Exercise walk-through

4.2 Histograms, cumulative frequency and box plots

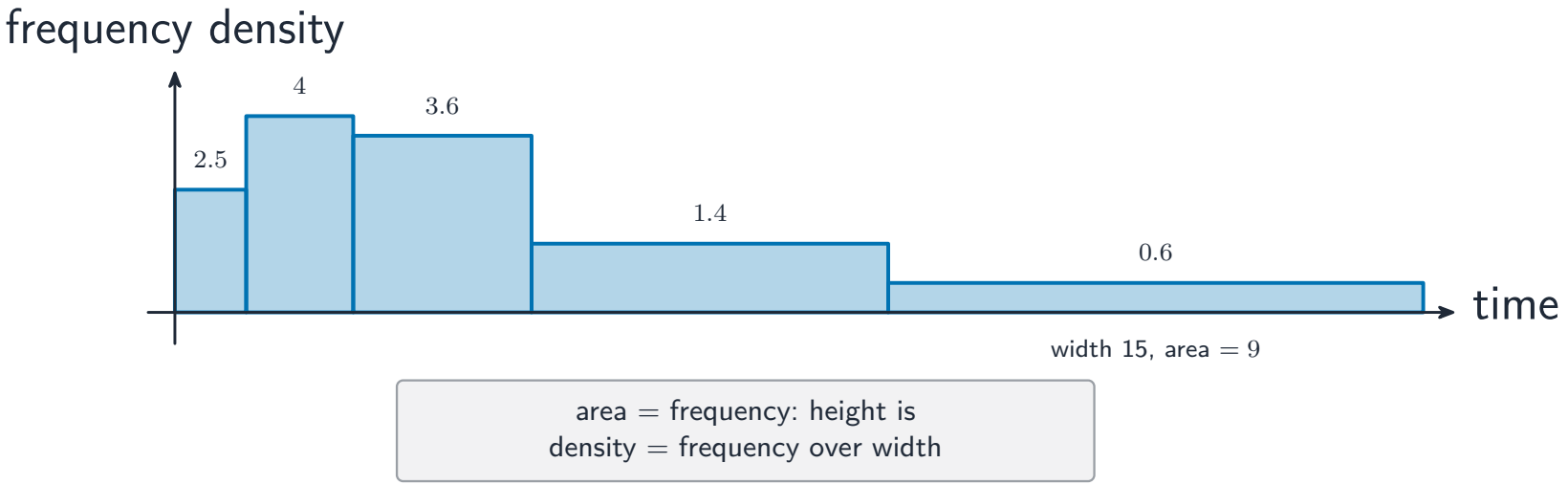
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Extension diagrams: unequal histograms, CF and box plots

- (Extension) A **histogram** can have **unequal class intervals** .
- Then the height of each bar is the **frequency density** :
- The area of each bar is the frequency.
- For classes of widths 2, 3, 5, 10 and 15 with frequencies 5, 12, 18, 14 and 9, the heights are 2.5, 4, 3.6, 1.4 and 0.6.

$$\text{frequency density} = \frac{\text{frequency}}{\text{class width}}$$

Figure: Extension diagrams: unequal histograms, CF and box plots



area = frequency: height is
density = frequency over width

- Height = **frequency density**
- Area of each bar = frequency

Exercise 2.1

2.1 Find the frequency density of each class in the table. [2]

class	frequency
$0 < x \leq 4$	12
$4 < x \leq 12$	10

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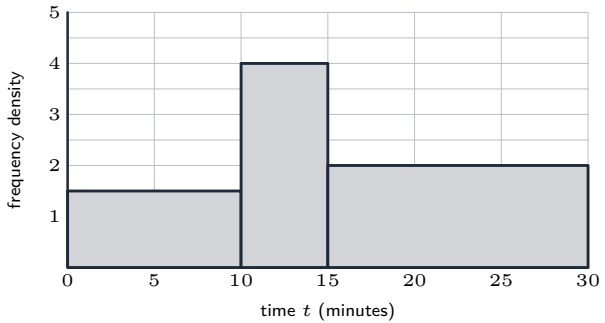
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2.1

- $\frac{12}{4} = \mathbf{3}$
- $\frac{10}{8} = \mathbf{1.25}$

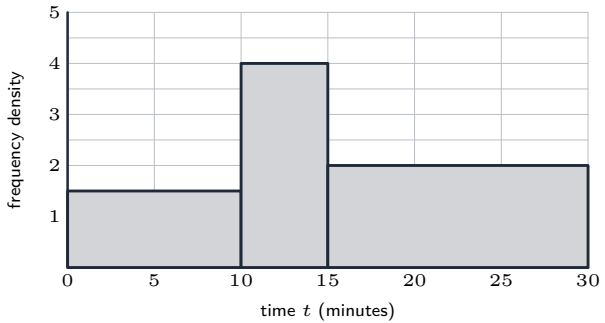
Exercise 2.2

2.2 The histogram shows the times some students spent on homework. How many students are in the class $10 < t \leq 15$? How many students are there in total? [2]



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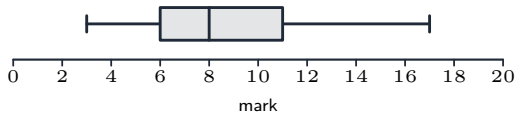


