

CLASS 10 — MATHEMATICS

Chapter: Statistics

Answer Key with Step-by-Step Solutions

Maximum Marks: 40

Time Allowed: 1 hour 30 minutes

Results used: Mean — direct $\bar{x} = \Sigma f_i x_i / \Sigma f_i$; assumed mean $\bar{x} = a + \Sigma f_i d_i / \Sigma f_i$; step-deviation $\bar{x} = a + h(\Sigma f_i u_i / \Sigma f_i)$, $u_i = (x_i - a)/h$. Mode $= l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$. Median $= l + \frac{n/2 - cf}{f} \times h$,

where cf is the cumulative frequency of the class preceding the median class. Empirical relation: $3 \text{ Median} = \text{Mode} + 2 \text{ Mean}$.

SECTION A — MCQ Answer Key

Q	Option	Answer	Explanation / calculation
Q1	(B)	17.5	Class mark $= (10 + 25)/2 = 17.5$.
Q2	(C)	26	Mode $= 3 \text{ Median} - 2 \text{ Mean} = 66 - 40 = 26$.
Q3	(C)	20 - 30	The highest frequency, 12, belongs to the class 20 - 30.
Q4	(B)	the class preceding the modal class	f_1 is the frequency of the modal class, f_0 of the class before it and f_2 of the class after it.
Q5	(B)	20 - 30	$n = 40$, $n/2 = 20$. Cumulative frequencies: 6, 15, 27, ... The first cf greater than 20 is 27, for the class 20 - 30.
Q6	(A)	47	$\bar{x} = a + h \times \Sigma f_i u_i / \Sigma f_i = 45 + 10 \times 10/50 = 47$.
Q7	(B)	centred at the class marks	Each class is represented by its mid-point (class mark).
Q8	(A)	28	$3 \text{ Median} = \text{Mode} + 2 \text{ Mean} \Rightarrow \text{Median} = (24.5 + 59.5)/3 = 84/3 = 28$.
Q9	(A)	Both true; R explains A	The cumulative frequencies locate the median class (cf just above $n/2$), which is then used in the median formula. R explains A.
Q10	(D)	A false, R true	The mode is given by the formula and lies within the modal class; it is generally not the class mark. A is false; R is true.

Marking: 1 mark for each correct option; no part marks in Section A.

SECTION B – Very Short Answer

Q11. Mean by the direct method [2 marks]

Class	f_i	x_i	$f_i x_i$
0-20	5	10	50
20-40	8	30	240
40-60	12	50	600
60-80	10	70	700
80-100	5	90	450
Total	40		2040

$$\bar{x} = \frac{2040}{40} = 51.$$

Answer: 51 marks

Marking scheme:

Correct table with class marks and $\Sigma f x = 2040$: 1 mark

Mean = 51: 1 mark

Q12. Mode [2 marks]

Modal class = 30 - 40 (highest frequency 14). $l = 30$, $f_1 = 14$, $f_0 = 8$, $f_2 = 9$, $h = 10$.

$$\text{Mode} = 30 + \frac{14 - 8}{28 - 8 - 9} \times 10 = 30 + \frac{60}{11} = 30 + 5.45 = 35.45.$$

Answer: 35.45 (approx.)

Marking scheme:

Modal class and values: 1 mark

Mode $\approx$ 35.45: 1 mark

Q13. Median [2 marks]

$n = 45$, $n/2 = 22.5$. Cumulative frequencies: 5, 14, 29, 39, 45. Median class = 20 - 30.

$$l = 20, cf = 14, f = 15, h = 10. \text{Median} = 20 + \frac{22.5 - 14}{15} \times 10 = 20 + 5.67 = 25.67.$$

Answer: 25.67 (approx.)

Marking scheme:

Cumulative frequencies and median class: 1 mark

Median $\approx$ 25.67: 1 mark

Q14. Find p [2 marks]

Class marks: 5, 15, 25, 35, 45. $\Sigma f_i = 25 + p$; $\Sigma f_i x_i = 25 + 15p + 250 + 210 + 180 = 665 + 15p$.

$$\frac{665 + 15p}{25 + p} = 25 \Rightarrow 665 + 15p = 625 + 25p \Rightarrow 10p = 40 \Rightarrow p = 4.$$

Answer: $p = 4$

Marking scheme:

Σf and $\Sigma f x$ in terms of p : 1 mark

$p = 4$: 1 mark

Q15. From cumulative frequencies to the mode [2 marks]

Frequencies: 0-10: 4, 10-20: $10 - 4 = 6$, 20-30: $24 - 10 = 14$, 30-40: $32 - 24 = 8$, 40-50: $36 - 32 = 4$.

