Analysis of Genetic Groups in MACE Evaluations with Different Time-Edit on Data

***Filippo Miglior*[1,2], *Peter G. Sullivan*[2,3] *and Brian J. Van Doormaal*[2]**
[1]*Agriculture and Agri-Food Canada, Dairy and Swine Research and Development Centre, Lennoxville, QC, Canada*
[2]*Canadian Dairy Network, Guelph, ON, Canada*
[3]*CGIL, University of Guelph, Guelph, ON, Canada*

Introduction

During the Interbull Technical Workshop in Beltsville, MD, US, a paper from de Jong (2003) raised the question of validity of applying a time-edit to incoming data for MACE evaluations. The time edit applied when selecting data for breeding value prediction and sire variance estimation was first used in 1998, based on studies by Weigel and Banos (1997). The authors studied the effects of upgrading populations on MACE results, by simulating populations with different genetic means and variances and importing from the population with high mean and variance to the population with low mean and variance. The effects of importation were to increase the mean and variance in the importing population over time. Comparisons of bulls, especially the best bulls, between populations were biased if all data were used in MACE. Restricting the data used in MACE to only recent years resulted in sire variance estimates that reflected current instead of base populations, which eliminated the biases and increased the accuracy of international comparisons. Sullivan (1999) derived procedures that could be used to estimate sire variances reflecting the current base populations without the need for a time-edit of the data. It has not been established, however, if the biases in the study of Weigel and Banos (1997) were strictly caused by the sire variance estimates used in MACE or if there were additional contributing factors. Effects of time-editing on differences in genetic group estimates, for example, may affect comparisons of bulls between populations.

A study of the impact of using different time edits on the Holstein evaluation has been performed by the Interbull Centre (Emanuelson, 2003). The research concluded that moving the time edit from 1986 to an earlier year (1983) had little effect on estimated sire variances and on the international ranking of bulls born since 1995. However, proofs of individual bulls might be highly affected. The author did not look at effects with a much more relaxed time-edit, or the effect on genetic groups or specific group of bulls most likely affected by change in time-edit.

The objectives of this follow-up study were to investigate the effects of various time-edits on both the genetic group solutions and on the international evaluations of bulls.

Materials and Methods

National Holstein bull proofs were kindly provided from ten major dairy countries (Australia, Canada, Denmark, France, Germany, Great Britain, Italy, The Netherlands, New Zealand and United States). A total of 59,657 Holstein bulls were evaluated with MACE based on protein genetic evaluation files and genetic correlation estimates used by Interbull in the November 2002 routine run.

Five different runs were performed based on different time-edits for proofs included in the evaluation and sires used for sire variance estimation:

1) **D85V85** emulated the official run by Interbull in November 2002. Proofs of bulls born after 1985 were included in the analysis. Sire variance estimates were based on bulls born after 1985.

2) **D83V85** included proofs of bulls born after 1983, and sire variance estimation was the same as in D85V85.

3) **D60V83** included proofs of bulls born after 1960, and sire variance estimation was the same as in D85V85.

4) **D83V83** included proofs of bulls born after 1983. Sire variance estimates were based on bulls born after 1983.

5) **D60V60** included proofs of bulls born after 1960. Sire variance estimates were based on bulls born after 1960.

Results from the five runs were compared based on four criteria: a) correlations of solutions for genetic groups and for bulls born before and after 1985; b) plots of solutions over time; c) correlations of average solutions for the top 5 bulls by country of origin; and d) correlations of country representation in the average top 100 bull list.

Results and Discussion

Average correlations across country scales, between D85V85 and the other four runs, are reported in Table 1. Correlations of MGS and MGD genetic group solutions were relatively low for all runs (.62 to .70). Correlations for sire genetic groups were much higher (.93) with the 1983 edits, but much lower (.53-.55) with the 1960 edits. Correlations were generally lower for the 1960 edits than the 1983 edits, for all group solutions and solutions for bulls, as expected. Bulls born before 1985 were strongly affected by the choice of time-edit, but the overall ranking of bulls born after 1985 was essentially unaffected (correlations of .994 and .999). The choice of time-edit for sire variance estimation had only small effects on group solutions and the overall rankings of bulls (i.e. D60V85 vs. D60V60 and D83V85 vs. D83V83).

Table 1. Average solution correlations of each run with run D85V85.

