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Canonical Correlation Analysis for Studying the Relationship Between Reproductive Traits and Milk Yield Traits of Brown Swiss Herd Raised at The State Farm of Konuklar in Konya Province

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Abstract: This study was carried out to investigate the relationship between reproductive traits and milk yield traits of Brown Swiss herd by using canonical correlation analysis. Data collected for 185 Brown Swiss cows, maintained at the state farm of Konuklar in Konya province. One of the set (Y set) was consisted of reproductive traits that were gestation period (GP), first service age (FSA), first calving age (FCA), service period (SP), calving interval (CI), number of insemination per (NIPC) and the other set (X set) was constituted of lactation milk yield (LMY) and lactation length (LL). The first canonical correlation coefficient between the two sets was 0.625 ($P<0.01$) and the second was 0.225 ($P>0.01$) respectively.

Key words: Brown Swiss, canonical correlation analysis, reproductive traits, milk yield traits

Introduction

Milk yield and reproduction traits are the most important indicators for the success of dairy cattle farms. For this reason, the relationships between milk yield and reproduction traits must be exposed to increase the success of dairy cattle farms. There were several studies in which canonical correlation analysis was used. Cottle (1988) determined the relationships between blood metabolites and fleece weight by using canonical correlation analysis. There was a significant correlation between total protein and fleece weight in the study.

Camussi *et al.* (1990) used canonical correlation analysis for studying the relationship between blood samples and body measurements of Chianina, Marchigian and Romognola young bulls.

Kocabas *et al.* (1998) studied the relationships among body measurements of Kilis Goat kids by using canonical correlation analysis. Researchers reported the canonical correlation coefficient between height and width measurements as 0.779 ($P<0.01$).

Tatar (1999) investigated the relationship between suckling period traits (X set) and fattening period traits (Y set) of Ile de Franee x Akkaraman crossbred male lambs by using canonical correlation analysis. There was a high canonical correlation coefficient (0.730) between two sets. Also high canonical correlation coefficients (0.730-0.850) between the sets of weaning weight and suckling period and the set of fattening traits were determined.

Thomas and Chakravarty (1999) used canonical correlation analysis for studying the relationship between growth and reproductive traits with breeding efficiency and real production ability.

This study was carried out to determine the canonical correlations between reproductive traits and milk yield traits of Brown Swiss cattle.

Materials and Methods

Data for the analysis were extracted from 185 Brown Swiss Cattle raised at The State Farm of Konuklar in Konya province. Gestation period (GP), first service age (FSA), firs calving age (FCA), number of insemination per conception (NIPC), calving interval (CI) and service period (SP) constituted the reproductive traits and lactation milk yield (LMY) and lactation length (LL) were accepted as milk yield traits.

Canonical correlation analysis enables the researchers to explain the relationships between two sets of variables set such as X and Y (Tatlidil 1996, Özdamar 1999).

It is supposed that the first team contains p variables; the second team contains q variables and also $p \leq q$. In this situation, it is possible that a correlation coefficient between the each linear combination of the variables of the first and second team can be calculated. Just like this a lot of combination couples can be taught. However, one of the correlation coefficients calculated from this combination couple is maximum. This correlation coefficient is called the first canonical correlation and the linear combination of the variable teams used for this correlation is also called "the first canonical variables" (Gürbüz, 1989).

Explained variance determines how much variance of observed variables is expressed by canonical variables for each set. The level of this proportion can obtain us to express whether the eigen values of analysis matrix used to calculate canonical correlations between variable sets is enough or not to interpret the correlation which really observed between the two sets.

Results and Discussion

The simple correlation coefficient between reproductive traits and mi1kyield traits of Brown Swiss cattle are given in Table 1.

The highest correlation coefficient were calculated between FCA and FSA (0.857); LL and LMY (0.648); CI and LMY (0.349) and SP and LMY (0.494).

The first canonical correlation coefficient between reproductive traits and milk yield traits was found as 0.625 ($P<0.01$). This calcu1ated value is higher than the correlation coefficient between reproductive traits and milk yield traits in Table 1 (CI and LMY 0.349; between SP and LMY 0.494).

