



eClassroom

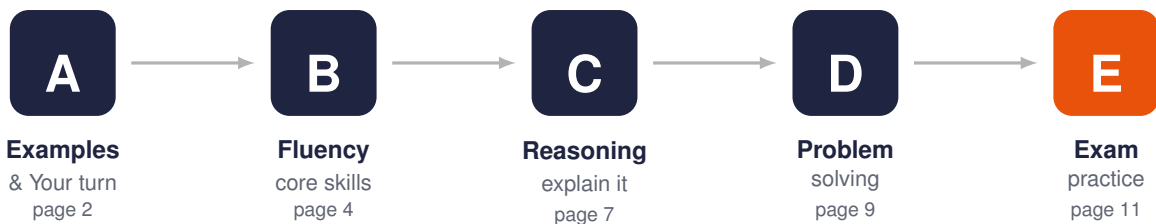
GCSE MATHEMATICS • DATA & STATISTICS

# Cumulative Frequency

## Worksheet

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • Calculator allowed

Free Cumulative Frequency worksheet for GCSE and iGCSE Maths, with full worked solutions



Tap a section to jump straight to it

**By the end of this worksheet you can:** work out running totals from a grouped frequency table • find how many values are below or above a boundary • find the class that contains the median • read a running-total graph and compare groups • *Higher:* cumulative frequency graphs, quartiles and the IQR, and box plots.

### Which questions are for me?

**FOUNDATION** Everyone starts here. These skills appear on both tiers.

**HIGHER** Higher only: cumulative frequency graphs, the median, quartiles and interquartile range from a graph, and box plots. Grades 6 to 9.

Every section has both, clearly labelled. Questions get harder as you go, and every skill in Sections A to D is needed in Section E.

### Track your progress

| Section          | B  | C  | D  | E  |
|------------------|----|----|----|----|
| Foundation marks | 23 | 10 | 13 | 15 |
| Higher marks     | 16 | 14 | 17 | 15 |
| My score         |    |    |    |    |

Full worked solutions

Data & Statistics revision engine

Free courses

Formula sheet builder

Name .....

Class .....

Date .....



Join students already acing their exams.

Book your FREE lesson at [www.eclassroom.org.uk](http://www.eclassroom.org.uk)

## A

## Worked examples &amp; Your turn

Read each example carefully. Cover it up, then answer the question beside it using the same method.

## FOUNDATION

Everyone starts here

## Worked example A1

Times (min):  $0 < t \leq 10$ : 4,  $10 < t \leq 20$ : 9,  $20 < t \leq 30$ : 12,  $30 < t \leq 40$ : 5. Work out the running totals. *Keep adding:* 4,  $4+9$ ,  $13+12$ ,  $25+5$

4, 13, 25, 30

## Your turn A1

Times (min):  $0 < t \leq 5$ : 6,  $5 < t \leq 10$ : 11,  $10 < t \leq 15$ : 8,  $15 < t \leq 20$ : 5. Work out the running totals.

## Worked example A2

Using A1's running totals (4, 13, 25, 30): how many took 20 minutes or less, and how many more than 20? *The running total at 20 is 13; the rest is  $30 - 13$*

13; 17

## Your turn A2

Masses:  $20 < m \leq 30$ : 3,  $30 < m \leq 40$ : 7,  $40 < m \leq 50$ : 10,  $50 < m \leq 60$ : 4. How many are 40 kg or less? How many are more than 50 kg?

## Worked example A3

For the 30 people in A1, which class contains the median? *The 15.5th value: running totals 4, 13, 25 pass it in the third class.*

$20 < t \leq 30$

## Your turn A3

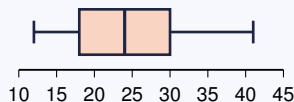
40 people:  $0 < t \leq 10$ : 7,  $10 < t \leq 20$ : 12,  $20 < t \leq 30$ : 9,  $30 < t \leq 40$ : 6,  $40 < t \leq 50$ : 6. Which class contains the median?

