University of New England

Introduction to Breeding Programs

Animal breeding in a nutshell

Where to go? — Breeding objectives

How to get there? — Quantitative genetics

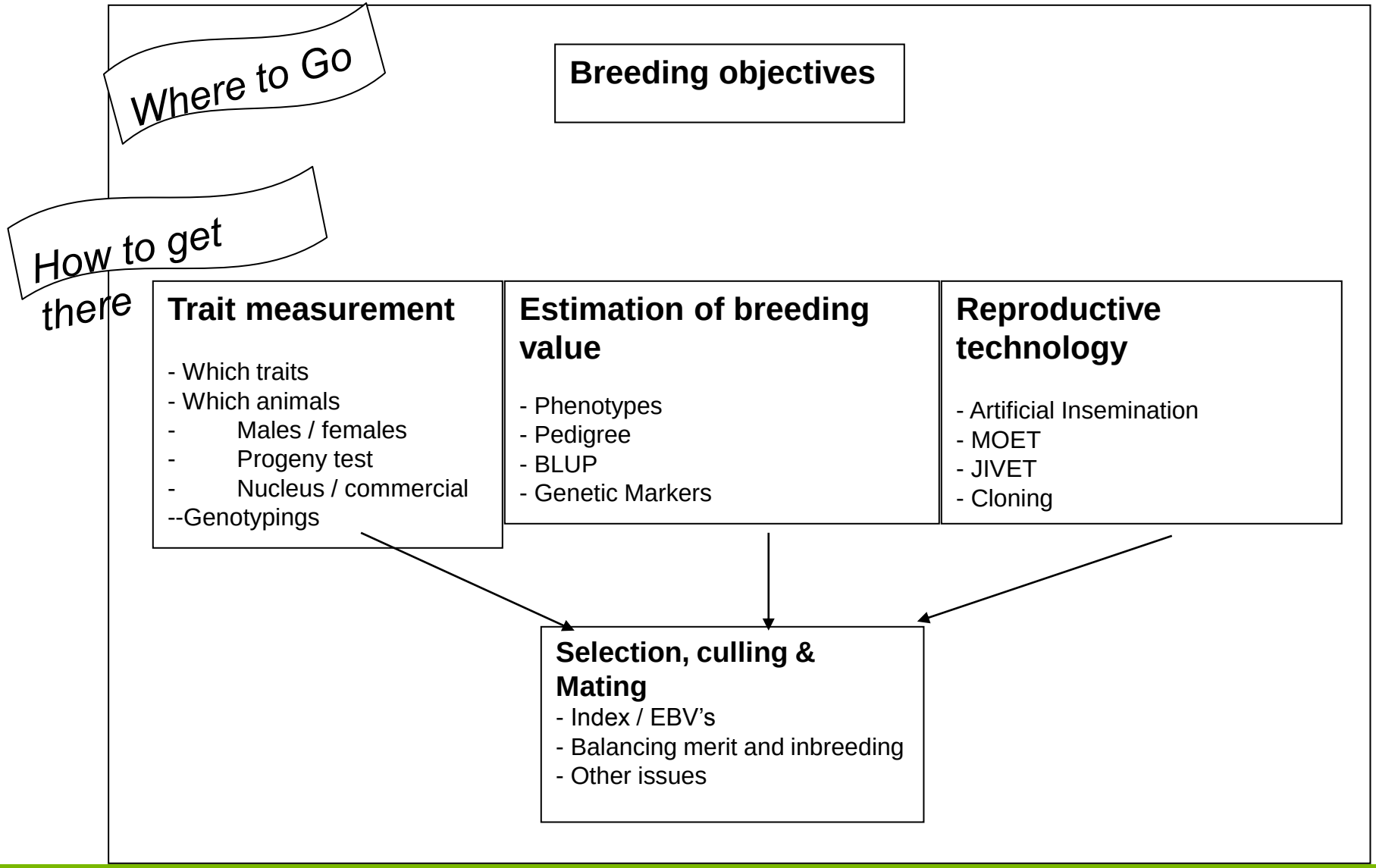
- Measurement of Traits: Which traits, Which animals? Pedigree and DNA testing
- Genetic Evaluation: Prediction of Breeding Value
- Reproductive technology? AI. MOET, JIVET, sexing

