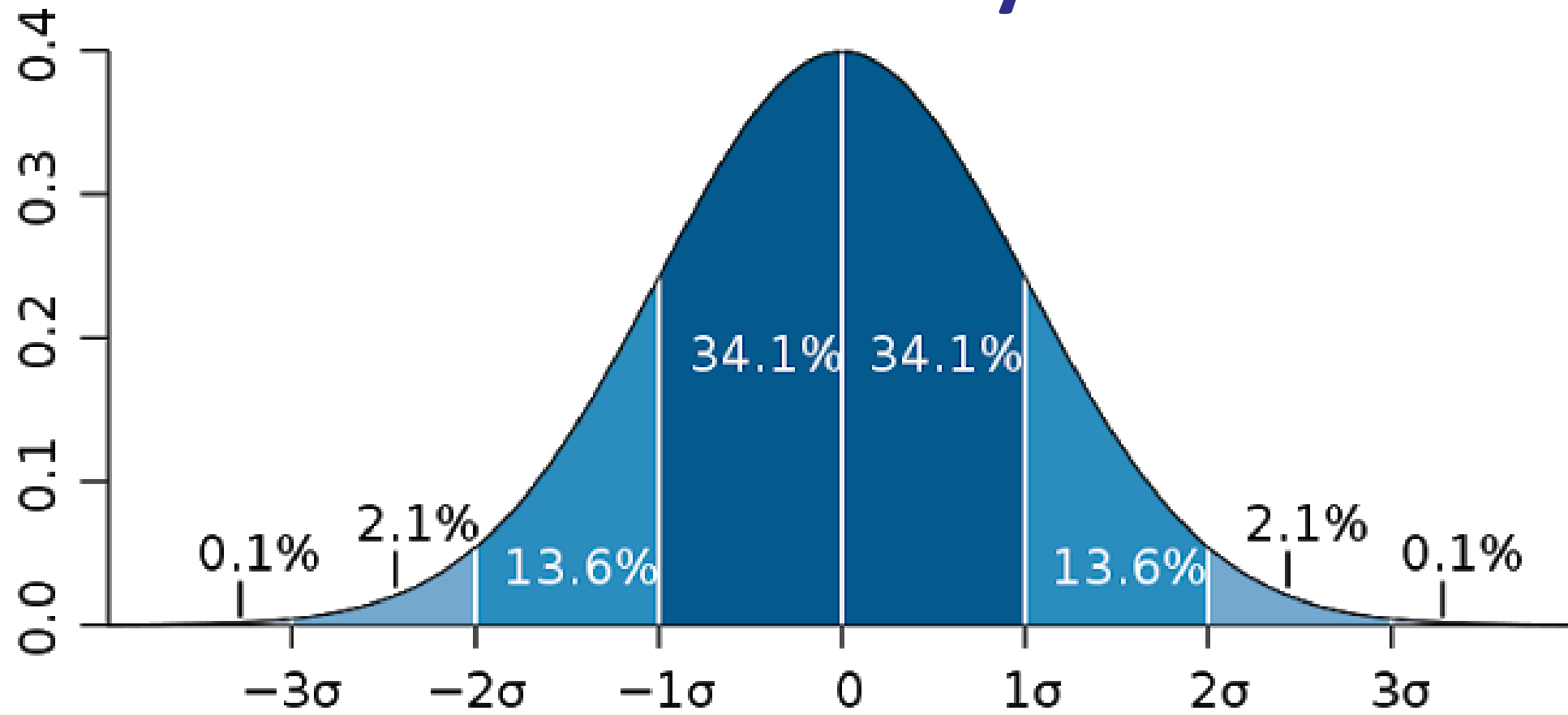
False positive 3%

Cost per 100 cows €378

Scanning cost per 100 cows ~€350 (+ labour)

Cost of one false negative?

Accuracy



Which animals are important to predict?



≤ 2.50



2.75



3.00



≥ 3.50

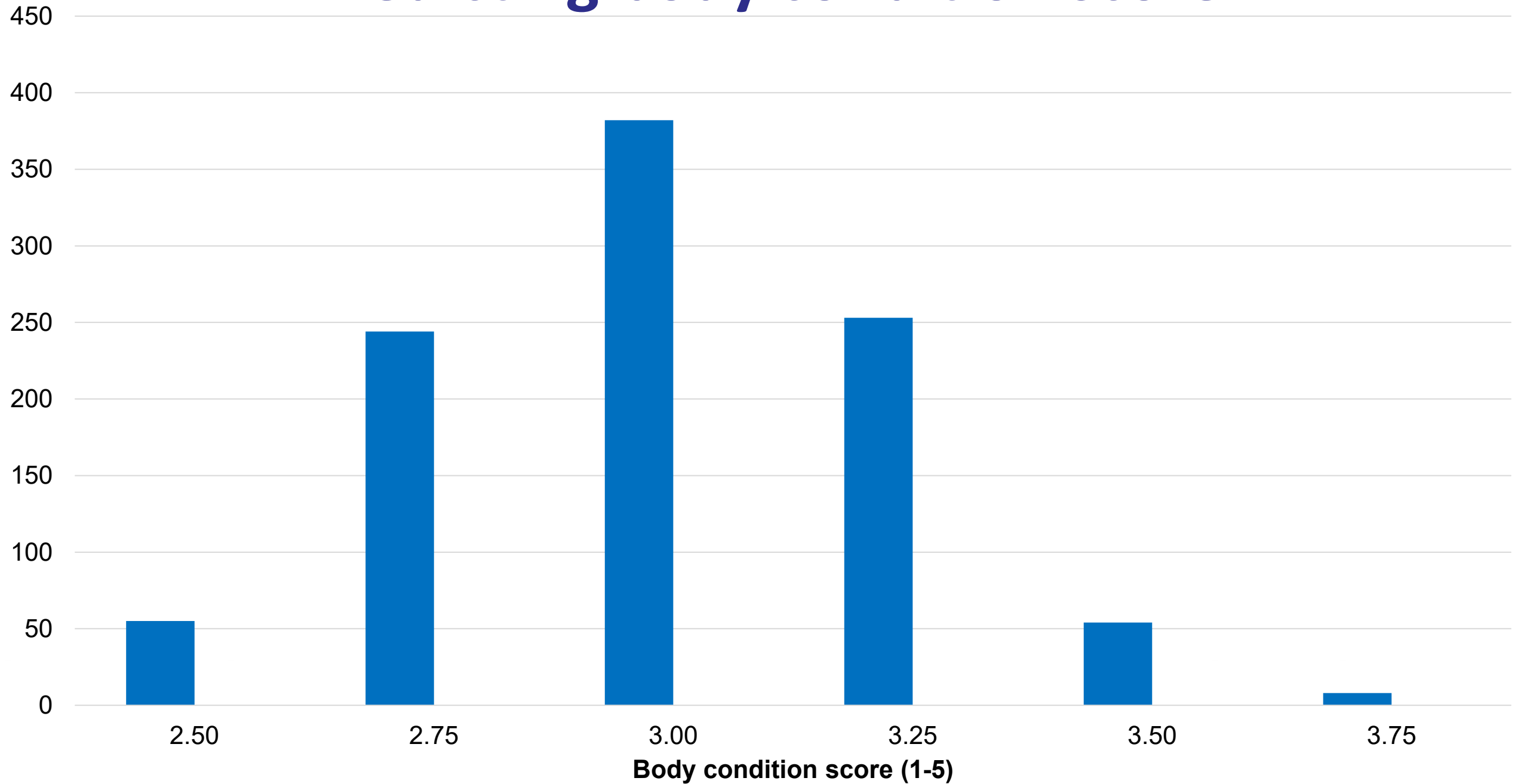
What is the appropriate measure of accuracy?

