## Chapter 14 - Statistics

## Exercise-14.1

Question 1: A survey was conducted by a group of students as a part of their environment awareness programme, in which they collected the following data regarding the number of plants in 20 houses in a locality. Find the mean number of plants per house.

| No. of plants | No. of houses |
| :---: | :---: |
| $0-2$ | 1 |
| $2-4$ | 2 |
| $4-6$ | 1 |
| $6-8$ | 5 |
| $8-10$ | 6 |
| $10-12$ | 2 |
| $12-14$ | 3 |

Which method did you use for finding the mean, and why?
Answer:

| Number of plants | Class mark $\left(x_{i}\right)$ | Number of houses <br> $\left(f_{i}\right)$ | $f_{i} x_{i}$ |
| :--- | :--- | :--- | :--- |
| $0-2$ | 1 | 1 | 01 |
| $2-4$ | 3 | 2 | 06 |
| $4-6$ | 5 | 1 | 05 |
| $6-8$ | 7 | 5 | 35 |
| $8-10$ | 9 | 6 | 54 |
| $10-12$ | 11 | 2 | 22 |
| $12-14$ | 13 | 3 | 39 |
| Total |  | $\sum f_{i}=20$ | $\sum f_{i} x_{i}=162$ |

We have, $\operatorname{Mean}(\bar{x})=\frac{\sum f_{i} x_{i}}{\sum f_{i}}=\frac{162}{20}=8.1$
We need to plant 8.1 plants per house.

Question 2: Consider the following distribution of daily wages of 50 workers of a factory.

| Daily wages (in ₹) | No. of workers |
| :---: | :---: |
| $100-120$ | 12 |
| $120-140$ | 14 |
| $140-160$ | 8 |
| $160-180$ | 6 |
| $180-200$ | 10 |

Find the mean daily wages of the workers of the factory by using an appropriate method.

Answer: Step-deviation method is needed here as the data is large.
Here, $\mathrm{a}=150$ and $\mathrm{h}=20$.

| Class Interval | Frequency $\left(f_{i}\right)$ | Class marks <br> $\left(x_{i}\right)$ | $u_{i}=\frac{x_{i}-a}{h}$ <br> $=\frac{x_{i}-150}{20}$ | $f_{i} u_{i}$ |
| :--- | :--- | :--- | :--- | :--- |
| $100-120$ | 12 | 110 | -2 | -24 |
| $120-140$ | 14 | 130 | -1 | -14 |
| $140-160$ | 8 | $150=\mathrm{a}$ | 0 | 0 |
| $160-180$ | 6 | 170 | 1 | 6 |
| $180-200$ | 10 | 190 | 2 | 20 |
|  | $\sum f_{i}=50$ |  |  | $\sum f_{i} u_{i}=-12$ |

We have, Mean $(\bar{x})=\mathrm{a}+\mathrm{h}\left(\frac{\sum f_{i} u_{i}}{\sum f_{i}}\right)$

$$
\begin{aligned}
& =150+20\left(\frac{-12}{50}\right) \\
& =150-\frac{240}{50} \\
& =\frac{750-24}{5} \\
& =145.20
\end{aligned}
$$

Hence, mean daily wages of the workers are Rs. 145.20

Question 3: The following distribution shows the daily pocket allowance of children of a locality. The mean pocket allowance is ₹ 18 . Find the missing frequency $f$.

| Daily pocket <br> allowances <br> (in ₹) | No. of <br> children |
| :---: | :---: |
| $11-13$ | 7 |
| $13-15$ | 6 |
| $15-17$ | 9 |
| $17-19$ | 13 |
| $19-21$ | $f$ |
| $21-23$ | 5 |
| $23-25$ | 4 |

Answer:

| Daily pocket <br> allowance <br> (in Rs.) | Class marks $\left(x_{i}\right)$ | Number of <br> children $\left(f_{i}\right)$ | $d_{i}=x_{i}-18$ | $f_{i} d_{i}$ |
| :--- | :--- | :--- | :--- | :--- |
| $11-13$ | 12 | 7 | -6 | -42 |
| $13-15$ | 14 | 6 | -4 | -24 |
| $15-17$ | 16 | 9 | -2 | -18 |
| $17-19$ | $18=\mathrm{a}$ | 13 | 0 | 0 |
| $19-21$ | 20 | F | 2 f |  |
| $21-23$ | 22 | 5 | 4 | 20 |
| $23-25$ | 24 | 4 | 6 | 24 |
| Total |  | $\sum f_{i}=44+f$ |  | $\sum f_{i} d_{i}=2 f-40$ |

We have, mean $=\mathrm{a}+\frac{\sum f_{i} d_{i}}{\sum f_{i}}$

$$
\begin{aligned}
& \text { or, } 18=18+\frac{2 f-40}{44+f} \\
& \text { or, } 0=\frac{2 f-40}{44+f} \\
& \text { or, } 0=2 f-40 \\
& \text { or, } \mathrm{f}=20
\end{aligned}
$$

