

From traditional EBVs to GEBVs - in Nordic and International evaluation

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Abbreviations

- **DGV (SNP effects)**
 - Direct Genomic Value
- **EBV (phenotypic registrations)**
 - Estimated breeding value
- **GEBV (SNP effects + phenotypic registrations)**
 - Genomic Enhanced Breeding value



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International estimation of breeding values

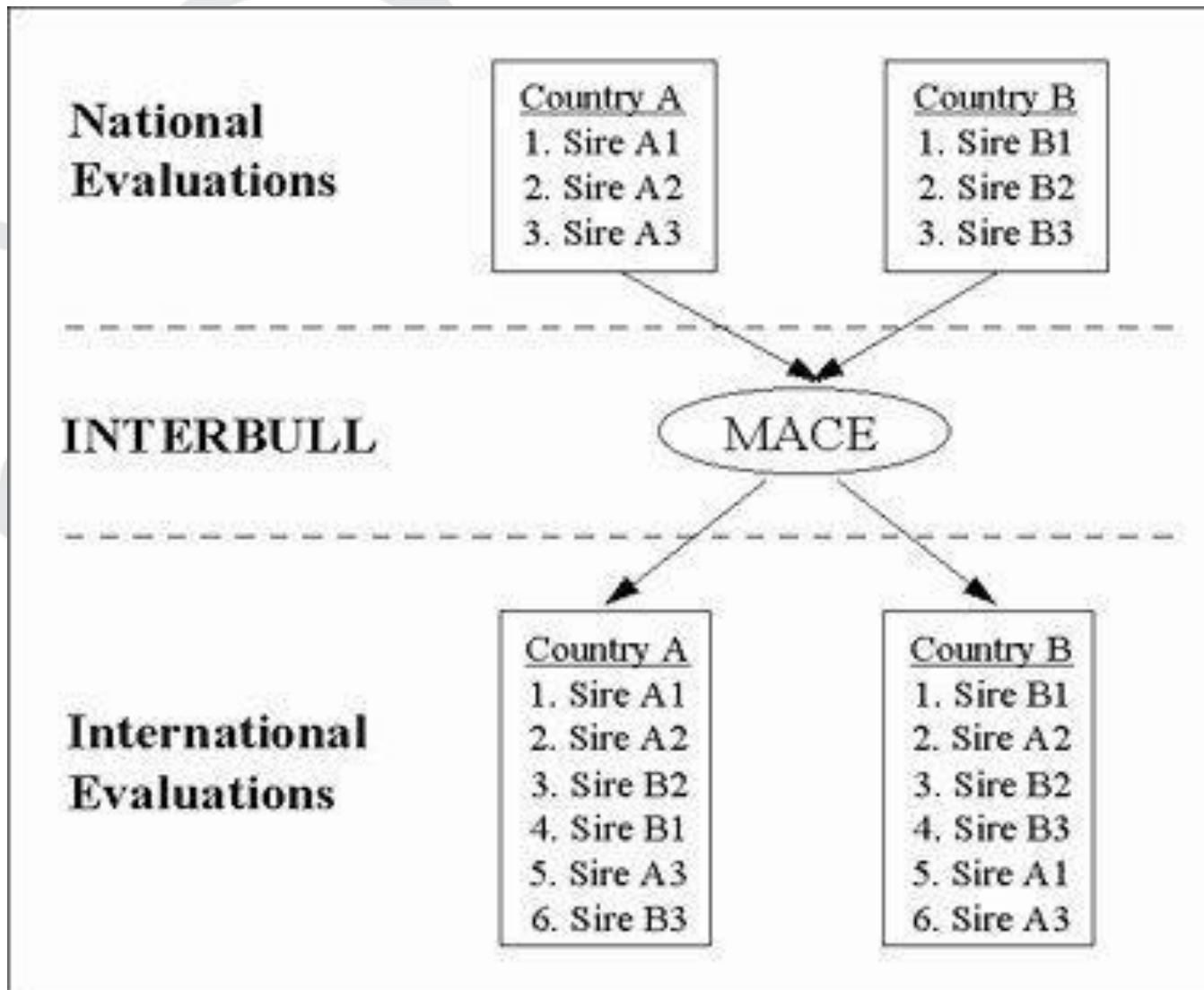
MACE – Multi Across Country Evaluation



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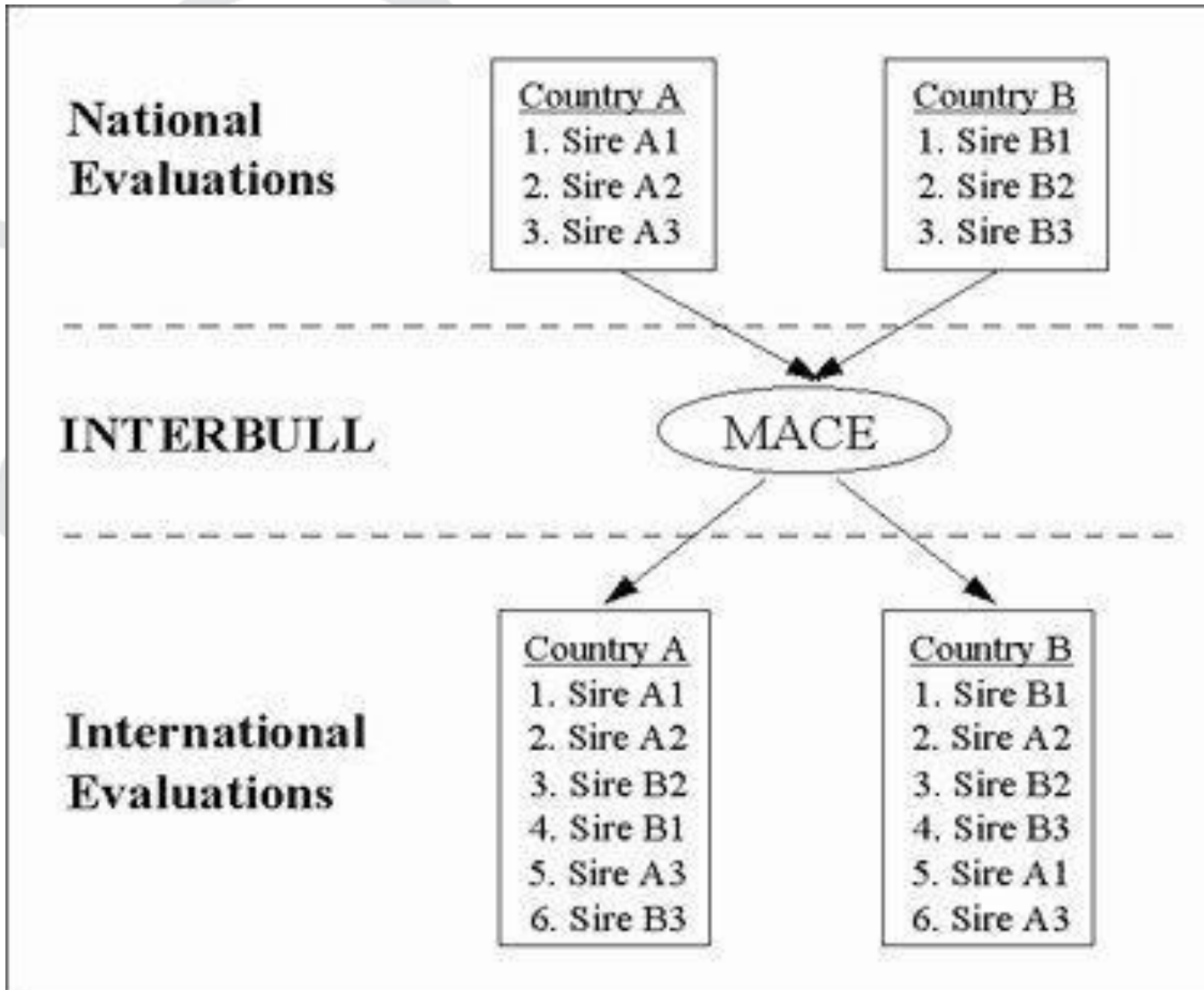