## HIGHER

Higher only: cumulative frequency graphs and box plots

## Worked example A4: drawing a box plot

Draw a box plot: smallest 12, LQ 18, median 24, UQ 30, largest 41. The box runs from LQ to UQ.



IQR 12, range 29

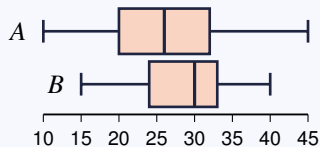
## Your turn A4

Draw a box plot for: smallest 5, LQ 11, median 14, UQ 20, largest 27. Write down the IQR and the range.



**Worked example A5: comparing box plots**

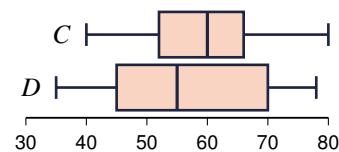
Compare A and B.

*Compare the medians, then the IQRs.*

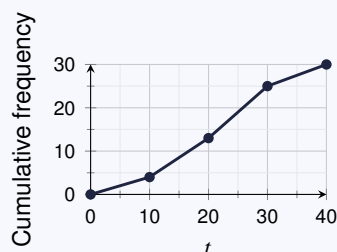
B higher on average and more consistent

**Your turn A5**

Compare C and D.

**Worked example A6: drawing a cumulative frequency graph**

Draw a cumulative frequency graph for the times in the first example.

*Plot each running total at the upper end of its class, starting at (0,0)*

(10,4), (20,13), (30,25), (40,30)

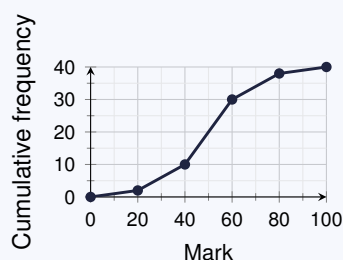
**Your turn A6**

Write down the points you would plot for a cumulative frequency graph of the times in Your turn A1

**Worked example A7: reading quartiles**

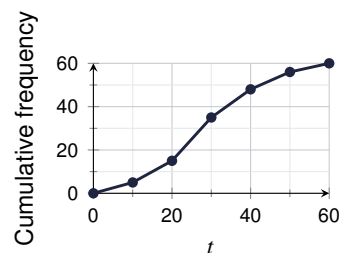
40 students.

Estimate the median and the IQR.

*Read across at 20 (median), 10 (LQ) and 30 (UQ).*median 50; IQR  $60 - 40 = 20$ **Your turn A7**

60 people.

Estimate the median and the IQR.



**B****Fluency**

Each question is a designed sequence. From one part to the next, ask yourself: what changed, and what did it do to the answer?

**FOUNDATION**

Everyone starts here

**B1** The table shows the times 40 people took.

| Time $t$ (min) | $0 < t \leq 10$ | $10 < t \leq 20$ | $20 < t \leq 30$ | $30 < t \leq 40$ | $40 < t \leq 50$ |
|----------------|-----------------|------------------|------------------|------------------|------------------|
| Frequency      | 3               | 8                | 14               | 10               | 5                |

Work out the running totals at (a) 10 (b) 20 (c) 30 (d) 40 [4 marks]

**B2** Use the table in B1.

- (a) How many took 30 minutes or less? (b) How many took more than 30 minutes?  
 (c) How many took more than 20 and at most 40 minutes? (d) What fraction took 20 minutes or less?

[4 marks]

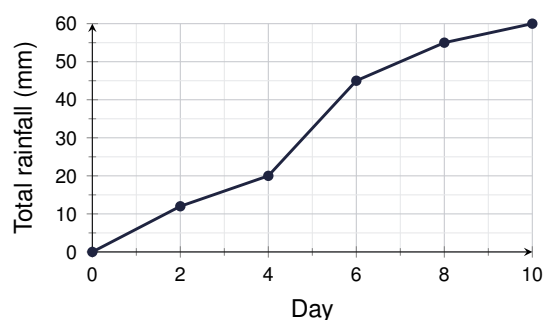
**B3** Which class contains the median?

