

- Sometimes the average may give a very absurd result. For example, if we are calculating average size of a family we may get a value 5.6. But this is impossible as persons cannot be in fractions. However, we should remember that it is an average value representing the entire group. For such situations one should report the approximate value.
- Generally, a wrong choice of an average leads to fallacious and funny conclusions. So, a proper and judicious choice of an average for a particular problem is very important.
- Measures of central value fail to give any idea about the formation of the series. Two or more series may have the same central value but may differ widely in compositions.

For example, let us consider the following series.

| | | | | Total | Mean |
|------------|----|----|----|--------------|-------------|
| Series I | 2 | 4 | 54 | 60 | 20 |
| Series II | 19 | 20 | 21 | 60 | 20 |
| Series III | 20 | 20 | 20 | 60 | 20 |

- We must remember that an average is a measure of central tendency. Hence, unless the data shows a clear single concentration of observations, an average may not be meaningful at all. This evidently precludes the use of any average to a bimodal, a U-shaped or a J-shaped distribution.

Theoretical Questions

- What is a statistical average? What are the desirable properties for an average to possess?
- What is meant by various measures of central tendency? What purposes do their measurements serve?
- What is a weighted average? When should it be used instead of a simple average? Define a 'weighted mean'. Under what circumstances would you prefer it to an unweighted mean?
- What are the relative merits of the median and the mean as a measures of central tendency?
- What are 'measures of location'? In what circumstances would you consider them as the most suitable measures for describing the central tendency of a frequency distribution?
- Explain the properties of a good average. In the light of these properties which average do you think is the best and why?
- Define A.M, G.M. and H.M and also state the properties of A.M.
- "It is said that the choice of an average depends upon the particular problem in hand". Explain the statement.
- State the ideal properties for a good measure of central tendency.
- Explain the general limitations of an average.

Numerical Questions

- Find the arithmetic mean of the given data:
15 35 10 5 25 45 50 30 20 40
- If the mean of the eight numbers 6, 4, 9, 10, 15, 5, 8, x is 10 then find the value of x .
- The mean of Supriya's marks on five tests was 77.4. The marks on the first 4 of these tests were 88, 77, 70 and 72. Find the mark on fifth test.
- The following is the frequency distribution of the number of telephone calls received in 245 successive one-minute intervals at an exchange:

| | | | | | | | | |
|--------------|----|----|----|----|----|----|----|----|
| No. of calls | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Frequency | 14 | 21 | 25 | 43 | 51 | 40 | 39 | 12 |

Obtain the mean number of calls per minute.

5. In an enquiry of 25 football matches, the number of goals scored recorded is as follows:
4, 0, 5, 2, 3, 1, 4, 3, 2, 3, 4, 3, 1, 6, 3, 2, 3, 4, 2, 1, 0, 3, 2, 5, 4
Represent the above data into discrete frequency distribution and then find the mean.

6. From the following data, find the mean.

| | | | | | | |
|-----------|----|----|----|----|----|----|
| Size | 10 | 12 | 14 | 16 | 18 | 20 |
| Frequency | 3 | 7 | 12 | 20 | 8 | 5 |

7. The marks secured by BBS students in Public Youth Campus in Statistics are given below:

| | | | | | | | |
|-----------------|----|----|----|----|----|----|----|
| Marks | 35 | 38 | 45 | 60 | 72 | 80 | 85 |
| No. of Students | 3 | 10 | 15 | - | 10 | 8 | 4 |

If the mean score of the marks distribution is 58, find out the missing number of students securing score 60 and the total number of students in the class.

8. The following data is related to the distance traveled by 520 villagers to buy their weekly requirements.

| | | | | | | | | | | |
|------------------|----|-----|---|----|----|----|----|----|----|----|
| Miles traveled | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
| No. of villagers | 38 | 104 | - | 78 | 48 | 42 | - | 24 | 16 | 2 |

If mean is given to be 7.8, then find the missing frequencies.

9. Following data indicates the number of vehicles arrived during past 100 days in a certain tolling station.

| | | | | | |
|-------------|--------|---------|---------|---------|---------|
| Vehicles | 0 - 10 | 10 - 20 | 20 - 30 | 30 - 40 | 40 - 50 |
| No. of Days | 3 | 14 | 53 | 20 | 10 |

Calculate average number of vehicles in a day.

