EVALUATION OF AUSTRALIAN HOLSTEIN-FRIESIAN SIRES FOR CALVING EASE: GETTING MORE OUT OF THE DATA

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INTRODUCTION

Calving difficulties are a major source of economic losses and inconvenience for dairy farmers (Berger, 1994) and are also of concern when considering the management and welfare of cows (Philipsson *et al*., 1979). Economic losses are due to increased likelihood of losing the calf or the cow, increased costs of medication, veterinary assistance and time input from the farmer (Philipsson, 1996). Further losses are incurred due to reduced milk production and fertility (Meijering, 1984; Meyer, 2002). The aim of this research is to develop a more accurate system for calving ease evaluation in Australia, which will allow farmers to select calving ease bulls, resulting in reduced economic losses, improved animal welfare and increased export sales of pregnant heifers. The accuracy of breeding values depends on the quantity and quality of the data collected. Approximately 64% of recorded calvings in Australia from registered Holstein bulls are classed as unobserved. These are not currently used for estimation of calving ease breeding values, on the assumption that unobserved calvings are unreliable resulting in possible reduced accuracy. However, there are calvings that are described as “unobserved – not ok” (70% of male calves born to heifers in this category die), and discarding these may well involve the loss of useful data with a high incidence of dead calves. Overall, exclusion of all unobserved calvings results in the discarding of more than half of the calving ease records. In addition, the majority of herds record no calving difficulties in a season, so the value from them is uncertain. The aim of this paper is to determine whether some of the data that has been traditionally discarded can be retained and used to enhance the reliability of the calving ease EBV.

MATERIALS AND METHODS

Calving ease data consisting of 662,287 records collected since 1981 was provided by the Australian Dairy Herd Improvement Scheme (ADHIS), which currently collects information on the performances of about 55% of Australia's dairy cows, although calving difficulty is recorded on only a small proportion of calvings. Pedigree information was obtained from ADHIS in order to compile a pedigree file consisting of sire, dam and maternal grandsire.

Editing of the data. Calving ease is recorded in Australia in seven categories on a standard scale. (see table 1):

Table 1. ADHIS Calving Ease Score

ADHIS calving category	ADHIS Description	reclassified calving difficulty score
1	unobserved - not ok	2
2	unobserved - ok	1
3	observed - no assistance	1
4	observed - easy pull	2
5	observed - very difficult	3
6	observed - surgical	3
7	observed - malpresentation	2

The calving ease scoring system used by ADHIS is not linear: score 1 is a harder calving than score 2, score 3 is easier that score 4, and score 7 may or may not be easier than score 5. For statistical analysis calving ease was reclassified using a point scale: no calving difficulty (categories 2 and 3), mild difficulty (1, 4 and 7) or severe difficulty (5 and 6).

The dataset was edited to include only calvings occurring between 1986 to 2001 (because numbers were relatively small before 1986), and calvings resulting from artificial insemination of Holstein cows with semen from Holstein bulls. The records were divided into Herd-Year-Season (HYS) groups based on calving date, the seasons being from January to June and from July to December of each year. Records that had no herd identification or from herds with less than three calvings were discarded. Records were excluded that had no details of sex, that were of twin calvings, of parities greater than 9, that had no recorded calf size or that were induced calvings. Three data sets were used:

- *All calvings* records from 354,466 multiparous cows remained after editing

This dataset was further edited in two ways:

- *Variable herds*: the HYS groups in which all calvings were recorded as either CE2 (unobserved – ok) or CE3 (observed – ok), or combinations of these two, were excluded from the data. 107,105 records from herds that each had variation of calving ease within the herd (ie not all trouble free) were retained.
- *Observed calvings*: simulating the method currently being used, all calving records that were recorded as ‘unobserved,’ whether the outcome was satisfactory or not, were excluded: 127,137 records remained (observed calvings dataset).

Each data set was split (by odd or even record number) into two parts. The half datasets were analysed separately and the heritability of the calving difficulty score estimated by REML using the asREML software (Gilmour, 2001). Using these heritabilities, BLUP was used to calculate sire solutions.