Tools and Investment

Getting there — Implementation

- Predicting and comparing alternative strategies
- Decision making: Mate Selection, Merit, Trait emphasis, Inbreeding

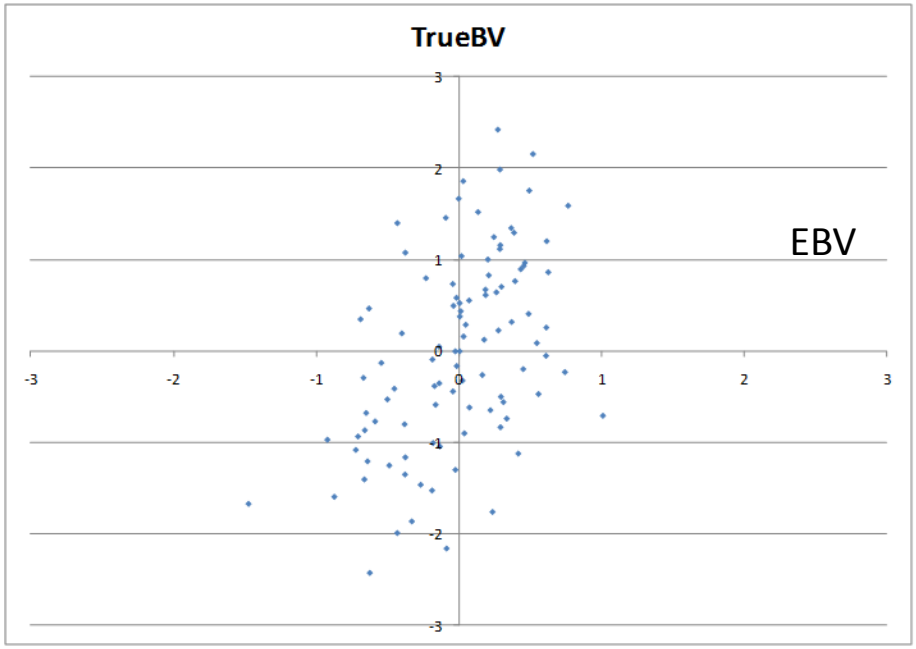
Animal Breeding in a nutshell



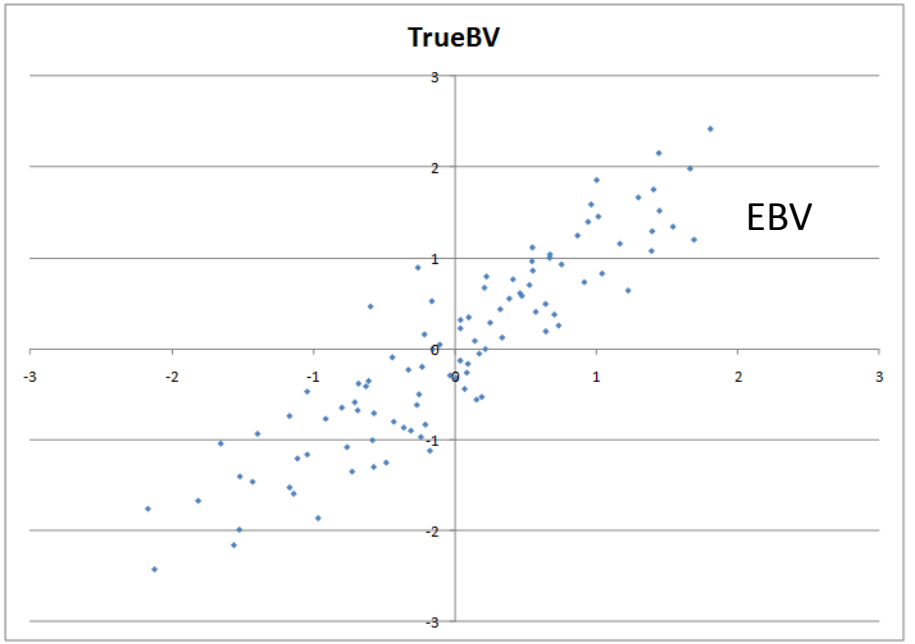
Breeding Values: EBVs and TBVs

- EBVs are estimates of the true breeding values (TBVs), which cannot be observed directly
- Quality of EBV is measured by Accuracy
- Accuracy is correlation between EBV and TBV (Acc 0-1)
- The closer the EBV is to the true breeding value the higher the accuracy, the greater the selection response

