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Comparison of different strategies of quantitative genetic analysis of health traits in dairy cattle

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objective

- improvement of the genetic predisposition for sensitivity to diseases with the objective to implement a breeding evaluation
- **motivation:** high standard in productive traits and antagonisms to health traits
- **in detail:** comparison of different traits as well as model definitions in regard to the estimation of heritabilities of single diseases or disease complexes

data and methods

- In Saxon a program of recording health traits is running since 2000. Altogether 13 different dairy farms are integrated in this program (average milk yield: between 8.000 and more than 10.000 kg cow/ year, about 10.000 living cows).
- In this analysis veterinarian diagnosis of dairy cows at the first lactation were used, that are 17.083 animals, the number of sires/ dams: 1.191/ 13.325 (average 14,3 / 1,3 offspring per parent (1-153 / 1-11), the pedigree includes in total 43.292 animals
- The expected days of illness were assumed as a certain time span after a diagnosis was detected, an additional half of this time span was added if a new diagnosis was detected between the half of length and the end of this time.
  - Feet and leg = 30 days,
  - Udder diseases = 14 days,
  - Metabolic and fertility interferences = 21 days (to correlate with the cycle)
- Genetic parameters were estimated by using REML via the program packet VCE 5.1.

lactation model

$$y_{ijkl} = HKJQ_i + EKA_j + a_k + e_{ijkl}$$

y	- days of illness per lactation
HKJQ	- effect of herd-year-season-calving
EKA	- class of first calving age in months
a	- animal

animal	herd-year-season	days of illness
1	1	14
2	2	0
3	1	0
4	1	28

test day model

$$y_{ijkl} = HKJQ_i + EKA_j + a_k + pe_k + e_{ijkl}$$

y	- illness per test day (0/1)
HKJQ	- effect of herd-year-season-calving
EKA	- class of first calving age in months
a	- animal
pe	- random environmental effect

animal	herd-year-season	trait definition 0/1	days in milk
1	1	0	n
1	1	0	n+1
1	1	1	n+2
1	1	1	n+3

trait		100 days	305 days	lactation model		test day model	
		mean ± s (min-max) [day]	mean ± s (min-max) [day]	100 days h^2 ± s	305 days h^2 ± s	100 days h^2 ± s	305 days h^2 ± s
udder:	clinical mastitis	0,76 ± 3,02 (0-35)	3,19 ± 7,96 (0-112)	0,007± 0,003	0,022 ± 0,008	0,002 ± 0,000	0,003 ± 0,001
feet	phlegmon	0,15 ± 1,25 (0-30)	0,78 ± 4,81 (0-120)	0,000 ± 0,003	0,046 ± 0,009	0,004 ± 0,002	0,002 ± 0,001
and leg	sole ulcer	0,13 ± 0,89 (0-30)	2,84 ± 11,72 (0-225)	0,000 ± 0,000	0,066 ± 0,010	0,004 ± 0,002	0,004 ± 0,001
	digital dermatitis	0,11 ± 0,56 (0-30)	0,70 ± 4,60 (0- 90)	0,009 ± 0,003	0,003 ± 0,003	0,002 ± 0,001	0,000 ± 0,000
	panaritium	0,26 ± 2,21 (0-30)	1,98 ± 8,59 (0-135)	0,008 ± 0,004	0,030 ± 0,007	0,003 ± *	0,004 ± 0,001
sum of feet and leg		0,35 ± 2,76 (0-60)	5,62 ± 15,99 (0-225)	0,006 ± 0,004	0,062 ± 0,009	0,006 ± 0,002	0,004 ± 0,001
metabolic	milk fever	0,21 ± 1,51 (0-42)	-	0,011 ± 0,004	-	0,000 ± 0,000	-
fertility	calving difficulties	0,27 ± 1,93 (0-53)	-	0,012 ± 0,007	-	0,005 ± 0,002	-
	puerperium difficulties	0,14 ± 0,93 (0-21)	-	0,000 ± 0,000	-	0,015 ± 0,002	-
	disorders of cycle	0,21 ± 1,56 (0-32)	2,87 ± 10,89 (0-200)	0,020 ± 0,008	0,022 ± 0,007	0,000 ± 0,000	0,001 ± 0,001
	endometritis	0,24 ± 1,75 (0-32)	3,63 ± 10,63 (0-158)	0,000 ± 0,000	0,022 ± 0,007	0,004 ± 0,000	0,001 ± 0,000
	ovarian cysts	--	0,98 ± 5,19 (0-116)	--	0,013 ± 0,006	--	0,004 ± 0,001
sum of fertility disorders		0,74 ± 4,34 (0-60)	8,75 ± 18,74 (0-195)	0,002 ± 0,004	0,017 ± 0,006	0,003 ± 0,002	0,002 ± 0,001

Results

- the heritabilites for all tested models and traits are very low
- lactation model:
  - 100 days: zero or mostly nearly 0,01 (exception cycle disorders (0,02))
  - 305 days: between 0,01 and 0,06 (higher then 100 days)
- test day model:
  - high permanent environmental effect (10-30% of total variance) but low heritabilities
  - 100 days: except puerperium difficulties estimates < 0,01
  - 305 days: length of data collection show no directed influence
- summarised traits for feet and fertility are located between the direct estimates for the single diseases

Interpretation and Conclusions

- For the three calving diseases a data collection for 100 days is sufficient (see - in table).
- For the cyst trait there was no incidence on the first 100 days (--)
- The estimates for the 100 days traits are not higher as for the whole lactation, but we suppose that here is the highest physiologic stress for the animal. Probably the reason was much earlier than the time where the diagnosis were detected. Next steps should be to investigate the relations between the single time spans and to use the diagnostics as a categorical trait.
- A general aggregation of diagnosis for the whole disease complexes seems not to be the solution because the genetic background for single diseases should be different.

* VCE not converge with status one

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