Median:-

Median is the value of that item in a series, which divides the series into two equal parts, one part consisting of all value less, and other all values greater than it. ie Median divides the total frequency into two halves.

Computation of Median:-

For ungrouped data

(a) arrange the series in ascending or descending order of magnitude.

(b) If n, no. of observation is odd find the midterm by using the formula

$$M = \frac{n+1}{2},$$

ie median is M^{th} term of data.

ie if no. of observation is odd, then median is the middle value after the values have been arranged in ascending or descending order

(c) If n is even then

$$\text{mid term } M = \frac{\left(\frac{n}{2}\right) + \left(\frac{n+1}{2}\right)}{2}$$

ie when no. of observation are even

there are two middle terms $\frac{n}{2}^{th}$ & $\frac{n+1}{2}^{th}$ then

median is the arithmatic mean of middle terms.

Ex Median of 25, 20, 15, 35, 18

Ans arranging

15, 18, 20, 25, 35

median is 20

$n = 5$

$\left(\frac{n+1}{2}\right)^{th}$

3^{rd} term

Ex:- 8, 20, 50, 25, 15, 30

arranging 8, 15, 20, 25, 30, 50.

n = even

median = average of 3^{rd} & 4^{th} term

$$\text{Median} = \frac{20+25}{2} = 22.5$$

Q Find the median from following table

1.	100	10.	50
2.	100	11.	50
3.	90	12	50
4.	90		
5	90		
6.	80		
7.	75		
8.	70		
9	60		

no. of observation = 12 even no.

$\frac{n}{2}^{th}$ term = 6^{th} term = 80

$\frac{n}{2}^{th} + 1$ term = 7^{th} term = 75

$$\text{median} = \frac{80 + 75}{2} = 77.5.$$

Computation of Median for discrete frequency distribution :-

In discrete frequency distribution, median is obtained by considering the commulative frequencies.

Step I :- write c.f by adding the previous frequencies

Step II :- find $\frac{N}{2}$ where $N = \Sigma f$

Step III :- See the commulative frequency just greater than $N/2$.

Step IV :- The corresponding value of x is median.

Q Obtain median of the given data :-

Size of item:	4	5	6	7	8	9	10	11	12
frequency :	2	5	8	9	12	14	14	15	11

	13	14	15	16	17
	13	9	7	4	3

Soln

Size	freq.	c.f
4	2	2
5	5	7
6	8	15
7	9	24
8	12	36
9	14	50
10	14	64
11	15	79
12	11	90
13	13	103
14	9	112
15	7	119
16	4	123
17	3	126
	N=126	

$N = 126$

$\frac{N}{2} = 63$

commutative freq. just greater than 63 is 64. and corresponding value of x is 10. ie

median = 10

Median of continuous frequency distribution:-

(1) Find $\frac{N}{2}$.

(2) The class corresponding to the cf just greater than $\frac{N}{2}$ is called median class.

Let l_1 is lower limit of median class

l_2 is upper " " " "

$h = l_2 - l_1$, is class length

f = frequency of median class

c is c.f of the class preceding the median class

then $\text{Median} = l_1 + \frac{l_2 - l_1}{f}\left(\frac{N}{2} - c\right)$

or $$\boxed{\text{Median} = l_1 + \frac{h}{f}\left(\frac{N}{2} - c\right)}$$

Q:- The weekly wages of workers is given find the median wages.

Wages	0-10	10-20	20-30	30-40	40-50	50-60
No. of labourer	1	1	5	6	9	8

60-70	70-80	80-90	90-100	100-110	110-120
12	9	8	6	3	2

wages	freq. (f)	commulative freq (cf)
0-10	1	1
10-20	1	2
20-30	5	7
30-40	6	13
40-50	9	22
50-60	8	30 - c
60-70	12 - f	42
70-80	9	51
80-90	8	59
90-100	6	65
100-110	3	68
110-120	2	70

$N = 70$

$\frac{N}{2} = 35$

commulative frequency just greater than 35 is 42.

ie Median class is 60-70.

