Service & Daten aus einer Quelle

# EBV trend validation for survival traits from a linear nine-trait model in German dairy cattle

65th annual meeting of the European Federation of Animal Science
Copenhagen, Denmark
August 25-29, 2014

**J.Wiebelitz[1,2], F.Reinhardt[1], H.Täubert[1], Z.Liu[1], M.Erbe[2], H.Simianer[2]**

[1]vit – Vereinigte Informationssysteme Tierhaltung w.V., 27283 Verden, Germany

[2]Animal Breeding and Genetics Group, Department of Animal Sciences, Georg-August-Universität, 37075 Göttingen, Germany

# Introduction

- Challenges of survival data
  - Censoring
  - Strictly conditional data structure

- Advantages of linear models for genetic evaluation of survival traits
  - Low computational requirements (compared to survival analysis or threshold models)
  - Easy implementation of multiple trait models (e.g. Boettcher et al. 1999, Sewalem et al. 2007, Holtsmark et al. 2009)

- Previous analyses on national data show plausible genetic structure for survival of different lactation periods (Wiebelitz et al. 2014)

- Trend validation necessary for international evaluations (INTERBULL 2014)

- **Aim:** Trend validation of a linear multiple trait model

# Data

- Full data set
  - Excerpt from data for national genetic routine evaluation for longevity
    - 7,901,517 cows
    - 93,786 sires
    - 19,333 herds
  - Editing
    - 2000 ≤ year of calving ≤ 2013
    - 500 ≤ age of first calving ≤ 1500 days
    - Only cows with all records from 1st lactation to last known lactation

- Truncated data set
  - Subset of full data set
  - Year of truncation: 2009

# Methods

## Trend validation (mod. Boichard et al. 1995: INTERBULL Method III)

- Estimation of breeding values
  - Full data
  - Truncated data

- Trend validation

$$\mathbf{v} = \mathbf{1a} + \mathbf{ub} + \mathbf{t}\delta + \mathbf{e}$$

| | |
|---|---|
| $\mathbf{v}, \mathbf{u}$: | Vector of sire EBV from estimation in full, partial data set |
| $\mathbf{a}$: | Intercept |
| $\mathbf{e}$: | Vector of residual effects |
| $\delta$: | Coefficient for the bias term; should not exceed 2% of $\sigma_a$ |

$$t_i = \sum_{j=2006}^{2013} \left( \frac{v_{ij}}{N_i} (j - j_0) \right)$$

| | |
|---|---|
| $v_{ij}$ : | additional number of daughters for sire $i$ in year $j$ |
| $N_i$: | total number of daughters on the complete data set |
| $j_0$: | average year of calving for daughters on the partial data set |

# Methods

## Definition of traits

- Survival (1000/0) of a period
- Missing, if animal had no chance to show survival of a period (i.e. culled or censored before)
- 70 days delay for accepting of phenotypes

| Lact. | Days | Abbr. | Lact. | Days | Abbr. | Lact. | Days | Abbr. |
|---|---|---|---|---|---|---|---|---|
| 1 | 0-49 | **B1.1** | 2 | 0-49 | **B2.1** | 3 | 0-49 | **B3.1** |
| 1 | 50-249 | **B1.2** | 2 | 50-249 | **B2.2** | 3 | 50-249 | **B3.2** |
| 1 | 250-n. calv. | **B1.3** | 2 | 250-n. calv. | **B2.3** | 3 | 250-n. calv. | **B3.3** |

# Methods

## Model for estimation of EBV

$$\mathbf{y} = \mathbf{Xb} + \mathbf{Z}\boldsymbol{s} + \mathbf{e}$$

$\mathbf{y}$: Vector of observations (1000/0)

$\mathbf{X}$: Incidence matrix for fixed effects (Herd*year)

