Genetic evaluations based on data from automatic milking systems

Bjørg Heringstad[1,2] and Heidrun K. Bugten[1]

[1]Department of Animal and Aquacultural Sciences, Norwegian University of Life Sciences, [2] Geno Breeding and A. I. Association
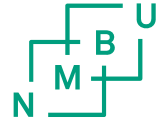
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Norwegian dairy farming

- Larger herds with automatic milking systems (AMS)
- 1/3 of the dairy cows are in AMS herds
    - ≈1200 milking robots
- Within a few years will AMS be the dominating dairy production system in Norway.

Automatic milking systems (AMS)

- Vast amounts of data are recorded daily

- Objective, frequent and accurate measures of many traits

- How can we best make use of these data?

Aim

- First genetic analysis of Norwegian AMS data
- Estimate heritability and predict breeding values for milkability in Norwegian Red.

AMS data

- 46 herds with DeLaval milking robots

- Minimum 2 years of data from each herd

- Information from >6000 cows and > 2 mill daily records

- Data for genetic analyses
    - Records from 6 to 305 days after calving
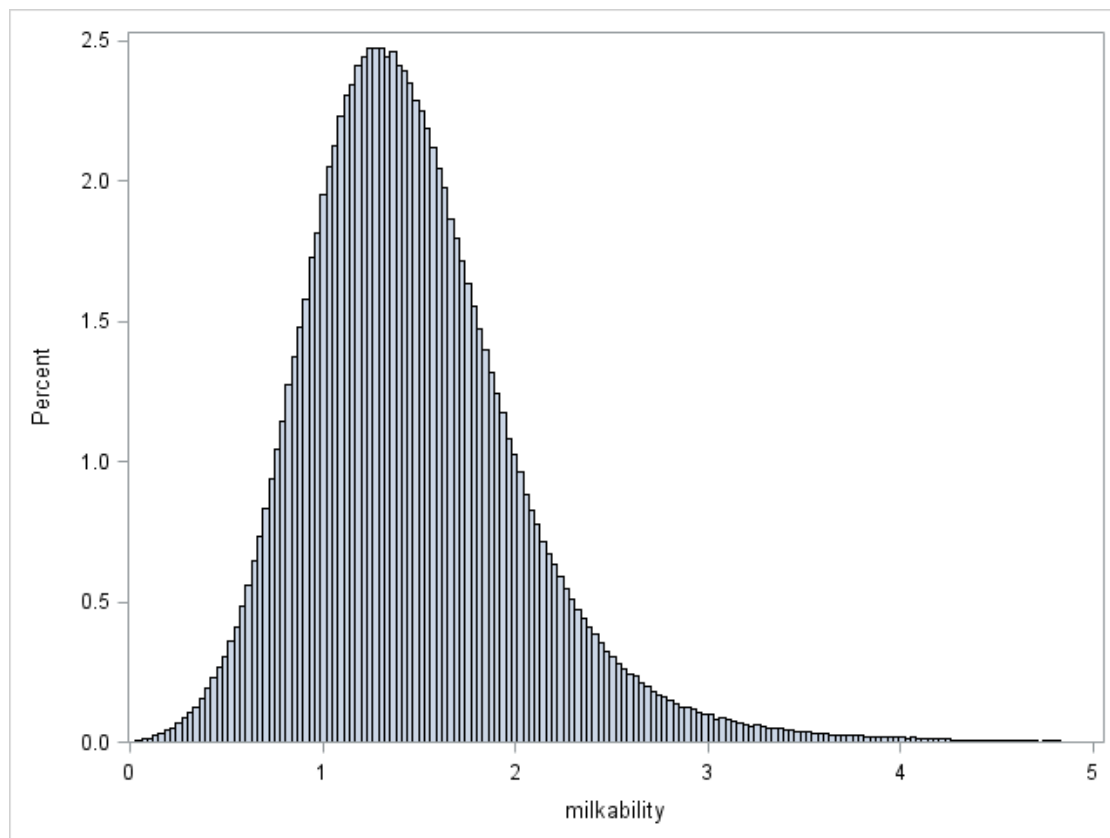   - Lactation 1-7
    - Norwegian Red A.I. sire

Milkability

MILKABILITY = Milk yield per total time spent in the milking robot; kg milk per minute "box time"

Box time = actual milking time
   + time used for preparation and attachment of teat cups
   + the time the cow uses before she decide to leave the robot

- A combined measure of milking speed / milk flow and how efficient the cow is when visiting the milking unit

- Directly associated with the capacity of the milking robot

Distribution of milk yield per minute spent in the milking robot

Overall mean: 1.5 kg milk per minute box time

95 % were within the interval 0.7 – 3.3.

