

$$HM = \frac{10}{\frac{1}{18} + \frac{1}{19} + \frac{1}{20} + \frac{1}{20} + \frac{1}{20} + \frac{1}{20} + \frac{1}{21} + \frac{1}{12} + \frac{1}{25}}$$

$$= \frac{10}{0.4791}$$

$$= 20.879$$

$$S^2 = \frac{\sum x_i^2}{n-1} - \frac{(\sum x_i)^2}{n}$$

$$\sum x_i^2 = (18^2 + 19^2 + 20^2 + 20^2 + 20^2 + 20^2 + 21^2 + 24^2 + 24^2 + 25^2)$$

$$= (324 + 361 + 1600 + 441 + 1152 + 625)$$

$$= 4503$$

$$\begin{aligned} (\sum x_i)^2 &= (18 + 19 + 80 + 21 + 48 + 25)^2 \\ &= (211)^2 \\ &= 44521 \end{aligned}$$

$$S^2 = \frac{4503 - \frac{44521}{10}}{9}$$

$$= 5.6556$$

$$S.D = \sqrt{5.6556}$$

$$= 2.378$$

$$C.V = \frac{S.D}{\text{Mean}} \times 100$$

$$= \frac{2.378}{21.1} \times 100$$

$$= 11.27$$

Properties of Variance

$$\textcircled{1} \text{Var}(X+c) = \text{Var}(X)$$

c is constant

$$\text{Var}(cX) = c^2 \text{Var}(X)$$

$$\text{Var}(aX+b) = a^2 \text{Var}(X)$$

Examples: Let's say the heights (in mm) are 610, 450, 160, 420, 310
Find the Variance.

$$\text{Solution:- Var} = \frac{\sum (x_i - \bar{x})^2}{n-1}$$

$$\bar{X} = (610 + 450 + 160 + 420 + 310) / 5$$

$$= 390$$

$$\text{Var} = \frac{\sum x_i^2 - \frac{(\sum x_i)^2}{n}}{n-1}$$

$$\sum x_i^2 = (610^2 + 450^2 + 160^2 + 420^2 + 310^2)$$

$$(\sum x_i)^2 = (610 + 450 + 160 + 420 + 310)^2$$

$$= 22440$$

Example - Find the variance of the numbers 3, 8, 6, 10, 12, 9, 11, 10, 12, 7

solution:- $\text{Var} = \frac{\sum (x_i - \bar{X})^2}{n-1}$

$$\bar{X} = 8.8$$

$$\text{Var} = \frac{73.6}{9}$$

$$= 8.178$$

The quadratic mean

$$\bar{Q} = \sqrt{\frac{\sum x_i^2}{n}}$$

Grouped Data: In constructing a frequency distributions, it is desirable to consider the following basic rules or criteria.

Class-Limits: It is important in frequency distributions to know about the limits or two boundaries of the class. The class-limits are the smallest or the lowest and largest or the highest values in the class.

For example, take the class 20-30. The lowest value is 20 and the highest value is 30.

Class-intervals: The class intervals depends on the range of the data and the number of classes. The range is the difference between the highest and the lowest value of the variable.

$$i = \frac{L - S}{C}$$

i = class-interval

L = Largest value

S = smallest value

C = Number of classes

For Example, if the mark of 100 students are varied between 20 and 80 and if we want to form 6 classes

then the class interval would be

$$i = \frac{L - S}{C} = \frac{80 - 20}{6} = 10$$

Therefore, the class interval would be 20-30, 30-40, 40-50, 50-60, 60-70, 70-80

The number of classes can be decided with the help of the "sturge Rule"

According to sturge, the class-intervals would be

$C = 1 + 3.322 \log N$ and size of the class-interval

$C = \frac{\text{Range}}{1 + 3.322 \log N}$

C = Number of classes

N = Total number of observations

$\log N$ = logarithm of N

For example, if 100 observations are being studied the number of classes will be

$$C = 1 + (3.322 \log 100)$$