

Consistency of Conformation Trait Definitions Across Time

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Abstract

Three methods are proposed to detect possible changes in trait definition across time. Foot angle and fore udder attachment changed both two times in the Netherlands and were analysed to check the methods. One method, which is based on daughter yield deviations (DYDs), is easy and fast to perform and pick up possible changes in trait definition. DYDs are already necessary for Interbull test 2 and countries could consider this method for checking the consistency of conformation traits across time.

1. Introduction

Interbull requires that each country pass strict genetic trend validation tests for each trait of each breed at least every other year. Before accepting data from a country to include in the international genetic evaluation, three trend validation tests are implemented. Test 1 compares the genetic trend estimated from first lactation records with the genetic trend from all lactation records; this is to investigate the impact of cow records from different age groups on the genetic trend. Test 2 examines the stability of DYDs across time within sire; DYDs are independent of the year of calving of bulls' daughters. This method investigates the non-genetic time trend over the entire period considered in the national evaluation. Test 3 predicts the most recent 4 years of data from preceding data; this is to investigate the random variation associated with new daughters. Data should pass all three tests, when applicable, in order to be included in the genetic evaluation of Interbull (Interbull, 2004).

The three Interbull tests assume that trait definitions stay the same across time. However, the definition of several conformation traits could have been changed once or more. Therefore it is not correct that the scores for a trait are considered as one and the same trait in the genetic evaluation. Countries should consider changes in trait definition in their genetic evaluations. This can be done by omitting data, scored with a former definition,

or by treating these different scores as different traits in a multiple trait evaluation (De Jong and Harbers, 2002). Changes in trait definition were incorporated in the Dutch genetic evaluation for conformation traits from 2002 onwards. When a change in trait definition is not taken into account, the breeding values of the trait will be a mix of the current and previous trait definition. This will result in a continuously changing ratio of data scored due to the previous and the current definition. This continued change will result in changes in breeding values at the national level (more than can be expected based on the reliability of the proof) and sub-optimal correlations between countries at the international level.

The aim of this study is to show some potential methods to find changes in trait definition within country.

2. Material and Methods

2.1 Data

Data were all classifications from first parity cows included in the Dutch database. Currently 19 conformation traits are evaluated in the MACE conformation evaluation. In the genetic evaluation, each trait was considered to be the same trait across time in order to pick up traits that changed definition. DYDs were calculated from the results of this genetic evaluation for conformation traits. From those 19 traits some have changed definition during time.

The results of foot angle and fore udder attachment are presented in this paper. The definition of foot angle was changed two times (1991 and 1997) and the definition of fore udder attachment was changed twice as well (1991 and 1996). Scores on first parity cows, classified between 1989 and 2003, were used in the analysis. The change of trait definition always occurred at the 1st of September. Therefore year of classification starts at the 1st of September and runs until 31st of August the next year.

2.2 Methods

Three methods were applied to the data:

1. *REML estimates of genetic correlations between consecutive years of classification (REML).*

A bivariate analysis of consecutive years was done with a sire model. The model is described by De Jong and Harbers (2002). The estimated correlations were tested if they were significantly different from 1.0 ($p=0.05$). This method was the reference method for the other two methods.

2. *Estimation of correlations between consecutive years of classification for DYDs (DYD-CORR).*

For this method a statistical package was used. In order to calculate weighted correlations it was required for the bulls to have DYDs in two consecutive years. DYDs should be based on at least 50 daughters. Without this requirement the DYD of a bull may not be accurate enough. With the Fisher's z test the significance level of the difference between two consecutive correlations could be calculated.

3. *Estimation of genetic correlations between consecutive years of classification for DYDs using MACE (DYD-MACE).*

Year of classification was used as trait in MACE instead of country. Because DYDs were used for MACE the deregression step was unnecessary. All bulls with offspring in multiple years and all bulls with $\frac{3}{4}$ sibs (same sire and maternal grandsire) in another year

were selected. All bulls with at least 50 daughters were included in the estimation of genetic correlations with MACE. It was not possible to test the correlations on significance, because MACE does not provide standard errors.

3. Results and Discussion

The correlations between years of classification for foot angle and fore udder attachment are presented in Figure 1 and 2 respectively. The vertical lines in the graphs indicate the years when a trait was changed. The general picture for both traits is that all three methods resulted in similar correlations, which are very high in the years without a change in definition. It was assumed that when a trait changed definition the correlation should drop followed by an increase. The increase of the correlation is due to the fact that both correlations are based on the new definition.

3.1 Foot angle

REML estimations resulted in three genetic correlations that were significantly different from 1.0: between the classification years 1991 and 1992, 1996 and 1997, and 1997 and 1998. With DYD-CORR the difference between correlations was significant in 1991, 1992, 1996, 1997 and 1998.

The change of definition in 1991 was obvious with all three methods. With REML and DYD-CORR the change in 1997 could be indicated, but with DYD-MACE the dip is smaller.

3.2 Fore udder attachment

The correlation between the classification years 1991 and 1992 with REML was significantly different from 1.0. The genetic correlation between 1999 and is missing, because REML did not converge. With DYD-CORR the difference between correlations was significant in 1991, 1992, 1997, 1999 and 2002.

