Estimation of direct and maternal genetic variances for calving ease in Croatian Holstein breed

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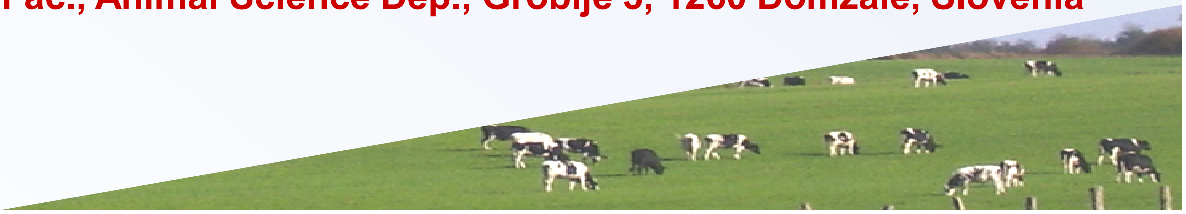
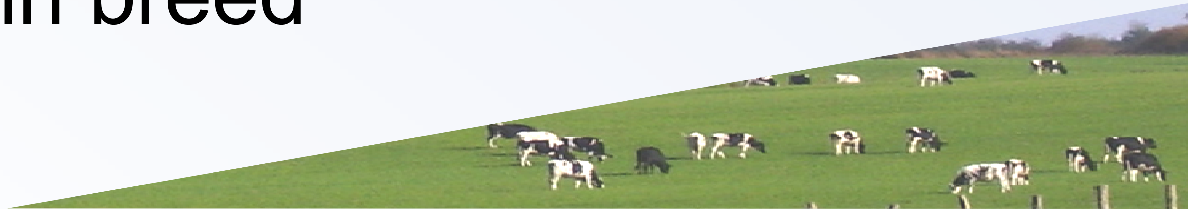


Introduction

- An important functional trait in dairy cattle
- … but not yet included in genetic evaluation of dairy cattle in Croatia → **genetic parameters needed**!!!

- Aim: Estimate genetic parameters for
  - **direct** additive genetic
  - **maternal** additive genetic
- Croatian Holstein breed

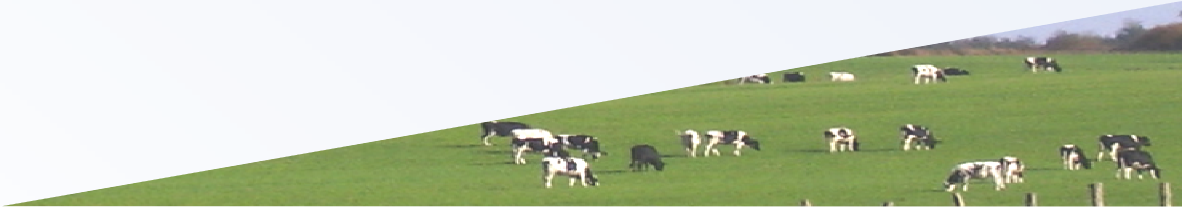


Material

- Central database of Croatian Agricultural Agency

- 134,949 calving ease records (after editing!)
  - 1 = no problem ~32%,
  - 2 = slight problem ~64%
  - 3 = cow needed assistance ~4%
  - 4 = veterinary assistance <1%
  - 1st and 2nd+ parities

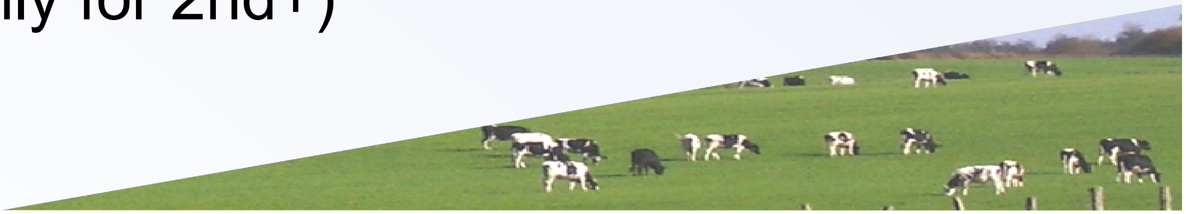
- Animal pedigree
  - 3 generations
  - 204,990 animals



Method (1)

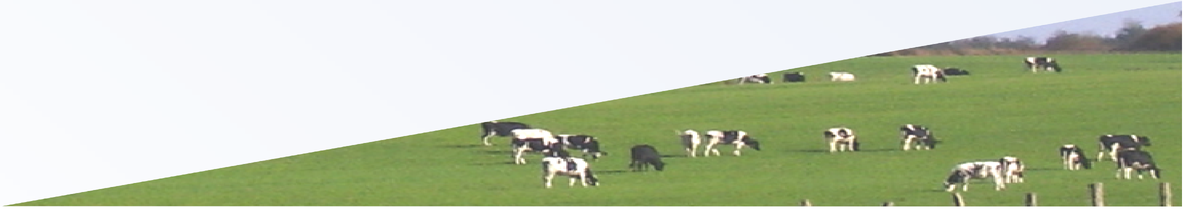
- Discrete trait! → threshold model
- … however “standard” Gaussian model was used :)

