Breeding the best with the best gives you the best – right?

(I hope you've had your coffee!!)

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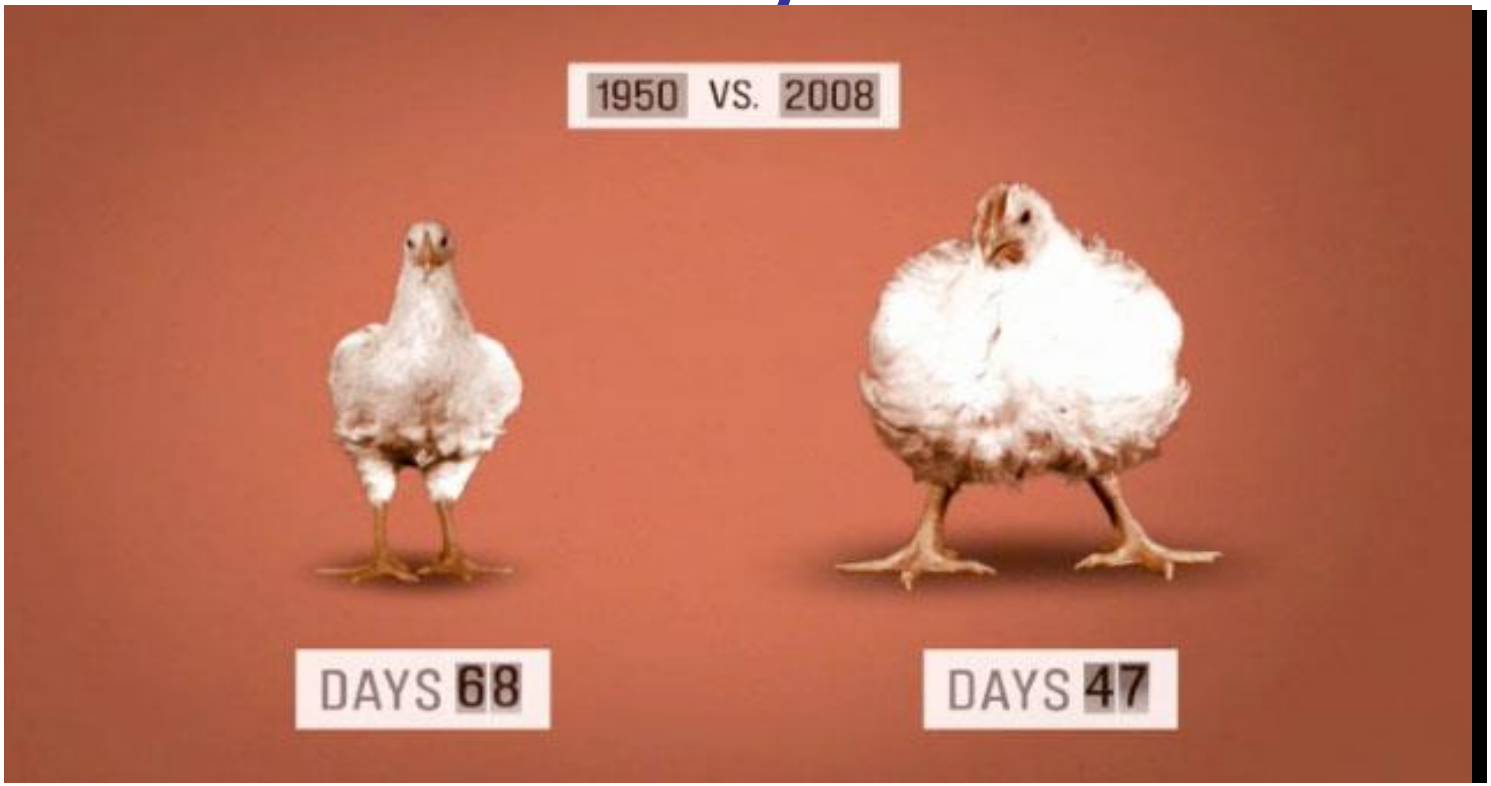
Irish Grasslands Association, Athy, May 2018

The sky is the limit

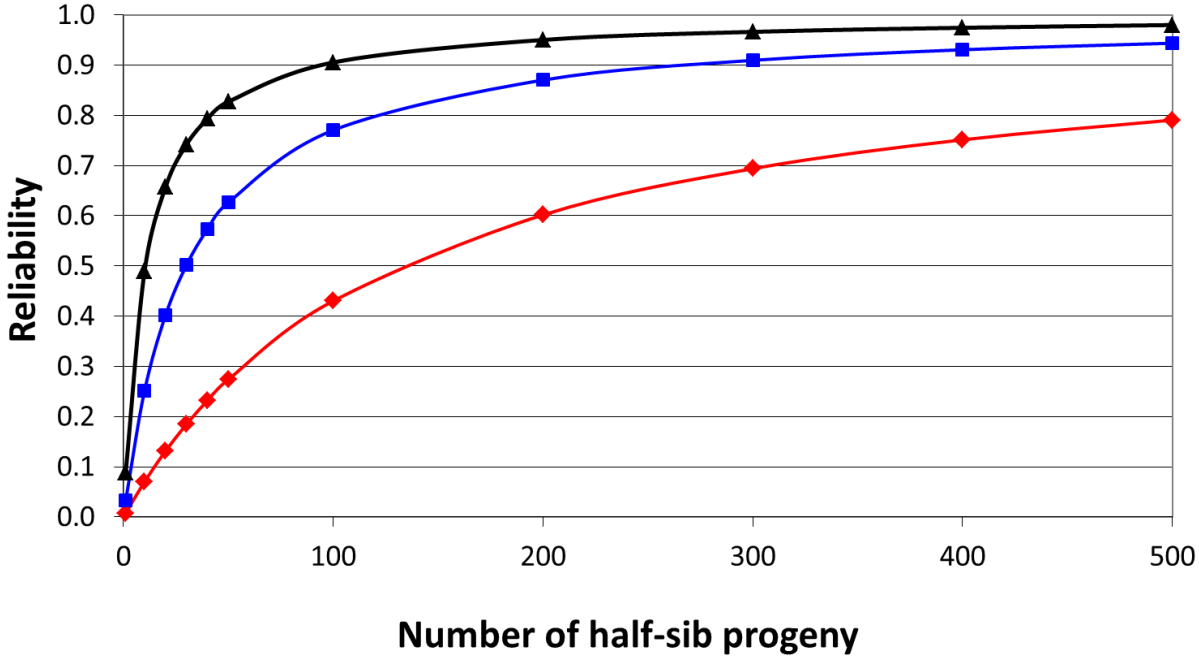


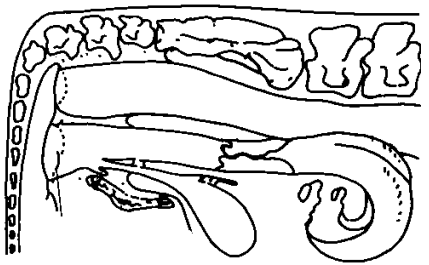
What the hell is heritability?
Is it actually important?

