Cumulative Frequency & Interquartile Range

Practice Worksheet (Problem Solving)

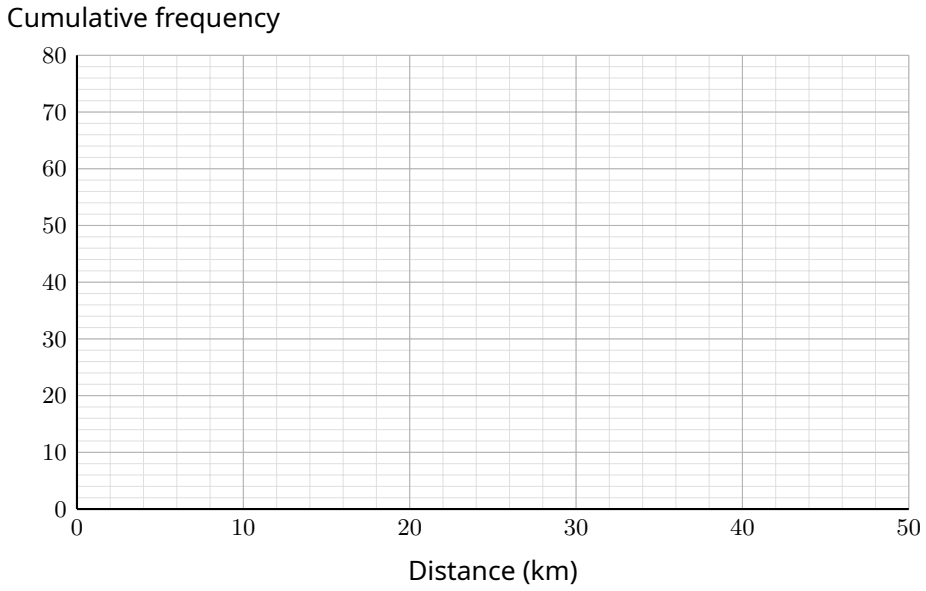
I Do

The table shows the distances travelled to an office by 80 workers.

Distance (d km)	**Frequency**	**Cumulative frequency**
$0 < d \leq 10$	14	
$10 < d \leq 20$	28	
$20 < d \leq 30$	22	
$30 < d \leq 40$	12	
$40 < d \leq 50$	4	

(a) Complete the cumulative frequency column. *(1 mark)*

(b) Draw a cumulative frequency graph on the grid.



(2 marks)

(c) Use your graph to estimate the interquartile range.

.....km *(2 marks)*

(Total for Question is 5 marks)

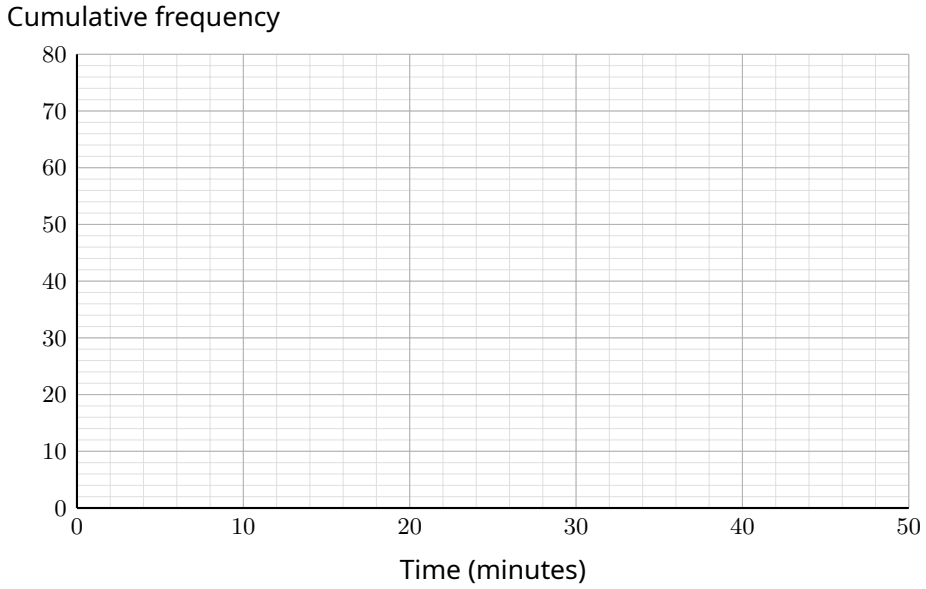
We Do

The table shows the times taken by 80 students to complete a puzzle.

