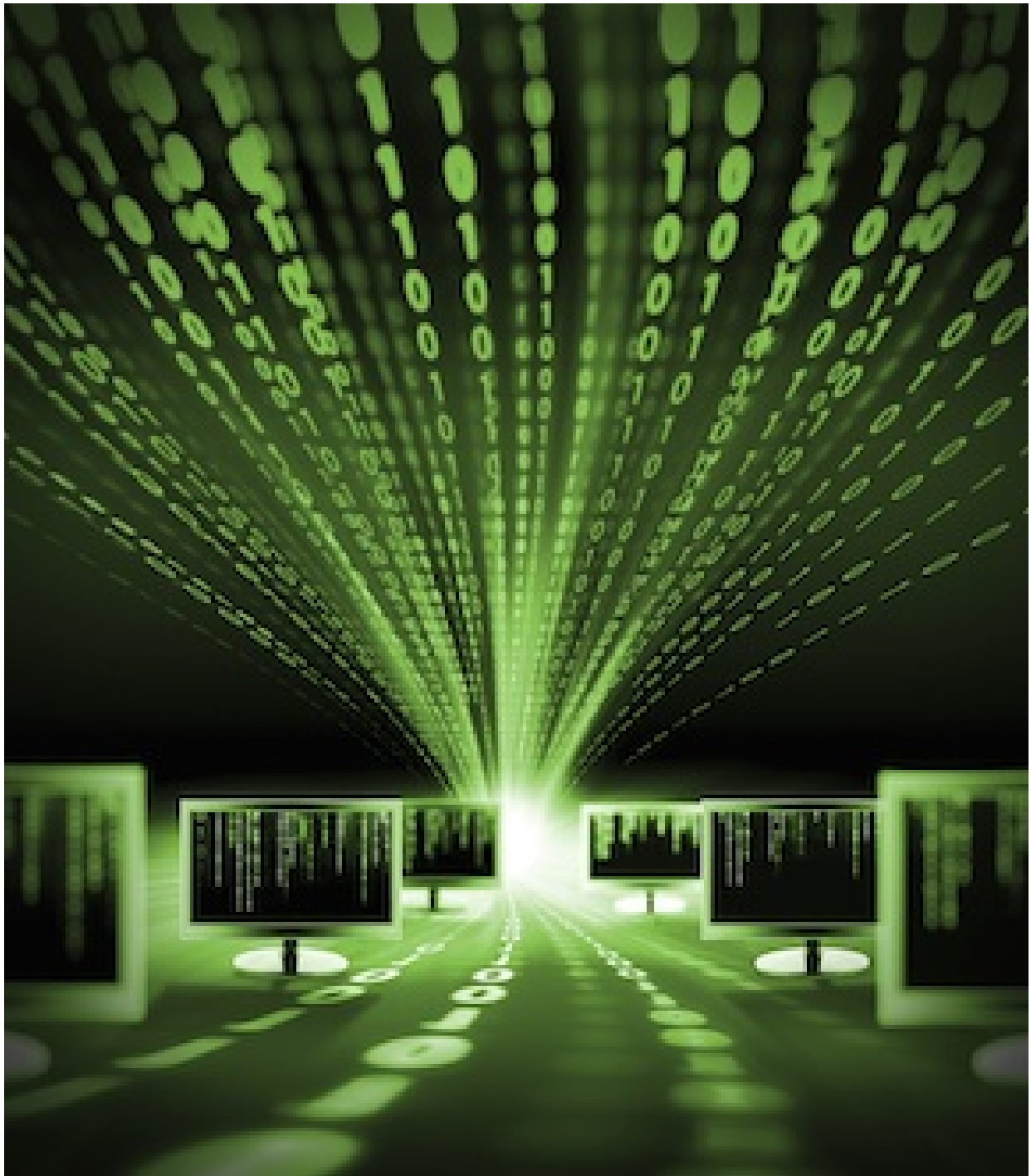


STATISTICS

HANDLING AND PROCESSING DATA



STATISTICS

HANDLING AND PROCESSING DATA

Lesson 1

GCSE Mathematics

Statistics II : Handling and Processing Data

1.1 Introduction

Many organisations busy themselves gathering data about us. In Britain the Government, for example, gathers information about each person in the country every ten years in what is termed a census. Simple and straight forward information, such as each citizen's age and where they live, help government plan and provide health and school services in each part of the country.

Supermarkets have invested large amounts of time and effort building up profiles on their customers, not simply observing what they buy but, for example, how they respond to a variety of special offers. Again the motivation is to better provide what their customers are likely to respond favourably to. Happy customers equals bigger profits.

The quantities of numbers, the data, generated by such practices is enormous. To look through pages and pages of numbers does not tell a typical human being very much. A statistic is a single number that tries to see into the character of the larger set of data in an informative way.

The statistical numbers that we shall investigate include mean, median, mode, range, interquartile range, standard deviation and skew. Statisticians are also very aware that a picture is an excellent way of passing impressions of what the "sea of numbers", or data, is saying. We will look at bar graphs, pie charts, line graphs (called frequency polygons) and histograms.

There is a dark side to statistics. Statisticians see themselves as neutral observers but sometimes the act of measuring something changes the thing being measured. More infamously, politicians often only report those statistics that support their vested interest, and don't mention any conflicting information. One best selling mathematics text book is called, "How to lie with statistics", another is "The Use and Abuse of Statistics". In these are detailed the many ways in which politicians and marketing managers use graphs and statistical numbers to mislead and give wrong impressions.

1.2 Exercise

Explain what a vested interest is.

Give an example.

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2.1 The Range

Given a collection of data the range is simply the smallest number subtracted from the largest. The range is thus a *measure of spread*.

In its favour, the range is simple to calculate.

Unfortunately it is easily fooled by what are termed *outliers*.

2.2 Example

Here are three groups of exam %age marks.

(i) For each, calculate the range.

Group 1 : 40 41 45 47 53 55 57

Group 2 : 33 35 43 47 50 53 54

Group 3 : 37 61 62 63 63 64 64

(ii) Group 3 contains an outlier.
State which number is the outlier.

(iii) Explain why the outlier has caused the range statistic to not give a true measure of spread in group 3.

2.3 The Interquartile Range: The IQR

In order to overcome the problems that the range has with outliers we need a better measure of spread. Consider the following data;

12 38 40 44 45 48 51

In essence, we throw away some data from the bottom and some from the top. In this case, as there are not many numbers, we'll just throw away the lowest and the highest item of data. What's then left is;

38 40 44 45 48

The 38 is referred to as the lower quartile, LQ, and the 48 as the upper quartile, UQ.

The interquartile range is then the range of what is left.

Thus, the IQR for the seven items of data is $UQ - LQ =$

Here is how to calculate the interquartile range in a more mathematical way.

Recall that the data is;

12 38 40 44 45 48 51

Step 1 : Count up how many items of data there are.
In this case 7.

Step 2 : Add 1. (Mindlessly accept that you always add 1 for now!)
So in this case we now have 8.

Step 3 : Divide by 4.
Thus the LQ is piece of data in position 2 from the left, which is 38.
And the UQ is piece of data in position 2 from the right, which is 48.

Step 4 : $IQR = UQ - LQ$
Which, in this case gives 10.

2.4 Exercise

Question 1

Consider the following data;

22 48 52 53 57 62 63 71 72 72 75 77 86 89 91

- Calculate
- (i) The lower quartile.
 - (ii) The upper quartile.
 - (iii) The interquartile range.

Question 2

Calculate the interquartile range of the following data;

31 43 45 46 49 50 54 55 58 62 63 63 66 66 68 73 75 92 100

Question 3

Consider the following data;

73 44 67 64 63 45 45

- (i) Put the data in order.
- (ii) Calculate the interquartile range of the (ordered) data.

Question 4

IGCSE (London) Examination Question : 6th November 2006

There are 15 students in class A.

In a test, the students gained these marks.

2 1 2 5 5 6 9 2 5 6 7 5 6 5 6

Find the interquartile range of these marks.

Question 5

In an IQ test, nine adult males scored as follows

123 89 112 105 74 118 96 101 93

Put the IQ scores in order and then calculate;

- (i) The lower quartile.
- (ii) The upper quartile.
- (iii) The interquartile range.

Question 6

In English, it is helpful to have a 'reading age' that provides a teacher with an idea of how difficult a book, paragraph or sentence is to read.

SENTENCE A : *It is hypothesized that sentences containing substantial variation in word length are difficult to read.*

SENTENCE B : *Are these words extraordinarily easy to read ?*

The number of letters in each of the words of sentence A are;

2 2 12 4 9 10 11 9 2 4 6 3 9 2 4

- (a) Calculate the range of the word letter lengths in Sentence A.

- (b) Calculate the range of the word letter lengths in Sentence B.

- (c) Which sentence does the range statistic predict is easier to read ?
Explain your answer.

- (d) Calculate the interquartile range of the word lengths of sentence A.

- (e) Calculate the interquartile range of the word lengths of sentence B.

- (f) Which sentence does the interquartile range predict is easier to read ?
Explain your answer.

- (g) What other factors might need to be taken into account when trying
to calculate a 'reading age' of a sentence ?

2.5 Answers

GCSE Mathematics Statistics II : Handelling and Processing Data

2.5.1 Solutions (Example)

- (i) **Group 1 :** $57 - 40 = 17$
 Group 2 : $54 - 33 = 21$
 Group 3 : $64 - 37 = 27$
- (ii) Outlier is 37
- (iii) Other than the 37, the data lies between 61 and 64, a range of just 3.
 So other than the 37 there is very little spread in the group 3 data.
 The range has failed to detect the extraordinary character of this data.

2.5.2 Solutions (Exercise)

Answer 1

22 48 52 53 57 62 63 71 72 72 75 77 86 89 91

15 items of data $\Rightarrow \frac{15 + 1}{4} = 4$

- (i) LQ is 4th from left which is 53 (ii) UQ is 4th from right which is 77
(iii) $\therefore$ IQR = 24

Answer 2

31 43 45 46 49 50 54 55 58 62 63 63 66 66 68 73 75 92 100

19 items of data $\Rightarrow \frac{19 + 1}{4} = 5$

LQ is 5th from left which is 49 and UQ is 5th from right which is 68
 $\therefore$ IQR = 19

Answer 3

73 44 67 64 63 45 45

- (i) Data in order : 44 45 45 63 64 67 73

- (ii) 7 items of data $\Rightarrow \frac{7 + 1}{4} = 2$

LQ is 2nd from left which is 45 and UQ is 2nd from right which is 67.
 $\therefore$ IQR = 22.

Answer 4

IGCSE (London) Examination Question : 6th November 2006.

2 1 2 5 5 6 9 2 5 6 7 5 6 5 6

Data in order becomes;

1 2 2 2 5 5 5 5 5 6 6 6 6 7 9

15 items of data $\Rightarrow \frac{15 + 1}{4} = 4$

LQ is 4th from left which is 2 and UQ is 4th from right which is 6
 $\therefore$ IQR = 4

Answer 5

123 89 112 105 74 118 96 101 93
 Data in order becomes;
 74 89 93 96 101 105 112 118 123

$$9 \text{ items of data} \Rightarrow \frac{9 + 1}{4} = 2.5$$

- (i) LQ is mean of 89 and 93 which is 91
 (ii) UQ is mean of 118 and 112 which is 115
 (iii) $\therefore$ IQR = 24

Answer 6

SENTENCE A : *It is hypothesized that sentences containing substantial variation in word length are difficult to read.*

2 2 12 4 9 10 11 9 2 4 6 3 9 2 4

SENTENCE B : *Are these words extraordinarily easy to read ?*

3 5 5 15 4 2 4

- (a) Range of sentence A is $12 - 2 = 10$
 (b) Range of sentence B is $15 - 2 = 13$
 (c) Sentence B is predicted by the range to be harder to read.

(d) Sentence A data in order is;

2 2 2 2 3 4 4 4 6 9 9 9 10 11 12

$$15 \text{ items of data} \Rightarrow \frac{15 + 1}{4} = 4$$

LQ is 4th item from left which is 2 and UQ is 4th item from right which is 9
 $\therefore$ IQR = 7

(e) Sentence B data in order is;

2 3 4 4 5 5 15

$$7 \text{ items of data} \Rightarrow \frac{7 + 1}{4} = 2$$

LQ is 2nd item from the left which is 3 and UQ is 2nd item from the right which is 5
 $\therefore$ IQR = 2

- (f) Sentence A is predicted by the IQR to be harder to read.
 (g) Number of words in sentence.
 Average (mean) word length.
 Grammatical structure of sentence.
 If words are technical, or scientific or otherwise specialist in some way.

Lesson 3

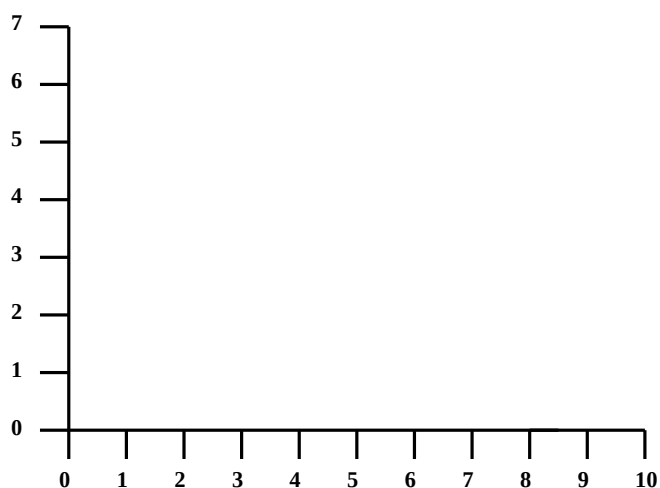
GCSE Mathematics Statistics II : Handelling and Processing Data

3.1 Stepper Graphs

A group of 7 people is given a short ten question test.
Here are the marks scored.

Group A data: 2 4 5 5 6 8 10

We can make a stepper graph of this data.

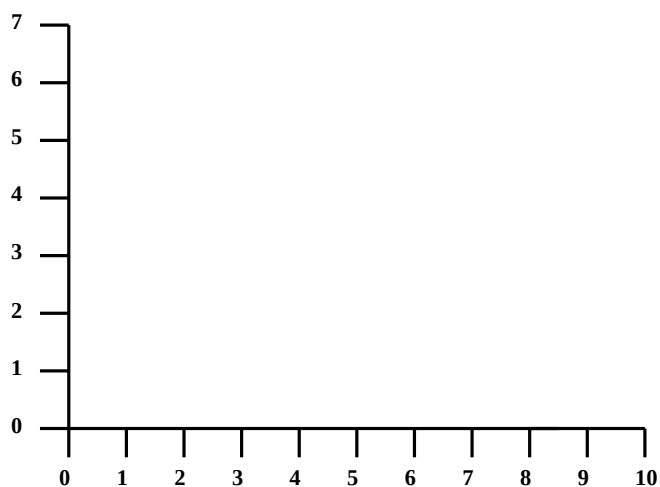


3.2 Exercise

Question 1

Make a stepper graph of the following data.

Group B data: 3 4 4 5 5 5 7



Question 2

- (a) Work out the IQR for the group A data.

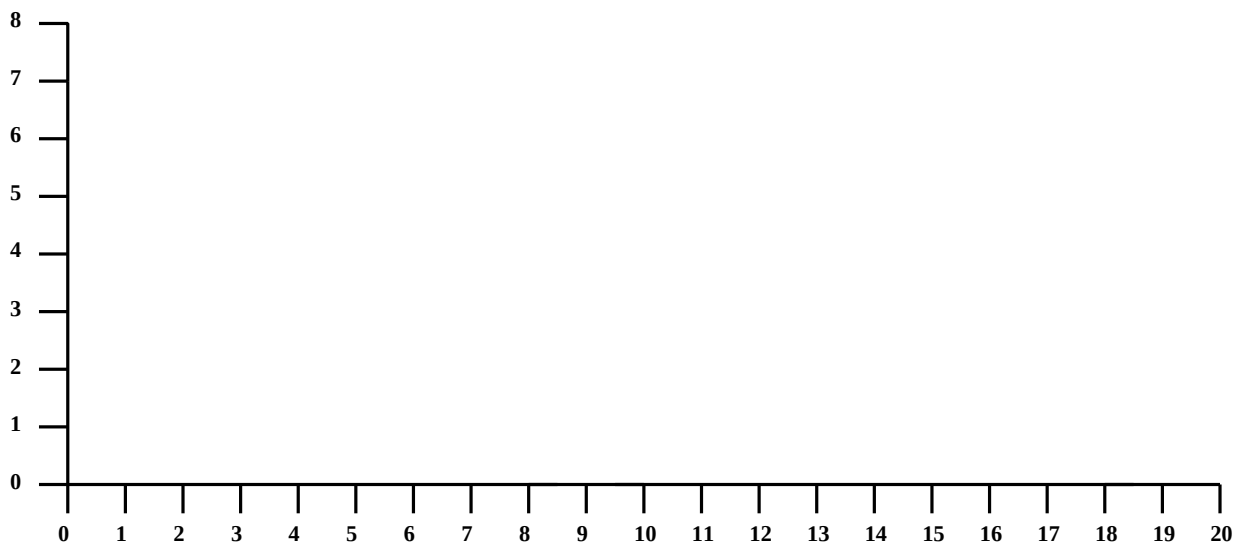
- (b) Work out the IQR for the group B data.

- (c) Use your part (a) and (b) answers to state which group has the **less** spread out data ?

- (d) How could you have spotted which group has the less spread out data from the two stepper graphs ?

Question 3

Make a stepper graph that shows where the prime numbers between 1 and 20 occur.



Several famous mathematicians have worked on the problem of trying to find a smooth line approximate formula for the prime number stepper graph.

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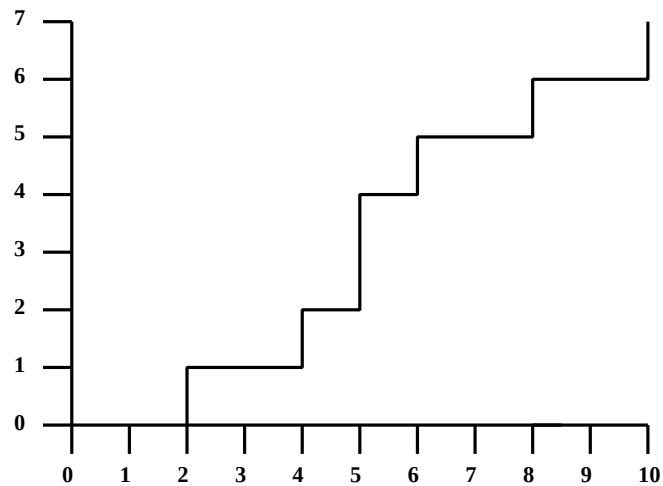
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3.3 Answers

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3.3.1 Solutions (Introduction)

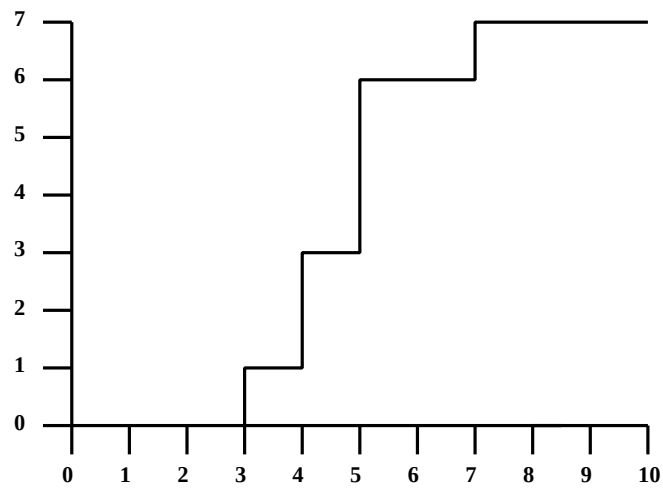
Group A data: 2 4 5 5 6 8 10



3.3.2 Solutions (Exercise)

Answer 1

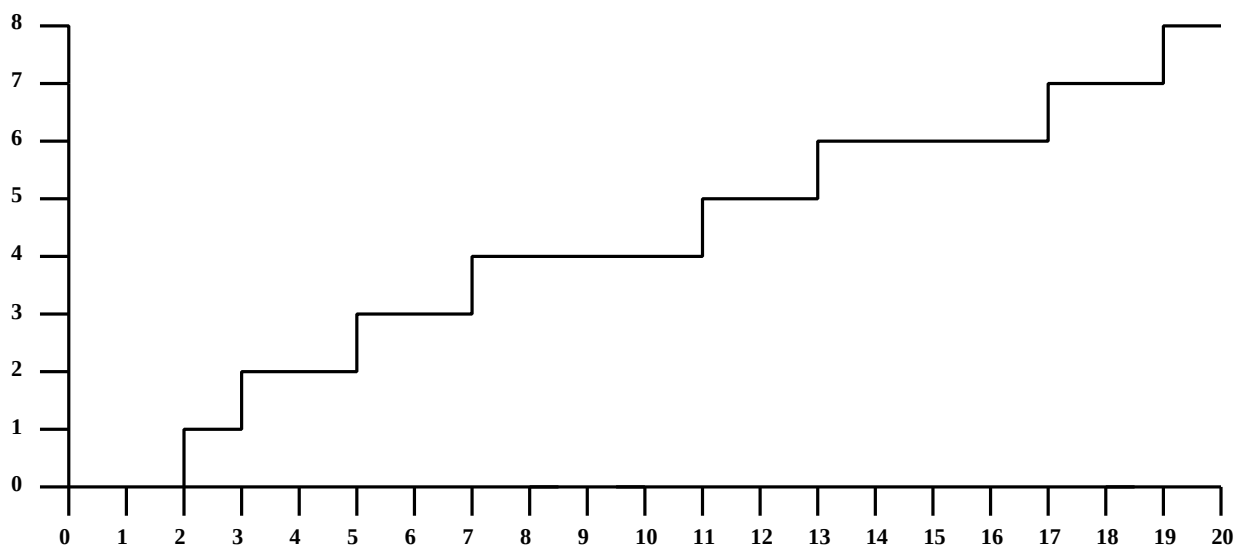
Group B data: 3 4 4 5 5 5 7



Answer 2

- (a) $IQR = 8 - 4 = 4$
- (b) $IQR = 5 - 4 = 1$
- (c) Group B data is the **less** spread out.
- (d) Group B graph is steeply climbing.

Answer 3



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Lesson 4

GCSE Mathematics Statistics II : Handelling and Processing Data

4.1 Box and whisker diagrams

Here are the English test percentage marks of 31 pupils

57	72	63	58	57	20	37	45	28
42	51	48	35	64	55	23	59	46
54	50	56	63	60	37	47	74	67
58	54	36	65					

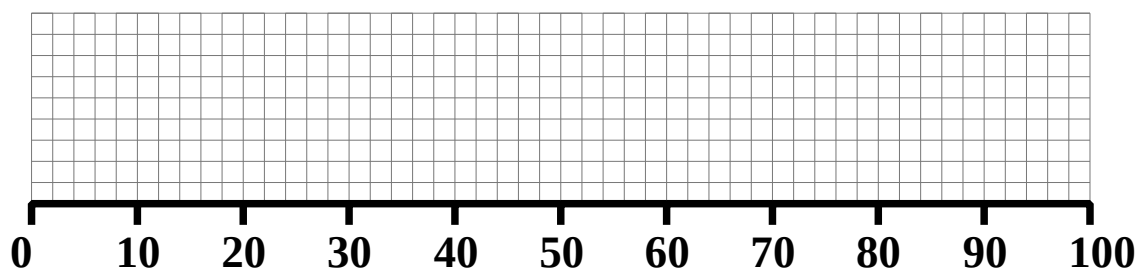
Suppose it was wished to work out the interquartile range. An immediate problem in doing so is the fact that the data is not in order. Rather than try to order the data by hand, it could be entered into a computer. Using a spreadsheet (such as Excel) ordering it is then easy.

Here is the same data, in order.

20	23	28	35	36	37	37	42	45
46	47	48	50	51	54	54	55	56
57	57	58	58	59	60	63	63	64
65	67	72	74					

4.2 Example

From the ordered English test data, work out the lower and upper quartiles, and the median. Hence plot a box and whisker diagram.



4.3 Exercise

Question 1

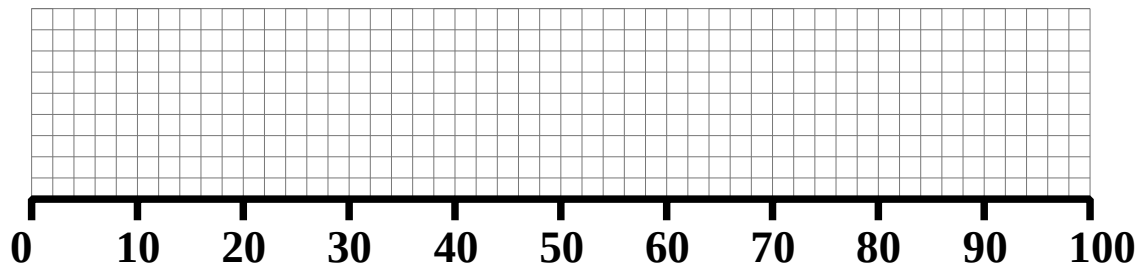
A supermarket knows the age of each person who pays for their shopping using a loyalty card. They are interested in the 'age profile' of their customers.