- **How much of the observed field variability is due to differences in genetics**
- **The correlation between the true genetic merit of an animal and what is actually observed**

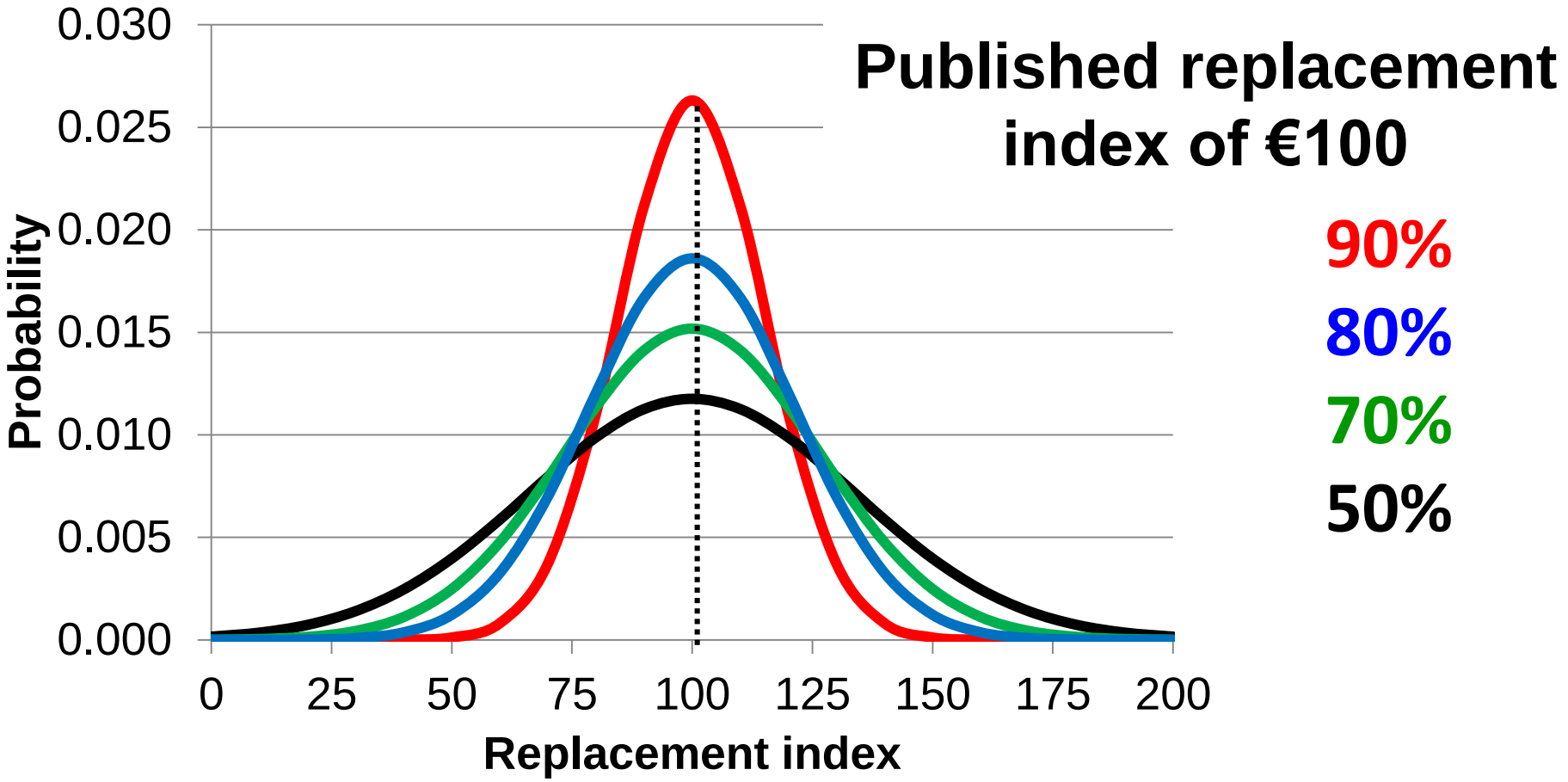
Heritability estimates in cattle

Trait	Heritability
Calving performance	
Direct calving difficulty	0.10
Maternal calving difficulty	0.04
Gestation length	0.35
Calf mortality	0.02
Performance traits	
Carcass traits	0.30 to 0.40
Average daily gain	0.31
Live weight	0.39
Efficiency traits	
Feed efficiency	0.33
Reproduction	
Calving interval	0.02
Survival	0.02