$l_1 = 60 \quad l_2 = 70 \quad h = 10, \quad f = 12, \quad C = 30$

$$\text{Median} = l_1 + \frac{h}{f}\left(\frac{N}{2} - C\right)$$

$$= 60 + \frac{10}{12}(35 - 30)$$

$$= 60 + 4.166$$

$$= 64.166 \quad \text{Ans}$$

Q:- find the Median Marks

Marks	45-50	40-45	35-40	30-35	25-30
No. of students	10	15	26	30	42

20-25	15-20	10-15	5-10
31	24	15	7

Sol^n:- arranging the data in ascending order

Marks	No. of students (f)	cf
5-10	7	7
10-15	15	22
15-20	24	46
20-25	31	77
25-30	42	119
30-35	30	149
35-40	26	175
40-45	15	190
45-50	10	200
	N=200	

Median is size of $\frac{N}{2}^{th}$ item

$\frac{N}{2} = 100^{th}$ item

ie Median class is 25-30

$l_1 = 25 \quad h = 5 \quad f = 42 \quad c = 77$

$$\text{median} = l_1 + \frac{h}{f}\left(\frac{N}{2} - c\right)$$

$$= 25 + \frac{5}{42}(100 - 77)$$

median = $25 + \frac{5}{42}(23)$

median = 27.74

Q Calculate the median of following data:-

weights (gm)	No. of apples
410 - 419	14
420 - 429	20
430 - 439	42
440 - 449	54
450 - 459	45
460 - 469	18
470 - 479	7

Soln

weights	No. of apples (f)	cf
409.5 - 419.5	14	14
419.5 - 429.5	20	34
429.5 - 439.5	42	76 - c
439.5 - 449.5	54 - f	130
449.5 - 459.5	45	175
459.5 - 469.5	18	193
469.5 - 479.5	7	200
	N=200	

Size of $\frac{N}{2}^{th}$ item = Size of 100^{th} item

ie median class is 439.5 - 449.5

$f = 54$, $c = 76$

Median = $439.5 + \frac{10}{54}(100 - 76)$

Median = 443.94

finding missing frequencies :-

Q find the missing frequency.

variable :-	0-10	10-20	20-30	30-40	40-50	50-60	60-70
freq :-	10	20	_	40	_	25	15

given that total freq is 170.
Median of data is 35.

Soln :- Say missing frequencies
for the class 20-30 is f_1
40-50 is f_2

given that

$$10+20+f_1+40+f_2+25+15=170$$
$$110+f_1+f_2=170$$
$$f_1+f_2=60 \quad \text{—— (1)}$$

$\frac{N}{2}^{th}$ term is $\frac{170}{2}^{th}$ term

ie 85^{th} term

Median = size of 85^{th} term

given that Median is 35
which lies in the class 30-40.

ie $l_1=30 \quad l_2-l_1=10, \quad f=40$
$c=30+f_1$

$$\text{Median} = l_1+\frac{h}{f}\left(\frac{N}{2}-c\right)$$
$$35 = 30+\frac{10}{40}\left(85-30-f_1\right)$$
$$35 = 30+\frac{1}{4}(55-f_1)$$
$$140 = 120+55-f_1$$
$$f_1 = 175-140$$
$$\boxed{f_1=35} \quad \text{from (1)} \quad \boxed{f_2=25}$$

Q:- Find the missing frequency

variable :-	10-20	20-30	30-40	40-50	50-60	60-70	70-80
freq:	12	30	—	65	—	25	18

given total freq. is 229. Median is 46.

soln:

variable	freq.	cf
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	$150+f_1+f_2$
	229	

given $N = 229$

ie $150 + f_1 + f_2 = 229$

$$\boxed{f_1 + f_2 = 79}$$

given median is 46

ie median class is 40-50

$l_1 = 40$, $h = 10$, $f = 65$, $c = 42 + f_1$

$$\text{Median} = l_1 + \frac{h}{f}\left(\frac{N}{2} - c\right)$$

$$46 = 40 + \frac{10}{65}\left(\frac{229}{2} - (42 + f_1)\right)$$

$$6 = \frac{10}{65} \times (114.5 - 42 - f_1)$$

$$39 = 1145 - 42 - f_1$$

$$f_1 = 1145 - 42 - 39 = 33.5$$

$f_1 \simeq 34$ (as freq. can not be fraction)

ii $f_2 = 45$