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Fine-tuning of season definition for genetic analysis of fertility, productivity, and longevity traits in Iranian Holstein dairy cows

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Abstract

Fixed environmental effects have shown to affect random genetic and residual effects. In this study, we evaluated various month merge classes as fixed environmental effect on estimation of genetic parameters for production, reproduction and longevity traits of Iranian Holstein dairy cows. Data were collected from Holstein cows, in Isfahan province of Iran from 1993 to 2009. First, the edited data (53,908 records) were analyzed using general linear model (GLM) in SAS package. Single-month classes yielded the least mean square error (MSE) and the highest R-square. Then, the restricted maximum likelihood (REML) and the best linear unbiased prediction (BLUP) procedures were used to estimate genetic parameters and breeding values (EBVs) from the best models, which included single-month effect compared to triple-month (standard astronomical season in northern hemisphere) effect as a traditional model. Agreeing with the analysis of variance (ANOVA) results, standard season effect also led to higher MSE, Akaike information criterion (AIC), Bayesian information criterion (BIC), and likelihood ratio test (LRT). However, estimated heritabilities and subsequently mean accuracies for EBVs were considerably higher, when alternative definitions of season were explored. In conclusion, results of this study showed a considerable tradeoff between "best" (MSE, AIC, BIC, and LRT) and "unbiased" model indicators (estimated heritability and mean accuracy of EBVs). Importantly, this confounding effect was more evident for reproduction traits, age at first service (AFS) in particular. However, further worldwide evaluations of Holstein dairy cows are needed to determine the importance of model optimization on random effect predictions.

Keywords: Fertility; genetic parameters; Holstein; model; reliability.

1. Introduction

Milk production has been the most emphasized selection goal in breeding programs of Iranian dairy cows (Eghbalsaied, 2011). Additionally, longevity and productive life have been considered as useful traits for sire selection of Iranian dairy cows through tandem selection or selection index (Sadeghi-Sefidmazgi *et al.,* 2012). Moreover, fertility indices play key roles in premature-culling or maintaining milked cows in the herd (Pritchard *et al.,* 2012).

As estimated breeding values are the main tool for sire selection, it is natural for breeders and scientists to be concerned with developing valid means to accurately estimate the heritability of a number of productive and reproductive traits (Jamrozik *et al.,* 2005, Toghiani, 2013, Eghbalsaied, 2011). There has been a trade-off between the most accurate (unbiased) and the best (minimum error variance) model (Posada & Buckley, 2004), while using the Bayesian model has been another approach to improve the model efficacy (Saberi & Ganjali, 2013). However, investigations are needed to define and quantify the impact of various month/season definitions as one of the basic fixed effects in animal models in order to improve the accuracy of genetic evaluations.

Based on the world map of the Köppen-Geiger climate classification, the northern strip of Iran is temperate and humid, similar to eastern and southern west parts of the Europe (Peel *et al.,* 2007). The west part of Iran, Zagros mountain chain, has a snow/cold climate with dry summers, while the south and most of east zones are arid areas with steppe and desert (Peel *et al.,* 2007). Isfahan is one of the largest provinces of Iran, located on the west border of Zagros mountain chain with a cold climate at the west and a large area of arid steppe climate. The climates of east and west parts of Isfahan province are somehow similar to most of the Middle East and European countries, respectively (Peel *et al.,* 2007). Most of the northern hemisphere countries including Europe and East Asia and Middle East have a four-season solar-based calendar. The officially accepted astronomical calendar of Iran is four-season though seasons with double (Ansari-Lari *et al.,* 2009) or triple-month classes (Nilforooshan & Edriss, 2007; Toghiani, 2013) have been used for genetic evaluations of Iranian dairy cows.

Even though optimizing statistical models for genetic evaluations is of very high importance in animal breeding, this has been rarely considered as experimental goal *per se*. This study was aimed to assess if model selection based on the contemporary groups and minimizing MSE could lead to the most accurate genetic evaluations for heifer fertility and first lactation production records.

