Actual and Prediction Body Weight Performance from Birth Until of 18 Months of Age in Dairy Cattle Friesian Holstein

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Abstract. The aim of this research is to get the body weight performance and growth pattern of Friesian Holstein dairy cows from birth to 18 months. This study used monthly weight data of dairy Friesian Holstein cows from birth to 18 months (508 head). Obtained standard equation of body weight by using logistic regression model \( \hat{y} = 363.53/e^{1+6.57e^{-0.21(x)}} \) (Se = 14.78 ; \( r = 0.989 \)), inflection point occurs at age 10 months (body weight 232.4 kg). The actual body weight of calves at birth until the age of 2 months is lower than the weight of the alleged body. The actual body weight of the calf aged 3 to 6 months is higher than the body weight of the estimation and the actual body weight of the calf above the estimation weight standard. The actual body weight of 7-9 months is still higher than the weight but at 10-12 months the actual body weight is lower than the expected weight, (puberty phase) that will affect growth. Month at 13-16 actual body weight is lower than the weight of the estimation body, as well as the previous month that is the first period of lust and puberty.

1. Introduction
Dairy cattle diversity plays an important role in the development of dairy cattle breeding. Currently some dairy farms have been managed in the form of commercial dairy farms and some are still smallholder farms, unstructured populations and have not used a targeted breeding system. The development of dairy cattle breeding has considerable potential in reducing the dependence on imports of dairy products and the importation of dairy cattle. Therefore, the government is obliged to foster and create a business climate that supports the business of dairy cattle breeding so that it can produce livestock seeds to meet the needs of quantity and quality according to the standard, in addition to providing facilities for increasing the added value of seed products.

Balai Besar Pembibitan Ternak Unggul (BBPTU) Dairy Cattle Baturaden is a government-owned hall that plays a role of quality dairy cows and get dairy cows with optimal milk production performance for the benefit of national dairy farmers. This hall has a recording system for the purpose of selecting superior seeds and improving milk production performance that can serve as the basis of information to conduct selection on livestock.

Efforts to select quality seeds to obtain dairy cows with high milk production continue to be pursued. Standards that can be used as the basis for selection are body weight, age of first child and milk production performance. Quality of seed and milk production performance is influenced by external factors and internal factors. These factors include environmental, physiological conditions of livestock, body weight achievement in accordance with the age of livestock, genetics, feed (quality and quantity), and maintenance management. The management of cattle raising from birth to adult livestock is important. It is very influential on the reproduction and production of milk.

Achievement of body weight from birth to age 18 months and ideal age of the first child will enable the birth of calves with a good birth weight and produce milk with optimal production. The weight of the livestock body is usually assumed with survival and growth performance with milk productivity during lactation, so evaluation of the growth pattern, the age of the first child and the milk production performance becomes very significant in the management of dairy farming. Purpose and objective this
research is to get the performance of body weight and growth pattern of Fries Holland dairy cattle from birth to 18 months old.

2. Materials and Methods
This study used monthly weight record of dairy cattle at the BBPTU-HPT Baturraden. The data used are of monthly weight records from 2014-2017 as many as 8,696 records derived from 213 head. Data on monthly weight of dairy Friesian Holstein cattle at birth to 18 months the observed variables included Body Weight (kg) from birth weight to 18 months, cattle number, age of cattle, time of cattle birth and daily gain body weight

2.1 Statistical Analysis
Standard body weight and growth curve Body weight data obtained was analyzed by logistic regression equation model with the following formula:

\[ \hat{y} = \frac{a}{1 + be^{-cx}} \]  

Information:
\( \hat{y} \) = Estimation Body weight (Kg)
\( x \) = cattle age (month)
\( a, b, c \) = coefficients
\( e \) = natural number (2,718)

The accuracy of the model is determined by the standard error (Se), the correlation coefficient (r) between the estimated value with the actual value, the minimum body weight standard, and the estimated weight gain of the body to find the inflection point and the inflection weight [1] with the following formula:

a. Standard error (Se) = \( \sqrt{KTr} \) es , the smaller the value of Se, the better
b. The correlation coefficient (r) = \( \sqrt{(R^2)} \) 
   R2 is obtained from the formula R2 = (JK reg)/(JK total), the greater the value of r, the more accurate the estimator.
c. Standard Minimum Body Weight
   The minimum body weight standard is calculated by reducing the average body weight estimate (\( \hat{y} \)) by the standard error (Se) = \( \hat{y} - Se \)
d. Daily Gain Body Weight Estimation
   The weight gain of the estimation body is useful for obtaining the infectious point of age and body weight by using quadratic equation with the following formula:

\[ y = a + bx + cx^2 \text{ and } x = \frac{-b}{2c} \]  

Information:
\( y \) = Added Body Weight Estimation (kg)
\( x \) = Inflection Point (age)
\( a, b, c \) = coefficients
3. Result and Discussions