Question 4: Thirty women were examined in a hospital by a doctor and the number of heart beats per minute were recorded and summarised as follows.
Find the mean heart beats per minute for these women, choosing a suitable
method

| Number of heart <br> beats per minute | No. of women |
| :---: | :---: |
| $65-68$ | 2 |
| $68-71$ | 4 |
| $71-74$ | 3 |
| $74-77$ | 8 |
| $77-80$ | 7 |
| $80-83$ | 4 |
| $83-86$ | 2 |

Answer:

| Class Interval | Frequency $\left(f_{i}\right)$ | Class Marks $\left(x_{i}\right)$ | $f_{i} x_{i}$ |
| :--- | :--- | :--- | :--- |
| $65-68$ | 2 | 66.5 | 133 |
| $68-71$ | 4 | 69.5 | 278 |
| $71-74$ | 3 | 72.5 | 217.5 |
| $74-77$ | 8 | 75.5 | 604 |
| $77-80$ | 7 | 78.5 | 549.5 |
| $80-83$ | 4 | 81.5 | 326 |
| $83-86$ | 2 | 84.5 | 169 |
|  | $\sum f_{i}=30$ |  | $\sum f_{i} x_{i}=2277$ |

Therefore, mean of the data $=\frac{\sum f_{i} x_{i}}{\Sigma f_{i}}=\frac{2277}{30}=75.9$

Question 5: In a retail market, fruit vendors were selling mangoes kept in packing boxes. These boxes contained varying number of mangoes. The following was the distribution of mangoes according to the number of boxes.

| No. of mangoes | No. of boxes |
| :---: | :---: |
| $50-52$ | 15 |
| $53-55$ | 110 |
| $56-58$ | 135 |
| $59-61$ | 115 |
| $62-64$ | 25 |

Find the mean number of mangoes kept in a packing box. Which method of finding the mean did you choose?

Answer: Here, h=3

| Number of <br> mangoes | Class Marks <br> $\left(x_{i}\right)$ | Number of <br> boxes $\left(f_{i}\right)$ | $u_{i}=\frac{x_{i}-a}{h}$ <br> $=\frac{x_{i}-57}{3}$ | $f_{i} u_{i}$ |
| :--- | :--- | :--- | :--- | :--- |
| $50-52$ | 51 | 15 | -2 | -30 |
| $53-55$ | 54 | 110 | -1 | -110 |
| $56-58$ | $57=\mathrm{a}$ | 135 | 0 | 0 |
| $59-61$ | 60 | 115 | 1 | 115 |
| $62-64$ | 63 | 25 | 2 | 50 |
| Total |  | $\sum f_{i}=400$ |  | $\sum f_{i} u_{i}=25$ |

We have, mean $=\mathrm{a}+h\left(\frac{\sum f_{i} u_{i}}{\Sigma f_{i}}\right)$

$$
\begin{aligned}
& =57+\left(\frac{25 \times 3}{400}\right) \\
& =57+0.19 \\
& =57.19 \text { mangoes } .
\end{aligned}
$$

Question 6: The table below shows the daily expenditure on food of 25 households in a locality.

| Daily expenditure <br> (in ₹) | No. of <br> households |
| :---: | :---: |
| $100-150$ | 4 |
| $150-200$ | 5 |
| $200-250$ | 12 |
| $250-300$ | 2 |
| $300-350$ | 2 |

Find the mean daily expenditure on food by a suitable method.
Answer: Here, $\mathrm{a}=225$ and $\mathrm{h}=50$

| Class Interval | Frequency $\left(f_{i}\right)$ | Class Marks <br> $\left(x_{i}\right)$ | $u_{i}=\frac{x_{i}-a}{h}$ | $f_{i} u_{i}$ |
| :--- | :--- | :--- | :--- | :--- |
|  |  |  | $u_{i}=\frac{x_{i}-225}{50}$ |  |
| $100-150$ | 4 | 125 | -2 | -8 |
| $150-200$ | 5 | 175 | -1 | -5 |


| $200-250$ | 12 | $225=\mathrm{a}$ | 0 | 0 |
| :--- | :--- | :--- | :--- | :--- |
| $250-300$ | 2 | 275 | 1 | 2 |
| $300-350$ | 2 | 325 | 2 | 4 |
|  | $\sum f_{i}=25$ |  |  | $\sum f_{i} u_{i}=-7$ |

Therefore, $\operatorname{Mean}(\bar{x})=\mathrm{a}+h\left(\frac{\sum f_{i} u_{i}}{\sum f_{i}}\right)$

$$
\begin{aligned}
& =225+50\left(\frac{-7}{25}\right) \\
& =225-14 \\
& =211
\end{aligned}
$$