2. Materials and methods

2.1. Data

Pedigree records and data files for insemination and calving dates of Iranian Holstein dairy cows were obtained from Animal Breeding Centre of Iran (ABCI) and Vahdat Industrial Agriculturists and Dairymen Cooperative, respectively. Data from 55 herds were collected in Isfahan province of Iran from 1993 to 2009. Lifetime (LT) and productive life (PL) were calculated by subtracting birth date or first calving date from their corresponding culling date, respectively. Data of milk yield (Kg), fat%, and protein% of primiparous cows were previously adjusted for 305-day production and twice daily milking by the ABCI. Birth, insemination and calving dates were used to derive age at first service (AFS), gestation length (GL), and 56-day non-return rate (NRR) as reproductive traits. The gestation length was measured as an interval from the last insemination date to its subsequent calving date. The following restrictions were made to minimize misleading figures: AFS from 329 day to 970 day, GL from 200 day to 300 day, LT from 700 to 5600 days, PL from 1 to 4800 days, daily milk yield from 15 to 100 kg, fat% from 1 to 8, protein% from 1 to 8.

Table 1. Summary statistics of phenotypic data used in model optimization and breeding value estimation.

Trait*	Mean	Standard Deviation	Min	Max	Skewness	Kurtosis
Milk yield (kg/day)	31.1	6.2	10.0	57.1	-0.1	0.1
Milk composition, %						
Fat	3.0	0.7	1.1	7.9	-0.5	1.6
Protein	2.7	0.7	1.1	7.74	-1.5	3.5
AFS (days)	474.9	59.0	330	967	2.2	8.9
GL (days)	276.5	7.6	201	299	-3.2	21.1
NRR-56 days (%)	66.8	4.7	0	100	-0.7	-1.5
LT (months)	53.6	19.8	23	183	1.2	1.9
PL (months)	28.2	19.6	0	158	1.2	2.0

*Age at first service (AFS); gestation length (GL); non-return rate (NRR); lifetime (LT); productive life (PL).

Table 2. Pedigree structure of the Holstein dairy cows in Isfahan province of Iran

Factor	**Number**
Animals in total	96540
Sires in total	2736
Dams in total	53369
Animals with progeny	56105
Base animals	10185
-Progeny	17256
-Sires	717
-Progeny	6035
-Dams	9468
-Progeny	13859
Non base animals	86355
-Sires	2019
-Progeny	76772
-Dams	43901
-Progeny	67123
-Only with known sire	5373
-Only with known dam	3548
-With known sire and dam	77434
Grand parents	34534
-Grand progeny	83552
-Grand sires	2335
-Grand progeny	83048
-Paternal grand sires	523

Moreover, animals without identified sire and dam were excluded from the data file. Summary statistics for the analyzed data are presented in Table 1. After the aforementioned data editing, records of 53,908 dairy cows remained for the analyses. Then, the pedigree file (96,540 animals) was constructed for the animals in the data file and their all known ancestors back to seven generations (Table 2). In brief, sires, dams, and base animals comprised 2.8, 55.3, and 10.6% of the pedigree. In addition, 7% and 93% of the base animals were sires and dams, respectively. Among 2736 total sires in the pedigree file, 85% were grand sire in which 22.4% were paternal grand sires (Table 2).

2.2. Season definitions

Twenty first of March was considered as the first day of the Solar Jalali calendar, which is in accordance with the astronomical months in northern hemisphere. Because of the presence of different climatic conditions in Isfahan province of Iran and climate changes, which are particularly taking place at present in arid and semi-arid areas of the world, different types of season definitions were devised in this study. Five types of merged month classes were defined as following: single-month (1M): each successive month, double-month1 (2M1): each two successive months starting from March (first month of spring), double-month2 (2M2): each two successive months starting from February (last month of winter), triple-month1 (3M1): each three successive months starting from March (first month of spring), which is considered as standard astronomical season in northern hemisphere, and triple-month2 (3M2): each three successive months starting from February (last month of winter). The definitions for months and seasons are presented in Table 3.