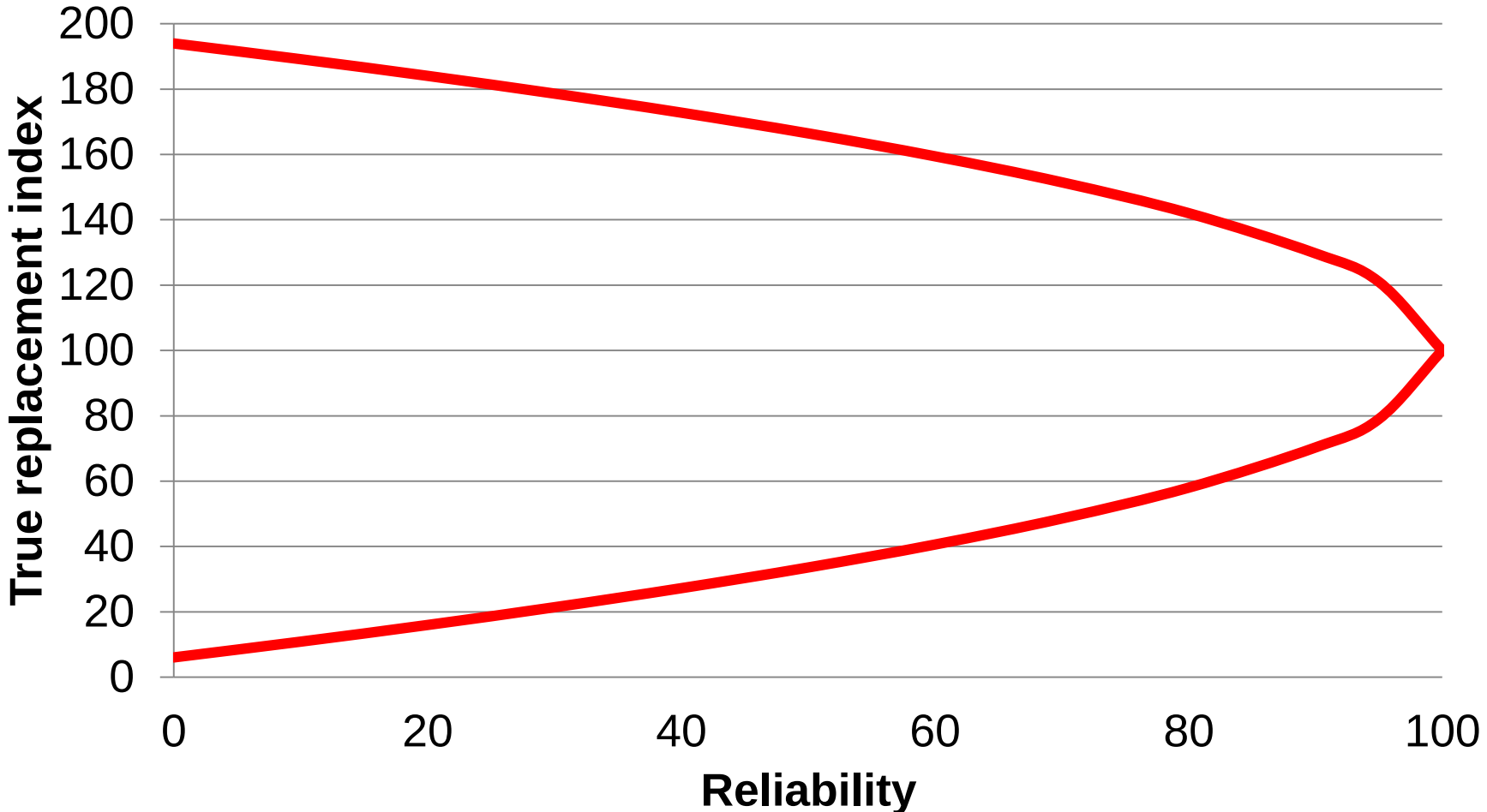




Reliability – a measure of confidence

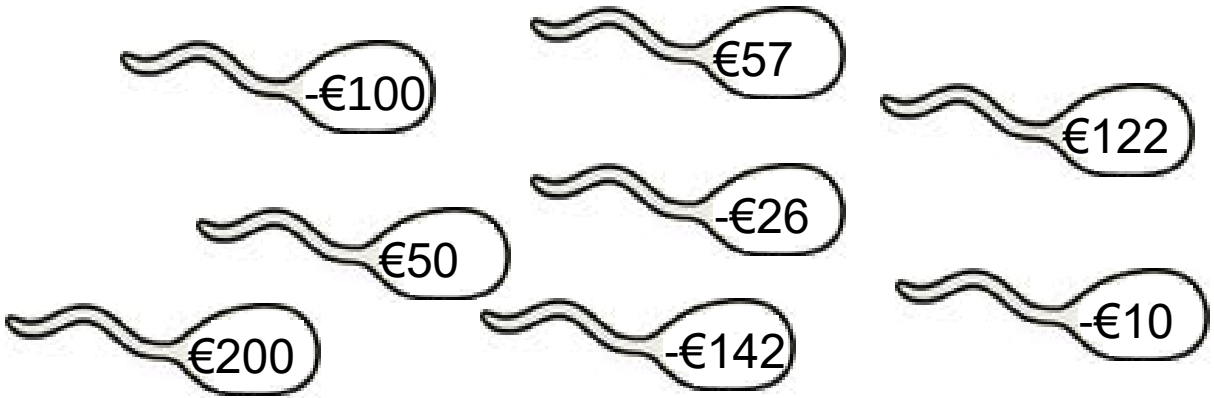


Reliability – a measure of confidence



How can the calf of high reliability parents, itself have low reliability

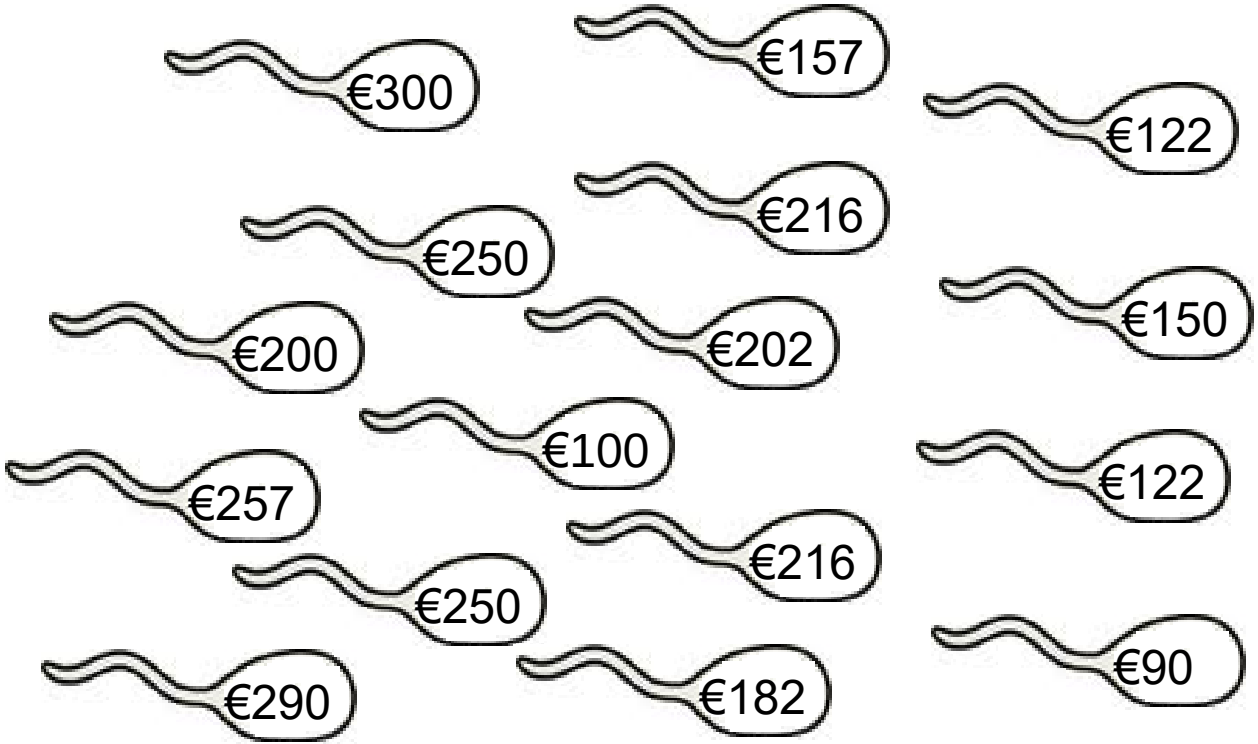
- **Animal reliability = ¼ sire reliability + ¼ dam reliability**
- **30% = ¼ 90% + ¼ 30%**



