Statistics

TALENT & OLYMPIAD

$\langle \rangle$ Introduction

Previously we have studied about the representation of data. Data handling in an art. It depends upon expertise or it. In this chapter we will emphasis on measure of central tendencies of data.

$\langle \rangle$ **Central Tendencies of Data**

We know that statistics is the branch of mathematics which deals with data collected for specific purpose. The central tendency gives us an idea that represents the entire data. There are three types of central tendencies (ii) Median (iii) Mode

(i) Mean

Mean

It is also known as arithmetic mean of a given observation is equal to ratio of sum of observation and total number of observation, i.e.

 $Mean = \frac{Sum of total observation}{Total Number of observation}$

If x_1, x_2, \dots, x_n are n observation then its mean

$$\overline{\mathbf{X}} = \frac{x_1 + x_2 + \dots + x_n}{n} = \frac{\sum x_i}{n}$$

The arithmetic mean of grouped data calculated by the following methods:

(i) Direct method

- (ii) Assumed mean method
- (iii) Step Deviation method

Direct Method

In this method, suppose x_1, x_2, \dots, x_n are the observation having frequency f_1, f_2, \dots, f_n respectively then

$$\overline{\mathbf{X}} = \frac{x_1 f_1 + x_2 f_2 + \dots, + x_n f_n}{f_1 + f_2 + \dots, f_n} = \frac{\sum x_i f_i}{\sum f_i}$$

Direct method for calculating mean depend on the following steps: Step 1: Find the class mark (which is discussed in previous class) for each class. Step 2: Calculate product of frequency and class mark for each class interval.

Step 3: Then calculate mean by using formula $\left(\frac{\sum fixi}{\sum fi}\right)$.



Find the mean of the following data:

Class Interval	Frequency
0 - 10	16
10 - 20	12
20 – 30	9
30 – 40	6
40 – 50	7
(a) 20.2	(b) 21.3
(c) 45.5	(d) 43.2
(e) None of these	

Answer: (a)

Explanation

Class Interval	Frequency (f_i)	Class Mark (x _i)	$f_i x_i$
0 - 10	16	5	80
10 – 20	12	15	180
20 – 30	9	25	225
30 – 40	6	35	210
40 – 50	7	45	315
	$\sum f_i = 50$		$\sum f_i x_i = 1010$

:. Mean = $\frac{1010}{50}$ = 20.2

Assumed Method for Calculating Mean

For calculating mean, we should follow the following steps:

Step 1: For each class interval, calculate the class mark using the formula $x_i = \frac{1}{2}$ (lower limit + upper limit)

- **Step 2:** Choose a suitable value of *x*. in the middle as the assumed mean and denoted by A.
- **Step 3:** Calculate the deviations $d_i(x_i A)$ for each *i*.
- **Step 4:** Calculate the product $f_i d_i$ for each *i*.
- **Step 5:** Calculate summation of frequency.

Step 6: Then at last calculate mean, by using formula $\overline{X} = A + \frac{\sum f_i d_i}{n}$ when $n = \sum f_i$

(c) 23.3

Illustrative EXAMPLE

Find the mean of the following data:				
Class Interval	Frequency			
0-10	7			
10-20	8			
20 - 30	12			
30 - 40	13			
40 - 50	10			

(a) 25.6 (b) 27.2 Answer: (b) Explanation

Class Mark Frequency (f_i) $f_i d_i$ **Class Interval** Deviation (x_i) 7 -20 0 - 105 -140 10 - 20 8 15 -10 -80 20 - 30 12 25=A 0 0 30 - 40 13 10 130 35 40 - 50 10 45 20 200 $\sum f_i = 50$ $\sum f_i d_i = 110$

(d) 24.5

(e) None of these

If A=25
Mean =
$$\overline{X} = A + \frac{\sum f_i d_i}{n}$$

 $25 + \frac{110}{50} = 27.2$

*

Step - Deviation Method

If the value of class marks and frequency are large then calculating mean by above method is very difficult, due to this region this method can be used.