- (a) The table in B1  
 (b) 25 values:  $0 < t \leq 10$ : 10,  $10 < t \leq 20$ : 6,  $20 < t \leq 30$ : 5,  $30 < t \leq 40$ : 4  
 (c) 50 values:  $0 < t \leq 10$ : 5,  $10 < t \leq 20$ : 18,  $20 < t \leq 30$ : 20,  $30 < t \leq 40$ : 7  
 (d) 15 values:  $0 < t \leq 10$ : 1,  $10 < t \leq 20$ : 2,  $20 < t \leq 30$ : 4,  $30 < t \leq 40$ : 8

[4 marks]

**B4** The graph shows the total rainfall since day 0

- (a) What was the total after 4 days?  
 (b) On which day did the total reach 50 mm?  
 (c) How much rain fell from day 4 to day 6?  
 (d) During which two days did most rain fall?



[4 marks]



**FOUNDATION***continued: comparing groups and reading statements*

**B5** Group A has median 24 and range 18. Group B has median 30 and range 10

- (a) Which group scored higher on average?      (b) Which group's scores were more consistent?  
(c) Write a sentence comparing the groups. [3 marks]

**B6** Use the table in B1. Is each statement true or false?

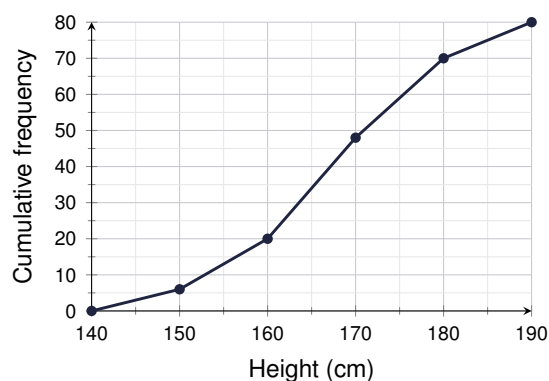
- (a) 35 people took 40 minutes or less.      (b) 5 people took more than 40 minutes.  
(c) The median is in the class  $30 < t \leq 40$       (d) More than half took over 20 minutes. [4 marks]

**HIGHER***Higher tier only*

**B7** The graph shows the heights of 80 students.

Estimate

- (a) the median  
(b) the lower quartile  
(c) the upper quartile  
(d) the interquartile range



[4 marks]

**B8** Use the graph in B7. Estimate

- (a) how many are shorter than 165 cm      (b) how many are taller than 175 cm  
(c) how many are between 155 cm and 185 cm      (d) the percentage taller than 180 cm

[4 marks]

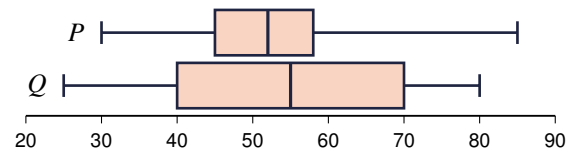


**HIGHER***continued: box plots*

- B9** (a) Find the IQR for: smallest 3, LQ 7, median 10, UQ 14, largest 20  
(b) Find the range for the same data.  
(c) Find the IQR for: smallest 21, LQ 25, median 30, UQ 38, largest 44  
(d) Find the range for the same data. [4 marks]

- B10** The box plots show the marks of two classes.  
Is each statement true or false?

- (a)  $P$  has the higher median.  
(b)  $Q$  has the larger IQR.  
(c)  $P$  has the larger range.  
(d) A quarter of  $Q$  scored more than 70



[4 marks]



**C****Reasoning**

Show your working and explain your thinking. A correct answer without a reason does not score full marks.