66% of sperm within ± €34 of the bull

Bull reliability is irrelevant

Example: €180 bull @ 99% reliability



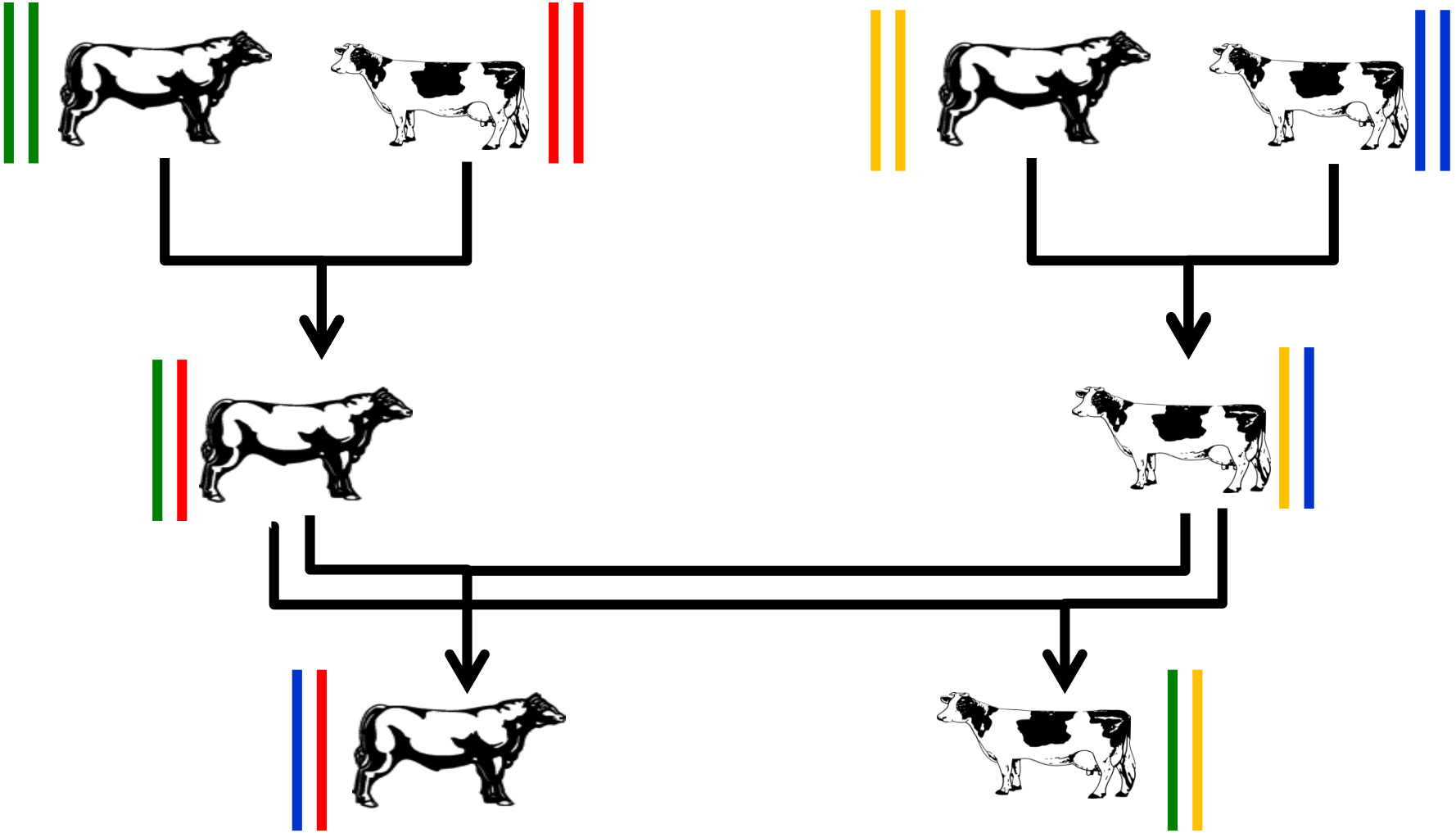
Average €180

66% of sperm between €146 and €214

16.5% <€146
2.5% <€113

How can one twin be a 1-star and the other twin be a 5-star

- One star : <€43 Five star >€96
- Twins from a €100 sire (90% rel.) + €40 dam (30%) reliability
  - €70 @ 30% reliability
- When genotyped
  - 10% chance of being a 1-star/11% chance of being a 5-star
- When proven
  - 25% chance of being a 1-star/26% chance of being a 5-star
- Twins
  - 2% chance one twin will be 5-star and the other will be a 1-star
  - 8% chance one twin will be 5-star and the other will be a 1/2-star