10. The frequency distribution below represent the time in seconds needed to serve a sample of customers by cashiers at Bulls Eye Discount store in December 2010.

| | | | | | | | | | |
|----------------|-------|-------|-------|-------|-------|-------|-------|-------|---------|
| Time (seconds) | 20-29 | 30-39 | 40-49 | 50-59 | 60-69 | 70-79 | 80-89 | 90-99 | 100-109 |
| Frequency | 6 | 16 | 21 | 29 | 25 | 22 | 11 | 7 | 4 |

Calculate mean by (a) direct method and (b) coding method.

11. Calculate A.M. from the following data

| | | | | | | | |
|-------------|------------|------------|------------|----------|---------|----------|----------|
| Temp °C | -40 to -30 | -30 to -20 | -20 to -10 | -10 to 0 | 0 to 10 | 10 to 20 | 20 to 30 |
| No. of days | 10 | 28 | 30 | 42 | 65 | 180 | 10 |

12. The following data provides the weekly wages of the worker in a firm. Calculate the average weekly wage per worker

| | | | | | | |
|--|--------|---------|---------|---------|---------|---------|
| Wages group (Rs.) | 80-100 | 100-120 | 120-140 | 140-160 | 160-180 | 180-200 |
| Total hours | 168 | 170 | 225 | 272 | 126 | 91 |
| Average no. of hours worked per worker | 12 | 10 | 9 | 8.5 | 7 | 6.5 |

13. An investor buys Rs.1200 worth of share in company each month. During the first 5 months he bought the share at a price of Rs.10, 12, 15, 20 and 24 per share. After 5 months what is the average price paid for the shares by him.
14. Find the missing frequency from the following distribution of sales of shops, given that the mean sale of shops is Rs.24.625.

| | | | | | |
|----------------|------|-------|-------|-------|-------|
| Sale ('00 Rs.) | 0-10 | 10-20 | 20-30 | 30-40 | 40-50 |
| No. of shops | 5 | 25 | - | 18 | 7 |

15. Following are the monthly salaries in rupees of 32 employees of a firm.

| | | | | | | | |
|-----|-----|-----|-----|-----|-----|----|-----|
| 91 | 139 | 126 | 119 | 100 | 87 | 65 | 77 |
| 116 | 76 | 69 | 88 | 112 | 118 | 89 | 116 |
| 65 | 77 | 99 | 95 | 108 | 127 | 86 | 148 |
| 97 | 105 | 95 | 80 | 86 | 106 | 93 | 135 |

The firm gives bonuses of Rs.10, 15, 20, 25, 30, 35, 40, 45 and 50 to employees in the respective salary groups: exceeding 60 but not exceeding 70, exceeding 70 but no exceeding 80 and so on up to exceeding 140 but not exceeding 150. Find out the total bonus paid per employee.

16. The mean weight of 150 students in a certain class is 60 kg. The mean weight of boys in the class is 70kg and that of girls is 55 kg. Find the number of boys and the number of girls in the class.
17. (a) The average income of 100 persons in village A is Rs. 3,500 and that of 150 persons in village B is Rs. 4,000. What is the total income of both the villages put together?
- (b) The mean marks got by 300 students in the subject of statistics are 45. The mean of the top 100 of them was found to be 70 and the mean of the last 100 was known to be 20. What is the mean of the remaining 100 students?
- (c) The mean monthly salary paid to all employees in a certain company is Rs.600. The mean monthly salaries paid to the male and female were Rs.620 and Rs.520 respectively. Obtain the percentage of male and female employees in the company.
- (d) 100 students took a test. The result of those who secured less than 60% mark are given below:

| | | | |
|-----------------|------|-------|-------|
| Marks | 0-20 | 20-40 | 40-60 |
| No. of students | 16 | 24 | 30 |

If the average mark of all students was 50, find out the average mark of those who secured more than 60% marks.