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National EBVs based on phenotypes

National EBVs based on phenotypes + genomic information



Is MACE working based on genomic EBVs?

**National
Evaluations**

Country A

1. Sire A1
2. Sire A2
3. Sire A3

Country B

1. Sire B1
2. Sire B2
3. Sire B3

**National EBVs based on
fænotypes + genomic
information**

INTERB

No!
What then?

**Internati
Evaluati**

5. Sire A3
6. Sire B3

5. Sire A1
6. Sire A3

**Is MACE
working based
on genomic
EBVs?**

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INTERBULL and genomic EBVs (GEBVs)

Goals:

- IB want to make GEBVs usable across countries

Challenges:

- Take genomic selection among young bulls into account – avoid possible selection bias and problems with INTERBULLS normal test criteria
- Avoid double counting of genomic information, if more countries deliver GEBVs for the same bulls

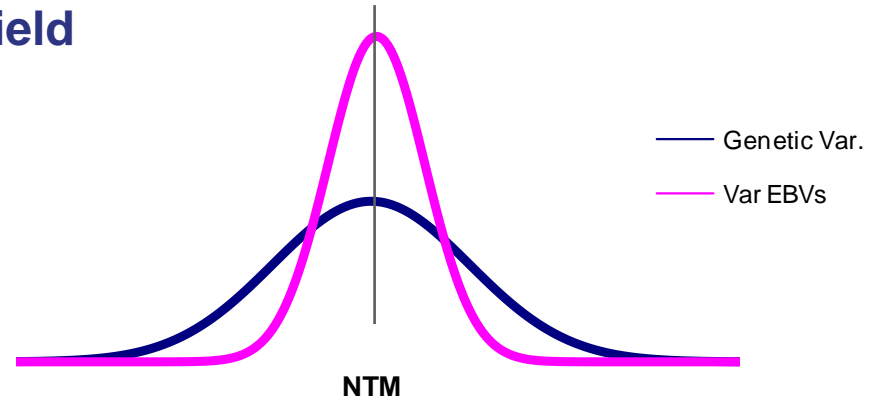
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Distribution of young bulls EBVs without genomic selection

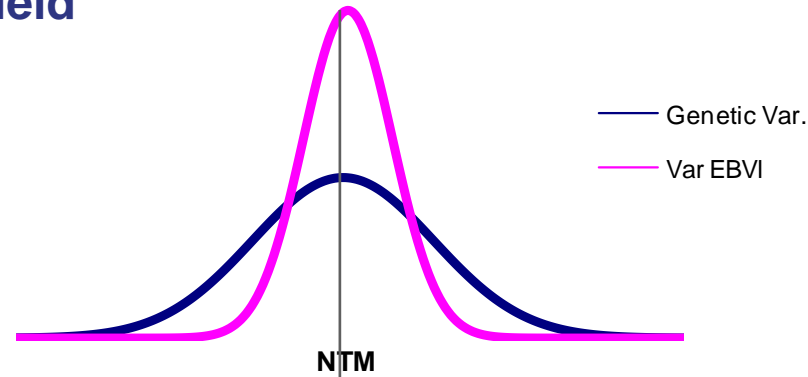
Young bulls – pedigree information
Reliability 31-38% - yield



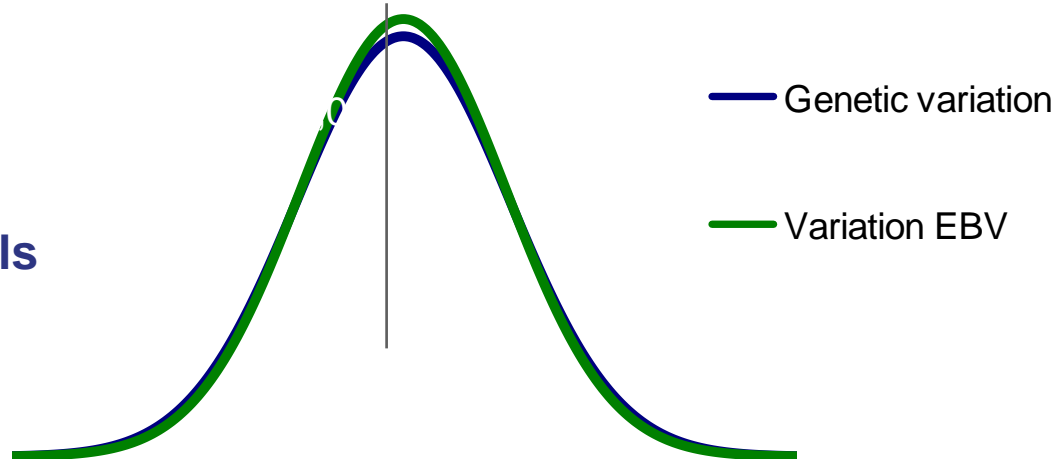
Distribution of young bulls EBVs without genomic and the same bulls EBV, when they get a progeny test

Young bulls – pedigree information
Reliability 31-38% - yield

Note the
average is
the same!