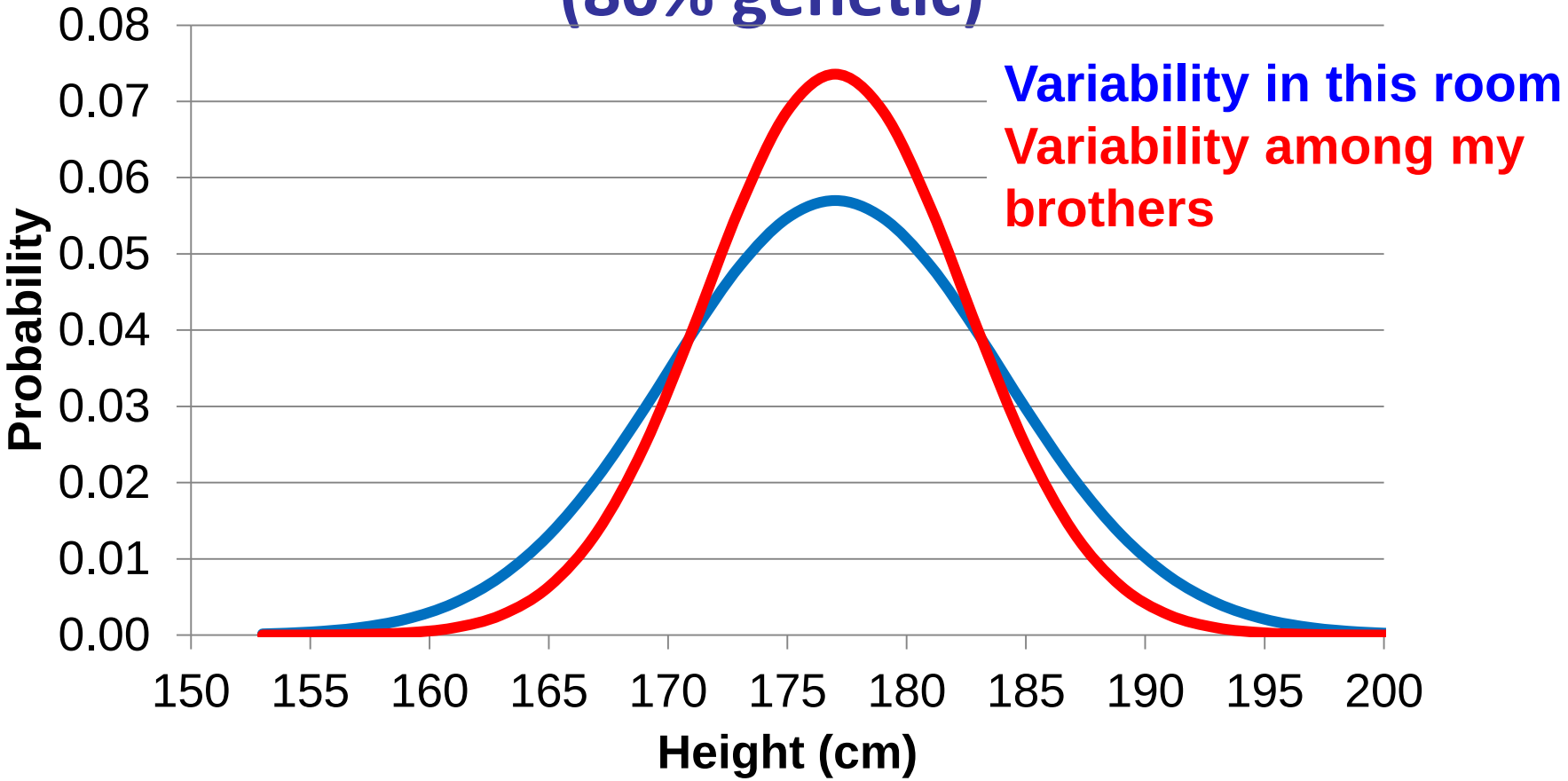


Breed composition

50% LM : 50% HF
(assuming parents are pure)

50% CH : 25% HF : 25% LM
50% CH : 50% HF : 0% LM
50% CH : 0% HF : 50% LM

Within-family variability in human height (80% genetic)



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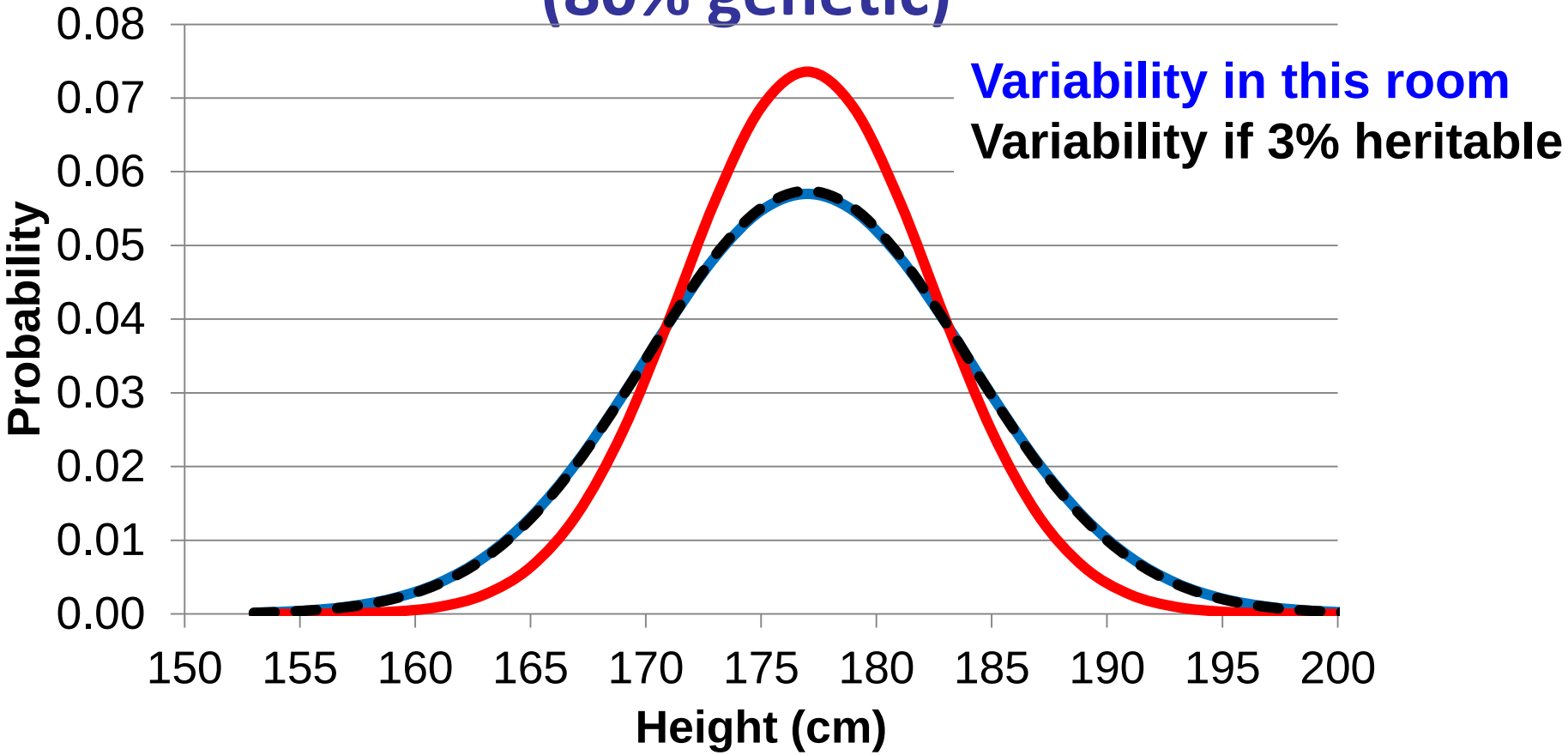
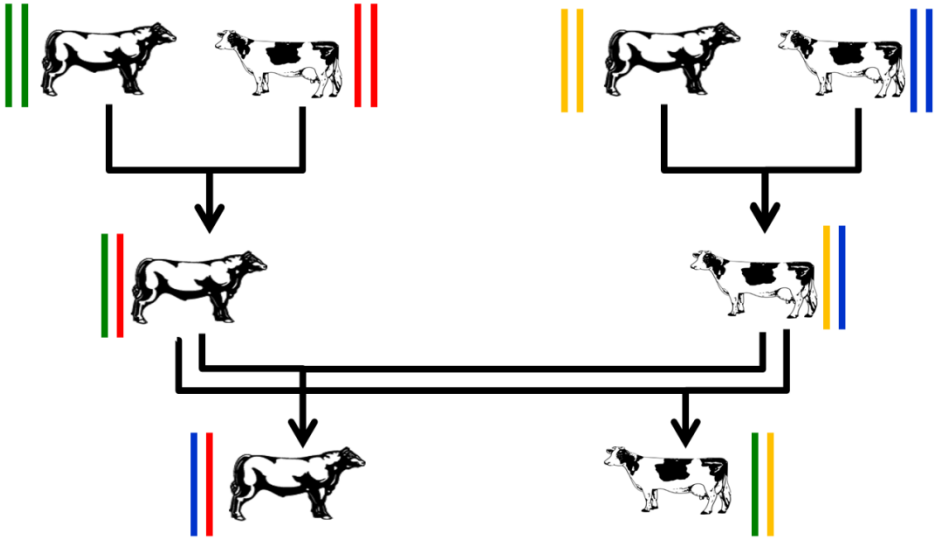