Time (t minutes)	Frequency	Cumulative frequency
$0 < t \leq 10$	10	
$10 < t \leq 20$	24	
$20 < t \leq 30$	26	
$30 < t \leq 40$	14	
$40 < t \leq 50$	6	

(a) Complete the cumulative frequency column. *(1 mark)*

(b) Draw a cumulative frequency graph on the grid.



(2 marks)

(c) Use your graph to estimate the interquartile range.

.....minutes *(2 marks)*

(Total for Question is 5 marks)

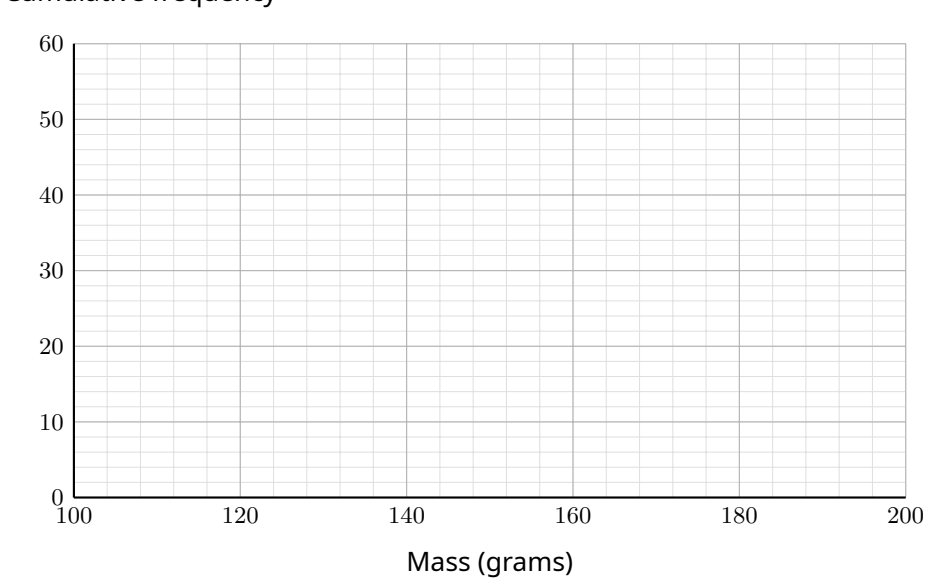
You Do 1

The table shows the masses of 60 apples.

Mass (m grams)	**Frequency**	**Cumulative frequency**
$100 < m \leq 120$	8	
$120 < m \leq 140$	16	
$140 < m \leq 160$	21	
$160 < m \leq 180$	11	
$180 < m \leq 200$	4	

(a) Complete the cumulative frequency column. *(1 mark)*

(b) Draw a cumulative frequency graph on the grid.



(2 marks)

(c) Use your graph to find an estimate for:

(i) the median mass .....g *(1 mark)*

(ii) the interquartile range. .....g *(2 marks)*

(Total for Question is 6 marks)