Progeny tested bulls
Reliability 80-95%

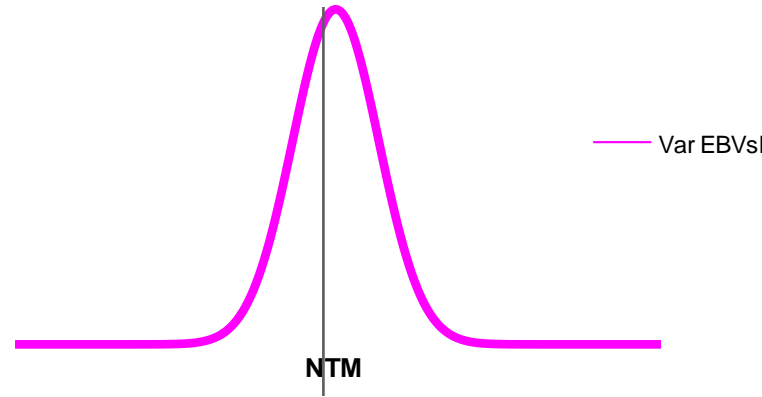


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   Nordisk Avl

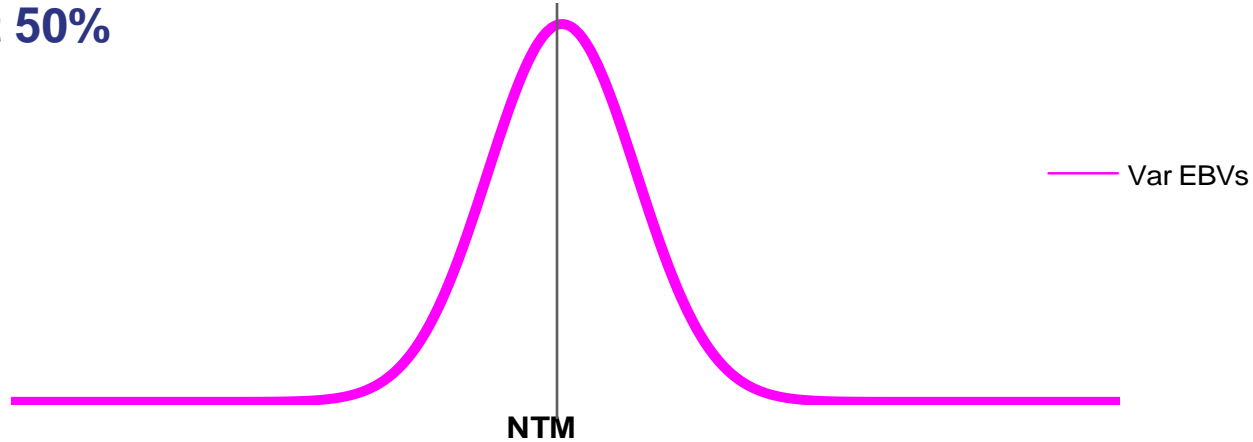
Distribution of young bulls EBVs with genomic

Young bulls – pedigree information
Reliability 31-38% - yield



**Note
standard
deviation
increases**

Young bulls – with genomic information
Reliability about 50%



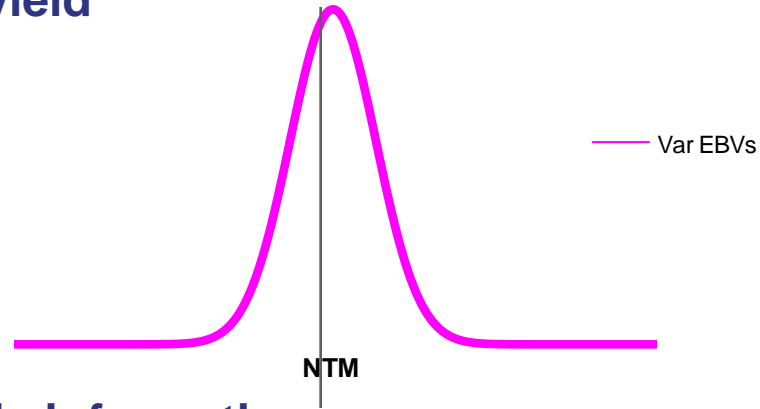
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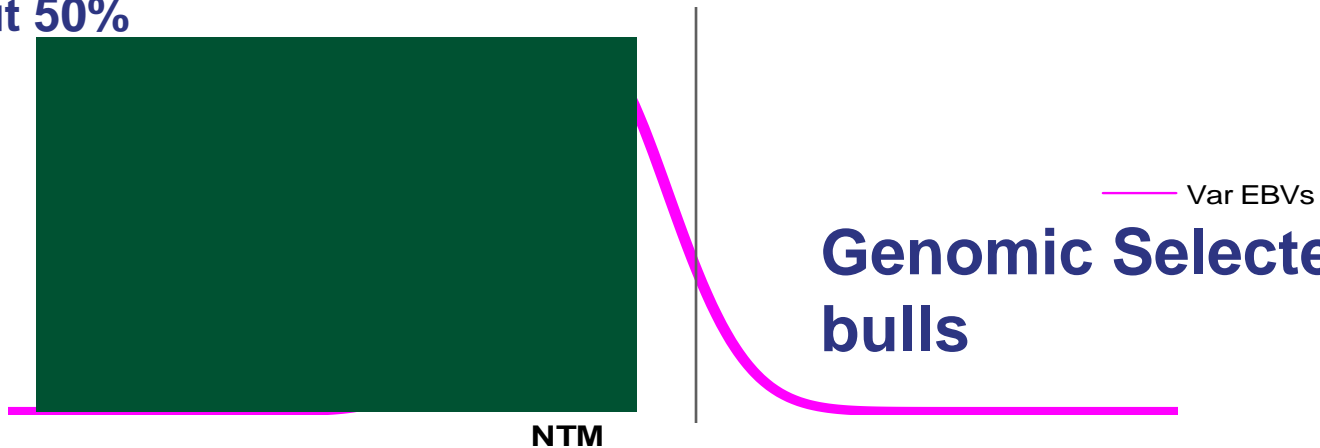
Distribution of young bulls EBVs after genomic

Young bulls – pedigree information
Reliability 31-38% - yield



Note standard deviation among selected bulls decrease and average increase

Young bulls – with genomic information
Reliability about 50%



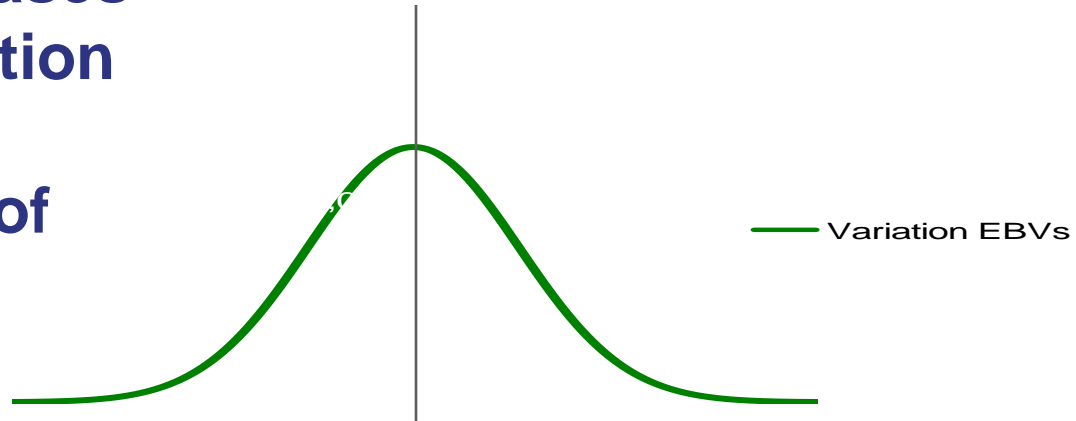
Genomic Selected bulls

Distribution of young bulls EBVs after genomic

Young bulls – with genomic information
Reliability about 50%



Note average increases
and standard deviation
a bit smaller due to
genomic selection of
young bulls



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Which effect does it have on estimation of breeding values?