$\mathbf{b}$: Vector of fixed effects

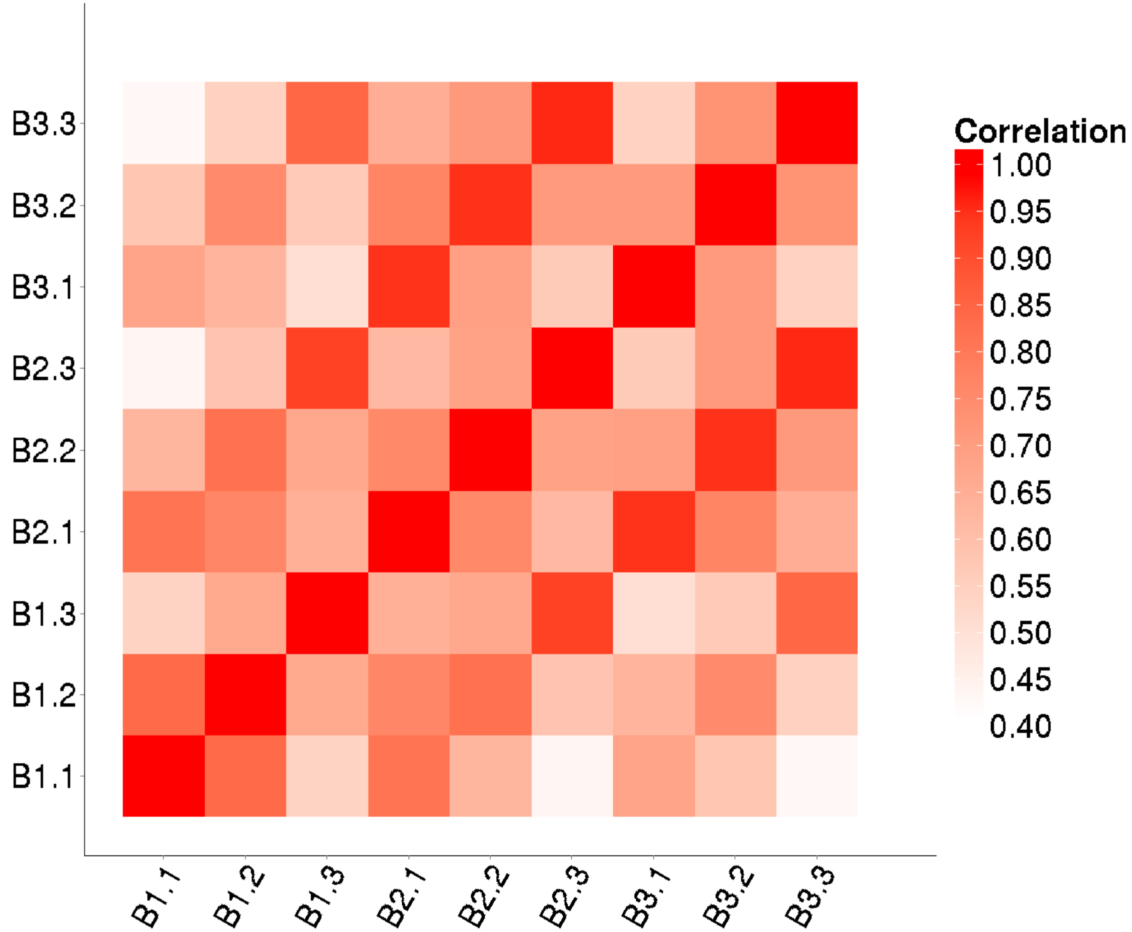
$\mathbf{Z}$: Design matrix for random genetic effects

$\mathbf{s}$: Vector of random sire effects ($\mathbf{s} \sim N(0, \mathbf{G_0} \otimes \mathbf{A})$; $\mathbf{G_0}$: genetic covariance matrix; $\mathbf{A}$: numerator relationship matrix for sires)

$\mathbf{e}$: Vector of random residual effects: $\mathbf{e} \sim N(0, \mathbf{R_0} \otimes \mathbf{I})$; $\mathbf{R_0}$: residual covariance matrix