The data reveals that the lowest age was 18 (persons below that age cannot own a loyalty card) and the highest was 98.

The lower quartile was 30 and the upper quartile was 68.

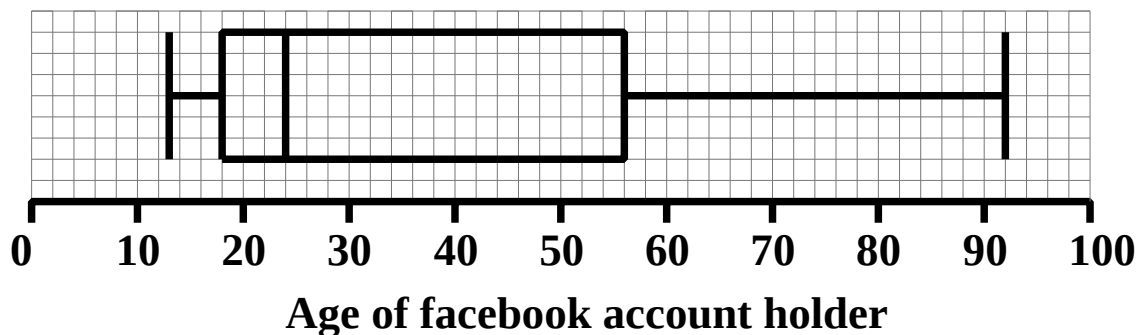
The median age of the shoppers was 44.

Plot a box and whisker diagram to show this information.



Question 2

The box and whisker diagram below shows the age profile of all persons with a facebook account. (Note: you must be 13 or over to have such an account)



- State
- (i) the lower quartile
 - (ii) the upper quartile
 - (iii) the interquartile rage
 - (iv) the median age

The data is skewed: What do you think this might mean ?

Question 3

In a 100 metre sprint the running time (in seconds) of 23 runners was as follows.

15.8	14.2	15.7	15.3	17.0	15.2	12.9	13.8	15.7
16.1	17.6	16.4	12.9	13.4	13.6	14.8	14.6	14.1
16.4	15.7	13.4	14.4	15.2				

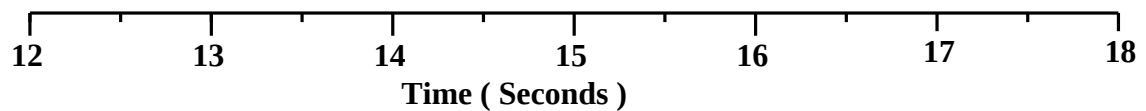
- (a) Put the data in order.
Take care to get this correct and try to get a methodical system going.

- (b) Calculate the lower quartile.

- (c) Calculate the upper quartile.

- (d) Calculate the median.

- (e) Plot a box and whisker diagram of the data.



- (f) What is the interquartile range for this data ?

Question 4

Over the course of a lucky year, Lucy finds the following lucky seven coins simply sitting on the ground.

20p 50p £1 50p £2 20p 20p

Find the median of her lucky finds.

Question 5

Mr Hansen asked his lower sixth mathematics set how much pocket money they received each week.

Here are the thirteen replies;

£20 £10 £200 £25 £20 £10 £50
£20 £30 £30 £45 £20 £40

- (a) Arrange the data in order.
- (b) What is the median of the data ?
- (c) If each week, all the pocket money was put in one pile and then each of the thirteen pupils took an equal amount, (until the pile was empty) how much would each pupil get each week ?

This is called the **mean** value of the data.

- (d) Both the **median** and the **mean** can be said to be “the average”. Which of these two averages is the statistic that best represents the “average pocket money received per week” ? Explain your choice.

- (e) There is a third type of average called the mode. This is the value which occurs most often in the data. What is the mode of the pocket money data ?

Question 6

In a mathematics test the percentage marks of 31 pupils is as follows:

44	72	31	93	68	56	85	47	53
74	59	12	66	25	46	54	37	03
62	83	37	23	36	76	56	91	27
34	52	85	14					

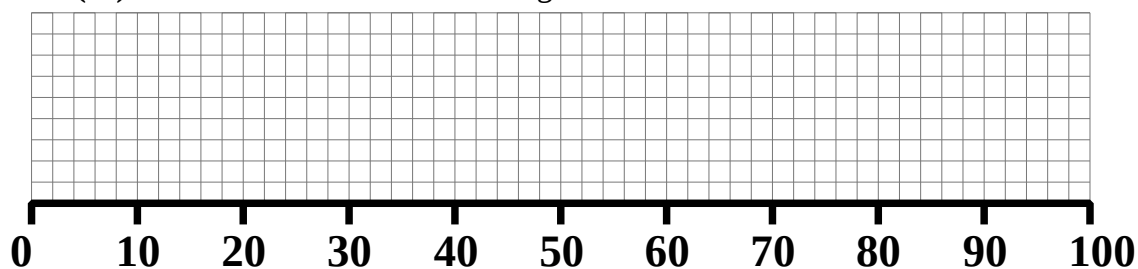
- (a) Put the data in order.
Take care to get this correct and try to get a methodical system going.

- (b) Calculate the lower quartile.

- (c) Calculate the upper quartile.

- (d) Calculate the median.

- (e) Plot a box and whisker diagram of the data.



- (f) What is the interquartile range for this data ?

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4.4 Answers

GCSE Mathematics Statistics II : Handelling and Processing Data

4.4.1 Solution (Example)

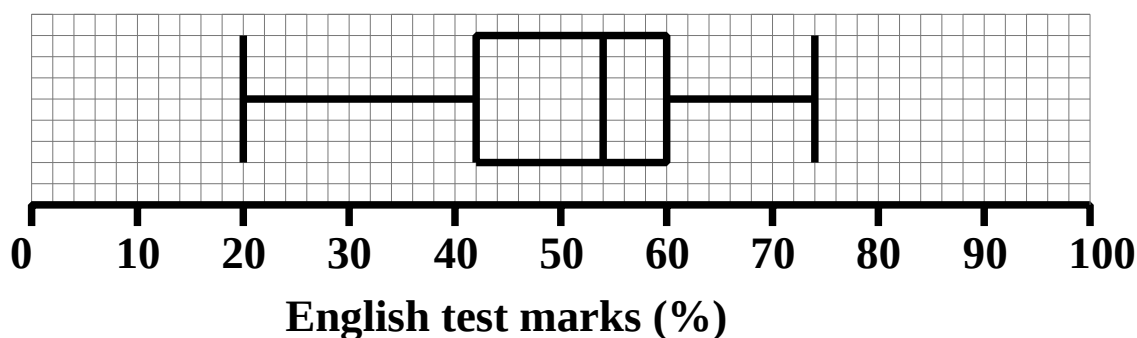
$$31 \text{ items of data} \Rightarrow \frac{31 + 1}{4} = 8$$

LQ is 8th item from left which is 42

Median is $2 \times 8 = 16$ th item from either end which is 54

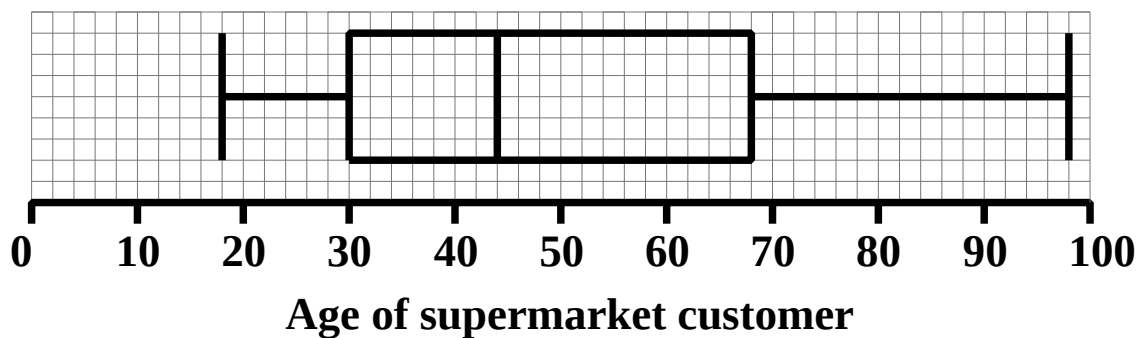
UQ is 8th item from right which is 60

$\therefore \text{IQR} = 18$



4.4.2 Solution (Exercise)

Answer 1



Answer 2

- (i) LQ is 18
- (ii) UQ is 56
- (iii) $\therefore \text{IQR is } 38$
- (iv) median is 24

Skewed: lots of younger people have facebook accounts.

Answer 3

(a) Data in order is

12.9	12.9	13.4	13.4	13.6	13.8	14.1	14.2	14.4
14.6	14.8	15.2	15.2	15.3	15.7	15.7	15.7	15.8
16.1	16.4	16.4	17.0	17.6				

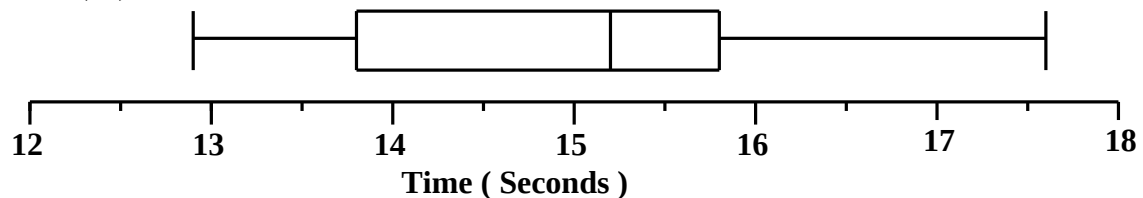
$$23 \text{ items of data} \Rightarrow \frac{23 + 1}{4} = 6$$

(b) LQ is 6th from left which is 13.8s

(c) UQ is 6th from right which is 15.8s

(d) Median is $2 \times 6 = 12$ th from either end which is 15.2s

(e)



(f) IQR = 2s

Answer 4

Data in order is

20p	20p	20p	50p	50p	£1	£2
-----	-----	-----	-----	-----	----	----

$$7 \text{ items of data} \Rightarrow \frac{7 + 1}{2} = 4$$

Median is 4th item from either end which is 50p.

Answer 5

(a) The data when put in order is,

£10	£10	£20	£20	£20	£20	£25
£30	£30	£40	£45	£50	£200	

$$(b) \quad 13 \text{ items of data} \Rightarrow \frac{13 + 1}{2} = 7$$

Median is 7th item of data from either end which is £25.

$$(c) \quad \text{Total is } £520 \Rightarrow \frac{520}{13} = £40$$

(d) The median is £25. The mean is distorted by the one person getting £200

(e) The mode is £20

Answer 6

(a) Data in order is;

03	12	14	23	25	27	31	34	36
37	37	44	46	47	52	53	54	56
56	59	62	66	68	72	74	76	83
85	85	91	93					

$$31 \text{ items of data} \Rightarrow \frac{31 + 1}{4} = 8$$

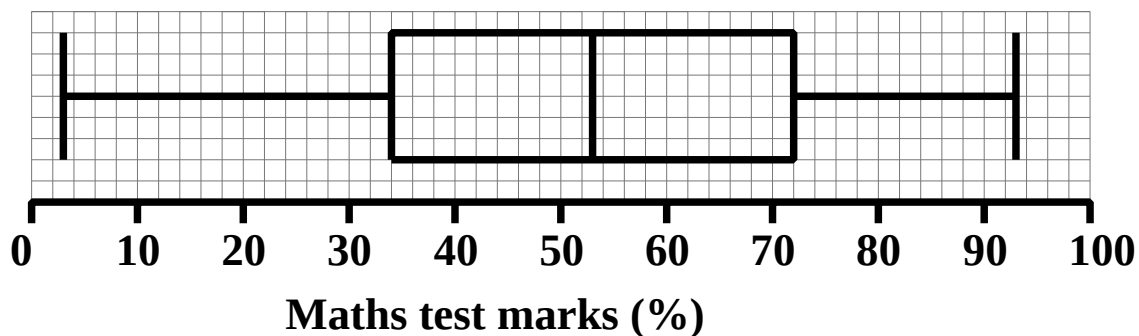
(b) LQ is 8th item from left which is 34

(c) UQ is 8th item from right which is 72

(d) Median is $2 \times 8 = 16$ th item from either end which is 53

(IQR = 38)

(e) Box and whisker diagram of the data.



Lesson 5

GCSE Mathematics

Statistics II : Handelling and Processing Data

5.1 Interquartile Range from Tabled Data

As the quantity of data increases it become impractical to work with it in a list where each individual item is listed separately. Instead, it is placed into a table.

5.2 Example

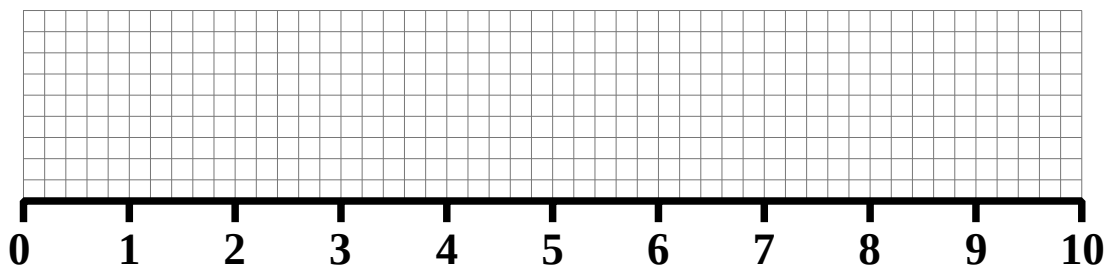
The table shows the scores of 99 pupils in a ten mark mental arithmetic test.

Score	Frequency	Cumulative Frequency
0	1	
1	0	
2	0	
3	6	
4	9	
5	11	
6	17	
7	21	
8	16	
9	11	
10	7	

- (i) Complete the column in the table headed Cumulative Frequency.
- (ii) Remembering to “add 1 and divide by 4” work out the IQR.

(iii) Determine the median score of the 99 pupils.

(iv) Plot a box and whisker diagram of the data.
Mark the outlier with an isolated cross, $\times$, and take the lowest score to be that with the outlier removed.



5.3 Exercise

Question 1

The table shows the scores of 183 contestants on *Mastermind*

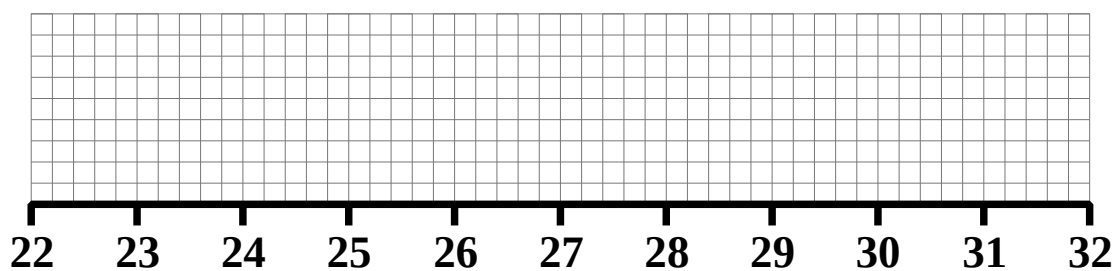
Score	Frequency	Cumulative Frequency
22	2	
23	15	
24	29	
25	32	
26	41	
27	31	
28	17	
29	11	
30	4	
31	0	
32	1	

(i) Complete the column in the table headed Cumulative Frequency.

- (ii) Remembering to “add 1 and divide by 4” work out the IQR of the *Mastermind* contestant's scores.

- (iii) Determine the median score of the 183 mastermind contestants.

- (iv) Plot a box and whisker diagram of the data.
Mark the outlier with an isolated cross, $\times$, and take the highest score to be that with the outlier removed.



Question 2

Shoe sizes in a class of 19 pupils.

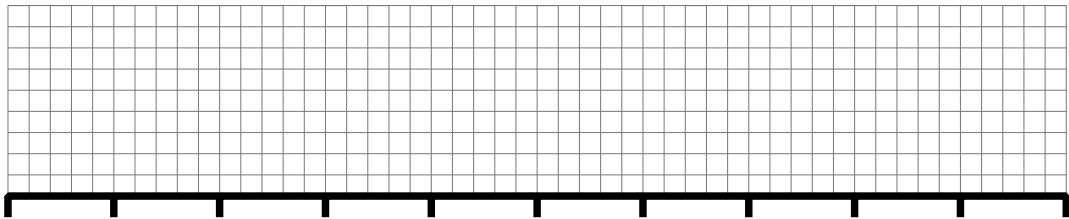
7 5½ 9½ 5½ 7½ 7 6 8 7 6½
6½ 7½ 5 6½ 6 5½ 7 5½ 6

(i) Put this data into the following table

Shoe Size	Tally	Frequency	Cumulative Frequency
4			
4½			
5			
5½			
6			
6½			
7			
7½			
8			
8½			
9			
9½			
10			

(ii) What is the IQR and median of this data ?
Show your working.

(iv) Plot a box and whisker diagram of the data by first labelling the x-axis.
Mark the outlier with an isolated cross, ×, and take the highest shoe size
to be that with the outlier removed.



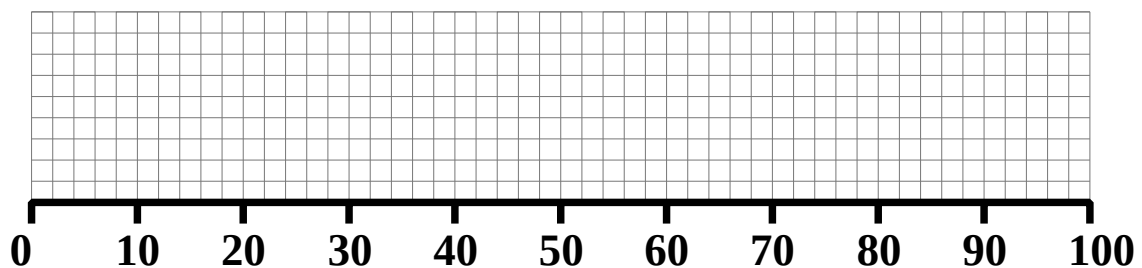
Question 3

In a 20 question test multiple choice test, each question is worth 5%.

A group of 115 pupils take the test and the results are tabulated below.

Test Score (%)	Frequency
50	5
55	9
60	14
65	29
70	21
75	11
80	10
85	9
90	6
95	0
100	1

- (i) Which percentage score was achieved by the greatest number of candidates ?
And what is this statistic called ?
- (ii) What is the range of the data ?
- (iii) Determine the lower quartile, upper quartile and median of the scores.
TOP TIP : Add a column for Cumulative Frequency.
- (iv) Plot a box and whisker diagram for the data.
Take the single score of 100% to be the only outlier.



5.4 Answers

GCSE Mathematics Statistics II : Handelling and Processing Data

5.4.1 Solution (Example)

(i)

Score	Frequency	Cumulative Frequency
0	1	1
1	0	1
2	0	1
3	6	7
4	9	16
5	11	27
6	17	44
7	21	65
8	16	81
9	11	92
10	7	99

The Cumulative Frequency is the running total of the number of pupils accounted for so far at the **END** of each interval.

If may help students understand what the table is telling them by starting to write out the data in a list....

0 3 3 3 3 3 3 4 4 4
 4 4 4 4 4 4 5 5 5 5
 5 5 5 5 5 5 5 6

* ^ *

(ii) As there are 99 items of data;

$$\frac{99 + 1}{4} = 25$$

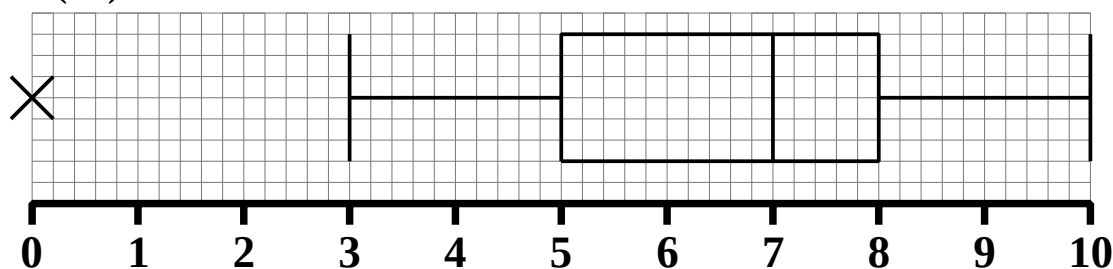
The lower quartile is the 25th item in the list which is a score of 5

The upper quartile is the 75th item in the list which is a score of 8

∴ IQR = 3.

(iii) Median is the 50th item in the list which is a score of 7

(iv)



5.4.1 Solution (Exercise)

Answer 1

(i)

Score	Frequency	Cumulative Frequency
22	2	2
23	15	17
24	29	46
25	32	78
26	41	119
27	31	150
28	17	167
29	11	178
30	4	182
31	0	182
32	1	183

(ii) As there are 183 items of data;

$$\frac{183 + 1}{4} = 46$$

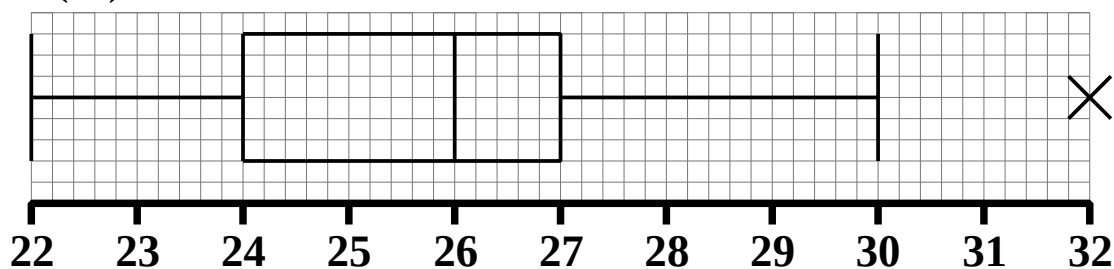
The lower quartile is the 46th item in the list which is a score of 24

The upper quartile is the 138th item in the list which is a score of 27

$\therefore \text{IQR} = 3$

(iii) Median is the 92nd item in the list which is a score of 26

(iv)

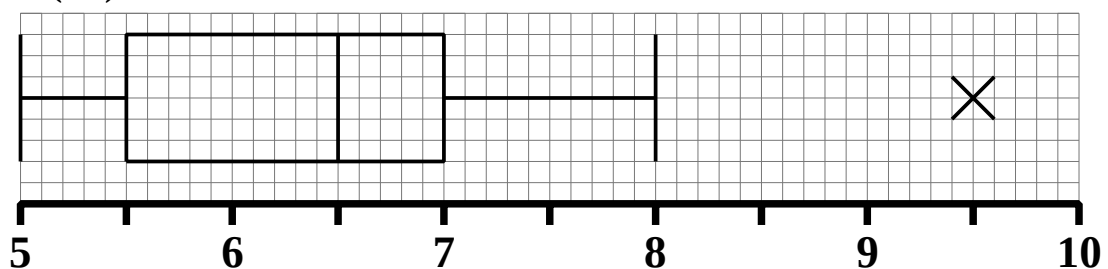


Answer 2**(i)**

Shoe Size	Tally	Frequency	Cumulative Frequency
4		0	0
4½		0	0
5		1	1
5½		4	5
6		3	8
6½		3	11
7		4	15
7½		2	17
8		1	18
8½		0	18
9		0	18
9½		1	19
10		0	19

(ii) As there are 19 items of data;

$$\frac{19 + 1}{4} = 5$$

The lower quartile is the 5th item in the list which is a score of 5½The upper quartile is the 15th item in the list which is a score of 7 $\therefore \text{IQR} = 1\frac{1}{2}$ Median is the 10th item in the list which is a score of 6½**(iii)**

Answer 3

(i) 65% is the mode

(ii) Range is 50%

(iii)

Test Score (%)	Frequency	Cumulative Frequency
50	5	5
55	9	14
60	14	28
65	29	57
70	21	78
75	11	89
80	10	99
85	9	108
90	6	114
95	0	114
100	1	115

As there are 115 items of data;

$$\frac{115 + 1}{4} = 29$$

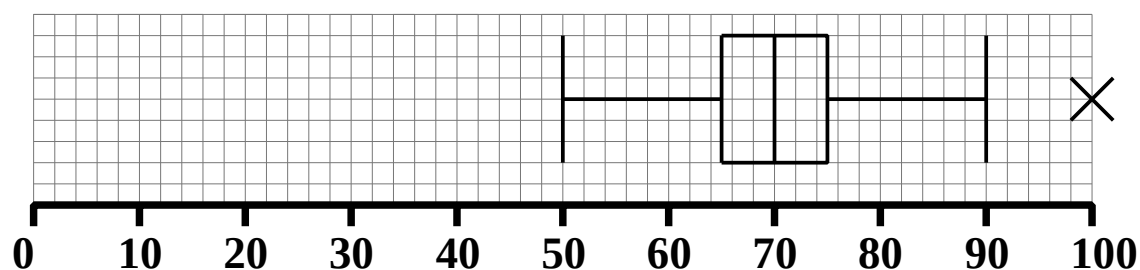
The lower quartile is the 29th item in the list which is a score of 65%

The upper quartile is the 87th item in the list which is a score of 75%

∴ IQR = 10%

Median is the 58th item in the list which is a score of 70%

(iv)



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Lesson 6

GCSE Mathematics Statistics II : Handelling and Processing Data

6.1 The Mean from Tabled Data

Question

GCSE Examination Question from May 2013, Paper 3H Q1

The table shows information about the mark scored on an examination question by each of 40 students.