- Traditional without genomic selection of young bulls

$$\text{EBV-bull calf} = \frac{1}{2} \text{EBV-dam} + \frac{1}{2} \text{EBV-sire}$$

- With genomic selection of young bulls

$$\text{EBV-bull calf} > \frac{1}{2} \text{EBV-dam} + \frac{1}{2} \text{EBV-sire}$$

Which effect does it has on estimation of breeding values?

- Genomic selection ignored/unknown leads to bias in EBVs
- Genomic selection "destroy" normal assumptions in relation to validation of EBVs



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Which effect does it have on EBVs?

- The challenge depends on:
 - Reliability of DGVs
 - Intensity of selection

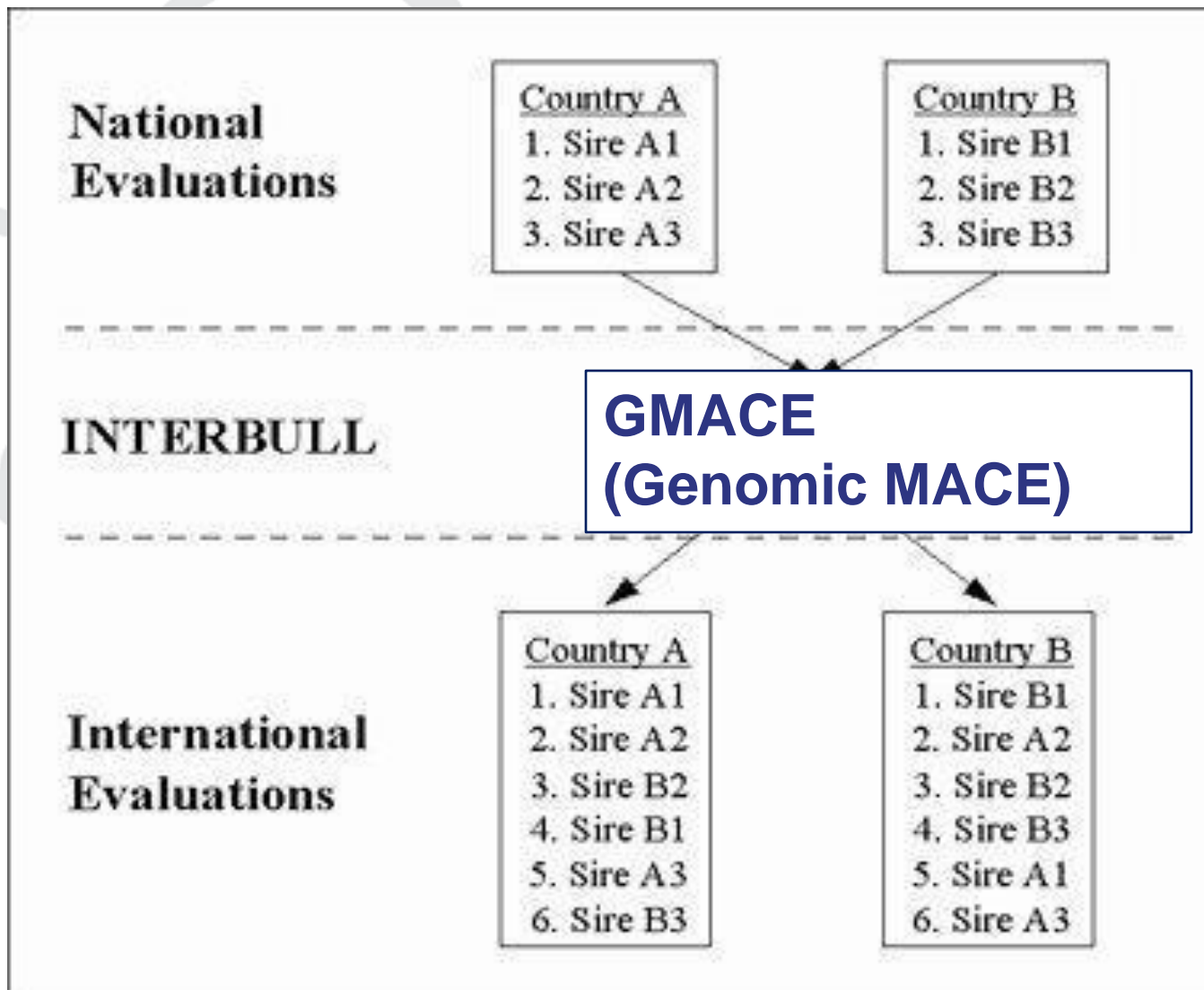


What has to be done?

- **Take genomic selection into account in estimation of EBVs**
- **Work is going on all over the world**
- **The problem is important 3-4 years ahead when the first genomic selected bulls get lactating daughters**

Problems with MACE and genomic information

- **Genomic information about the same bull can be included from more countries. The normal MACE will double count the genomic information – as to independent tests even though the same genomic information is used**
- **GMACE a method to avoid double counting of genomic information**



National EBVs based on fænotypes + genomic information

INTERBULL trend validation

Basis – 2 runs:

