

Exercise walk-through

E9.7

Histograms

IGCSE Mathematics

You must be able to

- calculate frequency density as $\text{frequency} \div \text{class width}$
- find a frequency from a bar's height and width
- identify the modal class from a histogram and explain why area represents frequency

1

The method

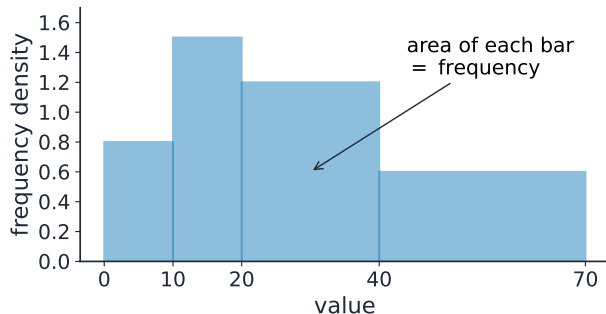
Method — Height is frequency DENSITY; area is frequency

- **Frequency density** = $\frac{\text{frequency}}{\text{class width}}$, and going back, frequency = density $\times$ width — which is the AREA of the bar.
- **Why not just frequency?** With unequal widths, a tall wide bar would exaggerate a class. Using density makes every bar's AREA proportional to its frequency.
- **Worked:** a class $0 < x \leq 20$ with frequency 30 has density $30 \div 20 = 1.5$.
- **Modal class:** the one with the greatest frequency DENSITY, which is not always the one with the greatest frequency.
- **No gaps:** the bars touch, because the data is continuous.

Answer shapes (marked by **method marks** — M1 for a correct method, A1 for the correct answer): the class width, written down before the division, is the method mark.

Method — Height is frequency DENSITY; area is frequency

Answer shapes (marked by method marks — M1 for a correct method, A1 for the correct answer): the class width,...



$$\text{density} = \text{freq} / \text{width} \cdot \text{area} = \text{frequency}$$

A histogram with unequal class widths

2

Practice

Practice 2.1 ■ 2 marks

A class $0 < x \leq 20$ has a frequency of 30. Find its frequency density.

Solution 2.1

Method: Height is frequency DENSITY; area is frequency — p.4

Worked steps

■ the class width is 20, so $30 \div 20$ **M1**

= 1.5

A1

Practice 2.2 ■ 2 marks

A bar has a frequency density of 2.4 and covers a class of width 5.
Find its frequency.

Solution 2.2

Method: Height is frequency DENSITY; area is frequency — p.4

Worked steps

$$\blacksquare \text{ frequency} = \text{density} \times \text{width} = 2.4 \times 5 \quad \text{M1}$$

$$= 12$$

A1

Practice 2.3 ■ 2 marks

Explain why a histogram uses frequency density rather than frequency on the vertical axis.

Solution 2.3

Method: Height is frequency DENSITY; area is frequency — p.4

Worked steps

- the classes have unequal widths **B1**
- using density makes the AREA of each bar proportional to its frequency, so a wide class is not made to look more common than it is **B1**

3

Exam-style

Exam-style 3.1 ■ 6 marks

The table shows the times t seconds taken by a group of runners.

Time (t seconds)	Frequency
$0 < t \leq 10$	15
$10 < t \leq 25$	30
$25 < t \leq 45$	24
$45 < t \leq 75$	18

Exam-style 3.1 (a) ■ 4 marks

Calculate the frequency density of each class.

Solution 3.1 (a)

Method: Height is frequency DENSITY; area is frequency — p.4

Worked steps

- widths are 10, 15, 20 and 30 (M1)
- $15 \div 10 = 1.5$ (A1)
- $30 \div 15 = 2$ (A1)
- $24 \div 20 = 1.2$ and $18 \div 30 = 0.6$ (A1)

Exam-style 3.1 (b) ■ 2 marks

Write down the modal class, and explain your choice.

Solution 3.1 (b)

Worked steps

- the modal class has the greatest frequency DENSITY, which is 2

$$10 < t \leq 25$$

B1

- it is not the class with the greatest frequency in this table — $25 < t \leq 45$ has a frequency of 24 but a density of only 1.2 B1

Exam-style 3.2 ■ 2 marks

In a histogram, a bar covering $20 < x \leq 30$ has a height of 3.5.
Find the frequency of that class.

Solution 3.2

Method: Height is frequency DENSITY; area is frequency — p.4

Worked steps

■ width = 10, so frequency = 3.5×10 **M1**

= **35**

A1