HIGHER

6.11 Cumulative Frequency: Test Pack

EDEXCEL 1MA1 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 State what is meant by cumulative frequency.

(Total for Question 1 is 1 mark)

2 Which of the following statements about a cumulative frequency graph is correct?

- ☐ A) It shows the frequency of each class interval only, not a running total.
- ☐ B) It can be used to find estimates for the median and the quartiles of grouped data.
- ☐ C) It can only be drawn for ungrouped, discrete data.
- ☐ D) The cumulative frequency always decreases as the value of the variable increases.

(Total for Question 2 is 1 mark)

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3 A cumulative frequency graph for the delivery times, in minutes, of 200 parcels gives these estimates: lower quartile = 14 minutes, median = 21 minutes, upper quartile = 33 minutes.

(a) Write down the interquartile range of the delivery times. **(1)**

.....

(b) By comparing the distances of the median from each quartile, state whether the distribution of delivery times is positively skewed or negatively skewed. Give a reason. **(2)**

.....

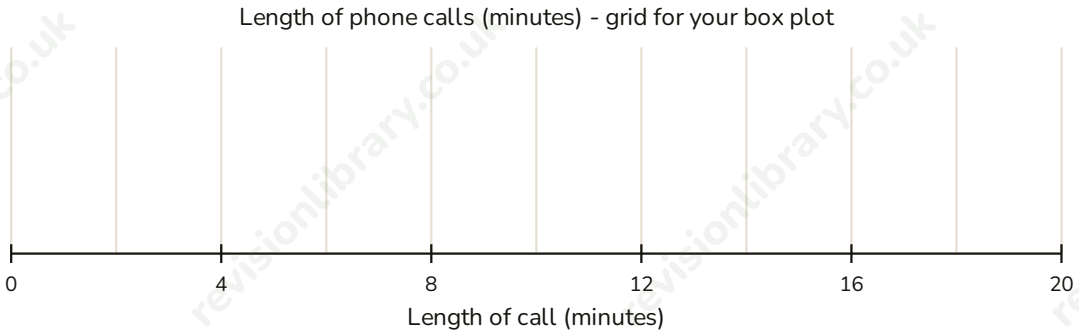
.....

(Total for Question 3 is 3 marks)

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4 The five-number summary for the length, in minutes, of 90 phone calls is:

Minimum = 1, Lower quartile = 4, Median = 7, Upper quartile = 12, Maximum = 20

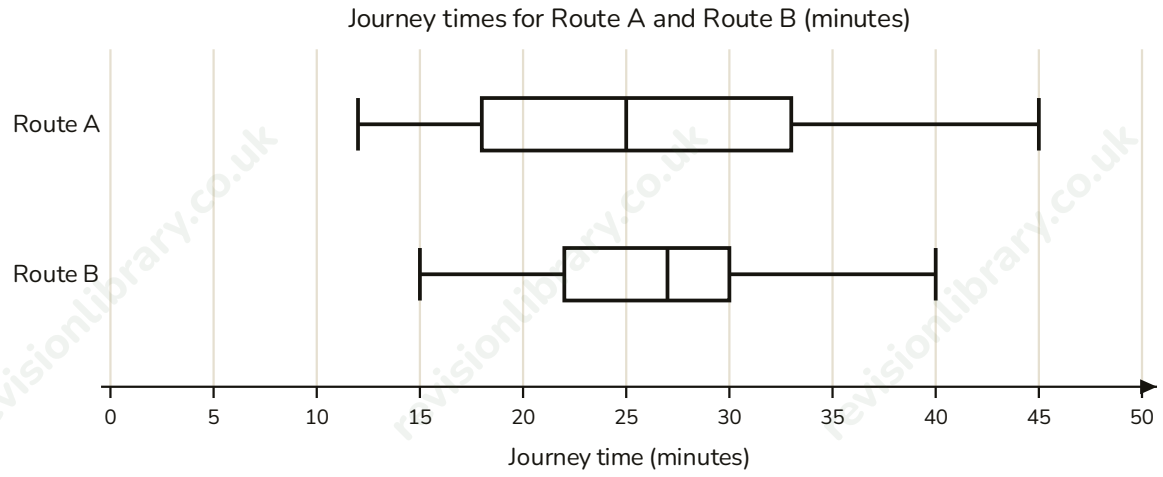


(Total for Question 4 is 4 marks)

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5 A commuter can travel to work using Route A or Route B. Box plots summarising the journey times (minutes) recorded over several weeks for each route are shown below.