	Genetic Groups			Bulls	Bulls
Run	Sire	MGS	MGD	< '85	>= '85
D60V85	.532	.622	.665	.783	.994
D60V60	.545	.629	.667	.787	.994
D83V85	.927	.660	.687	.938	.999
D83V83	.928	.680	.702	.938	.999

The differences in genetic group solutions, with different time-edits, are evident when plotted over time. Sire genetic group solutions for six countries on the American scale (ETA lb) are plotted in Figure 1, for D60V85 and D85V85. Re-rankings occurred within and across countries over time. The effects of sire genetic group solutions on international bull evaluations is very small, as bulls with missing sire represent only a small percentage of the total amount of bulls evaluated. However, genetic group solutions for missing MGD have a larger effect as a quarter of the parent average of every bull is determined by a MGD solution.

Genetic group solutions for American MGD on the American scale (ETA lb) are plotted in Figure 2, for D60V85, D83V85 and D85V85. The effects of time edit are again evident for all three runs. In D60V85, proofs of all bulls were included in the analysis and the trend of MGD solutions was smoothly increasing over time. For runs D83V85 and D85V85, bulls born before the time-edit are excluded, thus the much higher trends of MGD solutions are due to any ancestors (sire or MGS of sons) of bulls born after the time-edit. The higher trend is justified as it is an average of a selected group of bulls (approx. top 5% of all progeny tested bulls).

The effect of time-edit was more visible for bulls whose sires or MGS were born before 1985 (Figure 3). Proofs from D85V85 were on average 4.5 lb higher than proofs from D60V85 for bulls born in 1985. The difference decreased gradually for bulls born in later years. Proofs from D83V85 were on average lower and very close to proofs from D85V85.

Overall trends in the average ETA lb of all bulls, from the three runs, are plotted in Figure 4. Proofs of bulls born before and just after the time edit from D85V85 and D83V85 were substantially over-estimated, ranging respectively from 15.8 and 11.6 lb higher than D60V85 in 1970 to 4.5 and 3.6 lb in 1985, compared with less than a pound after 1990.

While the time-edit on data to compute breeding values has a clear effect on averages of bull proofs, especially those born before the time-edit, the time-edit on sire variance estimation has a large effect on relative variances of bull proofs for each country of origin, and as a consequence, on country representation in top bull lists. Correlations between runs, of the average solution of the top 5 bulls by country of origin, are shown in Table 2, for each country scale. The overall correlation between D60V85 and D85V85 was very high (.996), while between D60V60 and D85V85 it was much lower at .957, and very close to the overall correlation between D60V60 and D60V85 (.953). The same pattern was seen for country representation in the top 100 bull list (Table 3). The average correlation of number of bulls by country of origin in each country top 100 list was much higher between D60V85 and D85V85 (.996), than between D60V60 and D85V85 (.963) and D60V60 and D60V85 (.954). These results are strong evidence that the benefit of applying a time edit, as shown by Weigel and Banos (1997) was due to the effect of the edit on sire variance estimates, and not due to the edit of proofs in the MACE analysis. Restricting the edit to the sire variance estimation procedure only should therefore achieve the same result while allowing for the inclusion of all historical proof information (i.e. D60V85).

Table 2. Correlations between average top 5 bulls by country of origin in each country-scale.

Country	D60V85 vs. D85V85	D60V85 vs. D60V60	D85V85 vs. D60V60
CAN	.998	.937	.938
DEU	.996	.954	.957
DNK	.997	.956	.962
FRA	.995	.936	.943
ITA	.992	.945	.945
NLD	.997	.952	.957
USA	.996	.951	.958
GBR	.998	.978	.981
NZL	.997	.969	.972
AUS	.993	.948	.955
Average	.996	.953	.957

Table 3. Correlations of top 100 bulls by country of origin among different time-edits.

Time-Edit	Correlation
D60V85 vs. D85V85	.996
D60V85 vs. D60V60	.954
D85V85 vs. D60V60	.963

Conclusion

The time-edit was applied to account for different upgrading populations on international genetic evaluations. However, use of a time-edit for breeding value estimation impacts proofs of bulls, especially those born before and immediately after the time-edit. Inclusion of all available bulls per country and applying a time-edit only on sire-variance estimation yields a more accurate estimation of bull proofs and at the same time accounts for different upgrading in various populations.

