

ANALYSING GROWTH FOR SOME GENOTYPES OF CHICKENS

INTRODUCTION:

Growth in animals is a complex physiological process expressed by changes in body size and exists from conception to maturity. Analysing growth usually entails fitting mathematical functions to age-weight data. This has led to a variety of growth curves of various forms (e.g. monomolecular; logistic; Gompertz; and von Bertalanffy). They tend to reflect the lifetime interrelationships between an individual's inherent impulse to grow and mature in all body parts with the environment in which these impulses are expressed. Although various authors have successfully fitted these models to age-weight data in chickens, the use of three parameter Gompertz curve has received widespread support because of the biological ease of interpreting its three parameters. The parameters included are the initial body weight, the mature body weight and the rate of maturing. Due to difficulties in estimating initial body weight, the age at the point of inflection in the growth curve may be used in this respect.

The objective of this work was to estimate the growth curve parameters for some breeds of chickens and carry out some analyses of variance to test the existence of differences in the growth pattern for these breeds.

METHODOLOGY:

The following analysis is based on data collected for three breeds of chickens that were reared from day-old to 20 weeks of age receiving feed ad libitum and getting a free access to water. The breeds were the Barred Plymouth Rock, the indigenous Norwegian chickens (Jaerhons) and the commercial broilers. For this analysis results from only male chickens is presented. The chickens were weighed individually at the end of each two-week period.

The Gompertz equation used was of the form:

$$W = A e^{-e^{-B(t-t^*)}}$$

Where,

W = live-weight at time, t.

A = asymptotic body weight

B = rate of maturing, and,
t* = time at maximum growth

In order to estimate the three parameters for the three genotypes under study, I fitted the periodic body weight measurements to the Gompertz equation using PROC NLIN of SAS.

For the sake of getting a better precision of the estimates and for the purpose of making comparisons among the genotypes curves were fitted for each individual chicken. The results were further analysed using randomisation test where p-values were obtained for the hypothesis of no difference between the genotypes. A non-parametric bootstrapping was later used to get confidence intervals.

The randomisation test was done as follows:

- the estimates for each chicken for the three genotypes were stacked and then sampled to obtain a new sample of similar size to the original sample.
- using sum of squares as the test statistic 1000 iterations were made and comparisons were made for sum of squares in the new sample and that of the original data.
- the proportion of times the original sample produced values larger than those of the new sample produced the p-values for rejecting or accepting null hypothesis.

The non-parametric bootstrap was as follows:

- samples of size similar to the original samples were drawn at random with replacement 999 times and bootstrap means calculated.
- bootstrap means were then sorted and approximate 95% confidence limits were obtained by the percentile method.

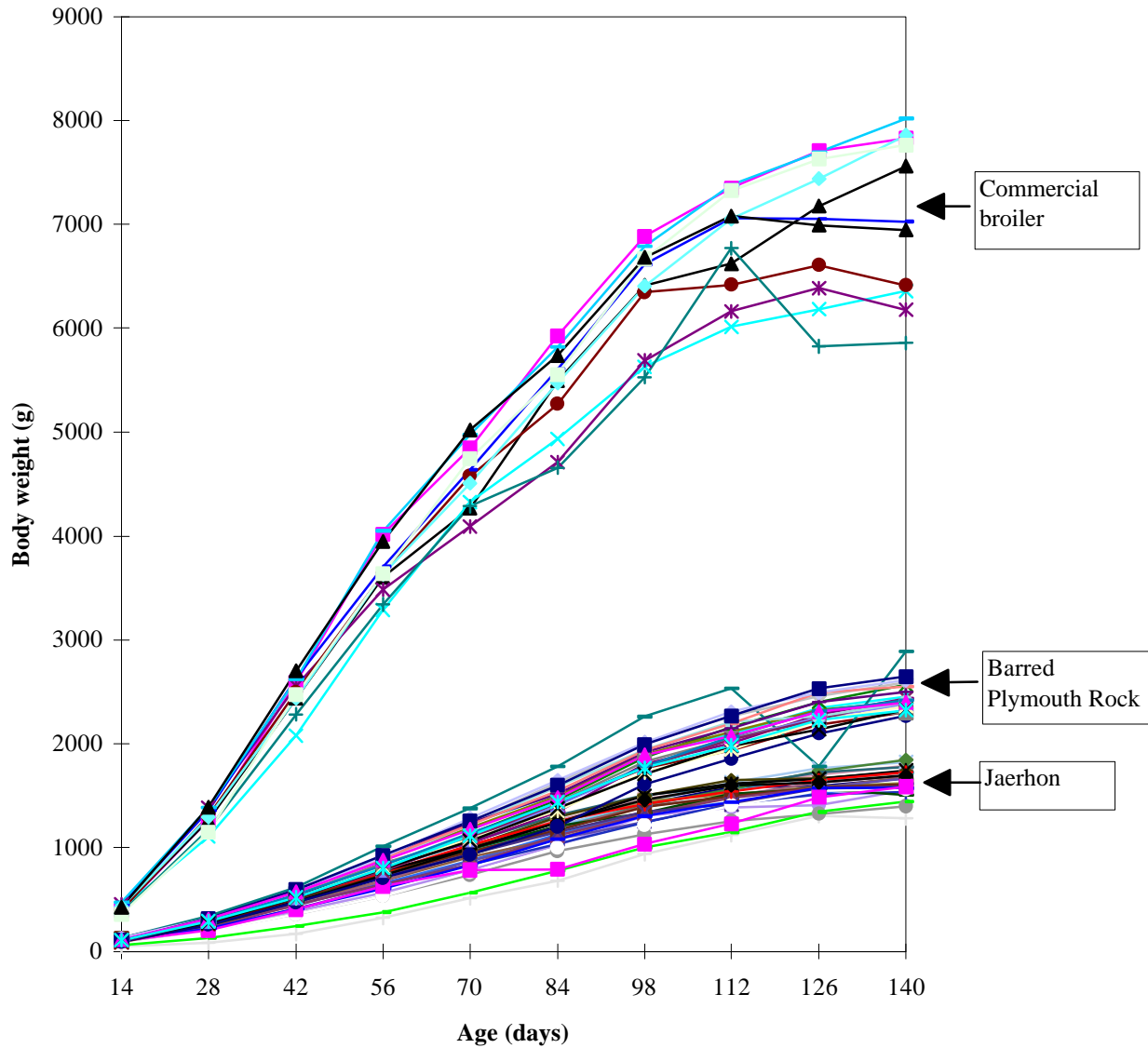
In addition to these analyses ordinary analysis of variance was done and descriptive statistics were also calculated.

