ACCURACY OF MILK YIELD ESTIMATION IN DAIRY CATTLE FROM MONTHLY RECORD BY REGRESSION METHOD

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ABSTRACT

This experiment was conducted to estimate the actual milk yield and to compare the estimation accuracy of cumulative monthly record to actual milk yield by regression method. Materials used in this experiment were records relating to milk yield and pedigree. The obtained data were categorized into 2 groups i.e. Age Group I (AG I) that was cow calving at < 36 months old as many as 33 cows with 33 lactation records and AG II that cows calving e" 36 months old as many as 44 cows with 105 lactation records. The first three to seven months data were used to estimate actual milk yield. Results showed that mean of milk yield/ head/ lactation at AG I (2479.5 ± 461.5 kg) was lower than that of AG II (2989,7 ± 526,8 kg). Estimated milk yields for three to seven months at AG I were 2455.6±419.7; 2455.7±432.9; 2455.5±446.4; 2455.6±450.8; 2455,64 ± 450,8; 2455,5 ± 459,3 kg respectively, meanwhile at AG II was 2972.3±479.8; 2972.0±497.2; 2972.4±509.6; 2972.5±523.6 and 2972.5±535.1 respectively. Correlation coefficients between estimated and actual milk yield at AG I were 0.79; 0.82; 0.86; 0.86 and 0.88, respectively, meanwhile at AG II were 0.65; 0.66; 0.67; 0.69 and 0.72 respectively. In conclusion, the mean of estimated milk yield at AG I was lower than AG II. The best record to estimate actual milk yield both at AG I and AG II were the seven cumulative months.

Keywords: Milk Yield, Records, Regression Method

INTRODUCTION

Milk is one of dairy products which are needed by human in various range of age. Increasing inhabitants every year followed by the increase of knowledge and society life standard tends to increase the demand for animal protein from cattle, especially milk. It means that the need for milk will also increase every year, thus it has to be followed by the increase of milk yield.

Dairy cattle breeding program is expected to be able to increase milk yield for every cow. The important steps which are necessary to be taken in an excellent animal breeding program are application of recording system including pedigree, reproduction, milk yield etc. It is clear that milk yield record can show the information about condition of cows either individually or grouped, management evaluation, as the basis of precise long term planning and decision making in dairy cattle farm (Ojango and Pollott, 2001; Danish Cattle Federation, 2006).

Most cows enrolled in a milk recording program in the US have had milk weight recorded monthly (Voelker, 1981). Many of the new plans require less labor for recording milk weight and collecting component sample, thereby reducing cost to the producers (Norman *et al.*, 1999). In Indonesia, the most dairy cattle farms have been recording the daily milk yield. Of course, this is not efficient. Alternatively, applicable recording system is a periodical record. Monthly or bimonthly records can be used to estimate the actual milk yield of 305 days in a lactation period. It was stated by Vasconcelos *et al.* (2004) that daily yield on test day is potent source of information for dairy cattle genetic evaluation and herd management.

It was stated by Lee and Wardrop (1984) that estimation of milk yield as a basis for herd

management decision and estimation of of lactation yield for use in cow and sire evaluation are objectives of milk recording. Study had consistently shown that the most important factors in estimating milk yield of the remainder of the lactation are the last available daily yield record and the number of days remaining to 305 d in milk (Danel, 1982).

According to the reason mentioned above, it is necessary to carry out experiment to estimate the actual milk yield using monthly records. The objective of this study was to estimate actual record from three to seven cumulative months by regression method.

MATERIALS AND METHODS

Materials

Materials used in this experiment were milk yield of 138 lactation records obtained from Naksatra Kejora Rawaseneng Farm-Temanggung, Central Java. Data used pedigree, date when milking started and desiccation. The obtained data in this experiment were categorized into 2 groups on the basis of age of calving. The first group was Age Group I (AG II, that was the first lactation) as many as 33 cows with 33 lactation records. Meanwhile, AG II as many as 44 cows with 105 lactation records (from 2nd to 9th lactations). The purpose of this categorization is to know the difference of milk yield in both age groups. Records data from each cow was from 270-335 days in lactation period. Data s used in this experiment was taken monthly after calving.

Methods

Method used to estimate dairy product in this experiment was a regression (Van Vleck and Henderson, 1961a). This method used milk yield record from the first three until seven cumulative months. The three cumulative month data was obtained by summing the first, second and third month records, as well as for the following cumulative months (4, 5, 6, and 7).

The actual dairy product is the real milk yield during one lactation period. In this experiment the actual product was obtained by summing daily milk yield records during 305 days or depends on the lactation period of the cows. Estimated milk yield for 305 days (w) by regression method was obtained by multiply w with 30.5 (assumption of average day in a month).

Statistical Analysis

According to Van Vleck and Henderson (1961[a]), the formula of regression method was:

$$\hat{y}_{(k-i)} = \mu_y + b_{k-1}\left(X_{k-1} - \overline{X}_{k-i}\right) \quad \text{.....(1)}$$

$\hat{y}_{k-i}$: Estimated milk yield of the first i cumulative month.
μ_y : Mean of milk yield on the first 10 cumulative months.
b_{k-I} : Regression coefficient of the first i cumulative month.
X_{k-I} : Dairy product of the first i cumulative month.
$\overline{X}_{k-i}$: Mean of milk yield on the first i cumulative month.