In 1996 fore udder attachment changed definition, but only DYD-CORR showed a

drop in correlation followed by a significant increase. With REML the drop was a year earlier and not significantly different from 1.0. With DYD-MACE the correlation did not change. However, with all three methods the correlation dropped in 1991 and increased in the following year. This was significant for both REML and DYD-CORR. This is in accordance with the change in trait definition that took place in 1991.

3.3 Comparison of REML, DYD-CORR and DYD-MACE

The three methods used each have their advantages and disadvantages:

With REML and DYD-MACE computation time and memory needed is much bigger than with the second method. For accurate estimates the data should be large enough, whereas with second method this is not a problem.

For DYD-CORR data in consecutive years is needed. This could result in a big loss of young bulls, with only first crop daughters, because they have data in one year only or do not meet the requirement of a minimum number of daughters in a year. With the other two methods a bull might have data in one year only, but his sons could have data in other years. Pedigree information can link this information to the bull and this increases the number of bulls available for the analysis.

Breeding values or DYDs are the input for MACE. The advantage of DYDs is that for each year a bull has daughters scored a DYD is calculated whereas with breeding values only one value is calculated.

DYD-CORR and DYD-MACE are able to reproduce the results of REML.

3.4 Validation of changes in trait definitions

To validate if a trait changed across time REML is able to recognize those changes, but not all. MACE seems to follow, but without standard errors it cannot be proven. With the simple DYD-CORR it was also possible to point out when a trait might be changed.

Like the other Interbull tests the DYD-CORR is relatively easy and fast to validate the data that is send to Interbull. Another advantage is that DYDs are already necessary for Interbull test 2. Countries, which are able to carry out test 2, can perform DYD-CORR as well. This is an initial step for the detection of changes in the trait definitions. The next step is to calculate REML estimates and implement the genetic parameters in the breeding value estimation.

3.5 General discussion

The changes of trait definitions are usually done by the herd books. It is important to know the date of change. When DYD-MACE was analysed with calendar years instead of classification years the change in 1991 for foot angle was not so clear. For other changes the dip might disappear. Therefore the contact with the herd book about changing traits is important.

When it is unknown when the exact change was a different approach should be applied. To track down the date of change the year of classification could be moved up per month and notice the possible dip in the correlation between years.

In some countries conformations traits are changed on a sliding scale. Random regression could be used to detect this or by splitting up a conformation trait in blocks of years. For a correct genetic evaluation those blocks are different traits correlated to the trait concerned. Best practice is to change a trait overnight.

4. Conclusions

- Changes in trait definition occur.
- The 3 methods used gave comparable results and are all suited to pick up potential changes in trait definition.
- DYD-CORR is a relatively simple method and fits with the already existing Interbull test 2.
- Knowing the exact date of change in trait definition is an essential condition for the proposed methods.

5. References

De Jong, G. & Harbers, A.G.F. 2002. Determining changes in definition of conformation traits and the effects on international evaluations. *Interbull Bulletin* 29, 39-42.

Interbull, 2004. Code of practice for the international genetic evaluation of dairy bulls at the Interbull centre: Appendix III: Interbull trend validation procedures (Update: April 27, 2004).