Hence, the mean daily expenditure on food is Rs. 211

Question 7: To find out the concentration of SO2 in the air (in parts per million, i.e. ppm), the data was collected for 30 localities in a certain city and is presented below:

| Concentration of <br> $\mathrm{SO}_{2}$ (in ppm ) | Frequency |
| :---: | :---: |
| $0.00-0.04$ | 4 |
| $0.04-0.08$ | 9 |
| $0.08-0.12$ | 9 |
| $0.12-0.16$ | 2 |
| $0.16-0.20$ | 4 |
| $0.20-0.24$ | 2 |

Find the mean concentration of $\mathrm{SO}_{2}$ in the air.
Answer: Here, h = 0.04

| Concentration <br> of $S O_{2}$ | Class marks <br> $\left(x_{i}\right)$ | Frequency $\left(f_{i}\right)$ | $u_{i}=\frac{x_{i}-a}{h}$ <br> $u_{i}=\frac{x_{i}-0.10}{0.04}$ |  |
| :--- | :--- | :--- | :--- | :--- |
| $0.00-0.04$ | 0.02 | 4 | $f_{i} u_{i}$ |  |
| $0.04-0.08$ | 0.06 | 9 | -2 | -8 |
| $0.08-0.12$ | $0.10=\mathrm{a}$ | 9 | -1 | -9 |
| $0.12-0.16$ | 0.14 | 2 | 0 | 0 |
| $0.16-0.20$ | 0.18 | 4 | 1 | 2 |
| $0.20-0.24$ | 0.22 | 2 | 2 | 8 |
|  |  | $\sum f_{i}=30$ |  | 6 |

We have, Mean $=\mathrm{a}+h\left(\frac{\sum f_{i} u_{i}}{\Sigma f_{i}}\right)$

$$
\begin{aligned}
& =0.10+\frac{(-1) \times 0.04}{30} \\
& =0.10+0.001 \\
& =0.099 \mathrm{ppm}
\end{aligned}
$$

Question 8 : A class teacher has the following absentee record of 40 students of a class for the whole term. Find the mean number of days a student was absent.

| No. of days | No. of students |
| :---: | :---: |
| $0-6$ | 11 |
| $6-10$ | 10 |
| $10-14$ | 7 |
| $14-20$ | 4 |
| $20-28$ | 4 |
| $28-38$ | 3 |
| $38-40$ | 1 |

Answer:

| Class interval | Frequency $\left(f_{i}\right)$ | Class marks $\left(x_{i}\right)$ | $f_{i} x_{i}$ |
| :--- | :--- | :--- | :--- |
| $0-6$ | 11 | 3 | 33 |
| $6-10$ | 10 | 8 | 80 |
| $10-14$ | 7 | 12 | 84 |
| $14-20$ | 4 | 17 | 68 |
| $20-28$ | 4 | 24 | 96 |
| $28-38$ | 3 | 33 | 99 |
| $38-40$ | 1 | 39 | 39 |
|  | $\sum f_{i}=40$ |  | $\sum f_{i} x_{i}=499$ |

Therefore, mean of the number of days $=\frac{\sum f_{i} x_{i}}{\sum f_{i}}=\frac{499}{40}=12.48$ days.

Question 9: The following table gives the literacy rate (in percentage) of 35 cities. Find the mean literacy rate.

| Literacy rate (in \%) | No. of cities |
| :---: | :---: |
| $45-55$ | 3 |
| $55-65$ | 10 |
| $65-75$ | 11 |
| $75-85$ | 8 |
| $85-95$ | 3 |

Answer:
$\left.\begin{array}{|l|l|l|l|l|}\hline \begin{array}{l}\text { Literacy rate } \\ \text { (in \%) }\end{array} & \begin{array}{l}\text { Class marks } \\ \left(x_{i}\right)\end{array} & \begin{array}{l}\text { Number of } \\ \text { cities }\left(f_{i}\right)\end{array} & u_{i}=\frac{x_{i}-a}{h} & f_{i} u \\ u_{i}=\frac{x_{i}-70}{10}\end{array}\right]$

$$
\begin{aligned}
\text { Mean } & =\mathrm{a}+h\left(\frac{\sum f_{i} u_{i}}{\sum f_{i}}\right) \\
& =70+\frac{(-2) \times 10}{35} \\
& =70-0.57 \\
& =69.43 \%
\end{aligned}
$$

## Exercise 14.2

Question 1: The following table shows the ages of the patients admitted in a hospital during a year.

| Age (in years) | No. of patients |
| :---: | :---: |
| $5-15$ | 6 |
| $15-25$ | 11 |
| $25-35$ | 21 |
| $35-45$ | 23 |
| $45-55$ | 14 |
| $55-65$ | 5 |

Find the mode and the mean of the data given above. Compare and interpret the two measures of central tendency.