Accuracy of EBV = correlation with True BV



Accuracy = 45%

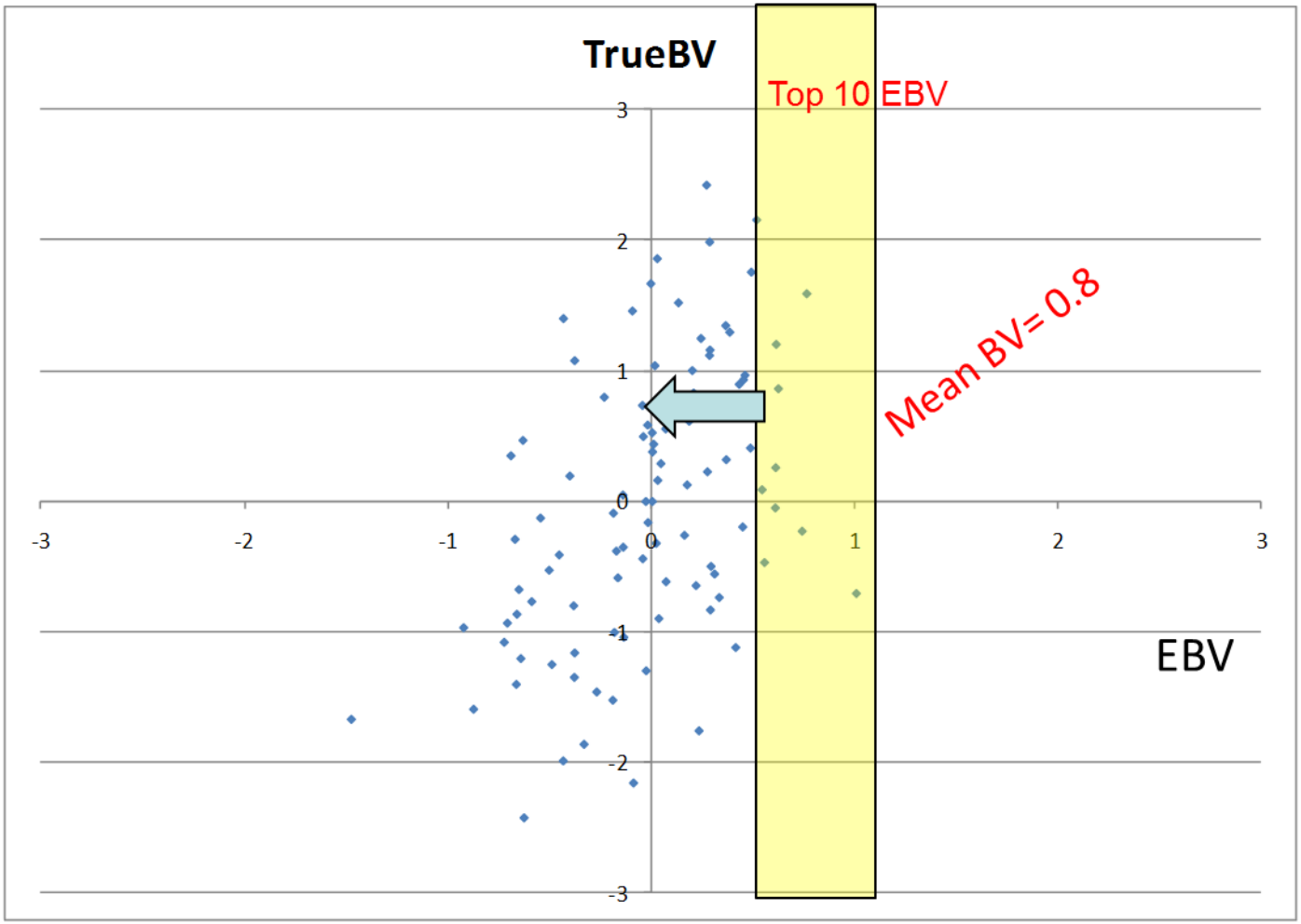


Accuracy = 90%