# Methods

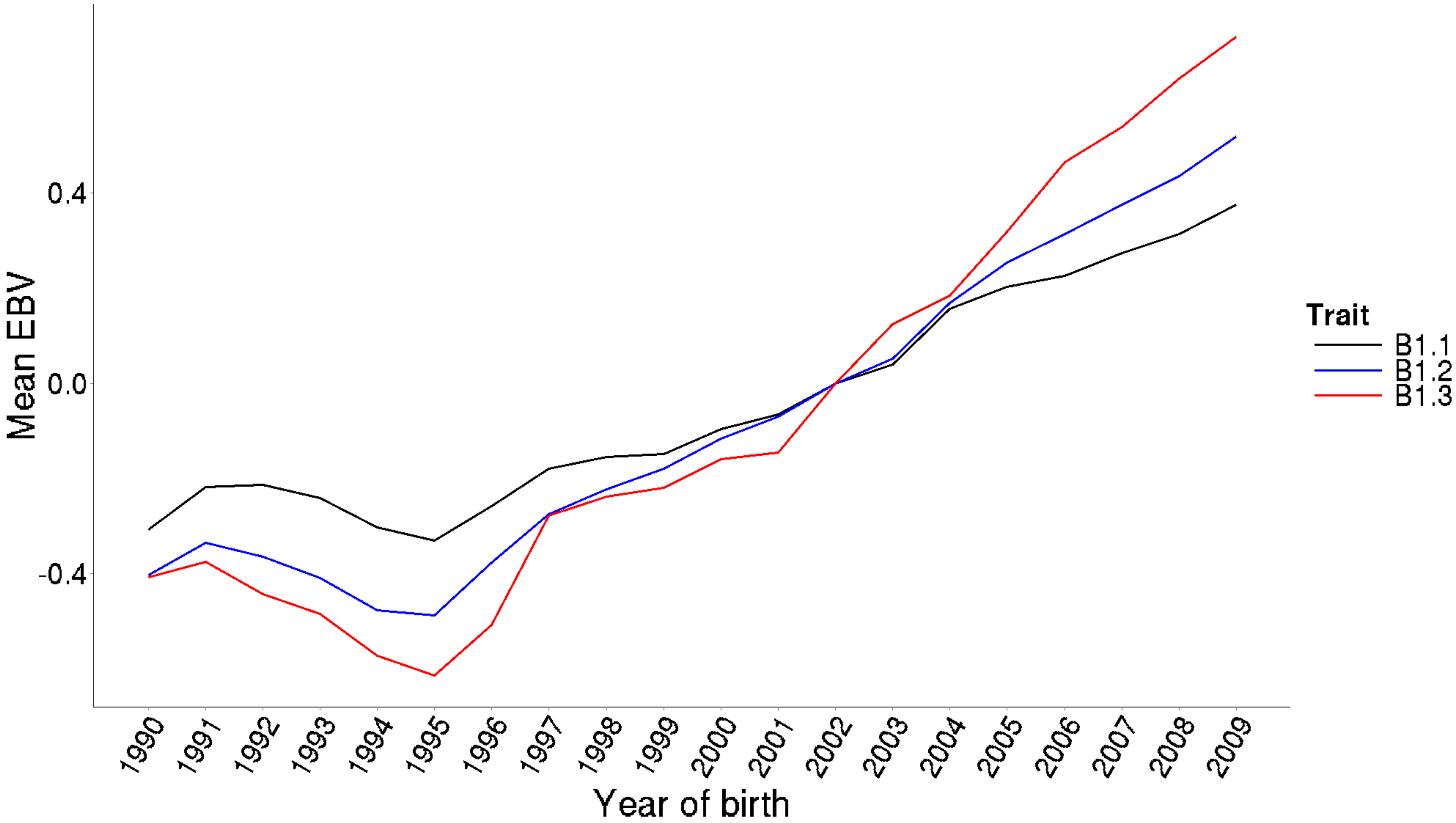
## Genetic parameters




| Period | B1.1 | B1.2 | B1.3 | B2.1 | B2.2 | B2.3 | B3.1 | B3.2 | B3.3 |
|---|---|---|---|---|---|---|---|---|---|
| $h^2$ (%) | 1.5 | 2.6 | 2.3 | 2.3 | 3.3 | 2.7 | 4.0 | 3.7 | 3.1 |

# Results and Discussion

## Genetic trends 1st lactation



# Results and Discussion

## Trend validation

| Period | $\hat{\delta}$ | | $\hat{\delta}/\sigma_a$ (%) |
|---|---|---|---|
| **B1.1** | 0.215 | *** | 0.97 |
| **B1.2** | 0.451 | *** | 0.96 |
| **B1.3** | 0.000 | | 0.00 |
| **B2.1** | 0.466 | *** | 1.19 |
| **B2.2** | 0.616 | *** | 1.07 |
| **B2.3** | 0.363 | | 0.62 |
| **B3.1** | 0.715 | *** | 1.11 |
| **B3.2** | 0.459 | * | 0.66 |
| **B3.3** | -0.341 | | -0.51 |