Answer: For Mode:

| Age <br> (in years) | $5-15$ | $15-25$ | $25-35$ | $35-45$ | $45-55$ | $55-65$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Number <br> of <br> patients | 6 | 11 | 21 | 23 | 14 | 5 |

Hence, maximum frequency $=23$
Modal class $=35-45=10$
Here, I = 35
$f_{1}=23$
$f_{0}=21$
$f_{2}=12$
$h=10$

$$
\begin{aligned}
\text { Mode } & =I+\left[\frac{f_{1-f_{0}}}{2 f_{1}-f_{0-f_{2}}}\right] h \\
& =35+\left[\frac{23-21}{46-21-14}\right] 10 \\
& =35+\left[\frac{2}{11}\right] 10 \\
& =36.8 \text { years. }
\end{aligned}
$$

For Mean,

| Age <br> (in years) | Class <br> Mark <br> $\left(\boldsymbol{x}_{\boldsymbol{i}}\right)$ | Number of <br> Patients <br> $\left(\boldsymbol{f}_{\boldsymbol{i}}\right)$ | $\boldsymbol{u}_{\boldsymbol{i}=} \frac{\boldsymbol{x}_{\boldsymbol{i}}-\mathbf{3 0}}{\mathbf{1 0}}$ | $\boldsymbol{f}_{\boldsymbol{i}} \boldsymbol{u}_{\boldsymbol{i}}$ |
| :---: | :---: | :---: | :---: | :---: |
| $5-15$ | 10 | 6 | -2 | -12 |
| $15-25$ | 20 | 11 | -1 | -11 |
| $25-35$ | $30=\mathrm{a}($ let $)$ | 21 | 0 | 0 |
| $35-45$ | 40 | 23 | 1 | 23 |
| $45-55$ | 50 | 14 | 2 | 18 |
| $55-65$ | 60 | 5 | 3 | 15 |
| Total |  | $\sum f_{i}=80$ |  | $\sum f_{i} u_{i}=43$ |

Here, $\mathrm{a}=30, \sum f_{i} u_{i}=43, \sum f_{i}=80, \mathrm{~h}=10$
We have,
Mean $=a+\frac{\sum f_{i} u_{i}}{\sum f_{i}} \times h=30+\frac{43 \times 10}{80}=30+5.37=35.37$ years
Hence, the maximum number of patients in the hospital are of the age 36.8 years. The average age of the patients admitted is 35.37 years.

Question 2: The following data gives information on the observed lifetimes (in hours) of 225 electrical components.

| Life times (in hours) | Frequency |  |
| :---: | :--- | :--- |
| $0-20$ |  | 10 |
| $20-40$ | 35 |  |
| $40-60$ | 52 |  |
| $60-80$ | 61 |  |
| $80-100$ | 38 |  |
| $100-120$ |  | 29 |

Determine the modal lifetimes of the components.
Answer: Modal class is $60-80$, as 61 is maximum frequency.
Here, $\mathrm{I}=60, f_{m}=61, f_{1}=52, f_{2}=38$ and $\mathrm{h}=20$.
Therefore, Mode $=I+\left[\frac{f_{m}-f_{1}}{2 f_{m}-f_{1}-f_{2}}\right] h$

$$
\begin{aligned}
& =60+\left[\frac{61-52}{122-52-38}\right] 20 \\
& =60+\left(\frac{9 \times 20}{32}\right)=60+\frac{45}{8} \\
& =60+5.63=65.36 \mathrm{hr}
\end{aligned}
$$

Question 3: The following data gives the distribution of total monthly household expenditure of 200 families of a village. Find the modal monthly expenditure of the families. Also, find the mean monthly expenditure:

| Expenditure (in ₹) | Number of families |
| :---: | :---: |
| $1000-1500$ | 24 |
| $1500-2000$ | 40 |
| $2000-2500$ | 33 |
| $2500-3000$ | 28 |
| $3000-3500$ | 30 |
| $3500-4000$ | 22 |
| $4000-4500$ | 16 |
| $4500-5000$ | 7 |

Answer: Here, maximum frequency $=40$
Therefore, modal class $=1500-2000$ and $\mathrm{I}=1500, f_{0}=24, f_{1}=40, f_{2}=33$
Mode $=I+\left[\frac{f_{m}-f_{1}}{2 f_{m}-f_{1}-f_{2}}\right] h$

$$
\begin{aligned}
& =1500+\left[\frac{40-24}{80-24-33}\right] 500 \\
& =1500+\left(\frac{16 \times 500}{23}\right)=1500+347.83=\text { Rs. } 1847.83
\end{aligned}
$$