**FOUNDATION**

Everyone starts here

**C1** The running totals of a table are 4, 13, 25, 30. Explain why the last running total must equal the number of people. [2 marks]

**C2** A table has classes  $0 < t \leq 10$  and  $10 < t \leq 20$ . Explain why you cannot tell exactly how many took less than 15 minutes. [2 marks]

**C3** The table shows the times 30 people took.

| Time $t$ (min) | $0 < t \leq 10$ | $10 < t \leq 20$ | $20 < t \leq 30$ | $30 < t \leq 40$ |
|----------------|-----------------|------------------|------------------|------------------|
| Frequency      | 12              | 4                | 5                | 9                |

Sam says the median is in  $0 < t \leq 10$  because it has the largest frequency. Explain Sam's mistake, and find the class that contains the median. [3 marks]

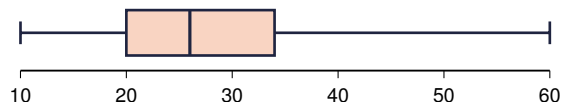
**C4** The running totals for a table with classes  $0 < t \leq 10$ ,  $10 < t \leq 20$ ,  $20 < t \leq 30$ ,  $30 < t \leq 40$  are 7, 19, 32, 50

Show that 18 people took more than 30 minutes. [3 marks]



**HIGHER***Higher tier only*

- C5** Kai plots his cumulative frequency graph with the points at the midpoints of the classes. Explain his mistake. [3 marks]
- C6** Explain why the median read from a cumulative frequency graph is only an estimate. [3 marks]
- C7** Two box plots have the same median. Box plot  $X$  has an IQR of 8 and box plot  $Y$  has an IQR of 20. Jo says, “ $Y$  is better because its values are bigger.” Explain why Jo’s reasoning is wrong. [3 marks]
- C8** The box plot shows the scores of 40 people.
- (a) How many people scored between 20 and 34?
- (b) Show that at least 10 people scored 34 or more.
- (c) Explain why the mean score is likely to be greater than 26



[5 marks]



**D****Problem solving**

You decide the method. Read the whole question first, and show every step.

**FOUNDATION**

Everyone starts here

**D1** The table shows the ages of 50 people.

| Age $a$   | $20 < a \leq 30$ | $30 < a \leq 40$ | $40 < a \leq 50$ | $50 < a \leq 60$ |
|-----------|------------------|------------------|------------------|------------------|
| Frequency | 6                | 14               | 20               | 10               |

How many people are over 40? What percentage is this?

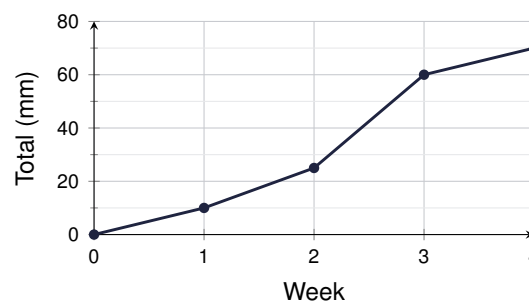
[3 marks]

**D2** Two classes did a test. Class  $A$  has 30 students: running totals of 5, 18, 30 for 10, 20 and 30 minutes. Class  $B$  has 25 students: running totals of 8, 14, 25

Which class had the greater percentage finishing within 20 minutes? Show your working.

[4 marks]

**D3** The graph shows the total rainfall since the start of a month. In which week did most rain fall? Explain how the graph shows this.



[3 marks]

**D4** The running totals for four classes are 8,  $x$ , 33 and 50. The second class has a frequency of 12. Find  $x$ , and the frequency of the third class.

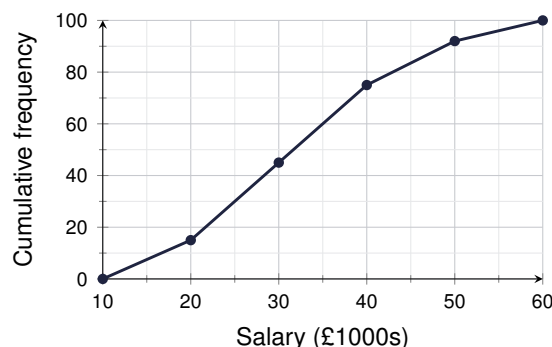
[3 marks]



**HIGHER***Higher tier only*

- D5** The graph shows the salaries of 100 employees. 40% of the employees earn more than £X thousand.

Estimate X.