Who do you not want to miss? – high sensitivity – minimise false negatives

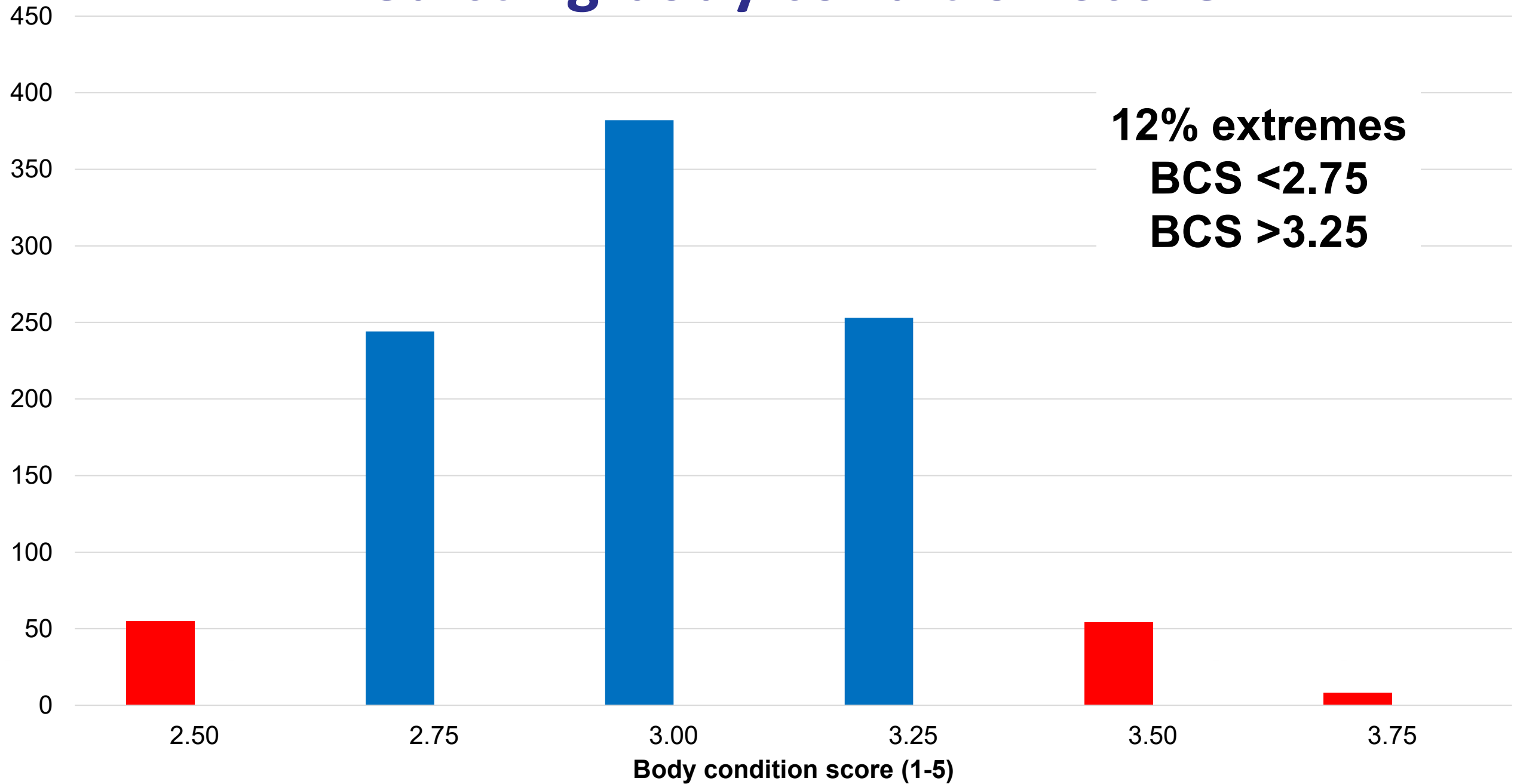
What is the cost of producer relying on the measure?

But why predict a predictor anyway?

