

### Measures of Dispersion

Measures of dispersion are used to describe the amount of scatter around the center of the distribution. They include range, mean deviation, variance, standard deviation, and coefficient of variation.

#### Range

This is simple the difference between the largest value and the smallest value.

#### Mean deviation

This is the mean absolute difference of each observation and averaged.

$$\overline{dev} = \frac{\sum_{i=1}^n |x_i - \bar{x}|}{n}$$

#### Variance

The formula for the populations is different that the formula for the sample.

Population variance is calculated as follows:

$$\sigma^2 = \frac{\sum_{i=1}^n (x_i - \mu)^2}{N}$$

Sample variance is estimated as follows:

$$s^2 = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n}$$

### Computer Formulation

The formulations are much easier to use when calculating these on a computer or calculator.

$$\sigma^2 = \frac{\sum_{i=1}^n x_i^2 - \frac{(\sum_{i=1}^n x_i)^2}{N}}{N}$$

$$s^2 = \frac{\sum_{i=1}^n x_i^2 - \frac{(\sum_{i=1}^n x_i)^2}{n}}{n - 1}$$

A simplified version

$$s^2 = \frac{\text{Sum } x^2 - \frac{(\text{Sum } x)^2}{n}}{n - 1}$$

### Standard Deviation

The standard deviation is the square root of the variance. The population standard deviation can be calculated as follows:

$$\sigma = \sqrt{\sigma^2}$$

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The sample standard deviation can be calculated as:

$$S = \sqrt{S^2}$$

### Coefficient of Variation

Coefficient of variation is a relative measure of dispersion that removes the units from the statistic. It can be calculated as:

$$CV = \frac{S}{\bar{x}}$$

### Standard Error

Because the variance on any sample will decrease with increasing n a method of comparing samples of different size is need. This is Standard Error for a sample and is given by:

$$S_{\bar{x}} = \sqrt{\frac{S^2}{n}}$$

### Also See:

Chapter 3 - Measure of Variability pages 35-46 in:

Phillips, J. L. 2000. How to think about statistics. W. H. Freeman and Co. New York. 202 pp. ISBN 0-7167-3654-3

Chapter 4 - Measure of Dispersion and Variability pages 27-32 in:

Zar, J. H. 2007. Biostatistical Analysis. Prentice-Hall, Inc. Englewood Cliffs, New Jersey. 718 pp.

