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Trend validation procedures applied by Interbull – historical overview

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ABSTRACT: A historical overview of the last fourteen years of Interbull validation activity for the Holstein breed, including red Holstein, has been carried out. Descriptive statistics for number of tests performed per different trait groups analyzed at Interbull, a list of the most common changes tested during such period and the frequency of their occurrence is presented together with the percentage of the different Interbull validation methods applied. Results showed that national evaluation centers promote more frequent changes in production, conformation and udder health traits when improving their genetic evaluation systems.
Keywords: dairy cattle; trend validation; international evaluations

Introduction

Breeding value prediction in dairy cattle is based on a different set of complex statistical models. High attention has to be given to data quality and model robustness in order to reduce possible sources of bias and therefore improve the accuracy of estimated breeding values (EBV). Systematic biases in genetic evaluations became even more a reason for concern with the introduction of genomic evaluations (Patry and Ducrocq, 2011).

Interbull carries out multiple-trait across country evaluations – MACE (Schaeffer, 1994) – using deregressed national EBVs as input. In order to ensure unbiasedness, a set of three different methods for testing biases in the national genetic trends have been proposed (Boichard et al., 1995) and implemented as a mandatory validation procedure for populations participating in Interbull evaluations. The present paper presents a historical overview of the validation activity carried out by different Holstein populations (including red Holstein) participating in Interbull evaluations from 2000 to 2013.

Materials and Methods

Interbull validation requirements. Interbull MACE evaluations are carried out five times per year: three official routine evaluations (April, August and December), in which results can be published by participating countries in their home scale and used for trading; and two test evaluations (January and September), which results are confidential and allow participating populations to verify the impact of changes made in their national statistical models or estimated genetic parameters. Test evaluations are also a requirement for incoming populations which wish to join the international evaluations for the first time.

Inclusion of data from a new population or from a modified national evaluation in a participating country is conditional to favorable validation results. In general, validation tests must be implemented when a country first enters the Interbull evaluation system and, thereafter, every time the country's national genetic evaluation system is modified, or when there is a time gap of more than two years since the last validation.

Interbull validation methodologies. Interbull has adopted three trend validation methodologies (Boichard, et al. 1995; Weller, J. et al, 2003; Lidauer, M., et al, 2005):

<u>IB validation method I:</u> is defined as the comparison of genetic trends estimated using only first lactation versus all lactations in the routine national genetic evaluations. Its aim is to investigate the impact of cow records from different age groups on the national genetic trend.

<u>IB validation method II:</u> is defined as the analysis of within bull yearly Daughter Deviations (DD). Its aim is to investigate the non-genetic time trend over the entire period considered in the national evaluation, as DD are independent of the year of calving of bulls´ daughters. Deviations from zero will indicate biases in the genetic trend estimation.

<u>IB validation method III:</u> is defined as the analysis of official national predicted genetic merit variation across evaluation runs, with a time interval of four years, i.e. a current evaluation in year YYYY and a previous evaluation in year YYYY-4. Its aim is to investigate the random variation associated with the addition of new progeny data.

National centers are encouraged to apply all three methodologies although their applicability is limited by the trait in hand and the type of data available. For example, direct longevity, which is a trait often evaluated using survival analysis methods, would not provide the necessary information to apply method I. Similarly, national centers not calculating DD will not be able to apply method II.

Data used. Trend validation data from countries participating in the Interbull Holstein international evaluation, including data for red Holstein, from years 2000 to 2013 were considered. Moreover, only validation data provided by countries as a consequence of changes in their national genetic evaluations or from countries joining the Interbull evaluations for the very first time were included. Therefore validation data due to the two years maximum interval between validations rule were not included.

Results and Discussion

Tables 1 to 3 present the overall descriptive statistics for the validation activity among Interbull service users divided per trait group. The last column shows the grand total or overall average.

Table 1. General descriptive statistics of validation tests applied by Interbull service users on Holstein data to test changes in national evaluation models during the period 2000-2013.