Table 3. Season definitions based on two solar calendars (the Gregorian and the Jalali calendars)

Gregorian calendar	**Single-month* (1M)**	**Double-month1 (2M1)**	**Double-month2 (2M2)**	**Triple-month1* (3M1)**	**Triple-month2 (3M2)**
21 Mar-20 Apr	1	1	1	1 (Spring)	1
21 Apr -20 May	2		2		
21 May-20 Jun	3	2			2
21 Jun-20 Jul	4		3	2 (Summer)	
21 Jul-20 Aug	5	3			
21 Aug-20 Sep	6		4		3
21 Sep-20 Oct	7	4		3 (Autumn)	
21 Oct- 20 Nov	8		5		
21 Nov- 20 Dec	9	5			4
21 Dec- 20 Jan	10		6	4 (Winter)	
21 Jan -20 Feb	11	6			
21 Feb- 20 Mar	12		1		1

*and ** indicates astronomical months and seasons, respectively, in northern hemisphere.

Herd structure comprised of 55 herds with an average of 980 cows per herd. Additionally, nearly 2160 classes had at least one record for herd-year-season (3M1) which was around 60% of expected classes. On average approximately 25 animals were associated for each class (Table 4). For each model the residual mean square (MSE) and the adjusted coefficient of determination (R-square) were estimated using general linear model procedure in SAS package V. 9.2. Using the above-mentioned month merging, different numbers of seasons were produced, i.e. four classes (triple-month), six classes (double-month), and twelve classes (single-month).

Table 4. Herd structure for the edited data of Holstein dairy cows in Isfahan province of Iran

Variable*	Min	Max	Median	Average
Herd size	50	10437	373.5	980.1
BHY1M size	1	137	5	9.4
FSHY1M size	1	152	5	10.2
CHY1M size	1	147	5	10.1
BHY3M1 size	1	292	10	23.8
FSHY3M1 size	1	343	12	25.5
CHY3M1 size	1	328	12	25.7

*Herd (H); Birth (B); First-service (FS); Calving (C); Year (Y); 1M and 3M1 are standard astronomical month and season in northern hemisphere, respectively.

2.3. Genetic evaluations

The best models were selected based on their MSE and R-square (Tables 5 and 6). Single-trait genetic analyses were carried out using BLUPF90 software. Animal models included the chosen fixed factors along with animal additive genetic and residual random factors. Heritability and mean accuracy of EBVs were estimated for each trait. AIC, BIC, and LRT were measured using the following formula:

AIC=-2 ln(ML) + 2m

BIC=-2 ln(ML) + m ln(n)

LRT=2 ln(ML2-ML1)

Where m is the number of estimated parameters, n is the number of observation, ML is maximum likelihood of the model, and ML1 and ML2 indicates ML of models containing 1M and 3M1, which are northern hemisphere months and seasons, respectively.

3. Results

3.1. Lower error mean square using single-month classes

First, we evaluated main effects of herd, birth year, and birth year partitions including single-month(1M), double-month (2M1 and 2M2), and triple-month (3M1 and 3M2) for milk yield, fat%, and protein% and life time and productive life (rows 1-5 in Table

5). Higher model R-square and lower error mean square were produced for main effects in contrast with their combination effect. Addition of calving date combined effects to the birth date information increased R-square and decreased MSE substantially. The highest R-square and the lowest MSE belonged to 1M classes. Furthermore, a greater model determination coefficient was achieved through 2M classes (Table 5, rows 13-14) compared to 3M classes (Table 5, rows 11 and 15) for all production and longevity traits. Inclusion of only main effects including herd, birth year, birth 1M, calving year, and calving 1M (Table 5, the last row) did not improve the model efficiency compared to those containing calving date combination effect (Table 5, rows 11-15).

Table 5. Models devised to estimate coefficient of determination and residual mean square for production and longevity traits in Holstein dairy cows.