Mark	Number of students
0	13
1	2
2	3
3	8
4	14

Work out the mean mark.

[3 marks]

Answer

It's important that it is understood what the table is saying.

It's a summary of the following list of data...

0 0 0 0 0 0 0 0 0 0
0 0 0 1 1 2 2 2 3 3
3 3 3 3 3 3 4 4 4 4
4 4 4 4 4 4 4 4 4 4

Thus, we add up all the numbers in this list and dividing by the number of numbers.

But writing out the list like this is tedious.

There is a more succinct way of obtaining the mean, that avoids writing out the list.

Mark	Number of students
0	13
1	2
2	3
3	8
4	14

So, the mean mark is :

6.2 Exercise

Question 1

GCSE Examination Question from January 2014, Paper 4H Q4

The table shows information about the number of goals scored by a football team in 30 matches.

Number of goals scored	Frequency
0	2
1	10
2	7
3	6
4	3
5	2

Work the mean number of goals scored.

[3 marks]

Question 2

GCSE Examination Question from January 2013, Paper 4H Q3

The table shows information about the marks of 20 students in a science test.

Mark	Frequency
6	2
7	4
8	5
9	8
10	1

Work the mean number of marks scored.

[3 marks]

Question 3

GCSE Examination Question from May 2014, Paper 4H Q10

The table shows information about the times, in minutes, taken by 50 people to get to work.

Time taken (t minutes)	Frequency
$0 < t \leq 10$	6
$10 < t \leq 20$	10
$20 < t \leq 30$	19
$30 < t \leq 40$	15

Work out an estimate for the mean time taken to get to work.

HINT : Use mid-interval times.

e.g. mid-interval of $0 < t \leq 10$ is 5

[4 marks]

Question 4

GCSE Examination Question from November 2006, Paper 3H Q4(b)

The table shows information about the ages of the students in a school.

Age, x years	Frequency
$9 \leq x < 11$	30
$11 \leq x < 13$	12
$13 \leq x < 15$	18
$15 \leq x < 19$	60

Calculate an estimate of the mean age of these students.

Give your answer correct to 3 significant figures.

[6 marks]

Question 5

GCSE Examination Question from May 2013, Paper 4H Q12

The table shows information about the amount of money, in dollars, spent in a shop in one day by 80 people.

money spent, x dollars	Frequency
$0 < x \leq 20$	24
$20 < x \leq 40$	20
$40 < x \leq 60$	9
$60 < x \leq 80$	12
$80 < x \leq 100$	15

Work out an estimate for the total amount of money spent in the shop that day.

NOTICE : You are **NOT** asked to work out the mean.

[3 marks]

Question 6

GCSE Examination Question from January 2012, Paper 3H Q7.

The table shows information about the numbers of text messages sent by 40 teenagers in one day.

Number of text messages	Number of teenagers	Mid-interval value
0 to 2	3	1
3 to 5	6	4
6 to 8	10	
9 to 11	15	
12 to 14	5	
15 to 17	1	

(a) Write down the modal class.

[1 mark]

(b) (i) Work out an estimate for the mean number of texts sent by the 40 teenagers in one day.

(ii) Explain why your answer to part (b) (i) is an estimate.

[5 marks]

Question 7

The number of commendations awarded to each Year 9 pupil in a week at Shrewsbury School is given in the table below.

Number of Commendations	Number of Pupils	Mid-interval value
$0 \leq x \leq 8$	60	4
$9 \leq x \leq 15$	30	12
$16 \leq x \leq 26$	18	
$27 \leq x \leq 45$	12	

Calculate an estimate of the mean number of commendations received by a pupil.

Give your answer correct to 3 significant figures.

6.3 Homework : Mean, Median, Mode

GCSE Mathematics

Statistics II : Handelling and Processing Data

Question 1

A researcher is investigating how old a group of alcoholics were when they first started to 'significantly' drink. The researcher tabulates her findings as follows:

Age	Frequency	
8	1	
9	2	
10	2	
11	6	
12	7	
13	4	
14	3	
15	1	
16	1	

- (a) Write out all the data as a list.
The list starts like this...

8 9 9 10 10 11 11 11 11 11
11 12 12 12 12 12 12 12 13 13
13 13

- (b) Work out the mean to one decimal place.

- (c) Work out the median.

- (d) Write down the mode.

Question 2

Six sweet pea seeds were planted in each of fifty plant pots.

After a few weeks the number of seedlings in each pot was counted and the results are given in the following table.

Number of seedlings	1	2	3	4	5	6
Frequency	4	2	8	7	20	9

Showing your working, calculate the mean number of seedlings that have germinated per plant pot.

Question 3

Twenty children were asked how they rated their English teacher.

Here are the results:

*** ** ** **** * *** ** *****
***** **** ** ** ***** *** *** *****
*** ** *** ***

Number of stars	*	**	***	****	*****
Frequency					

(a) Fill in the frequency row of the table.

(b) Showing your working, calculate the average (mean) star rating of the English teacher.

Question 4

Find the mean, median, mode(s) of the following sets of numbers

SET A

10 8 2 10 12 8 6

SET B

3 6 2 5 9 2 4

SET C

10 8 10 16 7 9 10 8 9

SET D

13 16 12 14 19 12 14 13

SET E

4 3 4 5 2 5 4 3

Question 5

GCSE Examination Question from May 2007, Paper 4H Q13

Here are the marks scored in a maths test by the students in two classes.

Class A	2	13	15	16	4	6	19	10
	11	4	5	15	4	16	6	
Class B	12	11	2	5	19	14	6	6
	10	14	9					

- (a) Work out the interquartile range of the marks for each class.

Class A _____

Class B _____

[4 marks]

- (b) Use your answers to give one comparison between the marks of Class A and the marks of Class B.

[1 mark]

Question 6

The following table shows the number of letters that come through my letter box on twenty-five consecutive days.

Number of letters	0	1	2	3	4	5
Number of days	6	7	6	4	1	1

What is the median number of letters through my letter box per day ?

Question 7

GCSE Examination Question from June 2011, Paper 4H Q7.

Six numbers have a mean of 5.

Five of the numbers are

3 2 7 6 2

The other number is x .

Work out the value of x .

[3 marks]

Question 8

GCSE Examination Question from May 2006, Paper 4H Q7.

- (a) Four numbers have a mean of 6.
 Three of the numbers are 3, 7 and 10
 Find the other number.

[2 marks]

- (b) Three numbers have a mode of 5 and a mean of 6.
 Find the three numbers.

[2 marks]

- (c) Find four numbers which have a mode of 7 and a median of 6

[2 marks]

Question 9

GCSE Examination Question from November 2010, Paper 3H Q9

- (a) Three positive whole numbers are all different.
They have a median of 5 and a mean of 4
Find the three numbers

[2 marks]

- (b) Find four whole numbers which have a mode of 5 and
a median of 6.

[2 marks]

Question 10

The time taken to travel to Liverpool from Shrewsbury of six different occasions
were as follows

1 hr 20 min	1 hr 30 min	1 hr 45 min
2 hr 10 min	1 hr 15 min	2 hr 00 min

- (a) Rewrite this data with all of the times converted into minutes.
- (b) Using your converted data, calculate the mean (average) time
of a journey in minutes.
- (c) Convert your part (b) answer to give the mean time in hours and minutes.

6.4 Answers

GCSE Mathematics

Statistics II : Handelling and Processing Data

6.4.1 Solutions (Introductionary Question)

$$\begin{aligned} \text{mean} &= \frac{(13 \times 0) + (2 \times 1) + (3 \times 2) + (8 \times 3) + (14 \times 4)}{40} \\ &= \frac{0 + 2 + 6 + 24 + 56}{40} \\ &= \frac{88}{40} \\ &= 2.2 \end{aligned}$$

6.4.2 Solutions (6.2 Exercise)

Answer 1

$$\begin{aligned} \text{mean} &= \frac{(2 \times 0) + (10 \times 1) + (7 \times 2) + (6 \times 3) + (3 \times 4) + (2 \times 5)}{30} \\ &= \frac{0 + 10 + 14 + 18 + 12 + 10}{30} \\ &= \frac{64}{30} \\ &= 2.13 \end{aligned}$$

Answer 2

$$\begin{aligned} \text{mean} &= \frac{(2 \times 6) + (4 \times 7) + (5 \times 8) + (8 \times 9) + (1 \times 10)}{20} \\ &= \frac{12 + 28 + 40 + 72 + 10}{20} \\ &= \frac{162}{20} \\ &= 8.1 \end{aligned}$$

Answer 3

$$\begin{aligned} \text{mean} &= \frac{(6 \times 5) + (10 \times 15) + (19 \times 25) + (15 \times 35)}{50} \\ &= \frac{30 + 150 + 475 + 525}{50} \\ &= \frac{1180}{50} \\ &= 23.6 \end{aligned}$$

Answer 4

Number of students is $30 + 12 + 18 + 60 = 120$

$$\begin{aligned} \text{mean} &= \frac{(30 \times 10) + (12 \times 12) + (18 \times 14) + (60 \times 17)}{120} \\ &= \frac{300 + 144 + 252 + 1020}{120} = \frac{1716}{120} = 14.3 \end{aligned}$$

Answer 5

$$\begin{aligned} \text{spend} &= (24 \times 10) + (20 \times 30) + (9 \times 50) + (12 \times 70) + (15 \times 90) \\ &= 240 + 600 + 450 + 840 + 1350 = \$ 3480 \end{aligned}$$

Answer 6

Number of text messages	Number of teenagers	Mid-interval value	Contribution to the total
0 to 2	3	1	3
3 to 5	6	4	24
6 to 8	10	7	70
9 to 11	15	10	150
12 to 14	5	13	65
15 to 17	1	16	16
Total :			328

(a) 9 to 11

(b) (i) 8.2 texts/pupil

(ii) 10 texts in 6 to 8 interval could all have been 6 texts, for example.
I assumed they were all 7 texts.

Answer 7

Number of Commendations	Number of Pupils	Mid-interval value	Contribution to the total
$0 \leq x \leq 8$	60	4	240
$9 \leq x \leq 15$	30	12	360
$16 \leq x \leq 26$	18	21	378
$27 \leq x \leq 45$	12	36	432
Total :			1410

$$\text{mean} = \frac{1410}{120} = 11.75 \text{ commendations/pupil}$$

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6.4.3 Solutions (6.3 Homework : Mean, Median, Mode)

GCSE Mathematics Statistics II : Handelling and Processing Data

Answer 1

(a) Data in order is...

8	9	9	10	10	11	11	11	11	11
11	12	12	12	12	12	12	12	13	13
13	13	14	14	14	15	16			

(b) Mean = $\frac{321}{27} = 11.9$ years old

(c) Median is $\frac{27 + 1}{2} = 14^{\text{th}}$ item of data which is one of the 12 year olds

(d) Mode is 12 years old

Answer 2

Number of seedlings	1	2	3	4	5	6
Frequency	4	2	8	7	20	9
Contribution to total	4	4	24	28	100	54

mean is $\frac{214}{50} = 4.28$ That is, 4.3 seedlings

Answer 3

Number of stars	*	**	***	****	*****
Frequency	1	6	8	3	2
Contribution to total	1	12	24	12	10

mean is $\frac{59}{20} = 2.95$ That is, 3.0 stars

Answer 4**SET A (In order)**

2 6 8 8 10 10 12

mean = 8

median is $\frac{7 + 1}{2} = 4^{\text{th}}$ item of data which is 8

mode = 8, 10 (bimodal)

SET B (In order)

2 2 3 4 5 6 9

mean = 4.4

median is $\frac{7 + 1}{2} = 4^{\text{th}}$ item of data which is 4

mode = 2

SET C (In order)

7 8 8 9 9 10 10 10 16

mean = 9.7

median is $\frac{9 + 1}{2} = 5^{\text{th}}$ item of data which is 9

mode = 10

SET D (In order)

12 12 13 13 14 14 16 19

mean = 14.125 That is, 14.1

median is $\frac{8 + 1}{2} = 4.5^{\text{th}}$ item of data which is $\frac{13 + 14}{2} = 13.5$

mode = 12, 13, 14

SET E (In order)

2 3 3 4 4 4 5 5

mean = 3.75 That is, 3.8

median is $\frac{8 + 1}{2} = 4.5^{\text{th}}$ item of data which is $\frac{4 + 4}{2} = 4$

mode = 4

Answer 5

Class A : 2 4 4 4 5 6 6 10
 (in order) 11 13 15 15 16 16 19

Class B : 2 5 6 6 9 10 11 12
 (in order) 14 14 19

(a) Class A
 LQ is 4th item of data which is 4
 UQ is 12th item of data which is 15
 $\therefore$ IQR = 11

Class B
 LQ is 3rd item of data which is 6
 UQ is 9th item of data which is 14
 $\therefore$ IQR = 8

(b) Class A has marks that are more spread out than those in Class B.

Answer 6

Number of letters	0	1	2	3	4	5
Number of days	6	7	6	4	1	1

Median is $\frac{25 + 1}{2} = 13^{\text{th}}$ item of data which is a 1

Answer 7

$$\frac{3 + 2 + 7 + 6 + 2 + x}{6} = 5$$

$$\frac{20 + x}{6} = 5$$

$$20 + x = 30$$

$$x = 10$$

Answer 8

(a) 4

(b) 5 5 8

(c) x 5 7 7 where $x < 5$

Answer 9

- (a) 1 5 6
 (b) 5 5 7 x where $x > 7$

Answer 10

- (a) 80 min 90 min 105 min
 130 min 75 min 120 min

(b) Mean = $\frac{600}{6} = 100$ minutes

- (c) 1 hour 40 minutes

Lesson 7

GCSE Mathematics

Statistics II : Handelling and Processing Data

7.1 Is the data discrete or continuous ?

Some data, such as age, is discrete. (from a legal point of view),

For example, you are 17 until the day of your 18th birthday.
When you are “17 and a half”, you cannot argue that this rounds up to 18 and therefore you are allowed into a pub to drink and to buy cigarettes from a shop.

One day the law says you are 17. The next, your 18th birthday, you are 18.
There is no “in between” from the Law's point of view.

NOT always having an “in between” indicates that the data is DISCRETE.

Some data, such as a height or weight, always has an 'in between'.
In between 14 kg and 15 kg is, for example, 14.5 kg.
In between 14.6 kg and 14.7 kg is, for example, 14.65 kg.

ALWAYS having an “in between” indicates that the data is CONTINUOUS.

7.2 Grouped Frequency tables

Continuous data is often presented in a grouped frequency table.

7.2.1 Example

GCSE examination question from 7th November 2005, paper 4H

The table gives information about the heights of some plants.

Height, h cm	Frequency		
$0 < h \leq 5$	4		
$5 < h \leq 10$	6		
$10 < h \leq 15$	8		
$15 < h \leq 20$	2		

Calculate an estimate of the mean height.

7.3 Exercise

Question 1

Fifty boxes of peaches were examined and the number of bad peaches in each box recorded, with the following result;

Number of bad peaches	Frequency		
$0 \leq bp \leq 4$	34		
$5 \leq bp \leq 9$	11		
$10 \leq bp \leq 14$	4		
$15 \leq bp \leq 19$	1		

Estimate the mean number of bad peaches per box.

Question 2

In a draft copy of a 140 page story, the number of typin mistakes on each paige was recordad, with the followring result;

Number of typing mistakes	Frequency		
$0 \leq m \leq 2$	72		
$3 \leq m \leq 5$	58		
$6 \leq m \leq 8$	7		
$9 \leq m \leq 11$	3		

Estimate the mean number of typing mistakes per page.

Question 3

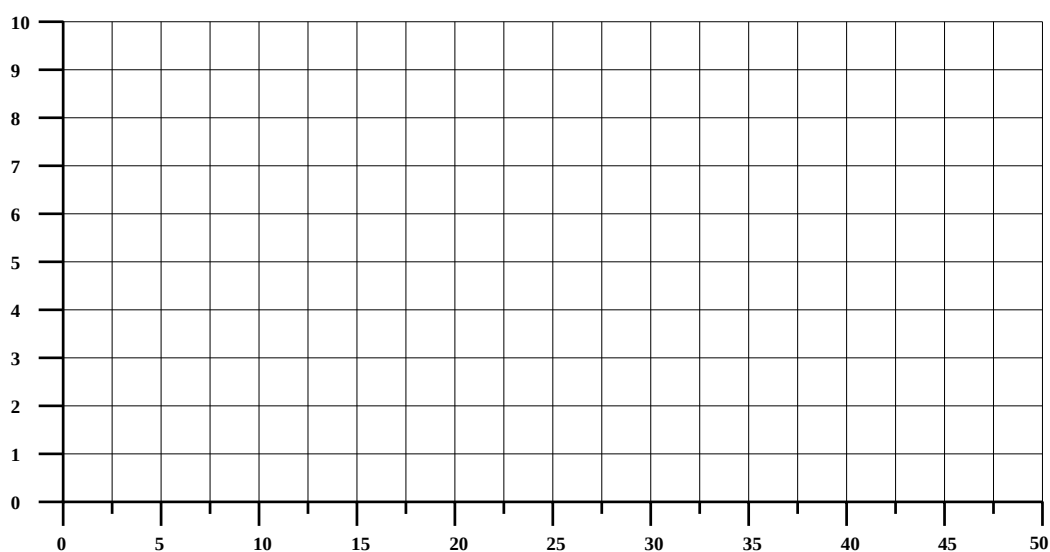
Twenty-four 14 year old pupils are asked to record how many hours they spend on a computer over a one week period. Here are the results;

28.5 26.25 24.0 18.25 28.75 36.0 12.75 27.5
23.75 16.0 19.5 26.25 32.25 28.5 29.75 34.0
15.25 24.25 27.25 18.5 8.5 34.5 32.0 22.5

(a) Transfer this data into the following grouped frequency table.

Number of hours	Tally	Frequency		
$5 \leq h < 10$				
$10 \leq h < 15$				
$15 \leq h < 20$				
$20 \leq h < 25$				
$25 \leq h < 30$				
$30 \leq h < 35$				
$35 \leq h < 40$				

(b) Plot a frequency polygon using the data in the table.
Label the axes, and add a title.



Question 4

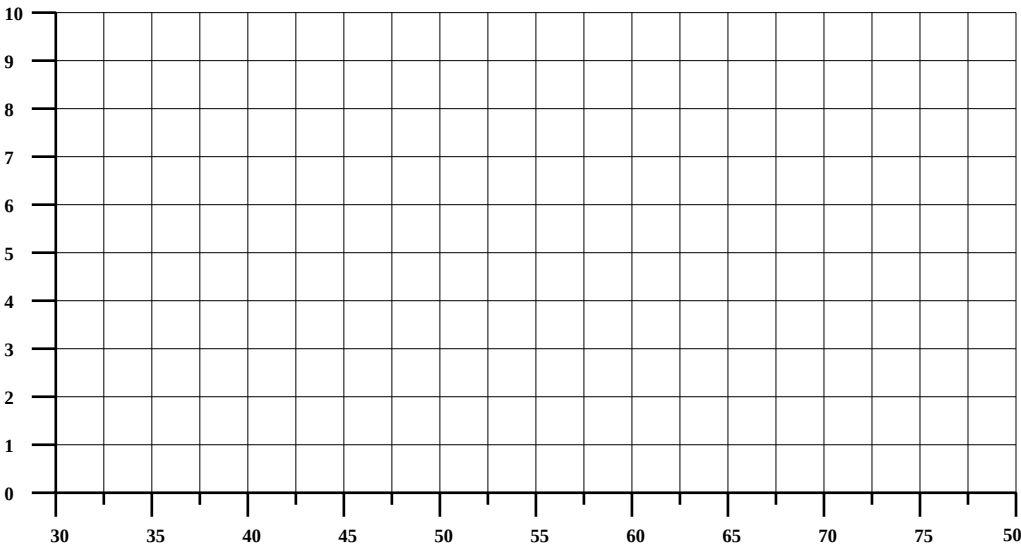
Here are the English test marks of 31 pupils

57	72	63	58	57	34	37	<u>45</u>	38
42	51	48	<u>35</u>	64	<u>55</u>	63	61	46
54	<u>50</u>	56	63	61	37	47	74	67
58	54	36	<u>65</u>					

- (a) Fill in the following table using the English marks data.
Take care over where you place the underlined data.

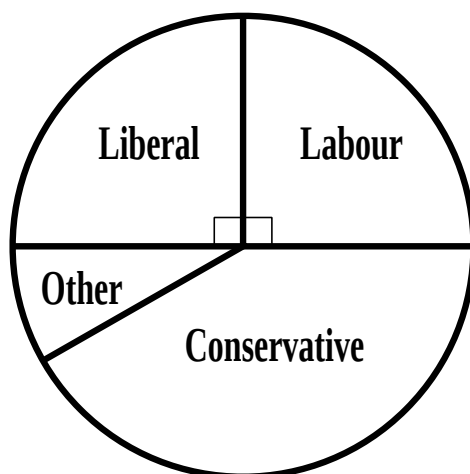
Mark	Tally	Frequency		
$30 < m \leq 35$				
$35 < m \leq 40$				
$40 < m \leq 45$				
$45 < m \leq 50$				
$50 < m \leq 55$				
$55 < m \leq 60$				
$60 < m \leq 65$				
$65 < m \leq 70$				
$70 < m \leq 75$				

- (b) Use the grouped frequency table to plot a frequency polygon to show the distribution of the marks from the English exam.
 Label the axes, and add a title.



Question 5

One hundred and eighty people are asked how they intend to vote at the next election. The responses are presented in the pie chart, shown below.



- (a) How many people said they would vote Labour ?

- (b) What *percentage* of people said they would vote Liberal ?

- (c) If seventy-two people said they would vote Conservative, how many said they would vote for “Other” ?

Question 6

Mr Minted invites private bids for the smallest of his many yachts. At the close of bidding the bids are revealed to be:

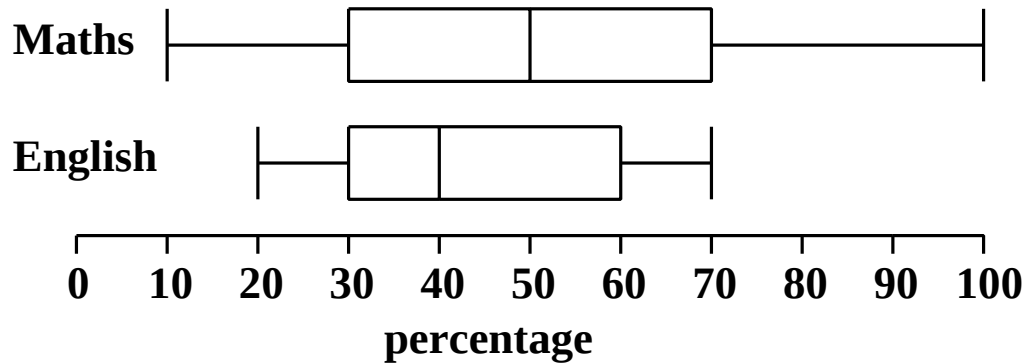
£8 000	£12 990	£2 000
£10 000	£2010	£7000

- (a) What is the mean amount of money bid ?

- (b) What is the median amount of money bid ?

Question 7

Here are two Box-and-Whisker diagrams which show the marks obtained by a class of pupils in a Maths and in an English test.



- (a) Is the median mark higher in Maths or English ?
- (b) What is the Inter Quartile Range of the
 - (i) Maths marks ?
 - (ii) English marks ?
- (c) What do your part (b) answers tell you about the two tests ?

Question 8

Buckie Thistle are a Scottish football club near to the city of Aberdeen.

The number of goals per match scored by Buckie Thistle in the Highland league last season are listed below.

1	3	1	1	2	1	3	5	0
0	1	6	2	0	1	2	0	1
2	1	3	2	4	6	3	5	2
5	2	3	3	1	0	1	2	4
4	1	4	2	1	2	0	6	5

(i) Complete the following frequency table.

Number of goals scored per match	Tally	Frequency
0		
1		
2		
3		
4		
5		
6		

(ii) Explaining your reasoning, determine the **median** number of goals scored per match.