Route A: minimum = 12, lower quartile = 18, median = 25, upper quartile = 33, maximum = 45
Route B: minimum = 15, lower quartile = 22, median = 27, upper quartile = 30, maximum = 40



(a) Calculate the interquartile range for Route A and for Route B. **(2)**

(b) Compare the two routes using the median journey time. **(1)**

(c) Compare the two routes using the interquartile range. **(1)**

(d) A commuter wants the most reliable, predictable journey time each day. Which route should they choose? Give a reason for your answer. **(1)**

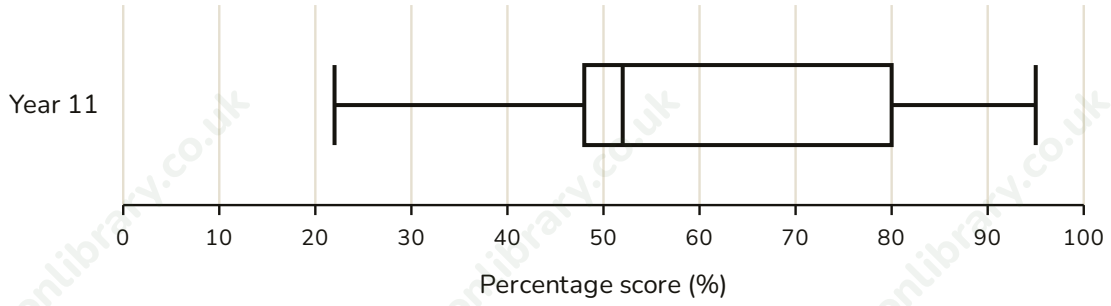
(Total for Question 5 is 5 marks)

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6 The box plot below shows the percentage scores of students in a Year 11 mock exam.

Minimum = 22, Lower quartile = 48, Median = 52, Upper quartile = 80, Maximum = 95

State, giving a reason, whether the distribution of scores is skewed, and if so in which direction.



(Total for Question 6 is 2 marks)

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7 The table shows the waiting time at a clinic (minutes) for 60 items, in grouped classes.

$40 < x \leq 60$: 4

$60 < x \leq 80$: 12

$80 < x \leq 100$: 17

$100 < x \leq 120$: 6

$120 < x \leq 140$: 4

$140 < x \leq 160$: 17

Work out the cumulative frequency for each class, in order.

(Total for Question 7 is 2 marks)

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8 The grouped frequency table shows the waiting time at a clinic (minutes) for 60 items.

