

Interbull Meeting 21 & 22 June 2025, Session II, Louisville, Kentucky

Introduction of Single Step genomic evaluations in German Holsteins

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Single Step GE in German Holsteins



Introduced officially in April 2025

- Holsteins (black-and-white & red-and-white)
- all traits
- Single-Step SNP-BLUP, including MACE information
- building on decades of multi-step GE development
 - > full model definitions (fixed & random effects) from previous conventional GE
 - > all data as used in previous conventional GE



Building on decades of GE development



- models with SSM stem from previous conventional models in MSM
 - trait definitions
 - fixed effects (but additionally: regression on inbreeding coefficients)
 - genetic effects
 - genetic parameters
 - index EBV calculation
- all data is used with SSM as previously used with conventional GE in MSM
 - Ieft-sided data truncation 01.01.2000
 - sire and dam's sire must be known
 - sire and dam's sire must belong to breeds consistent with the animal's breed
 - further trait-dependent plausibility checks





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Minor adjustments



| | MSM | SSM | comment |
|---|--|--|--|
| reference population for genomic evaluation | cows with phenotypes bulls with ≥ 10 herds MACE bulls born in 1986 or later further restrictions depending on the trait | all animals with own performance offspring performance genotypes (born 2005 or later) MACE EBVs if born 1995 or later | |
| consideration of inbreeding | depending on trait, usually via relationship matrix | for all traits via:relationship matrixfixed regression on inbreeding coefficient | low impact on EBVs; EG Golden Standard |
| reliabilities | from trait-dependent constant genomic reliability & conventional reliability | same principle as multi-step new calculation of the genomic EDC (effective daughter-contributions) new method for calibration of the genomic reliability | according to Interbull recommendation |
| genetic std of RZM (production index) | | recalibration of RZM's standard deviation | post-processing: std of RZM slightly reduced |



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GE runs with and without truncated data

- with current MSM
- with SSM
- in total 4 GE runs per trait

analysis within method:

- How are the EBVs confirmed 2 years later?
- Validation with German AI bulls:
 - 04/2021 purely genomic EBVs,
 04/2023 daughter-proven EBVs (≥ 20 EDC)

in 2024, we also ran 4-year validations, including TMACE

validation bulls approx. 6 years old, daughter-proven EBVs

validation bulls approx. 4 years old, purely genomic EBVs

- results were similar to 2-year validation
- for some traits, 4-year truncation removes to much data leading to decreased representativeness/informativeness

2 years of additional data





Validation

Data as of 04/2023

Data as of 04/2021

Number of validation bulls









GEBV correlations 04/2021 vs 04/2023



Single-Step



Index

- SSM GEBVs of young bulls predict later daughter-proven GEBVs better than Multi-Step
- improved stability of GEBVs

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0.20

0.18

Reliability gains

- 0.16 Increase of reliability 0.14 0.12 0.10 0.08 0.06 0.04 0.02 0.00 RZcalffit RZM RZS RZE RZN RZKd RZKm RZhealth RZD RZR RZKon RZG trait group
- reliabilities of GEBVs as of 04/2023
- 258 German Holstein Al bulls born 2021

- improved reliabilities in all traits with SSM
- functional traits, especially health traits improve most



RZEuro

8

Correlations SSM vs MSM (Holstein b&w)



Total Merit Index: RZG



results as of December 2024

- correlation of ca. 0.95 for daughter-proven bulls
- correlation going down to ca. 0.85 for purely genomic bulls

Alignment with the industry



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- we made clear from the beginning that introduction of single step
 - will be a major improvement over MSM
 - requires huge effort
 - will affect ranking of animals heavily
- we provided test results from Sept 2024 on
 - main evaluations
 - weekly evaluations
- we had multiple feedback rounds with breeding organisations
- we used the feedback for further improvements
 - see also the presentation from Zengting Liu on calf fitness (Session III, 15:45)
- strong support from the industry along the way

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Conclusions

- Single Step evaluations are a major improvement
 - increased reliabilities for all traits
 - better prediction of daughter-proven GEBVs from purely genomic GEBVs

- introduction of Single Step was a one-time major change
 - but increased stability over GE runs for all traits
 - strong support from the industry during the entire process



rhank you!

