Genetic parameters of milkability and temperament recorded in automatic milking systems (AMS)

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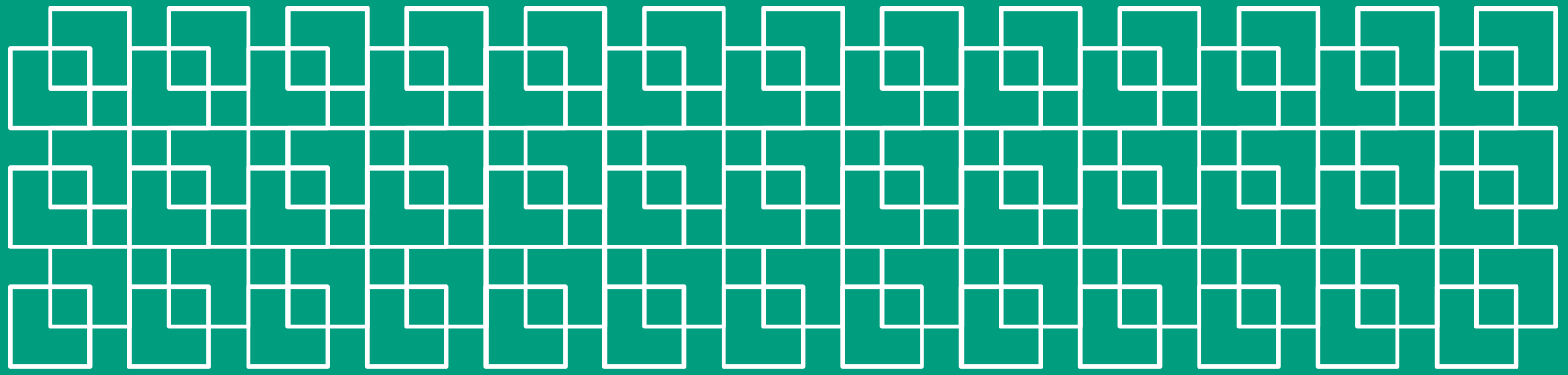


Background

More than **42 %** of Norwegian milk produced in AMS

> **1800** AMS in Norway

Advantages with AMS data in breeding

- Data from each visit
- Objective and repeated measurements
- Development / changes in traits

(Photo: http://www.bbl.is)

Aim

- Investigate *traits important for AMS cows* → genetically improve robot efficiency
- Define new milkability and temperament traits from data recorded in AMS
- Estimate *heritability (h^2)* and *genetic correlations (r_g)* between traits

Description of data

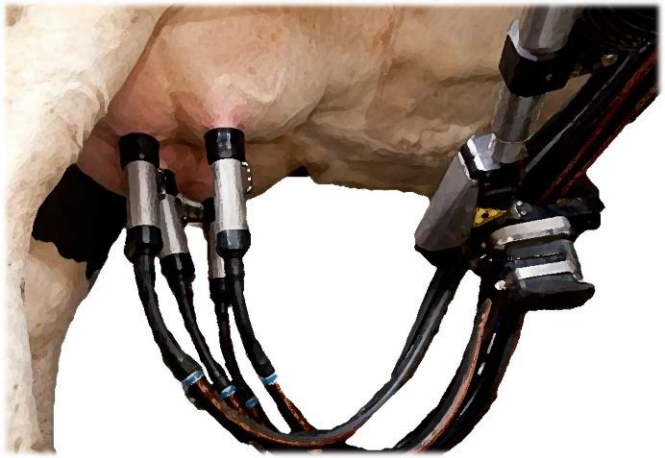
- Data from **77** Norwegian dairy herds**:**
  - With AMS from DeLaval > one year
  - AMS installed between *2000 to 2014.*
- Total of **4 277 955** observations before editing:
  - Records on milkings and rejected milkings
- 365 days with data from each farm

Data edits

- **Norwegian Red** (NR) breed
- From **6 to 305 days** in milk (DIM)
- ≥ **10 days** with milkings per cow & lactation
  - not more than 30 rejected milkings per day
  - not more than 10 milkings per day
  - **5 minutes** from one visit to the next (the same cow)

Data edits

- Restrictions on maximum milk yield and flow rate
- Lactation *1 – 9* (lactation ≥ 4 in one group)
- Calving from *april 2015* → *june 2017*



