

Cumulative frequency and percentiles

About 55 minutes Calculator allowed 39 marks



Hints online, answers free with an account:
mathswariz.uk/worksheets/stats-cumulative-frequency-and-percentiles/

Date _____

A Do Now

The first question is what today's lesson needs. The others bring back earlier topics.

- A1** Needed today [2 marks] **A2** From chapter 2 [2 marks]
- A histogram shows the times, in minutes, of some runners. The bar for $30 < t \leq 40$ has frequency density 2.8. The bar for $40 < t \leq 55$ has frequency density 2.4. Which of these two classes holds more runners, and how many more?

A council wants the views of all the adults in a town on a new park. Ben, who runs the survey, plans to choose 30 people at random from the list of members of the town's tennis club. Explain why this is not a suitable sampling frame.

Answer

- A3** From chapter 2 [2 marks] **A4** From chapter 2 [2 marks]
- Ben chooses a sample of the 600 students in a school. Ben numbers the 600 students and uses a random number generator, ignoring repeats, to choose 30. Does every student have an equal chance of being chosen? Give a reason.

A group has 141 day shift, 142 late shift and 233 night shift. A stratified sample of 50 workers is taken. Work out how many of each are in the sample, checking that they add to 50.

Answer

B Example, then your turn

Your teacher works through each example with you. Then try the one beside it.

EXAMPLE 1

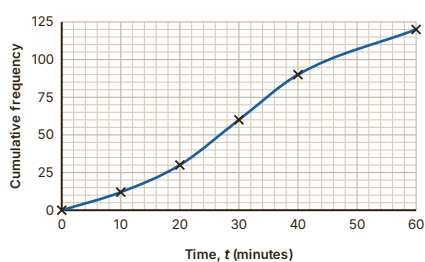
The table shows the heights, h cm, of 50 seedlings. Write down the points to plot for a cumulative frequency graph.

Height, h (cm)	Frequency
$0 < h \leq 5$	4
$5 < h \leq 10$	9
$10 < h \leq 15$	17
$15 < h \leq 20$	12
$20 < h \leq 25$	8

Hint Keep a running total; plot it at the end of its class.

EXAMPLE 2

The graph shows the journey times, t minutes, of 120 drivers. Estimate the median and the IQR. Compare them with cyclists on the same route: median 26 minutes, IQR 8 minutes.



Hint Median: across from 60, then down.

B1 The table shows the times, t seconds, of 80 swimmers. [2 marks]

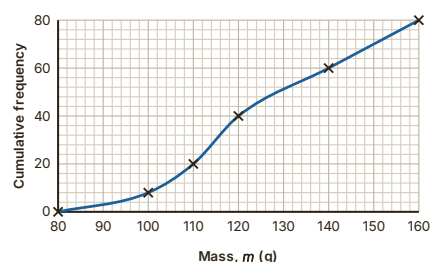
Write down the points you would plot for a cumulative frequency graph.

Time, t (seconds)	Frequency
$30 < t \leq 40$	6
$40 < t \leq 50$	15
$50 < t \leq 60$	28
$60 < t \leq 70$	21
$70 < t \leq 80$	10

Answer

B2 The graph shows the masses, m grams, of 80 apples. [3 marks]

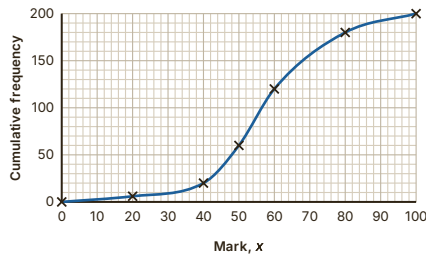
Estimate the median and the interquartile range.



Answer median g, IQR g

EXAMPLE 3

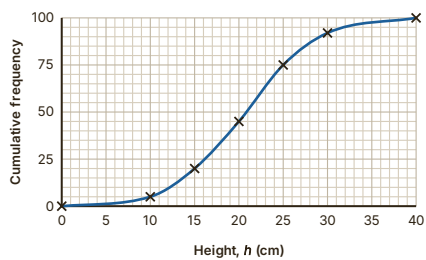
The graph shows the test marks, x , of 200 students. Estimate the 10th and 90th percentiles and the range between them. What does the 90th percentile tell you?



Hint 10% of 200 is 20: read across from 20.

EXAMPLE 4

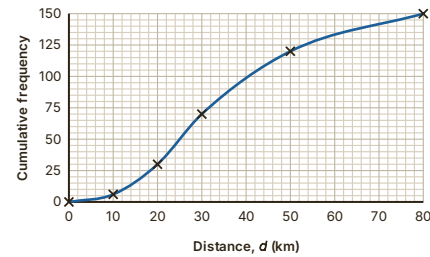
The graph shows the heights, h cm, of 100 plants. Estimate how many of the plants are taller than 25 cm.



