

E9.7 Histograms

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

KEY WORDS frequency density 频数密度 • class width 组距 • histogram 直方图
• modal class 众数组 • unequal classes 不等组距

Objective

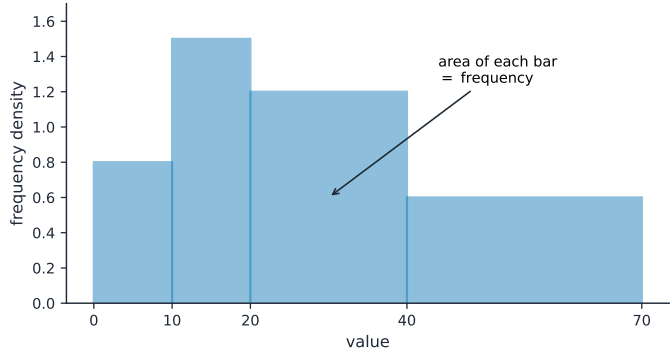
Build the skills to answer Extended exam questions on **histograms** 直方图 — calculating **frequency density** 频数密度, reading a frequency from a bar, and explaining why a histogram is used when the **class widths** 组距 are unequal.

You must be able to:

- calculate frequency density as frequency ÷ 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 Worked examples

■ Height is frequency DENSITY; area is frequency



density = freq / width • area = frequency

A wide class must be drawn shorter, or it would look far more common than it is

- **Frequency density** = $\frac{\text{frequency}}{\text{class width}}$, and going back, frequency = density × 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.

2 Practice

2.1 A class $0 < x \leq 20$ has a frequency of 30. Find its frequency density. [2]

2.2 A bar has a frequency density of 2.4 and covers a class of width 5. Find its frequency. [2]

2.3 Explain why a histogram uses frequency density rather than frequency on the vertical axis. [2]

3 Exam-style questions

3.1 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

(a) Calculate the frequency density of each class. [4]

(b) Write down the modal class, and explain your choice. [2]

3.2 In a histogram, a bar covering $20 < x \leq 30$ has a height of 3.5. Find the frequency of that class. [2]

Solutions

Marking: **M1** a correct method, **A1** the correct answer.

Each answer shows the steps, then the **result**.

2.1

- the class width is 20, so $30 \div 20$
 $= \mathbf{1.5}$

2.2

- frequency = density $\times$ width = 2.4×5
 $= \mathbf{12}$

2.3

- the classes have unequal widths
- 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

3.1

(a)

- widths are 10, 15, 20 and 30
- $15 \div 10 = \mathbf{1.5}$
- $30 \div 15 = \mathbf{2}$
- $24 \div 20 = \mathbf{1.2}$ and $18 \div 30 = \mathbf{0.6}$

(b)

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

$$\mathbf{10 < t \leq 25}$$

- 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

3.2

- width = 10, so frequency = 3.5×10
 $= \mathbf{35}$