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Prediction of annual egg production based on part year egg production in Nageswari ducks of Assam

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Abstract
Records on part year egg production of 106 Nageswari ducks belonging to Katigora Block of Cachar district and Ratabari Block of Karimganj district of Assam were utilized to predict annual egg production. Both simple and multiple regression equations were developed for studying the dependency of annual egg production up to 72 weeks (EP 72) of age on the basis of egg production up to 40 weeks (EP 40) and 56 weeks (EP 56) of age. The R^2 values of these equations were 24.18, 71.71 and 71.73 percent on the basis of 40 weeks egg production, 56 weeks egg production and combination of both 40 and 56 weeks egg production respectively.

Keywords: Egg production, prediction equation, Nageswari duck

1. Introduction
Raising ducks, compared with that of chicken, has several advantages like lower replacement costs, reduced space requirements, lesser feeding, exigencies and higher disease resistance, tremendous market potential considering its elite nutrient make up and nearly organic system of production [5]. The rate of egg production is the most important trait in layers because it ultimately determines the number of eggs produced in a given period of time. Nageswari ducks, popularly known as 'Nagi', is one of the important egg type native varieties of duck found only in a few areas of the Cachar and Karimganj districts of Assam [13]. These ducks have garnered attention for their prolific egg-laying capabilities, contributing significantly to the region's poultry industry. Understanding and accurately predicting their annual egg production is crucial for efficient management and planning within the sector. However, obtaining data for an entire year can be time-consuming and resource-intensive. Thus, there arises a need for predictive models that can estimate annual egg production based on partial-year data.
Annual egg production could be improved by selection based on part period egg production [10]. When selection is based on partial or cumulative part egg production then generation interval will be decreased [7]. Selection based on the early part of the egg record for improvement in annual production is a standard practice in poultry breeding [3, 7]. In the present investigation an attempt was made to predict the annual egg production of Nageswari ducks using data from 40 and 56 weeks of egg production. By leveraging part-year data, we aim to develop regression equations that can offer reliable forecasts for the entire year, spanning 72 weeks.

2. Materials and Methods
The present study was conducted on 106 Nageswari ducks belonging to Katigora Block of Cachar district and Ratabari Block of Karimganj district of Assam reared traditionally under free range system of management. For prediction of annual egg production on the basis of part year egg production, simple as well as multiple regression equations were developed and their reliability were tested by the statistic R^2 as per the method given by Steel *et al*. [12].
The form of simple regression equation was:

$$\hat{Y} = a + b_i x_i$$

Where,
$\hat{Y}$ = Predicted value of the dependent variable Y, i.e. the economic trait in questions

a= Intercept
b_i= Linear regression coefficient of the i^{th} independent variables on Y
x_i = Record of the i^{th} independent variable

The form of the multiple regression equation was:

$$\hat{Y} = a + b_1 x_1 + b_2 x_2 + \ldots\ldots\ldots\ldots + b_n x_n$$

Where,
$\hat{Y}$ = Predicted value of the dependent variable Y
a = Intercept
b_1 …… b_n = Partial regression coefficient
x_1 …… x_n = Records of the independent variables

3. Results and Discussion

In order to predict annual egg production (EP 72) on part year egg production up to 40 (EP 40) and 56 (EP 56) weeks of age, simple and multiple regression equations were developed as given below.

Table 1: Linear regression equations to predict EP 72 ($\hat{Y}$) along with their coefficient of determination (R^2 values) in Nageswari ducks of Assam

Regression equation	R^2 value (percent)
$\hat{Y} = 39.9385 + 1.0947\ x_1$	24.18
$\hat{Y} = -24.8531 + 1.5844\ x_2$	71.71

From the above equations it was evident that prediction of annual egg production (72 weeks) on the basis of 56 weeks egg production had a higher R^2 value (71.71 percent) than that based on 40 weeks egg production (24.81percent). However, Misra *et al.* (1992) [8] reported much higher value of R^2 (=90.44 percent) to predict annual (68 weeks) egg production on the basis of part record (56 weeks) egg production in White Leghorn breed of chicken. Goswami (1998) [4] also reported comparatively higher value of R^2(=81.717 percent) when 56 weeks egg production was used to predict annual (72 weeks) egg production in Khaki Campbell, desi and graded ducks of Assam. AI-Samarai *et al.* (2008) [2] used simple and multiple regressions to estimate prediction equations for the whole egg production from partial and cumulative egg production in White Leghorn hens. It was concluded that the choice of favorable prediction equations in dealing with partial egg production were depended on second and third month production, whereas first 3 or 4 months could be the best choices in case of cumulative egg production.

Table 2: Multiple regression equation to predict EP 72 ($\hat{Y}$) along with their coefficient of determination (R^2 values) in Nageswari ducks of Assam

Regression equation	R^2 value (percent)
$\hat{Y} = -25.7199 + 0.0364\ x_1 + 1.5671\ x_2$	71.73

Where,
x_1 = egg production up to 40 weeks
x_2 = egg production up to 56 weeks

In the present study, a higher value of R^2 (=71.73 percent) was obtained when both (40 weeks and 56 weeks) egg productions (x_1, x_2) were used to predict annual (72 weeks) egg production. Higher value of R^2 (=82.040 percent) was also reported by Goswami (1998) [4] when 40 and 56 weeks egg production were used to predict annual (76 weeks) egg production in Khaki Campbell, desi and graded ducks of Assam. Manjeet *et al.* (2019) [7] used multiple regressions analysis to predict 40 weeks egg production on the basis of part egg production and part cumulative egg production traits in Synthetic White Leghorn Strain. Prediction equation for 40 weeks egg production showed highest coefficient of determination (96 percent), when egg production at 36 weeks of age was taken in prediction equation with EPP4 (egg production during 36 to 40 weeks). However, when EP36 was taken into prediction equation with EPP2 (egg production from 29 to 32 weeks of age) or EPP3 (egg production from 33 to 36 weeks of age), the equation explained 90 percent of variation in 40 weeks (EP40) egg production. EP28 along with EPP1 (egg production from 25 to 28 weeks of age) explained 78% of the variation in 40 weeks egg production.
Abraham (2006) [1] adopted step wise regression analysis and developed prediction equations to estimate part term egg production up to 40 and 52 weeks of age from various segments of egg production, age and body weight at sexual maturity. The R^2 values of these equations were 82.5 percent, 92.9 percent, 70.2 percent and 79.4 percent, respectively. Kumar *et al.* (1997) [6] obtained the R^2 values in Guinea fowl for annual egg production up to 64 weeks of age based on EN40, EN44, EN48, EN52, body weight at 16 weeks of age and age at first egg in various combination, the maximum R^2 value was found to be 87.1 percent. With increase in the length of recording egg numbers the R^2 values for such equations increased from 53.3 percent to 87.1 percent. Similarly, Sakunthala Devi (2002) [9] predicted the values of the coefficient of determination, R^2 for the regression equations predicting EP64 from the combination of respective part records and age at first egg were as 35.03, 49.27, 55.19, 62.48 and 77.96 percent, respectively in White Leghorn hens. Increasing values of R^2 with increase in the duration of part record egg production was also reported by Singh *et al.* (1984), Mishra *et al.* (1992) [8] in White Leghorn breed of chicken and Goswami (1998) [4] in Khaki Campbell, desi and graded ducks of Assam.

4. Conclusions

Linear regression equation based on 56 weeks of egg production and multiple regression equation combining both 40 and 56 weeks of egg production were more reliable to predict annual egg production (EP 72). Therefore, it may be concluded that part year egg production records may be used for genetic improvement for annual egg production in Nageswari ducks of Assam.

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