Parameter Estimation for Fertility Traits of Dairy Cattle Using a Multiple Trait Model

Z. Liu, J. Jaitner, E. Pasman, S. Rensing, F. Reinhardt, R. Reents

VIT, Germany

http://vit.de

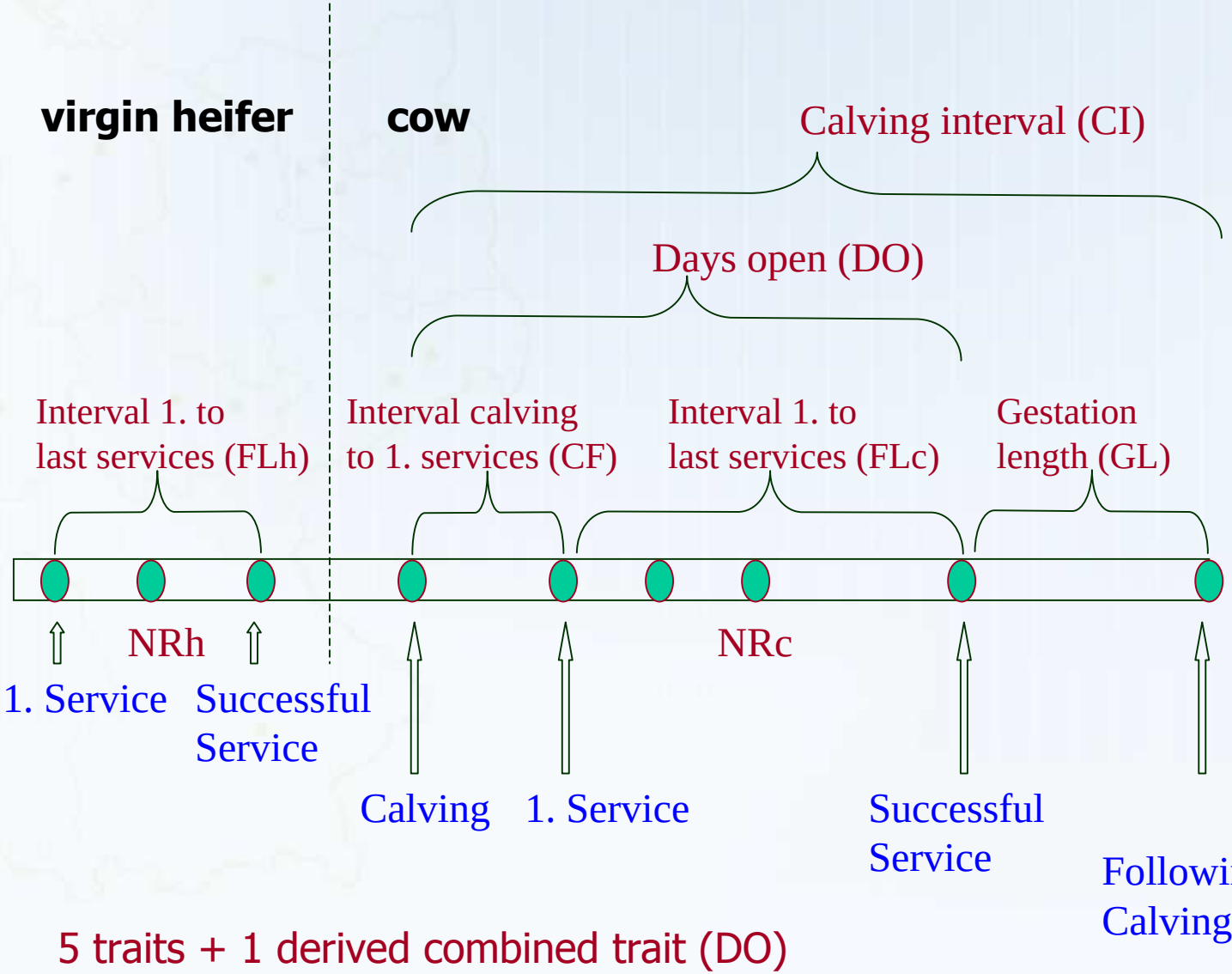
Overview

- The new fertility model
- Data selection for parameter estimation
- Parameter estimates
- Results and discussion

