Affiliated to CBSE, New Delhi (Affiliation No. 1030642)

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CLASS X · MATHEMATICS STANDARD (041) · CBSE BOARD EXAMINATION 2027

CHAPTER 13

Statistics

Answer Booklet · Full worked solutions with CBSE-style step marks

Every question of the Standard booklet | Step marks shown line by line | MCQ keys with working

INSIDE THIS BOOKLET

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HOW TO USE THE ANSWERS

1. Solve the question in your notebook **first**. Open this booklet only to check.
2. The orange number beside each line is the **step mark** an examiner gives for that line, as in the CBSE marking scheme.
3. Give yourself marks line by line. A right final answer without the working can lose step marks.
4. Make the table first. Most marks are lost in the table, not in the formula.
5. Copy every wrong answer to the My Mistakes page of your booklet.

READ THIS FIRST

Marking Guide

Full worked solutions to every question in the chapter booklet, set out the way a CBSE examiner marks them.

HOW MARKS ARE GIVEN IN STATISTICS ANSWERS

1. **1-mark MCQ / assertion–reason:** only the correct option scores. The working here is for your understanding.
2. **3-mark mean, median or mode:** table (x_i, f_ix_i or cf) 1 · the sums or the class and its values 1 · answer 1.
3. **5-mark question:** marks are split between the measures asked; each needs its table or values, the formula and the answer.
4. Write the formula before putting in the numbers.
5. Lines with no number are working that earns no separate mark but must be shown.

PART A · SOLUTIONS

A NCERT Practice – Solutions

Worked solutions with step marks for every question in Part A.

Mean of grouped data

A1. The table shows the hours of television watched in a week by 30 students. Find the mean number of hours. **[3]**

Hours	0–4	4–8	8–12	12–16	16–20
Students	4	8	10	6	2

Class marks and f_ix_i: 1

Hours	0–4	4–8	8–12	12–16	16–20	Total
f_i	4	8	10	6	2	**30**
x_i	2	6	10	14	18	
f_ix_i	8	48	100	84	36	**276**

$\Sigma f_i = 30$, $\Sigma f_ix_i = 276$ 1

Mean $\bar{x} = \dfrac{\Sigma f_ix_i}{\Sigma f_i} = \dfrac{276}{30} = 9.2$ hours 1

A2. The mean of the distribution below is 53.2. Find the missing frequency p. **[3]**

Class	0–20	20–40	40–60	60–80	80–100
Frequency	5	8	p	12	7

$x_i = 10, 30, 50, 70, 90$; $\Sigma f_i = 32 + p$; $\Sigma f_ix_i = 50 + 240 + 50p + 840 + 630 = 1760 + 50p$ 1

$\dfrac{1760 + 50p}{32 + p} = 53.2$, so $1760 + 50p = 1702.4 + 53.2p$ 1

$3.2p = 57.6$, so $p = 18$ 1

A3. The daily wages of 50 workers in a workshop are given. Find the mean daily wage by the assumed mean method. **[3]**

Wage (₹)	200–250	250–300	300–350	350–400	400–450
Workers	8	12	20	6	4

Take $a = 325$. Then d_i and $f_i d_i$: 1

Wage (₹)	200–250	250–300	300–350	350–400	400–450	Total
f_i	8	12	20	6	4	**50**
x_i	225	275	325	375	425	
$d_i = x_i - 325$	−100	−50	0	50	100	
$f_i d_i$	−800	−600	0	300	400	**−700**

$\Sigma f_i = 50$, $\Sigma f_i d_i = -700$ 1

$$\text{Mean } \bar{x} = a + \frac{\Sigma f_i d_i}{\Sigma f_i} = 325 + \frac{-700}{50} = ₹311$$ 1

A4. The marks of 50 students in a test are given. Find the mean marks by the step-deviation method. **[3]**

Marks	0–20	20–40	40–60	60–80	80–100
Students	7	11	15	10	7

Take $a = 50$, $h = 20$: 1

Marks	0–20	20–40	40–60	60–80	80–100	Total
f_i	7	11	15	10	7	**50**
x_i	10	30	50	70	90	
$u_i = \frac{x_i - 50}{20}$	−2	−1	0	1	2	
$f_i u_i$	−14	−11	0	10	14	**−1**