$100 < x \leq 110$: 4

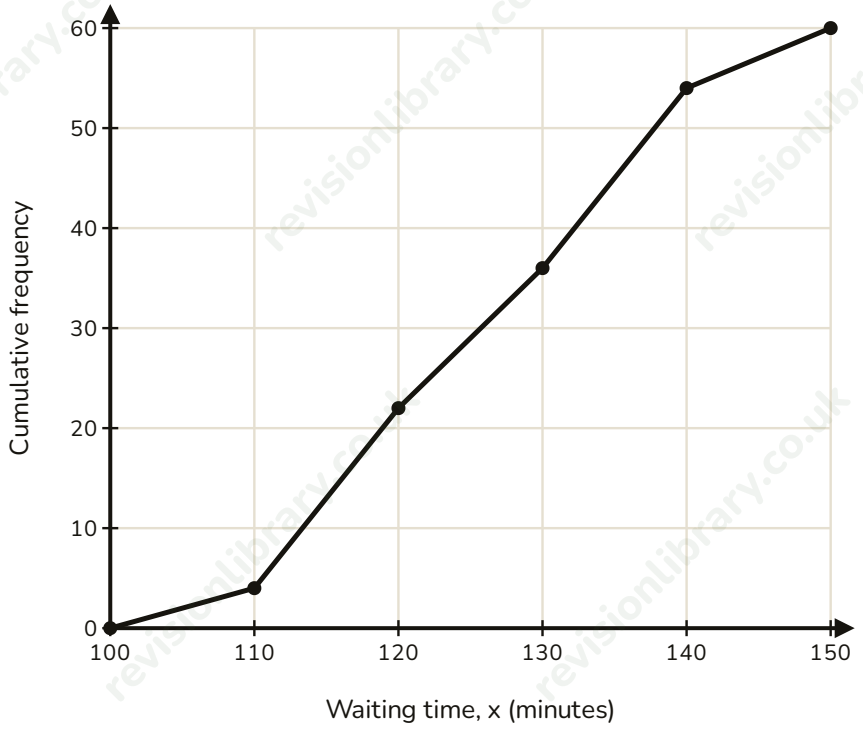
$110 < x \leq 120$: 18

$120 < x \leq 130$: 14

$130 < x \leq 140$: 18

$140 < x \leq 150$: 6

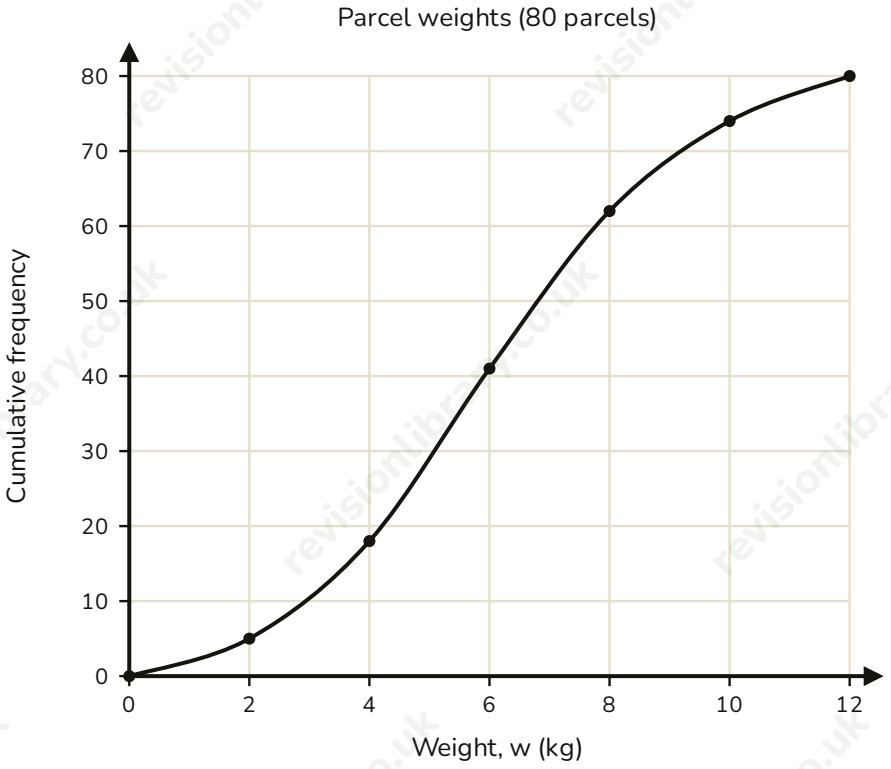
A cumulative frequency graph is drawn by plotting cumulative frequency against upper class boundary, joining the points with straight lines. Use linear interpolation to estimate the median. Give your answer to 1 decimal place.



(Total for Question 8 is 4 marks)

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9 Using the cumulative frequency graph for the parcel weights (shown again below), find an estimate for the interquartile range of the parcel weights.