RESULTS:

Graphical presentation:

The kind of data I worked with can be seen in the following graphical presentation of curves for three breeds of chickens.

Growth curves for the three breeds of chickens



The differences in the pattern of growth for the three breeds of chickens is very apparent from the graphical presentations. The curve for commercial broilers show a general agreement with the sigmoid nature of growth. Body weights increased with age in an increasing rate at the early ages but the rate tended to decline towards the end of the experimental period. This is not so clear with the other breeds of chickens where growth was almost linear for the major part of the growing period.

Analysis of variance:

When growth curve parameters from individual chickens were subjected to the analyses of variance the results from both randomisation test and ordinary analysis of variance showed that there were significant differences between the genotypes with regard to the growth curve parameters. The p-values were 0.001 for the randomisation test and 0.000 for the ordinary analysis of variance.

Confidence interval estimation:**Adult body weight:**

Confidence intervals for adult body weight estimated by the different methods are as shown in Table 1:

Table 1. Confidence interval estimation for asymptotic body weight

Method	Values	Breeds		
		Barred Plymouth Rock	Commercial broiler	Jaerhon
Proc NLIN (SAS)	estimate	3025.49	7539.99	1870.16
	std. error	70.81	150.32	45.06
	lower 95%	2885.93	7242.24	1781.44
	upper 95%	3165.05	7837.75	1958.88
Non-parametric bootstrap	estimate	3111.72	7412.92	1896.79
	std. error	47.97	254.04	39.23
	lower 95%	2982.61	7048.41	1837.99
	upper 95%	3172.72	8016.61	1988.72
Descriptive statistics	estimate	3069.90	7520.00	1906.00
	std. error	49.40	261.00	38.30
	lower 95%	2973.08	7008.44	1830.93
	upper 95%	3166.72	8031.56	1981.07

Except for the commercial broilers the estimates were in general higher for the non-parametric bootstrap and descriptive statistics when compared to those of Proc NLIN of SAS. However, the intervals were wider for Proc NLIN than for the other methods except for the commercial broilers where intervals were much wider the later methods.

Rate of maturing:

Confidence intervals for rate of maturing estimated by the different methods are as shown in Table 2:

Table 2. Confidence interval estimation for rate of maturing

		Breeds		
Method	Values	Barred Plymouth Rock	Commercial broiler	Jaerhon
Proc NLIN (SAS)	estimate	0.022	0.031	0.025
	std. error	0.001	0.002	0.001
	lower 95%	0.020	0.028	0.023
	upper 95%	0.024	0.035	0.027
Non-parametric bootstrap	estimate	0.022	0.030	0.027
	std. error	0.001	0.002	0.001
	lower 95%	0.021	0.030	0.024
	upper 95%	0.023	0.036	0.027
Descriptive statistics	estimate	0.022	0.033	0.025
	std. error	0.001	0.002	0.001
	lower 95%	0.018	0.029	0.021
	upper 95%	0.026	0.037	0.029

The estimates from the three methods were in close agreement with each other. However, the non-parametric bootstrap produced much narrower intervals compared to both Proc NLIN and descriptive statistics.

Time at maximum growth:

Confidence intervals for time at maximum growth estimated by the different methods are as shown in Table 3:

Table 3. Confidence interval estimation for time at maximum growth

		Breeds		
Method	Values	Barred	Commercial	Jaerhon

		Plymouth Rock	broiler	
Proc NLIN (SAS)	estimate	67.18	46.10	56.91
	std. error	1.37	1.08	1.34
	lower 95%	64.48	43.96	54.27
	upper 95%	69.89	48.24	59.55
Non-parametric bootstrap	estimate	67.42	46.70	59.34
	std. error	1.26	1.12	1.80
	lower 95%	65.74	43.71	55.13
	upper 95%	70.57	47.97	62.28
Descriptive statistics	estimate	68.17	46.00	58.53
	std. error	1.30	1.18	1.86
	lower 95%	65.62	43.69	54.88
	upper 95%	70.72	48.31	62.18

Non-parametric bootstrap produced higher estimates compared to other methods. Nevertheless, it produced narrower intervals compared to other methods except for the Jaerhon chickens.

CONCLUSION:

In general there is close agreement in the results from the different methods applied with respect to analyses of variance and confidence interval estimation. However, non-parametric bootstrap produce narrower confidence intervals compared to other methods. In this case any of the methods can be used for estimating growth curve parameters without much loss of precision.