

Histograms, cumulative frequency and box plots

Higher tier | Total marks: 100

Marks

- M** Method mark, for a correct method. It can be implied by a correct answer.
- A** Accuracy mark, for a correct answer. It needs the method mark before it.
- B** A mark for a correct value or statement, with or without working.
- ft** Follow through: the mark is given for using an earlier wrong answer correctly.
- oe** Or equivalent.
- [a, b]** Any value from a to b inclusive.

Questions

Q	Skill	Spec	Tier	Grade	Calculator	Marks
1	Drawing a box plot	S4	Higher	5	No	3
2	Comparing box plots to make a decision	S4	Higher	6	No	3
3	Interpreting a box plot	S4	Higher	6	No	4
4	Drawing and using a cumulative frequency graph	S3	Higher	6	No	6
5	Quartiles from a stem and leaf diagram	S4	Higher	6	No	4
6	Histogram and table: completing each from the other	S3	Higher	7	No	4
7	Matching a box plot to a cumulative frequency graph	S3 S4	Higher	7	No	2
8	Histogram with no vertical scale	S3	Higher	8	No	3
9	Histogram: the scale from a difference, and part of a class	S3	Higher	8	No	5
10	A value from a probability on a histogram	S3 P3	Higher	9	No	4
11	Cumulative frequency: a percentage and a cut-off	S3	Higher	6	Yes	5
12	From a cumulative frequency graph to a box plot	S3 S4	Higher	7	Yes	7
13	Drawing a histogram with unequal class widths	S3	Higher	7	Yes	4
14	Estimating a frequency from a histogram	S3	Higher	7	Yes	3
15	Estimating the mean from a histogram	S3 S4	Higher	7	Yes	5
16	Counts from box plots of two groups	S4	Higher	7	Yes	4

Q	Skill	Spec	Tier	Grade	Calculator	Marks
17	Estimating the median from a histogram	S3 S4	Higher	8	Yes	4
18	Histogram with combined probability	S3 P9	Higher	8	Yes	4
19	Cumulative frequency and a probability without replacement	S3 P9	Higher	8	Yes	5
20	Estimating the mean from a cumulative frequency graph	S3 S4	Higher	8	Yes	5
21	Histogram: a missing frequency from the median	S3 S4	Higher	9	Yes	5
22	The end of the last class from the estimated mean	S3 S4 A18	Higher	9	Yes	5
23	Two cumulative frequency graphs: a pass mark and a probability	S3 P9	Higher	9	Yes	6
	Total					100

Question 1 S4 · Higher · Grade 5 · 3 marks

Q	Answer	Mark	Comments
1	11 + 9 or 20, or 4 + 32 or 36	M1	the upper quartile or the longest time
	fully correct box plot: 4, 11, 15, 20, 36	B2	± half a small square. B1 for a box plot with at least three of the five values correct

Question 2 S4 · Higher · Grade 6 · 3 marks

Q	Answer	Mark	Comments
2	compares the medians in context	B1	eg the median for A (501 g) is closer to 500 g than B's (506 g)
	compares the interquartile ranges in context	B1	eg A's masses are more consistent as its IQR is 9 g and B's is 13 g
	Machine A, with both reasons	B1	a comparison of ranges alone does not get this mark

Question 3 S4 · Higher · Grade 6 · 4 marks

Q	Answer	Mark	Comments
3(a)	12	B1	
3(b)	$\frac{1}{4} \times 240$	M1	oe, 34 is the upper quartile
	60	A1	
3(c)	No, with a reason	B1	eg each part has 25% of the people, or 60 people in each; the longer part shows the ages are more spread out

Question 4 S3 · Higher · Grade 6 · 6 marks

Q	Answer	Mark	Comments
4(a)	10, 26, 50, 66, 76, 80	B1	
4(b)	at least five points plotted correctly at the upper class boundaries	B1	(5, 10), (10, 26), (15, 50), (20, 66), (25, 76), (30, 80) ± half a small square, ft their table
	a smooth curve or straight lines through their points, starting at (0, 0)	B1	
4(c)	12.9	B1ft	accept [12, 14], or ft their graph at 40
4(d)	reads their graph at 22 minutes	M1	eg 70
	10	A1ft	accept [8, 12], or 80 – their reading

Question 5 S4 · Higher · Grade 6 · 4 marks

Q	Answer	Mark	Comments
5(a)	75	B1	
5(b)	71 and 80 identified as the quartiles	M1	the 5th and 15th scores
	9	A1	
5(c)	76	B1	