Genomics & increasing the chance of breeding better stock

- New born calf = half the sire + half the dam genetic merit



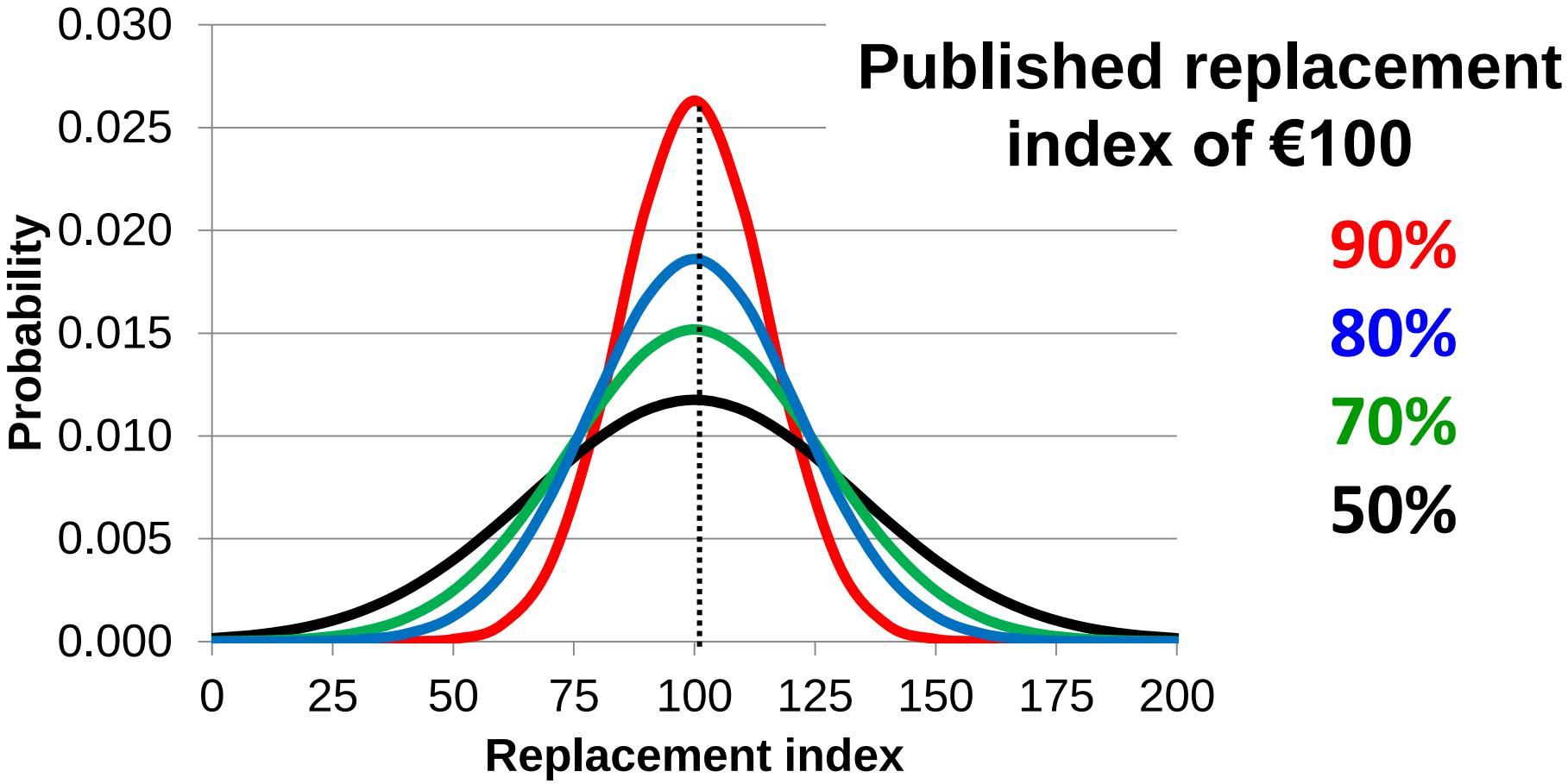
- DNA is the same throughout life

- Problem
- 3 billion pieces of DNA
- What is the effect of each??
  - Large dataset required