Reasoning _____

Answer _____

7.4 Answers

GCSE Mathematics Statistics II : Handelling and Processing Data

7.4.1 Solutions (Example)

Height, h cm	Frequency	Mid Interval Value	Contribution to Total
$0 < h \leq 5$	4	2.5	10
$5 < h \leq 10$	6	7.5	45
$10 < h \leq 15$	8	12.5	100
$15 < h \leq 20$	2	17.5	35

$$mean = \frac{190}{20} = 9.5 \text{ cm}$$

7.4.2 Solutions (Exercise)

Answer 1

Number of bad peaches	Frequency	Mid Interval Value	Contribution to Total
$0 \leq bp \leq 4$	34	2	68
$5 \leq bp \leq 9$	11	7	77
$10 \leq bp \leq 14$	4	12	48
$15 \leq bp \leq 19$	1	17	17

$$mean = \frac{210}{50} = 4.2 \text{ bad peaches per box}$$

Answer 2

Number of typing mistakes	Frequency	Mid Interval Value	Contribution to Total
$0 \leq m \leq 2$	72	1	72
$3 \leq m \leq 5$	58	4	232
$6 \leq m \leq 8$	7	7	49
$9 \leq m \leq 11$	3	10	30

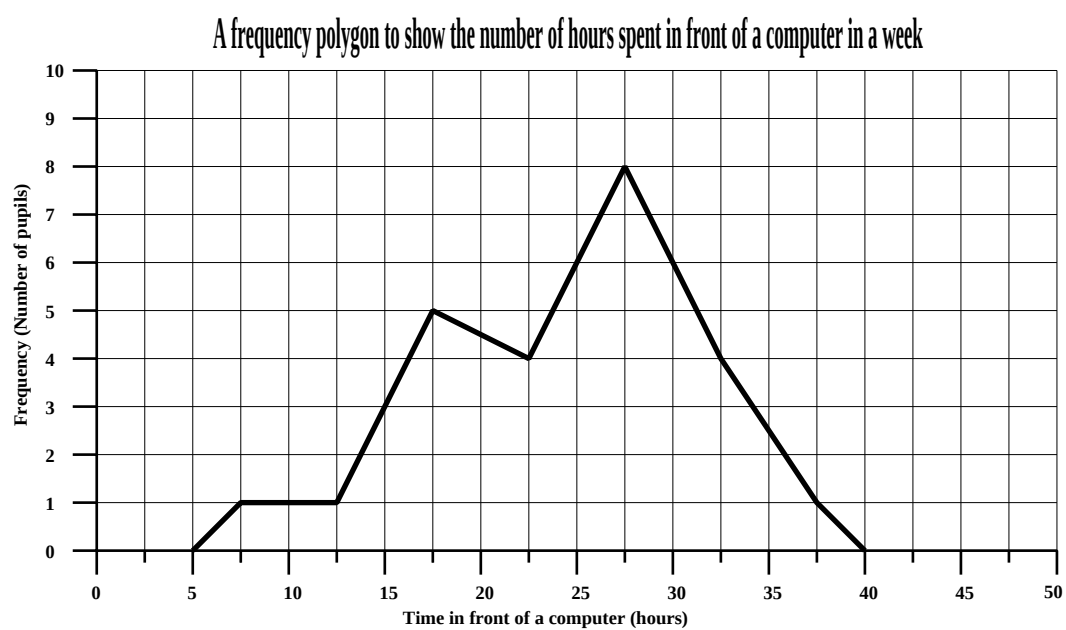
$$mean = \frac{383}{140} = 2.7 \text{ mistakes per page}$$

Answer 3

(a)

Number of hours	Tally	Frequency	Mid Interval Value
$5 \leq h < 10$		1	7.5
$10 \leq h < 15$		1	12.5
$15 \leq h < 20$		5	17.5
$20 \leq h < 25$		4	22.5
$25 \leq h < 30$		8	27.5
$30 \leq h < 35$		4	32.5
$35 \leq h < 40$		1	37.5

(b)



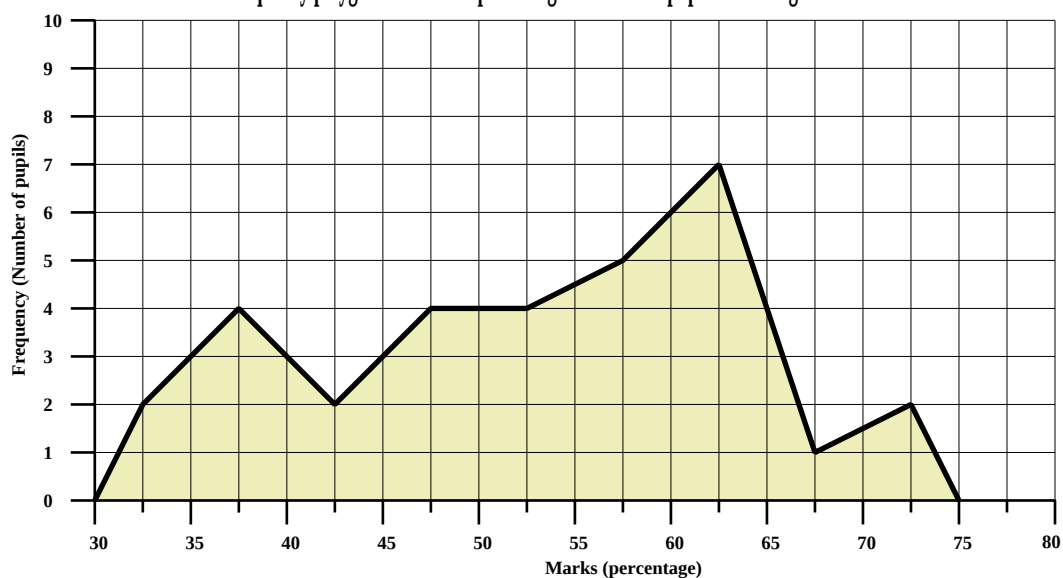
Answer 4

(a)

Mark	Tally	Frequency
$30 < m \leq 35$		2
$35 < m \leq 40$		4
$40 < m \leq 45$		2
$45 < m \leq 50$		4
$50 < m \leq 55$		4
$55 < m \leq 60$		5
$60 < m \leq 65$		7
$65 < m \leq 70$		1
$70 < m \leq 75$		2

(b)

A frequency polygon to show the percentage scores of 32 pupils in an English test



Answer 5

(a) 45 people

(b) 25%

(c) 18 people

Answer 6

(a) £7000

(b) £2000 £2010 £7000 £8000 £10000 £12990

^-----^

Median is £7500

Answer 7

- (a) Maths
- (b) (i) 40
(ii) 30
- (c) The maths marks are more spread out.

Answer 8

(i)

Number of goals scored per match	Tally	Frequency
0		6
1		12
2		10
3		6
4		4
5		4
6		3

(ii) There are 45 pieces of data.

$$\frac{45 + 1}{2} = 23$$

The 23rd piece of data is one of the 2s

∴ Median is 2 goals

Lesson 8

GCSE Mathematics

Statistics II : Handelling and Processing Data

8.1 Springer Spaniel Investigation (Homework)

The weights of 24 Springer Spaniels were measured (in kg) as follows;

15.1	17.9	16.6	15.3	17.3	16.2	17.0	14.2
14.7	15.8	16.2	17.7	17.8	16.9	15.1	15.8
16.1	15.5	14.6	15.3	16.9	15.2	18.1	15.7

- (i) Calculate the mean of this data.
Give your answer to 2 decimal places.
Be sure to show sufficient working to make your method clear.

- (ii) Transfer the list of data into the grouped frequency table below.

Weight	Tally	Frequency	Mid-interval	
$14.0 \leq w < 14.5$			14.25	
$14.5 \leq w < 15.0$				
$15.0 \leq w < 15.5$				
$15.5 \leq w < 16.0$				
$16.0 \leq w < 16.5$				
$16.5 \leq w < 17.0$				
$17.0 \leq w < 17.5$				
$17.5 \leq w < 18.0$				
$18.0 \leq w < 18.5$				

- (iii) Now suppose that the data list is lost.
From your grouped frequency table, calculate an estimate of the mean.
Use the 'extra' columns in the table to help you do this.
- (iv) Explain the difference, if any, between your part (i) and part (iii) answers.

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To do....

Answer to The Springer Spaniel Investigation....

GCSE Mathematics
Statistics II : Handelling and Processing Data

**** UNFINISHED ****

Weight	Tally	Frequency		
$14.0 \leq w < 14.5$		1		
$14.5 \leq w < 15.0$		2		
$15.0 \leq w < 15.5$		5		
$15.5 \leq w < 16.0$		4		
$16.0 \leq w < 16.5$		3		
$16.5 \leq w < 17.0$		3		
$17.0 \leq w < 17.5$		2		
$17.5 \leq w < 18.0$		3		
$18.0 \leq w < 18.5$		1		

Here is the best we can do, if we only have the grouped frequency table to work from.

It may help you to understand what you've done of the data in the table

14.25	14.75	14.75	15.25	15.25	15.25	15.25	15.25
15.75	15.75	15.75	15.75	16.25	16.25	16.25	16.75
16.75	16.75	17.25	17.25	17.75	17.75	17.75	18.25

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Lesson 9

GCSE Mathematics Statistics II : Handelling and Processing Data

9.1 Cumulative Frequency Polygons

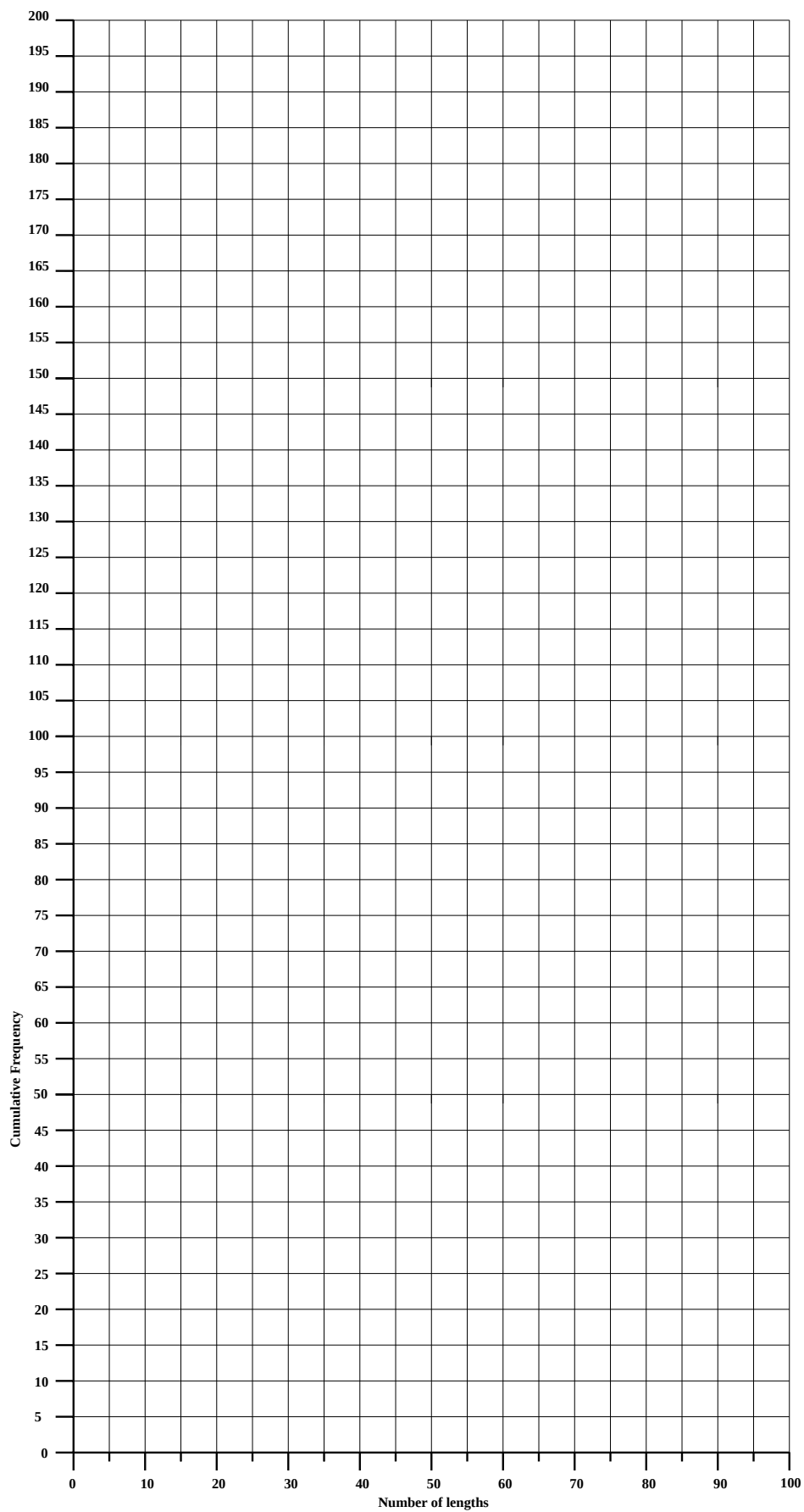
Having previously looked at how to calculate the mean from a grouped frequency table, obtaining the median and the quartiles will next be considered. This is often done by first plotting a **Cumulative** Frequency Polygon.

9.2 Example

In a sponsored swim the number of lengths swum by 200 children were recorded.

Number of lengths	Frequency	Cumulative Frequency
$1 \leq l \leq 10$	3	
$11 \leq l \leq 20$	16	
$21 \leq l \leq 30$	21	
$31 \leq l \leq 40$	22	
$41 \leq l \leq 50$	27	
$51 \leq l \leq 60$	32	
$61 \leq l \leq 70$	33	
$71 \leq l \leq 80$	18	
$81 \leq l \leq 90$	21	
$91 \leq l \leq 100$	7	

- (a) Complete the table by filling in the column headed 'Cumulative Frequency'.
- (b) On the graph paper on the next page, plot a Cumulative Frequency Polygon. Be sure to plot the points at the **ends of the intervals**.
- (c) Use your part (b) graph (*leave evidence*) to give estimates of
 - (i) The median.
 - (ii) The lower quartile.
 - (iii) The upper quartile.
- (d) What is the interquartile range ?
- (e) How many children swum more than 75 lengths ?



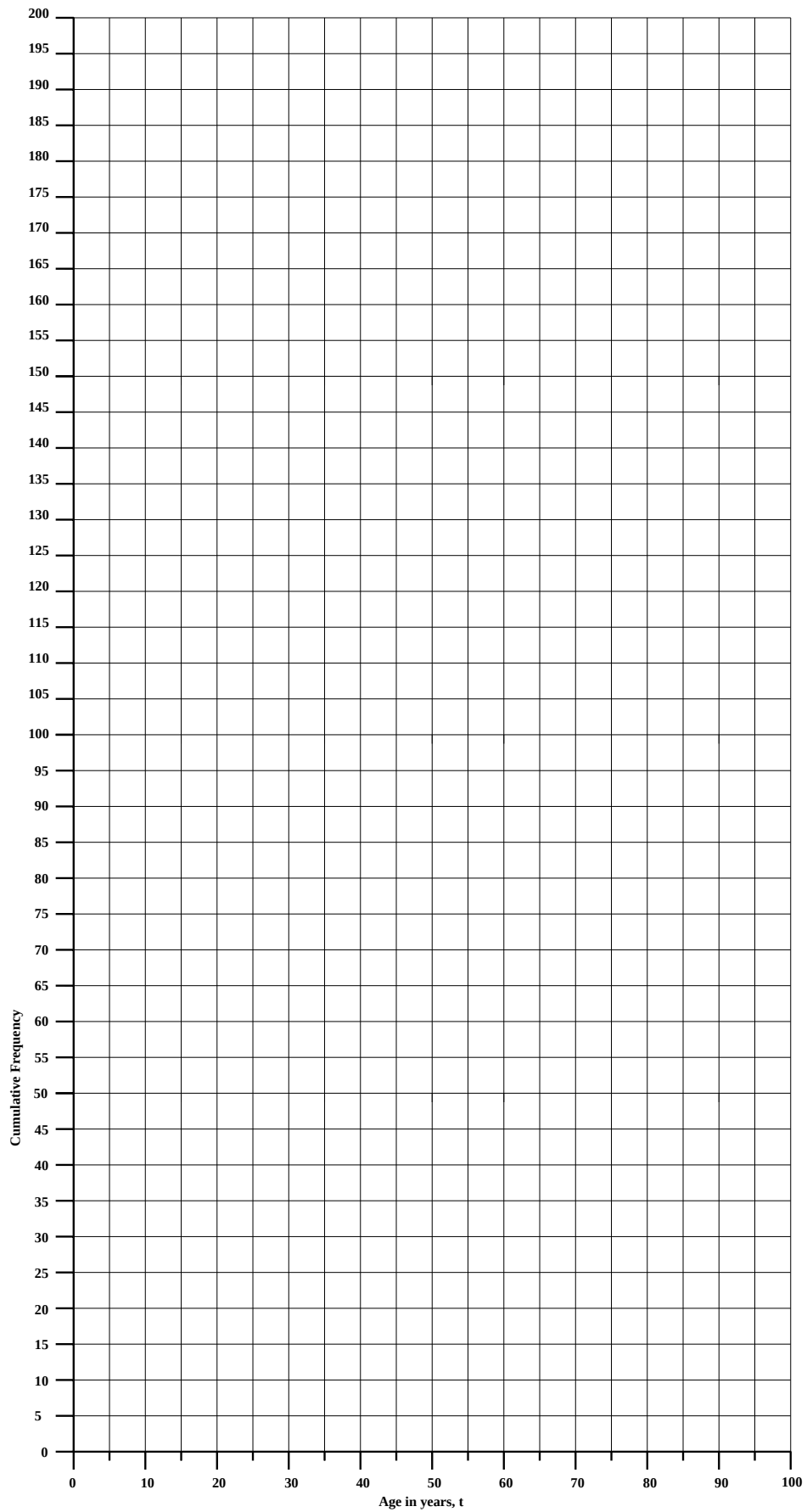
9.3 Exercise

Question 1

The grouped frequency table gives information about the ages of the birds in a flock of 200 African Grey parrots.

Age (t years)	Frequency	Cumulative Frequency
$0 < t \leq 10$	55	
$10 < t \leq 20$	60	
$20 < t \leq 30$	40	
$30 < t \leq 40$	22	
$40 < t \leq 50$	13	
$50 < t \leq 60$	10	

- (a) Complete the table by filling in the column headed 'Cumulative Frequency'.
- (b) On the graph paper on the next page, plot a Cumulative Frequency Polygon. Be sure to plot the points at the ***ends of the intervals***.
- (c) Use your part (b) graph (*leave evidence*) to give estimates of
- (i) The median.
 - (ii) The lower quartile.
 - (iii) The upper quartile.
- (d) What is the interquartile range ?
- (e) How many parrots in the flock are 35 years old, or older ?

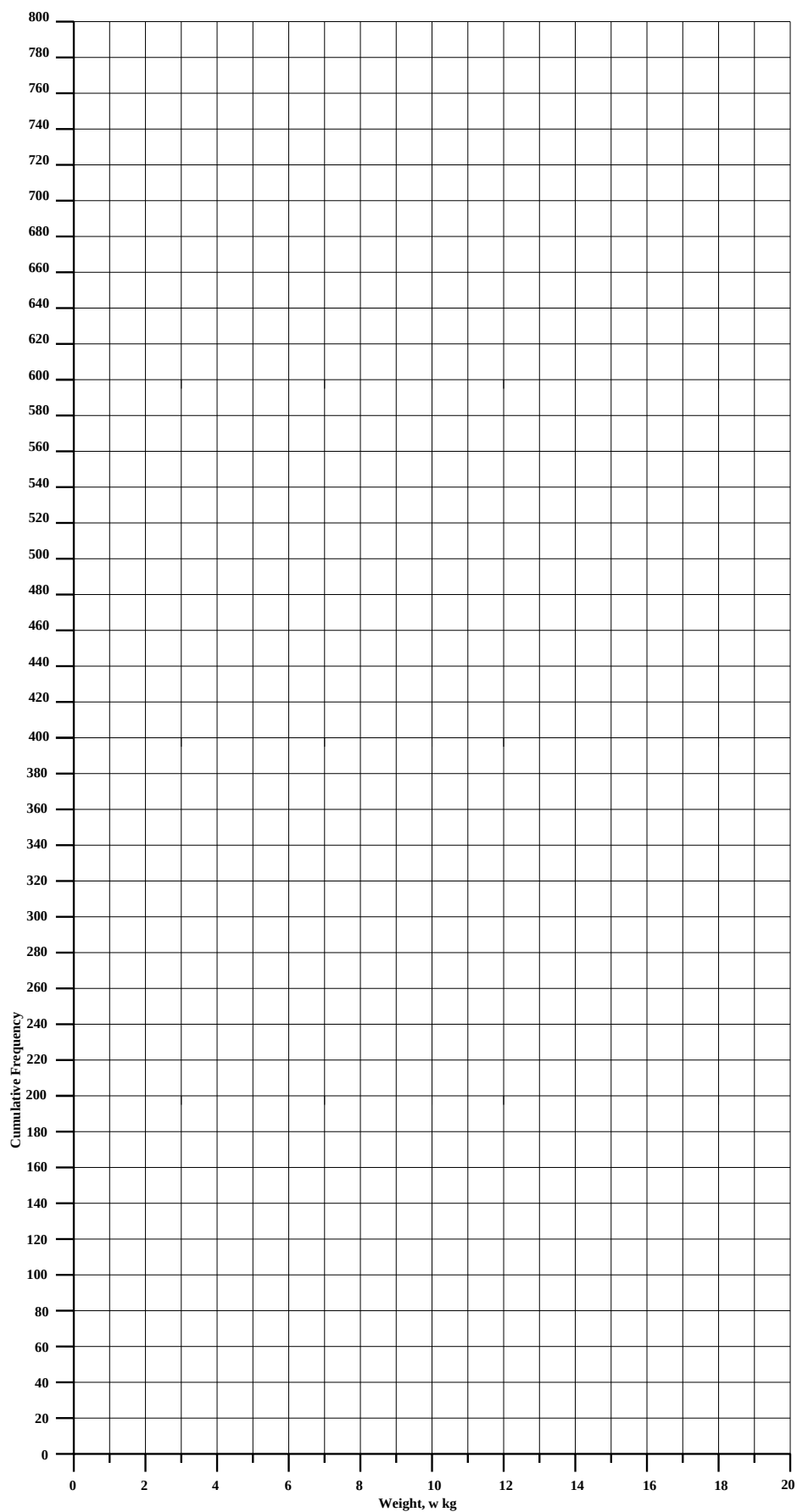


Question 2

The table shows information about the weights of 800 parcels.

Weight (w kg)	Frequency	Cumulative Freq	
$0 < w \leq 2$	82		
$2 < w \leq 4$	138		
$4 < w \leq 6$	255		
$6 < w \leq 8$	173		
$8 < w \leq 10$	102		
$10 < w \leq 12$	50		

- (a) (i) Work out an estimate for the total weight of the 800 parcels.
- (ii) Estimate the mean weight of a parcel.
- (b) Complete the table by filling in the column headed 'Cumulative Freq'.
- (c) On the graph paper on the next page, plot a Cumulative Frequency Polygon. Be sure to plot the points at the **ends of the intervals**.
- (d) Use your part (c) graph (*leave evidence*) to give estimates of
- (i) The median.
- (ii) The lower quartile.
- (iii) The upper quartile.
- (e) What is the interquartile range ?
- (f) Use your graph to find an estimate for the number of parcels which weighed less than 5.2 kg.



9.4 A statistical analysis of Scotland's 277 Munros.

A Monroe is a Scottish mountain with a height of 3000 feet or more.
Enthusiastic mountaineers aim to climb them all.

- (a) Use the data set of Monroe heights to fill in the column headed 'Frequency' in the following table. *Make sure you are looking at the heights in feet.*

Height, f , in feet	Frequency	Cumulative Frequency
$3000 \leq f < 3100$		
$3100 \leq f < 3200$		
$3200 \leq f < 3300$		
$3300 \leq f < 3400$		
$3400 \leq f < 3500$		
$3500 \leq f < 3600$		
$3600 \leq f < 3700$		
$3700 \leq f < 3800$		
$3800 \leq f < 3900$		
$3900 \leq f < 4000$		
$4000 \leq f < 4100$		
$4100 \leq f < 4200$		
$4200 \leq f < 4300$		
$4300 \leq f < 4400$		
$4400 \leq f < 4500$		

- (b) Complete the column headed “Cumulative Frequency” in the table.
- (c) On the graph paper provided, plot a cumulative frequency curve to show the distribution of the heights of the Munroes.

Comment on the distribution.

9.4 Answers

GCSE Mathematics Statistics II : Handelling and Processing Data

9.4.1 Solution (Example)

(a)

Number of lengths	Frequency	Cumulative Frequency
$1 \leq l \leq 10$	3	3
$11 \leq l \leq 20$	16	19
$21 \leq l \leq 30$	21	40
$31 \leq l \leq 40$	22	62
$41 \leq l \leq 50$	27	89
$51 \leq l \leq 60$	32	121
$61 \leq l \leq 70$	33	154
$71 \leq l \leq 80$	18	172
$81 \leq l \leq 90$	21	193
$91 \leq l \leq 100$	7	200

(b) See next page for graph.

(c) From the graph....