Model\Trait	Milk yield (kg/day)		Milk composition, %				Productive life (months)		Lifetime (months)	
			Fat		Protein					
	$R^{2\dagger}$	MSE	R^2	MSE	R^2	MSE	R^2	MSE	R^2	MSE
H+BY+B3M1	0.270	29.0	0.326	0.36	0.395	0.27	0.455	209.1	0.480	204.6
H+BY+B1M	0.271	28.0	0.326	0.36	0.395	0.27	0.455	208.9	0.481	204.3
H+BY+B2M1	0.271	28.0	0.326	0.36	0.395	0.27	0.456	208.9	0.481	204.3
H+BY+B2M2	0.269	28.0	0.326	0.36	0.395	0.27	0.452	210.2	0.476	205.9
H+BY+B3M2	0.269	28.0	0.326	0.36	0.395	0.27	0.451	210.5	0.476	206.2
HBY3M1	0.196	31.2	0.296	0.38	0.406	0.27	0.406	230.5	0.417	232.0
HBY1M	0.217	31.2	0.319	0.38	0.4300	0.27	0.427	228.1	0.438	229.6
HBY2M1	0.202	31.2	0.304	0.38	0.415	0.27	0.413	229.4	0.424	230.9
HBY2M2	0.199	31.3	0.298	0.38	0.404	0.27	0.410	230.7	0.440	232.3
HBY3M2	0.192	31.4	0.288	0.39	0.392	0.28	0.404	231.5	0.415	233.1
H+BY+B1M+CHY3M1	0.308	26.9	0.452	0.30	0.628	0.17	0.508	191.3	0.521	191.0
H+BY+B1M+CHY1M	0.330	26.7	0.479	0.29	0.655	0.16	0.523	190.1	0.535	190.0
H+BY+B1M+CHY2M1	0.316	26.8	0.462	0.29	0.640	0.16	0.512	191.0	0.524	190.9
H+BY+B1M+CHY2M2	0.311	27.0	0.455	0.30	0.630	0.17	0.507	192.9	0.524	191.0
H+BY+B1M+CHY3M2	0.304	27.1	0.444	0.30	0.620	0.17	0.501	193.8	0.520	191.6
H+BY+B1M+CY+C1M	0.277	27.7	0.339	0.36	0.455	0.27	0.470	203.6	0.483	203.6

† Adjusted R-square (R2); Residual mean square (MSE); Herd (H); Birth (B); Year (Y); First service(FS); Calving (C); Single-month (1M); Double-month1 (2M1); Double-month2 (2M2); Triple-month1 (3M1); and Triple-month2 (3M2).

Table 6. Models devised to estimate coefficient of determination and residual mean square for reproduction traits in Holstein heifers.

Model \Trait	Gestation length (days)		Age at first service (days)		Non-return rate (%)	
	$R^{2\dagger}$	MSE	R^2	MSE	R^2	MSE
H+BY+B3M1	0.022	56.9	0.247	2620.0	0.015	0.218
H+BY+B1M	0.023	56.9	0.248	2618.3	0.015	0.219
H+BY+B2M1	0.023	56. 9	0.248	2619.2	0.015	0.219
H+BY+B2M2	0.023	56. 9	0.247	2621.5	0.015	0.219
H+BY+B3M2	0.024	56. 9	0.246	2622.6	0.015	0.219
HBY3M1	0.038	56.7	0.223	2736.2	0.034	0.217
HBY1M	0.063	56.7	0.259	2677.2	0.062	0.216
HBY2M1	0.044	56.7	0.236	2710.6	0.041	0.217
HBY2M2	0.045	56.7	0.232	2724.5	0.041	0.217
HBY3M2	0.039	56.7	0.221	2747.0	0.032	0.217
HBYM+FSHY3M1	0.083	56.1	0.868	481.4	0.078	0.215
HBYM+FSHY1M	0.114	55.6	0.965	130.2	0.104	0.214
HBYM+FSHY2M1	0.092	56.0	0.922	287.7	0.086	0.215
HBYM+FSHY2M2	0.092	56.0	0.646	1302.7	0.086	0.215
HBYM+FSHY3M2	0.078	56.3	0.590	1494.9	0.075	0.215

† Adjusted R-square (R^2); Error mean square (MSE); Herd (H); Birth (B); First service (FS); Year (Y); Single-month (M); Double-month1 (2M1); Double-month2 (2M2); Triple-month1 (3M1); and Triple-month2 (3M2).

