4.3 Averages, quartiles and percentiles

Name: _____ Class: _____ Date: _____ **Total: 25 marks**

KEY WORDS percentiles • inter-quartile range

Averages, quartiles and percentiles

Objective

Calculate mean, median, mode and modal class (grouped via midpoints); quartiles, IQR and percentiles from data or the curve (rows S5 with the Extension additions).

1 Key knowledge and worked examples

Averages. Mean $= \sum fx / \sum f$ with MIDPOINTS for grouped data; median by ordering; mode most frequent; modal class by frequency density when widths differ. For 3, 7, 8, 10, 12: mean 8, median 8, range 9.

Quartiles and percentiles. Order, halve, halve again: Q_1 and Q_3 are the medians of the lower and upper halves; IQR $= Q_3 - Q_1$. The pth percentile reads at $\frac{p}{100}n$ of the ordered data or the CF curve – the 90th percentile of 60 values reads at the 54th value.

2 Practice

2.1 Find the mean, median and mode of 2, 4, 4, 6, 9 [3]

2.2 Classes 0–10, 10–20, 20–30 hold frequencies 5, 8, 7. Estimate the mean. [3]

2.3 Find Q_1, Q_3 and the IQR of 4, 6, 7, 9, 10, 12, 14, 15 [3]

2.4 For 200 values, at which ordered position does the 90th percentile read? [2]

3 Exam-style questions

3.1 *(Original.)* Ten bags of rice (kg): 12, 15, 15, 18, 20, 20, 20, 22, 25, 33. (a) Find the mean, median and mode. (b) The 33 is recorded in error as 73: state which averages change and which stays most representative. [5]

3.2 *(Original.)* Times are grouped 0–4, 4–8, 8–12, 12–20 minutes with frequencies 6, 10, 16, 8. (a) Estimate the mean. (b) State the modal class and compare its density with the last class's. [5]

3.3 *(Original, 2E 38% family.)* Of 50 people surveyed, 19 chose option A. (a) What percentage is this? (b) On a CF curve of 50 values, at which positions do the median, Q_1, Q_3 and the 38th percentile read? [4]

Solutions

2.1 Mean 5, median 4, mode 4.

2.2 Midpoints 5, 15, 25: $(25 + 120 + 175)/20 = 16$.

2.3 Median 9.5; lower half 4, 6, 7, 9 gives $Q_1 = 6.5$; upper half 10, 12, 14, 15 gives $Q_3 = 13$; IQR 6.5.

2.4 The 180th value.

3.1 (a) Mean $200/10 = 20$; median 20; mode 20. (b) With 73: the mean rises to 24 (sum 240), the median and mode stay 20 – the median is most representative because the outlier inflates the mean.

3.2 (a) Midpoints 2, 6, 10, 16: $(12 + 60 + 160 + 128)/40 = 9$ minutes. (b) Modal class 8–12 (frequency 16); its density is 4 versus the last class's 1 – even more clearly modal by density.

3.3 (a) $19/50 = 38\%$. (b) Median at 25; Q_1 at 12.5 (12th–13th values); Q_3 at 37.5 (37th–38th); the 38th percentile at the 19th value.

Local review guidance: midpoint products before dividing; exact values; percentile positions stated on the ordered list or curve. This is authored classroom guidance.