Estimating the median by linear interpolation

Grade 7 | Worked solutions

GCSE Statistics topic practice

1 The table shows the heights, h mm, of 50 seedlings.

Height (h mm)	Frequency
$0 < h \leq 10$	5
$10 < h \leq 20$	15
$20 < h \leq 30$	20
$30 < h \leq 40$	10

Use linear interpolation to estimate the median height. (3 marks)

Find where the median is

$50 \div 2 = 25$

The median is the 25th value

Cumulative frequencies

5, 20, 40, 50

The 25th value is in the class $20 < h \leq 30$

It is 25 − 20 = 5 values into a class of 20

$$\text{median} = 20 + \frac{5}{20} \times 10$$

$$\text{median} = 20 + 2.5$$

$$\text{median} = 22.5 \text{ mm}$$

22.5 mm

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2 The table shows the times, t minutes, that 60 customers spent in a supermarket.

Time (t minutes)	Frequency
$0 < t \leq 10$	6
$10 < t \leq 20$	14
$20 < t \leq 30$	22
$30 < t \leq 40$	12
$40 < t \leq 60$	6

a. Use linear interpolation to estimate the median time. Give your answer correct to 1 decimal place. (3)

b. Write down one assumption you made in part (a). (1)

(4 marks)

a) Find where the median is

$60 \div 2 = 30$

The median is the 30th value

Cumulative frequencies

6, 20, 42, 54, 60

The 30th value is in the class $20 < t \leq 30$

It is 30 − 20 = 10 values into a class of 22

$$\text{median} = 20 + \frac{10}{22} \times 10$$

$$\text{median} = 20 + 4.545...$$

median = 24.5 minutes (1 dp)

b)

The times are evenly spread

through the class $20 < t \leq 30$

a) 24.5 minutes b) times evenly spread in the class

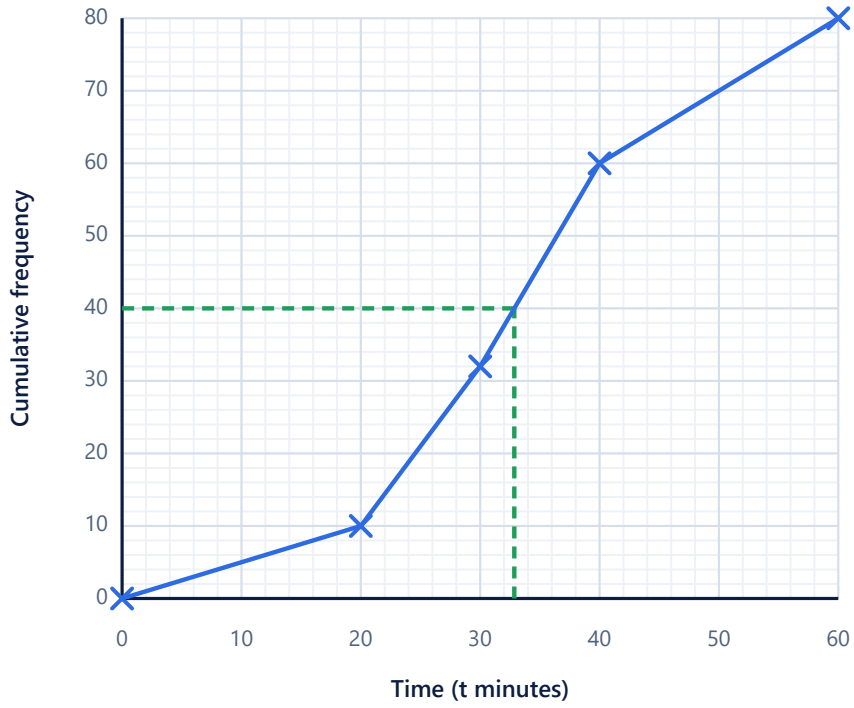
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3 The table shows the delivery times, t minutes, of 80 pizza orders. The cumulative frequency polygon for these data is also shown.

Time (t minutes)	Frequency
$0 < t \leq 20$	10
$20 < t \leq 30$	22
$30 < t \leq 40$	28
$40 < t \leq 60$	20

a. Use linear interpolation to estimate the median delivery time. Give your answer correct to 1 decimal place. (3)

b. Draw lines on the cumulative frequency polygon to show how the median can be read from it. (1)



(4 marks)

a) Find where the median is

$80 \div 2 = 40$

The median is the 40th value

Cumulative frequencies

10, 32, 60, 80

The 40th value is in the class $30 < t \leq 40$

It is $40 - 32 = 8$ values into a class of 28

$$\text{median} = 30 + \frac{8}{28} \times 10$$

$$\text{median} = 30 + 2.857...$$

median = 32.9 minutes (1 dp)

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b)

Draw a line across from 40 on the cumulative frequency axis to the polygon

Then draw a line down to the time axis

It meets the axis at about 33 minutes

a) 32.9 minutes b) Lines drawn at 40 and about 33

4 The table shows the weekly earnings, £e, of the 120 part-time workers at a company.

Weekly earnings (£e)	Frequency
$0 < e \leq 50$	18
$50 < e \leq 100$	30
$100 < e \leq 150$	40
$150 < e \leq 250$	32

a. Use linear interpolation to estimate the median weekly earnings. (3)

b. Explain why your answer to part (a) is only an estimate. (1)

c. Mia says, "The median is in the class $100 < e \leq 150$, so the best estimate of the median is the midpoint, £125." Explain why linear interpolation gives a better estimate than Mia's method. (1)

(5 marks)

a) Find where the median is

$120 \div 2 = 60$

The median is the 60th value

Cumulative frequencies

18, 48, 88, 120

The 60th value is in the class $100 < e \leq 150$

It is $60 - 48 = 12$ values into a class of 40

The class is 50 wide

$$\text{median} = 100 + \frac{12}{40} \times 50$$

$$\text{median} = 100 + 15$$

median = £115

b)

The data are grouped

so the exact earnings are not known

c)

Interpolation uses where the median is in the class

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It is only 12 values into a class of 40

so it is nearer to 100 than to the midpoint 125

a) £115 b) grouped data c) median is low in the class

5 The table shows the times, t minutes, taken by 60 runners to finish a 5 km fun run. Two of the frequencies are missing.

Time (t minutes)	Frequency
$20 < t \leq 25$	9
$25 < t \leq 30$	15
$30 < t \leq 35$	x
$35 < t \leq 45$	y

Using linear interpolation, the estimate of the median time is 31.5 minutes.

a. Work out the value of x. (4)

b. Work out the value of y. (1)

(5 marks)

a) Find where the median is

$60 \div 2 = 30$

31.5 is in the class $30 < t \leq 35$

Number of values below 30 minutes

$9 + 15 = 24$

The median is 6 values into a class of x, 5 wide

$$31.5 = 30 + \frac{6}{x} \times 5$$

$$1.5 = \frac{30}{x}$$

$$x = \frac{30}{1.5}$$

$x = 20$

b) The frequencies add up to 60

$y = 60 - 9 - 15 - 20$

$y = 16$

a) $x = 20$ b) $y = 16$

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