Table 1: The correlation coefficients between reproductive traits and milk yield traits

Traits	GP	FCA	FSA	NIPC	CI	SP	LMY	LL
GP		0.302±0.0705	0.278±0.0710	0.046±0.0738	0.072±0.0737	0.065±0.0738	0.143±0.0732	-0.016±0.0739
FCA	0.302±0.0705**		0.857±0.0381	.306±0.0704	0.007±0.0739	-0.043±0.0739	0.029±0.0739	-0.019±0.0739
FSA	0.278±0.0710**	0.857±0.0381**		0.235±0.0719**	0.001±0.0739	-0.055±0.0738	0.007±0.0739	0.040±0.0739
NIPC	0.046±0.0738	0.306±0.0704**	0.236±0.0718**		-0.014±0.0739	0.107±0.0735	0.069±0.0737	0.084±0.0737
CI	0.072±0.0737	0.007±0.0739	0.001±0.0739	-0.014±0.0739		0.397±0.0678**	0.349±0.0693**	0.322±0.0700**
SP	0.065±0.0738	-0.043±0.0739	0.055±0.0738	0.107±0.0735	0.397±0.0678		0.494±0.0643**	0.595±0.0594**
LMY	0.143±0.0732	0.029±0.0739	0.007±0.0739	0.069±0.0737	0.349±0.0693	0.494±0.0643**		0.648±0.0563**
LL	-0.016±0.0739	-0.019±0.0739	-0.040±0.0739	0.084±0.0737	0.322±0.0700**	0.595±0.0594**	0.648±0.0563**	

**: Statistically significant ($P< 0.01$).

Table 2: The correlations between canonical scores of X and Y sets

	W_1	W_2
V_1	0.5177	0.4887
V_2	-0.0006	-0.0011
V_3	-0.0712	-0.0672
V_4	-0.0111	-0.0169
V_5	0.1365	0.1211
V_6	-0.1814	-0.1589

Table 3: The correlation coefficients between reproductive traits and their own canonical variables

Traits	V_1	V_2	V_3	V_4	V_5	V_6
GP	-0.0772	0.1792	0.1635	0.2669	-0.0892	-0.1922
FCA	-0.0060	0.5197	0.4213	0.9865	-0.0617	-0.0302
FSA	0.0297	0.8622	0.7907	0.8637	-0.0493	-0.0407
NIPC	-0.1230	0.1576	0.1334	0.2845	-0.1366	0.1301
CI	-0.4100	-0.1924	-0.1352	0.11 06	0.5701	-0.4380
SP	-0.9982	0.0604	0.2072	-0.1091	-0.5182	0.6276

Table 4: The corre1ation coefficients between milk yield traits and their own canonical variables

Traits	W_1	W_2
LMY	-0.9983	-0.9997
LL	-0.6910	-0.6289

The second canonical correlation coefficient between reproductive traits and milk yield traits was found as 0.225 ($P<0.01$).

Linear combination of variables which obtains the highest canonical correlation was determined as follows;

$V_1=0.0239GP-0.0966FCA+0.0802\ FSA-0.0428NIPC-0.0249CI-0.9840SP$

$W_1=-0.3467LMY-0.7398LL$

The first canonical correlation coefficient (0.625) is equal to correlation coefficient V_1 and W_1 values calculated for each animal. The correlations between canonical scores of X and Y sets are given in Table 2.

Although the canonical variables are artificial, calculating the correlation coefficients between indexes of V_1 and W_1 and Original variables interpret them. Because these correlation coefficients indicate the contribution amount of whichever one original variable to the canonical variable.

The correlation coefficients between reproductive traits and their own canonical variables were given in Table 3. It can be seen from Table 3 that SP ($r = -0.9982$) has the most effect on the formation of V_1 canonical variable, FSA has the most effect on the formation of V_2 and V_3 canonical variables and also FSA and FCA have the most effect on V_4 canonical variable.

The correlation coefficients between milk yield traits and their own canonical variables were given in Table 4. LMY has the most effect on the formation of W_1 canonical variable ($r= 0.9983$) in Table 4.

In this study, calculations showed that 39.79 % of the variance of the standardized traits of X set (GP, FCA, FSA, NIPC, CI, SP) can be explained by the first canonical variable of X set traits and also 32.52 % of the total variance of e standardized traits of Y set (LMY, LL) can be explained by the first canonical variable of Y set traits.

The first canonical correlation was statistically significant but the second hasn't. Therefore the relationship between reproduction traits and milk yield traits in be explained by the first canonical correlation coefficient ($r=0.6255$) and canonical variable ($V_1=0.0239GP-0.0966FCA+0.0802FSA-0.0428NIPC\ 0249CI-0.9840SP$; $W_1=-0.3467LMY-0.7398LL$).

Consequently it can be said that the canonical correlation coefficient between reproduction traits and milk yield traits is high and reproductive traits can be used as a fine approach for estimating the milk yield traits.

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