References

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Figure 1. Sire genetic group solutions on the American scale, with D60V85 (left) and D85V85 (right).

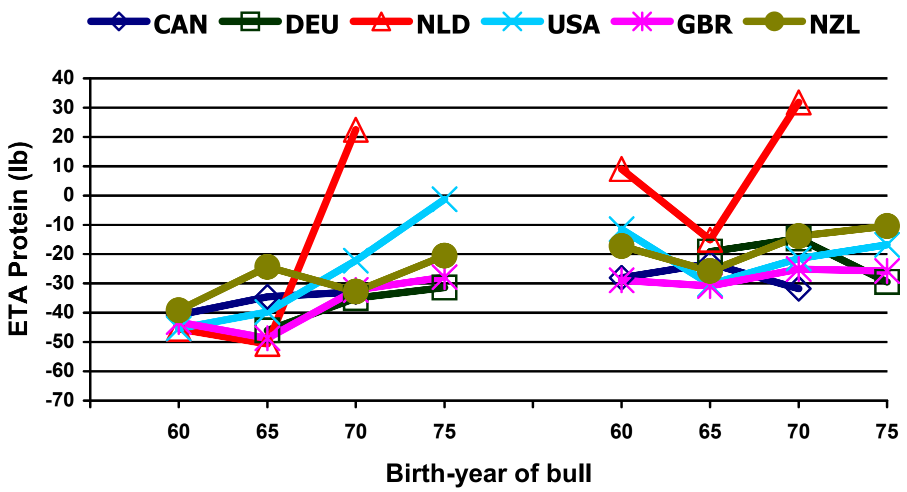

Figure 2. Genetic group solutions for American MGD on the American scale.

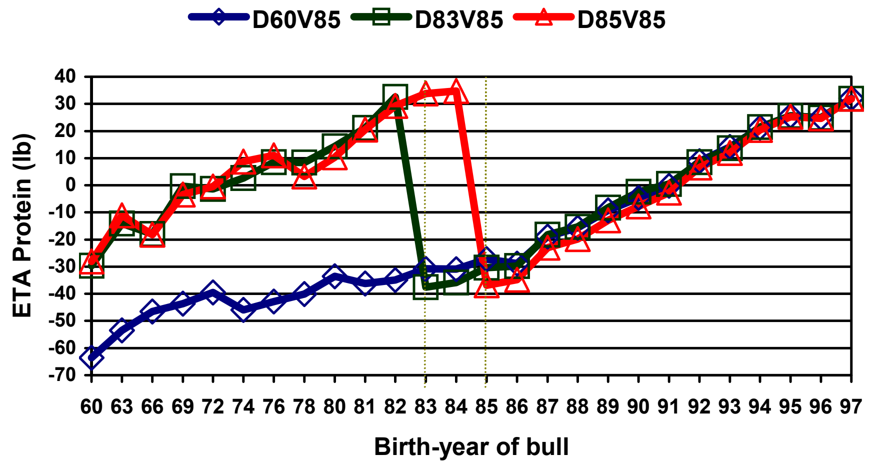

Figure 3. ETA of bulls whose sires were born before 1985, on the American scale.

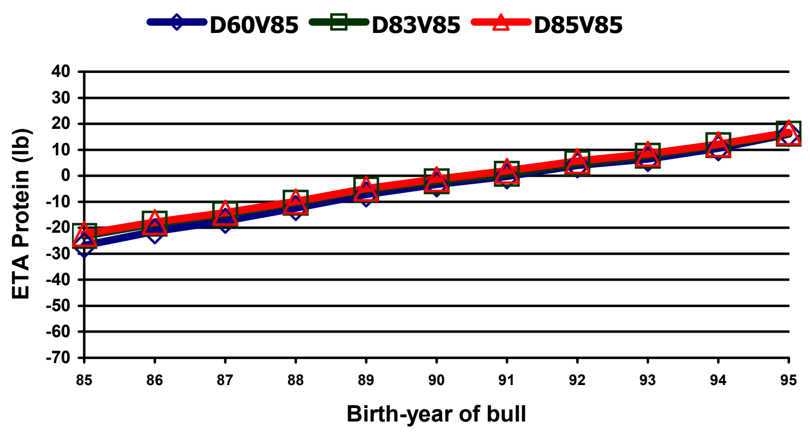

Figure 4. Average ETA of bulls over time on the American scale, with different time-edits.