3.1 Result

Table 1. Standard Weight Body (actual, estimation and minimum standards) and Added Body Weight Estimation Friesian Holstein cow

| Month | Body Weight Actual (kg) | Body Weight Estimation (kg) | Standard Minimum (kg) | Average daily Gain Estimation (kg) |
|-------|------------------------|----------------------------|----------------------|-----------------------------------|
| 0     | 39.51                  | 55.88                      | 47.81                | -                                 |
| 1     | 54.68                  | 65.44                      | 57.37                | 0.32                              |
| 2     | 69.98                  | 76.26                      | 68.20                | 0.36                              |
| 3     | 88.62                  | 88.39                      | 80.33                | 0.40                              |
| 4     | 108.97                 | 101.82                     | 93.76                | 0.45                              |
| 5     | 127.35                 | 116.51                     | 108.45               | 0.49                              |
| 6     | 144.06                 | 132.35                     | 124.29               | 0.53                              |
| 7     | 157.55                 | 149.17                     | 141.11               | 0.56                              |
| 8     | 170.57                 | 166.75                     | 158.69               | 0.59                              |
| 9     | 185.48                 | 184.82                     | 176.76               | 0.60                              |
| 10    | 199.98                 | 203.07                     | 195.01               | 0.61                              |
| 11    | 216.94                 | 221.19                     | 213.13               | 0.60                              |
| 12    | 232.24                 | 238.87                     | 230.81               | 0.59                              |
| 13    | 249.54                 | 255.83                     | 247.77               | 0.57                              |
| 14    | 267.17                 | 271.85                     | 263.79               | 0.53                              |
| 15    | 283.44                 | 286.74                     | 278.67               | 0.50                              |
| 16    | 299.17                 | 300.39                     | 292.32               | 0.45                              |
| 17    | 317.29                 | 312.73                     | 304.67               | 0.41                              |
| 18    | 331.52                 | 323.77                     | 315.71               | 0.37                              |

3.2 Discussion

Based on the calculation results obtained equation logistic regression model \( \hat{y} = \frac{363.53}{1+6.576^{-0.21(x)}} \) and has standard value error (Se) 14.78 and correlation (r) between the estimated weight of the body with a very high actual body weight value is 0.99 close to 1 or 100%, which means that the greater the value of r then the body weight of the guesswork is more appropriate.

Table 1 shows that the actual body weight of calves at birth to age 2 months is lower than the Estimation body weight, but the results of this study is higher than the research conducted \([2, 3]\), namely birth weight to age 2 months in the tropics (36 kg, 45 kg and 62 kg \([4, 1, 5]\) that the normal birth weight in Indonesia is 35-40 kg, so the birth weight until the age of 2 months is still within the normal range. factors that cause low birth weight are genetics of the male and the parent, the age and condition of the cow's body when the conception, quality and maturity of the ovum when fertilized, the number of calves born, the nutrients of growth, the presence of infectious diseases and stress level from the parent \([2, 6]\). The preparation of rations for dairy cattle should be balanced, in accordance with the number and proportion of dairy cattle nutrient needs in 24 hours worthy condition \([7, 8,4]\). The actual body weight of the calf aged 3 to 6 months is higher than the body weight of the Estimation and the actual body weight of the calf above the Estimation weight standard. The greater the actual body weight indicates the maintenance and feeding management in BBPTU-SP Baturraden done well.

The actual body weight of 7-9 months is still higher than the Estimation weight but at 10-12 months the actual body weight is lower than the expected weight, this is because the cow begins to
enter the puberty phase so that it will affect growth. At puberty marked estrus and ovulation, the cow becomes more active as a result of reduced nutritional intake so as not to meet the nutritional adequacy for growth. which states that puberty or adult sex occurs before the adult body is reached, so that the cow will be more active at the time of preparation of the first mate so that the consumption of feed becomes lower than the cattle that have grown the body. Growth after puberty is slow, parallel to the increase in adult body weight [2, 9, 10, 11].

Month 13-16 actual body weight is lower than the weight of the Estimation body, as well as the previous month that is the first period of lust and puberty. Based on calculation result obtained by quadratic equation that is \( y = 0.2264 + 0.0739x + 0.037x^2 \) and \( x = \frac{(-0.0739)}{2(0.0037)} \), so got infection point at age 10 months with a body weight of 232.4 kg.

Figure 1 shows the weight gain of the Estimation body and the inflection point seen at the age of 10 months with an infectious weight of 232.4 kg. Age 10-12 months is the period of puberty, where before the growth curve will take place rapidly and after puberty growth will slow again [1, 12]. the logistic regression model growth curve has advantages in accuracy and has good biological interpretation in explaining inflection points and inflection weights [1, 11, 13, 5].

Figure 2 shows that the growth curve of Friesian Holstein female cow in BBPTU-SP Baturraden is shaped sigmoid curve according to logistic model. The pattern of actual body weight growth and Estimation body weight does not very much, it is shown by mutual its coincided actual body weight line and weight of the estimation body on each month. Friesian Holstein cattle growth curve from conception to adult with a sigmoid or "S" curve has accelerated to the inflection point and undergoes a slowing phase until it reaches adulthood. The rate of growth is accelerated to the point of inflection, usually associated with puberty is the body weight of 10-12 months [10, 5] which is the most decisive weight for further livestock productivity [6, 13], because after puberty the growth will slow back to reach adulthood. The inflection point occurs in the virgin after a rapid phase growth indicating that the livestock is experiencing puberty. The age of puberty in cows under normal feeding conditions is 9 months, but may range from 5 to 15 months [4, 12, 5].

4. Conclusion
Based on the results of the analysis and discussion can be drawn conclusion that:

The standard weight equation \( \hat{y} = 363.53/1 + 6.57e^{-0.21x} \) with Se = 14.78 and r = 0.989, follows the sigmoid curve according to the logistic regression model. Based on quadratic equation that is \( y = 0.2264 + 0.0739x + 0.037x^2 \) and \( x = \frac{(-0.0739)}{2(0.0037)} \), got inflection point that is 10 months age with body weight 232.4 kg
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