$\Sigma f_i = 50$, $\Sigma f_i u_i = -1$ 1

$$\text{Mean } \bar{x} = a + h \times \frac{\Sigma f_i u_i}{\Sigma f_i} = 50 + 20 \times \frac{-1}{50} = 49.6 \text{ marks}$$ 1

A5. The distances (in km) that 40 students travel to school are given. Find the mean distance. **[3]**

Distance (km)	0–3	3–6	6–9	9–12	12–15
Students	9	12	10	6	3

Take $a = 7.5$, $h = 3$: 1

km	0–3	3–6	6–9	9–12	12–15	Total
f_i	9	12	10	6	3	**40**
x_i	1.5	4.5	7.5	10.5	13.5	
$u_i = \frac{x_i - 7.5}{3}$	−2	−1	0	1	2	
$f_i u_i$	−18	−12	0	6	6	**−18**

$\Sigma f_i = 40$, $\Sigma f_i u_i = -18$ 1

$$\text{Mean } \bar{x} = a + h \times \frac{\Sigma f_i u_i}{\Sigma f_i} = 7.5 + 3 \times \frac{-18}{40} = 6.15 \text{ km}$$ 1

Mode of grouped data

A6. The monthly electricity bills of 50 homes are given. Find the modal bill. **[3]**

Bill (₹)	400–600	600–800	800–1000	1000–1200	1200–1400
Homes	6	11	18	10	5

Modal class = 800–1000 (highest frequency 18): $l = 800$, $f_1 = 18$, $f_0 = 11$, $f_2 = 10$, $h = 200$ 1

$$\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h = 800 + \frac{18 - 11}{36 - 11 - 10} \times 200$$ 1

$$= 800 + \frac{7}{15} \times 200 \approx ₹893.33$$ 1

A7. The ages of 50 people at a health camp are given. Find the mean and the mode, and say what each tells you. **[5]**

Age (years)	10–20	20–30	30–40	40–50	50–60	60–70
People	4	8	13	15	7	3

(i) Take $a = 35$, $h = 10$: 1

Age	10–20	20–30	30–40	40–50	50–60	60–70	Total
f_i	4	8	13	15	7	3	**50**
x_i	15	25	35	45	55	65	
$u_i = \frac{x_i - 35}{10}$	−2	−1	0	1	2	3	
$f_i u_i$	−8	−8	0	15	14	9	**22**

$\Sigma f_i = 50$, $\Sigma f_i u_i = 22$

$$\text{Mean } \bar{x} = a + h \times \frac{\Sigma f_i u_i}{\Sigma f_i} = 35 + 10 \times \frac{22}{50} = 39.4 \text{ years}$$ 1

(ii) Modal class = 40–50 (highest frequency 15): $l = 40$, $f_1 = 15$, $f_0 = 13$, $f_2 = 7$, $h = 10$ 1

$$\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h = 40 + \frac{15 - 13}{30 - 13 - 7} \times 10$$ 1

$$= 40 + \frac{2}{10} \times 10 = 42 \text{ years}$$

The average age is about 39 years, but the most common age is about 42 years. 1

A8. Find the mode of the data below. **[3]**

Class	10–20	20–30	30–40	40–50	50–60
Frequency	16	12	9	7	6

Modal class = 10–20 (highest frequency 16): $l = 10$, $f_1 = 16$, $f_0 = 0$, $f_2 = 12$, $h = 10$ 1

$$\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h = 10 + \frac{16 - 0}{32 - 0 - 12} \times 10$$ 1

$$= 10 + \frac{16}{20} \times 10 = 18$$ 1

Median of grouped data

A9. The times (in minutes) that 50 students took to solve a puzzle are given. Find the median time. **[3]**