(Total for Question 9 is 3 marks)

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10 Two data sets have the same range but different interquartile ranges. Explain why the interquartile range might be considered a better measure of spread than the range for comparing these data sets.

(Total for Question 10 is 2 marks)

11 For a sample of house prices, the lower quartile is £180,000 and the upper quartile is £340,000. An estate agent identifies outliers using the rule: a value is an outlier if it is more than 1.5 x IQR below the lower quartile, or more than 1.5 x IQR above the upper quartile.

(a) Work out the interquartile range. **(1)**

(b) Work out the lower and upper boundaries for outliers. **(2)**

(Total for Question 11 is 3 marks)

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12 The distances, d km, travelled to work by 100 employees of a company were recorded.

Distance, d (km)	Frequency
$0 < d \leq 5$	14
$5 < d \leq 10$	28
$10 < d \leq 15$	32
$15 < d \leq 20$	18
$20 < d \leq 25$	8



(a) Complete the cumulative frequency table below. **(2)**

Distance, d (km)	Cumulative frequency
$d \leq 5$	14
$d \leq 10$	...
$d \leq 15$	...
$d \leq 20$	...
$d \leq 25$	100

(b) State the x-coordinate you would use to plot the cumulative frequency for the class $10 < d \leq 15$. **(1)**

(c) Use the graph to estimate the median distance travelled. **(1)**

(d) Use the graph to estimate the interquartile range of the distances travelled. **(2)**

(Total for Question 12 is 6 marks)

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13 Kwame, a quality controller at a battery factory, tested the battery life, in hours, of a sample of 200 batteries. He found: the median battery life is 18 hours; the interquartile range is 6 hours; 25% of batteries lasted less than 15 hours; the range of the data is 20 hours; the shortest-lasting battery lasted 6 hours.

(a) Write down the five-number summary for this data. **(3)**

(b) The manufacturer claims: "At least 75% of our batteries last longer than 14 hours." Using your five-number summary, determine whether this claim is definitely true, definitely false, or cannot be determined. Justify your answer fully. **(4)**

(Total for Question 13 is 7 marks)

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Mark scheme · 6.11 Cumulative Frequency: Test Pack

Question 1

oe: the running total of frequencies up to (and including) that class interval/value **B1**

Answer: The running total of all the frequencies up to and including that class interval.

Question 2

B cao **B1**

Answer: B

Question 3

(a) 19 minutes cao **B1**

(a) Answer: 19 minutes

(b) comparing (median - LQ) = 7 with (UQ - median) = 12 **B1**

(b) ft: positively skewed, since the upper quartile is further from the median than the lower quartile is oe **B1**

(b) Answer: Positively skewed

Question 4

box drawn correctly from the lower quartile (4) to the upper quartile (12) **B1**

median (7) correctly marked inside the box **B1**

whiskers drawn correctly from the box to the minimum (1) and to the maximum (20) **B1**

correct linear scale used with the axis labelled (length of call, minutes) **B1**

Answer: Box plot with min 1, LQ 4, median 7, UQ 12, max 20 (minutes)

Question 5

(a) Route A IQR = 15 cao **B1**

(a) Route B IQR = 8 cao **B1**

(a) Answer: Route A: 15 minutes; Route B: 8 minutes

(b) correct comparison in context, e.g. Route B has the higher median (27 minutes) than Route A (25 minutes), so journeys on Route B tend to take slightly longer on average oe **B1**

(b) Answer: Route B has the higher median, so on average its journeys take slightly longer than Route A's.

(c) ft: correct comparison in context, e.g. Route A has a much larger IQR (15) than Route B (8), so journey times on Route A are more variable/less consistent than on Route B oe **B1**

(c) Answer: Route A's journey times are more spread out/variable than Route B's, since its IQR (15) is greater than Route B's (8).

(d) ft: Route B, because it has the smaller interquartile range (less variation in journey times) oe **B1**

(d) Answer: Route B, because its journey times are more consistent (smaller IQR).

