



KS3.M-S8 Grouped Data and the Estimated Mean

AQA KS3.M-S8 · Calculators not allowed · about 70 minutes

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

- 1** Here are five class intervals and their frequencies for the ages of pupils in a club. State the modal class and give a reason.
Class intervals: 9-11 (5 pupils), 12-14 (12 pupils), 15-17 (9 pupils), 18-20 (3 pupils), 21-23 (1 pupil).

(a) State the modal class and give a brief reason. (1)

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- 2** Give the midpoints of these class intervals.

(a) Find the midpoint of 20-24. (1)

(b) Find the midpoint of 35-39. (1)

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- 3** Use midpoints to estimate the mean for the grouped data. Show your working.
Class intervals: 10-14 (6), 15-19 (10), 20-24 (8).

(a) Use midpoints to estimate the mean age. (3)

- 4** Identify the modal class and explain how you know. Then estimate the mean using midpoints.

Class intervals and frequencies: 0-9 (4), 10-19 (14), 20-29 (9), 30-39 (3).

(a) State the modal class and give a brief reason. (1)

(b) Estimate the mean for the data above using midpoints. (3)

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- 5** A frequency table is given. Complete the table by finding the missing frequency and then find the estimated mean.

Class intervals: 40-49 (7), 50-59 (k), 60-69 (5). Total number of items is 20.

(a) Find k. (1)

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(b) Using midpoints, estimate the mean for the completed table. (2)

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- 6** Work out the midpoint and show how it is used to estimate the mean for a single class with its frequency.

Class 70-79 with frequency 4.

(a) Find the midpoint and the contribution to total fx . (2)

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- 7** A teacher records times in seconds taken by 25 pupils to run 100 m and groups them as follows. Identify the modal class and estimate the mean time.
Class intervals: 10-12 (3), 13-15 (9), 16-18 (8), 19-21 (5).
- (a) State the modal class and explain why. (1)
- (b) Estimate the mean time using midpoints. (3)
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- 8** Complete the grouped frequency table and estimate the mean. The class widths are equal.
Class intervals: 1-3 (4), 4-6 (6), 7-9 (k), 10-12 (5). Total frequency is 25 and total fx is 173. Find k and then the estimated mean.
- (a) Find k , the missing frequency for class 7-9. (1)
- (b) Using the given total $fx = 173$, state the estimated mean for the table. (3)

9 A survey records number of books read by 30 pupils in a term. The grouped data is:
0-1 (4), 2-3 (8), 4-5 (10), 6-7 (6), 8-9 (2).

Find the modal class and estimate the mean. Explain each step.

(a) State the modal class and explain why. (1)

(b) Calculate midpoints, fx values and then the estimated mean. Show all working. (5)

10 Longer reasoning: A company records daily faults found on machines over 40 days.
Grouped data:

0-1 (12), 2-3 (14), 4-5 (8), 6-7 (6). Estimate the mean number of faults per day and identify the modal class. Comment on whether the modal class is a good indicator of the typical day compared with the mean.

(a) Estimate the mean number of faults per day using midpoints. (3)

(b) Identify the modal class and give a short comment comparing modal class with the mean as indicators of a typical day. (3)

11 Stretch problem 1. A science club measures the heights in cm of 28 students and groups the results as follows:

130-134 (4), 135-139 (6), 140-144 (8), 145-149 (6), 150-154 (4).

(a) Estimate the mean height. (b) Suppose two new students join with heights 160 cm and 162 cm and are added to class 160-163 (which would be 160-163 for calculation). Recalculate an approximate mean using the same grouped method and comment on how the mean changes.

(a) Estimate the mean height from the original grouped data. (4)

(b) Add two new heights 160 and 162 cm in a class with midpoint 161 and recalculate the estimated mean. Comment on the change. (3)

12 Stretch problem 2. A researcher gives grouped marks for a test out of 60: 0-11 (2), 12-23 (5), 24-35 (14), 36-47 (8), 48-59 (1).

(a) Estimate the mean test score. (b) The researcher realises that the top group should be 48-60 inclusive and that its midpoint should be 54. Recompute the mean using midpoint 54 for that group and state the difference between the two estimated means. Explain why changing the class boundary affects the mean estimate.

(a) Estimate the mean using midpoints 5.5, 17.5, 29.5, 41.5, 53.5. (4)

(b) Recompute the mean using midpoint 54 for the top group and state the difference. Explain why this change affects the mean. (3)

Mark scheme · KS3.M-S8 Grouped Data and the Estimated Mean

Question 1

- (a) **B1** 12-14 is modal class, highest frequency
- (a) Answer: **12-14**

Question 2

- (a) **B1** 22 cao
- (a) Answer: **22**
- (b) **B1** 37 cao
- (b) Answer: **37**

Question 3

- (a) **M1** midpoints 12, 17, 22 used and multiplied by frequencies or equivalent method
- (a) **M1** sum of fx calculated: $12 \times 6 + 17 \times 10 + 22 \times 8 = 72 + 170 + 176 = 418$
- (a) **A1** mean = $418 / 24 = 17.416\ldots$ so 17.4 to 1 dp cao
- (a) Answer: **17.4**