Time (min)	0–5	5–10	10–15	15–20	20–25	25–30
Students	3	8	12	15	8	4

Cumulative frequencies: 1

Minutes	0–5	5–10	10–15	15–20	20–25	25–30
f	3	8	12	15	8	4
cf	3	11	23	38	46	50

$\frac{n}{2} = 25$; first cf above 25 is 38, so median class 15–20: $l = 15$, $cf = 23$, $f = 15$, $h = 5$ 1

$$\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h = 15 + \frac{25 - 23}{15} \times 5 \approx 15.67 \text{ minutes}$$ 1

A10. The median of the distribution below is 32 and the total frequency is 50. Find x and y. **[3]**

Class	0–10	10–20	20–30	30–40	40–50	50–60
Frequency	4	x	12	15	y	5

$4 + x + 12 + 15 + y + 5 = 50$, so $x + y = 14$ 1

Median 32 is in 30–40: $l = 30$, $cf = 16 + x$, $f = 15$; $32 = 30 + \frac{25 - 16 - x}{15} \times 10$ 1

$9 - x = 3$, so $x = 6$ and $y = 8$ 1

A11. The heights of 50 plants are given as a cumulative table. Find the median height. **[3]**

Height (cm)	less than 140	less than 145	less than 150	less than 155	less than 160	less than 165
Plants	4	11	26	38	46	50

Frequencies by subtracting next-door values: 4, 7, 15, 12, 8, 4. Cumulative frequencies: 1

Height	135–140	140–145	145–150	150–155	155–160	160–165
f	4	7	15	12	8	4
cf	4	11	26	38	46	50

$\frac{n}{2} = 25$; first cf above 25 is 26, so median class 145–150: $l = 145$, $cf = 11$, $f = 15$, $h = 5$ 1

$$\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h = 145 + \frac{25 - 11}{15} \times 5 \approx 149.67 \text{ cm}$$ 1

A12. Find the median marks. **[3]**

Marks	1–10	11–20	21–30	31–40	41–50
Students	6	10	16	12	6

Make the classes continuous (subtract 0.5, add 0.5). Cumulative frequencies: 1

Marks	0.5–10.5	10.5–20.5	20.5–30.5	30.5–40.5	40.5–50.5
f	6	10	16	12	6
cf	6	16	32	44	50

$\frac{n}{2} = 25$; first cf above 25 is 32, so median class 20.5–30.5: $l = 20.5$, $cf = 16$, $f = 16$, $h = 10$ 1

$$\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h = 20.5 + \frac{25 - 16}{16} \times 10 \approx 26.13 \text{ marks}$$ 1

Mean, median and mode together

A13. The speeds of 50 vehicles on a road are given. Find the mean, the median and the mode. **[5]**

Speed (km/h)	20–30	30–40	40–50	50–60	60–70	70–80
Vehicles	5	9	16	12	6	2

Take $a = 45$, $h = 10$: 1

Speed	20–30	30–40	40–50	50–60	60–70	70–80	Total
f_i	5	9	16	12	6	2	**50**
x_i	25	35	45	55	65	75	
$u_i = \frac{x_i - 45}{10}$	−2	−1	0	1	2	3	
$f_i u_i$	−10	−9	0	12	12	6	**11**
cf	5	14	30	42	48	50	

$\Sigma f_i = 50$, $\Sigma f_i u_i = 11$. Mean $\bar{x} = a + h \times \dfrac{\Sigma f_i u_i}{\Sigma f_i} = 45 + 10 \times \dfrac{11}{50} = 47.2$ km/h 1

$\dfrac{n}{2} = 25$; median class 40–50: $l = 40$, $cf = 14$, $f = 16$ 1

Median $= 40 + \dfrac{25 - 14}{16} \times 10 \approx 46.88$ km/h 1

Mode $= 40 + \dfrac{16 - 9}{32 - 9 - 12} \times 10 = 40 + \dfrac{70}{11} \approx 46.36$ km/h 1

B

PART B · SOLUTIONS

Exemplar Practice – Solutions

Worked solutions with step marks for every question in Part B.

