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LINEAR MODELS OF REGRESSION AND CORRELATION AS AN AID TO FORE-CASTING THE POTENTIAL AND SPEEDING UP SELECTION OF THARPARKAR COW

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The modern and economical system of animal breeding requires early selection of dairy animals during the course of lactation. The object of present study was to estimate certain statistical parameters for extrapolating future performance, which will help as an aid to the breeder to make early decisions of rating the animals without waiting for the full lactation yield and in the evaluation of bulls with reasonable standard of reliability. 217 calvers of Tharparkar breed maintained at Rakh Ghulaman Farm were considered in the study. Partial and multiple effects of first four monthly records on the total lactation yield were studied. Milk yield in the first four months were 11.92, 16.9, 15.45 and 13.9% respectively. Reliability of the estimates of the prediction model was 14.73 % considering first month only and when first four months were taken into account simultaneously, it increased to 84.42 %.

INTRODUCTION

In Agriculture, new varieties have been evolved in short span where as in livestock (except poultry) the pace of development is slow due to longer generation interval. The usual practice ofselection/culling is to wait for till the lactation is completed. The modern and economical system of animal breeding requires early selection of dairy animals during the course of lactation. The object of the present study was to estimate certain statistical parameters for extrapolating future performance, which will help as an aid to the breeder to make early decisions about selection of animals without waiting for the full lactation yield with reasonable standard of reliability. Much emphasis has been laid on the technology of statistical models and analysis as a future guideline for the researchers in Animal Husbandary.

MATERIAL

The data pertaining to 217 calvers of Tharparker breed cows maintained at the Livestock Experiment Station, Rakh Ghulaman during 1972-76, utilized in the present study were taken from the Department of Animal Breeding & Genetics, University of Agriculture, Frisalabad.

Records affected by accidential factors (Permanent/Serious Sickness or Premature/Still Birth) were deemed abnormal and were not coneidered in the study.

METHOD

Thedata were subjected to Multiple Regression and Correlation analysis using the general linear model in Matrix notation :-

$$Y = XB + U$$

The model is used to regrees the endogeneous variable Y(total milk yield) in the exogeneous variables – first four monthly records X_1, X_2, X_3, and X_4.

$$S^2 = \frac{1}{N-K} \quad (Y'Y - B\ X'Y) \qquad \text{Var (B)} = \qquad (X'X)^{-1}\ S^2$$

First month milk record was taken as exogeneous variable in the regression analysis. Simultaneous effect of first two records was used to examine reduction in the sum of squares. Reduction in sum of square attributable to the use of additional monthly milk records was also worked out as shown in the table below :

Source.	d. f.	Sum of squares.
I egression on K variables.	P	$\lessgtr b : (\lessgtr x : y)$
Residual.	n-P-1	By subtraction
Total.	n-1	$\lessgtr y^2 i$

Kultiple correlation R was computed to examine the combined effect of the first four monthly milk records on the total milk yield.

$$R^2 = \frac{B'\ X'Y - \frac{1}{N}\ (\lessgtr Y)^2}{X'Y - \frac{1}{N}\ (\lessgtr Y)^2} \quad \text{or} \quad = \frac{\text{Regression sum of spuares}}{\text{Total sum of squares}}$$

R^2 - the coefficient of determination also reveals the explained portion of variability and when adjusted for degrees of freedom, R^{-2} is a statistic that measures concomitant covariation between the dependent variable Y and the set of independent variables X Null Hypothesis :Ho : Bi = O tested through the Regression Analysis.

REVIEW OF LITERATURE

Dutt *et al.* (1964) found highly significant correlation of 0.50, 0.74 and 0.86 between 305 day milk yield and cumulative yields for the first 15-, 75- and 135-day yield respectively in Hariana cows. Lamb and McGilliard (1967) worked on Holstein and found out the phenotypic correlations between cumulative and total production by adding one to nine months were 0.68, 0.81, 0.87, 0.91, 0.93, 0.95, 0.97, 0.98 and 0.99 respectively. Adding a second month to the first contributed the largest increase in accuracy of predicting complete lactation, and the correlation exceeded 0.9 by the time the 4th month was added. Ivanov *et al.* (1969) worked out correlation between 300-day milk yield and 30-, 60-, 90-, 120-, 150-, and 200-day yield. The respective estimates were 0.708, 0.733. 0.791, 0.800, 0.845 and 0.845 in pure bred Danish Red cows, and 0.750, 0.802, 0.718, 0.860, 0.907 and 0.934 in cross bred.