More accurate breeding values have more variation

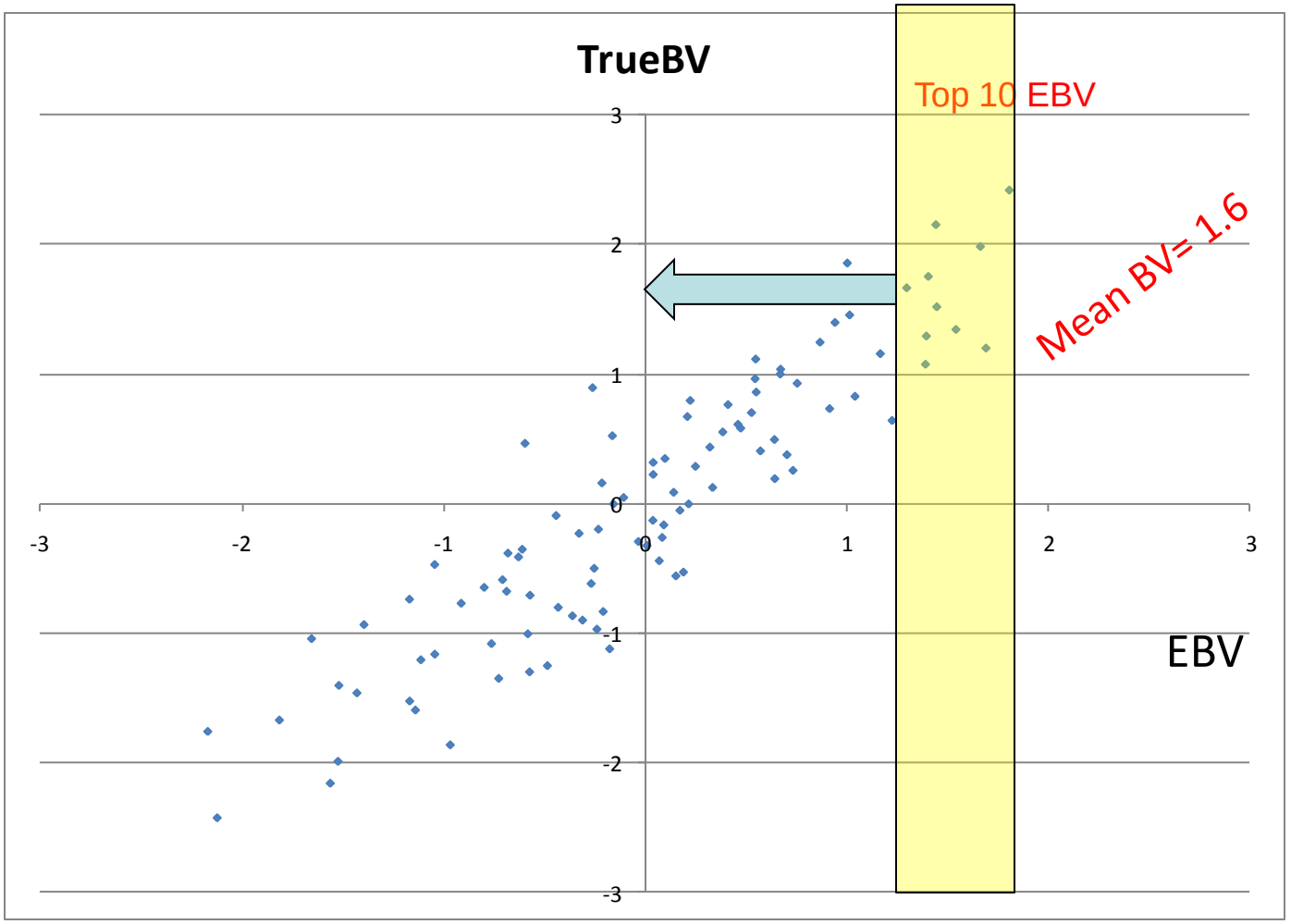
Select on EBV: accuracy related to response