This method depends on the following steps:

Step 1: For each class interval, calculating the class marks x_i ., where $x_i = \frac{1}{2}$ (lower limit + upper limit).

Step 2: Choose a suitable value of *x* , in the middle as the x; column as the assumed mean and denoted it by A.

Step 3: Calculate h = (upper limit) - (lower limit), which is the same for all the classes.

Step 4: Calculate $u_i = \frac{x_i - A}{h}$ for each class.

Step 5: Calculate for each class and hence, find $\sum (f_i \times u_i)$.

Step 6: Calculate the mean by using the formula $\overline{X} = A + \left[h \times \frac{\sum (f_i \times u_i)}{\sum f_i}\right].$

Illustrative

EXAMPLE

Find the mean of the following frequency distribution:(a) 112.2(b) 113.2(c) 114.5(d) 115.3(e) None of these

Answer: (a)

Explanation

Class Interval	Frequency (f_i)	Class Mark (x_i)	$u_i = (x_i - A) / n$	$f_i u_i$
50 - 70	18	60	-2	-36
70 – 90	12	80	-1	-12
90 - 110	13	100=A	0	0
110 - 130	27	120	2	37
130 - 150	8	140	2	16
150 - 170	22	160	3	66
	$\Sigma f_i = 100$			$\Sigma f_i u_i = 110$

From table, A = 100, h = 20, $\sum f_i = 100$ and $\sum f_i \times u_i = 61$

Mean,

$$\overline{X} = A + \left[h \times \frac{\sum (f_i \times u_i)}{\sum f_i}\right] = 100 + \left[20 \times \frac{61}{100}\right] = 112.2$$

Median

Median of a data is the value of the variable which divides it into two equal parts. It means it is the value of variable so that the number of observation above it is equal to the number of observation below it. Suppose $x_1, x_2, ..., x_n$ are n observation in ascending or descending order. The median of the above observation is:

(i) n is odd then median is the value of $\left(\frac{n+1}{2}\right)^{th}$ observation.

(ii) n is even then median is the value of arithmetic mean of $\left(\frac{n}{2}\right)^{th}$ and $\left(\frac{n}{2}+1\right)^{th}$ observation i.e

Mean = $\frac{\left(\frac{n}{2}\right)^{th} \text{ observation} + \left(\frac{n}{2} + 1\right)^{th} \text{ observation}}{2}$ Method for finding the median for grouped data. Step for

finding the median

Step 1: Forgiven frequency distribution, prepare the commutative frequency table and obtain $N = \sum f_i$. **Step 2:** Find (N/2).

Step 3: Look at the cumulative frequency Just greater than (N/2) and find the corresponding class, known as median class.

Step 4: Then by using median formula, calculate median, which is given below:

Median =
$$l + \left| h \times \frac{\frac{N}{2} - C}{f} \right|$$

where I = lower limit of median class,

h = width of median class,

f = frequency of median class

c =cumulative frequency of the class for preceding the median class

$$N = \sum fi$$

Illustrative EXAMPLE

MPLE

Find the median class of daily wages from the following frequency distribution

Daily Wages (I	n Rs.)	Frequency		Daily Wages (In Rs.)	Frequency
100 - 150		6		250 – 300	20
150 – 200		3		300 - 350	10
200 – 250		5			
(a) 250		(b) 260		(c) 270	(d) 280
Answer: (c)					
Explanation					
Class Interval	Frequer	(f_i)	Cf		
100 - 150	6	5	6		
150 – 200	3	}	9		
200 – 250	5	;	14		
250 - 300	2	0	34		
300 - 350	1	0	44		
	$\sum f_i = d$	44 = N			

(e) None of these

(In the above table c f represents cumulative frequency) median = $250 + \left\{ 50 + \left(\frac{22 - 14}{20} \right) \right\} = 270$

Mode

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Mode is the value that occurs the most of the time in a data or mode is a way of capturing important information about a random variable or a population in a single quantity. The mode is generally different from the mean and median.