Question 6 S3 · Higher · Grade 7 · 4 marks

Q	Answer	Mark	Comments
6(a)	15, 40 and 50	B2	B1 for one or two correct
6(b)	bar for $10 < l \leq 15$ at height 5	B1	
	bar for $30 < l \leq 50$ at height 1	B1	

Question 7 S3 S4 · Higher · Grade 7 · 2 marks

Q	Answer	Mark	Comments
7	B	B1	
	a correct reason	B1	eg the median is about 27 and the quartiles are about 20 and 34. The reason must rule out C (same median, wrong quartiles) as well as A

Question 8 S3 · Higher · Grade 8 · 3 marks

Q	Answer	Mark	Comments
8	a correct scale, eg each small square stands for 0.2 cars, or the 20 to 30 bar has a frequency density of 1.6	M1	oe, any correct method to link area to frequency
	at least two more correct frequencies from 22, 26, 24, 12	M1	
	100	A1	

Question 9 S3 · Higher · Grade 8 · 5 marks

Q	Answer	Mark	Comments
9	the bars for 0 to 10 and 20 to 30 compared, eg 45 and 105 small squares	M1	or heights 9 and 21 squares with equal widths
	a correct scale, eg 5 small squares for 1 person, or 60 squares for 12 people	M1	oe, or frequency densities 0.9 and 2.1
	$\frac{5}{20} \times 24$ or 6	M1	the people from 45 to 50
	12 in the class 50 to 80	M1	oe
	18	A1	

Question 10 S3 P3 · Higher · Grade 9 · 4 marks

Q	Answer	Mark	Comments
10	a total of 100 fish	M1	or at least three correct frequencies from 12, 30, 30, 16, 12
	$0.45 \times 100 = 45$ and $9 \times 2 = 18$ from 16 to 25	M1	oe
	$(45 - 18) \div 6 (= 4.5)$	M1	oe, the length needed in the class 25 to 30
	29.5	A1	

Question 11 S3 · Higher · Grade 6 · 5 marks

Q	Answer	Mark	Comments
11(a)	53	B1	accept [52, 55]
11(b)	reads the graph at 52 minutes (about 70)	M1	accept [67, 74]
	44	A1	accept [42.1, 45.9], their reading $\div 160 \times 100$
11(c)	$0.2 \times 160 = 32$	M1	oe, and reads across at 32
	47	A1	accept [45, 48]

Question 12 S3 S4 · Higher · Grade 7 · 7 marks

Q	Answer	Mark	Comments
12(a)	reads the graph at 30 and 90	M1	eg 140 and 171
	31	A1	accept [29, 34]
12(b)	median read as 155	B1	accept [153, 157]
	fully correct box plot	B2ft	ft their quartiles and median. B1 for at least three of the five values plotted correctly
12(c)	reads the graph at 175 (about 96) and subtracts from 120	M1	oe
	20	A1	accept [18, 23]

Question 13 S3 · Higher · Grade 7 · 4 marks

Q	Answer	Mark	Comments
13(a)	frequency densities 0.6, 1.8, 2.6, 1.5, 0.4	B1	at least three correct, may be seen in the table or implied by bars
	all five bars correct	B2	$\pm$ half a small square. B1 for at least three bars correct
13(b)	an explanation	B1	eg the area, not the height, shows the frequency; the class is twice as wide so its frequency density is lower

Question 14 S3 · Higher · Grade 7 · 3 marks

Q	Answer	Mark	Comments
14	12 (from 5 to 6) or 18 (from 8 to 10)	M1	oe, a correct part of a class
	their 12 + 38 + their 18	M1	oe
	68	A1	

Question 15 S3 S4 · Higher · Grade 7 · 5 marks

Q	Answer	Mark	Comments
15(a)	at least three correct frequencies from 8, 18, 36, 30, 18	M1	frequency density × class width
	$5 \times 8 + 12.5 \times 18 + 17.5 \times 36 + 21.5 \times 30 + 27.5 \times 18 (= 2035)$	M1	oe, at least three products of midpoints and their frequencies
	their 2035 ÷ their 110	M1	dep on the first M1
	18.5	A1	
15(b)	$\frac{9}{55}$	B1ft	oe, eg $\frac{18}{110}$, ft their frequencies