For Mean,

| Expenditure <br> (in Rupees) | Class Mark <br> $\left(x_{i}\right)$ | Number of <br> Families <br> $\left(f_{i}\right)$ | $u_{i=} \frac{x_{i}-2750}{500}$ | $f_{i} u_{i}$ |
| :---: | :---: | :---: | :---: | :---: |
| $1000-1500$ | 1250 | 24 | -3 | -72 |
| $1500-2000$ | 1750 | 40 | -2 | -80 |
| $2000-2500$ | 2250 | 33 | -1 | -33 |
| $2500-3000$ | $2750=\mathrm{a}($ let $)$ | 28 | 0 | 0 |
| $3000-3500$ | 3250 | 30 | 1 | 30 |
| $3500-4000$ | 3750 | 22 | 2 | 44 |
| $4000-4500$ | 4250 | 16 | 3 | 48 |
| $4500-5000$ | 4750 | 7 | 4 | 28 |
| Total |  | $\sum f_{i}=200$ |  | $\sum f_{i} u_{i}=-35$ |

Here, $\mathrm{a}=2750, \sum f_{i} u_{i}=-35, \sum f_{i}=200, \mathrm{~h}=500$
We have,
Mean $=a+\frac{\sum f_{i} u_{i}}{\Sigma f_{i}} \times h=2750+\frac{-35 \times 500}{200}=2750-87.50=R s .2662 .50$

## Question 4.

The following distribution gives the state-wise teacher- student ratio in higher secondary schools of India. Find the mode and mean of this data. Interpret the two measures.

| Number of students <br> per teacher | Number of <br> states/UT |
| :---: | :---: |
| $15-20$ | 3 |
| $20-25$ | 8 |
| $25-30$ | 9 |
| $30-35$ | 10 |
| $35-40$ | 3 |
| $40-45$ | 0 |
| $45-50$ | 0 |
| $50-55$ | 2 |


| Class Interval | Frequency $\left(f_{i}\right)$ | Class Marks <br> $\left(x_{i}\right)$ | $u_{i=} \frac{x_{i}-a}{h}$ | $f_{i} u_{i}$ |
| :--- | :--- | :--- | :--- | :--- |
| $15-20$ | 3 | 17.5 | -3 | -9 |
| $20-25$ | 8 | 22.5 | -2 | -16 |
| $25-30$ | $9\left(f_{1}\right)$ | 27.5 | -1 | -9 |
| $30-35$ | $10\left(f_{m}\right)$ | $32.5=\mathrm{a}$ | 0 | 0 |
| $35-40$ | $3\left(f_{2}\right)$ | 37.5 | 1 | 3 |
| $40-45$ | 0 | 42.5 | 2 | 0 |
| $45-50$ | 0 | 47.5 | 3 | 0 |
| $50-55$ | 2 | 52.5 | 4 | 8 |
|  | $\sum f_{i}=35$ |  |  | $\sum f_{i} u_{i}=-23$ |

Answer: Here, h=5

Since, the maximum frequency is 10 , so the modal class is $(30-35)$
Here, I = 30
$f_{m}=10$
$f_{1}=9$
$f_{2}=3$
$h=5$
$\mathrm{a}=32.5$
Mode $=I+\left[\frac{f_{m}-f_{1}}{2 f_{m}-f_{1}-f_{2}}\right] h$
$=30+\left[\frac{10-9}{2 \times 10-9-3}\right] \times 500$
$=30+\frac{5}{20-12}$
$=30.63$
Median $=\mathrm{a}+\frac{\sum f_{i} u_{i}}{\sum f_{i}} \times h$

$$
\begin{aligned}
& =32.5+\frac{-23}{35} \times 5 \\
& =29.22
\end{aligned}
$$

Question 5: The given distribution shows the number of runs scored by some top batsmen of the world in one-day international cricket matches.

| Runs scored | Number of batsmen |
| :---: | :---: |
| $3000-4000$ | 4 |
| $4000-5000$ | 18 |
| $5000-6000$ | 9 |
| $6000-7000$ | 7 |
| $7000-8000$ | 6 |
| $8000-9000$ | 3 |
| $9000-10000$ | 1 |
| $10000-11000$ | 1 |

Find the mode of the data.

Answer:

| Runs scored | Number of batsmen $\left(f_{i}\right)$ |
| :--- | :--- |
| $3000-4000$ | 4 |
| $4000-5000$ | 18 |
| $5000-6000$ | 9 |
| $6000-7000$ | 7 |
| $7000-8000$ | 6 |
| $8000-9000$ | 3 |
| $9000-10000$ | 1 |
| $10000-11000$ | 1 |

Maximum frequency $=18$
Therefore, Modal class $=4000-5000$
Here, $I=4000$
$f_{0}=4$
$f_{1}=18$
$f_{2}=9$

$$
\begin{aligned}
\text { Mode } & =I+\left[\frac{f_{1}-f_{0}}{2 f_{1}-f_{0}-f_{2}}\right] h \\
& =4000+\left[\frac{18-4}{36-4-9}\right] 1000 \\
& =4000+\frac{14000}{23} \\
& =4000+608.7 \\
& =4680.7 \text { runs }
\end{aligned}
$$

