



- 1 The frequency table shows the times, t minutes, taken by 35 students to finish a puzzle.

Time (t minutes)	Frequency
$0 < t \leq 5$	8
$5 < t \leq 10$	12
$10 < t \leq 15$	9
$15 < t \leq 20$	6

Noah makes a cumulative frequency table for this data. He writes the cumulative frequencies 8, 20, 29, 34.

Explain what is wrong with Noah's cumulative frequencies.

(1 mark)

The cumulative frequencies should be 8, $8 + 12 = 20$, $20 + 9 = 29$, $29 + 6 = 35$

Noah's final value of 34 cannot be right because the cumulative frequencies must end at the total frequency, 35

- 2 The table shows the masses, m grams, of 40 tomatoes.

Mass (m grams)	Frequency
$50 < m \leq 60$	5
$60 < m \leq 70$	11
$70 < m \leq 80$	14
$80 < m \leq 90$	7
$90 < m \leq 100$	3

Complete the cumulative frequency table.

Mass (m grams)	Cumulative frequency
$50 < m \leq 60$	
$50 < m \leq 70$	
$50 < m \leq 80$	
$50 < m \leq 90$	
$50 < m \leq 100$	

(2 marks)

Add the frequencies as you go down the table

$$5, 5 + 11 = 16, 16 + 14 = 30, 30 + 7 = 37, 37 + 3 = 40$$

The final value 40 matches the total number of tomatoes

3

The table shows the ages, a years, of the 60 members of a running club.

Age (a years)	Frequency
$10 < a \leq 20$	9
$20 < a \leq 30$	15
$30 < a \leq 40$	18
$40 < a \leq 50$	12
$50 < a \leq 60$	6

- Complete a cumulative frequency table for this data.
- Write down the class interval that contains the median age.

(3 marks)

Cumulative frequencies

$$9, 9 + 15 = 24, 24 + 18 = 42, 42 + 12 = 54, 54 + 6 = 60$$

For 60 members, the median lies between the 30th and 31st ordered values

The first 24 members are aged 30 or under and the first 42 are aged 40 or under. Both the 30th and 31st values therefore lie in $30 < a \leq 40$, so the median lies in this class

4

40 students took a typing test. Salma drew a cumulative frequency graph for their times.

Salma plotted each cumulative frequency against the midpoint of its class interval.

- Explain the mistake Salma made.
- Salma redraws the graph correctly. The correct graph shows a cumulative frequency of 34 at a time of 40 seconds. How many students took longer than 40 seconds?
- What percentage of the 40 students took longer than 40 seconds?

(3 marks)

A cumulative frequency tells you how many values are less than or equal to the top of the class, so it must be plotted at the upper class boundary

$$\text{Students taking longer than 40 seconds} = 40 - 34 = 6$$

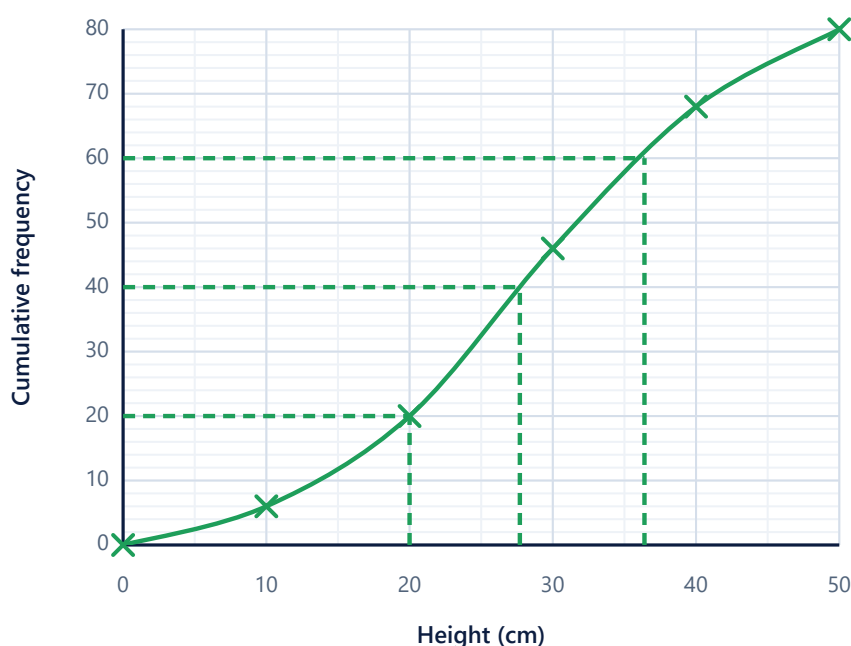
$$6 \text{ out of } 40 = \frac{6}{40} = 15\%$$

5

The table shows the heights, h cm, of 80 sunflower seedlings.