We used similar procedure to select the best model for AFS, GL, and NRR as the most important reproduction indices in terms of heritability and average additive genetic correlation with other reproduction indices (Eghbalsaied, 2011). Unlike production and longevity traits, evaluation of combination effects for herd, birth year, and birth seasons (Table 6, rows 6-10) showed that herd-birth year-1M (HBY1M) caused to the highest R-square and the lowest MSE among other corresponding seasons. At this stage, HBY1M factor was selected for all reproductive traits to produce the highest R-square and the lowest error variance. Then, the first-service (FS) date records were added to the combined herd, birth year, birth 1M factor (Table 6, rows 11-15). The model R-square values varied from 0.083 (HFSY3M2) to 0.114 (HFSY1M), 0.590 (HFSY3M2) to 0.965 (HFSY1M), and 0.075 (HFSY3M2) to 0.104 (HFSY1M) for GL, AFS, and NRR, respectively. Model residual variance ranged from 55.6 (HFSY1M) to 56.3 (HFSY3M2), 130.2 (HFSY1M) to 1494.9 (HFSY3M2), and 0.214 (HFSY1M) to 0.215 (other year sub-divisions) for GL, AFS, and NRR, respectively. In addition, the year subdivision into either six-season or four-season starting from the first month of spring, mid-March (Table 6, rows 11 and 13), resulted in a higher R-square and lower MSE compared to those subdivisions starting from the last month of winter, mid-February (Table 6, rows 14-15). This superiority in adjusted R-square was more obvious for AFS trait.

3.2. AIC and BIC indices agreed with adjusted R-square and minimum MSE

Following model selection based on maximizing known factors for description of dependent variables, the best model for each trait, which contained single-month effect, was chosen for further evaluations. Models containing triple-month effect were also analyzed as traditional models, which are currently employed in genetic evaluations of Iranian dairy cows.

Table 7. Estimates of information criteria using models containing either each month (1M) or each three successive months (3M1) as one class for production, longevity, and reproduction traits in Holstein dairy cows. Both types of models involved similar fixed and random effects except for the month effect.

Trait	Model	AIC	BIC	Likelihood Ratio Test
Milk yield (kg/day)	1M	220720	220725	8966.0
	3M1	229686	229691	
Milk composition, %				
Fat	1M	-4012	-4007	2175.1
	3M1	-6187	-6182	
Protein	1M	-21464	-21458	1401.4
	3M1	-22865	-22860	
Productive life (months)	1M	270444	270449	16844.0
	3M1	287288	287293	
Life time (months)	1M	281552	281557	22708.0
	3M1	304260	304265	
Age at first service (days)	1M	374608	374613	124626.0
	3M1	499234	499239	
Gestation length (days)	1M	280168	280173	28154.0
	3M1	308322	308327	
Non-return rate%	1M	-49321	-49315	1589.4
	3M1	-50910	-50905	

We further calculated AIC, BIC, and LRT parameters through various models for each trait. For all productive and longevity traits, estimates of AIC and BIC were almost similar (Table 7). Moreover, single-month classes minimized AIC and BIC compared to double-month and triple-month classes. The largest LRT for single-month and triple-month classes belonged to milk yield (8966) among production traits. This estimated statistics was higher for life time compared to productive life (22708 vs. 16844). The highest decrease in information criteria using single-month classes was recorded for AFS as reproduction index (124626 for both AIC and BIC). In parallel, the estimated LRT for AFS trait was also the largest among other traits (124626). The LRT statistics was also more evident for GL (28154) compared to NRR trait (Table 7). The estimated LRT was important for all production, longevity, and reproduction traits.