## Exercise 14.3

Question 1: The following frequency distribution gives the monthly consumption of electricity of 68 consumers of a locality. Find the median, mean and mode of the data and compare them.

| Monthly consumption <br> (in units) | $65-85$ | $85-105$ | $105-125$ | $125-145$ | $145-165$ | $165-185$ | $185-205$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| No. of <br> consumers | 4 | 5 | 13 | 20 | 14 | 8 | 4 |

Answer:

| Monthly <br> consumption | Number of <br> consumers <br> $\left(f_{i}\right)$ | Cumulative <br> frequency <br> $(\mathrm{cf})$ | Class mark <br> $\left(x_{i}\right)$ | $u_{i=} \frac{x_{i}-a}{h}$ | $f_{i} u_{i}$ |
| :--- | :--- | :--- | :--- | :--- | :--- |
| $65-85$ | 4 | 4 | 75 | -3 | -12 |
| $85-105$ | 5 | 9 | 95 | -2 | -10 |
| $105-125$ | 13 | 22 | 115 | -1 | -13 |
| $125-145$ | 20 | 42 | $135=\mathrm{a}$ | 0 | 0 |
| $145-165$ | 14 | 56 | 155 | 1 | 14 |
| $165-185$ | 8 | 64 | 175 | 2 | 16 |
| $185-205$ | 4 | 68 | 195 | 3 | 12 |
|  | $\sum f_{i}=68$ |  |  |  | $\sum f_{i} u_{i}=7$ |

We have, Mean $=\mathrm{a}+\frac{\sum f_{i} u_{i}}{\Sigma f_{i}} \times h$

$$
\begin{aligned}
& =135+\frac{7}{68} \times 20 \\
& =135+\frac{35}{17} \\
& =137.06 \text { units }
\end{aligned}
$$

Here, $\mathrm{n}=68$
$\frac{n}{2}=\frac{68}{2}=34$
Therefore, Median class = 125-145
Here, I = 125
$\mathrm{n}=68$
$\mathrm{f}=20$
$\mathrm{cf}=22$
$\mathrm{h}=20$
Median $=\mathrm{I}+\left(\frac{\frac{\mathrm{n}}{2}-c f}{f}\right) \mathrm{h}$
$=125+\left(\frac{34-22}{20}\right) 20$

$$
\begin{aligned}
& =125+12 \text { units } \\
& =137 \text { units }
\end{aligned}
$$

Maximum Frequency $=20$
Modal class $=125-145=20$
Here, I = 125
$f_{0}=13$
$f_{1}=20$
$f_{2}=14$

$$
\begin{aligned}
\text { Mode } & =I+\left[\frac{f_{1}-f_{0}}{2 f_{1}-f_{0}-f_{2}}\right] h \\
& =125+\left(\frac{20-13}{40-13-14}\right) 20 \\
& =125+\frac{7 \times 20}{13} \\
& =125+10.76 \\
& =135.76 \text { units }
\end{aligned}
$$

Mean > Median > Mode

Question 2: If the median of the distribution given below is 28.5 , find the values of $x$ and $y$.

| Class-interval | Frequency |
| :---: | :---: |
| $0-10$ | 5 |
| $10-20$ | $x$ |
| $20-30$ | 20 |
| $30-40$ | 15 |
| $40-50$ | $y$ |
| $50-60$ | 5 |
| Total | 60 |

Answer:

| Class Interval | Frequency | Cumulative Frequency |
| :--- | :--- | :--- |
| $0-10$ | 5 | 5 |
| $10-20$ | $x$ | $5+x(c)$ |
| $20-30$ | $20(f)$ | $25+x$ |
| $30-40$ | 15 | $40+x$ |


| $40-50$ | Y | $40+\mathrm{x}+\mathrm{y}$ |
| :--- | :--- | :--- |
| $50-60$ | 5 | $45+\mathrm{x}+\mathrm{y}$ |
| Total | $\mathrm{n}=60$ |  |

We have $45+x+y=60$
(1) [Given]

Since, $\mathrm{n}=60$
$\frac{n}{2}=\frac{60}{2}=30$
Since the median lies in the class interval (20-30).
Here, I = 20
$\mathrm{f}=20$
cf $=5+x$
$h=10$
Therefore, Median $=1+\left(\frac{\frac{n}{2}-c f}{f}\right) \mathrm{h}$

$$
\begin{aligned}
& \text { Or, } 28.5=20+\left(\frac{30-5-x}{20}\right) 10 \\
& \text { Or, } 28.5=20+\left(\frac{25-x}{2}\right) \\
& \text { Or, } 57=40+25-x \\
& \text { Or, } 25-x=57-40 \\
& \text { Or, } x=25-17=8
\end{aligned}
$$