(i) Median = 53

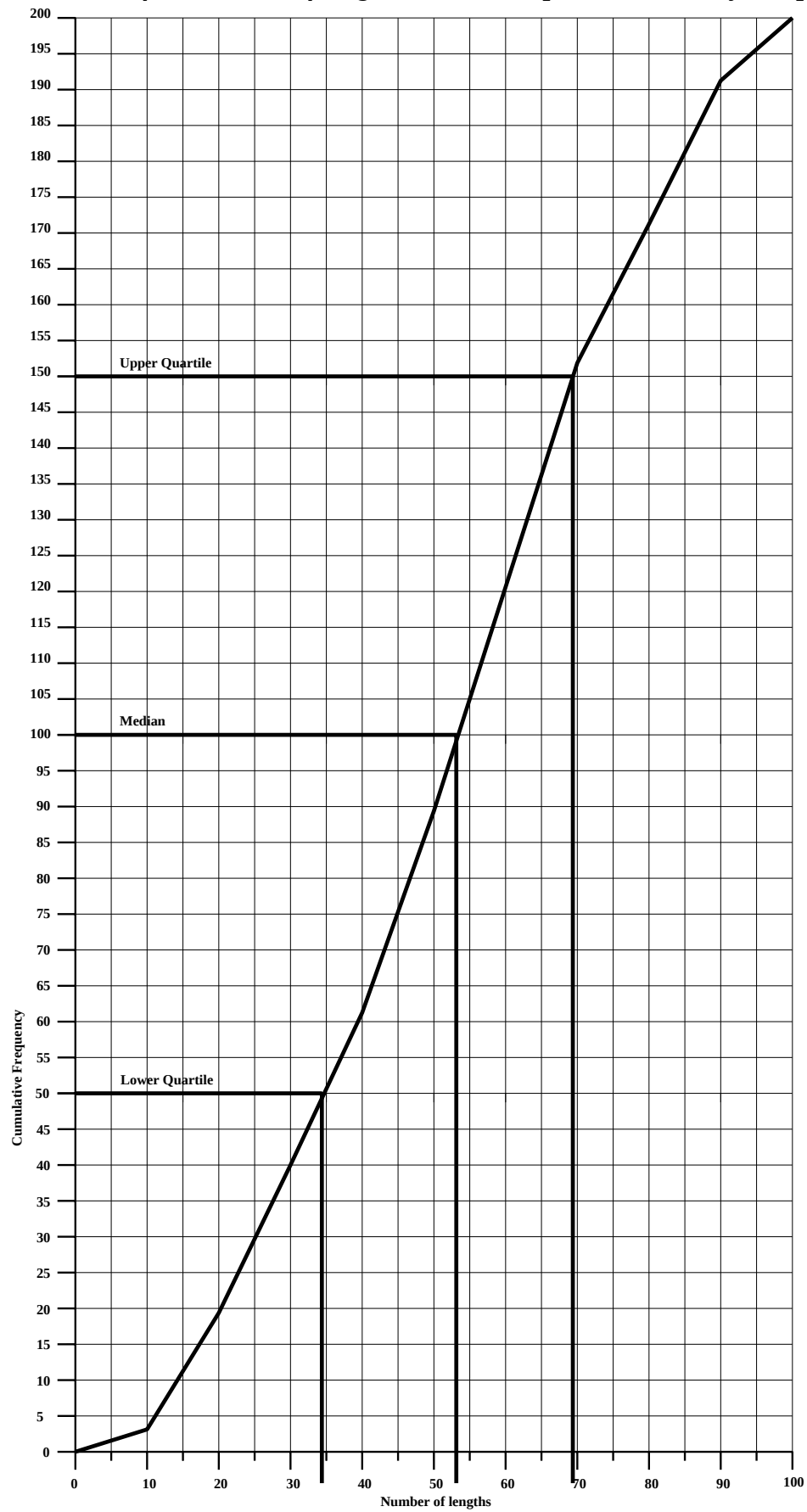
(ii) Lower quartile = 34

(iii) Upper quartile = 69

(d) Interquartile range = $69 - 34 = 35$

(e) $200 - 162 = 38$ children swam **MORE** than 75 lengths

*Cumulative frequency curve showing
the distribution of the number of lengths swum in a sponsored swim by 200 pupils*



9.4.2 Solution (Exercise)

Answer 1

(a)

Age (t years)	Frequency	Cumulative Frequency
$0 < t \leq 10$	55	55
$10 < t \leq 20$	60	115
$20 < t \leq 30$	40	155
$30 < t \leq 40$	22	177
$40 < t \leq 50$	13	190
$50 < t \leq 60$	10	200

(b) See next page for graph.

(c) From the graph....

(i) Median = 17

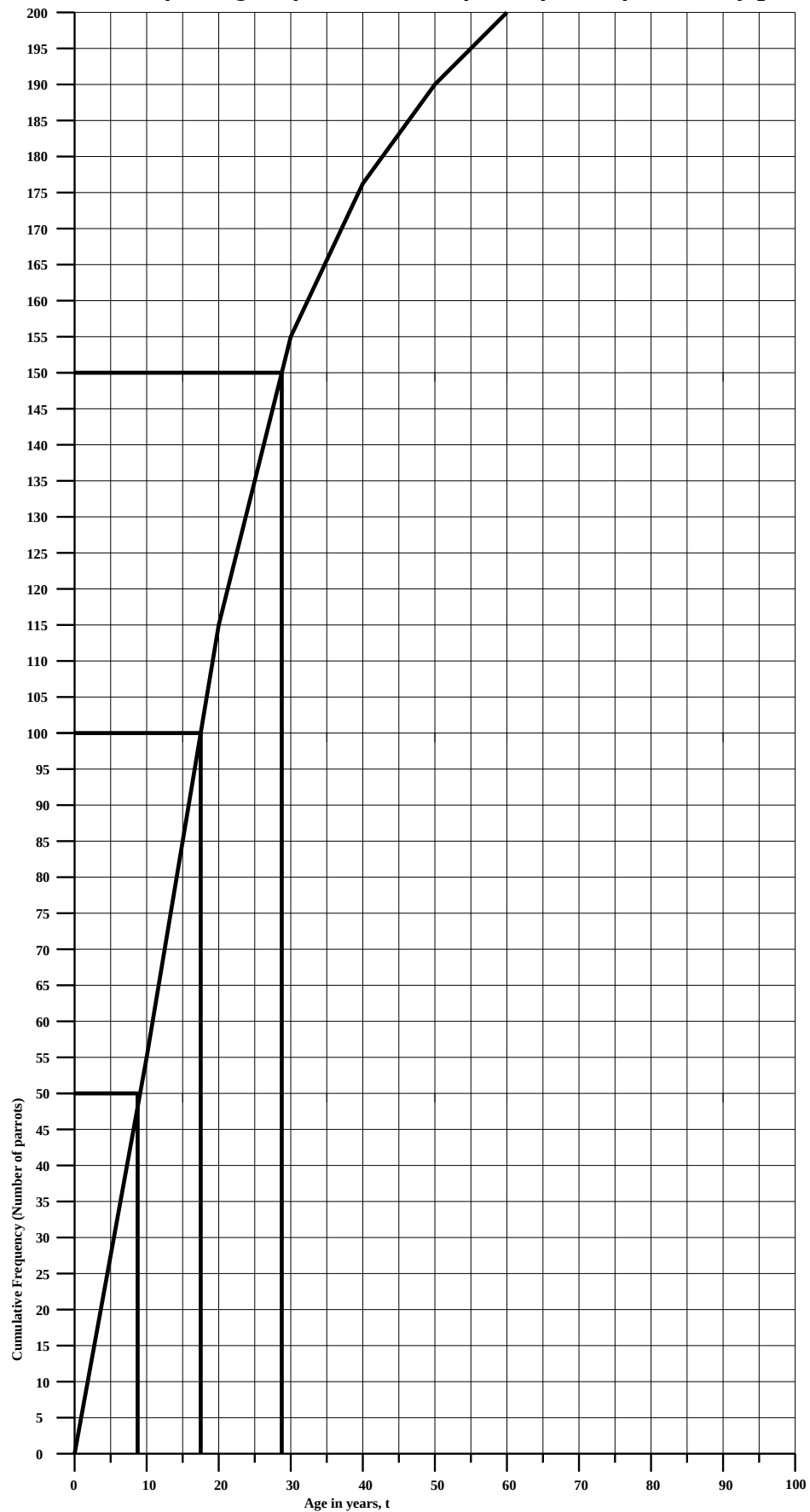
(ii) Lower quartile = 8

(iii) Upper quartile = 28

(d) Interquartile range = $28 - 8 = 20$

(e) $200 - 166 = 34$ parrots lived **MORE** than 35 years

*Cumulative frequency curve showing
the distribution of the ages of the birds in a flock of 200 African Grey parrots.*



Answer 2**(a) (i)***total weight*

$$\begin{aligned}
 &= (1 \times 82) + (3 \times 138) + (5 \times 255) + (7 \times 173) + (9 \times 102) + (11 \times 50) \\
 &= 82 + 414 + 1275 + 1211 + 918 + 550 \\
 &= 4450 \text{ kg} \quad \text{That is } 4.45 \text{ tonnes}
 \end{aligned}$$

(ii)

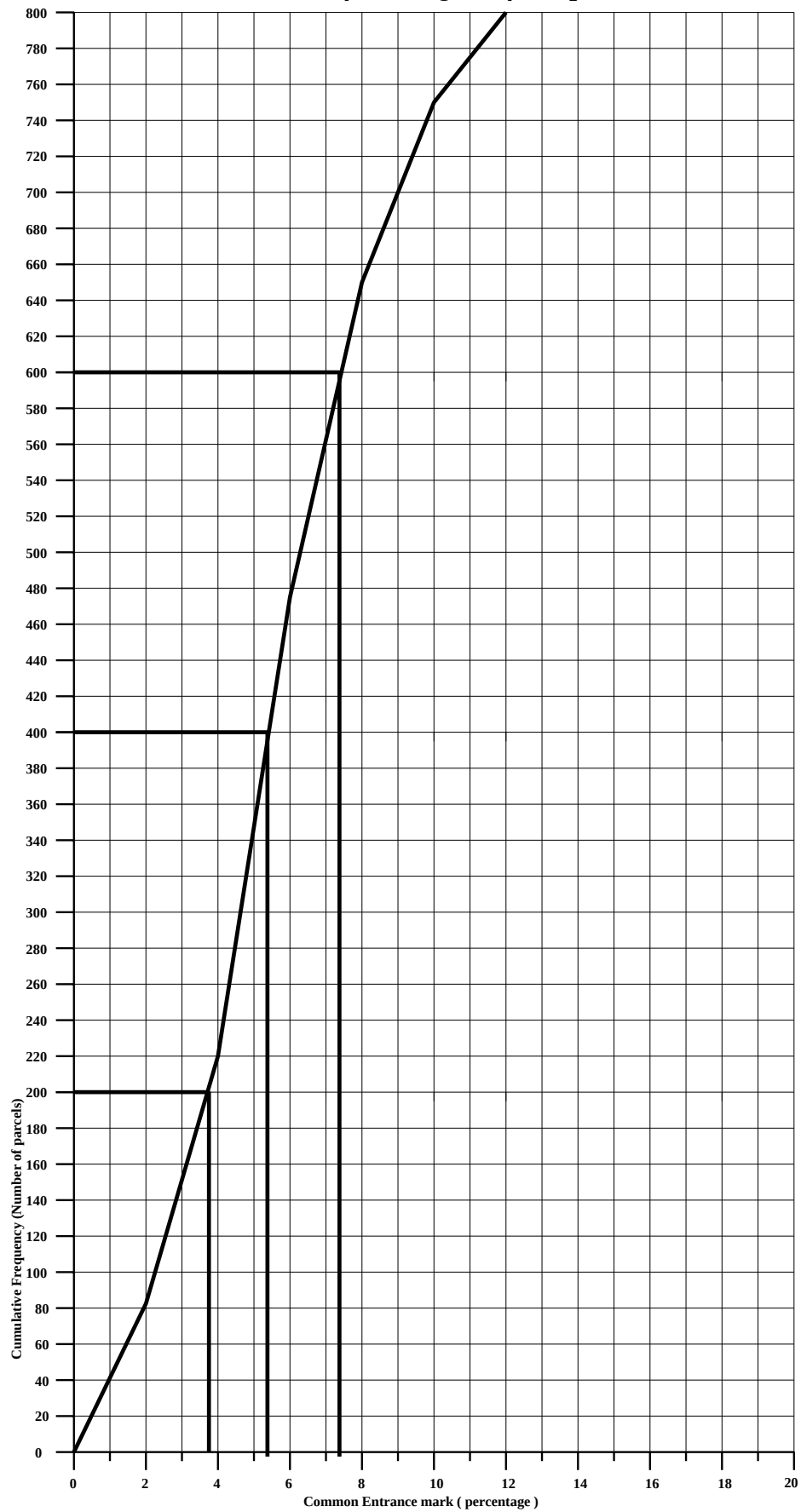
$$\begin{aligned}
 \text{mean} &= \frac{4450}{800} \\
 &= 5.56 \text{ kg}
 \end{aligned}$$

(b)

Weight (w kg)	Frequency	Cumulative Freq	
$0 < w \leq 2$	82	82	
$2 < w \leq 4$	138	220	
$4 < w \leq 6$	255	475	
$6 < w \leq 8$	173	648	
$8 < w \leq 10$	102	750	
$10 < w \leq 12$	50	800	

(c) See graph on next page : check points plotted at **END OF INTERVALS****(d) (i)** Median is 4.3 kg**(ii)** Lower Quartile is 3.8 kg**(iii)** Upper Quartile is 7.3 kg**(e)** Interquartile range is 3.5 kg**(f)** 380 parcels weigh less than 5.2 kg

*Cumulative frequency curve showing
the distribution of the weights of 800 parcels.*



Lesson 10

GCSE Mathematics Statistics II : Handelling and Processing Data

10.1 Histograms

A histogram looks similar to a bar chart but with one very important difference; on a bar chart the frequency is represented by **Height** but on a histogram the frequency is represented by **Area**.

10.2 Example

Over the course of a week a “screen time” survey is conducted into the number of hours that each person in a group of 214 people spent looking at their mobile phone. The results are summarised in a group frequency table and a histogram is to be drawn.

Screen time (hours)	Frequency (Number of people)	Width (hours)	Height Frequency Density (people per hour)
$0 < h \leq 5$	40		
$5 < h \leq 10$	35		
$10 < h \leq 20$	60		
$20 < h \leq 35$	24	15	1.6
$35 < h \leq 60$	55		

The class width column is filled in by noting, for example, that the class interval for $20 < h \leq 35$ is 15.

For any rectangle,

$$\text{Area} = \text{Width} \times \text{Height}$$

which can be rearranged to make *Height* the subject of the formula,

$$\text{Height} = \frac{\text{Area}}{\text{Width}}$$

The teaching video begins with this formula recast in the form

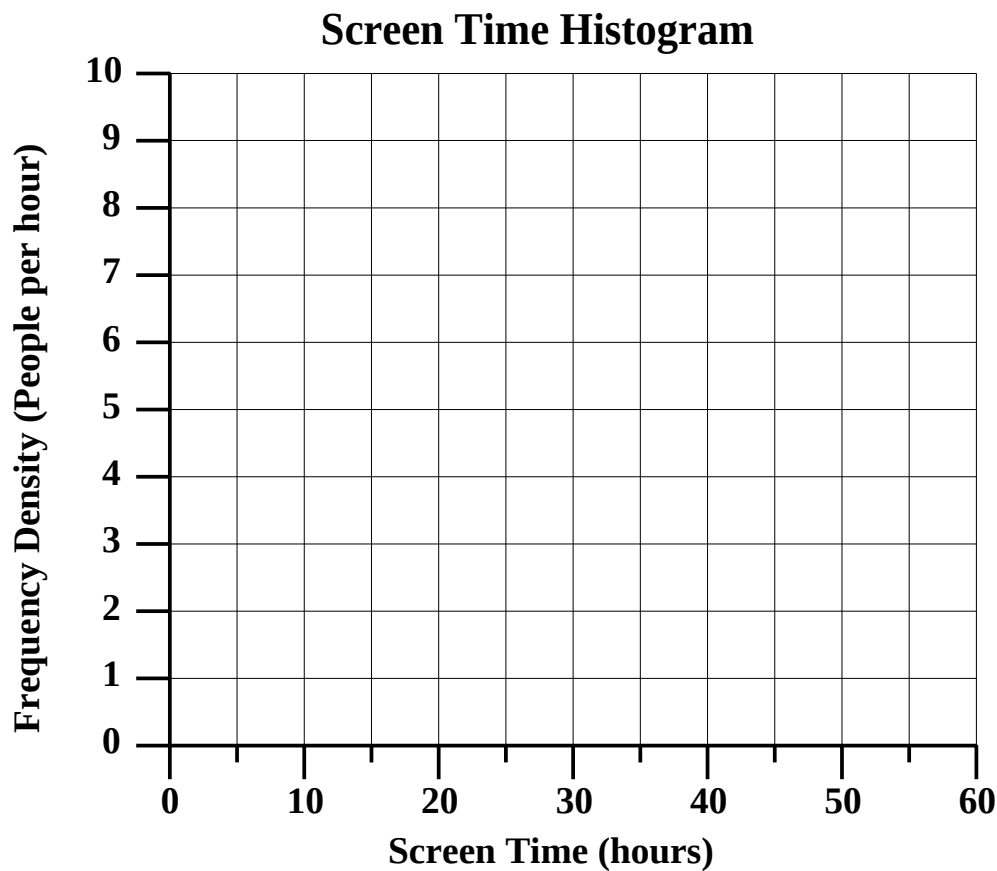
$$\text{Frequency Density} = \frac{\text{Frequency}}{\text{Class Width}}$$

As you watch the video you will see that the $20 < h \leq 35$ class interval has a corresponding *Frequency Density* of,

$$\begin{aligned}\text{Frequency Density} &= \frac{24}{15} \\ &= 1.6 \text{ people per hour}\end{aligned}$$

- (i) Watch the video : [http://www.NumberWonder.co.uk/Video/v9037\(10\).mp4](http://www.NumberWonder.co.uk/Video/v9037(10).mp4)
- (ii) Complete the group frequency table, above.

- (iii) Draw the histogram using the graph paper below.



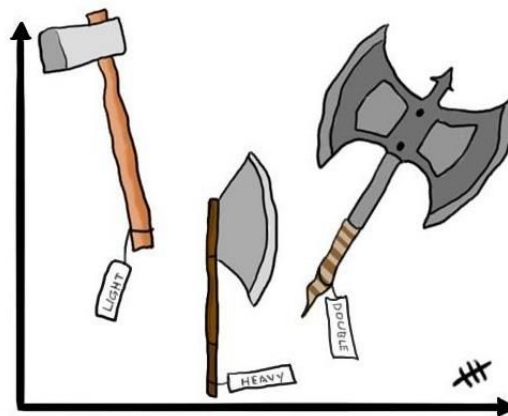
10.3 When to, and why, draw a histogram

A histogram should only be drawn for continuous data. There are many incorrect videos on the internet of histograms being drawn for discrete data.

A histogram, rather than a bar graph, is the correct diagram to draw when the class intervals are not all the same width. This is because the human eye looking at a rectangle finds it hard to only focus on height, it cannot help but see area.

10.4 And Don't Forget to....

Always label your axes



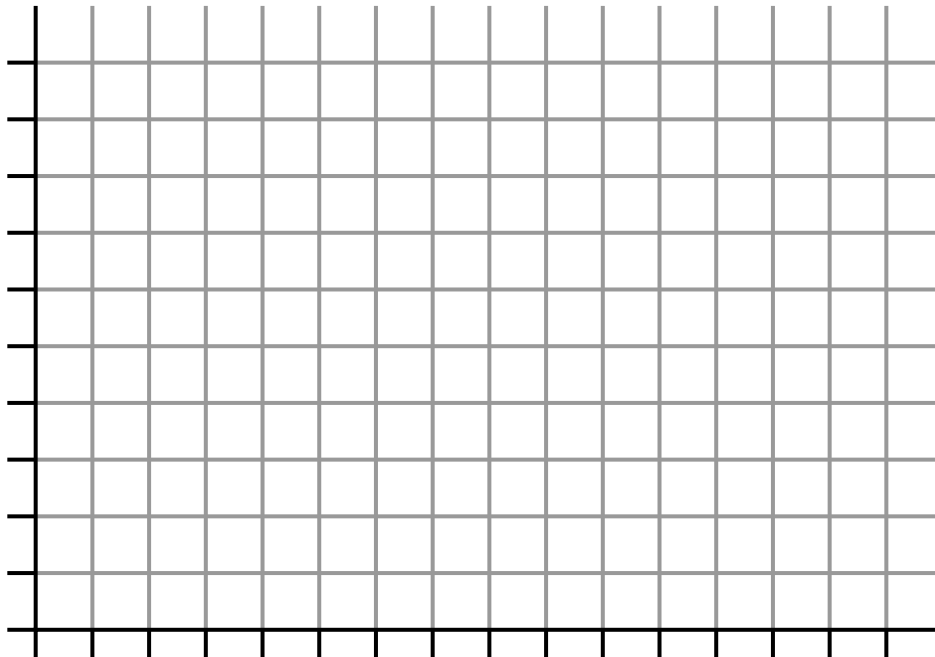
10.5 Exercise

Question 1

At a call centre the times taken to deal with 1000 calls were as follows:

Duration of call (minutes)	Number of calls Frequency = Area	Width	Height
$0 \leq t < 2$	200		
$2 \leq t < 6$	300		
$6 \leq t < 10$	200		
$10 \leq t < 30$	300		

Plot a histogram to show the distribution of the 1000 call times at the centre.
Be sure to number and label the axes and give the histogram a title.



Question 2

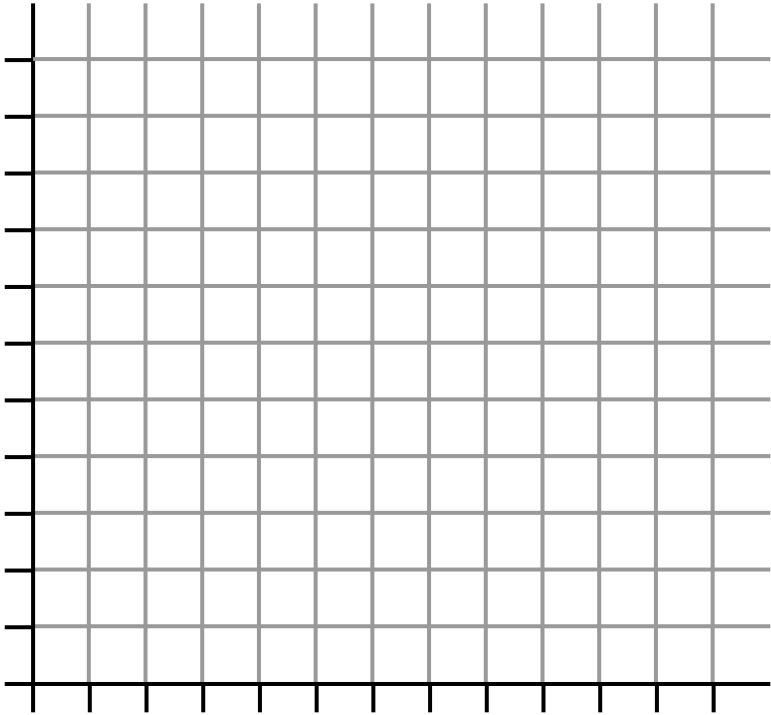
In a government survey, a questionnaire is emailed to 15000 people who have previously agreed to take part.

The time taken, in hours, to return the questionnaire is logged.

The following table presents a summary.

Response time (hours)	Number of questionnaires Frequency = Area	Width	Height
$0 \leq h < 2$	700		
$2 \leq h < 4$	1100		
$4 \leq h < 6$	2200		
$6 \leq h < 8$	1700		
$8 \leq h < 15$	3500		
$15 \leq h < 24$	2700		

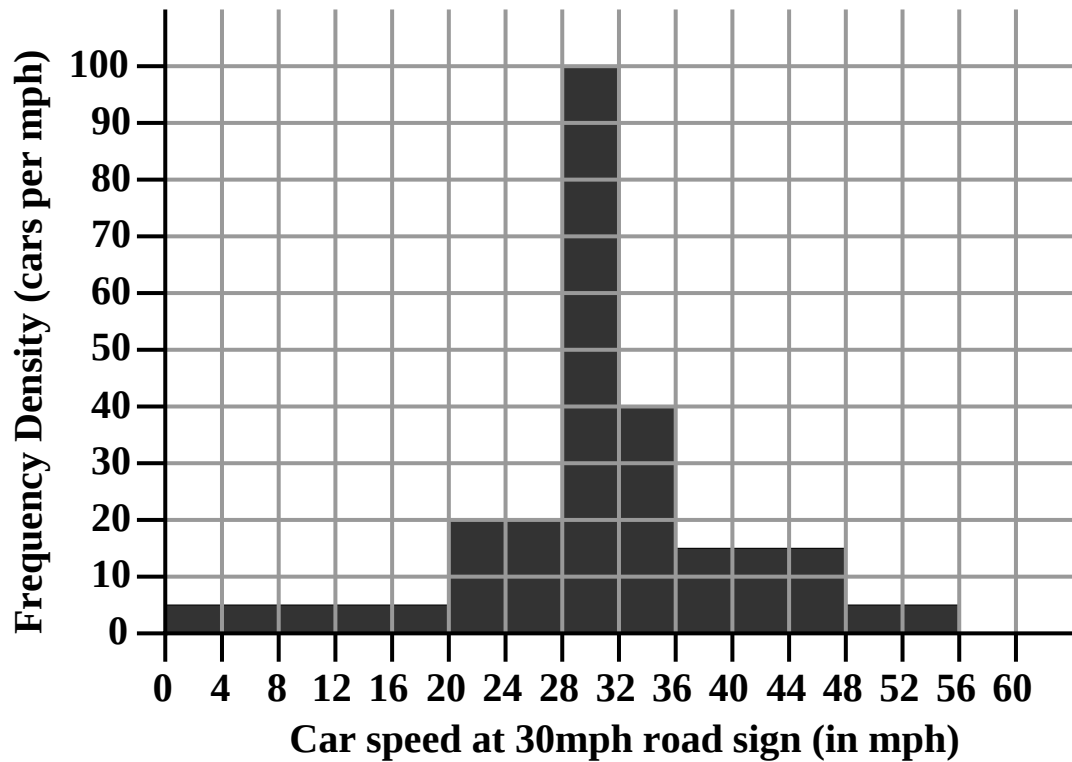
- (i) How many questionnaires have not generated a response ?
- (ii) Plot a histogram to show the distribution of the times taken in responding to the questionnaire. Complete the columns headed Width and Height in the table above to help you do this.



