KS3.M-S10 Statistical Enquiry and Misleading Graphs

AQA KS3.M-S10 · Calculators not allowed · about 60 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 State whether each term refers to the whole group being studied, or to a smaller group chosen to represent the whole.

(a) The whole group of pupils at a school **(1)**

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2 Put these steps of a statistical enquiry in the most sensible order. Write the correct order as numbers 1 to 5.
Steps: A Collect data, B Decide how to sample, C State the question, D Analyse the data, E Present conclusions.

(single) Write the letters in the correct order, for example C then B then A then D then E. **(2)**

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3 A researcher stands outside a cinema on Friday evening and asks the first 40 people who leave whether they prefer action films or comedies. Identify one likely bias in this sampling method.

(a) Give one likely bias **(1)**

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4 A town has 12 000 residents. A researcher takes a sample that is 0.5% of the population. How many people are in the sample?

(a) Calculate the sample size **(1)**

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5 Decide whether each variable is categorical or quantitative.

(a) Favourite school subject **(1)**

(b) Number of books read in a month **(1)**

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6 Find the mean of these ages of pupils in a club: 12, 13, 14, 13, 12.

(a) Calculate the mean age **(2)**

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7 Find the median of this set of test scores: 7, 8, 9, 6, 10.

(a) Calculate the median score **(1)**

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8 Find the mode of this dataset of shoe sizes: 5, 6, 6, 7, 5, 6.

(a) Write the mode **(1)**

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9 Find the range of the following heights in cm: 150, 162, 158, 170, 155.

(a) Calculate the range **(1)**

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10 A bar chart shows the number of books read by pupils each month, but the y axis starts at 20 instead of 0 and the bars look very different heights. Identify two ways this presentation could mislead the reader.

(a) Give two separate ways the chart could mislead **(2)**

11 A pie chart claimed slices were 30%, 30%, 30% and 30% for four categories. Explain what is wrong with this claim and show a simple calculation to justify your answer.

(a) Explain and justify with a calculation **(2)**

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12 A scatter plot shows points clustered close to an upward sloping line. State whether this indicates a weak, moderate or strong correlation and whether it is positive or negative.

(a) Describe the correlation **(1)**

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13 Use the grouped frequency table to estimate the mean number of minutes pupils spend on homework each evening.
Classes (minutes): 0-19, 20-39, 40-59
Frequencies: 8, 12, 5

(a) Estimate the mean using class midpoints **(3)**

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14 A survey of ice cream flavours found 15 chose vanilla out of 75 pupils. What is the relative frequency of vanilla?

(a) Give the relative frequency as a fraction **(1)**

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15 In a sample of 50 pupils, 6 said they cycle to school. Work out the sample proportion as a fraction and as a percentage.

(a) Give the fraction and the percentage **(2)**

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16 A dataset of household incomes has one very large outlier. The mean is much higher than the median. Which average (mean or median) is a better measure of a typical household income here? Explain your answer in one sentence.

(a) Give the better average and a brief reason **(2)**

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17 Describe how you would select a stratified sample of 80 pupils from a school with 4 year groups that have sizes 120, 150, 130 and 100. Give the number of pupils you would sample from each year group and one brief reason why stratified sampling is useful here.

(a) Give numbers from each year group and a reason **(3)**

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18 Stretch question. A local paper reports that 'most pupils prefer studying at home' based on a survey of 12 pupils and a bar chart that starts the y axis at 50. Write two criticisms of this report and suggest two improvements to make the enquiry more reliable.

(a) Give two criticisms and two improvements **(3)**

Mark scheme · KS3.M-S10 Statistical Enquiry and Misleading Graphs

Question 1

- (a) **B1** Population (the whole group) stated
- (a) Answer: **Population**

Question 2

- (single) **M1** Recognises correct ordering of at least three steps or shows method of sequencing oe
- (single) **A1** Correct full order: C, B, A, D, E cao
- (single) Answer: **C, B, A, D, E**

Question 3

- (a) **B1** Identifies a correct bias such as time bias, only cinema-goers asked, or non-random sample (oe)
- (a) Answer: **People leaving a cinema are not representative of the whole population (sampling bias)**

Question 4

- (a) **B1** 60 cao
- (a) Answer: **60**

Question 5

- (a) **B1** Categorical stated
- (a) Answer: **Categorical**
- (b) **B1** Quantitative stated
- (b) Answer: **Quantitative**

Question 6

- (a) **M1** Correct method shown, e.g. sum of values = 64 or 12+13+14+13+12
- (a) **A1** 12.8 cao
- (a) Answer: **12.8**

Question 7

- (a) **B1** 8 cao
- (a) Answer: **8**

Question 8

- (a) **B1** 6 cao
- (a) Answer: **6**

Question 9

- (a) **B1** 20 cm cao
- (a) Answer: **20 cm**

Question 10

- (a) **B1** First correct issue e.g. y axis not starting at 0 exaggerates differences
- (a) **B1** Second correct issue e.g. inconsistent bar widths or missing labels leading to misinterpretation
- (a) Answer: **Starting the y axis at 20 exaggerates differences; missing or unclear labels (or inconsistent bar widths) make comparisons unreliable**

Question 11

- (a) **M1** Shows that the percentages add to a total not equal to 100% or states the arithmetic error
- (a) **A1** Correct explanation e.g. 30%+30%+30%+30% = 120% so slices cannot be those values cao
- (a) Answer: **30% + 30% + 30% + 30% = 120% so the slices total 120%, not 100%**

Question 12

- (a) **B1** Strong positive correlation stated
- (a) Answer: **Strong positive correlation**

Question 13

- (a) **M1** Uses midpoints correctly: 9.5, 29.5, 49.5 and multiplies by frequencies
- (a) **M1** Adds products correctly to get total minutes
- (a) **A1** Estimated mean 27.1 minutes cao
- (a) Answer: **27.1**

Question 14

- (a) **B1** 15/75 or 1/5 cao
- (a) Answer: **1/5**

Question 15

- (a) **M1** Writes correct fraction 6/50 and simplifies to 3/25 or shows method for percentage
- (a) **A1** 3/25 and 12% cao
- (a) Answer: **3/25, 12%**

Question 16

- (a) **M1** Identifies median as better or mean as less suitable because of outlier
- (a) **A1** Explains median is less affected by the outlier so it better represents a typical household income
- (a) Answer: **Median; it is less affected by a very large outlier so better represents a typical household**

Question 17

- (a) **B1** Shows correct method of proportioning sample by year group (e.g. uses group sizes)
- (a) **B1** Gives correct numbers that sum to 80 (e.g. 19, 24, 21, 16) or equivalent proportional allocation
- (a) **B1** Gives a sensible reason such as ensures each year is represented or reduces sampling bias
- (a) Answer: **Sample sizes about 19, 24, 21, 16 from the year groups respectively; stratified sampling ensures each year group is represented and reduces bias**

Question 18

- (a) **M1** Identifies a correct criticism such as sample too small or not representative
- (a) **M1** Identifies a second correct criticism such as misleading axis exaggerating effect
- (a) **A1** Suggests two reasonable improvements e.g. use a larger random sample and start y axis at 0 or show counts as percentages
- (a) Answer: **Criticisms: sample of 12 is too small and likely unrepresentative; bar chart starting at 50 exaggerates differences. Improvements: use a larger, random or stratified sample; redraw the chart with y axis starting at 0 and report actual percentages or counts**