	Trait Group§							Tot (avg)
	CA	CO	FE	LO	PR	UD	WO	
Tests per-formed	6	59	30	46	86	65	5	302
No. years	8	14	7	9	14	13	4	14
Tests per year	1.4	4.2	4.3	5.1	6.1	5.0	1.3	22
Populations	6	24	15	20	31	29	5	31
Tests per population	1.8	2.5	2.0	2.2	3.0	2.2	1.0	2.3

§CA=calving traits; CO=conformation traits; FE=female fertility traits; LO=direct longevity; PR=production traits; UD=udder health traits; WO=workability traits.

Table 1 shows that production, udder health and conformation are the trait groups which undergo the higher number of tests (86, 65 and 59 tests respectively) over the entire period analyzed (number of years available equal to 14 for both production and conformation and 13 for udder health). Fertility and longevity show a lower frequency of tests (30 and 46 respectively), but in a total of 7 and 9 years, respectively. Therefore, considering the average number of tests per year, then validation activity is still highest for production traits, but longevity and udder health present more tests per year than conformation and fertility. The workability trait group, including milking speed and temperament, appears as the trait group with the least validation activity due to the fact that this trait group has started to be offered as a service by the Interbull Centre only from 2009 onwards.

Type of changes promoted by national evaluation centers are shown in Table 2. Among all the types of changes reported, "adjustments in the model", "changes in base, scale, trait definition" and "new data edits" are the one occurring more often. It is interesting to observe a high frequency of validation tests because of "type of evaluation model" for production traits during the period, which was boosted by the massive adoption of test day models worldwide. Moreover, as the period of analysis comprehends a good portion of the entire Interbull activity, it is not surprising to see that changes due to participating for the "First time" has the highest frequency across all trait groups. This is particularly evident for those trait groups added more recently to the Interbull service portfolio: workability, fertility and longevity, and it is also the case of populations adding new traits to their own portfolio (e.g. clinical mastitis).

Table 2. Frequency of changes in national evaluation models tested by Interbull service users on Holstein data during the period 2000-2013.

	Trait Group§							Tot
	CA	CO	FE	LO	PR	UD	WO	
Adjustments in model	3	12	5	6	17	13	0	56
New base, scale, trait definition	1	10	1	7	8	4	0	31
New data edits	3	10	5	5	14	11	1	49
Multi-trait or multi-breed	1	6	5	5	9	6	0	32
First time	3	15	15	20	10	29	3	95
Type of evaluation model	2	0	1	4	19	8	0	34
Update genetic pa-rameters	1	8	5	3	9	3	2	31

§CA=calving traits; CO=conformation traits; FE=female fertility traits; LO=direct longevity; PR=production traits; UD=udder health traits; WO=workability traits.

Finally, considering the type of validation method (Table 3), there is a big difference in the frequency with which the three validation methods, and their combinations, are applied to the different trait groups. This is a direct consequence of the trait and the type of data available. Overall, method III is the method more widely used across traits. Among the three validation methods, IB method III is in fact the least affected by the type of trait in hand or by its model, and can be applied to all traits and breeds. Its only limitation is the availability of enough data to perform proper backward validations.

Table 3. Percentage of trend validation methods applied by Interbull service users on Holstein data to test changes in national evaluation models during the period 2000-2013.

Method(s)	Trait Group§ (values expressed as %)							Tot
	CA	CO	FE	LO	PR	UD	WO	
I	NA£	0	0	NA	16	13	NA	7
II	18	10	7	24	6	10	0	10
III	82	50	33	65	30	19	100	41
I+II	NA	0	11	NA	10	10	NA	6
I+III	NA	7	15	NA	14	32	NA	13
II+III	0	33	26	12	2	0	0	12
I+II+III	NA	0	7	0	22	16	NA	11

§CA=calving traits; CO=conformation traits; FE=female fertility traits; LO=direct longevity; PR=production traits; UD=udder health traits; WO=workability traits.

£NA not applicable.

Conclusion

Reviewing the validation activity for Holstein in the last fourteen years highlights the constant effort from countries to improve their genetic evaluation systems. Fine tuning of national evaluation systems is done more often for production traits, followed by longevity, udder health, fertility, conformation, calving and workability traits. There is a range of reasons why Interbull service users seek validation of their national genetic models, being participation for the first time in Interbull evaluations and adjustments in the statistical models the most common ones. IB method III is the most frequently applied validation method.

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