Regression coefficient can be known by the following equation:

$$b_{k-1} = \frac{n\left(\sum X_{(k-i)}X_{k-10}\right) - \left(\sum X_{k-1}\right)\left(\sum X_{k-10}\right)}{n\left(\sum X_{k-i}{}^2\right) - \left(\sum X_{k-i}\right)^2} \quad \text{.....} \quad (2)$$

X_{k-i} : Milk yield of the first i cumulative month.
X_{k-10} : Milk yield of the first 10 cumulative months.
n : Number of cows

The estimated milk yield during one lactation period (305 days) was obtained by multiply the estimated milk yield with 30.5:

$$\hat{yr}_{305(k-i)} = \hat{y}_{(k-i)} \text{ x } 30,5 \quad \text{.....} \quad (3)$$

$\hat{yr}_{305(k-i)}$: Estimated milk yield during one lactation period by regression method
30,5 : Assumption of average day in a month

RESULTS AND DISCUSSION

Milk Yield

Dairy cattle productivity is depend on age of calving, body size, lactation period, calving interval

Table 1. Milk Yield According to Age Group

Age Group	Number of Cows	Number of Lactation	Mean and Standard Deviation (kg)
I	33	33*	2479.48 ± 461.54
II	44	105**	2989.69 ± 526.57

* The first lactation ; ** The second until ninth lactation

and management (Sudono, 2002); Anggraeni, 2008). The mean of dairy product in each cow per year from this experiment (Table 1) was 2479.48±461.54 kg at Age Group I (AG I) and 2989.69 ± 526.57 kg at AG II.

The milking activity in this experiment was conducted twice a day. Mean of milk yield in AG I was lower than that of AG II. This fact was relating to the opinion of Hedah *et al.* (1994) that age of calving was very influential to the milk yield. Sudono (2002) stated that the difference in this production caused by the cows calving above 3 years of age will produce more milk than those cows that were calving under 3 years of age. According to the observation of lactation period, increasing of milk yield is going along with lactation until maximum production on the third lactation (Anggraeni, 2008).

The mean of milk yield at AG I in this experiment was lower than the experiment result reported by Anggraeni (2008) in which first lactation was about 4083 ± 1329 kg, and first to forth lactations were about 4558 ± 1326 kg. The low milk yield at AG I in this experiment was caused by differences of environment such as temperature, humidity, and altitude. In addition to it, the low milk yield also can be caused by the quality of cows and problems in care management. Sudono *et al*. (2003) suggested that it needs adequate feeding to the cows that were still in reproduction or during lactation to fulfill their needs, basic and milk yield. If the quantity and quality of foods given were inadequate, then the productivity could not be optimal.

The mean of cows age on their first calving at Naksatra Kejora Farm was 29.21 months. If compared to experiment done by Anggreani (2008) with cows at BPPT-SP Cikole which mean of cows age on their first calving was 32.6 months, then the results of this experiment was younger. This condition was profitable because the lifetime for production will be longer.

Table 2. Mean of Milk Yield Estimation by Regression Method at Age Group I and II

Cumulative Production Months *	Mean of Milk Yield (kg) by Regression Method	
	AG I	AG II
3	2455.61 ± 419.70	2972.34 ± 479.80
4	2455.71 ± 432.90	2972.35 ± 497.20
5	2455.54 ± 446.40	2972.41 ± 509.60
6	2455.64 ± 450.80	2972.53 ± 523.60
7	2455.5 ± 459.30	2972.50 ± 535.10

Table 3. Correlation Coefficient between Estimated and Actual Milk Yield at Age Group I and II

Cumulative Production Months *	Correlation Coefficient	
	AG I	AG II
3	0.796	0.652
4	0.822	0.658
5	0.857	0.674
6	0.857	0.693
7	0.881	0.722

Milk Yield Estimation

The mean of milk yield estimation by regression method at AG I and AG II are presented in Table 2. In that table, the mean of milk yield at AG I was lower than milk yield at AG II. This fact in agreement with Siregar (1993) that milk yield will keep increasing as cows get older, starting from 2 years until 7 or 8 years old. This increase was pointed to the growing cows will put the body weight gain, thus tissues in the udder will also increase.

Calculation result of the correlation between estimated and actual milk yield at AG I and AG II are presented in Table 3.

Correlation obtained by this method showed that correlation was increasing along with the increasing number of lactation months. It means that the more months use to estimate, the closer estimated milk yield to actual milk yield. The highest correlation achieved was in the 7^{th} cumulative month as much as 0.88 at AG I and 0,72 at AG II. Obviously, more number of cumulative month used, the accuracy of milk yield estimation also increase (Norman *et al.*, 1999).

The results of this experiment were in agreement with experiment result of Van Vleck and Henderson (1961b) with 9036 FH cows at 274 dairy farms in New York. They stated that the best months to estimate dairy product in 305 days were the 3^{rd}, 4^{th}, 5^{th}, and 6^{th} month. The correlation was 0.85 for those three months. Meanwhile values for the first until ninth cumulative months were 0.57; 0.75; 0.82; 0.87; 0.90; 0.93; 0.95; 0.97 and 0.99.

When compared to Van Vleck and Henderson (1961b), the obtained correlation in this experiment was lower. It might be caused by the difference of milk yield during 10 months, weather and environment factors, also the cow's genetic factor. This correlation showed that there was a close relationship between estimated and actual milk yield, thus regression method can be used to estimate milk yield during lactation months.

CONCLUSION

The mean of estimated milk yield at PT. Naksatra Kejora Rawaseneng at AG I was lower than AG II. The correlation value by regression method is increasing along with the increasing number of lactation months. The best month to estimate milk yield both ata AG I and AG II were cumulative seven months.

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