Modal class = 20 - 30. Mode = $20 + \frac{14 - 6}{28 - 6 - 8} \times 10 = 20 + \frac{80}{14} = 20 + 5.71 = 25.71$.

Answer: Mode $\approx$ 25.71

Marking scheme:

Correct frequency distribution: 1 mark

Mode $\approx$ 25.71: 1 mark

SECTION C – Short Answer**Q16. Mean wage by step deviation** [3 marks]

Take $a = 150$, $h = 20$.

Wages	f_i	x_i	u_i	$f_i u_i$
100-120	12	110	-2	-24
120-140	14	130	-1	-14
140-160	8	150	0	0
160-180	6	170	1	6
180-200	10	190	2	20
Total	50			-12

$$\bar{x} = 150 + 20 \times \frac{-12}{50} = 150 - 4.8 = 145.20.$$

Answer: ₹ 145.20

Marking scheme:

Correct u_i values: 1 mark

$\Sigma f u_i = -12$: 1 mark

Mean ₹ 145.20: 1 mark

Q17. Missing frequencies from the median [3 marks]

Total: $4 + x + 10 + 12 + y + 5 = 50 \Rightarrow x + y = 19 \dots (1)$

Median 35 lies in 30 - 40, so $l = 30$, $f = 12$, $h = 10$, $cf = 4 + x + 10 = 14 + x$, $n/2 = 25$.

$$35 = 30 + \frac{25 - (14 + x)}{12} \times 10 \Rightarrow 5 = \frac{(11 - x) \times 10}{12} \Rightarrow 11 - x = 6 \Rightarrow x = 5.$$

From (1), $y = 14$. Check: cf before 30 - 40 is $19 < 25$ and cf up to 40 is $31 \geq 25$ ✓

Answer: $x = 5$, $y = 14$

Marking scheme:

Equation $x + y = 19$: 1 mark

Median equation: 1 mark

$x = 5$, $y = 14$: 1 mark

Q18. Mean and mode of patients' ages [3 marks]

Mean (assumed mean $a = 35$):

Age	f_i	x_i	$d_i = x_i - 35$	$f_i d_i$
10-20	7	15	-20	-140
20-30	12	25	-10	-120
30-40	20	35	0	0
40-50	16	45	10	160
50-60	9	55	20	180
60-70	6	65	30	180
Total	70			260

$$\bar{x} = 35 + \frac{260}{70} = 35 + 3.71 = 38.71 \text{ years.}$$

Mode: modal class 30 - 40, $l = 30$, $f_1 = 20$, $f_0 = 12$, $f_2 = 16$. Mode = $30 + \frac{20 - 12}{40 - 12 - 16} \times 10 = 30 + 6.67 = 36.67$ years.

Answer: Mean $\approx$ 38.71 years; mode $\approx$ 36.67 years

Marking scheme:

Table with $\Sigma fd = 260$: 1 mark

Mean $\approx$ 38.71 years: 1 mark

Mode $\approx$ 36.67 years: 1 mark

Q19. Missing frequencies from the mean [3 marks]

$$8 + f_1 + 20 + f_2 + 7 = 60 \Rightarrow f_1 + f_2 = 25 \dots (1)$$

$$\Sigma f_i x_i = 8(5) + 15f_1 + 20(25) + 35f_2 + 7(45) = 855 + 15f_1 + 35f_2.$$

$$\text{Mean } 24.5 \Rightarrow 855 + 15f_1 + 35f_2 = 60 \times 24.5 = 1470 \Rightarrow 15f_1 + 35f_2 = 615 \Rightarrow 3f_1 + 7f_2 = 123 \dots (2)$$

$$\text{From (1): } 3(25 - f_2) + 7f_2 = 123 \Rightarrow 4f_2 = 48 \Rightarrow f_2 = 12, f_1 = 13.$$

Answer: $f_1 = 13$, $f_2 = 12$

Marking scheme:

Equation (1): 1 mark

Equation (2) from the mean: 1 mark

$f_1 = 13$, $f_2 = 12$: 1 mark

SECTION D — Long Answer

Q20. Mean, median and mode [4 marks]