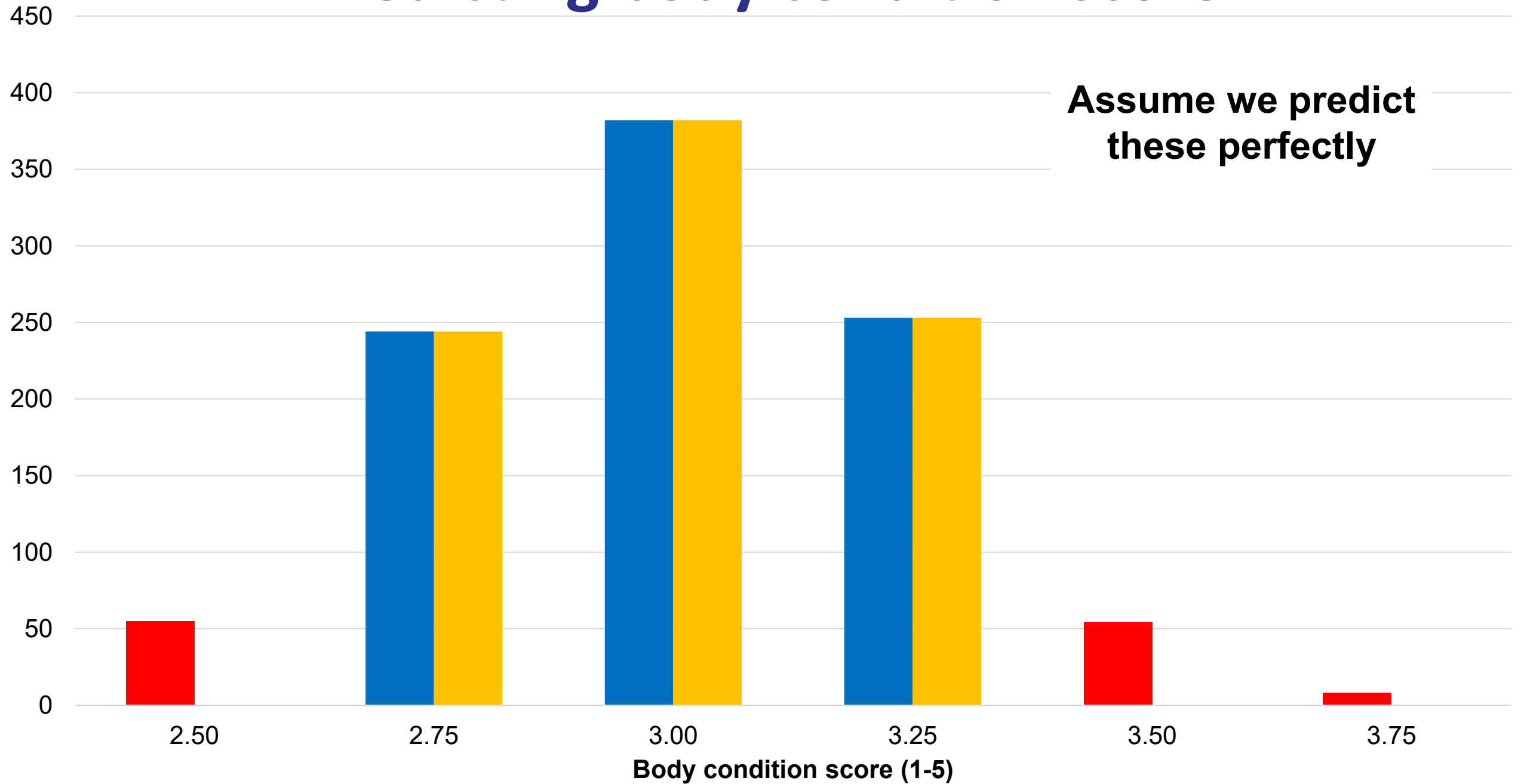
Predicting body condition score



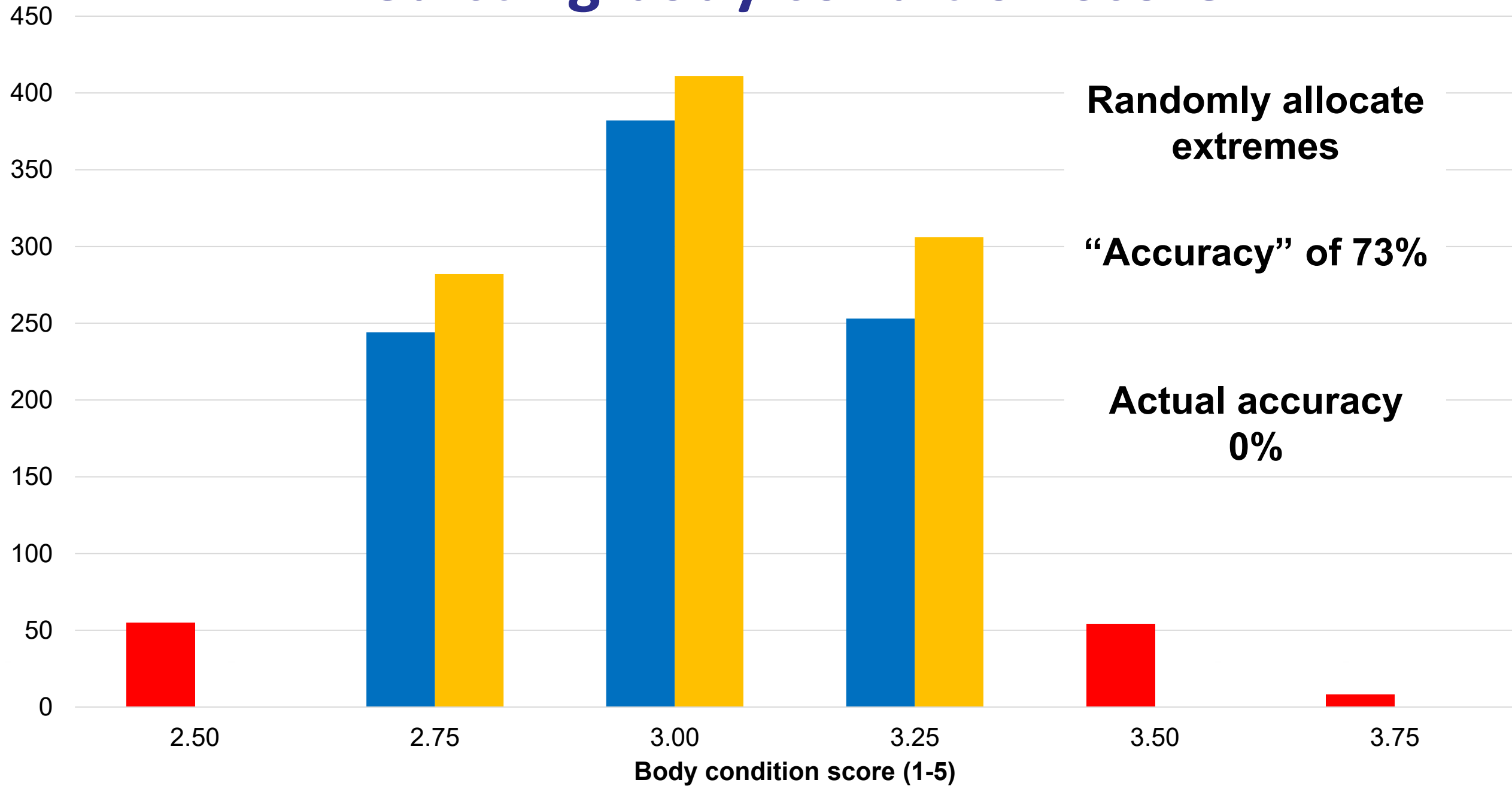
Predicting body condition score



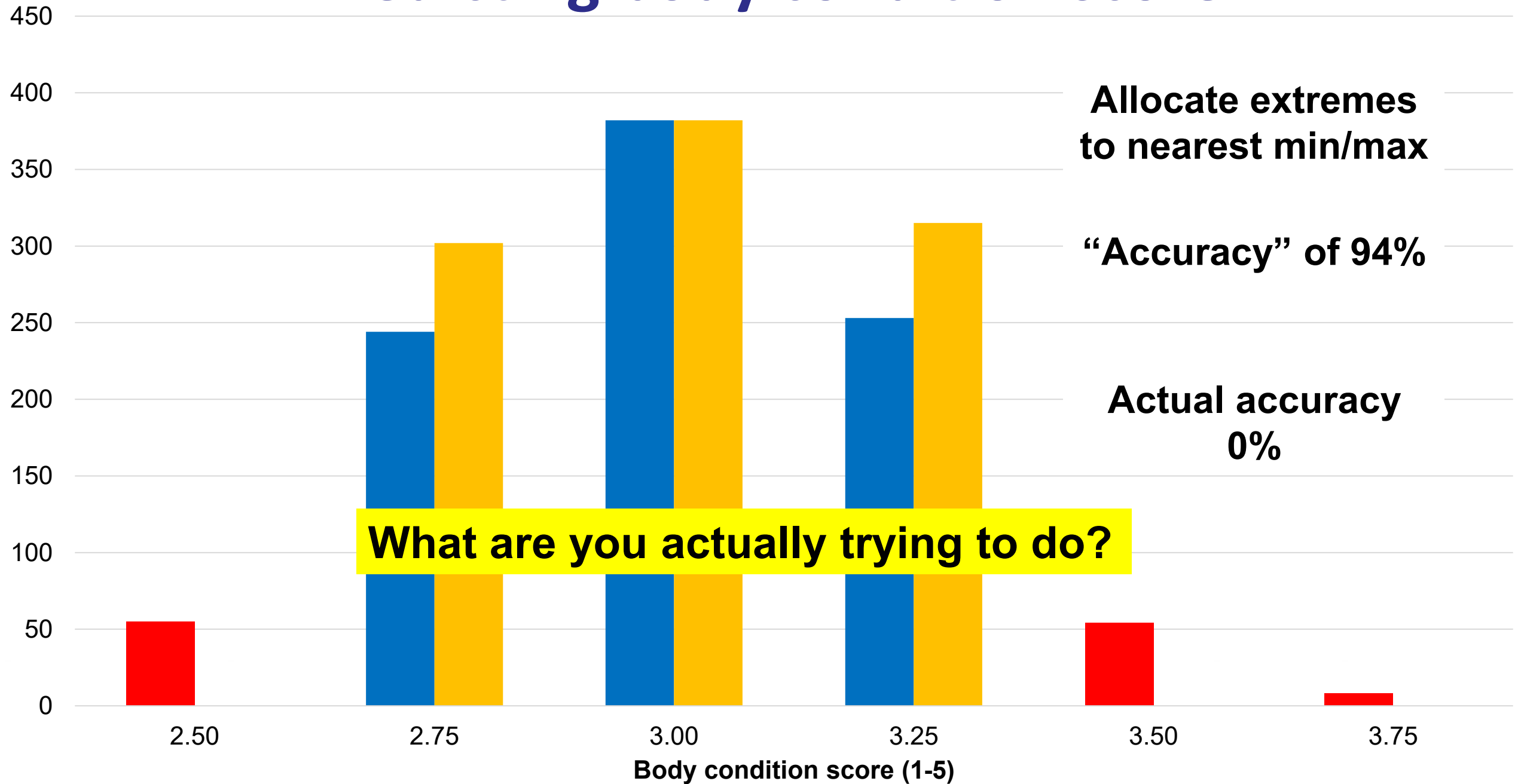
Predicting body condition score



Predicting body condition score



Predicting body condition score



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Right time of predictions



**How circumvent this?
What use has it?**

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Breeding

Factors affecting genetic gain

$$\text{Genetic gain} = \frac{\text{Intensity of selection} \times \text{Accuracy of selection} \times \text{Genetic variability}}{\text{Generation interval}}$$

