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Regression Factors for Extending Part Lactation Milk Records in Buffaloes

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A LEAST SQUARES analysis of variance was carried out to calculate uniquely two sets of regression factors for predicting 12-month milk records from single-month and cumulative monthly records, respectively. The data included sets of monthly milk records of 2832 normal lactation of buffaloes corrected for farm, parity, and season of calving effects. The best single months for predicting a complete record, judged by the squared correlation coefficients, were the 8*th* and 7*th* months, respectively. Cumulative monthly records, when available, would be more practical for use in predicting complete lactation records. The accuracy of prediction increased from 0.62 for the first month alone to 0.92 for the first seven months together.

The milk yield of a dairy animal is the manifestation of its genotype under a given set of environmental conditions. In field data, milk records of varying duration are obtained. The desirability of utilizing all available information in assessing an animal's genetic potentiality for milk production has increased the importance of part lactation records. These records could be converted to complete equivalent records of a standard duration to reduce variation resulting from the influence of the length and the stage of lactation, and to predict month-by-month and total milk output of a dairy animal.

The purpose of this study was to calculate simple regression factors based on single-month or cumulative monthly records for extending incomplete records to 12-month-lactation equivalent free of the effects of farm, purity and season of calving.

Material and Methods

Data

Sets of monthly milk records of 2832 normal lactations of buffaloes with at least 150-day lactation period, and not affected by any abnormal conditions were used in the study. The records were obtained in kilograms of milk from eight herds belonging to the meat and Milk Organization and collected during the period from 1964 to 1969 (2130 records), and the herd of the College of Agriculture, Cairo University at Giza (702 records accumulated during the period from 1931 to 1969). Only 914 records of animals who had completed 12-month lactations were used in computing regression factors for predicting total milk yield from cumulative monthly records.

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Construction of the regression factors

Overall least squares means for the monthly milk yield were estimated, and were used in calculating sets of regression factors for predicting 12-month lactation records from single - month or cumulative monthly records. The 12-month lactation period was adopted rather than the standard 10-month lactation period since the calving interval was larger in buffaloes than in most European breeds of cows kept under essentially the same conditions (Ragab *et al.* 1954, and Asker *et al.* 1958).

The usual normal equations were solved to estimate the desired regression factors. The sums of squares and cross products in the normal equations were adjusted for farm, parity and season of calving, *i.e.* the coefficient matrix consisted of farm-, parity-and season of calving-corrected sums of squares and cross products. The right hand sides of the normal equations were farm-, parity-, and season of calving-corrected sums of cross products. The criterion for determining the accuracy of prediction was the square of the correlation coefficient (r^2) between a single-month or a cumulative-monthly record and the complete record, since it would measure the amount of variability in the complete lactation yield which was accounted for by the single monthly records or by the cumulative monthly records. It should be noted that r^2 is an appropriate measure of accuracy if the only purpose is to predict total yield. If selection is based on the predicted recorder, progress due to selection is proportional to r rather than r^2. All analysis were performed after Harvey (1960).

Results and Discussion

Single-month factors

The regression coefficients for estimating total lactation milk yield from single-month records are given in Table 1. The best single months for predicting a complete record, judged from their coefficients of determination (r^2), are the *8th*, *7th* or *4th* months, respectively. Prediction of a complete record from any of the first two monthly records did not appear accurate enough to warrant consideration as a practical method of estimation. The last two monthly records were slightly better predictors.

Madden *et al.* (1955). presented data which indicated that in cowsthe 5th month was the most accurate in predicting a complete lactation record. The *4th*, *6th* or *7th* months were nearly as accurate. Van Vleck and Henderson (1961) also found that the best months for predicting total lactation yield were the *4th.*, *5th*, and *6th* months of lactation. They accounted individually for 72% of the variation in the complete records.

Records which are extended may be those not yet complete, in order to obtain preliminary evaluations, or those which are incomplete because of buffaloes leaving the herd prior to the completion of the records.

The general form of the prediction equation for estimating a complete record (12-month basis) from a single monthly record is

$$y = u_y + b_m (x_m - u_m), \quad m = 1,2, \ldots 12. \qquad (1)$$

Where y is the predicted complete record (corrected for farm, parity, and season of calving),

u_y is the farm ; parity ; and season of calving-corrected over all mean of the complete records,

b_m is the regression coefficient associated with the $_m$*th* month of lactation.

x_m is the farm, parity, and season of claving corrected yield for the $_m$*th* month of lactation.

and U_m is the farm, parity, and season of calving corrected mean of records of the m*th* month of lactation.

TABLE 1. **Regression factors for predicting complete lactation milk records from single monthly milk records**

Months	1	2	3	4	5	6	7	8	9	10	11	12
(1)												
b	3.59	4.11	5.09	5.85	6.01	6.50	6.83	6.96	6.10	5.78	4.33	4.25
S_b	0.18	0.19	0.18	0.17	0.18	0.18	0.17	0.16	0.18	0.17	0.18	0.21
r^2	0.16	0.18	0.25	0.33	0.26	0.29	0.36	0.38	0.30	0.32	0.22	0.20

(1) b = regression coefficient,
S_b = standard error of the regression coefficient, and
r^2 = accuracy of the predicted value.