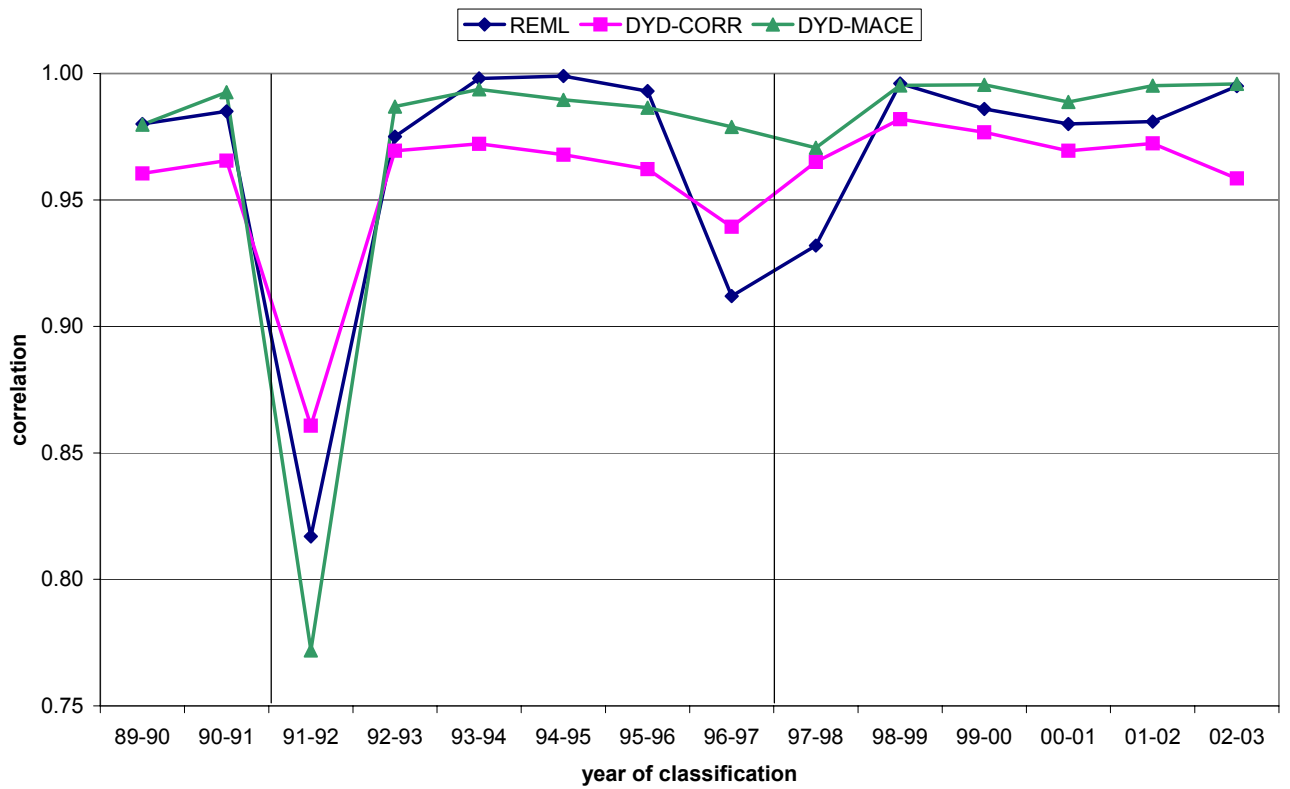


Figure 1. Correlations between years of classification for foot angle with three different methods.

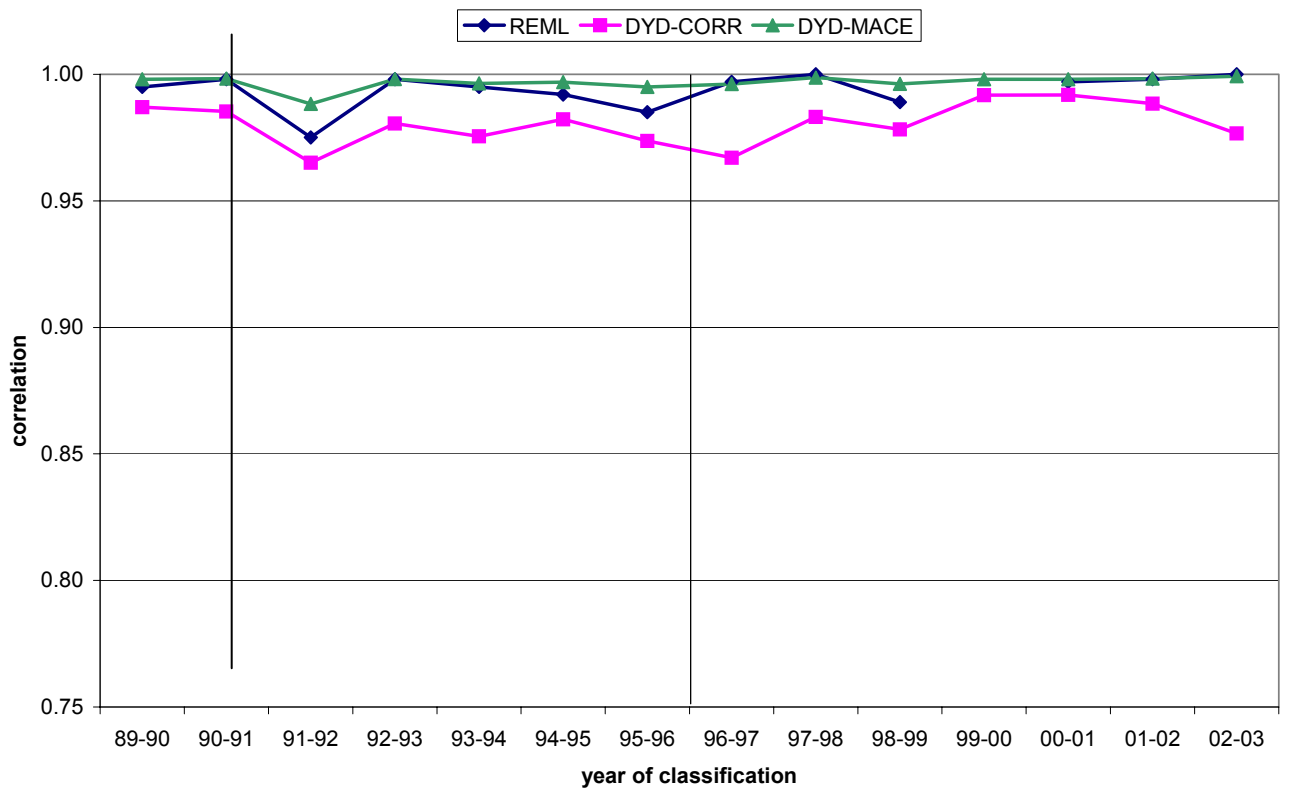


Figure 2. Correlations between years of classification for fore udder with three different methods.