14.3 MEDIAN

Median is the middle value of the distribution. It is the value of variable such that the number of observations above it is equal to the number of observations below it.

Median of raw data

(i) Arrange the data in ascending order.

(ii) Count the no. of observation (Let there be 'n' observation)

(A) if n be odd then median = value of $\left(\dfrac{n+1}{2}\right)^{th}$ observation.

(B) if n is even then median is the arithmetic mean of $\left(\dfrac{n}{2}\right)^{th}$ observation and $\left(\dfrac{n}{2}+1\right)^{th}$ observation.

Median of class - interval data (Grouped)

$$\text{Median} = \ell + \dfrac{\dfrac{N}{2}-C}{f}\times h$$

ℓ = lower limit of median class, N = total no of observation
C = cumulative frequency of the class preceding the median class
h = size of the median class
f = frequency of the median class.

What is median class :

The class in which $\left(\dfrac{N}{2}\right)^{th}$ item lie is median class.

Ex.8. Following are the lives in hours of 15 pieces of the components of air craft engine. Fin the median :

715, 724, 725, 710, 729, 745, 649, 699, 696, 712, 734, 728, 716, 705, 719

Sol. Arranging the data in ascending order

644. 696, 705, 710, 712, 715, 716, 719, 724, 725, 728, 729, 734, 745

N = 15

So, Median $= \left(\dfrac{N+1}{2}\right)^{th}$ observation

$= \left(\dfrac{15+1}{2}\right)^{th}$ observation

= 716.

Ex. 9 The daily wages (in rupees) of 100 workers in a factory are given below :

Daily wages (in Rs.)	125	130	135	140	145	150	160	180
No. of workers	6	20	24	28	15	4	2	1

Find the median wage of a worker for the above date.

Sol.

Daily wages (in Rs.)	No. of workers	Cumulative frequency
125	6	6
130	20	26
135	24	50
140	28	78
145	15	93
150	4	97
160	2	99
180	1	100

N = 100 (even)

$\therefore$ Median $= \dfrac{\left(\dfrac{N}{2}\right)^{th} \text{observation} + \left(\dfrac{N}{2}+1\right)^{th} \text{observation}}{2}$

Median $= \dfrac{50^{th} \text{ observation} + 51^{th} \text{ observation}}{2}$

$= \dfrac{135+140}{2}$

$= 137.50$

$\therefore$ Median wage of a workers in the factory is Rs 137.50.

Ex.10 Calculate the median for the following distribution class :

Class	0-10	10-20	20-30	30-40	40-50	50-60
Frequency	5	10	20	7	8	5

Class	f	c.f.
0-10	5	5
10-20	10	15
20-30	20	35
30-40	7	42

40-50	8	50
50-60	5	55

Sol. (i) First we find $\left(\dfrac{N}{2}\right)^{th}$ value i.e. $\left(\dfrac{55}{2}\right)^{th}$ = 27.5th

which lies in 20-30.

∴ 20-30 class in median class

here $\ell = 20$

$\dfrac{N}{2} = 27.5$, C = 15, f = 20, h = 10

∴ median = $20 + \dfrac{275-15}{20} \times 10$

Median = 26.25

Ex. 11 in the median of the following frequency distribution is 46,find the missing frequencies :

Variable	10-20	20-30	30-40	40-50	50-60	60-70	70-80	Total
Frequency	12	13	?	65	?	25	18	229

Sol.

Class Interval	Frequency	C.F
10-20	12	12
20-30	30	42
30-40	f_1	$42 + f_1$
40-50	65	$107 + f_1$
50-60	f_2	$107 + f_1 + f_2$
60-70	25	$132 + f_1 + f_2$
70-80	18	$150 + f_1 + f_2$

Let the frequency of the class 30 - 40 be f_1 and that of the class 50 - 60 be f_2. The total frequency is 229

$12 + 30 + f_1 + 65 + f_2 + 25 + 18 = 229$

$\Rightarrow \quad f_1 + f_2 = 79$

It is given that median is 46., clearly, 46 lies in the class 40 - 50. So, 40 - 50 is the median class

∴ $\ell = 40$, h = 10, f = 65 and C = $42 + f_1$, N = 229

Median = $\ell + \dfrac{\dfrac{N}{2} - C}{f} \times h$

$46 = 40 + \dfrac{\dfrac{229}{2} - (42 + f_1)}{65} \times 10$

$$46 = 40 + \frac{145 - 2f_1}{13}$$

$$\Rightarrow \quad 6 = \frac{145 - 2f_1}{13} \quad \Rightarrow \quad 2f_1 = 67$$

$$\Rightarrow \quad f_1 = 33.5 \text{ or } 34$$

Since, $f_1 + f_2 = 79$

$\therefore \qquad f_1 = 45$

Hence, $f_1 = 34$ and $f_2 = 45$.

Merits of Median:

(i) It is rigidly defined, easily, understood and calculate.

(ii) It is not all affected by extreme values.

(iii) It can be located graphically, even if the class - intervals are unequal.

(iv) It can be determined even by inspection is some cases.

Demerits of Median:

(i) In case of even numbers of observations median cannot be determined exactly.

(ii) It is not based on all the observations.

(iii) It is not subject to algebraic treatment.

(iv) It is much affected by fluctuations of sampling.

Uses of Median:

(i) Median is the only average to be used while dealing with qualitative data which cannot be measured quantitatively but can be arranged in ascending or descending order of magnitude.

(ii) It is used for determining the typical value in problems concerning wages, distribution of wealth etc.