

Measures of Central Tendency

Mean:-

└ Individual Series

Ex. x_1, x_2, x_3, x_4, x_5
10, 20, 30, 40, 50

$$\text{A.M or } \bar{X} = \frac{\sum X}{n} = \frac{x_1 + x_2 + x_3 + x_4 + x_5}{n}$$

$$\bar{X} = \frac{10 + 20 + 30 + 40 + 50}{5}$$

$$\bar{X} = \frac{150}{5} = 30$$

Measures of Central Tendency

Mean:-

F Discrete Series

method

① Direct method

② Shortcut method

Direct method

x	f	fx
20	8	160
30	12	360
40	20	800
50	10	500
60	6	360
70	4	280
$\Sigma f = N = 60$		$\Sigma fx = 2460$

$$\bar{X} = \frac{\Sigma fx}{N}$$

$$\bar{X} = \frac{2460}{60}$$

$$\bar{X} = 41$$

Measures of Central Tendency

Mean:-

F Discrete Series

method

① Direct method

② shortcut method

Short-cut method

x	f	$d = x - A$ $d = x - 40$	fd
20	8	-20	-160
30	12	-10	-120
40	20	0	0
50	10	10	100
60	6	20	120
70	4	30	120
$\Sigma f = N = 60$			$\Sigma fd = 60$

Assumed mean, $A = 40$

$$\bar{X} = A + \frac{\Sigma fd}{N}$$

$A =$ Assumed mean

$$d = X - A$$

$$\bar{X} = 40 + \frac{60}{60}$$

$$\bar{X} = 40 + 1 = 41$$

Measures of Central Tendency

Mean:-

Continuous Series

method

① Direct method

② Shortcut method

marks	(f) frequency	mid-value (m)	fm
0-10	5	5	25
10-20	10	15	150
20-30	25	25	625
30-40	30	35	1050
40-50	20	45	900
50-60	10	55	550
$\Sigma f = N = 100$			$\Sigma fm = 3300$

$$\bar{X} = \frac{\Sigma fm}{N}$$

m = mid-value of class

$$\bar{X} = \frac{3300}{100}$$

$$\bar{X} = 33$$

Measures of Central Tendency

Mean :-

method

① Direct method

② Shortcut method

Continuous Series

Shortcut method

marks	(f) frequency	midvalue (m)	$d = m - A$ $d = (m - 35)$	$f d$
0-10	5	5	-30	-150
10-20	10	15	-20	-200
20-30	25	25	-10	-250
30-40	30	35	0	0
40-50	20	45	10	200
50-60	10	55	20	200
$\Sigma f = N = 100$				$\Sigma fd = -200$

Assumed mean, $A = 35$

$$\bar{X} = A + \frac{\Sigma fd}{N}$$

$$\bar{X} = 35 + \frac{(-200)}{100}$$

$$\bar{X} = 35 - 2$$

$$\bar{X} = 33$$

Measure of Central Tendency

Median

Positional

Median
5 20 30 40 60
 $n=5$ (odd)

} Individual series

10 20 30 40 50 60
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$n=6$ (Even)

$$\text{median} = \frac{30 + 40}{2} = \frac{70}{2} = 35$$

Measure of Central Tendency

Median

Discrete Series

Income:- 4000 4500 5800 5060 6600 5380
 persons:- 24 26 16 20 6 30

Arrange in Ascending order

Income (x)	Persons (f)	C. f.
4000	24	24
4500	26	50
5060	20	70
5380	30	100
5800	16	116
6600	6	122
$N = \Sigma f = 122$		

Median = Size of $\left(\frac{N}{2}\right)^{\text{th}}$ item

= Size of $\left(\frac{122}{2}\right)^{\text{th}}$ item

= Size of 61st item
 c.f. just greater than 61 is 70.

Median = 5060 Ans

Measure of Central Tendency

Median

Continuous series

wages	workers (f)	C.f.
20-30	3	3
30-40	5	3+5=8 C.f.
40-50	20 f	3+5+20=28
50-60	10	3+5+20+10=38
60-70	5	3+5+20+10+5=43
N = $\Sigma f = 43$		

$$\begin{aligned}\text{Median} &= \text{Size of } \left(\frac{N}{2}\right)^{\text{th}} \text{ item} \\ &= \text{Size of } \left(\frac{43}{2}\right)^{\text{th}} \text{ item}\end{aligned}$$

$$\text{Median} = \text{Size of } 21.5^{\text{th}} \text{ item}$$

C.f. just greater than 21.5 is 28.
So, median class = 40-50

$$\text{Median} = L + \left(\frac{\frac{N}{2} - \text{C.f.}}{f} \times i \right)$$

$$L = 40, f = 20, \text{C.f.} = 8$$

$$i = 10, N = 43$$

$$\text{Median} = 40 + \left(\frac{\frac{43}{2} - 8}{20} \times 10 \right)$$

$$= 40 + \frac{21.5 - 8}{2}$$

Measure of Central Tendency

Median

Continuous Series

wages	workers (f)	C.f.
20-30	3	3
30-40	5	3+5=8 C.f.
40-50	20 f	3+5+20=28
50-60	10	3+5+20+10=38
60-70	5	3+5+20+10+5=43
N = $\Sigma f = 43$		

$$\text{Median} = \text{Size of } \left(\frac{N}{2}\right)^{\text{th}} \text{ item}$$