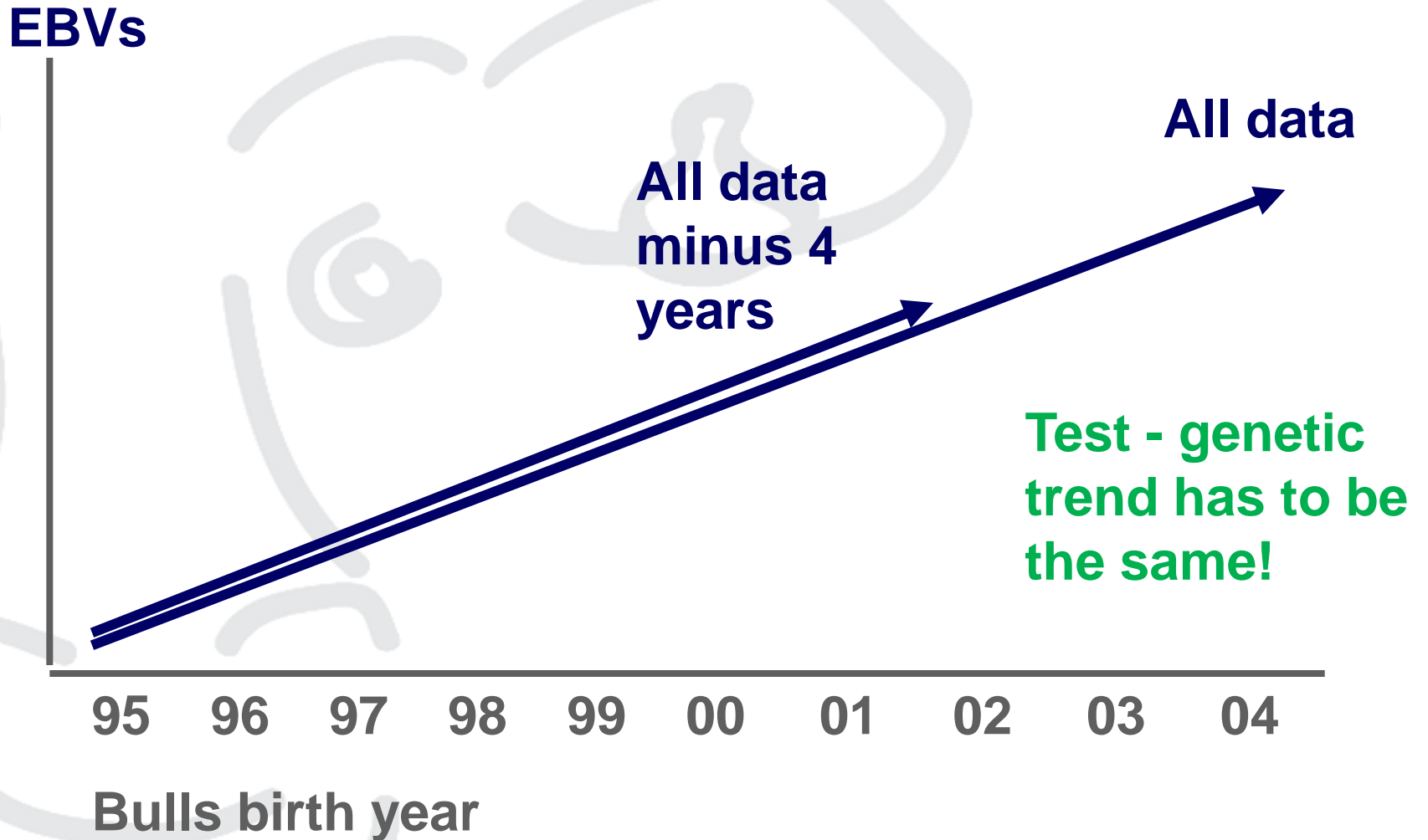
- Run including all data
- Run including all data minus the last four years of data
- Compare genetic trend – has to be equal – it means EBVs for proven bulls has to be stable when getting 2nd batch daughters

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INTERBULL test – phenotypic registration



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Bulls birth year



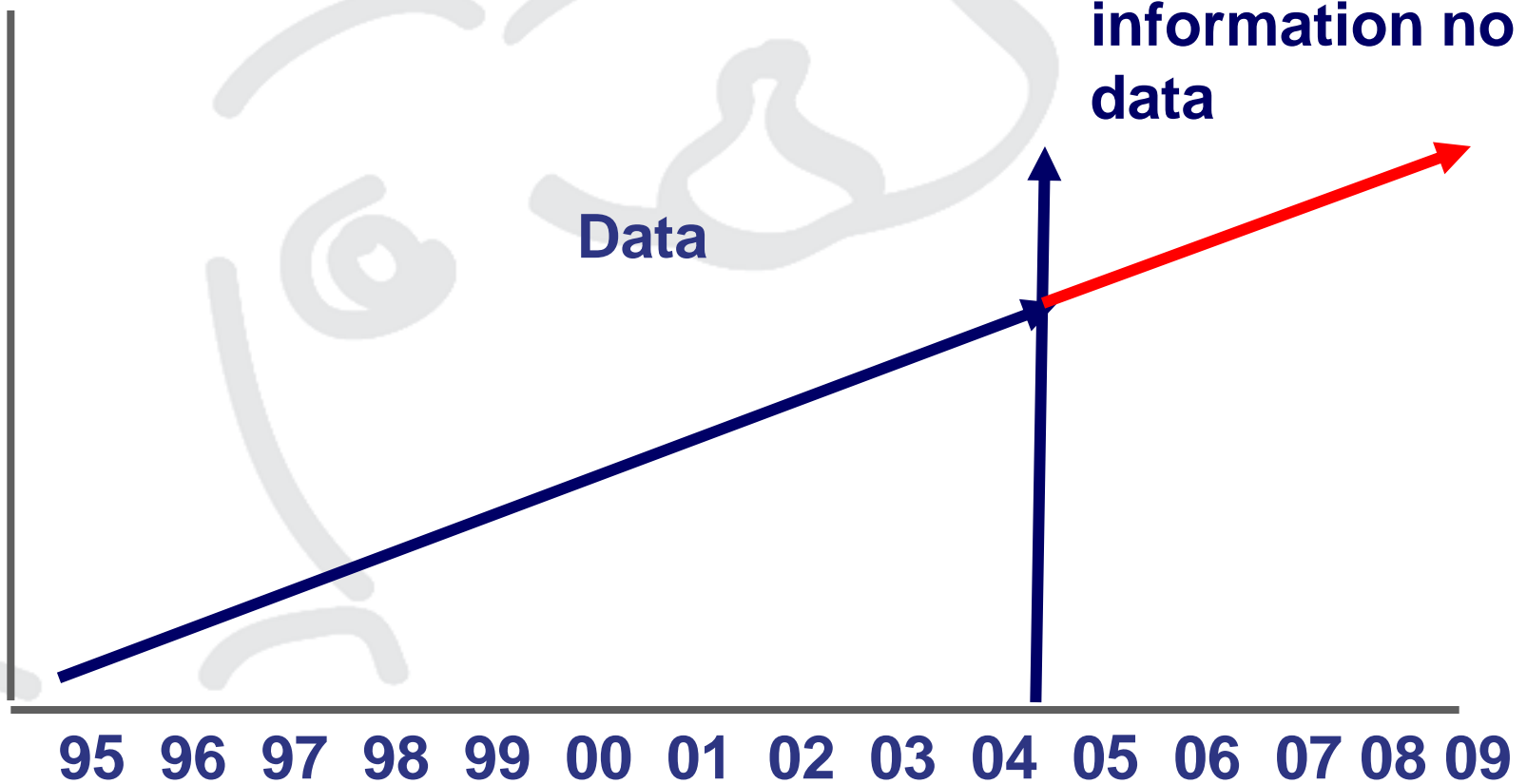
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INTERBULL test – genomic data?

