BASIC STATISTICS IN MEDICAL PRACTICE

Pages with reference to book, From 54 To 55

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The Variability of observations (Standard deviation)mean only defmes the general position of the distribution and other values of the distribution that are scattered or spread around it cannot be predicted by it. For this reason the mean alone is of limited value. The range is an important measurement as the figures at the top and bottom denote the trends as removed from generality. Range fails to give much indication of the spread of observations about the mean. This is where the standard deviation comes in. The theoreticalbasis of the standard deviation is complex but whenever a distribution is normal the standard deviation provides a useful basis for interpreting data. Many biological characteristics conform to normal distribution closely enough for it to be commonly used1.

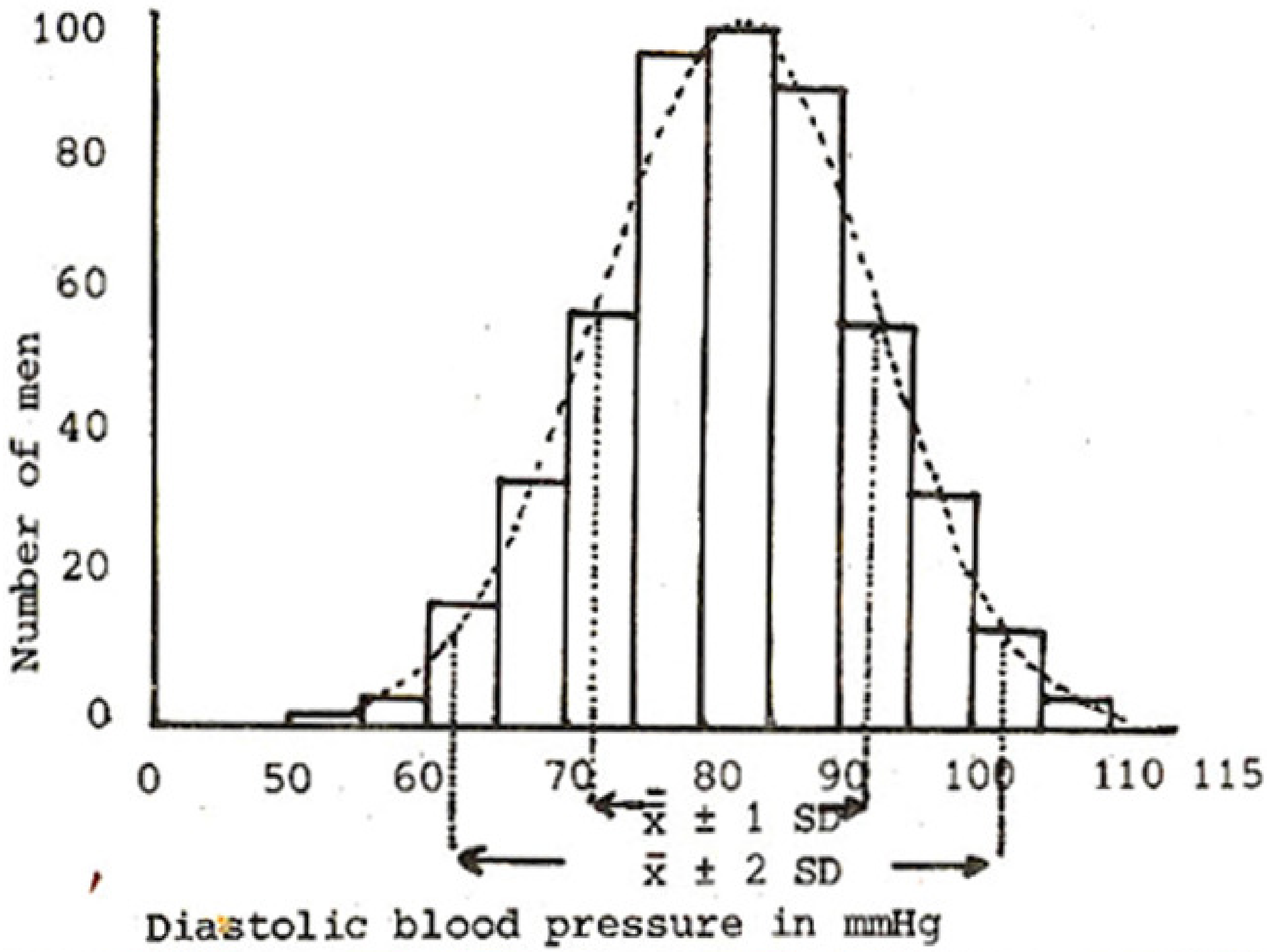

Figure 1. Normal (Gaussian) curve.

Figure shows the normal (Gaussian) distribution calculated from diastolic blood pressures of 500 men mean 82 mm Hg standard deviation 10mm Hg. The standard deviation is useful because if observations follow a normal distribution then mean ±ISD includes about 68% and mean ± 2SD covers about 95% of observations. However, the standard deviation can be calculated from the observations and the steps are as follows2:

1. List the observations and calculate the mean.
2. Alongside the listed observations write the difference between each value in turn and the mean.
3. These figures are now squared and added up, producing the sum of squares.
4. This sum of squares is divided by one less than the number of observations to produce the mean sum of squares or variance.
5. By taking the square root of the variance one obtains the standard deviation, which can lie on either side of the mean. Calculations using the height of ten subjects for standard deviation are shown in Table.

Table 1. Calculations using the height to the subjects for determining the standard deviation.

Height (in.) X	Difference from mean $(X-\bar{X})$	Square $(X-\bar{X})$
68	0	0
71	3	9
66	-2	4
60	-8	64
67	-1	1
65	-3	9
75	7	49
70	2	4
68	0	0
70	2	4
680	144 = sum of square $\sum (X-\bar{X})^2$	

The standard deviation is usually shown as mean ± 2S.D.
This mean and the scatter of values around it as described by two standard deviations is a much better way for expressing the results than just giving the range of values.

$$\text{Mean} = \frac{680}{10} = 68 \text{ in} \qquad \text{Variance} = \frac{\sum(X-\bar{X})^2}{n-1} = \frac{144}{9} = 16$$

$$\text{Standard deviation (S.D)} = \sqrt{\frac{(X-\bar{X})^2}{n-1}} = 16 = 4$$

Mean = 68 in., S.D = 4 in.

Therefore 68 ± 8 is Mean ± 2 S.D.

The two values which describe the limits of two standard deviations in either direction from the mean are 95% probability limits. Normal values for the laboratory data are commonly expressed in this way. In clinical pharmacology blood levels of drugs from limited numbers of subjects should also show the standard deviation to give the best idea of the total scatter of results. The number of estimations should also be given as for example, for 20 estimations of the serum protein: serum protein 6.7 ± 1.7 W100 ml2.

Standard error (S.E.):

It is the inherent variation from one sample to another. It shows the variability that the value would show if repeated samples are drawn from the same population. It is calculated by the formula: S.E = S.D /J~

where S.D. is the standard deviation of the observations and n is number of observation.

REFERENCES

1. Siddiqui, M.A. Role of Statistics in Medical Research. Pakistan Medical Research Council, pp. 30-37.

2. Hawkins, C., Sorgi, M. Research How to Plan, Speak and Write About it. R.J. Acford. Terminus Road Industrial Estate Chichester Sussex 1985; pp 140-141.