18. (a) There were 500 workers working in a factory. Their mean was calculated as Rs.200. Later on it was discovered that the wages of two workers were misread as 180 and 20 in place of 80 and 220. Find the correct average.
- (b) The mean marks of 100 students were calculated as 65. At the time of checking it was found the marks 40 and 50 was wrongly copied and weeded out. Find the correct mean marks.
19. (a) Calculate the weighted mean price of a table from the following data, assuming that weights are proportional to the number of tables sold.

| | | | | |
|-----------------------|-------|-------|-------|-------|
| Price per table (Rs.) | 36.00 | 40.00 | 44.00 | 48.00 |
| No. of tables sold | 14 | 11 | 9 | 6 |

- (b) In a certain course, a student's final mark is computed using the following weights: Quizzes 10%; Tests 40% and Examination 50%. Find his final average mark, if his marks in each of these categories 81, 75 and 70 respectively.
- (c) Dr. Khanal is very particular about the choice of pets. He selects kittens on the basis of 3 quotations: cuteness, fluffiness, and attitude. The quantities are given weights 5, 3, and x respectively. The scores for the three quantities in that order are 8, 9 and 4. If his weighted mean score was 7.5, what is the value of x , the weight for attitude?
20. (a) Six types of worker are employed in each of two workshops, but at different rates of wages as follows.

| Type of workers | Workshop A | | Workshop B | |
|-----------------|---------------------------------|----------------|---------------|----------------|
| | Rate of wages per workers (Rs.) | No. of workers | Rate of wages | No. of workers |
| Mechanic | 2.50 | 2 | 3.00 | 18 |
| Fitter | 3.50 | 14 | 3.00 | 50 |
| Electrician | 4.00 | 20 | 4.25 | 8 |
| Carpenter | 3.00 | 7 | 3.50 | 12 |
| Smith | 3.00 | 6 | 3.50 | 10 |
| Clerk | 2.00 | 1 | 5.00 | 2 |

In which of the two workshops is the average rate of wages per worker higher and by how much?

- (b) A contractor employs three types of workers- male, female and children. To a male worker, he pays Rs.16 per day, to a female worker Rs.13 per day and to a child worker Rs.10 per day. What is the average wage per day paid by the contractor if the number of males, females and children is 20, 15 & 5 respectively?

21. Find the median of the following set of observations.
- (a) 60, 70, 50, 80, 90, 100, 110
- (b) 70, 80, 60, 90, 120, 140
22. In a batch of 15 students, 3 students failed in an examination. The marks of passed 12 students were 9, 6, 7, 8, 4, 5, 8, 10, 9, 7, 5, 7. What was the median mark of all 15 students?
23. Following are the marks obtained by a batch of 10 students in a certain class tests in statistics (X) and accountancy (Y).

| Roll No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|----------|----|----|----|----|----|----|----|----|----|----|
| X | 63 | 64 | 62 | 32 | 30 | 60 | 47 | 46 | 35 | 28 |
| Y | 68 | 66 | 35 | 42 | 26 | 85 | 44 | 80 | 33 | 72 |

In which subject is the level of knowledge of the students higher?

24. Find the median of the pop quiz marks shown below:

| Marks | 0 | 1 | 2 | 3 | 4 | 5 |
|-----------|---|---|---|---|---|---|
| Frequency | 1 | 1 | 5 | 3 | 2 | 1 |

25. The following is the income distribution of the persons:

| Income (00 Rs.) | 50-80 | 80-100 | 100-110 | 110-120 | 120-130 | 130-150 | 150-180 | 180-200 |
|-----------------|-------|--------|---------|---------|---------|---------|---------|---------|
| No. of persons | 30 | 127 | 140 | 240 | 176 | 135 | 20 | 3 |

Find the median incomes.

26. Calculate the median annual income of a group of employees from the data given below:

| Annual Income in Rs. | Under 2000 | 2000 – 2999 | 3000 – 3999 | 4000 – 4999 | 5000 – 5999 | 6000 – 6999 | 7000 – 7999 | 8000 – 8999 |
|----------------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| No. of Employees | 15 | 32 | 65 | 79 | 90 | 57 | 36 | 14 |

27. Find the median wage of a labour from the following table

| Wages (Rs.) | Above 0 | Above 10 | Above 20 | Above 30 | Above 40 | Above 50 | Above 60 | Above 70 |
|----------------|---------|----------|----------|----------|----------|----------|----------|----------|
| No. of Laborer | 650 | 500 | 425 | 375 | 300 | 275 | 250 | 100 |

28. You are given below a certain statistical distribution:

| Value | Less than 100 | 100-200 | 200-300 | 300-400 | 400 & above | Total |
|-----------------|---------------|---------|---------|---------|-------------|-------|
| No. of families | 40 | 89 | 148 | 64 | 39 | 380 |

Calculate the most suitable average giving reason for your choice.