Trait definition

- Daily milkability (one observation per cow per day)
- Mean milkability from day 30 to 60
- Lactation mean milkability from day 6 to 305

Table 1. Summary statistics of milkability traits (kg milk per minute box time)
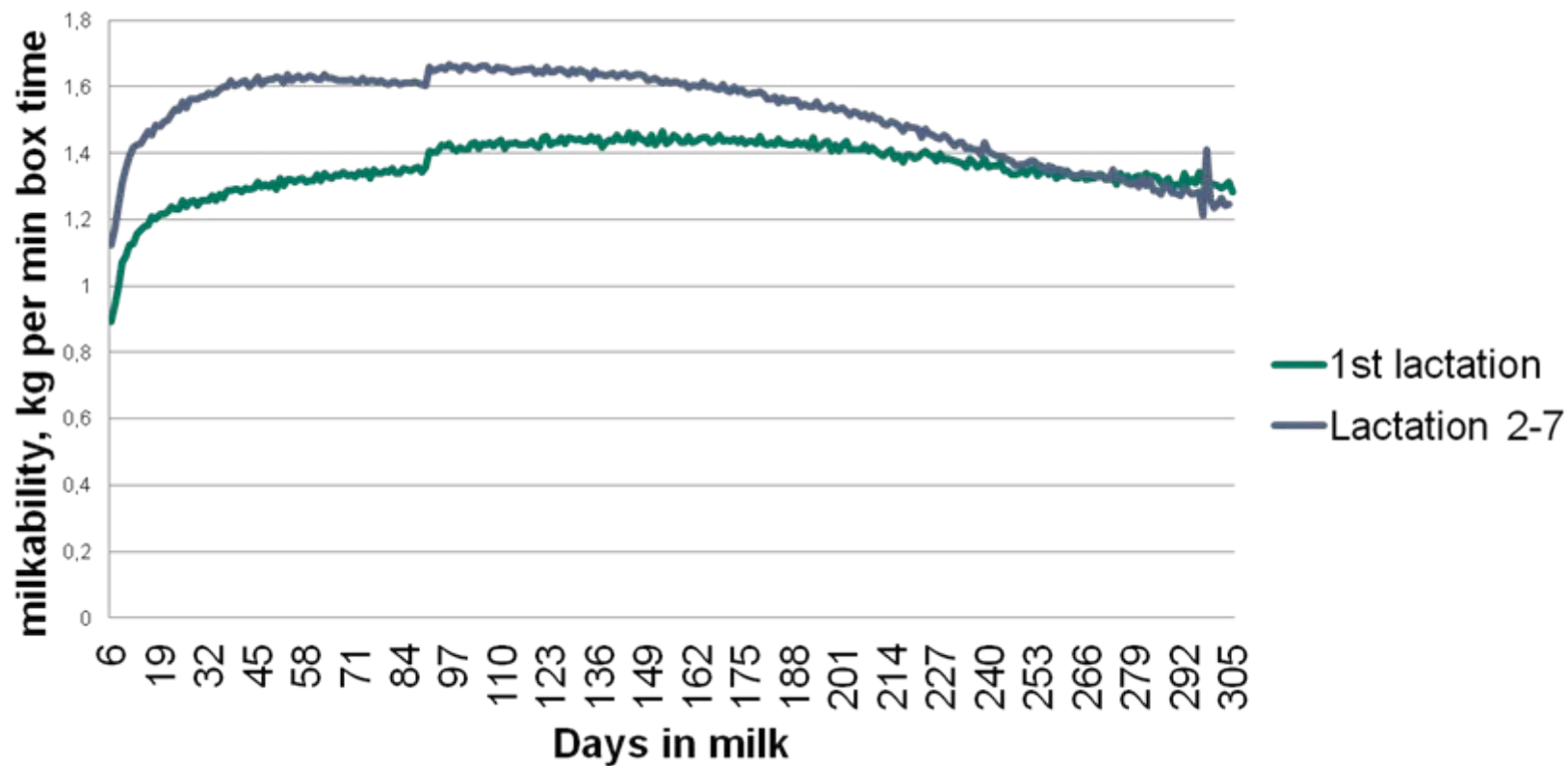
	Daily	Mean d 30-60	Lactation mean
No of observations	1,597,156	6,808	8,046
No of cows	4,835	4,264	4,787
Milkability, mean kg/min	1.47	1.48	1.44

Factors affecting milkability

- Days in milk

- Lactation number

- Herd

- Year and season

- Milking frequency

- Milk yield

- Box time also affected by cow behavior

Milkability by days in milk for first- and later lactations

Model

- Repeatability models
  - assumed to be the same trait across lactations
- Univariate linear animal models
  - fixed effects of herd-year, month-year of calving, and age at calving by lactation number.
    - For daily milkability: effect of DIM
  - random effects of animal and permanent environment

- Variance components estimated using DMU
  (Madsen & Jensen, 2007)

Heritability

Table 2. Estimated variance components, with their standard error (SE) and the corresponding heritability and repeatability of daily-, mean day 30-60 -, and lactation mean milkability.