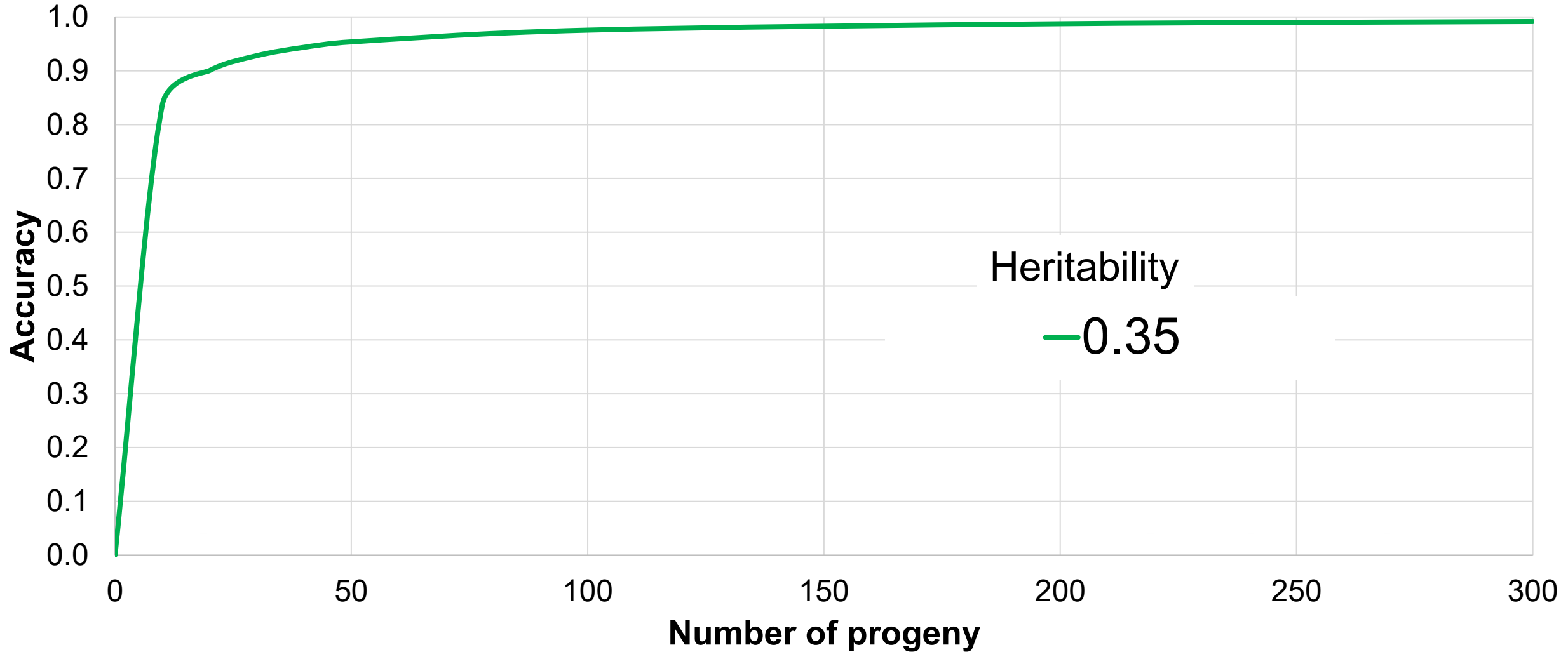
What do I want to know?

- Heritability?
- Genetic variability
 - Standard deviation



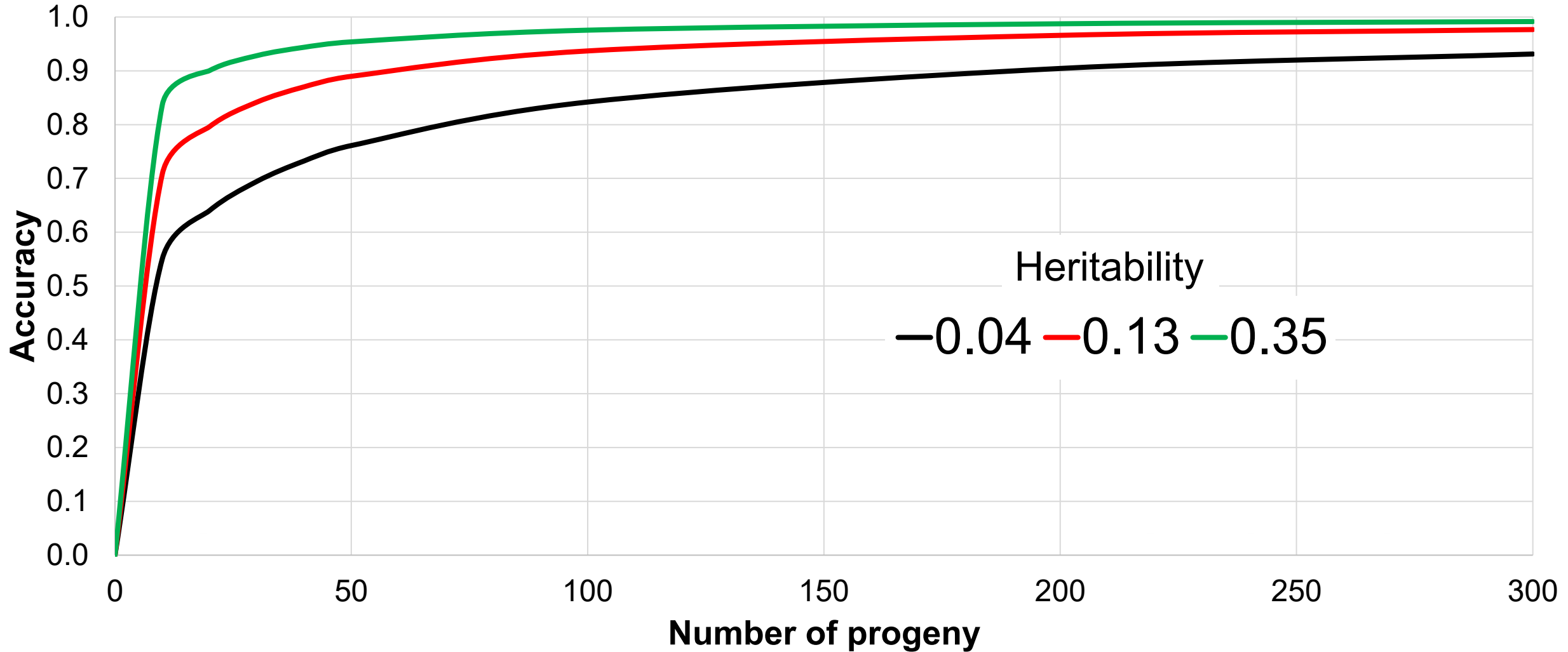
Is heritability really important?

$$\text{Genetic gain} = \frac{\text{Intensity of selection} \times \text{Accuracy of selection} \times \text{Genetic variability}}{\text{Generation interval}}$$