The new fertility model

- Current single trait maternal effect model for NR90
  - Correlated paternal genetic effect
- A multi-trait model (Sep 2006 to Jun 2007)
  - Age at first insemination (AF)
  - Interval calving to first insemination (CF)
  - Non-Return Rate 56 days for virgin heifer (NRh) & cow (NRc)
  - Days open (DO)
  - Calving interval (CI)
- The new, updated fertility model since July 2007
  - AF removed
  - Component fertility traits instead of combined trait DO
  - FL: interval first to last inseminations
  - DO = CF+FL, no longer CI

Relations among the fertility traits



5 traits + 1 derived combined trait (DO)

The genetic evaluation model

- Trait =

  herd-year (HY)

  + parity x age_class x month_insemination (PAM)
  + type_bull x owner_AI_stud x user_AI_stud (BOU)
  + random maternal genetic effect of female animal (a)
  + random permanent environmental effect of cow (p)
  + fixed effect of service sire (F)
  + random year effect within service sire (t)

  } **male fertility**

  + residual

  * NR56 traits ** cow fertility traits

Selection of insemination records

- Breeds: Holstein B&W and R&W
- Insemination ranged from 1999 to 2005
  - Slight difference between cows and virgin heifers
  - Shorter time span for animal model than sire model
- Selection on trait level: only valid trait values (min/max)
- Selection on lactation level
  - Only sequential missing trait patterns allowed
- Selection on animal level
  - Virgin heifer records present
- Selection on herd level
  - 10 cows or 5 virgin heifers per herd-year
- Selection on service sire level
  - 100 inseminations

The selected data sets

- Large datasets but within the limitations of computing resources
- Parameter estimation with sire model
  - 305,000 heifer and 282,000 cow inseminations
  - 2400 sires of females and service sires
  - 4700 animals in pedigree
- Parameter estimation with animal model
  - 60,000 heifer and 42,000 cow inseminations
  - 360,000 animals in Pedigree
  - Only applied to single trait analyses

Results: Paternal genetic effect for NR56

- Parameter estimates for heifer and cow NR56 traits
  - Heritability c.a. 0.2%
  - Genetic correlation with maternal genetic effect
    - -0.70 for heifer NR56
    - -0.31 for cow NR56
- Correlated with maternal genetic effect
  - Very low heritability estimates found worldwide
  - Only included in the current German model
  - International harmonisation
- The paternal genetic effect makes parameter estimation and genetic evaluations significantly more difficult
- Therefore, the effect was no longer considered in further parameter estimation

Genetic parameter estimates: h^2 and r_G

Trait	FLh	NRh	CF	NRc	FLc	DO
FLh	**.014**	-.53	.17	-.25	**.48**	.36
NRh		**.012**	-.02	**.63**	-.15	-.09
CF			**.039**	.05	.37	.89
NRc				**.015**	-.39	-.16
FLc					**.010**	.76
DO						**.026**

Discussion: Selection of fertility traits

- CF has a part-whole relationship with DO or CI
- Analysing CF with DO or CI in a model double counts phenotypic information of CF
- The double counting exists also for FLc and DO/CI.
- Including DO/CI with CF causes
  - Inflated heritability estimates
  - Higher proof variances
  - Less impact on genetic correlation estimates
- Using component traits CF and FLc is a better alternative (Jamrozik et al. 2005)

Summary

- Paternal genetic effects will no longer be modelled
- Low heritability estimates for the fertility traits 1-4%
- High genetic correlations among time interval traits
  - FLh, FLc, CF, and DO
- Moderate genetic correlations of the same traits between virgin heifer and cow (NR, FL)
- Nearly zero correlations between CF and NR
- Low to moderate residual / p.e. correlations
- Reasonably high genetic variances for NR56 traits
- Model with component traits for routine evaluations

Thank you !