Variance component	Milkability trait (kg milk per minute box time)		
	Daily	Mean day 30-60	Lactation mean
Animal	0.033 (0.004)	0.037 (0.005)	0.033 (0.004)
Permanent environment	0.073 (0.004)	0.050 (0.004)	0.046 (0.004)
Residual	0.198 (0.0002)	0.038 (0.001)	0.035 (0.001)
Heritability	**0.11**	**0.30**	**0.29**
Repeatability	**0.35**	**0.70**	**0.69**

Heritability

- Mean milkability day 30 to 60:   0.30
- Lactation mean milkability: 0.29

- Current genetic evaluation of milking speed for Norwegian Red
  - Trait: milking speed scored in 3 categories (slow, medium, fast)
  - Heritability: 0.19
- More precise phenotypes gives higher heritability and more accurate breeding values.
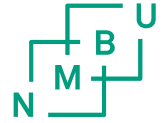
Breeding values for milkability
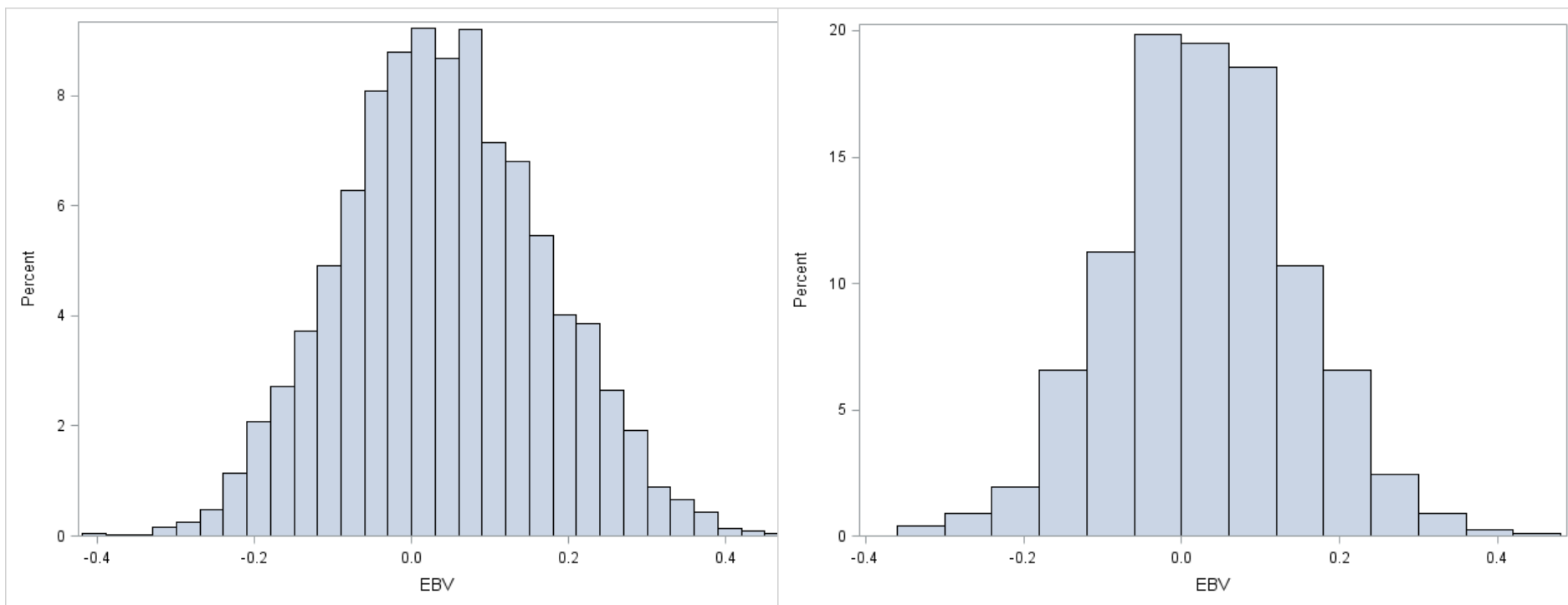
EBV for milkability (day 30-60) for cows with data (left panel) and AI sires with daughters in the dataset

Rank correlations EBV milkability

	Daily	Lactation mean
Mean d 30-60	0.87	0.88
Lactation mean	0.98	

Milkability

MILKABILITY = Milk yield per total time spent in the milking robot; kg milk per minute "box time"

- Directly associated with the capacity of the milking robot

- Interesting trait for breeding more efficient cows for AMS

- Genetic improvement of milkability would be beneficial also in other production systems

  - Milking speed and aspects of cow behavior

New traits

- The cow meet different challenges in the AMS herds
- The breeding program should be adjusted accordingly with respect to traits, trait definitions and weights in the total merit index
- Measures related to milking and cow traffic recorded in AMS that can be used to define new behavior and milking efficiency traits

Conclusion

- Data from AMS can be used for genetic evaluations
- Data routinely recorded in AMS provide information on new traits that can supplement or replace current traits in genetic evaluation

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