3.3. Antagonistic relationship of estimated genetic parameters and model efficiency indices

Variance components and estimated genetic parameters for models containing single-month or triple-month effect are presented in Table 8 for production/longevity and reproduction indices. As was previously shown, the inclusion of single-month classes into both fixed and mixed models minimized MSE substantially compared to triple-month classes for all evaluated traits. We did expect that these best models with least error variance would maximize the accuracy of heritability estimates and EBVs. However, in conflict with ‘best’ model indicators (adjusted R-square, MSE, AIC, BIC, and LRT), the estimated additive genetic variance and heritability were lower using models containing single-month for production, longevity, and reproduction indices (Table 8). Variance component studies indicated that even though lower residual variances were achieved through single-month classes, their comparatively lower additive genetic variance estimates resulted in lower heritability estimates. The difference was evident between estimated heritability from single- and triple-month classes for life time trait (0.15 vs. 0.11).

Table 8. Estimated genetic parameters using models containing either each month (1M) or each three successive months (3M1) as a class for production, longevity, and reproduction traits in Holstein dairy cows. Both types of models involved similar fixed and random effects except for the month effect.

Trait	Model	Additive Genetic Variance	Residual Variance	Heritability	Mean EBVs Accuracy (%)
Milk yield(kg/day)	1M	6.728	17.550	0.28	59.5
	3M1	6.790	17.643	0.28	60.2
Milk composition, %					
Fat	1M	0.646	0.247	0.21	55.1
	3M1	0.659	0.252	0.21	54.8
Protein	1M	0.339	0.153	0.18	50.1
	3M1	0.354	0.160	0.18	51.3
Productive life (months)	1M	53.628	484.573	0.11	44.1
	3M1	57.532	480.138	0.12	46.4
Life time (months)	1M	53.241	484.744	0.11	45.1
	3M1	74.530	484.640	0.15	48.1
Age at first service (days)	1M	1.273	136.407	0.01	30.7
	3M1	114.473	716.333	0.14	54.2
Gestation length (days)	1M	1.648	36.208	0.04	41.9
	3M1	3.234	49.340	0.06	45.4
Non-return rate%	1M	0.0020	0.1212	0.02	33.3
	3M1	0.0034	0.1339	0.02	37.8

The difference between estimated heritability through 3M1 and 1M classes was more obvious for reproduction trait; particularly AFS showed a 14 fold increases in the estimated heritability. Furthermore, we estimated average EBVs accuracy from single-month and triple-month models. In agreement with higher values of additive genetic variance and heritability, higher estimates of mean EBVs accuracy were achieved for triple-month classes in reproduction and longevity traits. The improvement was more intense for AFS (30.7% for single-month vs. 54.2% for triple-month). A similar trend was noted for PL (44.1% vs. 46.4%) and LT (45.1% vs. 48.1%). Since reproduction traits are less heritable than production and longevity traits, the impact of any gain in average EBVs accuracy of these traits is more important than those obtained for production and longevity traits. This indicates that model survey could be an appropriate approach for higher estimation of genetic parameters and average EBVs accuracy for fertility indices.

4. Discussion

In this study, various year compartments for birth, first insemination, and calving dates were assessed on production, reproduction, and longevity traits. Adding first service date to birth date effect in the model has considerably increased the model's ability in describing phenotypic variation of reproduction traits. Considering each month as one category resulted in the best model for fertility indices. This superiority was more significant for age at first service. Significance of season effect on dairy cows fertility has been reported (Jamrozik *et al.*, 2005, Ansari-Lari *et al.*, 2009, Pritchard *et al.*, 2012). Results of the current study indicated that a descending order in the model's ability was observed for all production and longevity indices as follows: 1M, 2M1, 2M2, 3M1, and 3M2. Based on the initial results for MSE and adjusted R-square, we selected models containing 1M for all production, reproduction, and longevity traits. For comparison, models containing 3M1 was also used as currently employed models. There was a positive association between MSE and information criteria for all evaluated traits; lower MSE favors lower AICs and BICs. AIC and BIC indices are based upon ML estimates and represent the best model (Ward, 2008). In agreement with Norberg *et al.* (2004), our results from AIC and BIC were completely in favor of the LRT results.