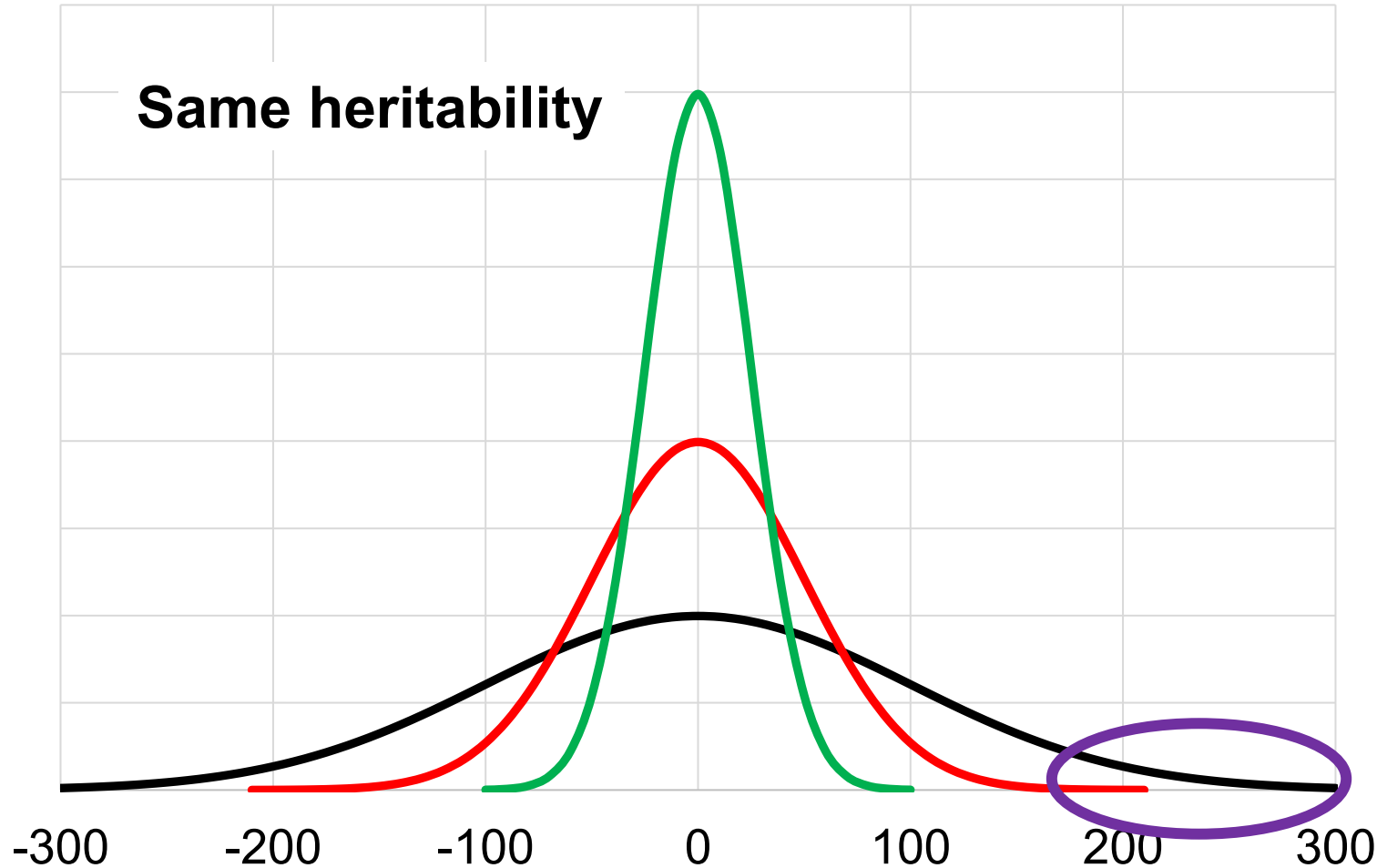
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Variability >> heritability

$$\text{Genetic gain} = \frac{\text{Intensity of selection} \times \text{Accuracy of selection} \times \text{Genetic variability}}{\text{Generation interval}}$$

