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Estimation of breeding values for type traits in Germany

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Introduction

Starting in June 1993 linear type traits are routinely evaluated in Germany using a Best Linear Unbiased Prediction (BLUP) animal model. The linear type classification was introduced in the year 1983 in Germany. The first run included data from 8 herdbook associations for the Black and White breed, recorded between 1984 and 1993. In the future evaluations will be done for the Black and White breed and the Red and White breed with the method described in this paper.

Data and model

Traits

The traits considered are the 12 *standard* linear type traits and two *optional* linear type traits scored between the biological extremes on a scale from 1 to 9. Additionally, the two general characteristics *body type* and *udder* are classified with a score of 1 to 50. The maximum score for cows in first lactation is 44. Table 1 lists the type traits in the evaluation.

Data structure

From 1983 to 1992 nearly all breeding associations classified 30 to 35 randomly chosen first lactation daughters of the testbulls with production proofs above the average. Because of the small average herd size in Germany only one or few testbull daughters of a herd were classified. Therefore herds have to be grouped in herd-classes. The analysis of a dataset with classifications of all heifers in the herd shows a close relationship between the estimated herdmanagement effects on most of the type traits and the herd level of production.
Starting in 1993 the data structure will be improved by classification of a random chosen group of 30 to 40 daughters of all testbulls and their herdmates. This means that daughters

group of 30 to 40 daughters of all testbulls and their herdmates. This means that daughters of testbulls were classified only together with their herdmates. Because of the larger number of contemporaries a direct consideration of the herd in the model is possible. But classifications from small herds have to be grouped further on. In a situation without classification of daughters from proven bulls, ties between regions are only given by the consideration of the sires of bulls in the evaluation. With the new sytem additional ties between the regions are given through the classification of daughters of proven bulls which are spread over all regions.

In the northern part of Germany the scoring is done by classifiers from the regional herdbook associations, in the middle and the south the classifiers are members of the agricultural administration.

Table 1. Type traits and estimates of heritabilities

Trait	h^2	Trait	h^2
Linear Standard Traits		Optional Linear Traits	
Stature	0,43	Chest width	0,21
Body depth	0,31	Angularity	0,32
Rump angle	0,26		
Rump width	0,24	General Characteristics	
Rear leg set	0,13	Body type	0,30
Foot angle	0,13	Udder	0,20
Fore udder (attachment)	0,20		
Rear udder height	0,18		
Central ligament	0,20		
Udder depth	0,31		
Teat placement	0,27		
Teat length	0,24		

Model

The model considered in the evaluation includes a "region * classifier * year" fixed effect, a "region * herdlevel * year" fixed effect, an "age at first calving" fixed effect, a "stage of lactation" fixed effect and a random additive genetic effect. Classifiers differ not only in their average scores but also in the respective standard deviations. A prestandardisation of the observations is done within classifier and year. The linear traits are standardised to a standard deviation of 1.33.

The statistical model is:

$$Y_{ijklmn} = Reg*Class*Year_i + Reg*HL*Year_j + Age_k + Stage\_of\_lact._l + a_m + e_{ijklmn}$$

Y_{ijklmn}	= observed score
$Reg*Class*Year_i$	= region (8 classes) * classifier (52 classes) * year (10 classes)
$Reg*HL*Year_j$	= region * herdlevel (9 classes) * year <u>or</u> herd * year if more than five heifers were classified
Age_k	= age at first calving (4 classes)
$Stage\_of\_lact._l$	= stage of lactation (9 classes)
a_m	= additive genetic effect
e_{ijklmn}	= error (random)

All known family relations were considered. The program written included the feature for setting up equations for unknown parent groups. However, this feature was not used since pedigree informations was almost complete for several generations.

The system of equations is solved by the well known Gauss-Seidel method with relaxation. According to the work of VANRADEN et al. (1990), who found an increase of the accuracy of the evaluations by the consideration of the genetic correlations between the linear traits in a multiple trait analysis, especially for traits with low heritability, the program contains a feature for a linear transformation of the vector of observations via the canonical transformation (THOMPSON, 1977), but the required variance/covariance matrices for the additive genetic effects and the residuals are not positive definite. When the structure of the dataset is better, a new estimation of variance components will be done. Up to this time breeding values will be estimated with an univariate model. Table 1 displays the estimates of heritabilities obtained by Hendersons method III. The dataset comprised 11276 heifers from 390 testbulls of a big breeding association, which were scored between 1984 and 1992. The effects of classifier, herdlevel, year, age at first calving and days in milk were included in the model. The estimates are in good agreement with the investigation of SWALVE and FLÖCK (1990) on a smaler subset of the data with the REML method.

The type breeding values are *relative* BV's with an average of 100 and a standard deviation of 12. As table 1 shows, the linear type traits differ substantially in heritability. Therefore the repeatability for the different traits vary in spite of the same number of daughters available for all traits. Figure 1 shows a useful form, to figure the breeding values together with their repeatabilities in one graph. The form of the rhomb is a function of the repeatability of the estimated breeding value.

Genetic base

For type traits the average breeding values of the actually proven testbull years, at present the testbulls born in 1984-86, was taken as genetic base.

Conditions for publication

Published breeding values for type traits are based on at least 20 daughters in 5 herds.

Literature

THOMPSON, R. (1977):
Estimation of quantitative genetic parameters.
Proceedings of the International Conference on Quantitative Genetics, E. Pollak, O. Kempthorne und T.B. Bailey, 639-657, Ames, Iowa
Iowa State University Press

SWALVE, H.H. and FLÖCK, D. (1990):
Consideration of mean and standard deviation of classifier as important effects in the analysis of linearly scored type data
Züchtungskunde, 62(5), 367-383

VANRADEN, P.M.; JENSEN, E.L.; LAWLOR, T.J. and FUNK, D.A. (1990):
Prediction of transmitting abilities for Holstein type traits.
J. Dairy Sci. 73: 191-197

Figure 1

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Breeding values for type traits / BLACK and WHITE

Bull:	**Jens**	**Number:**	**789321**	**Birth date:**	**13.05.87**
Type BV:	**rLn 06/93**	**Daughters:**	**51**	**Herds:**	**46**
Body-Type:	**98**	**Udder:**	**109**		

Standardised breeding values

Trait	Extreme	64	76	88	100	112	124	136	Extreme
Stature	small	96							tall
Body depth	shallow							118	deep
Rump angle	ascending	99							sloped
Rump width	narrow							126	wide
Rear leg set	straight							118	sickled
Foot angle	low angle	85							steep angle
Fore udder	loose	84							tight
Rear udder height	low							116	high
Central ligament	weak							114	strong
Udder depth	deep	88							shallow
Teat placement	wide							118	close
Teat length	short							111	long

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