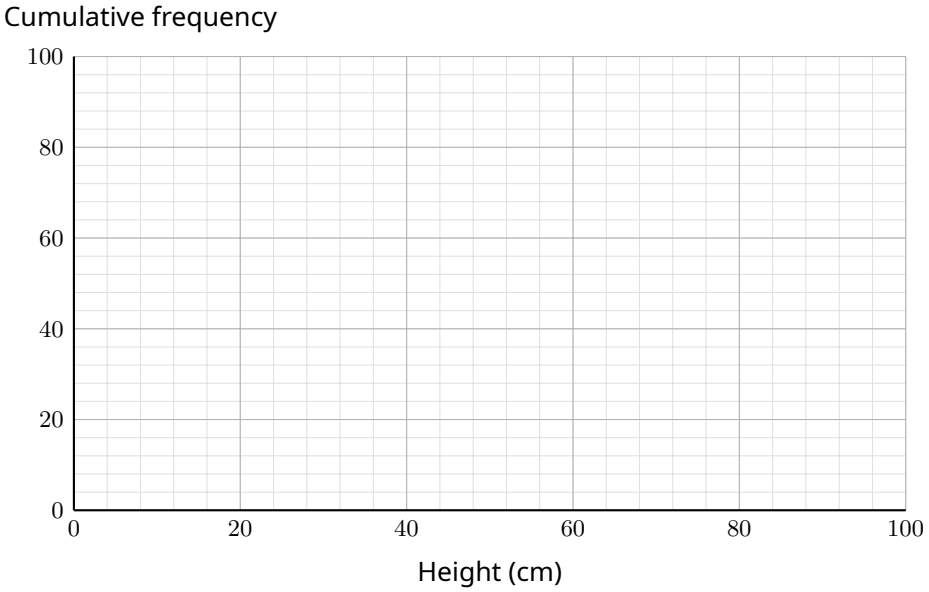
You Do 2

The table shows the heights of 100 plants in a greenhouse.

Height (h cm)	**Frequency**	**Cumulative frequency**
$0 < h \leq 20$	12	
$20 < h \leq 40$	26	
$40 < h \leq 60$	37	
$60 < h \leq 80$	17	
$80 < h \leq 100$	8	

(a) Complete the cumulative frequency column. *(1 mark)*

(b) Draw a cumulative frequency graph on the grid.



(2 marks)

(c) Use your graph to estimate the interquartile range. .....cm *(2 marks)*

(d) Use your graph to estimate the number of plants with a height greater than 70 cm.

..... *(2 marks)*

(Total for Question is 7 marks)

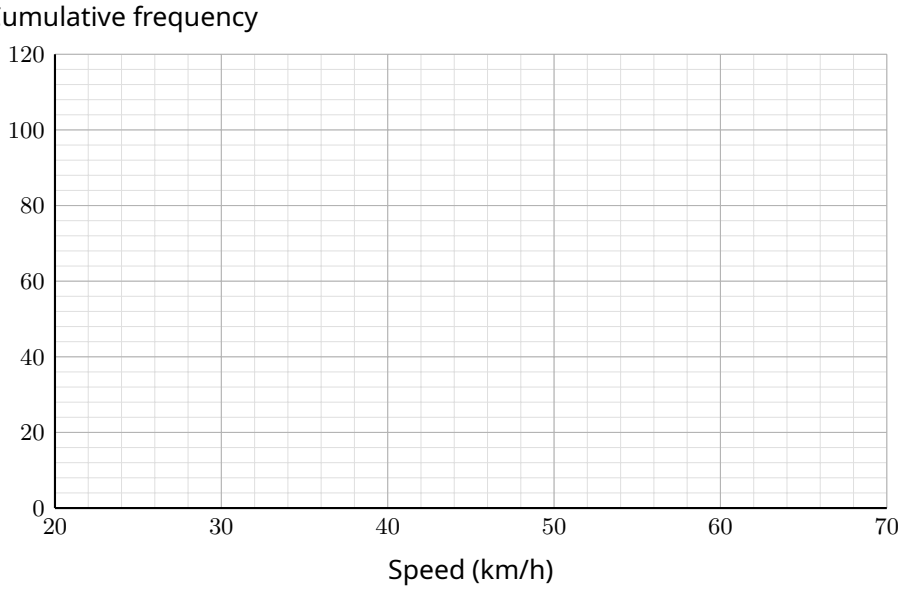
You Do 3

The table shows the speeds of 120 cars passing a speed camera.

Speed (s km/h)	Frequency	Cumulative frequency
$20 < s \leq 30$	10	
$30 < s \leq 40$	20	
$40 < s \leq 50$	42	
$50 < s \leq 60$	36	
$60 < s \leq 70$	12	

(a) Complete the cumulative frequency column. *(1 mark)*

(b) Draw a cumulative frequency graph on the grid.



(2 marks)

(c) Use your graph to estimate the median speed. .....km/h *(1 mark)*

(d) Estimate the percentage of cars travelling faster than 55 km/h.

.....% *(2 marks)*

(Total for Question is 6 marks)

Challenge 1

The cumulative frequency graph shows information about the lifetimes, in hours, of 80 batteries.



(a) Use the graph to complete the grouped frequency table below.