EBVs

Genomic information no data

Data



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Bulls birth year



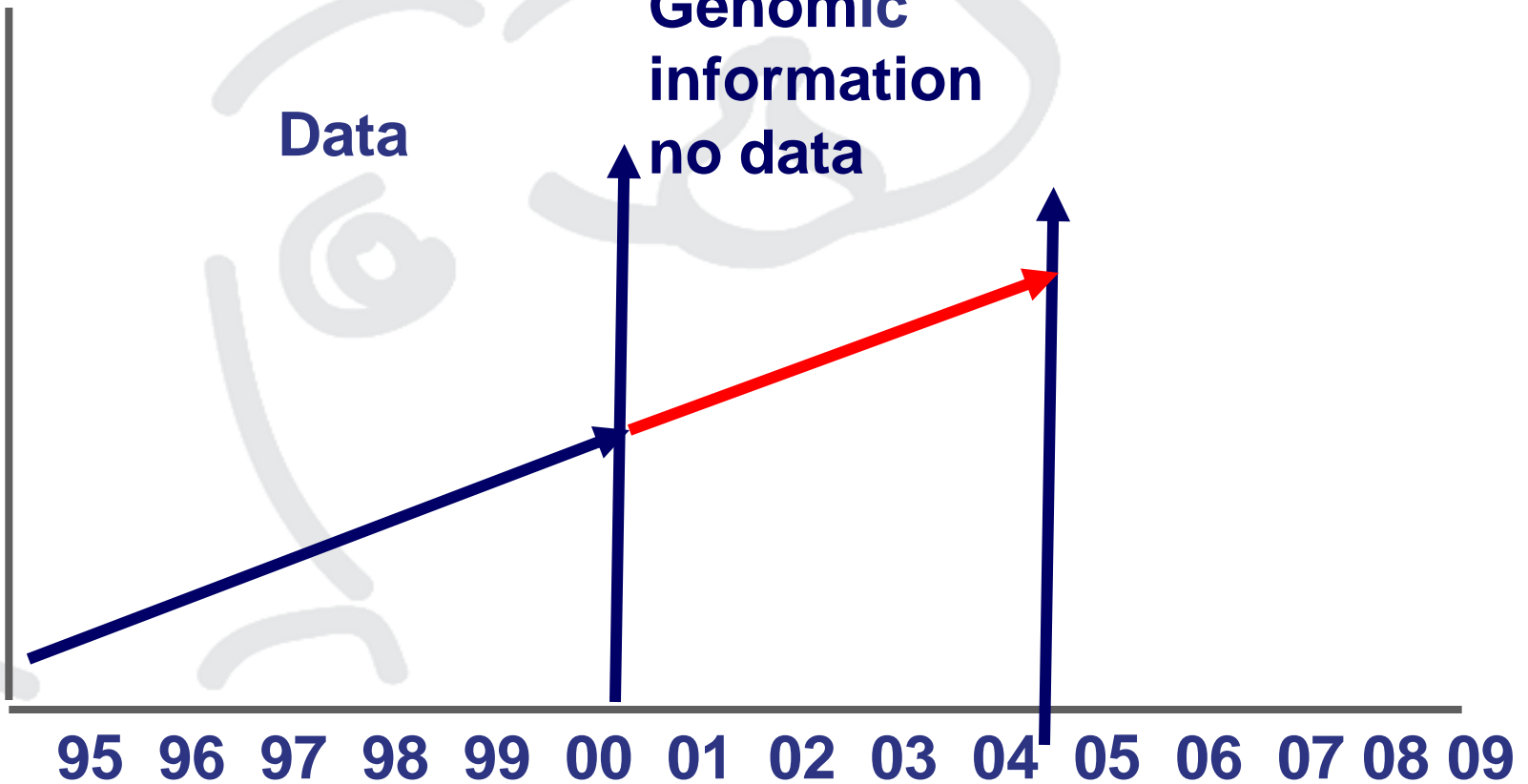
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INTERBULL test – Genomic information

EBVs

Data

Genomic
information
no data



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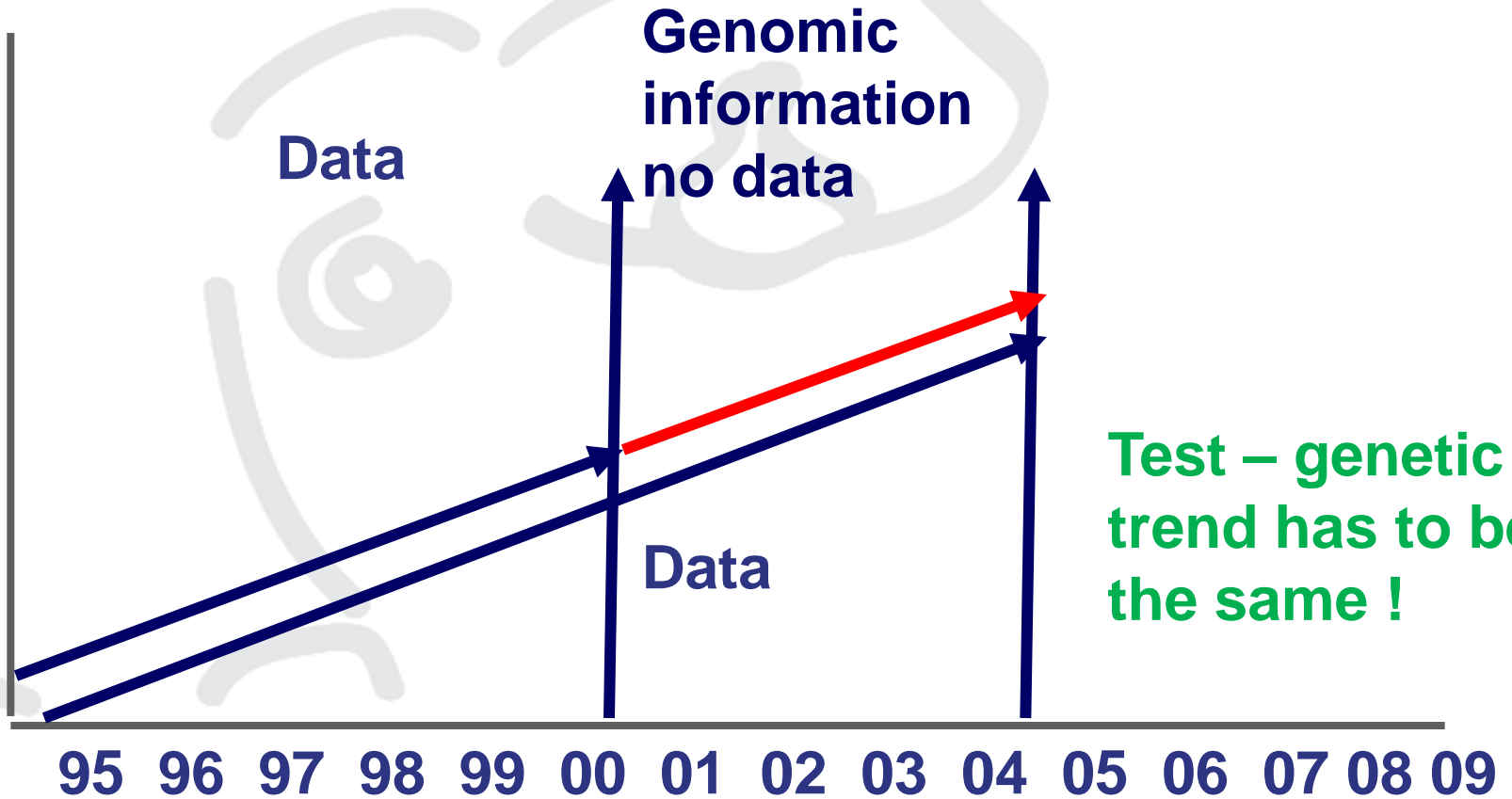
Bulls birth year