Model Class

In a frequency distribution, the class having maximum frequency is called modal class.

Formula for Mode

Mode can be calculated by a formula, which is given below:

Mode =
$$x_k + h \left[\frac{f_k - f_{k-1}}{2f_k - f_{k-1} - f_{k+1}} \right]$$

where x_k = lower limit of the modal class interval.

 f_k = frequency of the modal class

 f_{k-1} = frequency of the class preceding the modal class

 f_{k+1} = frequency of the class succeeding the modal class

h = width of the class interval

Illustrative EXAMPLE

Find the mode for the following frequency distribution:

Class Interval	Frequency	Class Interval	Frequency
0 - 10	5	40 – 50	28
10 -20	8	50 – 60	20
20 - 30	7	60 - 70	10
30 - 40	12	70 – 80	10

(a) 46.67	(b) 45.2
(c) 42.2	(d) 43.2
(e) None of these	

Answer: (a)

Explanation

From table 40-50 is modal class $\therefore x_{k} = 40, h = 10, f_{k} = 28, f_{k-1} = 12, d_{k+1} = 20$ then by using formula, $M = x_{k} + \left[h \times \frac{f_{k} - f_{k-1}}{2f_{k} - f_{k-1} - f_{k+1}}\right]$ $= 40 + \left[10 \times \frac{28 - 12}{2 \times 28 \times 12 - 20}\right] = 46.67$

You Must

- 17 is also the only prime number which is the sum of 4 consecutive prime 2,3,5 and 7
- 17 is the lowest number that can be written as $x^3 + y^2$ in 2 distinct ways: $17 = 2^3 + 3^2$ and $17 = 1^3 + 4^2$
- One of the earliest numerical approximation of $\sqrt{2}$ was found on a Babylonian clay tablet approximately between 1800 B.C. and 1600 B.C.
- Among all shapes with the same perimeter a circle has the largest area.



Commonly Asked

1	The arithmetic Me	ean of the foll	owing frequency d	istribution is 25. De	termine the value of P.
	Class Interval	Frequency	Class Interval	Frequency	
	0-10	5	30 - 40	Р	
	10 - 20	18	40 - 50	6	
	20 – 30	15			
	(a) P=16		(b) P=15		
	(c) P=14		(d) P=16		
	(e) None of these				
	Answer: (e)				
	Explanation				
	Explanation Class Interval	Fre	quency (f_i)	Class mark (x_i)	$f_i x_i$
	Explanation Class Interval 0-10	Fre	quency (f_i)	Class mark (x_i) 5	<i>f_ix_i</i> 25
	Explanation Class Interval 0-10 10-20	Fre	$\frac{quency(f_i)}{5}$ 18	Class mark (x _i) 5 15	<i>f_ix_i</i> 25 270
	Class Interval 0-10 10-20 20-30	Fre	quency(f _i) 5 18 15	Class mark (x _i) 5 15 25	<i>f_ix_i</i> 25 270 375
	Class Interval 0-10 10-20 20-30 30-40	Fre	quency (f _i) 5 18 15 P	Class mark (x _i) 5 15 25 35	f _i x _i 25 270 375 35P
	Explanation Class Interval 0-10 10-20 20-30 30-40 40-50	Fre	quency (<i>f_i</i>) 5 18 15 P 645	Class mark (x _i) 5 15 25 35 270	f _i x _i 25 270 375 35P

$$\therefore \text{Mean } x = \frac{\sum (F_1 \times x_1)}{\sum F_1} \Rightarrow \frac{(940 + 35P)}{(44 + P)} = 25$$
$$\Rightarrow (940 + 35P) = 25(44 + P)$$
$$\Rightarrow (35P - 25P) = (1100 - 940)$$
$$\Rightarrow 10P = 160$$
$$\Rightarrow P = 16$$



If the Mean of the following frequency distribution is 54 then find the value of P.