$$\mathbf{v} = \mathbf{1a} + \mathbf{ub} + \mathbf{t}\delta + \mathbf{e}$$

$$t_i = \sum_{j=2006}^{2013} \left( \frac{v_{ij}}{N_i} (j - j_0) \right)$$

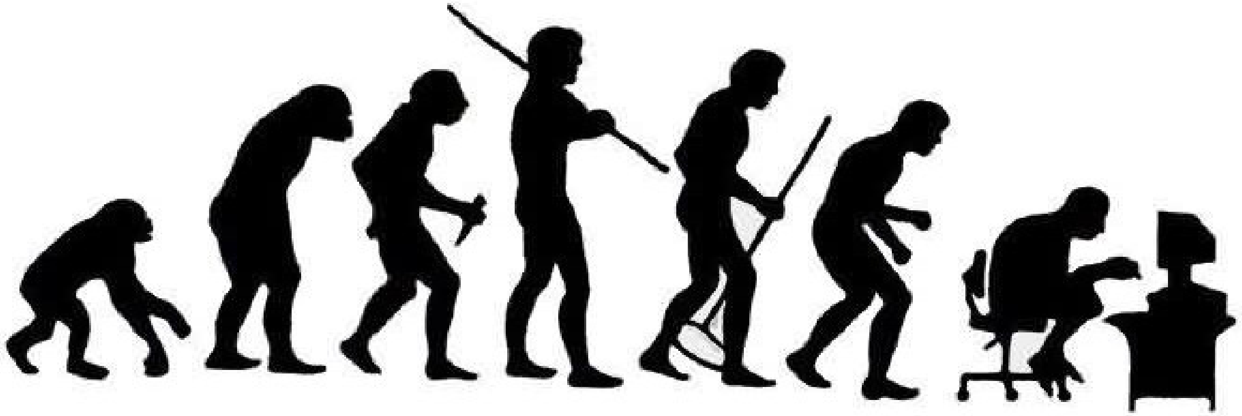
# Conclusions

- Bias of EBV for individual survival traits are below allowed limit of INTERBULL (2014)

- Applied method does not account for information from correlated traits

- Further research
  - Trend validation for index
  - Trend validation based on effective daughter contribution (EDC)
  - Validation compared to existing routine genetic evaluation for longevity

# Thank you for your Attendance!



# Acknowledgements

FBF Förderverein Biotechnologieforschung e.V.

# References

Boettcher, P.J., Jairath, L.K., Dekkers, J.C.M. (1999): Comparison of Methods for Genetic Evaluation of Sires for Survival of Their Daughters in the Frist Three Lactations. *J Dairy Sci* **82**:1034-1044.

Holtsmark, M., Heringstad, B., Ødegård, J. (2009): Predictive Abilities of different statistical models for analysis of survival data in dairy cattle. *J Dairy Sci* **92**: 5730-5738.

INTERBULL (2014): Trend validation. http://www.interbull.org/ib/validation (August 08, 2014)

Sewalem, A., Miglior, F., Kistemaker, G.J., Sullivan, P., Huapaya, G., Van Doormal, B.J. (2007) *Short Communication*: Modification of Genetic Evaluation of Herd Life from a Three-Trait to a Five-Trait Model in Canadian Dairy Cattle. *J Dairy Sci* **90**:2025-2028.

Wiebelitz, J., Reinhardt, F., Liu, Z., Erbe, M., Simianer, H. (2014): Genetic Evaluation of Survival Traits in German Holstein Dairy Cattle Using a Six-Trait Linear Model. WCGALP 2014.

# Appendix: Methods

## Range of considered years

- Example:

| Calving | Year |
|---|---|
| 1 | 2007 |
| 2 | 2009 |
| 3 | 2010 |

| Period | Year of 1st calving | partial data | full data |
|---|---|---|---|
| **B1.1** | 2007 | yes | yes |
| **B2.1** | 2007 | yes | yes |
| **B3.1** | 2007 | no | yes |

# Appendix: Results and Discussion

## Trend validation; years of first calving 2010 - 2013

| Period | $\hat{\delta}$ | | $\hat{\delta}/\sigma_a$ (%) |
|---|---|---|---|
| **B1.1** | 0.224 | ** | 1.01 |
| **B1.2** | 0.688 | *** | 1.47 |
| **B1.3** | 0.821 | ** | 1.68 |
| **B2.1** | 0.835 | *** | 2.13 |
| **B2.2** | 1.753 | *** | 3.04 |
| **B2.3** | 2.495 | *** | 4.26 |
| **B3.1** | 2.488 | *** | 3.85 |
| **B3.2** | 3.650 | *** | 5.25 |
| **B3.3** | 4.966 | *** | 7.39 |

$$\mathbf{v} = \mathbf{1a} + \mathbf{ub} + \mathbf{t}\delta + \mathbf{e}$$

$$t_i = \sum_j \left( \frac{v_{ij}}{N_i} (j - j_0) \right)$$