29. The expenditure of 1000 families is given as below:

| Expenditure (Rs.) | 40-59 | 60-79 | 80-99 | 100-119 | 120-139 |
|-------------------|-------|-------|-------|---------|---------|
| No. of families | 50 | ? | 500 | ? | 50 |

The median for the distribution is Rs.87. Calculate the missing frequencies.

30. The following table gives you the distribution of marks secured by some students in an examination.

| Marks | 0-20 | 21-30 | 31-40 | 41-50 | 51-60 | 61-70 | 71-80 |
|-----------------|------|-------|-------|-------|-------|-------|-------|
| No. of Students | 42 | 38 | 120 | 84 | 48 | 36 | 31 |

Find (a) Median marks, (b) The percentage of failures if the minimum for a pass is 35 marks.

31. Five percent of the workers in a firm employing a total of 2000 men earn less than Rs.2.00 per hour, 450 earn from Rs.2 to 2.24 per hour, 35 percent earn from Rs.2.25 to Rs.2.49 per hour, 370 earn from Rs.2.50 to Rs.2.74 per hour, 12 percent earn from Rs.2.75 to Rs.2.99 per hour and the rest earn Rs.3 or more per hour. What is the median wage?

32. Calculate quartiles from the following data.

| Months | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|------------------|----|----|----|----|----|----|----|----|----|----|----|----|
| Monthly earnings | 39 | 40 | 40 | 41 | 41 | 42 | 42 | 43 | 43 | 44 | 44 | 44 |

33. Calculate lower and upper quartiles from the following data.

| | | | | | | | |
|-------------------|----|----|-----|-----|-----|----|----|
| Age in years | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
| Number of members | 3 | 61 | 132 | 153 | 140 | 51 | 3 |

34. Calculate the lower and upper quartiles from the following marks distribution:

| | | | | | | |
|----------|----------|-------|-------|-------|-------|----------|
| Marks | Below 25 | 25-29 | 30-34 | 35-39 | 40-44 | Above 44 |
| Students | 5 | 12 | 22 | 25 | 17 | 9 |

35. Find the (a) lower quartile, (b) upper quartile, (c) 7th decile, (d) 60th percentile for the following distribution.

| | | | | | | | |
|----------------|--------|--------|--------|--------|--------|--------|---------|
| Wages (Rs.) | 30 -40 | 40 -50 | 50 -60 | 60 -70 | 70 -80 | 80 -90 | 90 -100 |
| No. of persons | 1 | 3 | 11 | 21 | 43 | 32 | 9 |

36. In a small branch of a bank in a rural area, the following is the average deposit balance of current accounts during a month. Calculate median, seventh decile and 85th percentile.

| | | | | | | | | | |
|-----------------------------|------|-----|-----|-----|-----|-----|-----|-----|-----|
| Deposit balance (less than) | 1000 | 900 | 800 | 600 | 550 | 500 | 400 | 250 | 100 |
| No. of deposit | 500 | 498 | 480 | 475 | 440 | 374 | 300 | 125 | 25 |

37. Calculate the median, 3rd decile and 20th percentile from the following data.

| | | | | | |
|--------------|-----|-----|------|------|------|
| Central size | 2.5 | 7.5 | 12.5 | 17.5 | 22.5 |
| Frequency | 7 | 18 | 25 | 30 | 20 |

38. Calculate the median income from the following income distribution. Also find out the lowest income of highest 10% earners.

| | | | | | | | | |
|-------------------------------|---|----|----|-----|-----|-----|-----|-----|
| Income in Rs. 000 (Less than) | 5 | 10 | 15 | 20 | 25 | 34 | 35 | 40 |
| No. of Earners | 5 | 25 | 60 | 100 | 125 | 140 | 150 | 156 |

39. The monthly salary distribution of 250 families in a certain locality is given below.

| Monthly salary (Rs.) | No. of families | Monthly salary (Rs.) | No. of families |
|----------------------|-----------------|----------------------|-----------------|
| More than 0 | 250 | More than 2000 | 55 |
| More than 500 | 200 | More than 2500 | 30 |
| More than 1000 | 120 | More than 3000 | 15 |
| More than 1500 | 80 | More than 3500 | 5 |

Find the following:

- (a) Limits of the income of middle 50% of the families and
 (b) If income tax is to be levied on families whose income exceeds Rs. 1,800 per month, calculate the percentage of families, which will be paying income tax.
40. One hundred and twenty students appeared for a certain test and the following marks distribution was obtained.

| | | | | | |
|----------|-------|--------|--------|--------|---------|
| Marks | 0 -20 | 20 -40 | 40 -60 | 60 -80 | 80 -100 |
| Students | 10 | 30 | 36 | 30 | 14 |

Find:

- (a) The limits of marks of middle 30% students.
 (b) The percentage of students getting marks more than 75.
 (c) The number of students who fail, if 35 marks are required for passing.

