

MEASUREMENT OF DIVERSITY

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1. Introduction

The several measurements used by ecologists to measure diversity in plant and animal populations have been summarized by Pielou [6]. This present paper is concerned with an extension of the idea of diversity in plant populations and in particular with the description of data produced by a densitometer. Further papers applying the present ideas to actual forests counts where there is more than one observation to a cell will appear elsewhere.

2. The problem

A film is taken by an airplane flying over a natural forest. The film is put through a densitometer which prints out at equal intervals a letter corresponding to its optical density. In the particular experiment which was presented to us there were 120 letters printed out for the scan across the film, the letters being A through G inclusive. The number of letters for the scan down the film is dependent only on the length of the film. The optical density of the film and therefore the letter corresponding to it is supposedly representative of the type of tree. A measure of the clustering of the trees is required.

Essentially the same problem arises if the forest is gridded, the fuel bed computed for each square, and the results of the computations assigned to one or other of ten classes.

It will be recognized that if there are m letters one way and n letters the other the problem reduces to that of a board with $m \times n$ cells on which $m \times n$ letters are arranged, one letter to a cell, the arrangement under the null hypothesis being that of randomness.

3. Notation

Let there be s kinds of letters, with k_t of the t th kind. Denote

$$(3.1) \quad \sum_{t=1}^s k_t^{(r)} = K_r,$$

and

$$(3.2) \quad K_1 = mn = \sum_{t=1}^s k_t.$$

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