Height (h cm)	Frequency
$0 < h \leq 10$	6
$10 < h \leq 20$	14
$20 < h \leq 30$	26
$30 < h \leq 40$	22
$40 < h \leq 50$	12

- Complete the cumulative frequency table.
- On the grid, draw a cumulative frequency graph for this information.
- Use your graph to find an estimate for the median height.
- Use your graph to find an estimate for the interquartile range of the heights.



(6 marks)

Cumulative frequencies: 6, 20, 46, 68, 80

Plot each cumulative frequency at the upper class boundary and join with a smooth curve

Median: read across from 40 on the cumulative frequency axis; this gives roughly 28 cm

Lower quartile: read across from 20, giving about 20 cm. Upper quartile: read across from 60, giving about 36 cm

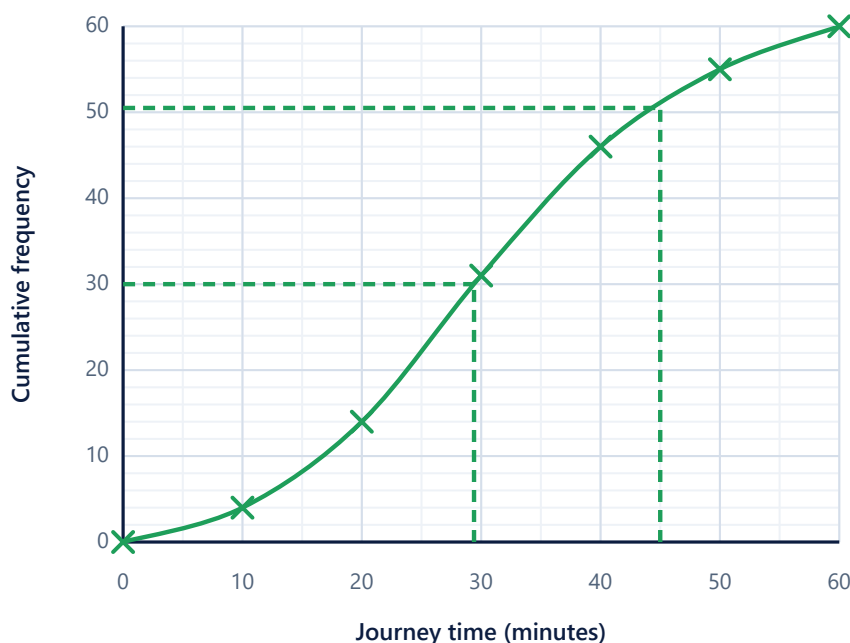
Interquartile range is approximately $36 - 20 = 16$ cm

6

The table shows the journey times, t minutes, of 60 commuters.

Time (t minutes)	Frequency
$0 < t \leq 10$	4
$10 < t \leq 20$	10
$20 < t \leq 30$	17
$30 < t \leq 40$	15
$40 < t \leq 50$	9
$50 < t \leq 60$	5

- Complete the cumulative frequency table.
- On the grid, draw a cumulative frequency graph for this information.
- Use your graph to find an estimate for the median journey time.
- Use your graph to estimate the percentage of commuters whose journey took more than 45 minutes.



(6 marks)

Cumulative frequencies: 4, 14, 31, 46, 55, 60

Plot at the upper class boundaries and join with a smooth curve

Median: read across from 30 on the cumulative frequency axis, giving roughly 29 minutes

At 45 minutes the cumulative frequency is roughly 50 or 51, so about $60 - 50.5 = 9.5$ commuters took longer

9.5 out of 60 is roughly 16%

7

The table shows the lengths, t minutes, of 40 phone calls.

Length (t minutes)	Frequency
$0 < t \leq 5$	6
$5 < t \leq 10$	14
$10 < t \leq 15$	12
$15 < t \leq 20$	8

- Complete a cumulative frequency table for this data.
- How many calls lasted 10 minutes or less?
- Estimate the number of calls that lasted more than 12 minutes. Assume the calls in each class are spread evenly.

