The Relationship Between Age and Chick Weight

Introduction: Research was performed to study the relationship between the dry weight of chicks (lbs) and their age (days) for chicks raised in traditional high-density chicken farms. The ultimate goal was to compare the results with those for chicks raised in cage-free environments.

Methods: Data were collected on the weight (lbs) and ages (days) of high-density farm chicks which were between 6 and 16 days old. The relationship between these two variables was studied using correlation analysis and the following simple linear regression model:

$Y = \beta_0 + \beta_1 X + E$ where
Y = weight (lbs), X = age (days)
E is a random error term, assumed to be distributed $N(0,\sigma^2)$
β_0 is the true y-intercept, and β_1 is the true slope.

A 95% confidence interval (CI) for the average weight of median-age chicks was calculated from the estimated model.

Results: In our sample of 11 chicks, the mean age was 11 days (standard deviation, sd, 3.3 days) (Table 1); age was uniformly distributed (Figure 1A). Weights were strongly skewed, with a median of 0.26 lbs (interquartile range 1.05 lbs) (Figure 1B, Table 1).

Table 1. Chick Characteristics (n=11)

Characteristic	Mean (SD)	Median (Inter-Quartile Range)	Range
Age (years)	11.00 (3.32)	11.00 (6.00)	5 – 16
Weight (lbs)	0.70 (0.90)	0.26 (1.05)	0.03 – 2.81

Figure 1 A-B. Distributions of Age and Weight   Figure 2. Weight vs. Age
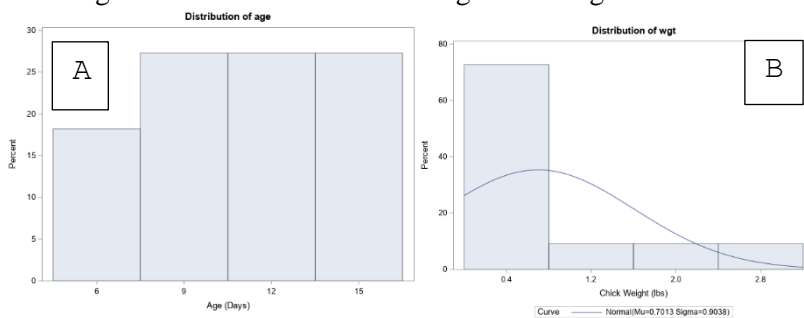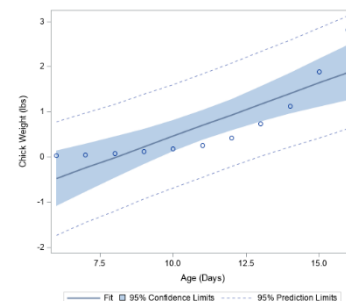

The correlation between age and weight was r=0.86 (95% CI 0.54 -0.96) The estimate of the regression model was $\hat{Y} = -1.88 + 0.24X$, with standard errors 0.53 (intercept estimate) and 0.05 (slope estimate). The model was significant ($p = 0.0006$), with $R^2 = 0.74$. The 95% confidence interval for the average weight of 11-day old chicks is 0.37 lbs to 1.03 lbs.

Comments and Conclusions: There is a statistically significant and strong correlation (r=0.86, 95% CI 0.54-0.96) between chick age and weight. For each 1 day increase in age, weight increases, on average, by 0.24 lbs (95% confidence interval 0.13 lbs to 0.34 lbs). At the median age of 11 days, the model predicts that average weight will be between 0.37 lbs to 1.03 lbs. Although the model explains 74%, a fairly large portion, of the variation in chick weight, it is apparent from Figure 2 that an alternative model, one which takes the observed curvature in the relationship into account, and for which the dependent variable is normally distributed, would be more appropriate.

```sas
*BIOS 591P Spring 2021;
*SLR Exercise Code;

DATA chick_weight;
INPUT age wgt;
LABEL age = 'Age (Yrs)';
LABEL wgt = 'Chick Weight (lbs)';
DATALINES;
6          0.029
7          0.052
8          0.079
9          0.125
10         0.181
11         0.261
12         0.425
13         0.738
14         1.13
15         1.882
16         2.812
;
RUN;

*Initial Descriptive Statistics;
PROC UNIVARIATE DATA=chick_weight;
  VAR age wgt;
  HISTOGRAM age;          *Examine distribution of age;
  HISTOGRAM wgt / NORMAL;  *Examine distribution of wgt...normal?;
  PROBPLOT wgt / NORMAL;   *Normal probability plot of mass;
RUN;

*Correlation analysis;

PROC CORR DATA=chick_weight FISHER(BIASADJ=NONE);
  VAR age;
  WITH wgt;
RUN;

*SLR analysis;
PROC REG DATA=chick_weight;
  MODEL wgt = age / CLB CLM;      *CLB produces 95% CI for slope and intercept;
  id age;                          *CLM produces 95% CI for average predicted weight;
RUN;                               *Could use CLI to produces 95% prediction interval for weight;
```