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INTERBULL TEST – Genomic information

EBVs



Test – genetic trend has to be the same !

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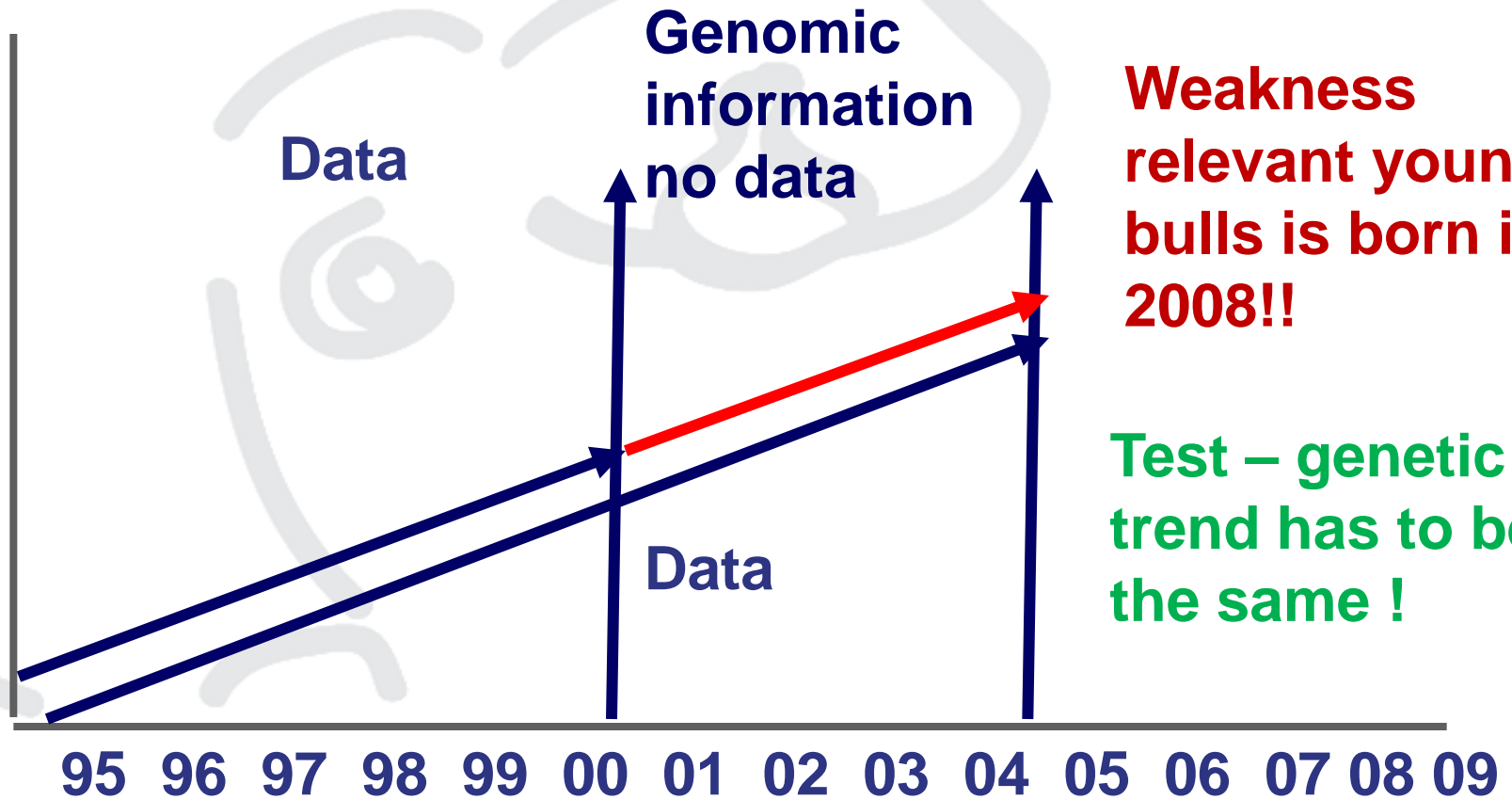
Bulls birth year



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INTERBULL TEST – Genomic information

EBVs



**Weakness
relevant young
bulls is born in
2008!!**

**Test – genetic
trend has to be
the same !**

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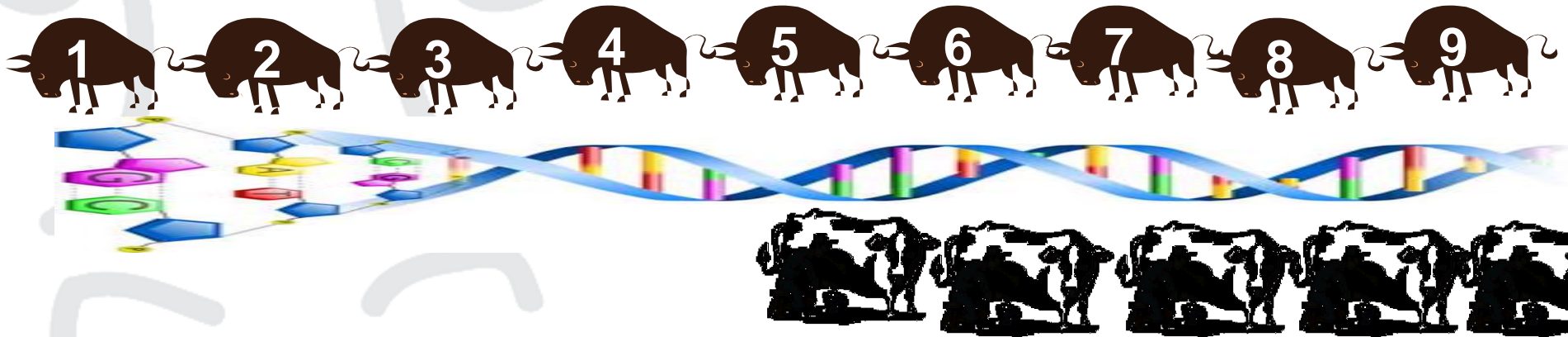
Bulls birth year



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INTERBULL validation - genomic

Challenge 4 youngest birth years of bulls have only genomic information no daughters with data!