2.2

- $4 \times 5 = \mathbf{20}$
- $15 + 20 + 30 = \mathbf{65}$

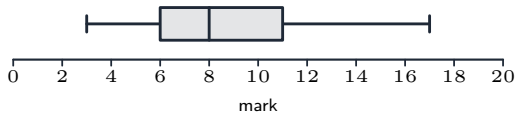
Exercise 2.3

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2.3

- median $= \mathbf{8}$
- IQR $= 11 - 6 = \mathbf{5}$

Exercise 3.1

3.1 The table shows the times 60 workers took to travel to work. Work out the cumulative frequencies. Which class contains the median? [3]

time t (min)	frequency	cum. freq.
$0 < t \leq 10$	8	
$10 < t \leq 20$	14	
$20 < t \leq 30$	20	
$30 < t \leq 40$	12	
$40 < t \leq 50$	6	

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3.1

- 8, 22, 42
- 54, 60
- the median is the 30th value, in the class $\mathbf{20 < t \leq 30}$

Setup for exercise 3.2

3.2 The table shows the times 100 runners took to finish a 5 km race. The histogram shows the first two classes.

time t (minutes)	**frequency**
$15 < t \leq 20$	10
$20 < t \leq 25$	25
$25 < t \leq 30$	30
$30 < t \leq 40$	25
$40 < t \leq 60$	10

Exercise 3.2 (a)

(a) Work out the frequency density of each class. [2]

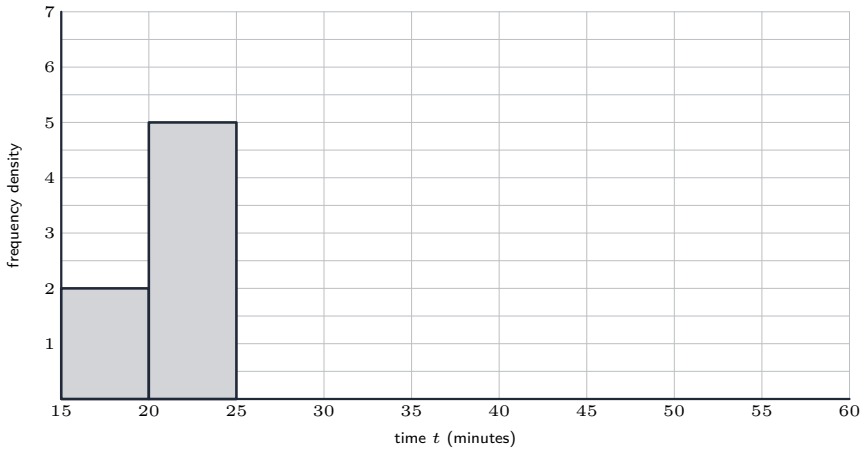
Exercise 3.2 (a)

(a) Work out the frequency density of each class. [2]

(a) 2, 5, 6; 2.5, 0.5

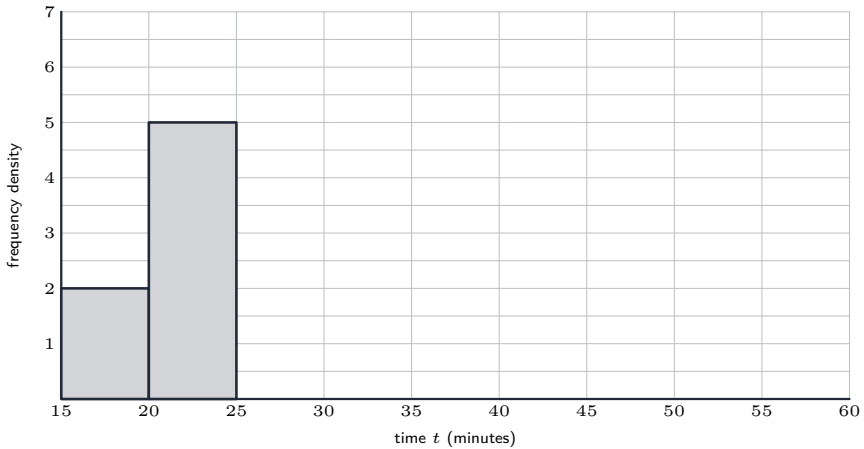
Exercise 3.2 (b)

(b) Complete the histogram. [3]



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(b) bar 25 to 30 at height 6; bar 30 to 40 at height 2.5; bar 40 to 60 at height 0.5

Exercise 3.2 (c)

(c) Estimate the number of runners who took between 27 and 35 minutes. [4]

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(c) 27 to 30: $\frac{3}{5} \times 30 = 18$; 30 to 35: $\frac{5}{10} \times 25 = 12.5$; $18 + 12.5 \approx \mathbf{31}$ runners

Exercise 3.2 (d)

(d) Estimate the median and the interquartile range. A second race has median 31 minutes and interquartile range 12 minutes. Compare the two races. [5]

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(d) cumulative frequencies 10, 35, 65, 90, 100; median $= 25 + \frac{15}{30} \times 5 =$ **27.5** min; $Q_1 = 20 + \frac{15}{25} \times 5 = 23$, $Q_3 = 30 + \frac{10}{25} \times 10 = 34$; IQR $=$ **11** min; the first race was faster on average ($27.5 < 31$) and its times were a little more consistent ($11 < 12$)