

A PROBLEM INVOLVING THE LEXIS THEORY OF DISPERSION

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The attention of the author was recently directed to a study of the hatchability of chicken eggs at the U. S. Animal Husbandry Experiment Station, Beltsville, Maryland. It was necessary to find the average hatchability of the fertile eggs incubated for each of a number of lots of birds and the corresponding standard errors of those averages.

It was very apparent that some methods for computing such values, in common use at the present time, do not give satisfactory results. This is due to the fact that the fertile eggs produced by different birds vary considerably with respect to hatchability as well as with respect to number of eggs available for incubation. It seems reasonable to suppose that the variability in hatchability of a number of fertile eggs, produced by a given number of birds, should obey the Lexis law of dispersion. This supposition is based on two hypotheses:

(a) The probability that a fertile egg will hatch is constant for all fertile eggs produced by the same bird during the time interval under consideration.

(b) The probability that a fertile egg will hatch varies from bird to bird.

The reader familiar with the principles of genetics may question the validity of the first of these hypotheses. The probability that a fertile egg will hatch is largely governed by the genes carried by the chromosomes of the ovum of the hen and the sperm of the male bird which fertilized that ovum. The kinds of genes carried by various ova and spermatozoa are not necessarily the same, even when those ova and spermatozoa are produced by the same female and male birds, respectively. However, if we have a sample of a number of fertile eggs produced by the same hen, we are justified in assuming that the proportion of those eggs which will hatch is constant, except for sampling fluctuations, when successive samples of fertile eggs produced by the given hen are incubated, provided, of course, that the eggs in the successive samples were fertilized by the same male bird or birds. The limit approached by the proportion of fertile eggs which hatch as the number of fertile eggs produced by the given hen becomes infinitely large may be defined as the probability that a fertile egg produced by that hen will hatch. It will be recognized that this definition is based on purely academic considerations, since there are physical limitations to the number of fertile eggs which a hen can produce in a given period of time. Hypotheses (a) and (b) are to be interpreted in the light of this definition of the probability that a fertile egg produced by a given bird will hatch.

Let s_1, s_2, \dots, s_n represent the numbers of fertile eggs produced by n birds during a period of time and let f_1, f_2, \dots, f_n , respectively, represent the numbers