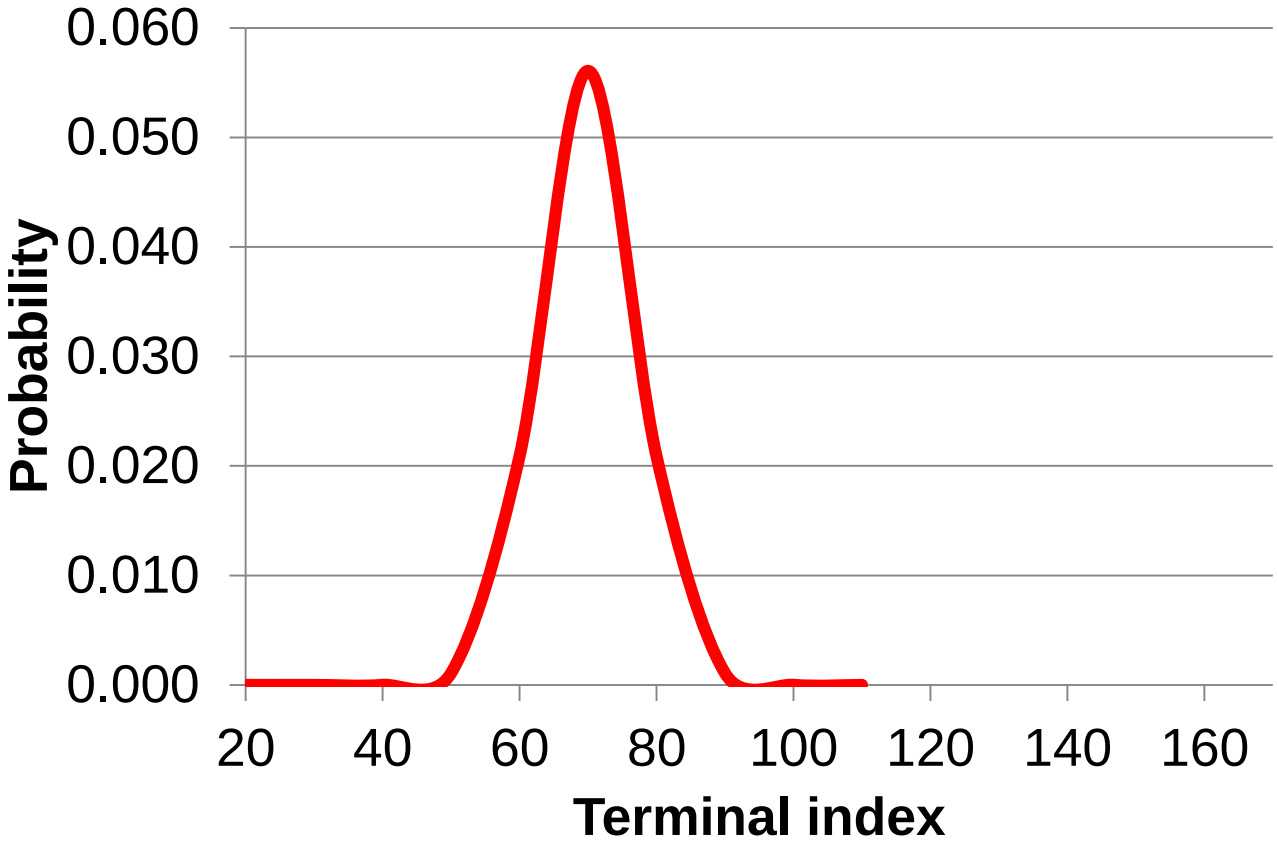
Choice between bulls

- Differences in overall genetic merit
- Differences in reliability
- ….breed preferences, semen price, genetic merit for individual traits…..
- A higher genetic merit lower reliability bull versus a lower genetic merit high reliability bull?
  - Difference in genetic merit v difference in reliability