41. (a) When 11 students were asked for their favourite number, the responses were: 7, 10, 72, 7, 1600, 4, 1, 7, 2, 1, 7.

What measure of central tendency is the most appropriate to describe their answers?

- (b) Compute mode from the following:

| | | | | | | | | |
|---|----|-----|-----|-----|-----|-----|-----|-----|
| x | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 400 |
| f | 5 | 14 | 40 | 91 | 150 | 87 | 60 | 38 |

42. Calculate the modal size in the following distribution:

| | | | | | | |
|---------------|----------|-------|-------|-------|-------|-------|
| Size (inches) | Below 10 | 10-12 | 12-14 | 14-16 | 16-18 | 18-20 |
| Demand | 3 | 15 | 27 | 20 | 3 | 2 |

Will the median fall under the same size?

43. Calculate the modal value from the following data:

| | | | | | | |
|--------------------------|-----|-----|-----|-----|-----|-----|
| Income (Rs.) (less than) | 100 | 200 | 300 | 400 | 500 | 600 |
| No. of persons | 8 | 22 | 35 | 60 | 67 | 70 |

44. Determine the mode using empirical relation between mean, median and mode.

| | | | | | | | | | | |
|---|----|----|----|----|----|----|----|----|----|----|
| x | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| f | 6 | 9 | 4 | 2 | 10 | 8 | 7 | 5 | 1 | 3 |

45. Calculate the mode for the following data by using empirical relationship.

| | | | | | | | | |
|------------------------|------|------|------|------|------|------|------|------|
| Annual Wages up to Rs. | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 |
| No. of worker | 12 | 30 | 80 | 100 | 150 | 220 | 300 | 330 |

46. The following table represents the marks of 100 students.

| | | | | | |
|-----------------|------|-------|-------|-------|--------|
| Marks | 0-20 | 20-40 | 40-60 | 60-80 | 80-100 |
| No. of students | 14 | - | 27 | - | 15 |

If the mode value is 48 find the missing frequencies and the mean marks of all 100 students.

47. You are given the following incomplete frequency distribution. It is known that the total frequency is 1000 and that the median is 413.11. Estimate by calculation, the missing frequencies and find the value of the mode.

| | | | | | | | | |
|---------------|---------|---------|---------|---------|---------|---------|---------|---------|
| Value (x) | 300-325 | 325-350 | 350-375 | 375-400 | 400-425 | 425-450 | 450-475 | 475-500 |
| Frequency (f) | 5 | 17 | 80 | ? | 326 | ? | 88 | 9 |

48. Calculate the most repeated value from the following data.

| | | | | | |
|-----------------|--------|---------|---------|---------|---------|
| Marks | 0 - 10 | 10 - 20 | 20 - 40 | 40 - 50 | 50 - 70 |
| No. of students | 5 | 15 | 40 | 32 | 28 |

49. Calculate mean, median and mode from the following data of the heights in inches of a group of students.

| | | | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 61 | 62 | 63 | 61 | 61 | 64 | 64 | 60 | 65 | 63 | 64 | 65 | 66 | 64 |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|

Now, suppose that a group of students whose heights are 60, 66, 59, 68, 67 and 70 inches is added to the original group. Find the mean, median and mode of the combined group.

50. A locality with 16 schools has the following distribution of average number of teachers in different income groups.

| | | | | | |
|-------------------------|-----|-----|------|------|------|
| Income (central value) | 600 | 800 | 1000 | 1200 | 1400 |
| No. of schools | 2 | 3 | 5 | 4 | 2 |
| Average no. of teachers | 20 | 26 | 21 | 21 | 9 |

Find the mean, median and modal income of all the teachers.