Question 4

- (a) **B1** 10-19, it has the highest frequency
- (a) Answer: **10-19**
- (b) **M1** midpoints 4.5, 14.5, 24.5, 34.5 used and fx method shown
- (b) **M1** correct total fx : $4.5 \times 4 + 14.5 \times 14 + 24.5 \times 9 + 34.5 \times 3 = 18 + 203 + 220.5 + 103.5 = 545$
- (b) **A1** mean = $545 / 30 = 18.166\ldots$ so 18.2 to 1 dp cao
- (b) Answer: **18.2**

Question 5

- (a) **B1** $k = 8$ cao
- (a) Answer: **8**
- (b) **M1** midpoints 44.5, 54.5, 64.5 used and fx calculated: $44.5 \times 7 + 54.5 \times 8 + 64.5 \times 5$
- (b) **A1** mean = $(311.5 + 436 + 322.5) / 20 = 1070 / 20 = 53.5$ cao
- (b) Answer: **53.5**

Question 6

- (a) **M1** midpoint 74.5 and multiply by frequency
- (a) **A1** midpoint 74.5; fx contribution $74.5 \times 4 = 298$ cao
- (a) Answer: **Midpoint 74.5; contribution 298**

Question 7

- (a) **B1** 13-15, highest frequency of 9
- (a) Answer: **13-15**
- (b) **M1** midpoints 11, 14, 17, 20 used and fx calculated
- (b) **M1** total $fx = 11 \times 3 + 14 \times 9 + 17 \times 8 + 20 \times 5 = 33 + 126 + 136 + 100 = 395$
- (b) **A1** mean = $395 / 25 = 15.8$ seconds cao
- (b) Answer: **15.8**

Question 8

- (a) **B1** $k = 10$ cao
- (a) **Answer: 10**
- (b) **M1** use total fx 173 and total f 25 in mean calculation
- (b) **A1** mean = $173 / 25 = 6.92$ so 6.92 to 2 dp or 6.9 to 1 dp cao
- (b) **A1** final answer stated as 6.92 (or 6.9 to 1 dp) cao
- (b) **Answer: 6.92**

Question 9

- (a) **B1** 4-5, highest frequency 10
- (a) **Answer: 4-5**
- (b) **M1** midpoints 0.5, 2.5, 4.5, 6.5, 8.5 used and multiplied by frequencies
- (b) **M1** fx values: $0.5 \times 4 = 2$, $2.5 \times 8 = 20$, $4.5 \times 10 = 45$, $6.5 \times 6 = 39$, $8.5 \times 2 = 17$ and sum fx computed
- (b) **M1** sum $fx = 2 + 20 + 45 + 39 + 17 = 123$
- (b) **M1** total $f = 30$ used
- (b) **A1** mean = $123 / 30 = 4.1$ books cao
- (b) **Answer: 4.1**

Question 10

- (a) **M1** midpoints 0.5, 2.5, 4.5, 6.5 used and fx calculated
- (a) **M1** total $fx = 0.5 \times 12 + 2.5 \times 14 + 4.5 \times 8 + 6.5 \times 6 = 6 + 35 + 36 + 39 = 116$
- (a) **A1** mean = $116 / 40 = 2.9$ faults per day cao
- (a) **Answer: 2.9**
- (b) **B1** modal class 2-3, highest frequency 14
- (b) **M1** comment that modal class shows most common class while mean gives average value
- (b) **A1** conclusion: mean 2.9 is close to modal class 2-3 so both indicate similar typical day, but mean may be influenced by higher classes so mean gives a precise average while modal class indicates most frequent range
- (b) **Answer: Modal class 2-3; mean 2.9 so both suggest around 2 to 3 faults per day, but mean is an average and modal class only shows most frequent range**

Question 11

- (a) **M1** midpoints 132, 137, 142, 147, 152 used and fx calculated
- (a) **M1** fx values: $132 \times 4 = 528$, $137 \times 6 = 822$, $142 \times 8 = 1136$, $147 \times 6 = 882$, $152 \times 4 = 608$
- (a) **M1** sum $fx = 528 + 822 + 1136 + 882 + 608 = 3976$
- (a) **A1** mean = $3976 / 28 = 142.0$ cm cao
- (a) **Answer: 142.0**
- (b) **M1** add fx contribution for midpoint $161 \times 2 = 322$ and new total $f = 30$
- (b) **M1** new total $fx = 3976 + 322 = 4298$ and new mean = $4298 / 30 = 143.266...$ used
- (b) **A1** conclusion: mean increases to 143.27 (approx) so mean is sensitive to added larger values
- (b) **Answer: 143.27**

Question 12

- (a) **M1** midpoints used and fx calculated: 5.5×2 , 17.5×5 , 29.5×14 , 41.5×8 , 53.5×1
- (a) **M1** fx values: 11, 87.5, 413, 332, 53.5 and sum fx computed
- (a) **M1** sum $fx = 11 + 87.5 + 413 + 332 + 53.5 = 897$
- (a) **A1** mean $= 897 / 30 = 29.9$ (to 1 dp) cao
- (a) Answer: **29.9**
- (b) **M1** replace top group fx contribution with $54 \times 1 = 54$ and compute new total $fx = 897 - 53.5 + 54 = 897.5$
- (b) **M1** new mean $= 897.5 / 30 = 29.9166\dots$ and difference $= 29.9166\dots - 29.9 = 0.0166\dots$ approx 0.02
- (b) **A1** conclusion: small increase ~ 0.02 ; changing class midpoint changes fx and so the mean because mean depends on midpoint values used
- (b) Answer: **29.92**