- Bivariate animal model (1st and 2nd+ parities)
  - **Fixed effects:**
    - sex*age(*parity), calving season, region*year
  - **Random effects:**
    - herd*year, direct and maternal genetic, and permanent environment (only for 2nd+)

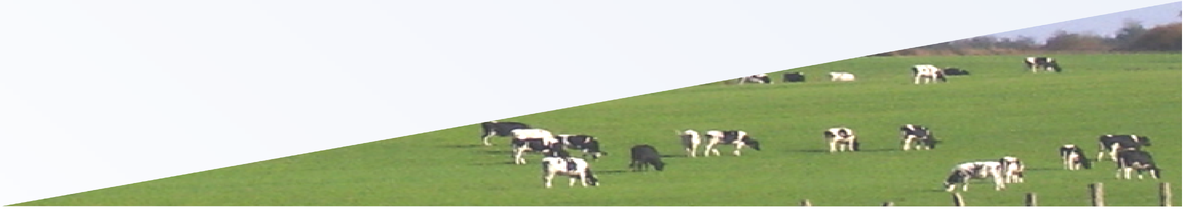


Method (2)

- To partially account for discrete trait properties:
  - harmonization of scores by region and recording period
  - heterogeneous residual variances by sex of a calf → 4 residual variances (sex within parity class)
- Method REML in VCE-6
  - average estimates from 10 data samples



Results

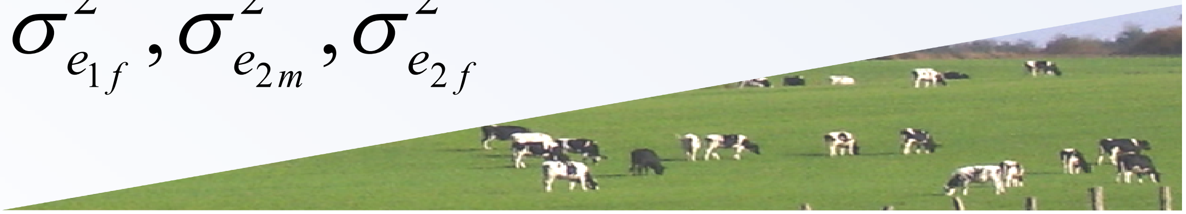


Results – variance components

- Bivariate model - heterogeneous residual variances
  - herd*year: $\sigma^2_{hy_1}, \sigma^2_{hy_2}, \sigma_{hy_1,hy_2}$
  - direct & maternal genetic:

$$\begin{array}{cc|c|cc} \sigma^2_{d_1} & \sigma^2_{d_2} & \sigma_{d_1,d_2} & \sigma_{d_1,m_1} & \sigma_{d_1,m_2} \\ \hdashline \sigma^2_{m_1} & \sigma^2_{m_2} & \sigma_{m_1,m_2} & \sigma_{d_2,m_1} & \sigma_{d_2,m_2} \end{array}$$

  - permanent environment: σ^2_{pe}
  - residual: $\sigma^2_{e_{1m}}, \sigma^2_{e_{1f}}, \sigma^2_{e_{2m}}, \sigma^2_{e_{2f}}$



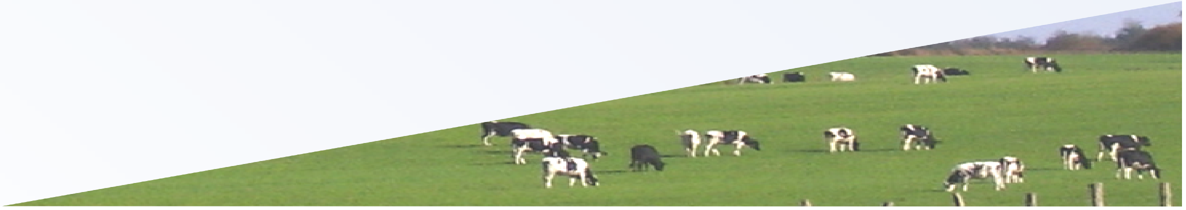
Results – residual variances*

- By sex of calf within parity class

	1st	2nd+	Average
Male	0.295	0.228	0.262
Female	0.204	0.162	0.183
Average	0.250	0.195	/

larger mean (1st, males) → larger variance

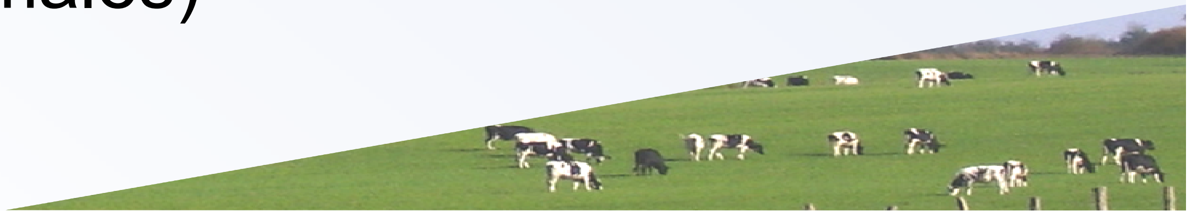
*SE~0.005



Results – percentages[*] and correlations

	HY	Direct (=h^2)	Maternal	Perm.
1st	27.5 (24.6, 31.2)	4.5 (4.0, 5.1)	3.5 (3.1, 4.0)	/
2nd+	24.4 (22.3, 27.0)	9.9 (9.0, 10.9)	4.2 (3.8, 4.6)	5.1 (4.6, 5.6)
Corr.	0.845	**0.548**	0.743	/