Lifetime (L hours)	**Frequency**
$0 < L \leq 10$	
$10 < L \leq 20$	
$20 < L \leq 30$	
$30 < L \leq 40$	
$40 < L \leq 50$	

(2 marks)

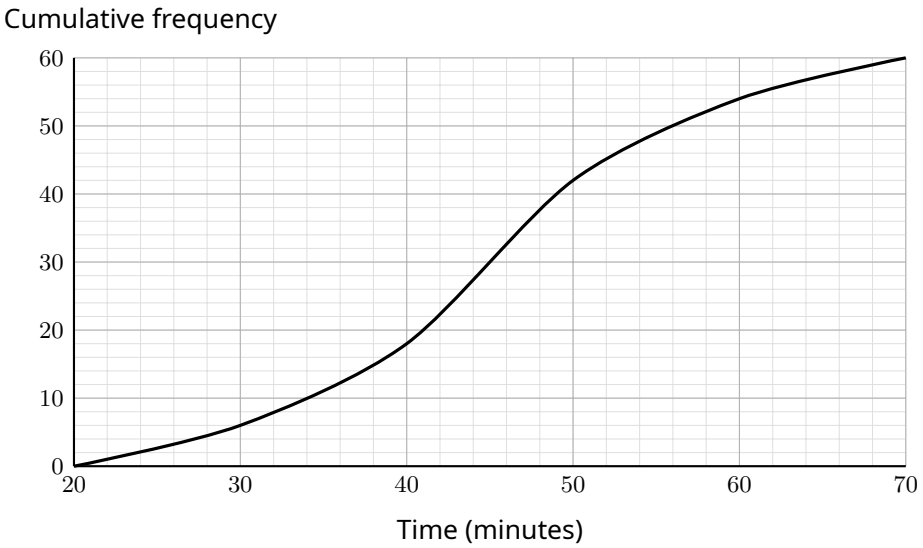
(b) Use the graph to estimate the median and the interquartile range of the lifetimes.

Median: .....hours IQR: .....hours *(3 marks)*

(Total for Question is 5 marks)

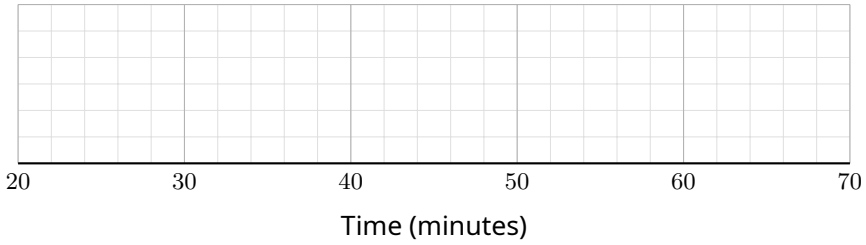
Challenge 2

The cumulative frequency graph shows the times, in minutes, taken by 60 cyclists in Group A to complete a race.



The fastest cyclist in Group A took 24 minutes and the slowest cyclist took 68 minutes.

(a) On the grid below, draw a box plot to represent the race times of Group A.



(3 marks)

(b) Group B also completed the race. Their median time was 49 minutes and their interquartile range was 10 minutes.
Make **two** comparisons between the race times of Group A and Group B.

(2 marks)

(Total for Question is 5 marks)

Extreme Challenge

The table shows the waiting times, in minutes, of 100 customers at a service desk.

Waiting time (w minutes)	**Frequency**
$0 < w \leq 10$	12
$10 < w \leq 20$	a
$20 < w \leq 30$	b
$30 < w \leq 40$	22
$40 < w \leq 50$	6

Exactly 32% of the 100 customers waited 20 minutes or less.

(a) Find the value of a and the value of b.

$a =$ ..... $b =$ ..... *(2 marks)*

(b) Write down the class interval that contains the median waiting time.

..... *(1 mark)*

(c) Calculate an estimate for the **mean** waiting time of the 100 customers.
Show all of your working clearly.

.....minutes *(3 marks)*

(Total for Question is 6 marks)

Worked Answers

I Do
(a) Cumulative frequencies: **14**, **42**, **64**, **76**, **80**.
(b) Plot at upper class boundaries: $(0,0),(10,14),(20,42),(30,64),(40,76),(50,80)$ and join with a smooth curve (or straight line segments).
(c) Lower quartile (at CF $=20$) ≈ 12 km; Upper quartile (at CF $=60$) ≈ 28 km.
IQR $\approx 28-12=$ **16 km** *(accept* 15 *to* 17 *km depending on curve)*.