The model used was:

$$CE_{ijklm} \sim \mu + s_i + m_j + p_k + b_l + HYS_m + e_{ijklmn}$$

Where

CE_{ijklmn} denotes the calving difficulty score of the ijklmnth calving

μ is the population mean

s_i the effect of the ith sex of the calf, fitted as a fixed effect

m_j the effect of the jth month of birth, fitted as a fixed effect

p_k the effect of the k^{th} parity of the dam of the $ijklm^{th}$ calf, a fixed effect
b_l the effect of the l^{th} bull, the sire of the calf, a random effect
HYS_m the effect of the m^{th} herd-year-season, fitted as a fixed effect (sparse)
e_{ijklmn} the random error associated with the n^{th} calving in the m^{th} herd

Correlations between sire solutions from the split datasets of 47 bulls with the most calvings were calculated. The number of calvings that an hypothetical bull needed to have in order to achieve specific reliabilities was calculated, and the number of bulls that had at least those numbers of calvings (and thus were above these levels of reliability) in each dataset was determined from bull calving frequencies in each dataset. This calculation requires a general estimate for the numbers of effective daughters that a bull might have. The numbers of effective daughters (or calvings) of a typical ADHIS AI bull is 0.7 times his actual daughters or calvings. (pers. com: Les Jones to Sara McClintock)

RESULTS AND DISCUSSION

Heritability of calving ease was h^2 0.03, (± 0.012) in the 'observed calving' dataset, highest (h^2 0.04, ± 0.014) in the 'variable herds' (herds that had some variation in calving scores) and lowest (h^2 0.02, ± 0.002) in the all calvings dataset.
Correlations between the two halves of each of the three data sets are shown in table 2:

Table 2. Results of Split Dataset Analysis

Dataset	correlation between split sets	split1 h^2	split1 se	split1 n	split2 h^2	split2 se	split2 n
observed calvings	0.68	0.037	0.010	63,618	0.030	0.009	63,519
variable herds	0.62	0.047	0.017	53,489	0.039	0.015	53,616
all calvings	0.79	0.020	0.003	177,323	0.0197	0.002	177,143

The correlation between the sire solutions from the two data half sets was highest when all calving ease records were included, suggesting that all calving ease data should be included when estimating breeding values. Correlations between the split data sets were reduced by including only variable herds, and also by only including observed calvings.

Table 3. Numbers of bulls with calving ease EBVs above a target

	observed calvings	variable herds	all calvings	observed calvings	variable herds	**all** calvings
target reliability		0.7			0.6	
heritability	0.03	0.04	0.02	0.03	0.04	0.02
number of effective calvings needed	289	218	463	162	125	297
actual calvings required	413	312	662	232	178	424
numbers of bulls in dataset with this number of calvings	34	38	73	70	71	112

The numbers of bulls achieving levels of reliability of 60% and 70% increased when all calvings were included. There was an increase in reliability when the variable herds were included, and the smallest number of bulls achieved a reliability of 0.6 if only observed

calvings were used in the estimation of EBVs. A bull's EBV is not published unless reliability exceeds 60%, so this large increase in the number of bulls with publishable proofs is of practical importance to Australian farmers.
The accuracy of sire solutions or sire EBVs depends on the heritability of the trait being analysed and the number of effective records per sire. Compared with the current ADHIS practice, including unobserved calvings from variable herds in the data increases the heritability by a third but only slightly increases the number of bulls achieving targeted reliabilities, because so many herds are excluded due to their having no variation in calving ease. Including all calvings from all herds (whether variable or not) reduced the heritability, but increased the numbers of bulls achieving targeted levels of reliability.
Reliability of calving ease EBVs are ultimately dependent on the recording system and its ease of use, and the diligence of the reporters. Definitions of calving difficulty vary according to country: in Australia any intervention excludes the calving from the 'ok' categories. Herd recording organisations have differing levels of compulsion in the recording of calving events. One dairy data processing centre (DPC) will not accept records without calving details. Another herd recording system (used by several DPCs) has the on farm PC (*i. e.* entered directly by farmers) default category of calving ease as 'unobserved – ok,' putting the bonus on farmers of changing this to some other calving ease category if they so desire. In these circumstances it seems likely that farmers who fill in all calvings with the same code to make the system accept their records, or who rarely change the default score, will generate data of poorer quality than more assiduous recorders. The results show that this data contains information and that using it increases the accuracy of EBVs. The accuracy could be further increased by inspiring farmers to increase their diligence and accuracy of recording calving ease.

CONCLUSION

The accuracy of calving ease EBVs is increased, and the number of bulls passing reliability thresholds is increased by including information on unobserved calvings and from herds that have no variation in calving difficulty in the data used to calculate EBVs.

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