Question 3

In trying to decide if a speed camera is required in the town of Numberville, a consultant provides the following histogram which shows the distribution of car speeds as cars pass the 30mph sign heading into Numberville.

A histogram to show the distribution of car speeds at a 30mph road sign



(i) Use the histogram to complete the following table :

Car speed (miles per hour, mph)	Number of cars Frequency = Area	Width	Height
$0 \leq m < 20$			
$20 \leq m < 28$			
$28 \leq m < 32$			
$32 \leq m < 36$			
$36 \leq m < 48$			
$48 \leq m < 56$			

(ii) How many cars in total had their speed recorded entering Numberville ?

(iii) What percentage of cars were travelling within 2mph of the speed limit ?

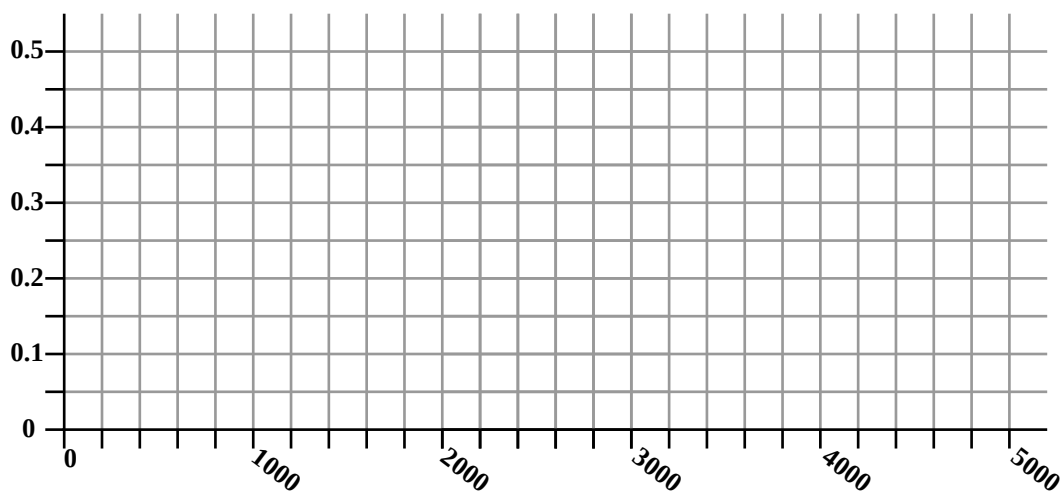
Question 4

As part of a quality control test, 1100 light bulbs are left on continuously and the time taken before they fail is recorded.

The results are summarised in the table below.

Bulb lifetime (in hours)	Number of bulbs Frequency	Width	Height
$0 \leq t < 100$	50		
$100 \leq t < 1000$	180		
$1000 \leq t < 2000$	100		
$2000 \leq t < 4000$	500		
$4000 \leq t < 4500$	250		
$4500 \leq t < 4600$	20		

Plot a histogram to show the distribution of the life-times of the bulbs. Complete the columns headed Width and Height in the table above, to help you do this.



Be sure to number and label the axes and give the histogram a title.

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Video “Drawing Histograms” © 2012 Corbettmaths

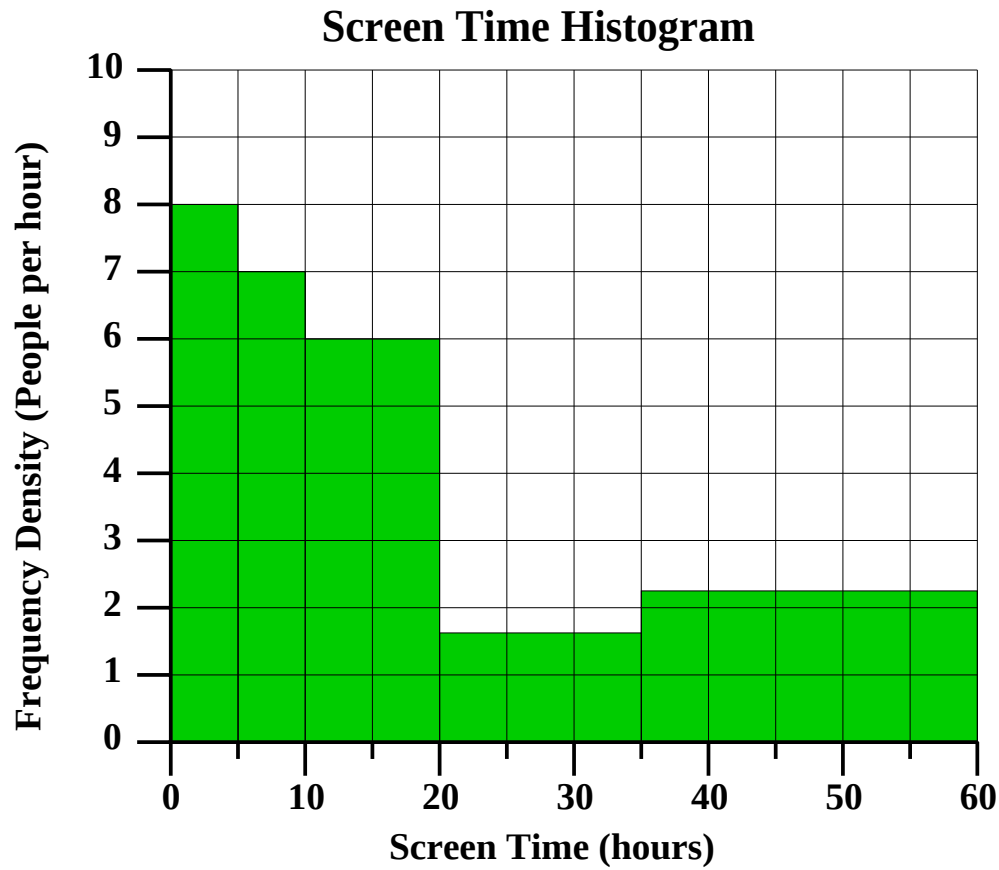
10.6 Answers

10.6.1 Solution to 10.2 Example

(ii)

Screen time (hours)	Frequency (Number of people)	Width (hours)	Height Frequency Density (people per hour)
$0 < h \leq 5$	40	5	8
$5 < h \leq 10$	35	5	7
$10 < h \leq 20$	60	10	6
$20 < h \leq 35$	24	15	1.6
$35 < h \leq 60$	55	25	2.2

(iii)



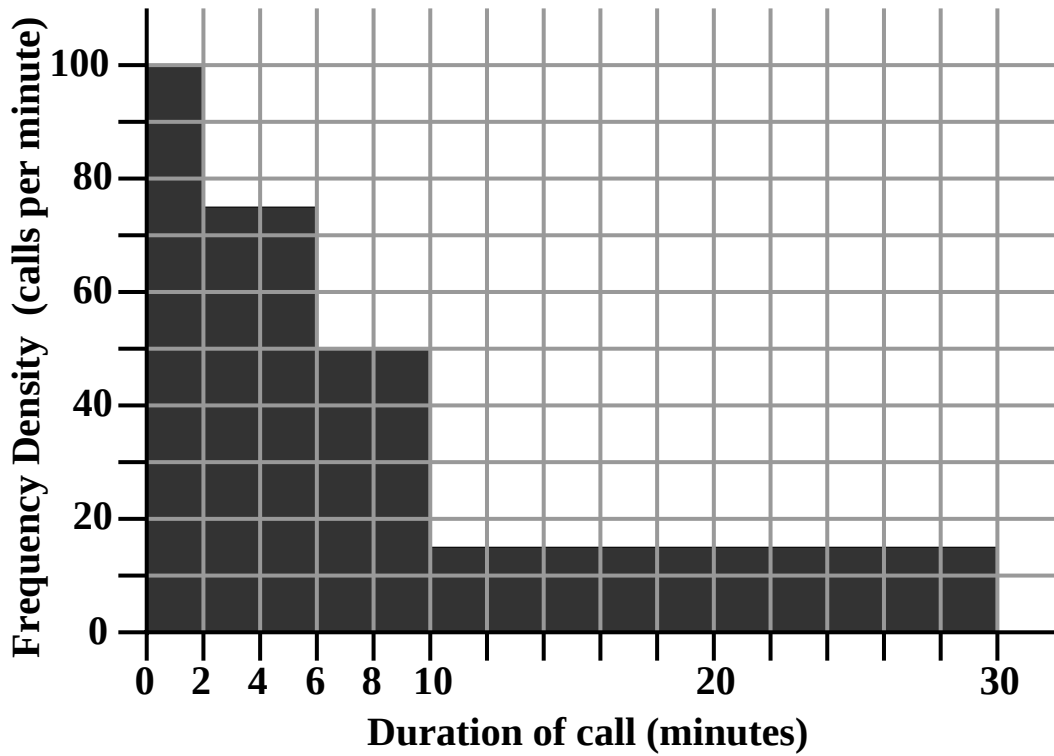
10.6.2 Solutions to 10.5 Exercise

Answer 1

Duration of call (minutes)	Number of calls Frequency = Area	Width	Height
$0 \leq t < 2$	200	2	100
$2 \leq t < 6$	300	4	75
$6 \leq t < 10$	200	4	50
$10 \leq t < 30$	300	20	15

[4 marks]

A histogram to show the distribution of call times at a call centre



Suitable title [1 mark]

An x-axis that is numbered, labelled, and with the units clearly stated [1 mark]

A y-axis that is numbered, labelled, and with the units clearly stated [1 mark]

For each bar that is of the correct width and height [4 x 1 mark]

Total : 11 marks

Answer 2

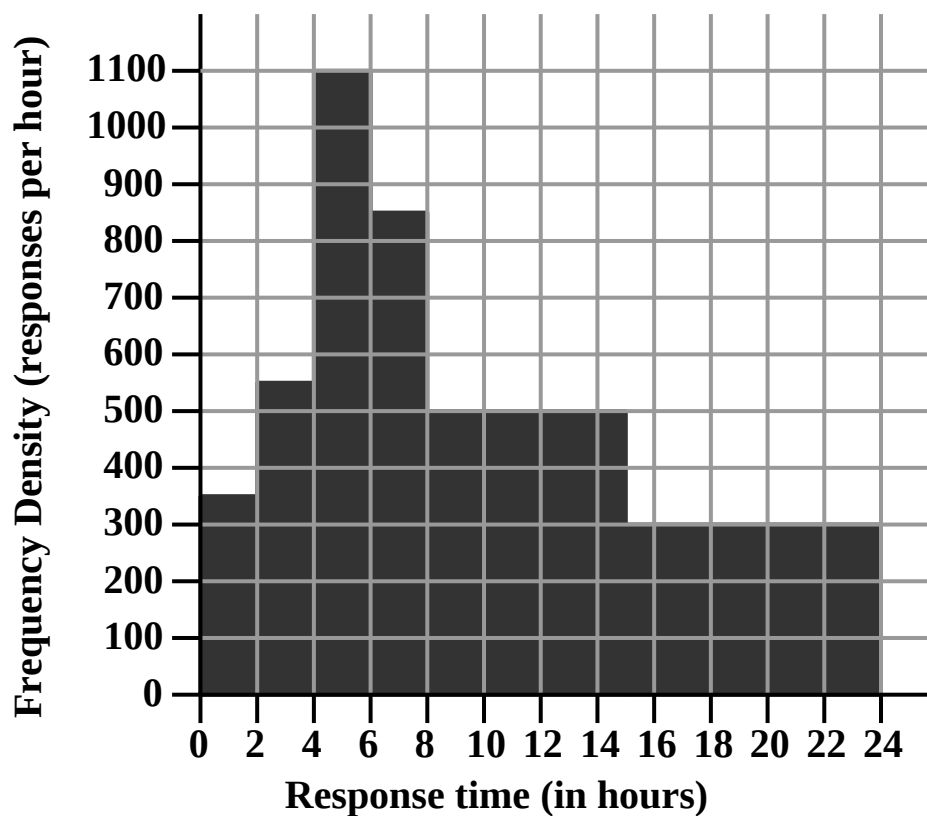
(i) 3100

(ii)

Response time (hours)	Number of questionnaires Frequency = Area	Width	Height
$0 \leq h < 2$	700	2	350
$2 \leq h < 4$	1100	2	550
$4 \leq h < 6$	2200	2	1100
$6 \leq h < 8$	1700	2	850
$8 \leq h < 15$	3500	7	500
$15 \leq h < 24$	2700	9	300

[4 marks]

A histogram to show response times to an emailed survey questionnaire



Suitable title

[1 mark]

An x-axis that is numbered, labelled, and with the units clearly stated

[1 mark]

A y-axis that is numbered, labelled, and with the units clearly stated

[1 mark]

For each bar that is of the correct width and height.

[6 x 1 mark]

Total : 13 marks

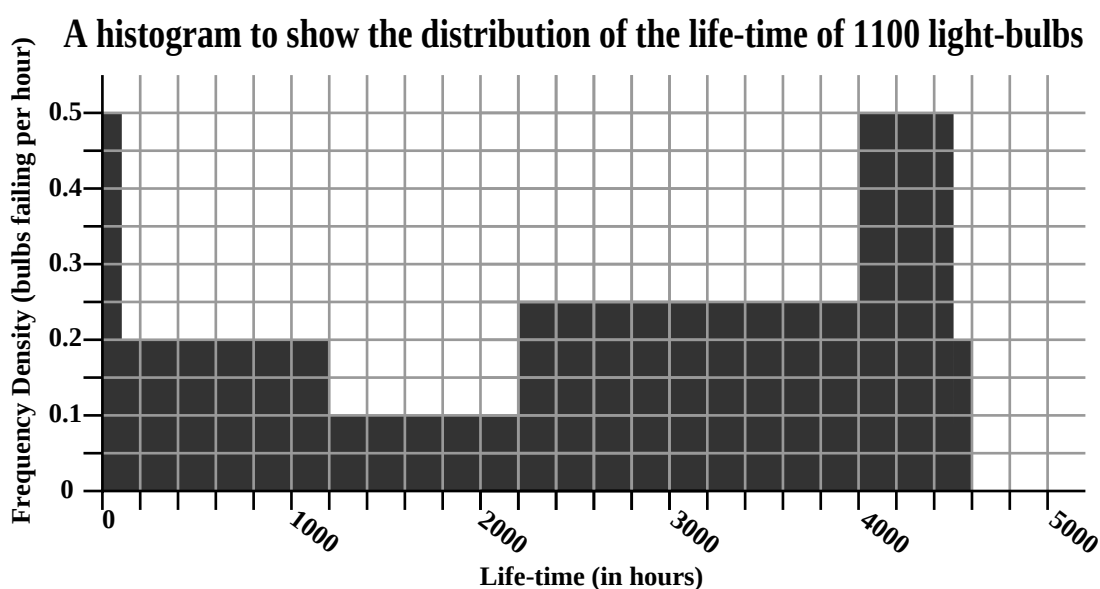
Answer 3

Car speed (miles per hour, mph)	Number of cars Frequency = Area	Width	Height
$0 \leq m < 20$	100	20	5
$20 \leq m < 28$	160	8	20
$28 \leq m < 32$	400	4	100
$32 \leq m < 36$	160	4	40
$36 \leq m < 48$	180	12	15
$48 \leq m < 56$	40	8	5

(ii) 1040 cars (iii) $\frac{400}{1040} \times 100 = 38.5\%$

Answer 4

Bulb lifetime (in hours)	Number of bulbs Frequency	Width	Height
$0 \leq t < 100$	50	100	0.5
$100 \leq t < 1000$	180	900	0.2
$1000 \leq t < 2000$	100	1000	0.1
$2000 \leq t < 4000$	500	2000	0.25
$4000 \leq t < 4500$	250	500	0.5
$4500 \leq t < 4600$	20	100	0.2



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Lesson 11

GCSE Mathematics Statistics II : Handelling and Processing Data

11.1 Revision Exercise

Marks Available : 60

Question 1

Nineteen students took part in a spelling test.

There were thirty words in the test, one mark for each word spelt correctly.

Here are the marks that resulted.

28	25	18	23	23	12	24	27	18	21
25	30	15	28	30	21	22	23	19	

(a) Put the data in order.

[2 marks]

(b) Find (i) The lower quartile.

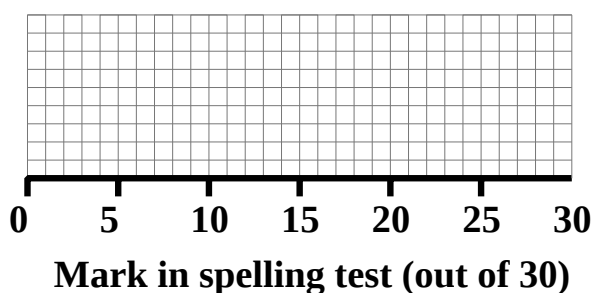
(ii) The median.

(iii) The upper quartile.

(iv) The interquartile range.

[4 marks]

(c) Plot a box and whisker diagram to show the distribution of the test marks.



[5 marks]

Question 2

Twenty children were asked how they rated their maths teacher.
Here are the results:

***** *** *** ***** * *** ** *****
***** *** ***** ***** ***** *** *** *****
*** ** ***** ***

Number of stars	*	**	***	****	*****
Frequency					

- (a) Fill in the frequency row of the table.

[3 marks]

- (b) Showing your working, calculate the average (mean) star rating of the maths teacher.

[3 marks]

Question 3

The table shows the distribution of the number of *minor errors* made by a random sample of 35 people sitting their driving test.

Number of errors	0	1	2	3	4	5	6	7	8	9	10
Frequency	2	12	9	6	2	3	1	0	0	0	0

- (a) In the test, people making three or fewer *minor errors* pass.
What percentage of people pass the test ?

[2 marks]

- (b) What is the median number of *minor errors* made ?

[2 marks]

Question 4

The table below shows the distribution of the weights of 150 peaches.

Weight (w grams)	Number of peaches		
$40 < w \leq 50$	23		
$50 < w \leq 60$	41		
$60 < w \leq 70$	50		
$70 < w \leq 80$	20		
$80 < w \leq 90$	16		

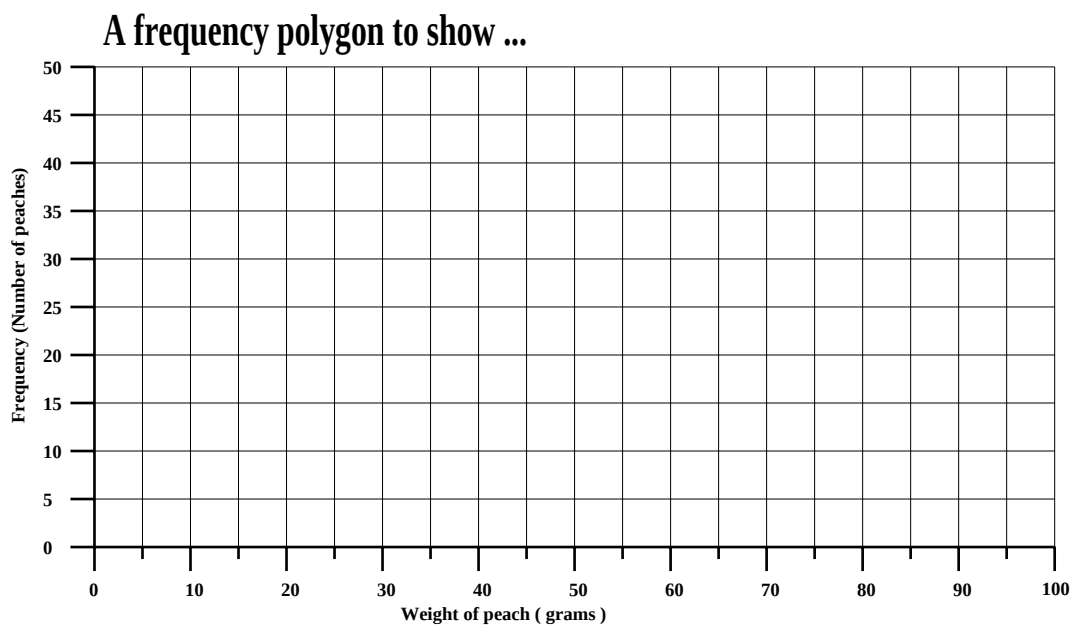
(a) What is the modal class ?

[1 mark]

(b) Showing your working, calculate an estimate of the mean weight of a peach.

[4 marks]

(c) Plot a frequency polygon to show the distribution of the weights of the peaches.



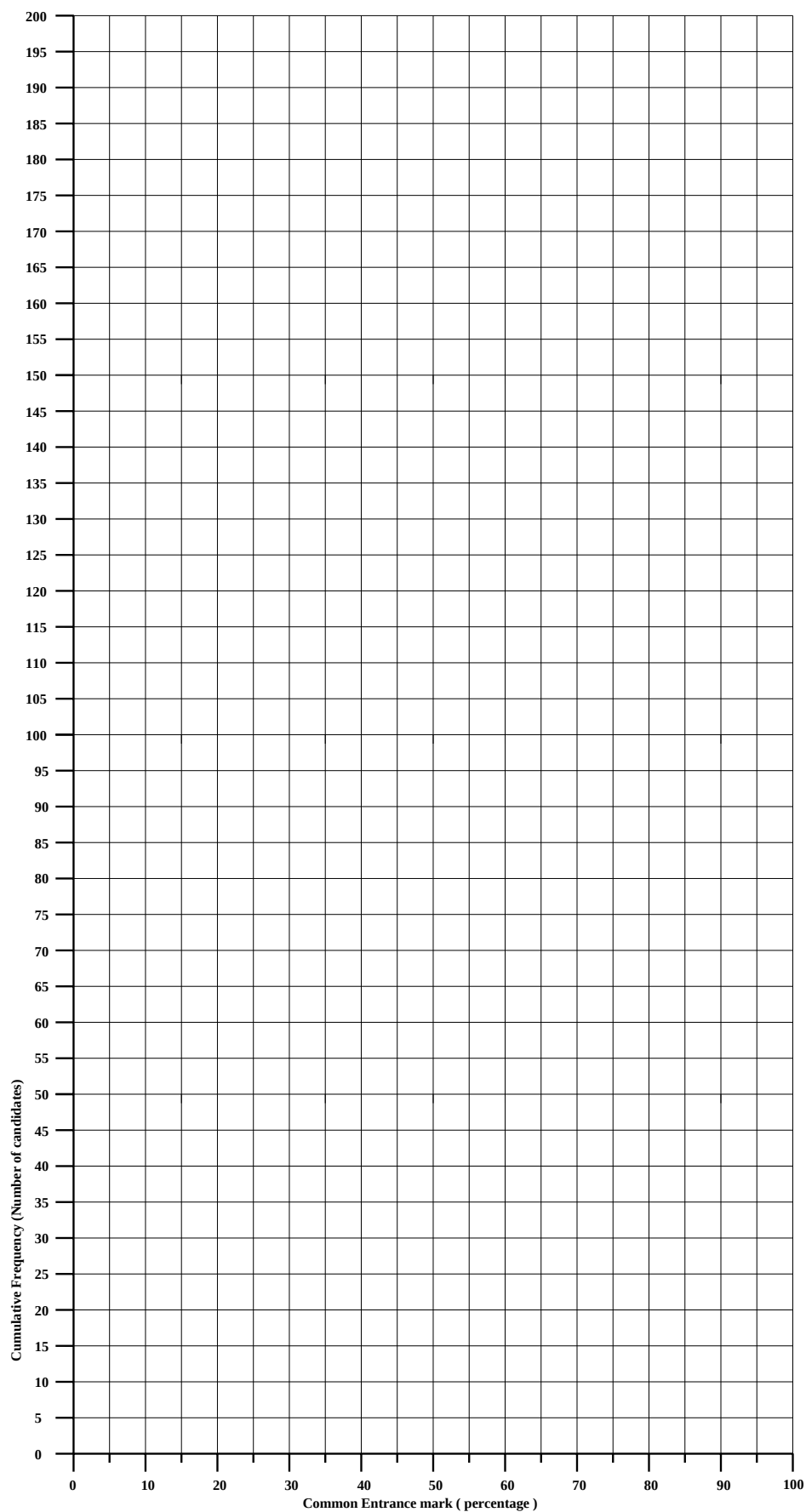
[4 marks]

Question 5

The following table shows the distribution of the marks scored by last year's common entrance candidates in their mathematics papers;

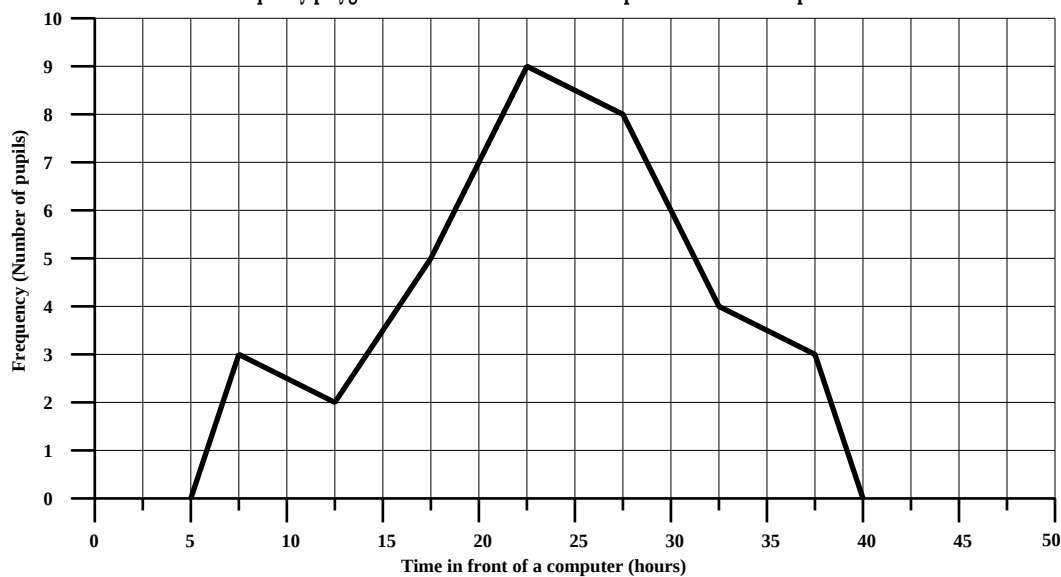
Mark (m percent)	Frequency	Cumulative Frequency
$1 \leq m \leq 10$	0	
$11 \leq m \leq 20$	7	
$21 \leq m \leq 30$	14	
$31 \leq m \leq 40$	18	
$41 \leq m \leq 50$	33	
$51 \leq m \leq 60$	36	
$61 \leq m \leq 70$	43	
$71 \leq m \leq 80$	28	
$81 \leq m \leq 90$	8	
$91 \leq m \leq 100$	5	

- (a) Complete the column headed “cumulative frequency” in the above table.
[3 marks]
- (b) How many candidates were there ?
[1 mark]
- (c) How many candidates scored 50% or less ?
[1 mark]
- (d) How many candidates scored more than 60% ?
[2 marks]
- (e) On the graph paper provided on the next page, plot the cumulative frequency curve to show the distribution of the common entrance marks.
[3 marks]
- (f) *Use your graph* to determine,
- (i) The lower quartile mark.
[1 mark]
- (ii) The median mark.
[1 mark]
- (iii) The upper quartile mark.
[1 mark]
- (iv) The interquartile range.
[1 mark]



Question 6

A frequency polygon to show the number of hours spent in front of a computer in a week



The frequency polygon shows the number of hours spent on a computer by a class of pupils in a week.