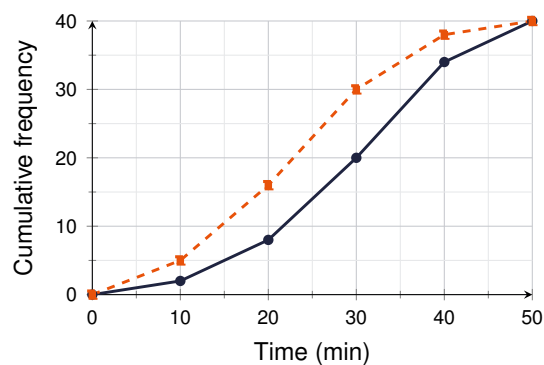
[4 marks]

- D6** Use the graph in B7. The shortest student is 142 cm and the tallest is 188 cm.  
Draw a box plot for the heights, and write down its IQR.

[4 marks]

- D7** The graph shows the times of 40 boys and 40 girls.

- (a) Estimate the median for each group.  
(b) Estimate the IQR for each group.  
(c) Compare the times of the boys and the girls.



solid line: boys; dashed line: girls

[4 marks]

- D8** The table shows 60 values. The frequencies of two classes are  $x$  and  $2x$

| Value $v$ | $0 < v \leq 10$ | $10 < v \leq 20$ | $20 < v \leq 30$ | $30 < v \leq 40$ | $40 < v \leq 50$ |
|-----------|-----------------|------------------|------------------|------------------|------------------|
| Frequency | 6               | $x$              | $2x$             | 12               | 6                |

- (a) Find  $x$ .  
(b) Assuming the values in each class are evenly spread, estimate the median and the interquartile range.

[5 marks]





## Exam practice

Exam-style questions. Write your answers in the spaces. Aim for about one minute per mark.

### FOUNDATION

*Foundation and Higher crossover*

**E1** The table shows the times 50 people took.

| Time $t$ (min) | $0 < t \leq 10$ | $10 < t \leq 20$ | $20 < t \leq 30$ | $30 < t \leq 40$ | $40 < t \leq 50$ |
|----------------|-----------------|------------------|------------------|------------------|------------------|
| Frequency      | 6               | 11               | 15               | 12               | 6                |

(a) Work out the running totals.

.....  
(2)

(b) How many people took 40 minutes or less?

.....  
(1)

(Total for Question E1 is 3 marks)

**E2** Use the table in E1.

(a) Which class contains the median?

.....  
(1)

(b) How many people took more than 30 minutes?

.....  
(2)

(Total for Question E2 is 3 marks)

**E3** The marks of two year groups are summarised below.

Year 10: median 32, range 20      Year 11: median 28, range 12

Compare the marks of the two year groups.

(Total for Question E3 is 3 marks)



Join students already acing their exams.

Book your FREE lesson at [www.eclassroom.org.uk](http://www.eclassroom.org.uk)

**E4** The graph shows the total rainfall since day 0

(a) What was the total after 10 days?

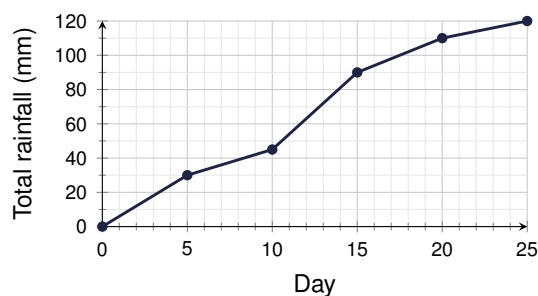
.....  
(1)

(b) On which day did the total reach 100 mm?

.....  
(1)

(c) How much rain fell from day 10 to day 15?

.....  
(1)



(Total for Question E4 is 3 marks)

**E5** The table shows the times 30 people took.

| Time $t$ (min) | $0 < t \leq 10$ | $10 < t \leq 20$ | $20 < t \leq 30$ | $30 < t \leq 40$ |
|----------------|-----------------|------------------|------------------|------------------|
| Frequency      | 16              | 3                | 2                | 9                |

Ria says the median is the middle class,  $10 < t \leq 20$  or  $20 < t \leq 30$ , because there are four classes. Explain Ria's mistake, and find the class that contains the median.