51. A cement company sells his production in different cities through the appointed dealers. The sales of his production in the last year is given in the following tabular form:

| | | | | | | |
|----------------------|---------|------------|-------------|-------------|-------------|---------------|
| Sales (in '00' bags) | 0 - 500 | 500 - 1000 | 1000 - 1500 | 1500 - 2000 | 2000 - 2500 | 2500 and more |
| Number of dealers | 40 | 48 | 60 | 52 | 35 | 22 |

The annual general meeting of the company decided to give award of Rs. 5,000 to each dealer whose sales are more than the most usual sales. Calculate the total amount of money that would be given to the dealers.

52. (a) For moderately asymmetrical distribution, the arithmetic mean = 28 and the median = 27. Find mode of this distribution.
 (b) In a moderately asymmetrical distribution, the values of mode and mean are 32.1 and 35.4 respectively. Find the median value.

53. (a) Calculate G.M. and H.M. of the following data.

(i)

| | | | | | |
|--------------------|---|---|---|----|----|
| Variable value (X) | 5 | 7 | 9 | 12 | 18 |
|--------------------|---|---|---|----|----|

(ii)

| | | | | | |
|---|----|----|----|----|----|
| X | 10 | 20 | 30 | 40 | 55 |
| f | 2 | 4 | 8 | 3 | 2 |

(iii)

| | | | | | |
|------|------|-------|-------|-------|-------|
| C.I. | 5-14 | 15-24 | 25-34 | 35-44 | 45-54 |
| f | 5 | 7 | 10 | 4 | 2 |

- (b) A cyclist pedals from his house to his college at a speed of 10km per hour and back from the college to his house at 15km per hour. Find the average speed.
 (c) You make a trip which entails traveling 900km by train at a speed of 60km/hour, 3000km by boat at an average of 25km/hour, 400km by plane at 350 km/hour and finally 15km by taxi at 25km/hour, what is your average speed for the entire distance?
 (d) If H.M., A.M., and G.M. of a set of 5 observations are 10.2, 16 & 14 respectively. Comment upon these values.

Additional Problems

1. The operation manager of a digital watch company is considering to switch from batch production process to continuous assembly line. He conducted a time study of the batch process. From the data he collected, the following frequency distribution of total production time for one watch resulted.

| Production time (in minutes) | Below 5 | 5.01 - 5.50 | 5.51 - 6.00 | 6.01 - 6.50 | 6.51 - 7.00 | Above 7.00 |
|------------------------------|---------|-------------|-------------|-------------|-------------|------------|
| Frequency | 16 | 22 | 39 | 21 | 19 | 14 |

If the median is over 6.00 minutes, operation manager can switch from batch production process to continuous assembly line. What should be his decision?

2. The following are the weekly production in units of 60 workers in a manufacturing company.

| | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|
| 23 | 35 | 41 | 82 | 75 | 46 | 48 | 88 | 72 | 44 | 85 | 51 |
| 51 | 77 | 62 | 75 | 68 | 50 | 64 | 25 | 49 | 56 | 55 | 16 |
| 82 | 39 | 32 | 51 | 52 | 62 | 19 | 52 | 54 | 63 | 45 | 56 |
| 33 | 48 | 67 | 59 | 40 | 54 | 50 | 64 | 46 | 69 | 57 | 40 |
| 39 | 49 | 55 | 53 | 20 | 55 | 72 | 57 | 52 | 57 | 42 | 75 |

The manager has decided to give bonus of Rs.5, 10, 15, 20 and 25 to each worker in the respective output group of 40 or over weekly output. Find the average bonus received by the workers.

3. A factory pays worker on piece rate basis and also a bonus to each worker on the basis of individual output in each quarter. The rate of bonus payable is as follows.

| | | | | | | | |
|-----------------|-------|-------|-------|-------|-------|-------|---------|
| Output in units | 70-74 | 75-79 | 80-84 | 85-89 | 90-94 | 95-99 | 100-104 |
| Bonus in rupees | 40 | 45 | 50 | 60 | 70 | 80 | 100 |

The individual output of a batch of 50 workers is given below

| | | | | | | | | | |
|----|----|-----|----|----|----|-----|----|----|----|
| 94 | 83 | 78 | 76 | 88 | 86 | 93 | 80 | 91 | 82 |
| 89 | 87 | 84 | 85 | 97 | 88 | 97 | 83 | 92 | 88 |
| 80 | 75 | 84 | 81 | 75 | 72 | 82 | 95 | 93 | 83 |
| 80 | 86 | 101 | 98 | 85 | 99 | 82 | 77 | 83 | 81 |
| 82 | 87 | 98 | 87 | 89 | 71 | 103 | 90 | 72 | 80 |