(a) Use the graph to fill in the following grouped frequency table;

Number of hours	Frequency		
$5 \leq h < 10$			
$10 \leq h < 15$			
$15 \leq h < 20$			
$20 \leq h < 25$			
$25 \leq h < 30$			
$30 \leq h < 35$			
$35 \leq h < 40$			

[2 marks]

(b) Calculate an estimate for the mean (average) number of hours a pupil spends on a computer during a week.
Answers without working will not be marked.

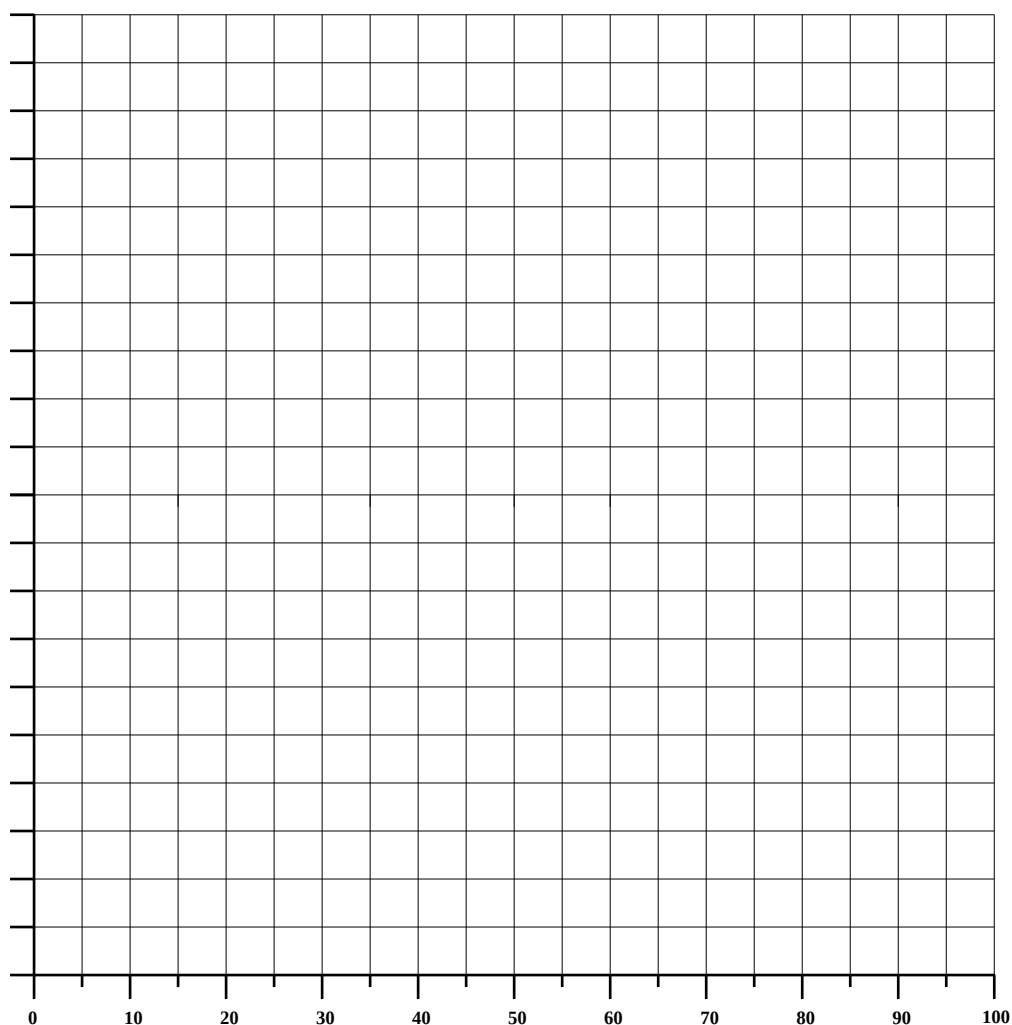
[4 marks]

Question 7

The following table shows the distribution of the times taken by 300 teenagers to get up in the morning following 7.30am alarm call.

Time Taken (t minutes)	Frequency	Width	Height
$0 < t \leq 4$	64		
$4 < t \leq 10$	42		
$10 < t \leq 20$	84		
$20 < t \leq 30$	64		
$30 < t \leq 50$	36		
$50 < t \leq 90$	10		

After completing the above table, draw a histogram to represent the data.



[10 marks]

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11.2 Solutions (Revision Exercise)

GCSE Mathematics Statistics II : Handelling and Processing Data

Answer 1

(a) Put the data in order.

12 15 18 18 19 21 21 22 23 23
23 24 25 25 27 28 28 30 30

[2 marks]

(b) $\frac{19 + 1}{4} = 5^{\text{th}}$

(i) LQ is 5th from left which is 19

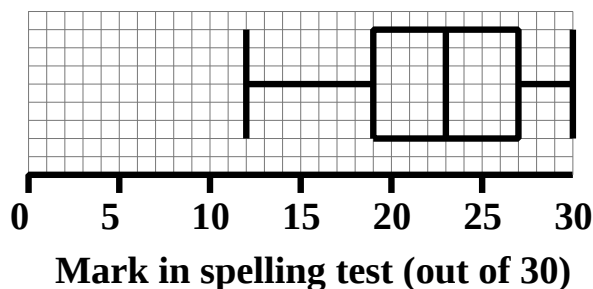
(ii) Median is 10th from either end which is 23

(iii) UQ is 5th from right which is 27

(iv) $\therefore \text{IQR} = 8$

[4 marks]

(c)



[5 marks]

Answer 2

(a)

Number of stars	*	**	***	****	*****
Frequency	1	2	8	4	5
Contribution to Total	1	4	24	16	25

[3 marks]

(b) $\text{mean} = \frac{1 + 4 + 24 + 16 + 25}{20}$
 $= 3.5 \text{ stars}$

[3 marks]

Answer 3

(a) $\frac{29}{35} \times 100 = 83\% \text{ pass}$

[2 marks]

(b) $\frac{35 + 1}{2} = 18^{\text{th}}$ piece of data which is 2 minor errors

[2 marks]

Answer 4

(a) The modal class is $60 < w \leq 70$

[1 mark]

(b)

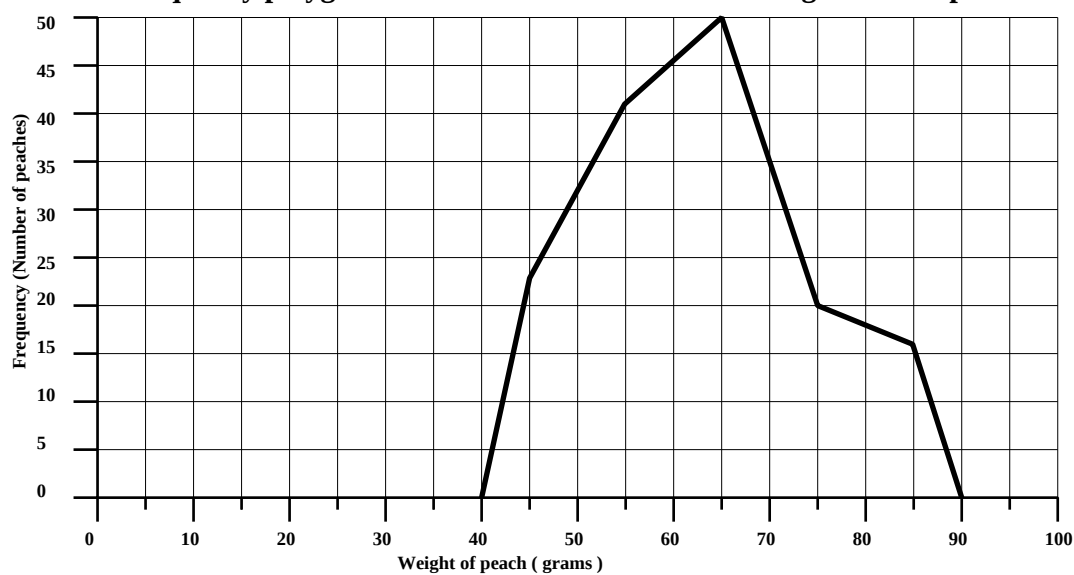
Weight (w grams)	Number of peaches	Mid Interval	Contribution to Total
$40 < w \leq 50$	23	45	1035
$50 < w \leq 60$	41	55	2255
$60 < w \leq 70$	50	65	3250
$70 < w \leq 80$	20	75	1500
$80 < w \leq 90$	16	85	1360

$$\begin{aligned} \text{mean} &= \frac{1035 + 2255 + 3250 + 1500 + 1360}{150} \\ &= \frac{9400}{150} \\ &= 63 \text{ grams} \end{aligned}$$

[4 marks]

(c)

A frequency polygon to show to distribution of the weights of 150 peaches

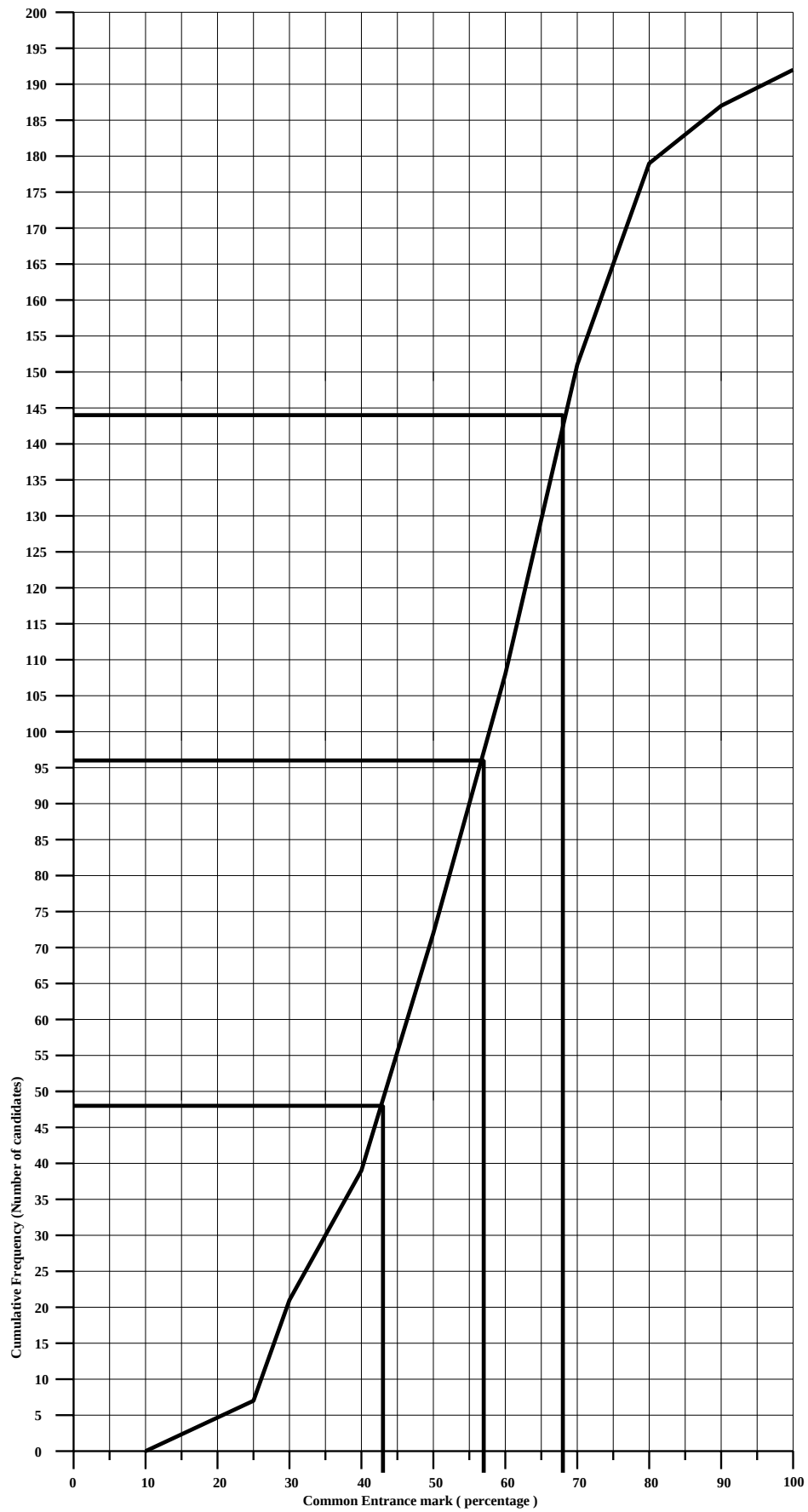


[4 marks]

Answer 5**(a)**

Mark (m percent)	Frequency	Cumulative Frequency
$1 \leq m \leq 10$	0	0
$11 \leq m \leq 20$	7	7
$21 \leq m \leq 30$	14	21
$31 \leq m \leq 40$	18	39
$41 \leq m \leq 50$	33	72
$51 \leq m \leq 60$	36	108
$61 \leq m \leq 70$	43	151
$71 \leq m \leq 80$	28	179
$81 \leq m \leq 90$	8	187
$91 \leq m \leq 100$	5	192

[3 marks]**(b)** 192 candidates**[1 mark]****(c)** 72 scored 50% or less**[1 mark]****(d)** 84 scored more than 60%**[2 marks]****(e)** See graph on the following page**[3 marks]****(f)** *From the graph,***(i)** LQ is 43**[1 mark]****(ii)** Median is 57**[1 mark]****(iii)** UQ is 72**[1 mark]****(iv)** IQR is 28**[1 mark]**



Answer 6**(a)**

Number of hours	Frequency	Mid Interval	Contribution to Total
$5 \leq h < 10$	3	7.5	22.5
$10 \leq h < 15$	2	12.5	25.0
$15 \leq h < 20$	5	17.5	87.5
$20 \leq h < 25$	9	22.5	202.5
$25 \leq h < 30$	8	27.5	220.0
$30 \leq h < 35$	4	32.5	130.0
$35 \leq h < 40$	3	37.5	112.5

[2 marks]**(b)**

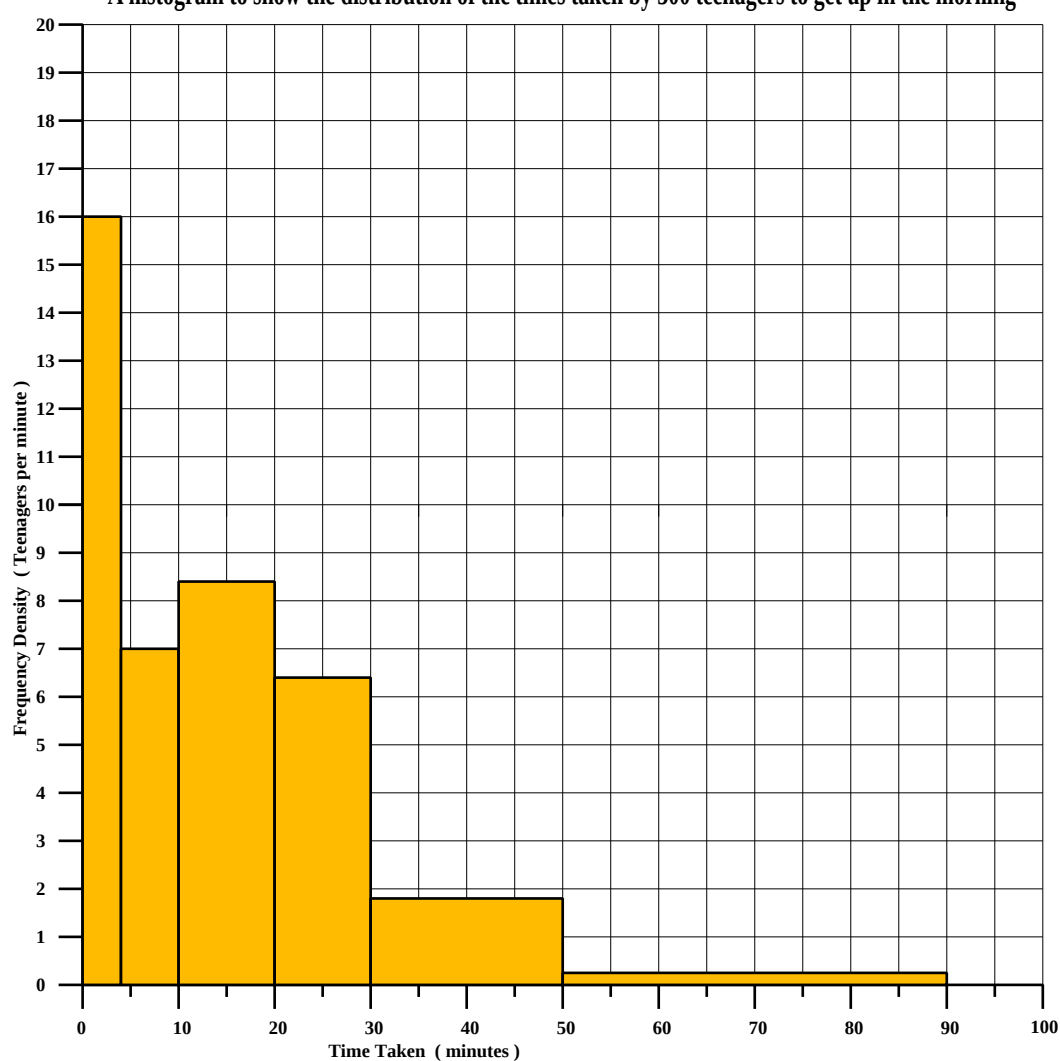
$$\begin{aligned}\text{mean} &= \frac{22.5 + 25 + 87.5 + 202.5 + 220 + 130 + 112.5}{3 + 2 + 5 + 9 + 8 + 4 + 3} \\ &= \frac{800}{34} \\ &= 23.5 \text{ hours}\end{aligned}$$

[4 marks]

Answer 7

Time Taken (t minutes)	Frequency	Width	Height
$0 < t \leq 4$	64	4	16
$4 < t \leq 10$	42	6	7
$10 < t \leq 20$	84	10	8.4
$20 < t \leq 30$	64	10	6.4
$30 < t \leq 50$	36	20	1.8
$50 < t \leq 90$	10	40	0.25

A histogram to show the distribution of the times taken by 300 teenagers to get up in the morning



[10 marks]

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Lesson 12

GCSE Mathematics Statistics II : Handelling and Processing Data

12.1 Test

Marks Available : 60

Question 1

Twenty-three hikers took part in a 30 km sponsored walk.
Here is how far each hiker walked.

21	18	27	30	14	16	20	20	28
23	17	26	19	24	19	18	15	16
21	30	26	28	26				

(a) Put the data in order.

[2 marks]

(b) Find (i) The lower quartile.

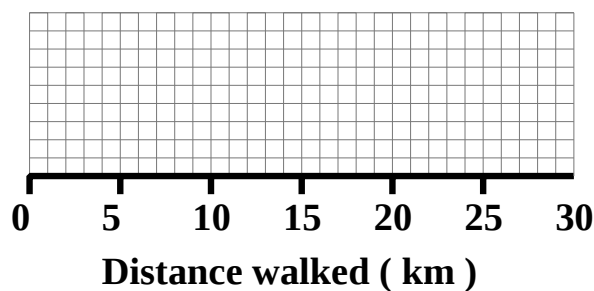
(ii) The median.

(iii) The upper quartile.

(iv) The interquartile range.

[4 marks]

(c) Plot a box and whisker diagram of the distribution of distances walked.



[5 marks]

Question 2

Twenty children were asked how they rated the new Dr Who.
Here are the results:

```

*****  ***      *****  **      *      ***      *****  *****
**      *****  *****  *****  *****  ***      *****  **

*****  *****  *****  ***

```

Number of stars	*	**	***	****	*****
Frequency					

(a) Fill in the frequency row of the table.

[3 marks]

(b) Showing your working, calculate the average (mean) star rating of the new Dr Who.

[3 marks]

Question 3

The table shows the distribution of the number of *unsatisfactory assignments* submitted by a class of 25 pupils over a two year course.

Number of unsatisfactory assignments	0	1	2	3	4	5	6	7	8	9	10
Frequency	7	5	4	4	0	2	0	0	2	0	1

(a) In assessing the course, pupils submitting three or more *unsatisfactory assignments* fail the course.

What percentage of pupils fail ?

[2 marks]

(b) What is the median number of *unsatisfactory assignments* submitted ?

[2 marks]

Question 4

The table below shows the the weights of 150 eggs from Mrs Tweedy's chicken farm.

Weight (w grams)	Number of eggs		
$30 < w \leq 40$	13		
$40 < w \leq 50$	38		
$50 < w \leq 60$	42		
$60 < w \leq 70$	35		
$70 < w \leq 80$	22		

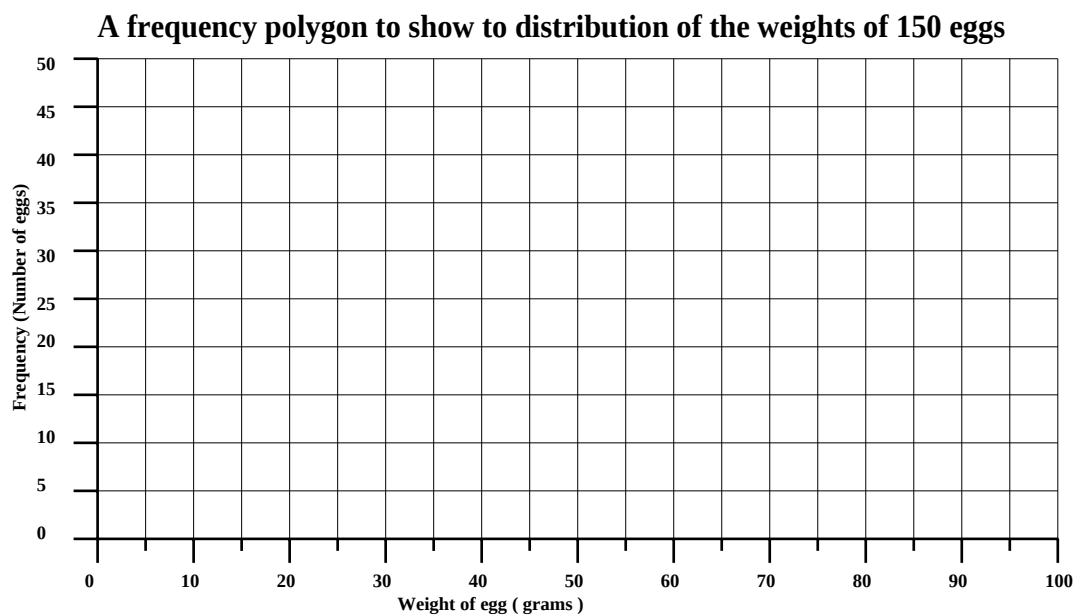
(a) What is the modal class ?

[1 mark]

(b) Showing your working, calculate an estimate of the mean weight of an egg.