.....

(Total for Question E5 is 3 marks)

**HIGHER**

Higher tier only

**E6** The table shows the masses of 50 parcels.

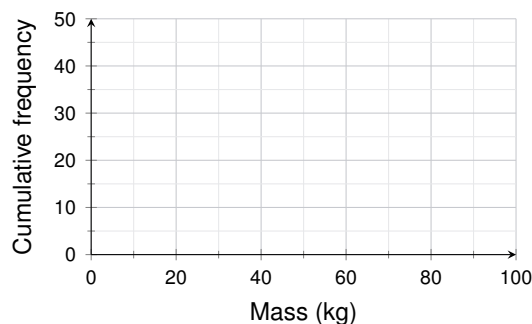
| Mass $w$ (kg) | $0 < w \leq 20$ | $20 < w \leq 40$ | $40 < w \leq 60$ | $60 < w \leq 80$ | $80 < w \leq 100$ |
|---------------|-----------------|------------------|------------------|------------------|-------------------|
| Frequency     | 5               | 12               | 18               | 10               | 5                 |

(a) Draw a cumulative frequency graph for this information.

(2)

(b) Use your graph to estimate the median mass.

.....  
(1)



(Total for Question E6 is 3 marks)



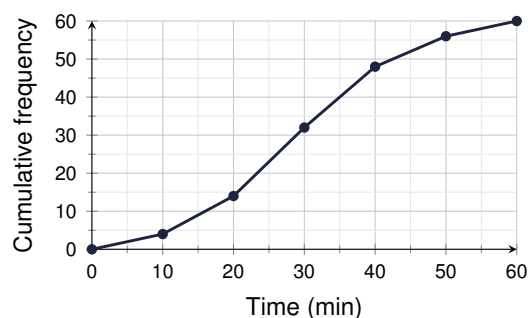
**E7** The graph shows the times of 60 runners.

(a) Estimate the median.

.....  
(1)

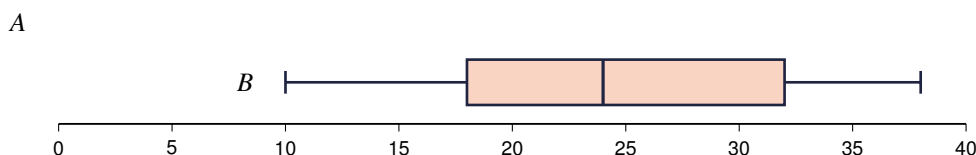
(b) Estimate the interquartile range.

.....  
(2)



(Total for Question E7 is 3 marks)

**E8** The box plot for group *B* is drawn on the scale below. For group *A*, the shortest time was 8 minutes and the longest was 35 minutes; the lower quartile was 15, the median 21 and the upper quartile 26



(a) Draw the box plot for group *A* on the scale above.

(2)

(b) Compare the two groups.

(2)

(Total for Question E8 is 4 marks)

**E9** The graph shows the marks of 80 students in a test.

(a) 70% passed. Estimate the pass mark.

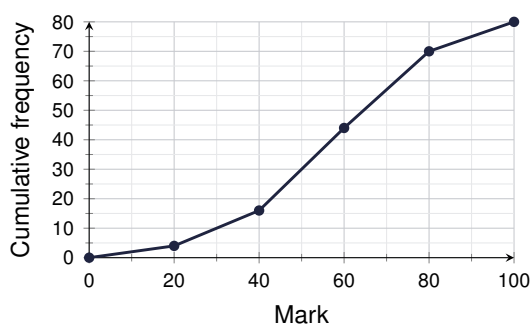
.....  
(2)

(b) Estimate how many scored 50 to 70

.....  
(2)

(c) Estimate the % scoring over 75

.....  
(1)



(Total for Question E9 is 5 marks)

**Finished?** Mark your work with the **full worked solutions**, fill in your scores on the front page, then keep the skill sharp with unlimited questions on the **Data & Statistics revision engine**.



Join students already acing their exams.

Book your FREE lesson at [www.eclassroom.org.uk](http://www.eclassroom.org.uk)