$$= \text{Size of } \left(\frac{43}{2}\right)^{\text{th}} \text{ item}$$

$$\text{Median} = \text{Size of } 21.5^{\text{th}} \text{ item}$$

$$= 40 + 13.5$$

$$\text{Median} = 40 + 6.75$$

$$\boxed{\text{Median} = 46.75}$$

$$\text{Median} = LT \left(\frac{\frac{N}{2} - C.f.}{f} \times i \right)$$

$$L = 40, f = 20, C.f. = 8$$

$$i = 10, N = 43$$

$$\text{Median} = 40 + \left(\frac{\frac{43}{2} - 8}{20} \times 10 \right)$$

$$= 40 + \frac{21.5 - 8}{2}$$

To find Missing Frequencies when Median Given

find Missing frequencies

Class	Frequency	C. f.
0-10	10	10
10-20	20	30
20-30	a	30+a C.f.
30-40	40 f	70+a
40-50	b	70+a+b
50-60	25	95+a+b
60-70	15	110+a+b
N=170 (given)		

Given median Value = 35
and total frequency = 170

$$\text{Total freq., } N = 170$$

$$\text{Total freq., } N = 110 + a + b$$

$$110 + a + b = 170$$

$$a + b = 170 - 110$$

$$\boxed{a + b = 60} \quad \text{--- (1)}$$

Given, median = 35

\therefore median class = 30-40

$$\text{Median} = L + \left(\frac{\frac{N}{2} - \text{C.f.}}{f} \times i \right)$$

$$L = 30, N = 170, f = 40$$

$$\text{C.f.} = 30 + a, i = 10$$

To find Missing Frequencies when Median Given

find Missing frequencies

Class	Frequency	C.f.
0-10	10	10
10-20	20	30
20-30	a	30+a C.f.
30-40	40 f	70+a
40-50	b	70+a+b
50-60	25	95+a+b
60-70	15	110+a+b

N=170
(given)

Given median Value = 35
and total frequency = 170

$$35 = 30 + \left(\frac{\frac{170}{2} - (30+a)}{40} \times 10 \right)$$

$$35 - 30 = \frac{85 - 30 - a}{4}$$

$$5 \times 4 = 55 - a$$

$$20 = 55 - a$$

$$a = 55 - 20$$

$$a = 35$$

from ①

$$a + b = 60$$

$$35 + b = 60$$

$$b = 60 - 35 = 25$$

Measure of Central Tendency

Mode

5, 4, 5, 6, 6, 5, 3, 2, 5, 5, 1, 2, 5

mode = 5

Measure of Central Tendency

Mode

Discrete Series

Shoe size:	6	7	8	9	10
No. of Pairs sold:	3	11	128	57	4

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Measure of Central Tendency

Mode

Continuous Series

marks	Students (f)
10-20	3
20-30	11
30-40	24
40-50	58
50-60	40
60-70	25
70-80	16
80-90	7

f_0
 max. freq. f_1
 f_2

modal class = 40-50

$$\text{mode} = L + \frac{f_1 - f_0}{2f_1 - f_2 - f_0} \times i \quad \text{--- (1)}$$

$$L = 40, i = 10$$

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$$\text{Mode} = 40 + \frac{58 - 24}{2 \times 58 - 40 - 24} \times 10$$

$$\text{Mode} = 40 + \frac{34}{116 - 64} \times 10$$

$$= 40 + \frac{340}{52}$$

$$= 40 + 6.54$$

$$\text{Mod} = 46.54$$

Mode (By Method of Grouping)

find mode

x	f(I)	II	III	IV	V	VI
4	2	7				
5	5		13			
6	8	17				
7	9		21			
8	12	26				
9	14		28			
10	14	29				
11	15		26			
12	11	24				
13	13					

column

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Analysis Table

col. No.	Max. Freq.	Values or combinations
I	15	11
II	29	10, 11
III	28	9, 10
IV	40	10, 11, 12
V	40	8, 9, 10
VI	43	9, 10, 11

Mode = 10

Combined Mean

Ist group

IInd group \bar{X}_1 \bar{X}_2 N_1 N_2 \bar{X}_{12}

$$\bar{X}_{12} = \frac{N_1 \bar{X}_1 + N_2 \bar{X}_2}{N_1 + N_2}$$

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Q.

Mean salary of male employee, $\bar{X}_1 = 520$

mean salary of female employee, $\bar{X}_2 = 420$

mean salary of all employees, $\bar{X}_{12} = 500$

find percentage of male and female employees

N_1 = no. of male employees

N_2 = no. of female employees

Assume

$$N_1 + N_2 = 100 \quad \text{--- (1)}$$

Combined Mean

$$\bar{X}_{12} = \frac{N_1 \bar{X}_1 + N_2 \bar{X}_2}{N_1 + N_2}$$

$$500 = \frac{N_1(520) + N_2(420)}{N_1 + N_2}$$

$$500 = \frac{520N_1 + (100 - N_1)(420)}{100}$$

$$50,000 = 520N_1 + 42,000 - 420N_1$$

$$8000 = 100N_1$$

$$N_1 = \frac{8000}{100}$$

$$N_1 = 80$$

Q.

Mean salary of male employee, $\bar{X}_1 = 520$

mean salary of female employee, $\bar{X}_2 = 420$

mean salary of all employees, $\bar{X}_{12} = 500$

find percentage of male and female employees

N_1 = no. of male employees

N_2 = no. of female employees

Assume

$$N_1 + N_2 = 100 \quad \text{--- (1)}$$

$$N_2 = 100 - N_1$$