We Do
(a) Cumulative frequencies: **10**, **34**, **60**, **74**, **80**.
(b) Plot $(0,0),(10,10),(20,34),(30,60),(40,74),(50,80)$.
(c) LQ (at CF $=20$) ≈ 14 min; UQ (at CF $=60$) $=30$ min.
IQR $\approx 30-14=$ **16 minutes** *(accept* 15 *to* 17 *minutes)*.

You Do 1
(a) Cumulative frequencies: **8**, **24**, **45**, **56**, **60**.
(b) Plot $(100,0),(120,8),(140,24),(160,45),(180,56),(200,60)$.
(c) (i) Median (at CF $=30$) $\approx$ **146 g** *(accept* 144 *to* 148 *g)*.
(ii) LQ (at CF $=15$) ≈ 129 g; UQ (at CF $=45$) $=160$ g.
IQR $\approx 160-129=$ **31 g** *(accept* 29 *to* 33 *g)*.

You Do 2
(a) Cumulative frequencies: **12**, **38**, **75**, **92**, **100**.
(b) Plot $(0,0),(20,12),(40,38),(60,75),(80,92),(100,100)$.
(c) LQ (at CF $=25$) ≈ 30 cm; UQ (at CF $=75$) $=60$ cm. IQR $\approx 60-30=$ **30 cm**.
(d) Read up from $h=70$ cm $\implies$ CF ≈ 84. Number taller than 70 cm $\approx 100-84=$ **16 plants** *(accept* 14 *to* 18*)*.

You Do 3
(a) Cumulative frequencies: **10**, **30**, **72**, **108**, **120**.
(b) Plot $(20,0),(30,10),(40,30),(50,72),(60,108),(70,120)$.
(c) Median (at CF $=60$) $\approx$ **47 km/h** *(accept* 46 *to* 48 *km/h)*.
(d) Read up from $s=55$ km/h $\implies$ CF ≈ 90. Cars faster than 55 km/h $=120-90=30$.
Percentage $=\dfrac{30}{120}\times 100\%=$ **25%** *(accept* 23% *to* 27%*)*.

Challenge 1

(a) Read cumulative frequencies at $10, 20, 30, 40, 50$ ($8, 24, 52, 72, 80$) and subtract consecutive values:
$0 < L \leq 10$: **8**
$10 < L \leq 20$: $24 - 8 =$ **16**
$20 < L \leq 30$: $52 - 24 =$ **28**
$30 < L \leq 40$: $72 - 52 =$ **20**
$40 < L \leq 50$: $80 - 72 =$ **8**.

(b) Median (at CF $= 40$) $\approx$ **26 hours**.
LQ (at CF $= 20$) ≈ 18 hours; UQ (at CF $= 60$) ≈ 34 hours.
IQR $\approx 34 - 18 =$ **16 hours** *(accept* 15 *to* 17 *hours)*.

Challenge 2

(a) Key values for Group A box plot:
- Minimum $= 24$, Maximum $= 68$
- LQ (at CF $= 15$) ≈ 38, Median (at CF $= 30$) ≈ 45, UQ (at CF $= 45$) ≈ 52.
(Draw whiskers from 24 *to* 38 *and* 52 *to* 68*, with a box from* 38 *to* 52 *and a vertical line at* 45*.)*

(b) Two valid comparisons in context:
1. **Average (Median):** On average, Group A was faster than Group B because Group A has a lower median time (45 minutes compared to 49 minutes).
2. **Spread (IQR):** Group B's times were more consistent (less spread out) than Group A's because Group B has a smaller interquartile range (10 minutes compared to 14 minutes).

Extreme Challenge

(a) 32% of $100 = 32$ customers waited 20 minutes or less:
$12 + a = 32 \implies$ **a** $=$ **20**.
Total frequency is 100:
$12 + 20 + b + 22 + 6 = 100 \implies 60 + b = 100 \implies$ **b** $=$ **40**.

(b) The 50th value lies after CF $= 32$ and up to CF $= 32 + 40 = 72$:
Median class interval is **20** $<$ **w** $\leq$ **30**.

(c) Multiply class midpoints ($5, 15, 25, 35, 45$) by their frequencies:
$(5 \times 12) + (15 \times 20) + (25 \times 40) + (35 \times 22) + (45 \times 6)$
$= 60 + 300 + 1000 + 770 + 270 = 2400$.
Estimated mean $= \dfrac{2400}{100} =$ **24 minutes**.