[4 marks]

(c) Plot a frequency polygon to show the distribution of weights of eggs.



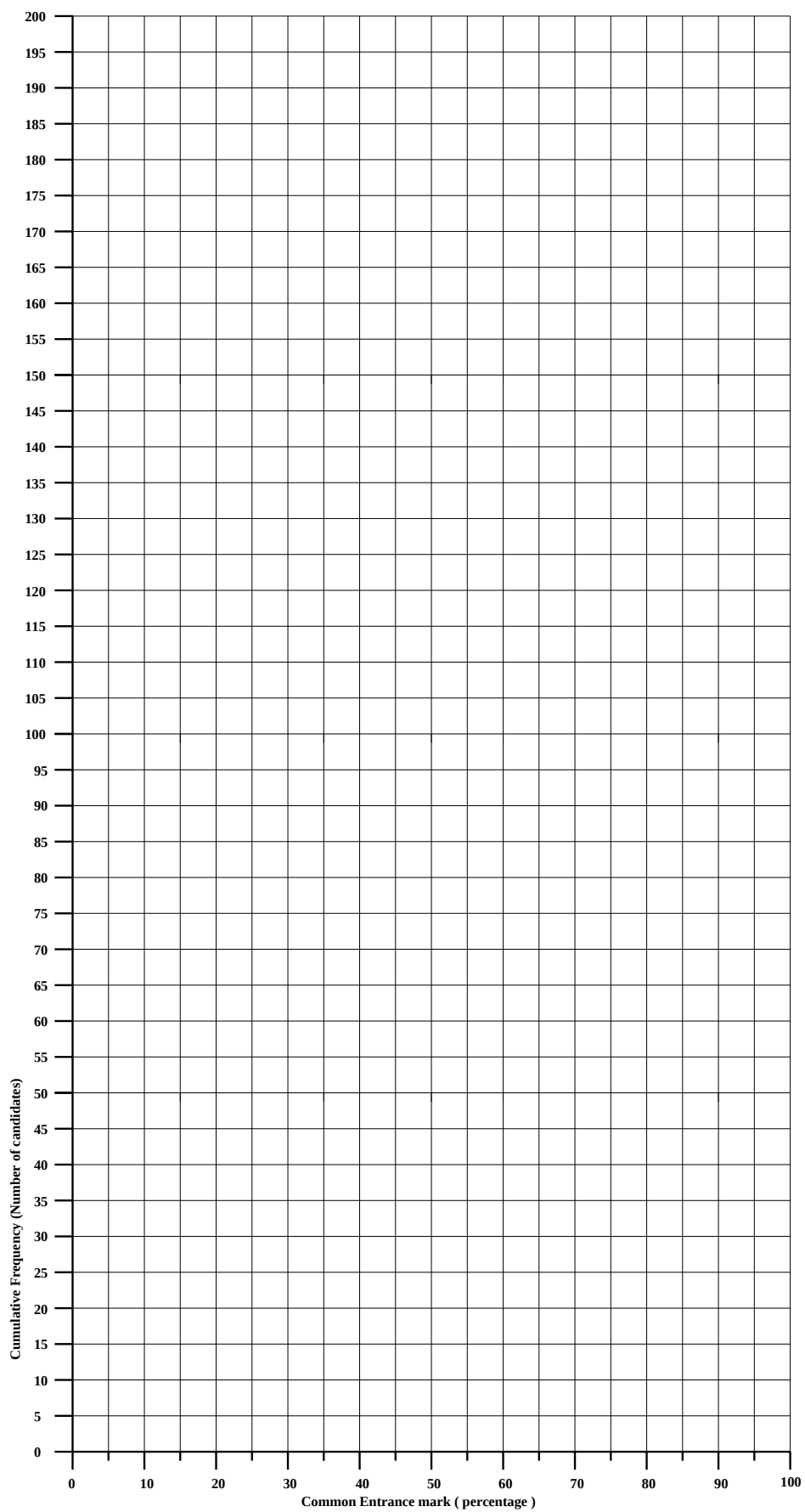
[4 marks]

Question 5

The following table shows the distribution of the marks scored by this year's common entrance candidates in their mathematics papers;

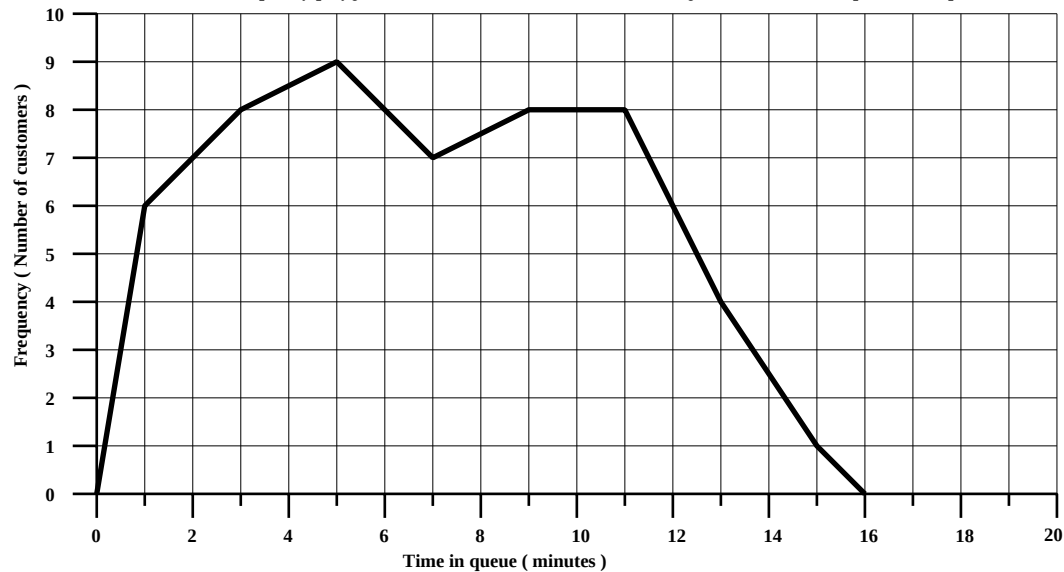
Mark (m percent)	Frequency	Cumulative Frequency
$1 \leq m \leq 10$	0	
$11 \leq m \leq 20$	5	
$21 \leq m \leq 30$	8	
$31 \leq m \leq 40$	16	
$41 \leq m \leq 50$	35	
$51 \leq m \leq 60$	41	
$61 \leq m \leq 70$	38	
$71 \leq m \leq 80$	32	
$81 \leq m \leq 90$	14	
$91 \leq m \leq 100$	11	

- (a) Complete the column headed “cumulative frequency” in the above table.
[3 marks]
- (b) How many candidates were there ?
[1 mark]
- (c) How many candidates scored 40% or less ?
[1 mark]
- (d) How many candidates scored more than 50% ?
[1 mark]
- (e) On the graph paper provided on the next page, plot the cumulative frequency curve to show the distribution of the common entrance marks.
[3 marks]
- (f) *Use your graph* to determine,
- (i) The lower quartile mark.
[1 mark]
- (ii) The median mark.
[1 mark]
- (iii) The upper quartile mark.
[1 mark]
- (iv) The interquartile range.
[1 mark]



Question 6

A frequency polygon to show the number of minutes waiting to be served in a supermarket queue



The frequency polygon shows the number of minutes spent waiting to be served in a queue at a supermarket.

(a) Use the graph to fill in the following grouped frequency table;

Number of minutes	Frequency		
$0 \leq m < 2$			
$2 \leq m < 4$			
$4 \leq m < 6$			
$6 \leq m < 8$			
$8 \leq m < 10$			
$10 \leq m < 12$			
$12 \leq m < 14$			
$14 \leq m < 16$			

[2 marks]

(b) Calculate an estimate for the mean (average) number of minutes a customer spends in a queue waiting to be served in this supermarket.
Answers without working will not be marked.

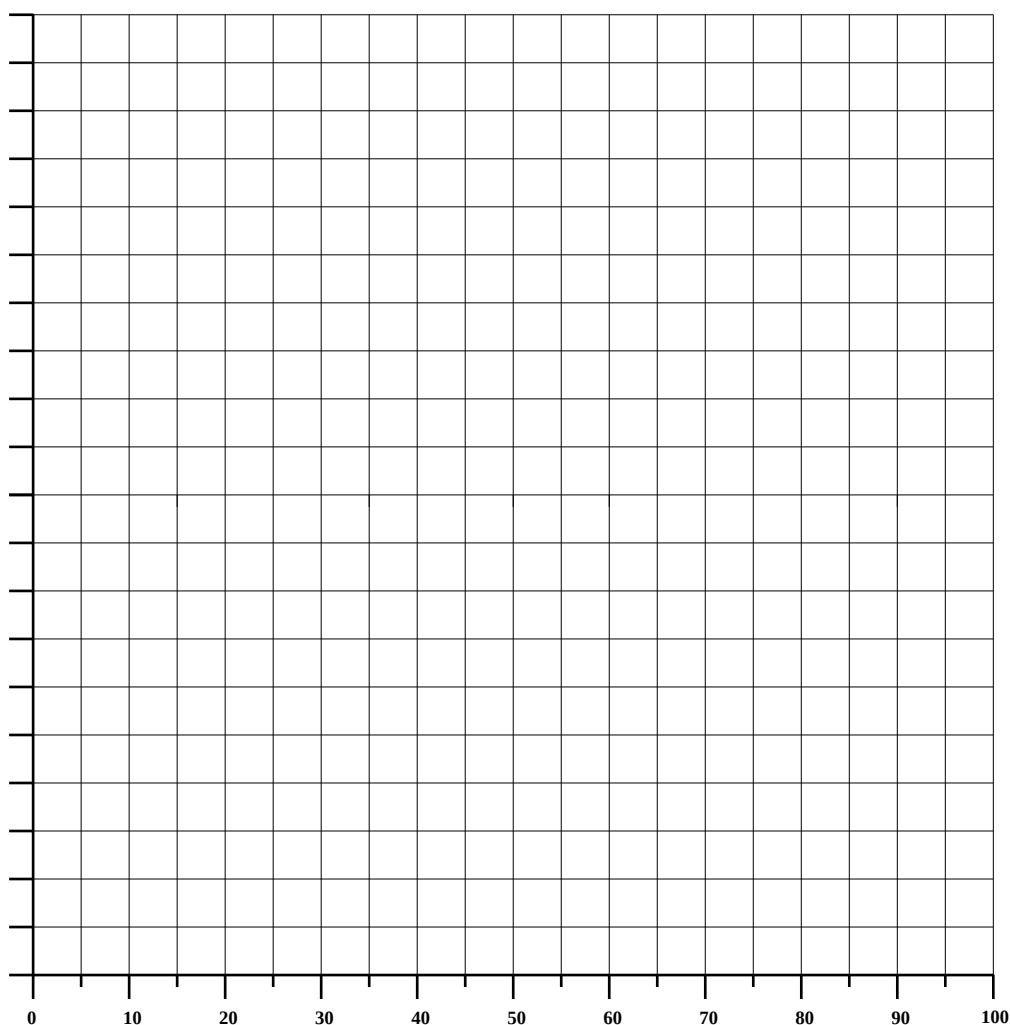
[4 marks]

Question 7

The following table shows the distribution of the times taken by 300 teenagers to get up in the morning following a 7.30 am alarm call.

Time Taken (t minutes)	Frequency	Width	Height
$0 < t \leq 4$	24		
$4 < t \leq 10$	84		
$10 < t \leq 20$	100		
$20 < t \leq 30$	60		
$30 < t \leq 50$	20		
$50 < t \leq 90$	12		

After completing the above table, draw a histogram to represent the data.



[10 marks]

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12.2 Solutions (Test)

GCSE Mathematics Statistics II : Handelling and Processing Data

Answer 1

(a) Put the data in order.

14	15	16	16	17	18	18	19
19	20	20	21	21	23	24	26
26	26	27	28	28	30	30	

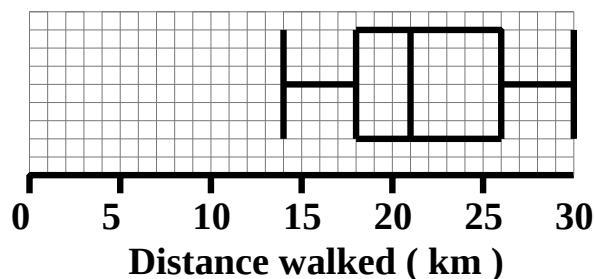
[2 marks]

(b) $\frac{23 + 1}{4} = 6^{\text{th}}$

- (i) LQ is 6th from left which is 18
- (ii) Median is 12th from either end which is 21
- (iii) UQ is 6th from right which is 26
- (iv) IQR = 8

[4 marks]

(c)



[5 marks]

Answer 2

(a)

Number of stars	*	**	***	****	*****
Frequency	1	3	4	6	6
Contribution to Total	1	6	12	24	30

[3 marks]

(b)
$$\text{mean} = \frac{1 + 6 + 12 + 24 + 30}{20}$$
$$= \frac{73}{20} = 3.65 \text{ stars}$$

[3 marks]

Answer 3

(a) $\frac{9}{25} \times 100 = 36 \% \text{ pass.}$

[2 marks]

(b) $\frac{25 + 1}{2} = 13^{\text{th}}$ which is 2 minor errors.

[2 marks]

Answer 4

(a) The modal class is $50 < w \leq 60$

[1 mark]

(b)

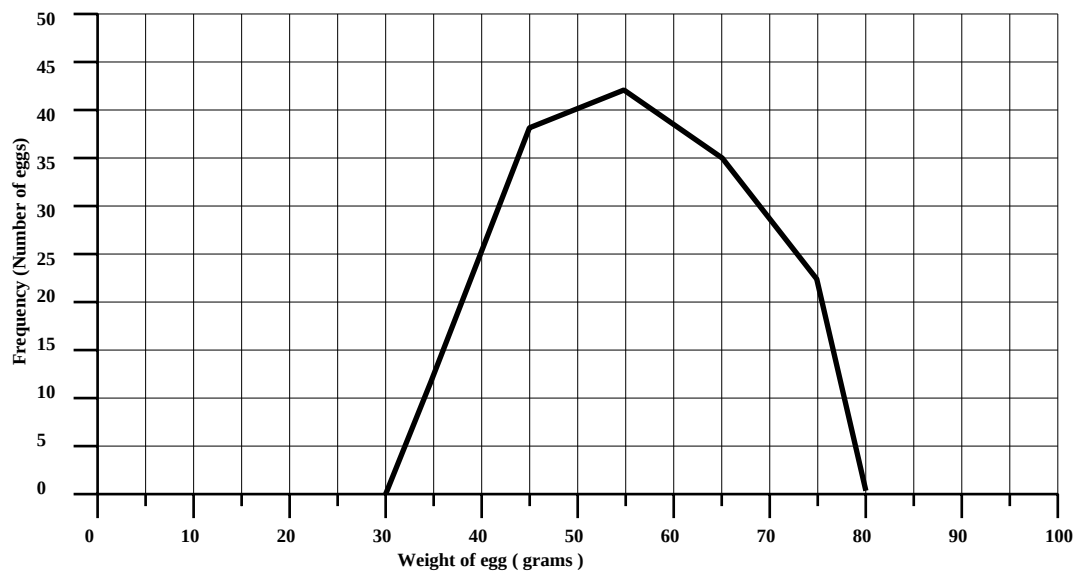
Weight (w grams)	Number of eggs	Mid Interval	Contribution to Total
$30 < w \leq 40$	13	35	455
$40 < w \leq 50$	38	45	1710
$50 < w \leq 60$	42	55	2310
$60 < w \leq 70$	35	65	2275
$70 < w \leq 80$	22	75	1650

$$\begin{aligned} \text{mean} &= \frac{455 + 1710 + 2310 + 2275 + 1650}{150} \\ &= \frac{8400}{150} \\ &= 56 \text{ grams} \end{aligned}$$

[4 marks]

(c)

A frequency polygon to show to distribution of the weights of 150 eggs

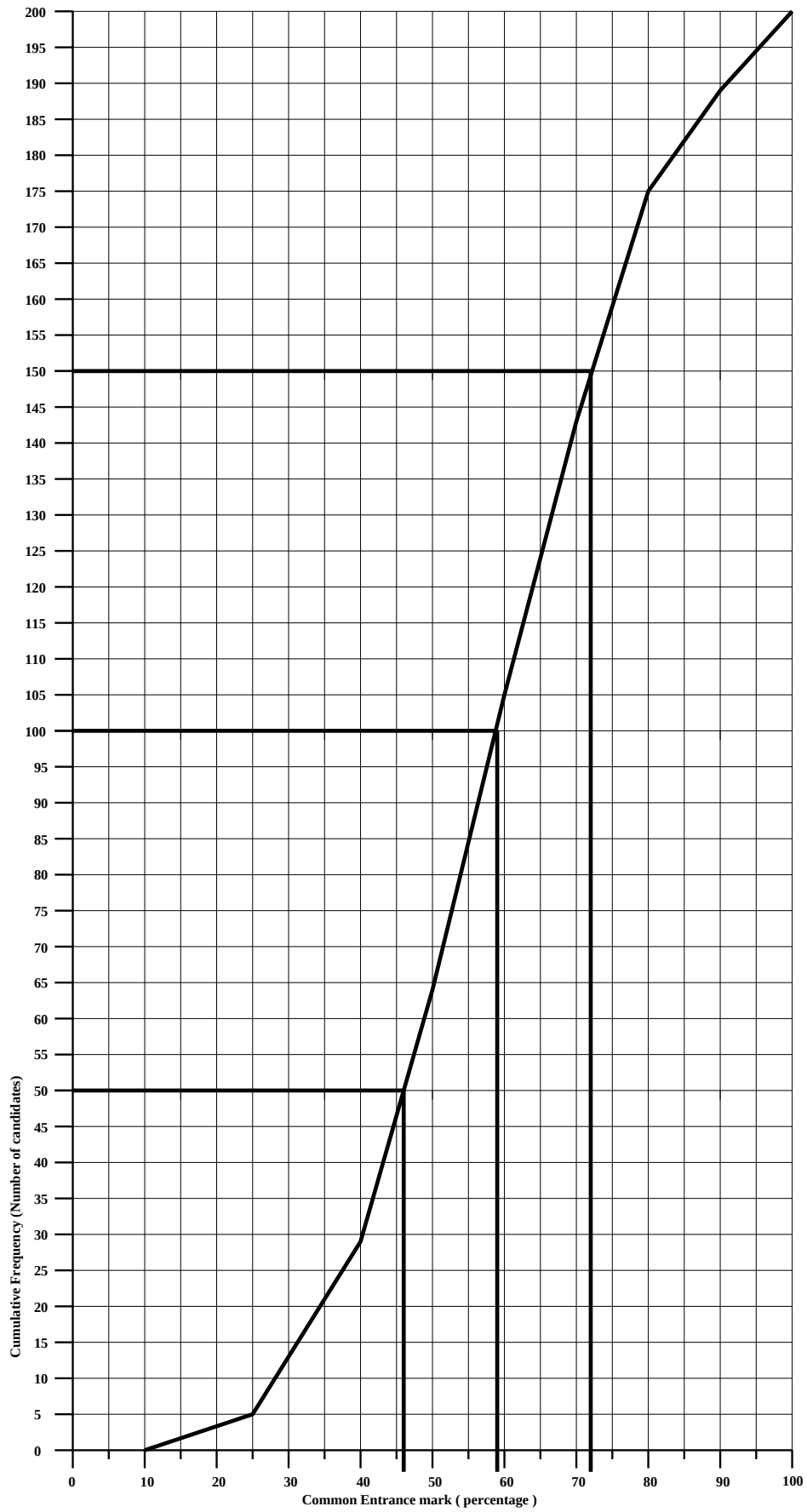


[4 marks]

Answer 5**(a)**

Mark (m percent)	Frequency	Cumulative Frequency
$1 \leq m \leq 10$	0	0
$11 \leq m \leq 20$	5	5
$21 \leq m \leq 30$	8	13
$31 \leq m \leq 40$	16	29
$41 \leq m \leq 50$	35	64
$51 \leq m \leq 60$	41	105
$61 \leq m \leq 70$	38	143
$71 \leq m \leq 80$	32	175
$81 \leq m \leq 90$	14	189
$91 \leq m \leq 100$	11	200

[3 marks]**(b)** 200 candidates**[1 mark]****(c)** 29 scored 40% or less**[1 mark]****(d)** 136 scored more than 50%**[2 marks]****(e)** See the graph on the next page.**[3 marks]****(f)** *From the graph,***(i)** LQ is 47**(ii)** Median is 57**(iii)** UQ is 72**(iv)** IQR is 25**[4 marks]**



Answer 6**(a)**

Number of minutes	Frequency	Mid Interval	Contribution to total
$0 \leq m < 2$	6	1	6
$2 \leq m < 4$	8	3	24
$4 \leq m < 6$	9	5	45
$6 \leq m < 8$	7	7	49
$8 \leq m < 10$	8	9	72
$10 \leq m < 12$	8	11	88
$12 \leq m < 14$	4	13	52
$14 \leq m < 16$	1	15	15

[2 marks]**(b)**

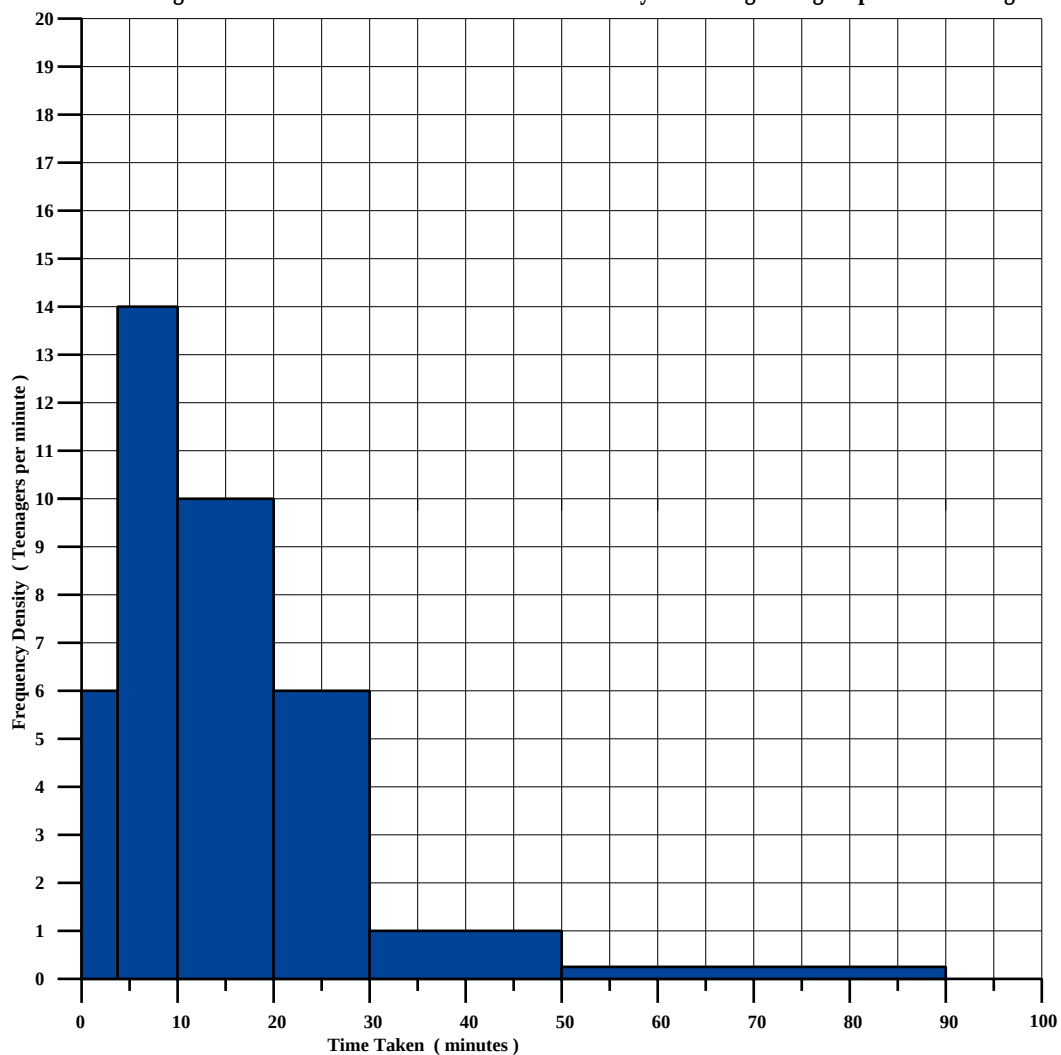
$$\begin{aligned} \text{mean} &= \frac{6 + 24 + 45 + 49 + 72 + 88 + 52 + 15}{6 + 8 + 9 + 7 + 8 + 8 + 4 + 1} \\ &= \frac{351}{51} \\ &= 6.9 \text{ minutes} \end{aligned}$$

[4 marks]

Answer 7

Time Taken (t minutes)	Frequency	Width	Height
$0 < t \leq 4$	24	4	6
$4 < t \leq 10$	84	6	14
$10 < t \leq 20$	100	10	10
$20 < t \leq 30$	60	10	6
$30 < t \leq 50$	20	20	1
$50 < t \leq 90$	12	40	0.3

A histogram to show the distribution of the times taken by 300 teenagers to get up in the morning



[10 marks]

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