Putting $x=8$ in eq. (1) we get,
$45+8+y=60$
or, $y=60-53$
or, $y=7$

Question 3: A life insurance agent found the following data for distribution of ages of 100 policy holders. Calculate the median age, if policies are given only
to persons having age 18 years onwards but less than 60 years.

| Age <br> (in years) | Number of <br> policy holders |
| :---: | :---: |
| Below 20 | 2 |
| Below 25 | 6 |
| Below 30 | 24 |
| Below 35 | 45 |
| Below 40 | 78 |
| Below 45 | 89 |
| Below 50 | 92 |
| Below 55 | 98 |
| Below 60 | 100 |

Answer:

| Age (in years) | Number of policy holders | Cumulative frequency |
| :--- | :--- | :--- |
| $0-20$ | 2 | 2 |
| $20-25$ | $6-2=4$ | 6 |
| $25-30$ | $24-6=18$ | 24 |
| $30-35$ | $45-24=21$ | 45 |
| $35-40$ | $78-45=33$ | 78 |
| $40-45$ | $89-78=11$ | 89 |
| $45-50$ | $92-89=3$ | 92 |
| $50-55$ | $98-92=6$ | 98 |
| $55-60$ | $100-98=2$ | 100 |
| Total | 100 |  |

Here, $\frac{n}{2}=\frac{100}{2}=50$
Therefore, median class $=35-40$
I = 35
$\mathrm{cf}=45$
h $=5$
$\mathrm{f}=33$
We have, Median $=1+\left(\frac{\frac{n}{2}-c f}{f}\right) \mathrm{h}$

$$
\begin{aligned}
& =35+\left(\frac{50-45}{33}\right) 5 \\
= & 35+\frac{25}{33} \\
= & 35+0.76=35.76 \text { years }
\end{aligned}
$$

Question 4: The lengths of 40 leaves of a plant are measured correct to nearest millimetre, and the data obtained is represented in the following table:

| Length <br> (in mm) | Number of leaves |
| :---: | :---: |
| $118-126$ | 3 |
| $127-135$ | 5 |
| $136-144$ | 9 |
| $145-153$ | 12 |
| $154-162$ | 5 |
| $163-171$ | 4 |
| $172-180$ | 2 |

Find the median length of the leaves.
Answer:

| Class interval | Frequency | Cumulative Frequency |
| :--- | :--- | :--- |
| $117.5-126.5$ | 3 | 3 |
| $126.5-135.5$ | 5 | 8 |
| $135.5-144.5$ | 9 | $17(\mathrm{c})$ |
| $144.5-153.5$ | $12(\mathrm{f})$ | 29 |
| $153.5-162.5$ | 5 | 34 |
| $162.5-171.5$ | 4 | 38 |
| $171.5-180.5$ | 2 | 40 |
|  | $\mathrm{n}=40$ |  |

Here, $\mathrm{n}=40$
Hence, $\frac{n}{2}=\frac{40}{2}=20$
Since, 12 is the maximum frequency, so the median class $=144.5-153.5$
I = 144.5
$\mathrm{cf}=17$
h $=9$
$\mathrm{f}=12$
We have, Median $=1+\left(\frac{\frac{n}{2}-c f}{f}\right) \mathrm{h}$

$$
\begin{aligned}
& =144.5+\left(\frac{20-17}{12}\right) 9 \\
= & 144.5+\frac{9}{4} \\
= & 144.5+2.25=146.75 \mathrm{~mm}
\end{aligned}
$$

Hence, the median length of leaves is 146.75 mm

Question 5: The following table gives the distribution of the lifetime of 400 neon lamps:

| Life time <br> (in hours) | Number of <br> lamps |
| :---: | :---: |
| $1500-2000$ | 14 |
| $2000-2500$ | 56 |
| $2500-3000$ | 60 |
| $3000-3500$ | 86 |
| $3500-4000$ | 74 |
| $4000-4500$ | 62 |
| $4500-5000$ | 48 |

Find the median lifetime of a lamp.
Answer:

| Lifetime (in hours) | Number of lamps | cf |
| :--- | :--- | :--- |
| $1500-2000$ | 14 | 14 |
| $2000-2500$ | 56 | 70 |
| $2500-3000$ | 60 | 130 |
| $3000-3500$ | 86 | 216 |
| $3500-4000$ | 74 | 290 |
| $4000-4500$ | 62 | 352 |
| $4500-5000$ | 48 | 400 |
| Total | 400 |  |