Finally, estimated heritability and mean EBVs accuracy which are the main indicators for animal breeders were explored. The findings of this study indicated that unlike MSE and information criteria, single-month effect caused lower accuracy of both heritability and EBVs. The drop in estimated genetic parameters was substantial for AFS trait. In agreement with our finding, higher residual variance had a positive association with higher estimations for heritability and mean EBVs accuracy (Neves *et al.,* 2012). Lower estimation of residual variance but higher estimation of heritability using triple-month effect compared to single-month effect may indicate existence of a confounding effect either between single-month (1M) fixed effect and additive genetic random effect or between month of insemination and the duration of two successive inseminations due to synchronization issue, within a 21 days interval. It seems that in our study, the less efficient models for fixed effect favors higher estimates for both additive genetic and residual effects yielding higher estimates of heritability. This interaction was considerably high for traits which were defined as duration time, whereas production traits which are not length index did not notably differ by single- or triple-month definition. This strongly indicates that date-influenced traits should be carefully viewed for season definitions. In agreement with our finding, the influence of environmental fixed effects on additive genetic and residual variances have been reported in beef cattle and broiler chicks (Mulder *et al.,* 2009; Neves *et al.,* 2012). We suggest considering the tradeoff between lower MSE and higher EBVs accuracy, mainly due to the season effect inclusion in the model, for genetic evaluation of these traits in Holstein dairy cows. Additionally, considering seasons and their combination with herd as a random effect can also be helpful for further elucidation of season effect on EBVs accuracy.

5. Conclusion

Results from this study showed that fine-tuning of season definition at birth-, first service-, and calving-date could improve model efficiency for production, reproduction, and longevity traits. In addition, lower Log L, AIC, and BIC were produced in models containing lower residual variance. Surprisingly, these models with lower MSE caused lower estimates for heritability and mean EBVs accuracy. Our results indicated the presence of a confounding effect between fixed season effects and random additive genetic effects for fertility and longevity traits.

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قل تعريف الموسم للتحليل الجيني للاخصوبة والإنتاجية، وطول العمر الصفات في هولشتاين الإيراني الأبقار الحلوب

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خلاصة

للآثار البيئية الثابتة اثر على التأثيرات الجينية العشوائية والمتبقية. قمنا في هذه الدراسة بتقييم اثردمج تأثير فئات الاشهر المختلفة كتأثير بيئي ثابت على تقدير المتغيرات الوراثية في انتاج وتناسل وطول العمر في الأبقار هولشتاين الإيرانية. تم جمع البيانات من الأبقار هولشتاين، في أصفهان احدى مقاطعات إيران من عام 1993 إلى عام 2009. أولا، تم تحليل البيانات (53908 سجلا) باستخدام النموذج الخطي العام (GLM) في حزمة SAS الاحصائية. أسفرت فئة الشهر الواحد أقل (MSE) وأعلى مربع–R. استخدمت احتمال (REML) وأفضل (BLUP) لتقدير المتغيرات الوراثية وقيم التربية (EBVs) من أفضل النماذج، والتي تضمنت تأثير الشهر الواحد مقارنة مع الشهر الثلاثي المدمج (الموسم الفلكي المعياري في نصف الكرة الشمالي) باعتباره النموذج التقليدي. توافقت نتائج تحليل التباين (ANOVA) و MSE و AIC و BIC، ان احتمال الموسم التقليدي ادى الى مستويات اعلى من MSE. لكن، الموروثات المقدرة وعدلات الدقة التالية EBVs كانت أعلى بكثير، عند تم تحليلها باستخدام تعريفات بديلة للموسم.

في الختام، أظهرت نتائج هذه الدراسة علاقة تبادلية كبيرة بين أفضل MSE، AIC، BIC، و LRT ومؤشرات النموذج "الغير منحازة". والأهم من ذلك، كان أثر هذا الخلط أكثر وضوحا في صفات التناسل والسن عند الخول في الخدمة لأول مرة (AFS) على وجه الخصوص. ومع ذلك، هناك حاجة إلى تقييم ابقارهولشتاين الحلوبة في مختلف أنحاء العالم لتحديد أهمية الحصول على النموذج الأمثل المتعلق بتأثير التنبؤات العشوائية.

كلمات البحث: الخصوبة، المتغيرات الجينية؛ هولشتاين، نموذج، الموثوقية.