Class Interval	Frequency	Class Interval	Frequency
0 – 20	7	60 - 80	9
20 - 40	Р	80-100	13
40 - 60	10		
(a) P=8		(b) P=9	
(c) P=10		(d) P=11	
(e) None of thes	e		

Answer: (d) Explanation

Class Interval	Frequency (f_i)	Class mark (x_i)	$f_i x_i$
0-20	7	10	70
20-40	Р	30	30P
40-60	10	50	500
60-80	9	70	630
80-100	13	90	1170
	$\sum f_i = (39 + P)$		$\sum f_i x_i = (2370 + 30P)$

$$\therefore \text{Mean, } x = \frac{\sum (f_i \times x_i)}{\sum f_i}$$

$$\Rightarrow \frac{2370 + 30P}{(39 + P)} = 54$$

$$\Rightarrow (2370 + 30P) = 54(39 + P)$$

$$\Rightarrow 24P = (2370 - 2106) = 264$$

$$\Rightarrow P = 1$$



The mean of the following frequency distribution is 62.8 and the sum of all frequencies is 50. Compute the missing frequencies f_1 and f_2 .

Class Interval	0-20	20-40	40-60	60-80	80-100	100-120	Total	
Frequency	5	f_1	10	f_2	7	8	50	
(a) 8 & 12		(b) 8 &	13					
(c) 14 & 12		(d) 15 8	. 8					
(e) None of these	e							
Answer; (a)								
Explanation								

 $5 + f_1 + 10 + F_2 + 7 + 8 = 50$

$$\Rightarrow F_2 = (20 - F_1)$$

Now we may prepare the table given below:

Class Interval	Frequency (f_i)	Class mark (x_i)	$f_i x_i$
0-20	5	10	50
20-40	F_1	30	30 <i>F</i> ₁
40-60	10	50	500
60-80	$20 - F_1$	70	1400-70F
80-100	7	90	630
100-120	8	110	880
	$\sum f_i = 50$		$\sum f_i x_i = (3460 - 40F_1)$

$$\therefore \text{ Mean, } x = \frac{\sum (f_i \times x_i)}{\sum f_i} = \frac{(3640 - 40f_1)}{50}$$

But mean = 62.8 (given)
$$\therefore \frac{3400 - 40F_1}{50} = 62.8 \implies 3460 - 40F_1 = 3140$$
$$\implies 40F_1 = 320 \implies F_1 = 8$$

Thus $F_1 = 8 \& F_2 = (20 - 8) = 12$



Find the arithmetic mean of the following frequency distribution:

Class Interval	25-29	30-34	35-39	40-44	45-49	50-54	55-59
Frequency	14	22	16	6	5	3	4
(a) 36.46		(b) 36.36					
(c) 48.56		(d) 99.95					
()							

(e) None of these

Answer: (b)

Explanation

The given series is in inclusive series. Making it exclusive series, we get

Class Interval	Frequency (f_i)	Class Mark (x_i)	$u_i = \frac{x_i - A}{h} (x_i) = \frac{x_i - 42}{5}$	$f_i u_i$
24.5-29.5	14	27	-3	-42
29.5-34.5	22	32	-2	-44
34.5-39.5	16	37	-1	-16
39.5-44.5	6	42=A	0	0
44.5-49.5	5	47	1	5
49.5-54.5	4	52	2	6
54.5-59.5	3	57	3	12
	$\Sigma f_i = 70$			$\Sigma f_i u_i = -70$

Thus
$$A = 42, h = 5, \sum F_i \& \sum (F_i \times u_i) = 79$$

Mean,
$$\overline{X} = A + \left[h \times \frac{\sum(F_i \times u_i)}{\sum F_i}\right] = 42 \left[5 \times \frac{(-79)}{70}\right] = (42 - 5.64) = 36.36$$