Multiple choice

Q	Answer	Working / reason
B1	**(b)** 17.5	$\dfrac{10 + 25}{2} = 17.5$.
B2	**(c)** $\dfrac{\text{xi} - \text{a}}{\text{h}}$	$u_i = \dfrac{x_i - a}{h}$, so that $x_i = a + hu_i$.
B3	**(d)** 24	$3\,\text{Md} = 30 + 42 = 72$, so the median is 24.
B4	**(a)** 70	$n = 55$, $\frac{n}{2} = 27.5$; cf: 5, 17, 27, 35, so the median class is 30–40. Modal class 40–50. $30 + 40 = 70$.
B5	**(d)** class mark	We assume the values of a class are centred at its class mark.
B6	**(d)**	The mode is found with the formula and need not be the class mark, so A is false. R is true.
B7	**(a)**	$\dfrac{1000}{40} = 25$, found with the formula in R.
B8	**(b)**	Both are true, but the class size does not give the class mark.

Short answer with reasons

B9. The mean of the data below is 19. Find p. [2]

Class	10–14	14–18	18–22	22–26	26–30
Frequency	5	7	p	6	2

$x_i = 12, 16, 20, 24, 28$: $\Sigma f_i = 20 + p$, $\Sigma f_i x_i = 372 + 20p$ 1

$372 + 20p = 19(20 + p) = 380 + 19p$, so $p = 8$ 1

B10. The runs scored by a batter in 40 innings are given. Find the modal score. [2]

Runs	0–20	20–40	40–60	60–80	80–100
Innings	5	9	14	8	4

Modal class = 40–60 (highest frequency 14): $l = 40$, $f_1 = 14$, $f_0 = 9$, $f_2 = 8$, $h = 20$ 1

$$\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h = 40 + \frac{14 - 9}{28 - 9 - 8} \times 20$$ 1

$$= 40 + \frac{5}{11} \times 20 \approx 49.09 \text{ runs}$$

B11. Find the median of the data below. [3]

Value	≥ 0	≥ 10	≥ 20	≥ 30	≥ 40	≥ 50
Frequency	50	46	38	24	12	4

("≥ 10" means 10 or more. No value is 60 or more.)

Frequencies: $50 - 46 = 4$, $46 - 38 = 8$, 14, 12, 8, 4. Cumulative frequencies: 1

Class	0–10	10–20	20–30	30–40	40–50	50–60
f	4	8	14	12	8	4
cf	4	12	26	38	46	50

$\frac{n}{2} = 25$; first cf above 25 is 26, so median class 20–30: $l = 20$, $cf = 12$, $f = 14$, $h = 10$ 1

$$\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h = 20 + \frac{25 - 12}{14} \times 10 \approx 29.29$$ 1

B12. The total frequency is 30 and the mean is 26. Find f_1 and f_2. [3]

Class	0–10	10–20	20–30	30–40	40–50
Frequency	3	f_1	10	f_2	4

$17 + f_1 + f_2 = 30$, so $f_1 + f_2 = 13$ 1

$\Sigma f_i x_i = 15 + 15f_1 + 250 + 35f_2 + 180 = 445 + 15f_1 + 35f_2 = 26 \times 30 = 780$ 1

$15f_1 + 35(13 - f_1) = 335$ gives $20f_1 = 120$: $f_1 = 6$, $f_2 = 7$ 1

Long answer

B13. Find the mean, median and mode of the data below, and check the empirical relation. **[5]**

Class	0–10	10–20	20–30	30–40	40–50	50–60	60–70
Frequency	4	7	12	16	10	7	4

Take $a = 35$, $h = 10$: 1

Class	0–10	10–20	20–30	30–40	40–50	50–60	60–70	Total
f_i	4	7	12	16	10	7	4	**60**
x_i	5	15	25	35	45	55	65	
$u_i = \frac{x_i - 35}{10}$	−3	−2	−1	0	1	2	3	
$f_i u_i$	−12	−14	−12	0	10	14	12	**−2**
cf	4	11	23	39	49	56	60	

$\Sigma f_i = 60$, $\Sigma f_i u_i = -2$. Mean $\bar{x} = a + h \times \dfrac{\Sigma f_i u_i}{\Sigma f_i} = 35 + 10 \times \dfrac{-2}{60} \approx 34.67$ 1