By suitable classification, you are required to find:

- Average bonus per worker for the quarter
 - Total quarterly bonus paid to the whole batch
 - Average output per worker
4. Incomes of employees in an industrial concern are given below. The total income of the 10 employees in the class over Rs. 250 is Rs. 3000. Compute the mean income. Every employee belonging to the top 25% of the earners is required to pay 1% of his income to workers relief fund. Estimate the contributions to this fund.

| Income (Rs.) | Frequency | Income (Rs.) | Frequency |
|--------------|-----------|--------------|-----------|
| 0 -50 | 90 | 150 -200 | 80 |
| 50 -100 | 150 | 200 -250 | 70 |
| 100 -150 | 100 | 250 and over | 10 |

Answers

1. 27.5
2. 23
3. 80
4. 3.763
5. 2.8
6. 15.38
7. f_1 (missing freq.) = 20; Total freq. = 70
8. 138 and 30
9. 27 vehicles
10. (a) 60.10 (b) 60.10
11. 4.29°C
12. Rs. 140.83
13. Rs. 14.63
14. 25
15. Rs. 26.56
16. Boys = 50 and Girls = 100
17. (a) Rs. 950,000 (b) 45 (b) 80%, 20% (c) 87.33
18. (a) 200.2 (b) 65.41
19. (a) Rs.40.70 (b) $\bar{x}_w = 73.1$ (c) $x = 2$
20. (a) $\bar{X}_A = \text{Rs.}3.50$; $\bar{X}_B = \text{Rs.}3.25$, In workshop A, by 25 paise (b) Rs. 14.13
21. (a) 80 (b) 85
22. 7 marks
23. $M_d(x) = 46.5$, $M_d(y) = 55$, level of knowledge of students is higher in Accountancy
24. 2
25. Rs. 11577.08
26. $M_d = \text{Rs.}5032.83$
27. $M_d = \text{Rs.}36.67$
28. $M_d = \text{Rs.}241.22$
29. $262.5 \approx 263, 137$
30. $M_d = 40.46, 33.58\%$
31. Rs. 2.41
32. $Q_1 = 40.25$ and $Q_3 = 43.75$
33. $Q_1 = 40$ yrs and $Q_3 = 60$ yrs.
34. $Q_1 = 30.75$ marks and $Q_3 = 40.53$ marks
35. (a) Rs. 67.14, (b) Rs. 83.44, (c) Rs. 81.56, (d) Rs. 78.37
36. $M_d = 357.14, D_7 = 467.57, P_{55} = 538.64$
37. $M_d = 15, D_3 = 11$ and $P_{20} = 8.61$
38. $M_d = \text{Rs.} 17250; P_{90} = \text{Rs.} 30,200$
39. (a) $Q_1 = \text{Rs.} 578$ (approx.), $Q_3 = \text{Rs.}1850$, (b) 26%
40. (a) $P_{35} = 41.11, P_{65} = 61.33$; (b) 17.9%; (c) $32.5 \approx 33$
41. (a) Mode = 7 (b) Mode 250
42. Mode = 13.26 inches; $M_d = 13.26$ inches, Yes the median falls under the same size
43. Mode = Rs.340
44. 24.18
45. Rs. 1704.89
46. $f_1 = 23, f_2 = 21, \bar{x} = 50$
47. 227 and 248, Mode = 413.98
48. 44 marks
49. First group: Mean = 63.07, $M_d = 63.5$, Mode = 64;
Combined group: Mean = 63.65, $M_d = 64$, Mode = 64
50. Mean = Rs. 976.62, $M_d = \text{Rs.} 984.76$, Mode = Rs. 1012.50
51. Rs. 6,65,000
52. (a) Mode = 19 (b) 34.3
53. (a) (i) 9.259, (ii) 27.369, (iii) 23.506 (b) 12km/hr, (c) 31.56 km/hr.

Additional Problems

1. $M_d = 5.86$ minutes; Since the median is not over 6.00 minutes the operation manager cannot switch from batch production to continuous assembly line. Hence, the manager continuous batch production process.
2. Rs. 12
3. (a) Rs.59.3; (b) Rs.2965; (c) 85.9 units
4. Mean income = Rs. 117.50; estimated contribution to the fund = Rs. 271.20