(4 marks)

a)

6

$$6 + 14 = 20$$

$$20 + 12 = 32$$

$$32 + 8 = 40$$

6, 20, 32, 40

b)

cumulative frequency at 10 minutes = 20

20

c)

12 is $\frac{2}{5}$ of the way through 10 to 15

$$\frac{2}{5} \times 12 = 4.8$$

$$\text{calls up to 12 minutes} \approx 20 + 4.8 = 24.8$$

$$\text{more than 12 minutes} \approx 40 - 24.8 = 15.2$$

about 15 calls

8

The cumulative frequency table shows the marks of 60 students in a test.

Mark	Cumulative frequency
up to 20	5
up to 40	18
up to 60	41
up to 80	57
up to 100	60

- How many students scored more than 40 marks and up to 60 marks?
- How many students scored more than 80 marks?
- Estimate the median mark. Assume the marks in each class are spread evenly.

(4 marks)

a)

$$41 - 18 = 23$$

23

b)

$$60 - 57 = 3$$

3

c)

median is the $60 \div 2 = 30$ th value

class 40 to 60 holds the 19th to 41st values

$30 - 18 = 12$ th value in the class

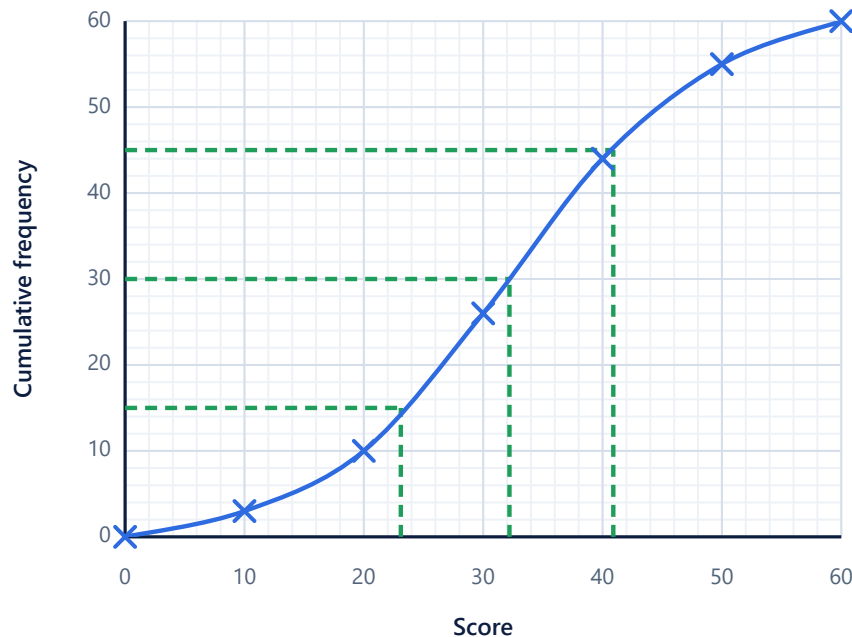
$$= \text{median} \approx 40 + \frac{12}{23} \times 20$$

50.4

9

The cumulative frequency graph shows the test scores of the 60 students in Class A.

- Use the graph to find an estimate for the median score.
- Use the graph to find an estimate for the interquartile range of the scores.
- The 60 students in Class B had a median score of 45 and an interquartile range of 12. Compare the scores of the two classes.



(6 marks)

Median: read across from 30 (half of 60) to the curve and down, giving roughly 32 marks

Lower quartile: read across from 15, giving about 23. Upper quartile: read across from 45, giving about 41

Interquartile range is approximately $41 - 23 = 18$

Class B's median of 45 is higher than Class A's, so on average Class B scored better