Median class 30–40 ($\frac{n}{2} = 30$, $cf = 23$, $f = 16$): $30 + \dfrac{7}{16} \times 10 \approx 34.38$ 1

Mode $= 30 + \dfrac{16 - 12}{32 - 12 - 10} \times 10 = 34$ 1

$3 \times 34.38 = 103.13$ and $34 + 2 \times 34.67 = 103.33$: nearly equal, as the relation says 1

B14. The monthly savings of 50 families are given. Find the mean saving. **[3]**

Saving (₹)	1000–1500	1500–2000	2000–2500	2500–3000	3000–3500
Families	6	10	15	12	7

Take $a = 2250$, $h = 500$: 1

Saving (₹)	1000–1500	1500–2000	2000–2500	2500–3000	3000–3500	Total
f_i	6	10	15	12	7	**50**
x_i	1250	1750	2250	2750	3250	
$u_i = \frac{x_i - 2250}{500}$	−2	−1	0	1	2	
$f_i u_i$	−12	−10	0	12	14	**4**

$\Sigma f_i = 50$, $\Sigma f_i u_i = 4$ 1

Mean $\bar{x} = a + h \times \dfrac{\Sigma f_i u_i}{\Sigma f_i} = 2250 + 500 \times \dfrac{4}{50} = ₹2290$ 1

C

PART C · SOLUTIONS

Board Pattern Practice – Solutions

Worked solutions with step marks for every question in Part C.

One-mark questions

Q	Answer	Working / reason
C1	**(c)** 36	Mode $= 3 \times 32 - 2 \times 30 = 36$.
C2	**(a)** 40	$\frac{30+u}{2} = 35$, so $u = 40$.
C3	**(b)** 25	The highest frequency is 11, for 15–25. Its upper limit is 25.
C4	**(d)** 40–60	$\frac{n}{2} = 20$; cf: 7, 16, 28. The first cf above 20 is for 40–60.
C5	**(c)** 38	$40 + 10 \times \frac{-5}{25} = 40 - 2 = 38$.
C6	**(a)**	$\frac{18+30}{3} = 16$, found with the relation in R.

C7. Find the mean of the data below. [2]

Class	0–6	6–12	12–18	18–24
Frequency	3	5	8	4

Class marks and $f_i x_i$: 1

Class	0–6	6–12	12–18	18–24	Total
f_i	3	5	8	4	**20**
x_i	3	9	15	21	
$f_i x_i$	9	45	120	84	**258**

$\Sigma f_i = 20$, $\Sigma f_i x_i = 258$

Mean $\bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{258}{20} = 12.9$ 1

Mean, median and mode: 3–5 marks

C8. The ages of 50 patients in a clinic are given. Find the modal age. [3]

Age (years)	15–25	25–35	35–45	45–55	55–65	65–75
Patients	6	10	17	12	4	1

Modal class $= 35$–45 (highest frequency 17): $l = 35$, $f_1 = 17$, $f_0 = 10$, $f_2 = 12$, $h = 10$ 1

Mode $= l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h = 35 + \frac{17 - 10}{34 - 10 - 12} \times 10$ 1

$= 35 + \frac{7}{12} \times 10 \approx 40.83$ years 1

C9. The masses of 60 eggs are given. Find the mean mass by the step-deviation method. **[3]**

Mass (g)	100–120	120–140	140–160	160–180	180–200
Eggs	10	14	18	12	6

Take $a = 150$, $h = 20$: 1

Mass (g)	100–120	120–140	140–160	160–180	180–200	Total
f_i	10	14	18	12	6	**60**
x_i	110	130	150	170	190	
$u_i = \frac{x_i - 150}{20}$	−2	−1	0	1	2	
$f_i u_i$	−20	−14	0	12	12	**−10**

$\Sigma f_i = 60$, $\Sigma f_i u_i = -10$ 1

$$\text{Mean } \bar{x} = a + h \times \frac{\Sigma f_i u_i}{\Sigma f_i} = 150 + 20 \times \frac{-10}{60} \approx 146.67 \text{ g}$$ 1