Remember this…

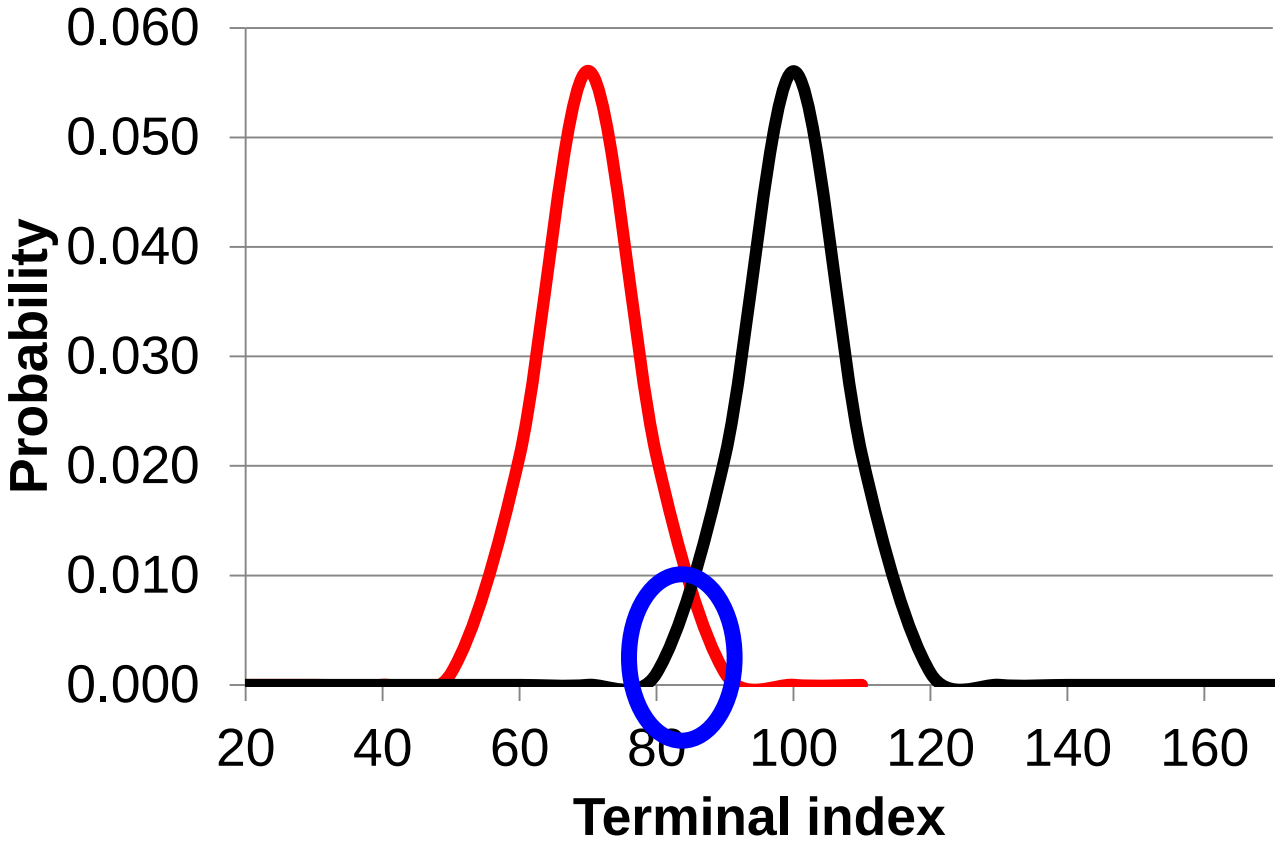


Compounded when comparing bulls



€70 @ 90% rel

Compounded when comparing bulls

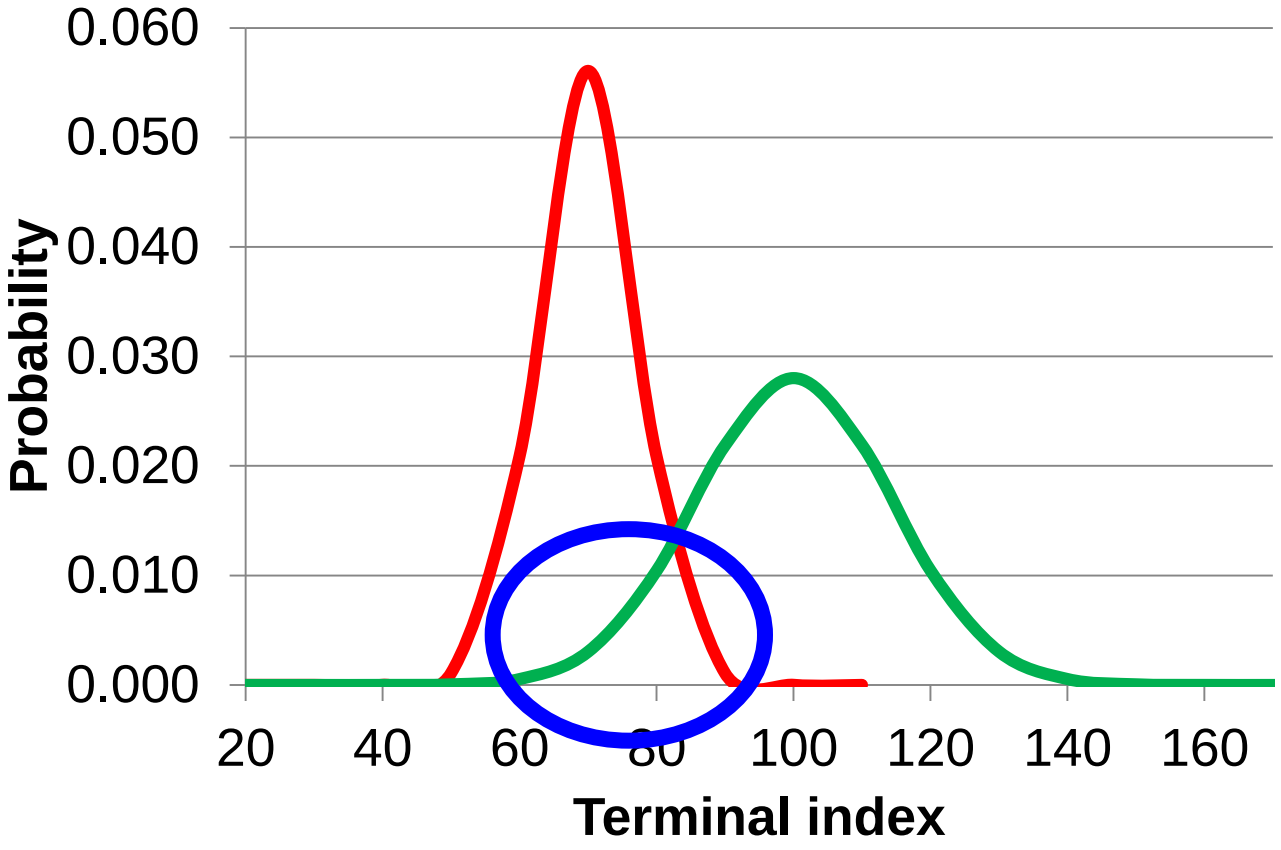


€70 @ 90% rel

€100 @ 90% rel

0.1% chance black will be worse than red

Compounded when comparing bulls



€70 @ 90% rel

€100 @ 60% rel

3% chance black will be worse than red

Terminal index

Probability the true terminal index of less reliable bull (50% to 90% reliability) is less than the true terminal index of a 90% reliability bull by difference in terminal index

	Reliability of less reliable bull				
Difference in terminal index	0.5	0.6	0.7	0.8	0.9
5	39%	38%	36%	34%	31%
10	28%	26%	24%	21%	16%
15	19%	17%	15%	11%	7%
20	13%	10%	8%	5%	2%
25	8%	6%	4%	2%	1%
30	4%	3%	2%	1%	0.1%

Replacement index

Probability the true replacement index of less reliable bull (50% to 90% rel) is less than the true replacement index of a 90% reliability bull by difference in replacement index

	Reliability of less reliable bull				
Difference in terminal index	0.5	0.6	0.7	0.8	0.9
10	39%	38%	37%	35%	32%
20	30%	28%	25%	22%	18%
30	21%	19%	16%	13%	8%
40	14%	12%	9%	6%	3%
50	9%	7%	5%	3%	1%
60	5%	4%	2%	1%	0.3%

Take home message

- Every prediction has uncertainty – genetic evaluations are no exception
- Using a genetically elite parent increases the chances of a high genetic merit offspring, but does not guarantee it
- Genomics improves the confidence (i.e., reliability) of published proofs
- Genomics does not impact whether the good genes or the bad genes are transmitted to offspring
- Keep breeding the best with the best (just also hope for the best!)