Here, $\frac{n}{2}=\frac{400}{2}=200$
Median class is $3000-3500$
So, $f=86$
cf $=130$
$h=500$
We have, Median $=\mathrm{I}+\left(\frac{\frac{n}{2}-c f}{f}\right) \mathrm{h}$

$$
\begin{aligned}
& =3000+\left(\frac{200-130}{86}\right) 500 \\
& =3000+\frac{35000}{86} \\
& =3000+406.8=3406.98 \text { hours }
\end{aligned}
$$

Question 6: 100 surnames were randomly picked up from a local telephone directory and the frequency distribution of the number of letters in the English
alphabet in the surnames was obtained as follows:

| Number of <br> letters | Number of <br> surnames |
| :---: | :---: |
| $1-4$ | 6 |
| $4-7$ | 30 |
| $7-10$ | 40 |
| $10-13$ | 16 |
| $13-16$ | 4 |
| $16-19$ | 4 |

Determine the median number of letters in the surnames. Find the mean number of letters in the surnames. Also, find the modal size of the surnames.

Answer: Here, h=3

| Class <br> interval | Frequency <br> $\left(f_{i}\right)$ | Cumulative <br> Frequency <br> $(\mathrm{cf})$ | Class <br> marks $\left(x_{i}\right)$ | $u_{i=} \frac{x_{i}-a}{h}$ | $f_{i} u_{i}$ |
| :--- | :--- | :--- | :--- | :--- | :--- |
| $1-4$ | 6 | 6 | 2.5 | -2 | -12 |
| $4-7$ | $30\left(f_{1}\right)$ | $36(\mathrm{c})$ | 5.5 | -1 | -30 |
| $7-10$ | $40\left(f_{m}\right)$ | 76 | $8.5=\mathrm{a}$ | 0 | 0 |
| $10-13$ | $16\left(f_{2}\right)$ | 92 | 11.5 | 1 | 16 |
| $13-16$ | 4 | 96 | 14.5 | 2 | 8 |
| $16-19$ | 4 | 100 | 17.5 | 3 | 12 |
|  |  |  | $\mathrm{n}=100$ |  | $\sum f_{i} u_{i}$ <br> $=-6$ |

$\because \quad n=100$
$\therefore \quad \frac{n}{2}=\frac{100}{2}=50$
Since 40 is the maximum frequency, so the median class is $(7-10)$
Here, $l=7, f_{m}=40, c f=36$ and $h=3$.

$$
\begin{aligned}
\therefore \text { Median } & =l+\left(\frac{\frac{n}{2}-c f}{f_{m}}\right) \times h \\
& =7+\left(\frac{50-36}{40}\right) \times 3=7+\frac{14}{40} \times 3 \\
& =7+\frac{21}{20}=7+\frac{10.5}{10} \\
& =7+1.05=8.05 \\
\text { Mean } & =a+\frac{\sum f_{i} u_{i}}{\sum f_{i}} \times h=8.5+\frac{(-6)}{100} \times 3 \\
& =8.5+\frac{(-18)}{100}=8.50-0.18=8.32
\end{aligned}
$$

Now since the maximum number of letters in surnames $=40$
$\therefore$ Modal class $=7-10$

$$
\begin{aligned}
\therefore \text { Mode } & =l+\left(\frac{f_{m}-f_{1}}{2 f_{m}-f_{1}-f_{2}}\right) \times h \\
& =7+\left(\frac{40-30}{80-30-16}\right) \times 3 \\
& =7+\frac{10}{34} \times 3=7+\frac{30}{34}=7+0.88 \\
& =7.88
\end{aligned}
$$

## Question 7:

The distribution below gives the weight of 30 students of a class. Find the median weight of the students.

| Weight (in kg) | Number of <br> students |
| :---: | :---: |
| $40-45$ | 2 |
| $45-50$ | 3 |
| $50-55$ | 8 |
| $55-60$ | 6 |
| $60-65$ | 6 |
| $65-70$ | 3 |
| $70-75$ | 2 |

Answer:

| Weight (in kg) | Number of Students $\left(\boldsymbol{f}_{\boldsymbol{i}}\right)$ | $\boldsymbol{c f}$ |
| :---: | :---: | :---: |
| $40-45$ | 2 | 2 |
| $45-50$ | 3 | 5 |
| $50-55$ | 8 | 13 |


| $55-60$ | 6 | 19 |
| :---: | :---: | :---: |
| $60-65$ | 6 | 25 |
| $65-70$ | 3 | 28 |
| $70-75$ | 2 | 30 |
| Total | 30 |  |

Here, $\frac{n}{2}=\frac{30}{2}=15$
$\therefore$ Median class $=55-60$,
So, $I=55, f=6, c f=13, h=5$

$$
\begin{aligned}
\text { Median weight } & =l+\left(\frac{\frac{n}{2}-c f}{f}\right) \times h \\
& =55+\left(\frac{15-13}{2}\right) \times 5=55+\frac{55}{3} \\
& =55+1.67=56.67 \mathrm{~kg}
\end{aligned}
$$

