Disposal reasons as potential indicator traits for direct health traits in German Holstein cows

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Motivation

- direct health data
  - labor intensive and costly
  - small proportion of animals phenotyped
    - in current population
    - no historical data
  - difficult to increase reliabilities of EBV

- disposal reasons
  - routinely recorded via milk recording since decades
  - but challenging
    - 9 standardized codes for culling
    - only one reason of potentially multiple reasons recorded
  - pre-analyses were promising (Heise et al. 2018)
Can we use disposal reasons to increase the reliability of EBV for direct health traits?
Data

- **health**
  - documentation by Farmers, Hooftrimmers, Veterinarians
  - data from prototype German genetic evaluation of health traits for Holsteins
  - No. of obs. per herd and year ≥ 20 (any trait, sum of 1st and 2nd lactation)
  - No. of daughters per sire ≥ 10

- **disposal reasons**
  - from data preparation for genetic evaluation of longevity
  - age at first calving from 20 to 40 months
  - both parents known
  - calving intervals from 300 to 600 days

- **in total:**
  - 484,362 animal records
  - 5,969 sires
Health traits

- 1st and 2nd lactation separately
- binary coding

reproduction
- retained placenta
- other puerperial disorders
- endometritis
- ovarial cycle disorders
- ovarial cysts

udder
- early mastitis (DIM -10 to 50)
- late mastitis (DIM 51 to 305)
- mastitis (DIM -10 to 305)

claw and leg disorders
- interdigital hyperplasia
- laminitis
- white line defect/abscess
- claw ulcers
- digital phlegmona
- digital dermatitis

metabolic diseases
- left-displaced abomasum
- ketosis
- milk fever
**Trait definition**

'Culling because of a certain reason'

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>lactation survived or culled for another reason</td>
</tr>
<tr>
<td>1</td>
<td>culled for respective reason</td>
</tr>
<tr>
<td>-</td>
<td>survival observation in lactation right- or left-censored or culled in previous lactation</td>
</tr>
</tbody>
</table>

**Example:** culled in 1st lactation because of 'udder diseases'

```
<table>
<thead>
<tr>
<th></th>
<th>infertility</th>
<th>udder diseases</th>
<th>metabolic diseases</th>
<th>claw and leg disorders</th>
</tr>
</thead>
<tbody>
<tr>
<td>lactation 1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>lactation 2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
```
Estimation of variance components

\[ y = Xb + Zs + e \]

- **y**: vector with observations (1/0)
  - incidence matrix, linking observations to classes of fixed effect
- **b**: vector with values for fixed effect (herd × year of calving)
- **Z**: incidence matrix, linking observations to sires
- **s**: vector with values for sires; \( s \sim N(0, G \otimes A) \)
- **e**: vector with values for residuals; \( e \sim N(0, R \otimes I) \)
- **G**: genetic (co)variance matrix
- **R**: residual (co)variance matrix
- **A**: pedigree-based relationship matrix for sires (1 generation)

- bivariate runs
  - health trait
  - disposal reason trait

- software: VCE (Groeneveld et al., 2010)
Disposal reasons – heritabilities

- infertility
- udder diseases
- claw and leg disorders
- metabolic diseases

heritability

- 0.000
- 0.005
- 0.010
- 0.015
- 0.020

lactation 1
lactation 2

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Genetic correlations

infertility
- retained placenta
- other puerperial disorders
- endometritis
- ovarian cycle disorders
- ovarian cysts

udder diseases
- early mastitis (DIM -10 to 50)
- late mastitis (DIM 51 to 305)
- mastitis (DIM -10 to 305)

0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
lactation 1  lactation 2

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Genetic correlations

claw and leg disorders
- interdigital hyperplasia
- laminitis
- white line defect/abscess
- claw ulcers
- digital phlegmona
- digital dermatitis

metabolic diseases
- left-displaced abomasum
- ketosis
- milk fever

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Mean reliabilities (AI bulls)

parameters (udder diseases):
  \( h^2 \) 0.013
  lact. 1

Trait
- Disposal reason (* 0.8^2)
- Late mastitis
Can we use disposal reasons to increase the reliability of EBV for direct health traits?

Yes, we can!
Conclusions and prospect

- patterns are plausible
- further analyses and plausibility checks
- development of a routine genetic evaluation of disposal reasons
Thank you for your attention!
References