Final dataset:

- 1 012 912 daily obs on *4 883 cows*
- *566 testdays*
- Records from dec 2015 – july 2017

Traits – AMS efficiency

- **Milkability and temperament traits investigated:**

- Boxtime (**BT**) in minutes
- Handlingtime (**HT**) in minutes
- Yieldtime → kg / min boxtime (**YT**)
- Flowrate (**FR**) → kg / min milking time

Traits – AMS efficiency

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One observation per *day* and *cow:*

Average per visit

Traits – AMS efficiency

→ **Traits with information on unsuccessful milkings:**

- No of milkings with kick off ≥ 1 **(KO)**
- No of milkings with 1 or more incompletely milked teat **(IM)**
- No milkings with 1 or more teat not found **(TNF)**
- No of rejected milkings **(RM)**

Traits – AMS efficiency

→ Traits with information on unsuccessful milkings:

- No of milkings with kick off ≥ 1 **(KO)**
- No of milkings with 1 or more incompletely milked teat **(IM)**
- No milkings with 1 or more teat not found **(TNF)**
- No of rejected milkings **(RM)**

Discrete distribution:

→ 0 to 7

→ 0 to 7

→ 0 to 7

→ 0 to 30

Definition 1 — **Daily number** of milkings with KO, IM, TNF or RM

Definition 2 — **Proportion** of KO, IM, TNF and RM (over lactation)

Material and method

→ Mixed linear animal repeatability models

- Univariate models → for variance components → h^2 – Heritability
- Bivariate models → for genetic correlations, r_g

- Proc GLM (SAS 9.4)
- DMU package (Madsen & Jensen 2007)

Model 1- daily traits

Y= *Pa*age + DIM + CYM + HY + HTD + a + pe + e*

Yij **=** *observation i of* ***BT, HT, FR or YT*** *for cow j*

Fixed effects: *Parity-Age at calving, Days in milk, Calvingyear-month, Herd-year*

Random effects: *Herd-testday,* permanent environment (pe), genetic effect of animal (a), residual (e)

Model 2 - frequency traits

$$\mathbf{Y} = Pa*age + CYM + HY + a + pe + e$$

Yij = *observation i of* ***pKO, pRM, pIM* and pTNF**** *for cow j*

Fixed effects: *Parity-Age at calving, Calvingyear-month*

Random effects: *Herd-year,* permanent environment (pe), genetic effect of animal (a), residual (e)

**** pIM and pTNF*** → *random model with herd-year, animal (a), pe and e.*

Results: heritability (h^2)

Trait: (daily records)	h^2	SE	r	Trait: (1 obs/lactation)	h^2	SE
BT	**0.27**	0.03	0.68	**pKO**	**0.11**	0.03
YT	**0.22**	0.03	0.66	**pIM**	**0.14**	0.02
HT	**0.05**	0.01	0.48	**pTNF**	**0.12**	0.03
FR	**0.48**	0.04	0.86	**pRM**	**0.06**	0.02

Heritability calculated as: $$h^2 = \frac{\sigma_a^2}{\sigma_a^2 + \sigma_{pe}^2 + \sigma_e^2}$$

Repeatability calculated as: $$r = \frac{\sigma_a^2 + \sigma_{pe}^2}{\sigma_a^2 + \sigma_{pe}^2 + \sigma_e^2}$$

Results – genetic correlations

Traits with daily records:

Trait	BT	HT	YT
HT	**0.53 (0.01)**		
YT	**-0.87 (0.03)**	**-0.58 (0.10)**	
FR	**-0.92 (0.02)**	**-0.50 (0.11)**	**0.98 (0.01)**

Traits with 1 obs/lactation:

Trait	TNF	KO	IM
KO	*0.02 (0.16)*		
IM	**1 (0.02)**	0.30 (0.14)	
RM	*0.14 (0.17)*	*0.21 (0.17)*	*0.19 (0.16)*

Conclusion

- High heritabilities and favorable genetic correlations for many of the traits investigated
- New traits in AMS → we can improve milking efficiency genetically
- Our results confirms the potential for AMS data in breeding → substitute subjective evaluation of traits

Thank you for your attention!