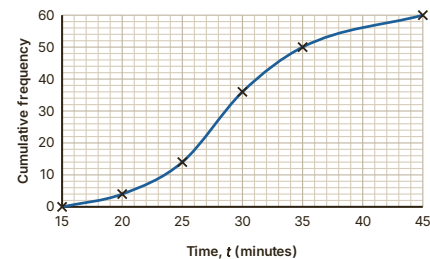
Hint The curve counts plants of 25 cm or less.

B3 The graph shows the distances, d km, of 150 delivery vans in one day. [3 marks]

Estimate the 20th and 80th percentiles. What does the 80th percentile tell you?

**B4** The graph shows the times, t minutes, of 60 runners in a race. [3 marks]

Estimate the percentage who took more than 30 minutes.



Answer

c Practice**C1** Sam says, "The 90th percentile is 54, because 90% of 60 is 54." [2 marks]

Sam has a cumulative frequency graph of the times, in minutes, of 60 cyclists in a race. Explain Sam's mistake, and say how he should find the 90th percentile.

C3 The cumulative frequency table shows the masses, m kg, of 90 suitcases at an airport. [2 marks]

Estimate the number of suitcases with a mass between 15 kg and 25 kg.

Mass, m (kg)	Cumulative frequency
$m \leq 10$	12
$m \leq 15$	30
$m \leq 20$	61
$m \leq 25$	82
$m \leq 30$	90

Answer

- C4** Freya has a cumulative frequency graph of the masses of 250 lambs. Write down the cumulative frequency she should read across from to estimate (i) the 3rd decile, (ii) the 85th percentile. [2 marks]

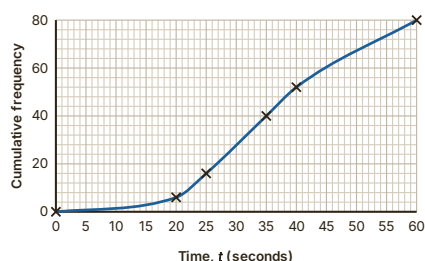
- C5** On a cumulative frequency graph of the reaction times of 80 drivers, a time of 0.42 seconds reads across to a cumulative frequency of 60. Which percentile is 0.42 seconds? Explain what it means for these drivers. [2 marks]

Answer (i) (ii)

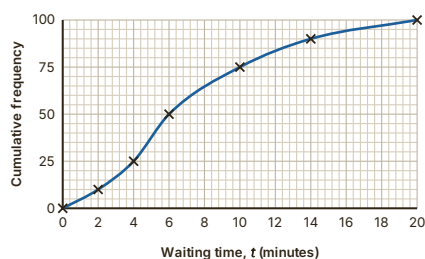
D Exam-style questions

- D1** Jo says, "The median is the class $25 < t \leq 35$, so the median is 30 seconds, the middle of that class." [2 marks]

The graph shows the times, t seconds, of 80 people in a puzzle. Is Jo correct? You must give a reason.



- D2** The graph shows the waiting times, t minutes, of 100 callers to Centre A.



- (a) Estimate the median and the interquartile range. [3 marks]

Answer median min, IQR min

- (b) Estimate the 90th percentile, and interpret your answer for these callers. [2 marks]

- (c) At Centre B the median waiting time was 8 minutes and the interquartile range was 3 minutes. Compare the waiting times at the two centres. [2 marks]

Total for D2: 7 marks

E Extension

No route is given. The hints are at the end of the sheet. Use one at a time.

- E1** Two groups of students did the same task. By 10, 20, 30 and 40 minutes, 4, 16, 34 and 40 of the 40 students in Group A had finished, and 6, 24, 46 and 60 of the 60 students in Group B. Estimate the median time for all 100 students together. [3 marks]

Answer

Extension hints

Cover these with paper. Uncover one at a time.

- E1** **Hint 1** Add the two cumulative frequencies at each time.
- Hint 2** Together: 10, 40, 80, 100. The 50th student is between 20 and 30 minutes.
- Hint 3** 40 students are done by 20 minutes; 10 more of the 40 in the next class: $20 + \frac{10}{40} \times 10$.

How did it go?

Colour one circle on each line: not yet, nearly, yes.

I can work out cumulative frequencies and the points to plot at the upper class boundaries. ☐ ☐ ☒

I can read the median, quartiles, deciles and percentiles from a curve, and how many lie above or below a value. ☐ ☐ ☒

I can say what a percentile means in context, and compare two distributions. ☐ ☐ ☒