Question 16 S4 · Higher · Grade 7 · 4 marks

Q	Answer	Mark	Comments
16	£36 000 is the upper quartile for A or the median for B	M1	may be implied
	$\frac{1}{4} \times 436 (= 109)$ or $\frac{1}{2} \times 618 (= 309)$	M1	oe
	$\frac{1}{4} \times 436 + \frac{1}{2} \times 618$	M1	oe
	418	A1	

Question 17 S3 S4 · Higher · Grade 8 · 4 marks

Q	Answer	Mark	Comments
17	at least three correct frequencies from 12, 18, 24, 26, 10	M1	
	45th value, in the class $15 < t \leq 20$	M1	oe, eg $12 + 18 = 30$, so 15 more are needed
	$15 + \frac{15}{24} \times 5$	M1	oe
	18.1	A1	accept [18, 18.3], eg 18.2 from the 45.5th value

Question 18 S3 P9 · Higher · Grade 8 · 4 marks

Q	Answer	Mark	Comments
18	9 and 4, or 13 videos longer than 30 minutes	M1	
	$\frac{13}{50}$ or $\frac{12}{49}$	M1	ft their 13
	$\frac{13}{50} \times \frac{12}{49}$	M1	oe, ft their 13
	$\frac{78}{1225}$	A1	oe, eg $\frac{156}{2450}$, or 0.0637 or better

Question 19 S3 P9 · Higher · Grade 8 · 5 marks

Q	Answer	Mark	Comments
19(a)	reads the graph at 73 g (about 162)	M1	accept [159, 165]
	38	A1	accept [35, 41], 200 – their reading
19(b)	reads the graph at 63 g and finds about 128 eggs over 63 g	M1	accept [125, 131]
	$\frac{38}{128} \times \frac{37}{127}$	M1	oe, ft their numbers
	0.086	A1	oe, accept [0.069, 0.106]

Question 20 S3 S4 · Higher · Grade 8 · 5 marks

Q	Answer	Mark	Comments
20(a)	frequencies 12, 24, 40, 28, 16	M1	at least four correct, from the differences of the cumulative frequencies
	$2 \times 12 + 6 \times 24 + 10 \times 40 + 14 \times 28 + 20 \times 16 (= 1280)$	M1	oe, at least four products with midpoints
	their $1280 \div 120$	M1	dep on the second M1
	10.7	A1	accept 10.7 or [10.66, 10.67]
20(b)	10.4	B1	accept [10.2, 10.6]

Question 21 S3 S4 · Higher · Grade 9 · 5 marks

Q	Answer	Mark	Comments
21(a)	at least three correct frequencies from 12, 20, 30, 26, 8	M1	
	$12 + 20 + \frac{8}{10} \times 30$ or 56	M1	oe, the median is the 56th value
	$2 \times \text{their } 56 - (12 + 20 + 30 + 26 + 8)$	M1	oe, 112 – 96
	16	A1	accept 15 from using the $\frac{n+1}{2}$ th value
21(b)	bar for $40 < t \leq 60$ at height 0.8	B1ft	ft their (a) $\div 20$

Question 22 S3 S4 A18 · Higher · Grade 9 · 5 marks

Q	Answer	Mark	Comments
22	at least three correct frequencies from 12, 24, 30, 24	M1	frequency density $\times$ class width
	$0.5(k - 60)$ and midpoint $\frac{60 + k}{2}$ for the last class	M1	oe
	$\frac{2970 + 0.25(k^2 - 3600)}{90 + 0.5(k - 60)} = 36.7$	M1	oe, 2970 from $10 \times 12 + 25 \times 24 + 35 \times 30 + 50 \times 24$
	$0.25k^2 - 18.35k - 132 = 0$ and a correct method to solve it	M1	oe, eg $k^2 - 73.4k - 528 = 0$
	80	A1	with -6.6 rejected or not given

Question 23 S3 P9 · Higher · Grade 9 · 6 marks

Q	Answer	Mark	Comments
23(a)	30% of 280 = 84 students fail	M1	oe
	reads both graphs at the same score and adds, aiming for 84	M1	eg at 50: $58 + 30 = 88$
	49	A1	accept [48, 51]
23(b)	196 students passed	M1	oe, $280 - 84$
	120 – their reading of the girls' graph at their pass mark	M1	eg at 49: $120 - 28 = 92$
	0.47	A1	accept [0.43, 0.5], or a fraction such as $\frac{92}{196}$