Question 6

correct conclusion: the distribution is positively skewed (skewed to the right/towards higher scores) oe **B1**

valid reason, e.g. the gap between the upper quartile and the median (80 - 52 = 28) is much bigger than the gap between the median and the lower quartile (52 - 48 = 4), showing greater spread among the higher-scoring students oe **B1**

Answer: Positively (right) skewed

Question 7

adds frequencies progressively (at least 3 correct) **M1**

4, 16, 33, 39, 43, 60 cao **A1**

Answer: 4, 16, 33, 39, 43, 60

Question 8

cumulative frequencies found **M1**

median at 30th value **M1**

linear interpolation within the correct class **M1**

125.7 minutes (accept ±0.1) **A1**

Answer: 125.7 minutes

Question 9

identifying the lower quartile position (20th value, n/4 = 20) and interpolating, awrt 4.2 kg (accept 3.8-4.6) **M1**

identifying the upper quartile position (60th value, 3n/4 = 60) and interpolating, awrt 7.8 kg (accept 7.4-8.2) **M1**

ft: IQR = UQ - LQ, awrt 3.6 kg (accept 3.0-4.2) **A1**

Answer: awrt 3.6 kg

Question 10

the range only uses the two extreme values (the minimum and the maximum), so it can be greatly affected by an unusually small or large value (an outlier/anomaly) oe **B1**

the interquartile range is based on the middle 50% of the data, so it is not affected by extreme values/outliers and gives a more reliable/representative measure of spread oe **B1**

Answer: The IQR is less affected by outliers/extreme values than the range, since it only considers the middle 50% of the data.

Question 11

(a) £160,000 cao **B1**

(a) Answer: £160,000

(b) 1.5 x their IQR (= 240,000) used correctly in at least one boundary calculation **M1**

(b) lower boundary = -£60,000 and upper boundary = £580,000, both cao (ft) **A1**

(b) Answer: Lower boundary = -£60,000 (so no house price could be a low outlier); upper boundary = £580,000

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Question 12

(a) at least two of d ≤ 10 : 42, d ≤ 15 : 74, d ≤ 20 : 92 correct **B1**

(a) all three values correct: d ≤ 10 : 42, d ≤ 15 : 74, d ≤ 20 : 92 **B1**

(a) Answer: d ≤ 10 : 42, d ≤ 15 : 74, d ≤ 20 : 92

(b) 15 cao **B1**

(b) Answer: 15

(c) ft: awrt 11.3 km (accept 11.0-11.5) **B1**

(c) Answer: approx 11.3 km

(d) ft: correct interpolation (or graph reading) for both the lower quartile (25th value, awrt 7.0 km) and the upper quartile (75th value, awrt 15.3 km) **M1**

(d) ft: awrt 8.3 km (accept 7.8-8.8) **A1**

(d) Answer: approx 8.3 km

Question 13

(a) maximum = 6 + 20 (= 26), using range = maximum - minimum **M1**

(a) upper quartile = 15 + 6 (= 21), using IQR = upper quartile - lower quartile, with lower quartile = 15 **M1**

(a) all five values correct: minimum 6, lower quartile 15, median 18, upper quartile 21, maximum 26 **A1**

(a) Answer: Minimum = 6, lower quartile = 15, median = 18, upper quartile = 21, maximum = 26 (all in hours)

(b) recognising that the lower quartile of 15 hours means exactly 25% of batteries lasted less than 15 hours, so the remaining 75% lasted 15 hours or more **M1**

(b) recognising that 15 hours is itself greater than 14 hours **M1**

(b) concluding that every battery in that 75% (lasting 15 hours or more) therefore also lasted longer than 14 hours **A1**

(b) cso: the claim is definitely TRUE, since at least 75% (in fact exactly the top 75%) of batteries lasted 15 hours or more, which is more than 14 hours **A1**

(b) Answer: Definitely true.

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