C10. Find the median of the data below. **[3]**

Class	10–20	20–30	30–40	40–50	50–60	60–70
Frequency	6	12	18	24	9	1

Cumulative frequencies: 1

Class	10–20	20–30	30–40	40–50	50–60	60–70
f	6	12	18	24	9	1
cf	6	18	36	60	69	70

$\frac{n}{2} = 35$; first cf above 35 is 36, so median class 30–40: $l = 30$, $cf = 18$, $f = 18$, $h = 10$ 1

$$\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h = 30 + \frac{35 - 18}{18} \times 10 \approx 39.44$$ 1

C11. The monthly electricity used (in units) by 100 shops is given. Find the median and the mode. **[5]**

Units	0–50	50–100	100–150	150–200	200–250	250–300
Shops	8	15	22	30	17	8

(i) Cumulative frequencies: 1

Units	0–50	50–100	100–150	150–200	200–250	250–300
f	8	15	22	30	17	8
cf	8	23	45	75	92	100

$\frac{n}{2} = 50$; first cf above 50 is 75, so median class 150–200: $l = 150$, $cf = 45$, $f = 30$, $h = 50$ 1

$$\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h = 150 + \frac{50 - 45}{30} \times 50 \approx 158.33 \text{ units}$$ 1

(ii) Modal class = 150–200 (highest frequency 30): $l = 150$, $f_1 = 30$, $f_0 = 22$, $f_2 = 17$, $h = 50$ 1

$$\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h = 150 + \frac{30 - 22}{60 - 22 - 17} \times 50$$ 1

$$= 150 + \frac{8}{21} \times 50 \approx 169.05 \text{ units}$$

C12. The median of the data below is 416 and the total frequency is 90. Find p and q. **[5]**

Class	100–200	200–300	300–400	400–500	500–600	600–700
Frequency	5	p	20	25	q	10

$5 + p + 20 + 25 + q + 10 = 90$, so $p + q = 30$ — 1

$\frac{n}{2} = 45$; the median 416 is in 400–500, so $l = 400$, $f = 25$, $h = 100$ — 1

cf before 400–500 $= 5 + p + 20 = 25 + p$ — 1

$416 = 400 + \frac{45 - 25 - p}{25} \times 100$ gives $4(20 - p) = 16$ — 1

$p = 16$, $q = 14$ — 1

C13. The masses of 50 bags of rice are given. Find the mean and the mode, and say which is larger. **[5]**

Mass (kg)	5–15	15–25	25–35	35–45	45–55
Bags	7	12	20	8	3

(i) Class marks and $f_i x_i$: — 1

Mass (kg)	5–15	15–25	25–35	35–45	45–55	Total
f_i	7	12	20	8	3	**50**
x_i	10	20	30	40	50	
$f_i x_i$	70	240	600	320	150	**1380**

$\Sigma f_i = 50$, $\Sigma f_i x_i = 1380$

Mean $\bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{1380}{50} = 27.6$ kg — 1

(ii) Modal class = 25–35 (highest frequency 20): $l = 25$, $f_1 = 20$, $f_0 = 12$, $f_2 = 8$, $h = 10$ — 1

Mode $= l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h = 25 + \frac{20 - 12}{40 - 12 - 8} \times 10$ — 1

$= 25 + \frac{8}{20} \times 10 = 29$ kg

The mode (29 kg) is larger than the mean (27.6 kg) — 1

PART D · SOLUTIONS

D Case-Based Questions – Solutions

Worked solutions with step marks for every question in Part D.

