Fish Population Dynamics

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BIOSTATISTICS

- The amount of literature on statistical methods is staggering, so there is no problem if you want to do further studies in biostatistics. Only two references are given here. The book "Biometry" by Sokal and Rohlf (1981) deals with the theory in a rather accessible way, while "Sampling techniques" by Cochran (1977) is perhaps a bit more complicated, but still recommended as an introduction. However, there are many other textbooks which may be equally useful.

MEAN VALUE AND VARIANCE

- Let us consider a sample of n fish all of one species caught in one trawl haul and let x(i) be the length of fish no. i, i = 1,2,...,n. The "*mean length*" (in general the "*mean value*") of the sample is defined:

$$\bar{x} = [x(1) + x(2) + ... + x(n)]/n = \frac{1}{n} * \sum_{i=1}^{n} x(i) ....(2.1.1)$$

The two first columns of show an example for n = 27.
The variance, which is a measure of the variability about the mean value is defined as follows:

$$s^2 = \frac{1}{n-1} * \left[(x(1) - \bar{x})^2 + (x(2) - \bar{x})^2 + ... + (x(n) - \bar{x})^2\right] = \frac{1}{n-1} * \sum_{i=1}^{n} [x(i) - \bar{x}]^2 ....(2.1.2)$$

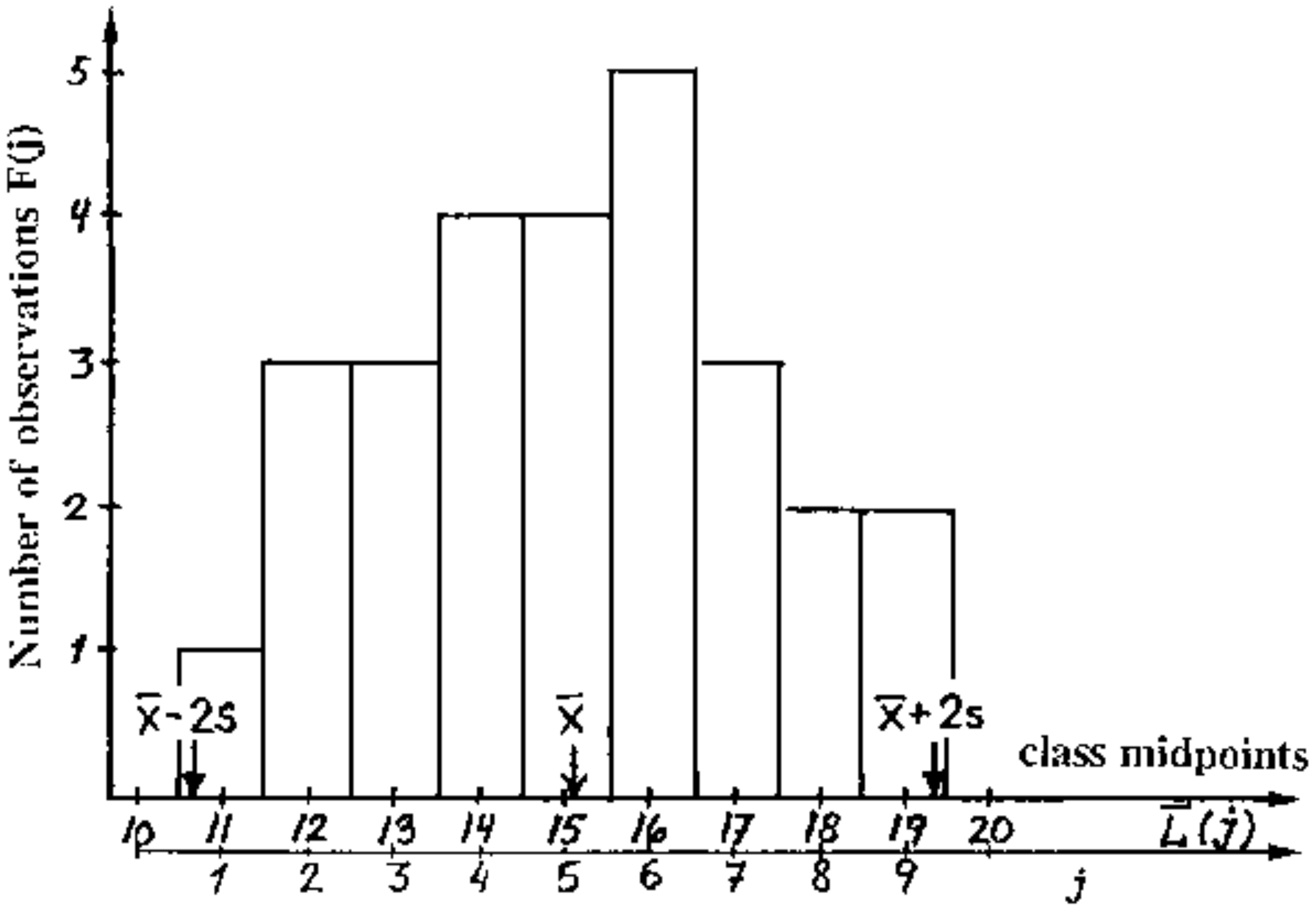
- Thus, the variance, s^2, is the sum of the squares of the deviations from the mean divided by the number, n, minus one. The third and fourth column of illustrate the calculation of the variance. Note that if all fish in the sample had the same length this would equal the mean length and the variance would be zero.

- The sum of the deviations (not squared) is always zero. The larger the deviations from the mean value, the larger the variance will be. The two largest values of the square of the deviations from the mean occurred for the smallest and the largest observations.

- The square root of the variance, s, is called the "*standard deviation*". Often one is interested in the variance relative to the size of the mean length, and for that purpose s is the relevant quantity as it has the same unit as the mean. This leads to the relative standard deviation, s/ , also X called the "*coefficient of variation*".
- When doing the calculations by hand it is easier to work with a rearranged form of Eq., which is equivalent to

$$s^2 = \frac{1}{n-1} * \left[\sum_{i=1}^{n} x(i)^2 - \frac{1}{n} * \left[\sum_{i=1}^{n} x(i)\right]^2\right] \text{..........}(2.1.3)$$

- However, as most scientific pocket calculators contain an option for automatic calculation of mean and variance the calculations here are illustrated by Eq. , which is conceptually easier to understand.
- For many purposes, e.g. for graphical representation, it is convenient to arrange the sample in the form of a "*frequency table*" by dividing the length range into a number of length intervals. The length range for the sample in goes from 11.2 to 19.0 cm. With length groups of 1 cm we need nine length groups to cover the range. Using 10.5 as the lower limit of the first length interval, the intervals and the frequencies of lengths become those shown in the first four columns of , which is a so-called length-frequency table.


Number of observations F(j)
5
4
3
2
1
x̄-2s
x̄
x̄+2s
class midpoints
10 11 12 13 14 15 16 17 18 19 20
L(j)
1 2 3 4 5 6 7 8 9
j