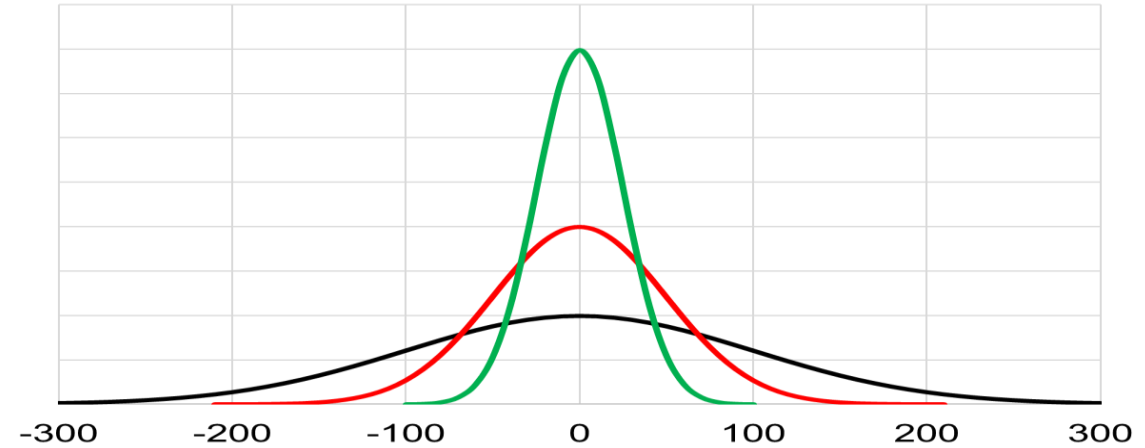


$$E[X|X>x] = \mu + \sigma \frac{\phi(z_x)}{1 - \Phi(z_x)}$$

Mean of the top 10%
175 kg
88 kg
44 kg

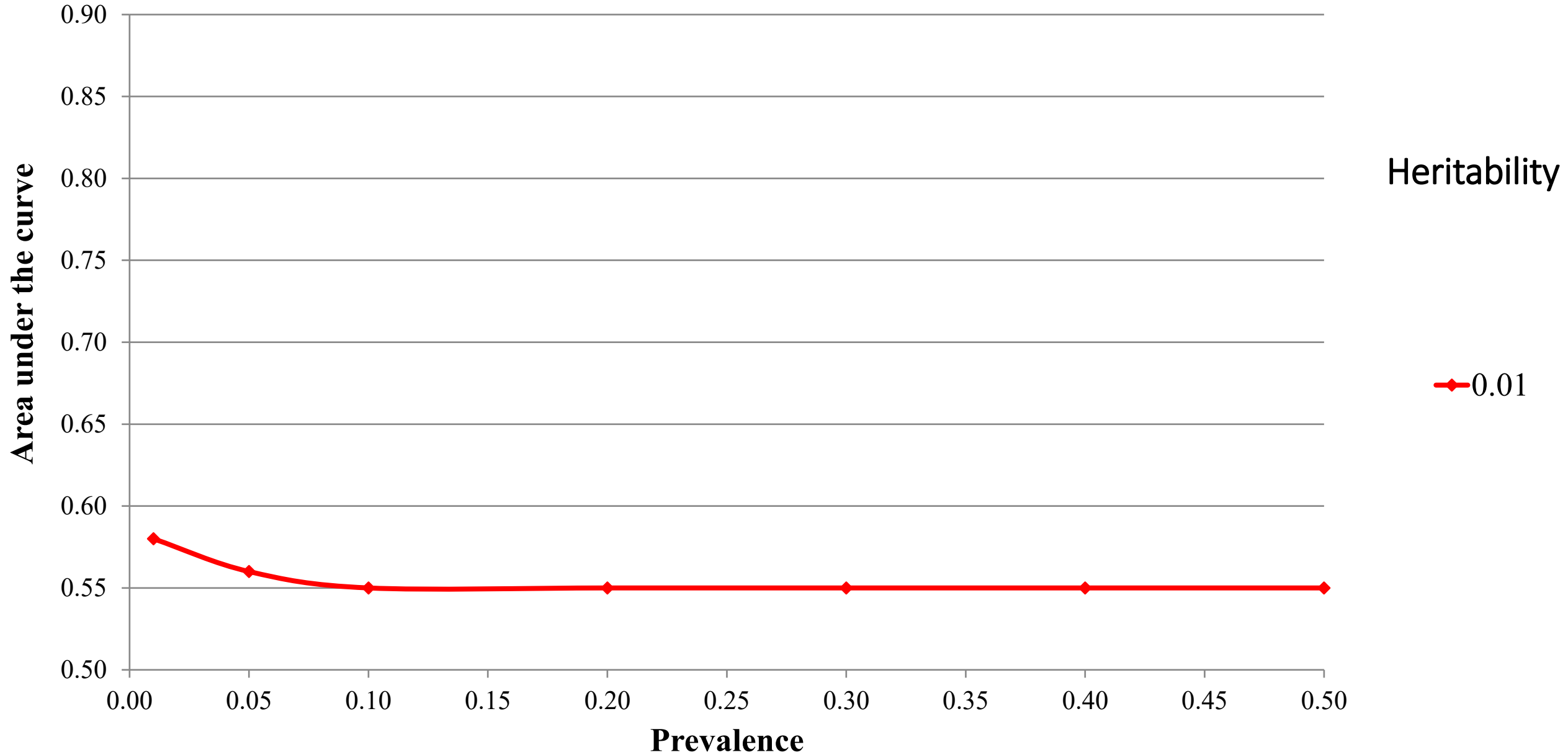
What does the heritability actually tell us?

$$\text{Genetic gain} = \frac{\text{Intensity of selection} \times \text{Accuracy of selection} \times \text{Genetic variability}}{\text{Generation interval}}$$