Mean (step deviation, $a = 45$, $h = 10$):

Marks	f_i	x_i	u_i	$f_i u_i$	cf
20-30	5	25	-2	-10	5
30-40	9	35	-1	-9	14
40-50	15	45	0	0	29
50-60	12	55	1	12	41
60-70	7	65	2	14	48
70-80	2	75	3	6	50
Total	50			13	

$$\bar{x} = 45 + 10 \times \frac{13}{50} = 45 + 2.6 = 47.6.$$

Median: $n/2 = 25$; median class 40 - 50 (cf 29). Median = $40 + \frac{25 - 14}{15} \times 10 = 40 + 7.33 = 47.33$.

Mode: modal class 40 - 50, $f_1 = 15$, $f_0 = 9$, $f_2 = 12$. Mode = $40 + \frac{15 - 9}{30 - 9 - 12} \times 10 = 40 + 6.67 = 46.67$.

Check: $3 \text{ Median} = 3 \times 47.33 = 142.0$; $\text{Mode} + 2 \text{ Mean} = 46.67 + 95.2 = 141.87$. These are approximately equal, so the relation holds approximately.

Answer: Mean = 47.6; Median $\approx$ 47.33; Mode $\approx$ 46.67; relation holds approximately ($142.0 \approx 141.87$)

Marking scheme:

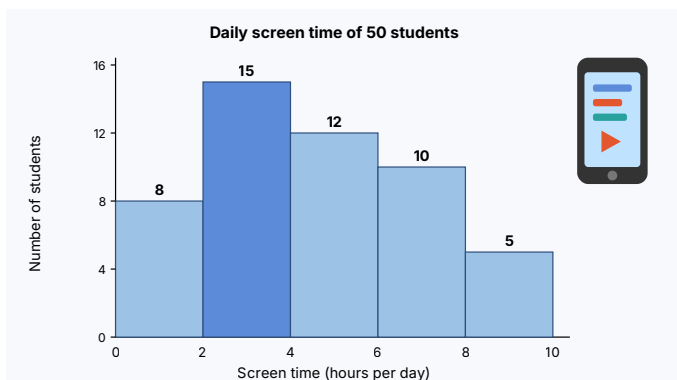
Mean 47.6: 1 mark

Median $\approx$ 47.33: 1 mark

Mode $\approx$ 46.67: 1 mark

Checking the empirical relation: 1 mark

SECTION E — Case Study



Q21. Screen time survey [4 marks]

Frequency table: 0-2: 8, 2-4: 15, 4-6: 12, 6-8: 10, 8-10: 5 (total 50).

(i) The highest frequency is 15, so the modal class is **2 - 4 hours**.

(ii) $n/2 = 25$. Cumulative frequencies: 8, 23, 35, 45, 50. The first cf greater than 25 is 35, so the median class is **4 - 6 hours**.

(iii) Class marks 1, 3, 5, 7, 9. $\sum f_i x_i = 8 + 45 + 60 + 70 + 45 = 228$.

$$\bar{x} = \frac{228}{50} = \mathbf{4.56 \text{ hours}}.$$

Answer: (i) 2 - 4 h (ii) 4 - 6 h (iii) 4.56 hours

Marking scheme:

(i) 2 - 4 hours: 1 mark

(ii) 4 - 6 hours: 1 mark

(iii) $\sum fx = 228$: 1 mark; mean 4.56 hours: 1 mark

Final Answer Summary

Q	Final answer	Q	Final answer
Q1	(B) 17.5	Q12	≈ 35.45
Q2	(C) 26	Q13	≈ 25.67
Q3	(C) 20 - 30	Q14	$p = 4$
Q4	(B)	Q15	≈ 25.71
Q5	(B) 20 - 30	Q16	₹ 145.20
Q6	(A) 47	Q17	$x = 5, y = 14$
Q7	(B)	Q18	Mean ≈ 38.71 ; mode ≈ 36.67
Q8	(A) 28	Q19	$f_1 = 13, f_2 = 12$
Q9	(A)	Q20	47.6; 47.33; 46.67
Q10	(D)	Q21	2-4 h; 4-6 h; 4.56 h
Q11	51		

Marks: Section A 10 + Section B 10 + Section C 12 + Section D 4 + Section E 4 = **40**

— End of Solutions —