[*] average (males, females)



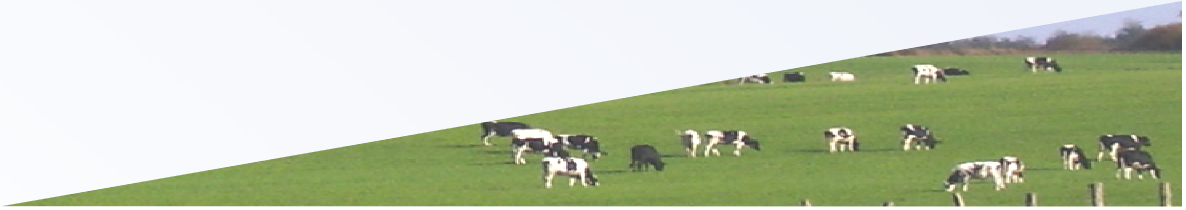
Results – direct-maternal

$$\text{covariances} \pm \text{SE}$$

$$\begin{pmatrix} \sigma_{d_1,m_1} & \sigma_{d_1,m_2} \\ \sigma_{d_2,m_1} & \sigma_{d_2,m_2} \end{pmatrix} = \begin{pmatrix} -0.008 \pm 0.004 & -0.007 \pm 0.003 \\ -0.008 \pm 0.004 & -0.016 \pm 0.004 \end{pmatrix}$$

$$\text{correlations}$$

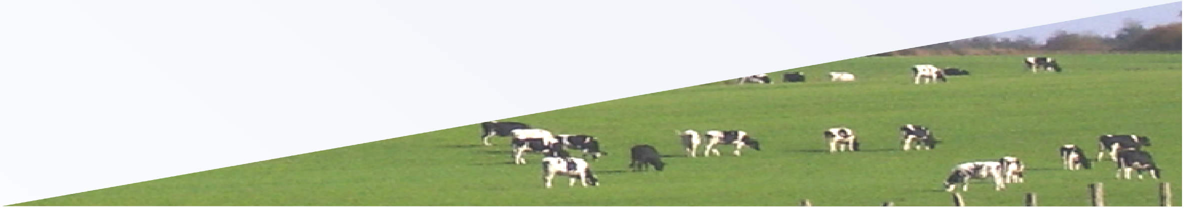
$$\begin{pmatrix} \rho_{d_1,m_1} & \rho_{d_1,m_2} \\ \rho_{d_2,m_1} & \rho_{d_2,m_2} \end{pmatrix} = \begin{pmatrix} -0.490 & -0.433 \\ -0.377 & -0.730 \end{pmatrix}$$



Conclusions and future work

- Variance components were estimated for calving ease in Holstein cattle in Croatia
- **Gaussian model**
- **harmonized calving ease scores**
- **heterogeneous residual variances**

- Comparison with **threshold model** is on the way



Estimation of direct and maternal genetic variances for calving ease in Croatian Holstein breed

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The objective of this study was to estimate genetic parameters for calving ease in Croatian Holstein breed. Data for 134,949 first and later calvings were taken from the database of the Croatian Agricultural Agency. Calving ease was scored from 1 to 4 (1 = no problem, 2 = slight problem, 3 = cow needed assistance, 4 = veterinary assistance). Scores were harmonized by region and period of recording. The number of animals in pedigree was 204,990. Calving ease in the first and later parities was treated as two traits using a bivariate model. Fixed effects in the model were: calving season, interaction of sex, calving age, and parity, and interaction of region and calving year. Herd and calving year interaction, direct and maternal genetic effect were included as random effects for first and later parities, while permanent effect was also included for later parities. Residual variance was assumed heterogeneous by sex and parity (first and later calvings) to partly account for relationship of mean and variance in discrete traits. Variance components were estimated from Gaussian model using REML method as implemented in the VCE-6 program. The estimated variances (±standard error) for the first, second and later parities (correlations) were: 0.107±0.005, 0.085±0.004 (0.845) for herd-year, 0.017±0.004, 0.034±0.006 (0.548) for direct genetic, 0.014±0.004, 0.014±0.004 (0.743) for maternal genetic, and 0.018±0.003 for permanent effect. Correlation between direct and maternal genetic effect was -0.490 for the first and -0.730 for the later parities. Estimates for residual variance followed biological expectations: 0.295 and 0.228 for males and 0.204 and 0.162 for females in the first and later parities, respectively – all standard errors were about 0.005. Results provide genetic parameters for the application of genetic evaluation for calving ease in Croatian Holstein breed.