Find the mean age (in years) from the following frequency distribution:

Age(in year)	15-19	20-24	25-29	30-34	35-39	40-44	45-49	Total
Frequency	3	13	21	15	5	4	2	63
(a) 29.06	(b) 26.96							
(c) 42.96	(d) 95.99							
(c) 42.96		(d) 95	.99					

(e) None of these

Answer: (a)

Explanation

The given series is in inclusive. Making it an exclusive series. We get:

Class Interval	Frequency (f_i)	Class Mark (x_i)	$u_i = \frac{x_i - A}{h} (x_i) = \frac{x_i - 32}{5}$	$f_i u_i$
14.5-19.5	3	17	-3	-9
19.5-24.5	13	22	-2	-26
24.5-29.5	21	27	-1	-21
29.5-34-5	15	32=A	0	0
34.5-39.5	5	37	1	5
39.5-44.5	4	42	2	8
44.5-49.5	2	47	3	6
	$\Sigma f_i = 63$			$\sum f_i u_i = 19 - 56 = -37$

= -37

Thus
$$A = 32, h = 5_1 \sum F_i = 63 \& \sum (F_i \times u_i) = -37$$

Mean, $\overline{X} = A + \left[h \times \frac{\sum (F_i \times u_1)}{\sum F_i} \right]$
 $= 32 + \left[5 \times \left(\frac{-37}{63} \right) \right] = (32 - 2.936) = 32 - 2.94) = 29.06$



Find the median for the following frequency distribution:

Height(In cm)	Frequency	Height (In cm)	Frequency		
160 - 162	15	169 – 171	118		
163 – 165	117	171 – 174	14		
166 - 168	136				
(a) 168cm	(b) 167cm	(c) 189cm	•	(d) 198cm	(e) None of these
Answer: (b)					

Explanation

The given series is in inclusive form. Converting it into exclusive form and preparing the cumulative frequency table, we get

Class Interval	Frequency (f_i)	CF
159.5-162.5	15	15
162.5-165.5	117	132
165.5-168.5	136	268
168.5-171.5	118	368
171.5-174.5	14	400
	$N = \sum f_i = 400$	

 $N = 400 \implies (N/2) = 200$

The cumulative frequency Just greater than 200 in 268 and the corresponding class is 165.5 - 168.5 Thus the median class is 165.5 - 168.5

 \therefore L = 165.5, h = 3 F = 136, C = c.f of preceding class = 132 & (N/2) = 200

Median,
$$M_c = l + \left[n \times \frac{\left(\frac{N}{2} - C \right)}{F} \right]$$

= 165.5 + $\left[3 \times \frac{(200 - 132)}{136} \right] = 165.5 + \left(\frac{3 \times 68}{136} \right) = (165.5 + 1.5) = 167$



The following is the distribution of IQ of 100 students, find the Median IQ.

IQ	75-84	85-94	95-104	105-114	114-124
Frequency	8	11	26	31	18
(a) 100.1 (b) 106.1					
(c) 146.1 (d) 149.7					
()					

(e) None of these

Answer; (b)

Explanation

The following series is in inclusive form. Converting it into exclusive form and preparing the cumulative frequency table, we get:

Class Interval	Frequency (f_i)	C F
74.5-84.5	8	8
84.5-94.5	11	19
94.5-104.5	26	45
104.5-114.5	31	76
114.5-124.5	18	94
124.5-134.5	4	98
134.5-144.5	2	100
	$N = \sum f_i = 100$	

Now N=100 $\Rightarrow (N/2) = 50$

The cumulative frequency just greater than 50 is 70 and the corresponding class interval is 104.5 - 114.5. \therefore L = 104.5, h = 10 f = 31, C = C.F of preceding class = 45 & (N/2) = 50

Median,
$$M_c] = L \left[h \times \frac{\left(\frac{N}{2} - C \right)}{F} \right]$$