TABLE 2. **Regression factors for predicting complete lactation milk records from cumulative monthly milk records**

Months	1	2	3	4	5	6	7	8	9	10	11
(1)											
b	4.52	2.63	1.94	1.62	1.41	1.27	1.18	1.12	1.07	1.04	1.02
S_b	0.21	0.32	0.42	0.45	0.47	0.46	0.43	0.39	0.35	0.28	0.19
r^2	0.63	0.72	0.77	0.82	0.86	0.89	0.92	0.94	0.96	0.97	0.99

(1) b = regression coefficient,
S_b = standard error of the regression coefficient, and
r^2 = accuracy of the predicted value.

As an example of the prediction procedure, suppose that the farm-, parity-, and season of calving-corrected means are those given in Table 3, and that the record of a buffalo in the 7th month was 172.5 kg of milk. Thus, an estimate of the 12-month equivalent record is

$$y = 1790.30 + 6.83\ (172.50 - 152.50),$$
$$= 1926.90 \text{ Kg of milk.}$$

TABLE 3. **The overall least squares means of the farm, parity, and season of calving-corrected monthly milk records (U_m) and their corresponding standard errors (SE)[1].**

	Months of lactation											
	1	2	3	4	5	6	7	8	9	10	11	12
U_m	165.0	186.6	182.1	181.5	169.1	162.6	152.5	139.9	127.7	117.6	105.8	99.9
SE	4.77	4.55	3.58	3.31	2.80	2.68	2.68	2.72	3.03	3.50	11.70	7.21

(1) In kilograms of milk.

Cumulative monthly factors

The regression factors for predicting a complete record from cumulative monthly records (Table 2) were computed from the records of those animals which had completed 12-month lactations. It seemed that these factors were more accurate predictors than those based on the single-monthly records. The accuracy of the predicted values, judged by the magnitude of the coefficients of determination (r^2) associated with the cumulative records, were higher. The amount of variation in the total milk yield which was accountd for by the first month was 0.63. The record of the first two months accounted for 0.72 of the variation. Four months of cumulative information accounted for more than 80% of the variation in total milk yield, and about 90% of the variation in total milk yield was determined by the milk produced in the first seven months of lactation. Cumulative monthly records, when available, would be more practical than single-month records for predicting complete lactation yield. Fewer factors could be required and more accurate results would be obtained.

The use of the model presented in equation 1, can be extended to predict a complete lactation record from cumulative monthly yield. Yet, the definition of the subscript m should be changed to denote the months included in the cumulative record from the first up to the m^{th} month. As an example,

suppose that the cumulative milk yield of the first five months of lactation of a buffalo was 854.30 Kg, and given Uy = 1790.30 Kg, and um = 884.30 Kg., then

$$y = 1790.30 + 1.41\ (854.3 - 884.3).$$

$$= 1748.09 \text{ Kg of milk.}$$

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معاملات الانحدار لاطالة سجلات الحليب الجزئية فى الجاموس

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أجرى تحليل التباين بطريقة « الحد الأدنى للمربعات » لحساب مجموعة من معاملات الانحدار للتنبؤ بكمية اللبن الكلية – على أساس أن طول موسم الحليب الكامل ١٢ شهرا – من أنتاج اللبن الشهرى ومن أنتاج اللبن التراكمى فى عدة شهور متتالية أبتداء من الشهر الاول من موسم الحليب **بعد ازالة تأثير المزرعة وموسم الحليب وفصل الوضع .**

وقد شملت الدراسة سجلات الحليب الشهرى لمواسم حليب كاملة (٣٥٠ يوم أو أكثر وغير متـــأثرة بأى ظروف غير ضبيعية) عددهـــا ٢٨٣٢ . وقد كانت أفضل الشهور المنفردة لتقدير ناتج اللبن الكلى هى الشهر الثامن أو الســـــابع على التوالى ، حيث كان لهـا أكبر دقة (٣٨ر٠ ،٣٦ر٠)٠ أما بالنسبة لتقدير ناتج اللبن الكلى من الأنتاج التراكمى – الذى أستعملت فيه الســـجلات الكـــاملة فقط – فقد أتضـــح أن دقة التنبؤ من ناتج اللبن ترتفع من ٦٣و٠ من الشـــهر الأول فقط الى ٩٢ر٠ اذا كـــان التقـــدير من الشهور السبعة الأولى معا . وعموما فان ناتج اللبن التراكمى – اذا توفرت عنه المعلومات الكافية – يكون أسهل حسابا وأكثر دقة فى تقدير نـاتج اللبن الكلى .