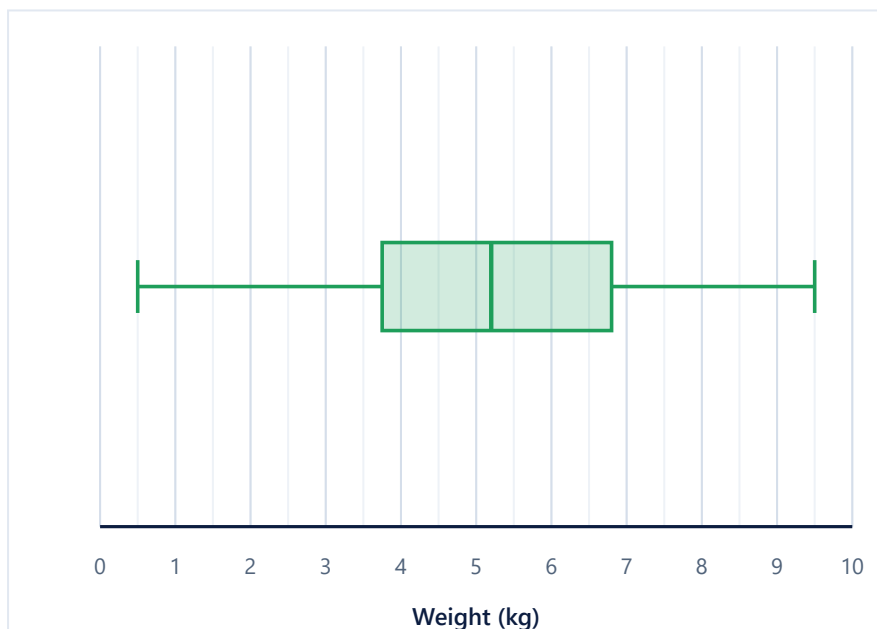
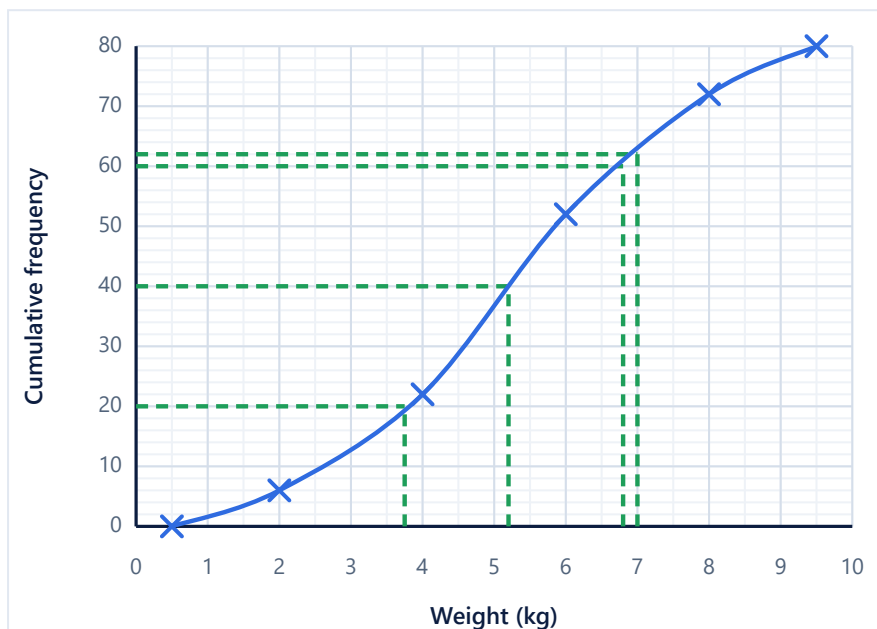
Class B's interquartile range of 12 is smaller than Class A's, so Class B's scores are more consistent

10

The cumulative frequency graph shows the weights, in kg, of 80 parcels sent from a depot on Monday.

The lightest parcel weighed 0.5 kg and the heaviest weighed 9.5 kg.

- Use the graph to draw a box plot for the weights of Monday's parcels.
- Use the graph to estimate the number of parcels that weighed more than 7 kg.
- On Tuesday the parcels had a median weight of 4.4 kg and an interquartile range of 2.1 kg. Compare the weights of Monday's and Tuesday's parcels.



(6 marks)

Median: read across from 40, giving about 5.2 kg

Lower quartile: read across from 20, giving about 3.75 kg. Upper quartile: read across from 60, giving about 6.8 kg

Draw the box from the lower quartile to the upper quartile with a line at the median, and whiskers to 0.5 kg and 9.5 kg

At 7 kg the cumulative frequency is about 62, so about $80 - 62 = 18$ parcels weighed more than 7 kg

Monday's median (about 5.2 kg) is higher than Tuesday's (4.4 kg): Monday's parcels were heavier on average. Monday's IQR (about $6.8 - 3.75 = 3.05$ kg) is larger than Tuesday's (2.1 kg): Monday's weights were more spread out

11

The table shows the heights, h cm, of 80 plants.