RESULTS AND DISCUSSION

Average milk yield and contribution of each part lactation relative to the total production were computed and are presented in Table 1.

Table 1. *Means and & contribution of* monthly *lactations on total lactation yield.*

Part-Lactations	Mean Kg. of milk.	Contribution	
		Subsequent parts %	Cumulative parts %
First month X_1	157.5	11.92	11.92
Second month X_2	223.3	16.90	28.82
Third month X_3	204.02	15.45	44.27
Fourth month X_4	183.6	13.90	58.16
Total Yield Y	132.46	100.00	100.00

Estimates of regression and correlation on the total production (Y) and different lactation parts X_1, X_2, X_3 and X_4 were worked out and are presented in Table 2, 3, 4 and 5.

Table 2. *Simple and partial regression coefficients with standard errors.*

Independent variable,	b Y1	b Y2	b Y3	b Y4
X_1	2.3222 ± 0.4335	--	—	—
X_1, X_2	0.2913 ± 0.0983	3.9542 ± 0.1319	-- —	—
X_1, X_2, X_3	0.5506 ± 0.237	1.0302 ± 0.3179	3.9027 ± 0.4179	—
X_1, X_2, X_3, X_4	0.7742 ± 0.1853	0.677 ± 0.2486	1.376 ± 0.3267	3.2185 ± 0.2755

Table 3. *Reduction in the total sum of squares attributable to regression of Y on X' and testing significance of regression.*

Source of variation.	d. f.	Sum of Squares.	Mean Square.	F. Ratio
Total	116	12 12 82 339.0	—	—
Reduction due to X_1	1	17867413.6	17867413.6	37.15**
Error for testing X_1	215	103414925.4	480999.7	—
Reduction due to X_2 after fitting X_1	1	68351974.6	68351974.6	276.35**
Error for testing X_2	214	52930364.0	247338.2	—
Reduction due to X_3 after fitting X_1, X_2	1	90666753.2	90666753.2	630.79**
Error for testing X_3	213	30615586.8	143735.1	—
Reduction due to X_4 after fitting X_1,X_2,X_3	1	101655758.0	102655758.0	1168.35**
Error for testing X_4	222	18626581.0	87861.2	

** Significant at 1% level.

Table 4. *Correlation coefficients and coefficients of determinations.*

Correlation Coefficients		Coefficient of Determinations	
		Unadjusted R^2	Adjusted
RY.1	= 0.3838	14,73	14.73
RY.12	= 0.7507	56.36	56.15
RY.123	= 0.8646	74.75	74.51
RY.1234	= 0.02	84.44	84.42

Table 5. *Lineat models for predicting total yield on the basis of part lactations and reliability of the estimates.*

Variables	Prediction models.	Reliability estimates %	Subsequent increase in accuracy.
First month X_1	$Y = 955.85 + 2.3222\ X_1$	14.73	—
First 2 months X_1 and X_2	$Y = 392.75 + 0.2913\ X_1 + 3.9542\ X_2$	56.15	41.63
First 3 months X_1, X_2 and X_3	$Y = 207.91 + 0.5506\ X_1 + 0.677X_2 + 3.9027X_3$	74.51	18.39
First 4 months X_1,X_2,X_3 and X_4	$Y = 176.59 + 0.7742\ X_1 + 0.677X_2 + 1.376X_3 + 3.2185\ X_4$	84.42	9.89

A sufficiently high degree (56.15%) of reliability in prediction is at the second month. The increase at the third month was 18.39% and therefore the rate (9.89%) was slow. However, total potential of the animal can be predicted with a reasonable high degree (84.42%) of reliability through the prediction model taking into account the milk yield of the first four months.

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