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Assessment of fixed models for age at first service and gestation length in Iranian dairy cows

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Abstract. To determine effective factors on reproduction traits, model development should be carried out. In this report different factors which might be important for age at first service (AFS) and gestation length (GL) were assessed. Data from 16,383 Holstein heifers (1987 to 2010) in Isfahan province of Iran was used. Model equations were optimized using general linear model (GLM) in SAS (9.0) package. For each equation error mean square (MSE) and adjusted coefficient of determination (R2) was estimated. Estimated MSE varied from 123.17 to 125.61 and from 381.09 to 2566.87 for GL and AFS traits, respectively. For GL trait first service herd-year-month (FSHYM) was the most important factor to be included in the model. Inclusion of both herd-year-month (BHYM) and FSHYM in the AFS model led to the lowest MSE and the highest R2. In conclusion, this study showed that for Isfahan province of Iran considering the month of birth and inseminations are more important than the season of them.

Keywords: Birth month, Calving month, Gestation length, Age at first service, Dairy.

1. Introduction

Reproduction performance is one of the most economical characters which affect on the profitability of dairy industry. There are many traits which represents reproduction performance of dairy cows. Age at first service (AFS) and gestation length (GL) are two main traits which are relatively more heritable than other fertility traits (Eghbalsaied, 2011). Model selection is important to determine which factors are important for phenotypic variation of traits. This is mainly in order to minimizing error variance and subsequently maximizing the accuracy of genetic evaluations. Normally combination of herd, year and season of birth, insemination or parturition dates are considered as significant fixed effects (Eghbalsaied, 2011). However, seasons are different in different latitudes and could be classified into 1, 2, or 4 classes. For some cases, it might be preferred to include months instead of seasons in the model (Norman et al., 2009). This study was aimed to estimate fixed effect parameters which significantly affect on AFS and GL traits.

2. Materials and methods

Data (16,383 heifer records) was collected from 1987 to 2010 in Isfahan province of Iran for GL and AFS traits. Models were developed using general linear model procedure (GLM) in SAS package (9.0). For each model residual mean square (MSE) and coefficient of variation (R^2) were estimated. Number of classes for birth year (BY), birth season (BS), birth month (BM), herd (H), first service year (FSY), first service season (FSS), and first service month (FSM), and their interactions as BHYS, BHYM, FSHYS, FSHYM are presented in table 1.

3. Results and discussion

Even though birth season and all of its interactions with herd and birth year was not significantly effective for AFS ($P<0.05$), this effect and its interactions with both birth year and herd were significant for GL. So birth month was examined instead of birth season.

Swapping of birth season with birth month in model 3 did not caused to decrease in residual variance for GL, while decreased it for AFS trait. Since both birth month and season were not significantly effective for GL trait, model4 with birth year and first service year-season was developed. The least error mean square for both GL and AFS traits was obtained in these cases, even though coefficient of determination was not highest for GL trait at this stage. Moreover, first service information including year, season, and month was evaluated separately in models 5 and 6. Considering first service herd-year season caused to considerably low MSE for GL trait, while error variance was increased substantially for AFS trait. Considering both BHYS and FSHYS in model equation 7 showed that the model adequacy was not improved for GL in terms of both MSE and R2. However, significant drop in MSE was observed for AFS trait. Looking at R2 also showed very high increase (30%) related to model 6 which just contained the FSHYM factor. Then BM effect was eliminated from model 7 to assess its effect from backward selection. Slight changes were observed for GL trait in two mentioned parameters. This model without BM considerably changed both parameters for AFS trait. Norman et al. (2009) also included month of conception in genetic analysis of GL trait. Inclusion of year, season and month of birth is routinely included in most of papers, though none of them has not been considered in some cases (Bahonar et al., 2009). However, in most of papers season have been included in the model (Fatehi et al., 2005; Ansari-Lari et al., 2009; Eghbalsaied, 2011).

4. Conclusion

Over viewing of all factors in model for GL trait showed that BHY and FSHYS minimized estimated error variance. However, including only FSHYS in the model also led to very low residual variance so that this model might be preferred than model 4, if model simplicity considered as the main index. On the other side, provided that model ability in description of GL variable would be the main goal, models including birth month or first service month have greatest value. Among them, FSHYM caused to the least MSE as well, though the highest R2 belonged to the model containing both BHYM and FSHYM.

For AFS scenario, models in which BHYM or FSHYM are included had lower MSE and higher R2 values related to those contained BHYS or FSHYS factors. AFS model selection was quite straight forward compared to GL models. The best model in terms of both minimizing MSE and maximising R2 pertained to moedl7 which included both BHYM and FSHYM with noticeable differences with other models.

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6. References

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Table 1. number of classes for fixed effects in analysis of GL and AFS

Factor	Number of classes
Herd (H)	62
Birth year (BY)	22
Birth month (BM)	12
Birth season (BS)	4
First service year (FSY)	23
First service season (FSS)	4
First service month (FSM)	12
BHYS	1807
BHYM	3975
FSHYM	3701
FSHYS	1708

Table 2. Model selection for Age at first service (AFS) and gestation length (GL)

Model No.	Model equation	GL		AFS	
		MSE	R2_Adjust	MSE	R2_Adjust
1	H,BY,BS	125.61	0.067427	2566.87	0.280986
2	BHYS	123.85	0.177565	1677.80	0.579657
3	BHYM	128.46	0.273826	1507.55	0.678487
4	BHY,FSHYS	123.17	0.195660	1282.67	0.683984
5	FSHYS	123.31	0.175586	1876.53	0.526676
6	FSHYM	124.35	0.281555	1702.97	0.628789
7	BHYM,FSHYM	125.07	0.338990	381.09	0.924011
8	BHY,FSHYM	124.48	0.297040	1148.98	0.755197
9	BHYS,FSHYS	123.61	0.246297	535.38	0.876838