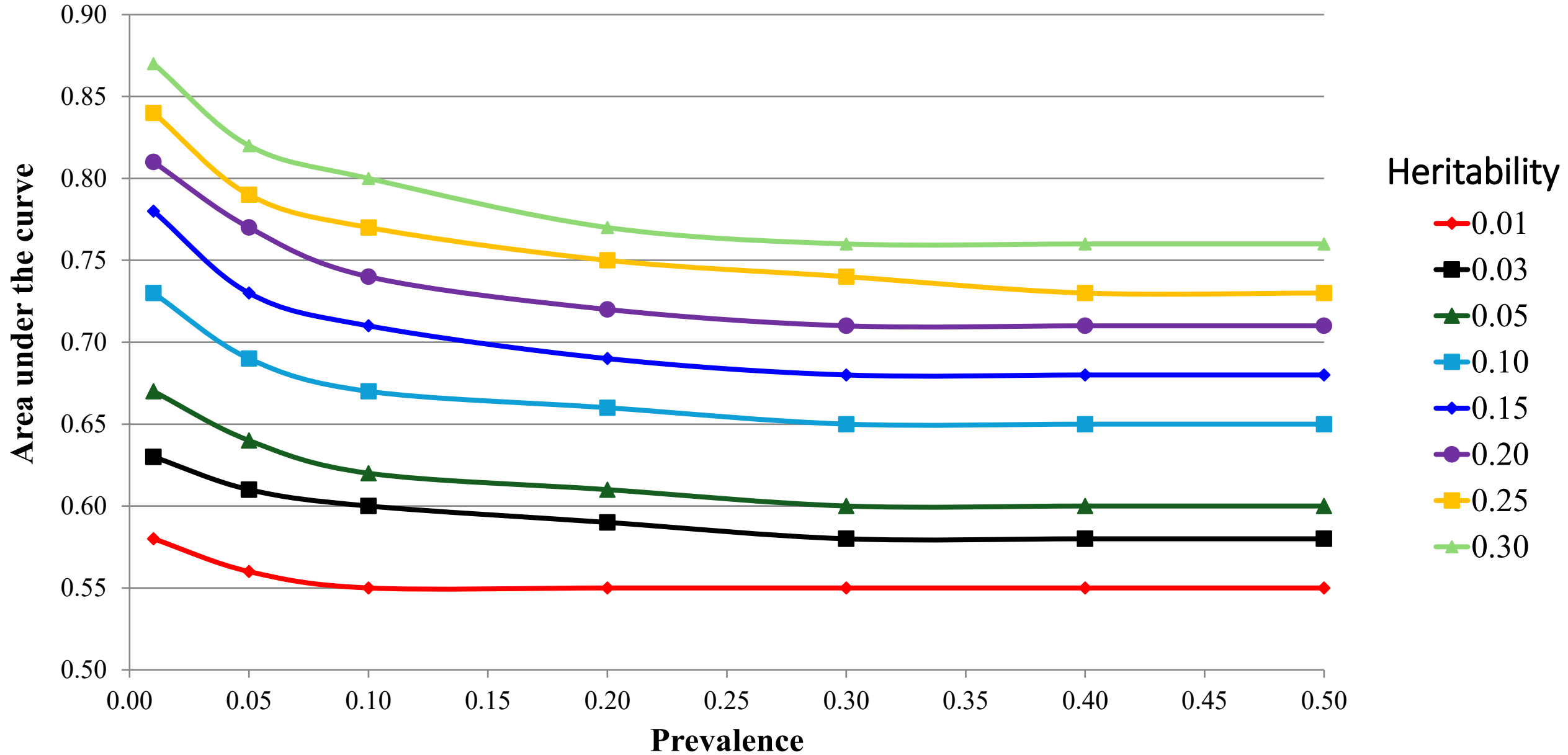


$$\text{Heritability} = \frac{\text{Genetic var}}{\text{Phenotypic var}}$$

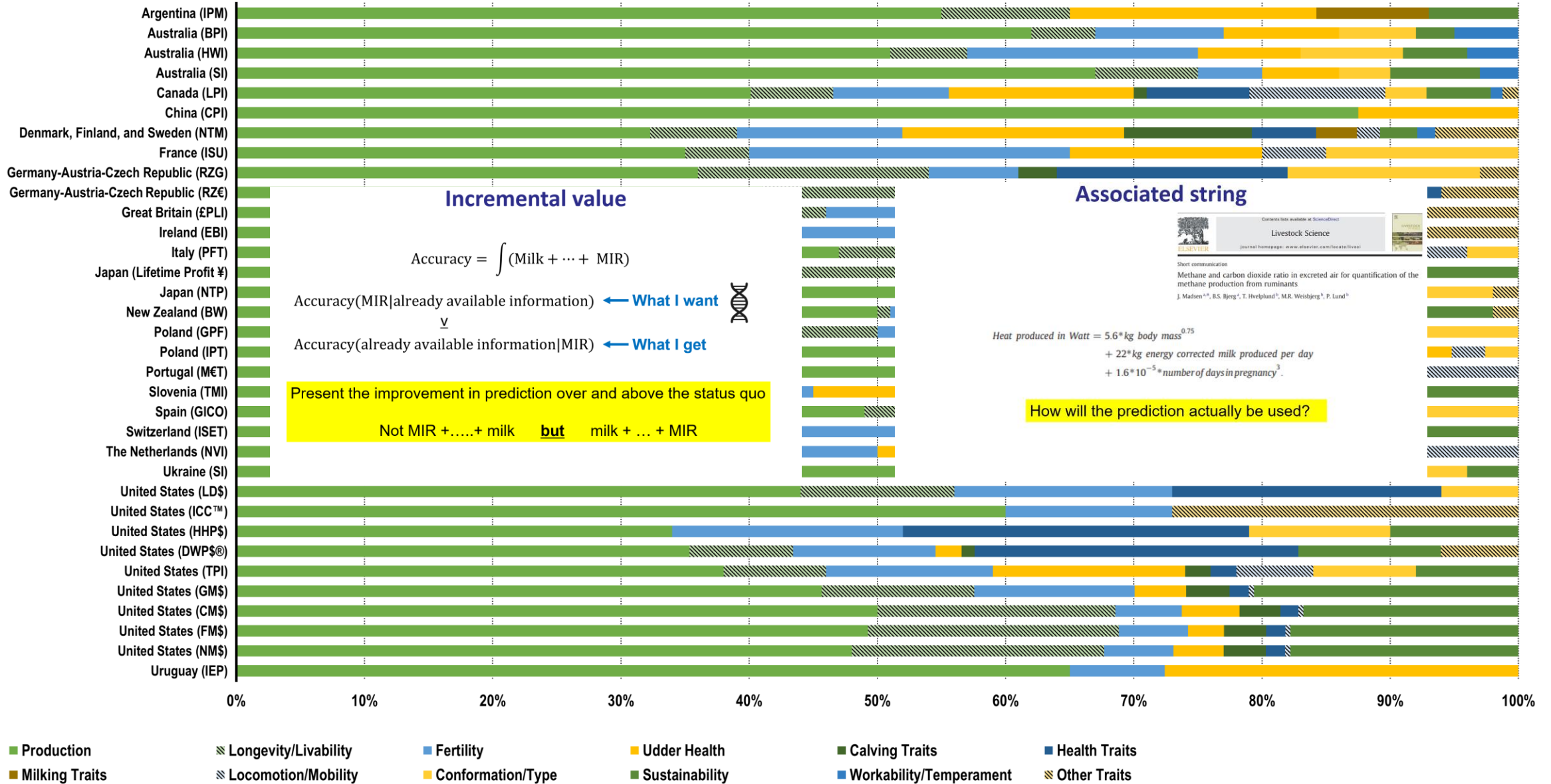
When is the heritability useful?



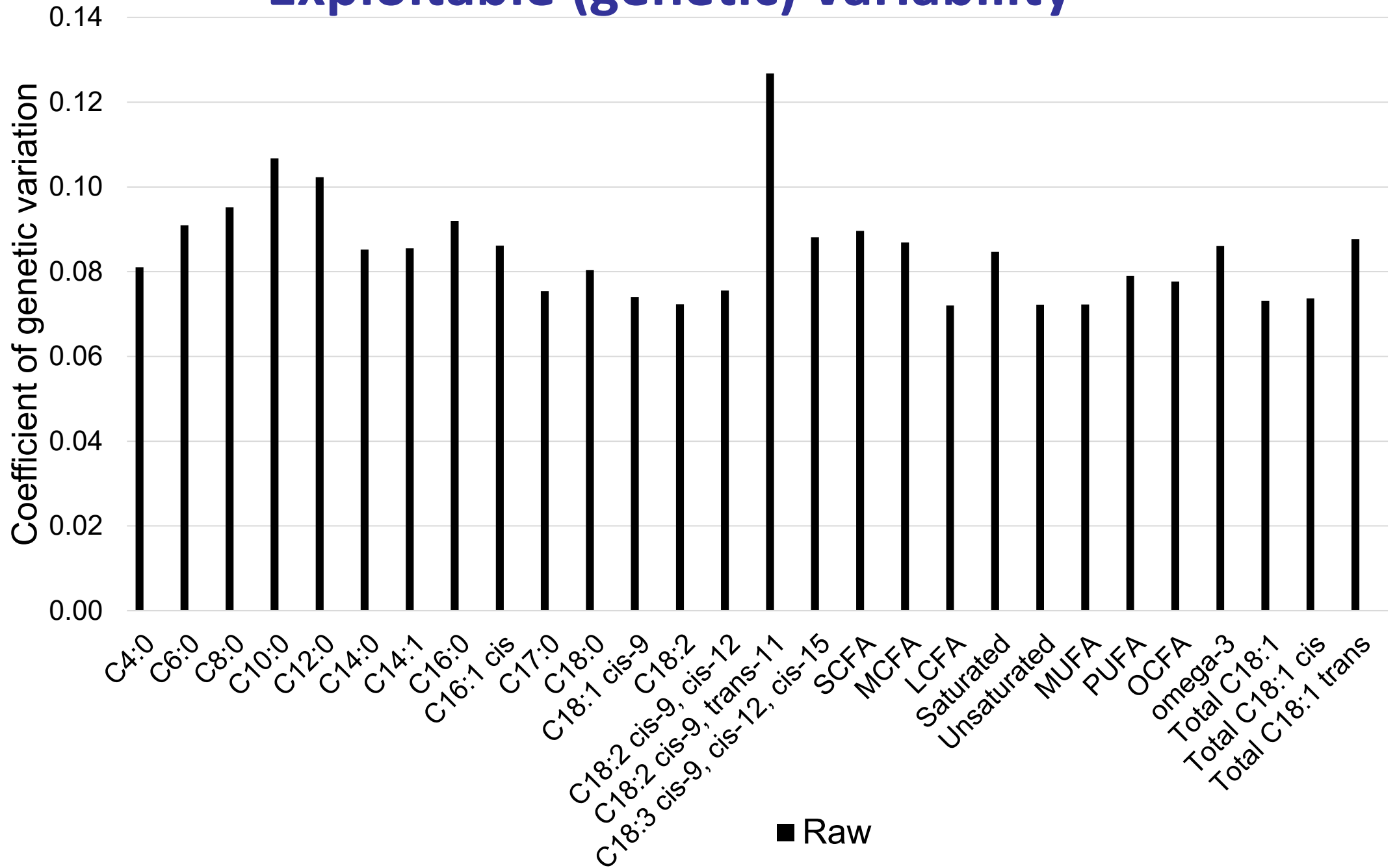
When is the heritability useful?