Accuracy = 45%



Double accuracy gives double selection response!

Accuracy = 90%



Accuracy of predicting a breeding value

Info used. h2 = 0.25	Accuracy of EBV
Sire + Dam	0.35
Prog Tested Sire + Dam	0.49
… ……. + Own Record	0.63
..... + DNA markers	0.71
..... . + 30 progeny	0.85
..... + 1000 progeny	0.99

Selection on own phenotype

$$R = i \; h^2 \; \sigma_P$$

$$R = i \; h \; \sigma_A$$

Accuracy of MASS selection

Selection on an EBV

$$R = i \; r_{IA} \; \sigma_A$$

Accuracy of index selection

Making genetic improvement

- Select only the very best
- Select based on *accurate* breeding values
- Select animals *early* in life

Example: Comparing current rates with potential rates of genetic improvement in sheep

Genetic progress in Sheep	Annual response ($ per ewe)		
	Potential	Realised *Since 2000*	Ratio (%)
Border	2.0	1.7	85
Merino	2.3	0.7	30
Terminals	1.8	2.0	111

Put things in perspective – what part are we working on?

Response

=

intensity …….i

accuracy…….r

genetic SD…….σ

/

generation interval…….L

$$R = \frac{i_m r_m + i_f r_f}{L_m + L_f} \sigma_G$$

It is important to know in a breeding program where the big gains are

About making genetic improvement

Progress is restricted due to need to balance

- ... between *early* and *accurate* selection
- ... multiple traits, limited information on some traits

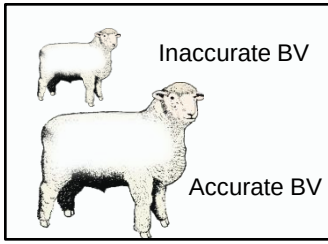
  → Emphasis usually on traits that are easiest to improve

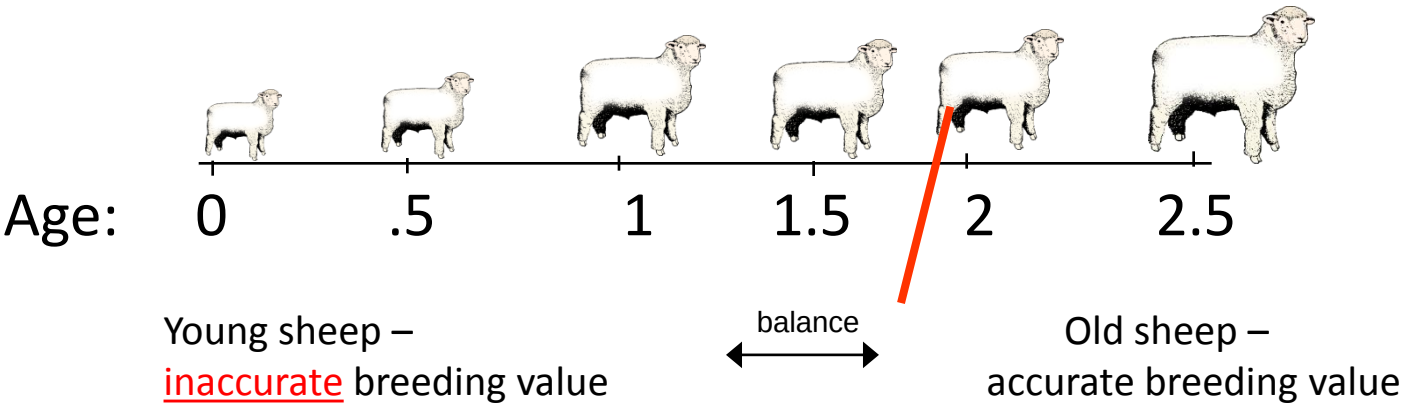
Genomic information:

- Will increase selection accuracy
- Is early information

  → favours traits that are *hard to measure or late in life*: *HTML*
- Shifts the balance towards more emphasis on *HTML traits*

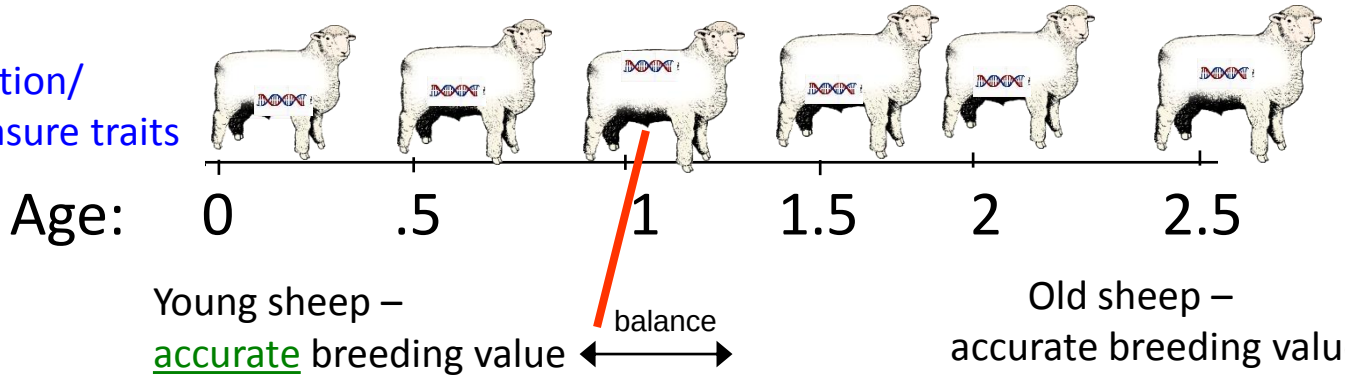
Traditional Selection



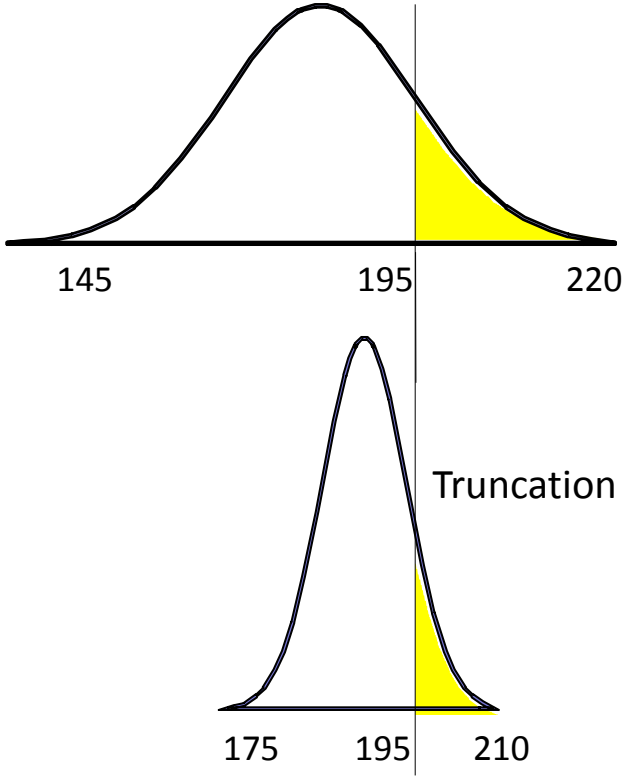


Genomic Selection

Earlier selection/
Hard to measure traits



Use old or young bulls?



proven sires

young sires

Acc = 0.85

Acc = 0.55

Breeding Program Design