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INTERBULL validation - genomic

Challenge 4 youngest birth years of bulls have only genomic information no daughters with data!

Basis – 2 runs:

- Run including all data
- Run including all data minus the last four years of data
- Compare genetic trend – has to be equal – it means GEBVs has to be stable when getting daughters

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INTERBULLS plan for GMACE

Time schedule

What to do?

Autumn 2009

Set up validation criteria

December 2009

GMACE ready for use
Request for data for validation
and GMACE pilot run

December 2009

January-February 2010

Pilot run GMACE

March 2010

Discussion of GMACE results

May 2010

GMACE test run

August 2010

GMACE routine run

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NAV plans

1. **Combine PA and DGV for young genomic tested animals (end 2009- start 2010)**
2. **Blend DGV in the traditional NAV evaluation for all animals (work started – end spring 2010)**
3. **Investigate possibilities to improve the methods further?(2009 - 201?)**

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NAV plans

- **Change from unofficial DGVs and official EBV's (today) to official GEBVs (spring/summer 2010)**
- **Participate in INTERBULL test run with GEBVs in Mai 2010**

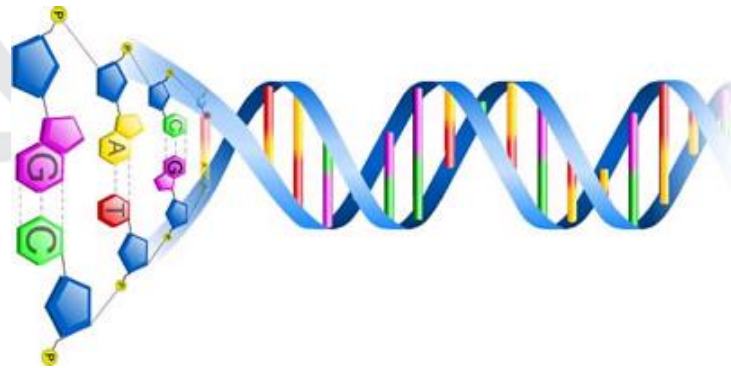
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Critical point in relation to blending

- **Robustness of DGV**
- **Reliability of DGV – same for all animals/different from animal to animal?**



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Critical points in relation to GEBV

- **Comparison of genomic tested one year old bulls and bulls with lactating daughters**
 - **Stability of DGV**
 - **Reliability of DGV**
 - **PA unbiased – bull dams are critical**

German INTERBULL paper 2009

Best use of conventional EBV of bull dams and combination with direct genomic values

Dr. Stefan Rensing, Erik Pasma, Fritz Reinhardt,
Vereinigte Informationssysteme Tierhaltung w.V.
(vit), Verden/Germany

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German Interbull paper 2009

- **Overestimation of parent average (PA) for highly selected young bulls at least for production traits is it obvious**
- **Most probably due to over-estimated dam EBVs (preferential treatment)**
- **Question of unbiased PA has become new dimension in time of GEBVs. PA has high impact on combined genomic EBVs this high impact remains for longer time for animals without daughter information**

German INTERBULL paper 2009

- **SCC**
 - **Difference PA-EBV = 0,0**
- **Protein**
 - **Difference EBV-PA = -16,1 kg**
 - **Difference EBV-PA-only sires = -1,7 kg**

Same results in Nordic countries

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German INTERBULL paper 2009

- Bull dams own records for yield will lead to bias in PA and GEBV
- Critical for a fair comparison of genomic tested one year old bulls and bulls with lactating daughters!!



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What to publish in Nordic countries?

- **GEBVs – the future combination of information from DGV and EBV**
- **Esa will tell you how it can be done**

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Summary international

- Ignoring of genomic selection in EBVs create bias
- Genomic selection means that normal assumption in estimation of BV do not hold any more
- GMACE in 2010
- MACE has to continue

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Summary – NAV plans

- NAV routine GEBV in 2010 assumptions:
 - Robust DGV
 - Knowledge about reliability of DGV
- Bull dam information has to be looked at critically

**Can it be fulfilled
for all breeds?**

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Traditional MACE

We still need MACE, since INTERBULL EBVs are used to increase number of bulls in the reference-group to improve predictions formulas for DGVs – has to be improved constantly

INTERBULL and the future

Exchange of SNP information between countries for all relevant young bulls are more efficient than GMACE. It means:

- **A Nordic GEBV bull gets highest reliability on US scale by using US predictions formulas directly to calculate US DGV**
and
- **A US bull get highest reliability on Nordic scale by using Nordic predictions formulas directly to calculate Nordic DGV**

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INTERBULL and future

INTERBULL's role:

- Short run - GMACE for international EBVs and traditional MACE for prediction formulas
- Long run ??
 - INTERBULL host calculation of prediction formulas
 - or INTERBULL partly superfluous
 - or role of national organizations are changed ?

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Bull dams in reference population

- Note: several countries has found that bull dams in reference population do not increase reliability of genomic solutions
- Reason – presumably overestimation!

Although I believe that equally large reason is the low accuracy of female EBVs

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- You concentrated more on genetic trend
- I see 2 other Interbull expectations:
 - The consistency of GEBVs compared to EBVs
If the accuracy (i.e. $STD(GEBV)$) is not consistent with r^2 of EBVs, then the regression of current EBVs on GEBVs minus 4 years is not valid
 - The general accuracy of GEBVs.
As ITB has to "bless" the GEBVs to be usable in international trade, ITB has to approve the GEBVs accuracy. Currently only material that has $r^2 > 0.5$ can be exported. And there is no rule to judge that!

Esa's own opinion:

INTERBULL will have equally or more important role as a reference lab, even when countries will start more to calculate their own GEBVs

-If countries would only import, then the "company vision" could be possible, but since they also want to export, a international reference organization is needed.

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