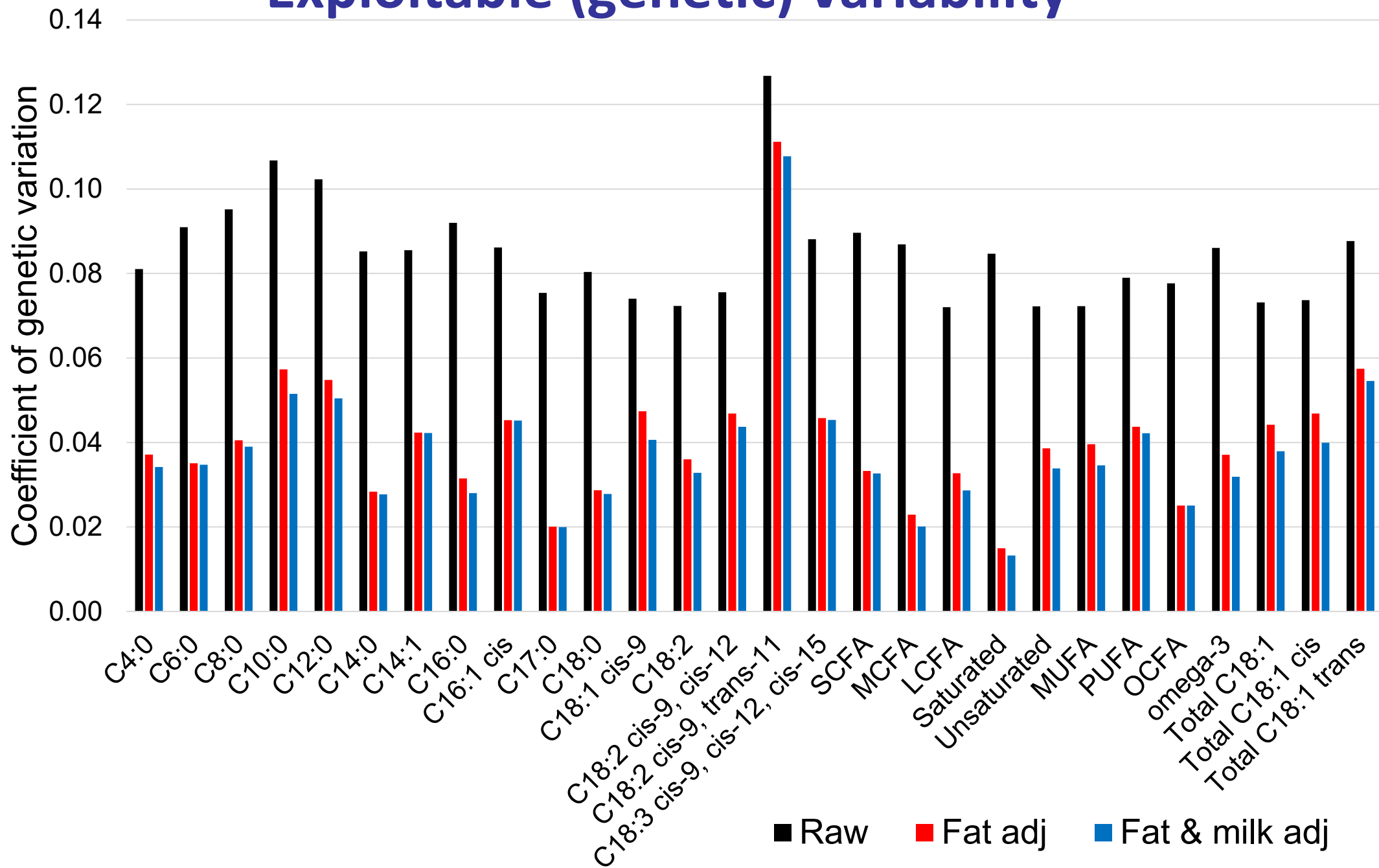
Back to variability - "New" variability



Exploitable (genetic) variability



Exploitable (genetic) variability



Ratio traits in breeding

RATIOS AS CRITERIA FOR SELECTION IN ANIMAL OR PLANT
BREEDING, WITH PARTICULAR REFERENCE TO EFFICIENCY OF
FOOD CONVERSION IN SHEEP

By HELEN NEWTON TURNER*

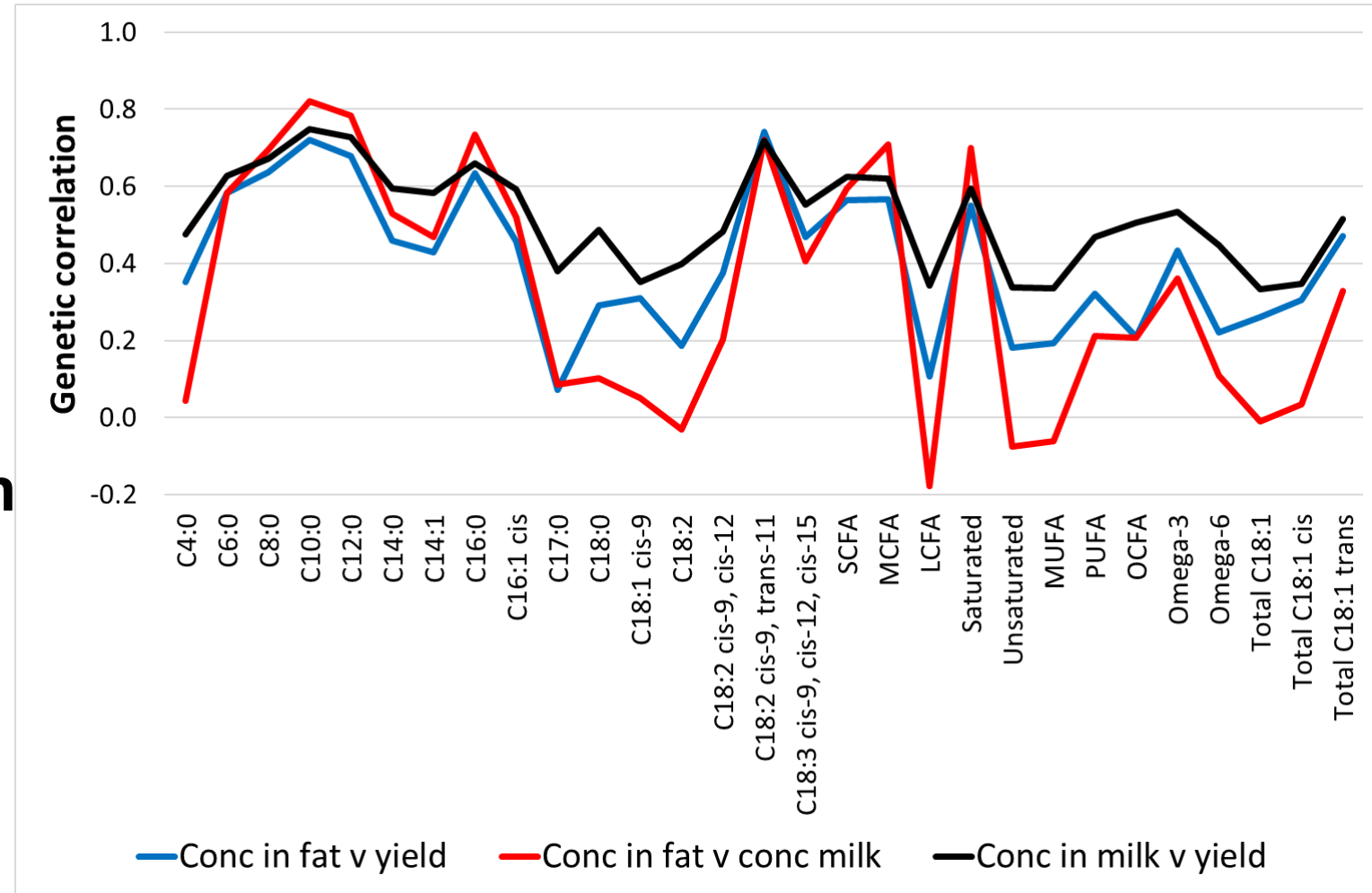
[Manuscript received December 22, 1958]



- **What is somatic cell count?**
- **What is milk fat or protein percent?**
 - **France, Italy, Switzerland...**

Ratio traits in breeding

Fatty acid concentration
Lactoferrin concentration
Proteins concentration
 β -Hydroxybutyric concentration
Methane intensity/yield



Heritability of ratio traits

$$\text{Heritability} = \frac{\text{Genetic variance (of ratio)}}{\text{Phenotypic variance (of ratio)}}$$

$$\text{Methane intensity} = \frac{\text{Methane emissions}}{\text{Output}}$$

Present genetic variation and heritability conditional on other performance traits

Permanent environmental effects

$$\text{Heritability} = \frac{\text{Genetic variance}}{\text{Phenotypic variance}}$$

$$\text{Repeatability} = \frac{\text{Genetic} + \text{permanent env variance}}{\text{Phenotypic variance}}$$

Milk	Condition	Weight
0.35	0.30	0.40
0.52	0.50	0.25

More to life than breeding!!!

Where too from here....



Prediction to Prescription