= 104.5 + $\left[10 \times \frac{(50 - 45)31}{3} \right] = \left(104.5 + \frac{50}{3} \right) =$

(104.5+1.6) = 106.1



Calculate the median for the following date:Marks ObtainedNo. of studentsBelow 106Below 2015Below 3029Below 4041Below 5060Below 6070

(c) 35 (e) None of these

Answer: (c)

(a) 30

Explanation

From the given table, we may get back frequency and cumulative frequency as shown below;

(b) 31

(d) 33

Class Interval	Frequency (f_i)	C F
0-10	6	6
10-20	9	15
20-30	14	29
30-40	12	41
40-50	19	60
50-60	10	70
	$N = \sum f_i = 70$	

$$N = 70 \implies \left(\frac{N}{2}\right) = 35$$

The cumulative frequency just greater than 35 is 41 and the corresponding class is 30-40 Thus the median class is 30-40

$$\ell = 30, h = 10, f = 12, C = C.F \text{ of preceding class} = 29 \& \left(\frac{N}{2}\right) = 35$$

Median, $M_c = \ell + \left[\frac{\frac{N}{2} - Cf}{f}\right] \times h = 30 + \frac{35 - 29}{12} \times 10 = 35$



Find the missing frequencies in the following frequency distribution table, if N = 100 and median is 32.

Marks	0-10	10-20	20-30	30-40	40-50	50-60	Total
No. of Students	10	?	35	30	?	10	100
(a) 12 & 16		(b) 9 & 16					

(a) 12 & 16	(b) 9 & 16
(c) 14 & 9	(d) 15 & 16
(a) Nana of thosa	

(e) None of these

Answer: (b)

Explanation

Let $F_{\rm 1}\,\&\,F_{\rm 2}$ be the frequencies of class intervals 10-20 & 40-50 respectively. Then

$$10 + f_1 + 25 + 30 + f_2 + 10 = 100 \Rightarrow f_1 + f_2 = 25$$

Median is 32, which is in 30-40, so, the median class is 30-40
 \therefore L = 30, h = 10 f = 30, N = 100 & C = 10 + f_1 + 25 = (f_1 + 35)
Now median, $Me = L + \left[h \times \frac{\left(\frac{N}{2} - C \right)}{F} \right]$
 $\Rightarrow 30 + \frac{(15 - f_1)}{3} = 32 \Rightarrow (15 - f_1) = 6$
 $\Rightarrow f_1 = 9$



The mode of the following series is 36, find the missing frequency in it.

Class Interval	0-10	10-20	20-30	30-40	40-50	50-60	60-70
Frequency	8	10		16	12	6	7
(a) 9		(b) 10					
(c) 12		(d) 15					
(e) None of thes	e						

Answer: (b)

Self Evaluation



1.	The mean age of 6 person is in	creased by 4 years if one of them whose age is 26 years is replaced by new
	man then the age of new man	is:
	(a) 50 years	(b) 30 years

- (c) 32 years (d) 34 years
- (e) None of these

2. The median of the following data is: 36, 46, 32, 42, 33, 52, 50, 48, 56, 60, 53, 95, 75, 80, 70.

- (a) 48 (b) 56 (c) 52 (d) 60
- (e) None of these

3. The mode of the following data is:

Size of shoe	1	2	3	5	6	7	8	9
No. of Pairs used	5	6	4	8	9	7	4	10
(a) 5		()	o) 9					
(c) 7		(0	d) 4					
(e) None of these								

4. In a football team, the mean age of eleven player is 30 years. These are three groups of three players each and whose mean ages are 25 years, 26 years & 32 years respectively. If in these groups the captain and the youngest player are excluded and the captain is thirteen years older than the youngest player then the age of captain is:

(a) 39 years	(b) 44 years
(c) 34 years	(d) 47 years
(e) None of these	

5. Find the mean of the following data:

Class Interval	25-29	30-34	35-39	40-44	45-49	50-54
Frequency	5	10	15	5	7	8
(a) 40.5		(b) 35.5				
(c) 39.5		(d) 25.5				
(e) None of these	e					

6. The following data is the distribution of total monthly saving of 100 families of Delhi. The modal monthly income of the family will be:

Income	Frequency	Income	Frequency
1000-1500	10	3000-3500	15
1500-2000	20	3500-4000	11
2000-2500	16	4000-4500	9
2500-3000	15	4500-5000	4
(a) 1875.142		(b) 1857.142	
(c) 1814.752		(d) 1871.542	
()			

(e) None of these

7. The median for the following frequency distribution is:

Class Interval	Frequency	Class Interval	Frequency	
5-10	2	25-30	7	
10-15	3	30-35	5	
15-20	5	35-40	3	
20-35	1	40-45	5	
(a) 28.214	(b) 2	25.024	(c) 28.124	(d) 28.024
(e) None of these				

8. The median for the following data is :

Class Mark	110	120	130	140	150	160	170	180	190
Frequency	6	25	38	45	100	75	85	39	50
(a) 155.3		(b)	143.3		(c) 157.33	3		(d) 175.3	
(e) None of the	se								

9. The following table shows marks obtained by students in an examination of mathematics paper:

Marks	0-10	10-20	20-30	30-40	40-50]
No. of Students	10	24	40	46	20	
(a) 28.5		(b) 27.5		(c) 29.00		(d) 28.00
(e) None of these						

10. Which one of the following is the correct option

(a) Mode = 3 median - 2 mean (b) Mode = 3 median + 2 mean

- (c) 2 Mode = Median-2 mean (d) 2 Mode = 3 median+4 mean
- (e) None of these

							A	Inswer	s – Se	elf Eval	uatio	n Test						
1.	А	2.	С	3.	А	4.	В	5.	А	6.	Α	7.	В	8.	С	9.	D	10. C

Self Evaluation Test SOLUTIONS

- **1.** The total age of 6 person increased = $6 \times 4 = 24$ years Age of new person = 26 + 24 = 50 years
- 2. Arrange the data in ascending order 32, 33, 36,42,46,48, 50, 52, 53, 56, 60, 70, 75, 80,95. Here, total number of observation is fifteen which is odd. Therefore, median = $n\left(\frac{15+1}{2}\right)^{th}$ observation = 8th observation that is "52"
- **3.** Here, the frequency of size 9 is maximum, that is why modal size of shoe is 9.
- 4. Total age of 11 players = $11 \times 3 = 330$ years The total age of different Three groups = $25 \times 3 + 26 \times 3 + 32 \times 3$ = 75 + 78 + 96 = 249 years The age of captain and youngest player is 330 - 249 = 81 years According to question x + x + 13 = 81 $\Rightarrow 2x + 13 = 81 \Rightarrow 2x = 81 - 13 \Rightarrow 2x = 68 \Rightarrow x = 34$
- 5. Here, class intervals are formed by exclusive method. We can calculate its mean by the same formed or, 'Make it inclusive. Calculate it by any three methods.

Class Interval	Frequency (f_i)	Class mark (x_i)	$f_i x_i$
24.5-29.5	5	27	135
29.5-34.5	10	32	320
34.5-39.5	15	37	555
39.5-44.5	5	42	210
44.5-49.5	7	47	329
49.5-54.5	8	52	416

6. We observe that the modal class is 1500 - 2000

$$mode = \ell + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

= 1500 + $\frac{20 - 10}{2 \times 20 - 10 - 16} \times 500$
= 1500 + $\frac{10}{14} \times 500 = 1500 + 357.142 = 1857.142$

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Class Interval	Frequency (f_i)	Class Mark
0-10	10	5
10-20	24	15
20-30	40	25
30-40	46	35
40-50	20	45

Calculate mean by using any three of the method.