Height (h cm)	Frequency
$0 < h \leq 20$	8
$20 < h \leq 40$	22
$40 < h \leq 60$	30
$60 < h \leq 80$	14
$80 < h \leq 100$	6

- Complete a cumulative frequency table for this data.
- Estimate the median height.
- Estimate the interquartile range.

Assume the heights in each class are spread evenly.

(6 marks)

a)

8

$$8 + 22 = 30$$

$$30 + 30 = 60$$

$$60 + 14 = 74$$

$$74 + 6 = 80$$

8, 30, 60, 74, 80

b)

median is the 40th value, in class 40 to 60

$40 - 30 = 10$ th of 30 plants

$$= \text{median} \approx 40 + \frac{10}{30} \times 20$$

46.7 cm

c)

LQ is the 20th value, in class 20 to 40

$$LQ \approx 20 + \frac{12}{22} \times 20 = 30.9$$

UQ is the 60th value = 60

$$= IQR \approx 60 - 30.9$$

29.1 cm

The table shows the commute times, t minutes, of 100 office workers.

Time (t minutes)	Frequency
$0 < t \leq 15$	12
$15 < t \leq 30$	30
$30 < t \leq 45$	34
$45 < t \leq 60$	18
$60 < t \leq 75$	6

- How many workers have a commute of 30 minutes or less?
- Write down the class interval that contains the median commute time.
- Write down the class interval that contains the upper quartile.
- A local newspaper claims that more than a third of the workers commute for over 45 minutes. Is the claim correct? Show your working.

(6 marks)

Cumulative frequencies: 12, 42, 76, 94, 100

Workers with a commute of 30 minutes or less = 42

The median is between the 50th and 51st values; 42 workers take 30 minutes or less and 76 take 45 minutes or less, so the median is in $30 < t \leq 45$

The upper quartile is the 75th value, which also lies in $30 < t \leq 45$ (cumulative frequency reaches 76 at 45 minutes)

Over 45 minutes

$18 + 6 = 24$ workers, which is 24% of 100. A third of 100 is about 33.3, so the claim is not correct

13

80 students sat an exam marked out of 100. The table shows their scores, s marks.

Score (s marks)	Frequency
$0 < s \leq 20$	6
$20 < s \leq 40$	18
$40 < s \leq 60$	28
$60 < s \leq 80$	20
$80 < s \leq 100$	8

- Complete the cumulative frequency table.
- Write down the class interval that contains the median score.
- A cumulative frequency graph of the data gives these estimates: median 51, lower quartile 37, upper quartile 66. Work out an estimate for the interquartile range.
- The pass mark was 60. Work out the percentage of students who scored more than 60.
- Last year the same exam had a median of 46 and an interquartile range of 24. Compare this year's scores with last year's.

(7 marks)

Cumulative frequencies: 6, 24, 52, 72, 80

The median is between the 40th and 41st values; 24 students scored 40 or less and 52 scored 60 or less, so the median is in $40 < s \leq 60$

$$\text{Interquartile range} = 66 - 37 = 29$$

$$\text{Students scoring more than 60} = 20 + 8 = 28, \text{ and } \frac{28}{80} = 35\%$$

This year's median of 51 is higher than last year's 46, so on average students did better this year; this year's IQR of 29 is bigger than 24, so this year's scores were more varied

14

The table shows the waiting times, t minutes, of 120 customers in a cafe.

Waiting time (t minutes)	Frequency
$0 < t \leq 2$	15
$2 < t \leq 4$	35
$4 < t \leq 6$	40
$6 < t \leq 8$	20
$8 < t \leq 10$	10

- Complete a cumulative frequency table for this data.
- Estimate the 90th percentile of the waiting times. Assume the times in each class are spread evenly.
- The cafe says that "at least 90% of customers wait 8 minutes or less". Is the cafe correct? Give a reason.

(5 marks)

a)

15

$$15 + 35 = 50$$

$$50 + 40 = 90$$

$$90 + 20 = 110$$

$$110 + 10 = 120$$

15, 50, 90, 110, 120

b)

$$90\% \text{ of } 120 = 108$$

108th value is in class 6 to 8

$$108 - 90 = 18 \text{th of } 20 \text{ customers}$$

$$= 90 \text{th percentile} \approx 6 + \frac{18}{20} \times 2$$

7.8 minutes

c)

$$110 \div 120 = 91.7\%$$

Yes, the cafe is correct