D1. Case Study · School Canteen [4]

(i) Find the modal class. **[1]**

Highest frequency 13, so the modal class is 80–100 **1**

(ii) Find the median class. **[1]**

$\frac{n}{2} = 20$; cf: 5, 14, 27, so the median class is 80–100 **1**

(iii) Find the mean number of samosas sold per day. **[2]**

Class marks and $f_i x_i$: **1**

Samosas	40–60	60–80	80–100	100–120	120–140	Total
f_i	5	9	13	8	5	**40**
x_i	50	70	90	110	130	
$f_i x_i$	250	630	1170	880	650	**3580**

$\Sigma f_i = 40$, $\Sigma f_i x_i = 3580$

$$\text{Mean } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{3580}{40} = 89.5$$ **1**

OR

(iii) Find the mode of the data. **[2]**

Modal class = 80–100 (highest frequency 13): $l = 80$, $f_1 = 13$, $f_0 = 9$, $f_2 = 8$, $h = 20$ **1**

$$\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h = 80 + \frac{13 - 9}{26 - 9 - 8} \times 20$$ **1**

$$= 80 + \frac{4}{9} \times 20 \approx 88.89$$

D2. Case Study · Blood Donation Camp [4]

(i) Find the class mark of the class 30–36. **[1]**

$$\frac{30 + 36}{2} = 33$$ **1**

(ii) How many donors were younger than 30? **[1]**

$10 + 16 = 26$ donors **1**

(iii) Find the median age of the donors. **[2]**

Cumulative frequencies: **1**

Age	18–24	24–30	30–36	36–42	42–48
f	10	16	14	12	8
cf	10	26	40	52	60

$\frac{n}{2} = 30$; first cf above 30 is 40, so median class 30–36: $l = 30$, $cf = 26$, $f = 14$, $h = 6$

$$\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h = 30 + \frac{30 - 26}{14} \times 6 \approx 31.71 \text{ years}$$ **1**

OR

(iii) Find the mean age of the donors. **[2]**

Class marks and f_ix_i: 1

Age	18–24	24–30	30–36	36–42	42–48	Total
f_i	10	16	14	12	8	**60**
x_i	21	27	33	39	45	
f_ix_i	210	432	462	468	360	**1932**

$\Sigma f_i = 60$, $\Sigma f_i x_i = 1932$

Mean $\bar{x} = \dfrac{\Sigma f_i x_i}{\Sigma f_i} = \dfrac{1932}{60} = 32.2$ years 1

D3. Case Study · Screen Time [4]

(i) Find the modal class. **[1]**

Highest frequency 15, so the modal class is 2–3 1

(ii) How many students use a screen for 3 hours or more? **[1]**

$12 + 7 + 3 = 22$ students 1

(iii) Find the mode of the screen time. **[2]**

Modal class = 2–3 (highest frequency 15): $l = 2$, $f_1 = 15$, $f_0 = 9$, $f_2 = 12$, $h = 1$ 1

$$\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h = 2 + \frac{15 - 9}{30 - 9 - 12} \times 1$$ 1

$$= 2 + \frac{6}{9} \times 1 \approx 2.67 \text{ hours}$$

OR

(iii) Find the median screen time. **[2]**

Cumulative frequencies: 1

Hours	0–1	1–2	2–3	3–4	4–5	5–6
f	4	9	15	12	7	3
cf	4	13	28	40	47	50

$\frac{n}{2} = 25$; first cf above 25 is 28, so median class 2–3: $l = 2$, $cf = 13$, $f = 15$, $h = 1$

$$\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h = 2 + \frac{25 - 13}{15} \times 1 = 2.8 \text{ hours}$$ 1

D4. Case Study · Monthly Rainfall [4]

(i) Find the median class. **[1]**

$\frac{n}{2} = 18$; cf: 5, 12, 22, so the median class is 40–60 1

(ii) In how many months was the rainfall less than 40 mm? **[1]**

$5 + 7 = 12$ months 1

(iii) Find the mean monthly rainfall by the step-deviation method. **[2]**

Take $a = 50$, $h = 20$: 1

mm	0–20	20–40	40–60	60–80	80–100	100–120	Total
f_i	5	7	10	8	4	2	**36**
x_i	10	30	50	70	90	110	
$u_i = \frac{x_i - 50}{20}$	−2	−1	0	1	2	3	
$f_i u_i$	−10	−7	0	8	8	6	**5**

$\Sigma f_i = 36$, $\Sigma f_i u_i = 5$

Mean $\bar{x} = a + h \times \dfrac{\Sigma f_i u_i}{\Sigma f_i} = 50 + 20 \times \dfrac{5}{36} \approx 52.78$ mm 1

OR

(iii) Find the median rainfall. **[2]**

Cumulative frequencies: 1

mm	0–20	20–40	40–60	60–80	80–100	100–120
f	5	7	10	8	4	2
cf	5	12	22	30	34	36

$\frac{n}{2} = 18$; first cf above 18 is 22, so median class 40–60: $l = 40$, $cf = 12$, $f = 10$, $h = 20$

Median $= l + \dfrac{\frac{n}{2} - cf}{f} \times h = 40 + \dfrac{18 - 12}{10} \times 20 = 52$ mm 1

E · Challenge Questions – Solutions

PART E · SOLUTIONS

Worked solutions with step marks for every question in Part E.

E1. The median of the data below is 25 and the mean is 26.2. Find a and b. **[3]**

Class	0–10	10–20	20–30	30–40	40–50	50–60
Frequency	6	a	14	10	b	4

$n = 34 + a + b$; median class 20–30, $cf = 6 + a$: $\dfrac{34 + a + b}{2} - 6 - a = \dfrac{5 \times 14}{10} = 7$, so $b = a - 8$ 1

Mean: $\Sigma f_i x_i = 950 + 15a + 45b = 26.2(34 + a + b)$; with $b = a - 8$: $590 + 60a = 26.2(26 + 2a)$ 1

$7.6a = 91.2$, so $a = 12$, $b = 4$ 1

E2. Every value in a grouped distribution is increased by k, so every class moves up by k. Show that the mean, the median and the mode all increase by k. **[3]**

Mean: $\dfrac{\Sigma f_i(x_i + k)}{\Sigma f_i} = \dfrac{\Sigma f_i x_i}{\Sigma f_i} + \dfrac{k\Sigma f_i}{\Sigma f_i} = \bar{x} + k$ 1

The frequencies, cf and h do not change; only l becomes $l + k$ 1

So the median $l + \dfrac{\frac{n}{2} - cf}{f} h$ and the mode $l + \dfrac{f_1 - f_0}{2f_1 - f_0 - f_2} h$ each increase by k 1

E3. Section P has 30 students with mean marks 18 and Section Q has 20 students with mean marks 23. (i) Find the mean of all 50. (ii) Later a mark of 41 was found to have been entered as 14. Find the correct mean. **[3]**

Totals: $30 \times 18 = 540$, $20 \times 23 = 460$ — 1

(i) Mean $= \dfrac{1000}{50} = 20$ — 1

(ii) Correct total $= 1000 - 14 + 41 = 1027$; mean $= \dfrac{1027}{50} = 20.54$ — 1

E4. Find the mode and the median of the ages below. **[3]**

Age (years)	15–19	20–24	25–29	30–34	35–39
People	8	14	20	12	6

Make the classes continuous: 14.5–19.5, 19.5–24.5, 24.5–29.5, 29.5–34.5, 34.5–39.5; $h = 5$ — 1

Mode: $l = 24.5$, $f_1 = 20$, $f_0 = 14$, $f_2 = 12$: $24.5 + \dfrac{6}{14} \times 5 \approx 26.64$ years — 1

Median: $\frac{n}{2} = 30$, $cf = 22$, $f = 20$: $24.5 + \dfrac{8}{20} \times 5 = 26.5$ years — 1

E5. The mode of the data below is 36, and the class 30–40 has the highest frequency. Find x. **[3]**

Class	0–10	10–20	20–30	30–40	40–50	50–60
Frequency	8	10	x	16	12	6

$l = 30$, $f_1 = 16$, $f_0 = x$, $f_2 = 12$, $h = 10$ — 1

$36 = 30 + \dfrac{16 - x}{32 - x - 12} \times 10$, so $6(20 - x) = 10(16 - x)$ — 1

$120 - 6x = 160 - 10x$, $4x = 40$, $x = 10$ (less than 16, as needed) — 1