7.14 Data Handling: Descriptive Statistics, Graphs and Levels of Measurement

AQA 7182 · about 55 minutes · Write-in edition

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions.

1 A psychologist records whether 30 participants completed a cognitive task correctly: 18 answered correctly and 12 answered incorrectly. State the level of measurement for this variable and explain briefly why it matters when choosing a descriptive statistic.

(Total for Question 1 is 2 marks)

2 A small study records test scores (out of 20) for five participants: 12, 15, 15, 18, 20. Calculate the range and explain two limitations of range as a measure of dispersion for this small data set.

(Total for Question 2 is 5 marks)

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3 A researcher tabulates category counts for participants' preferred therapy type: CBT 14, Systematic desensitisation 6, Drug therapy 10. Construct a simple frequency table and calculate the percentage of participants who preferred CBT to 1 decimal place.

(Total for Question 3 is 4 marks)

4 State which measure of central tendency is most appropriate for ordinal data from a Likert-scale questionnaire, and give one brief reason why.

(Total for Question 4 is 2 marks)

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5 Calculate the mean, median and mode for the following interval-level reaction time data (milliseconds) recorded from eight participants in a lab task: 210, 245, 198, 232, 245, 220, 205, 238. Show your working.

(Total for Question 5 is 4 marks)

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6 Explain one strength and one limitation of using the mean and standard deviation together to summarise interval-level psychological data from a laboratory task.

(Total for Question 6 is 4 marks)

7 A researcher wants to present the distribution of scores from a memory test (scores 0 to 10) for a sample of 12 participants. Which graph is most appropriate to show the frequency distribution of these interval-level whole-number scores, and state two labelling conventions that must be followed for that graph.

(Total for Question 7 is 3 marks)

8 Calculate the mode and median for these ordinal satisfaction ranks collected from seven participants: 4, 2, 3, 4, 5, 2, 4. Explain briefly why the mean would be less appropriate here.

(Total for Question 8 is 6 marks)

9 Explain two strengths and two limitations of using the median and interquartile range (IQR) to summarise skewed interval-level reaction time data from a small study. Your answer should make clear why these measures might be preferred to the mean and standard deviation for skewed data.

(Total for Question 9 is 8 marks)

10 Calculate the sample standard deviation for the five test scores in Question 2: 12, 15, 15, 18, 20. Show full working and give your answer to two decimal places. State whether you used the sample or population formula and why.

(Total for Question 10 is 4 marks)

Mark scheme · 7.14 Data Handling: Descriptive Statistics, Graphs and Levels of Measurement

Question 1

level of measurement: nominal (two categories: correct/incorrect) cao **B1**

explanation: nominal data cannot have a mean or standard deviation calculated; appropriate statistics are mode or percentages/proportions oe **B1**

Answer: Nominal. It matters because you cannot compute a mean or standard deviation for nominal data; use mode, counts or percentages instead.

Question 2

calculates the range: max 20 minus min 12 = 8 oe **M1**

range = 8 cao **A1**

identifies a limitation: range is affected by extreme values/outliers oe **M1**

explains consequence: a single unusually high or low score would change the range substantially, so it may not reflect typical variability in a small sample oe **A1**

alternative limitation: it uses only two scores and ignores distribution of the rest, so it can be misleading for small samples oe **A1**

Answer: Range = 8. Limitation: it is sensitive to outliers and uses only the highest and lowest scores, so in a small sample an unusual score can give a misleading impression of variability.

Question 3

constructs a frequency table with three categories and counts: CBT 14, Systematic desensitisation 6, Drug therapy 10, and total = 30 oe **M1**

calculates percentage: (14 / 30) x 100 oe **M1**

percentage = 46.666...% => 46.7% to 1 dp cao **A1**

presents the table or states the total n = 30 cao **B1**

Answer: Frequency table: CBT 14, Systematic desensitisation 6, Drug therapy 10, Total 30. Percentage preferring CBT = (14/30) x 100 = 46.7% (1 dp).

Question 4

median cao **B1**

reason: median does not assume equal intervals between ranks and is not distorted by extreme values, so it is appropriate for ordinal Likert data oe **B1**

Answer: Median. It is appropriate because it does not assume equal spacing between ranks and is robust to outliers, unlike the mean.

Question 5

correctly calculates the mean: sum all values = 210+245+198+232+245+220+205+238 = 1793 oe **M1**

mean = 1793 / 8 = 224.125 ms, allow 224.1 ms or 224.13 ms cao **A1**

orders data to find median: ordered list 198,205,210,220,232,238,245,245; median is average of 4th and 5th values oe **M1**

median = (220 + 232) / 2 = 226 ms cao; mode = 245 ms (most frequent) cao **A1**

Answer: Mean = 224.125 ms (224.1 ms). Median = 226 ms. Mode = 245 ms.

Question 6

identifies strength: the mean uses all data points and is sensitive to small differences in scores oe **M1**

explains consequence: combining mean with SD gives a precise picture of central tendency and spread, useful for comparing groups and calculating further statistics oe **A1**

identifies limitation: both mean and SD are affected by outliers and non-normal distributions oe **M1**

explains consequence: in skewed data or with extreme scores the mean and SD can misrepresent typical performance, so median and IQR might be preferable oe **A1**

Answer: Strength: mean and SD use all data and together give a precise summary of central tendency and spread, aiding group comparisons. Limitation: both are sensitive to outliers and skew, so they can misrepresent typical scores in non-normal distributions.

Question 7

graph: histogram or bar chart for frequency distribution of whole-number interval scores (histogram preferred for continuous data grouped in bins) oe **B1**

labelling convention 1: x-axis labelled with the variable name and units, e.g. 'Memory test score (0 to 10)' oe **B1**

labelling convention 2: y-axis labelled with 'Frequency' or 'Number of participants', and bars touching for a histogram or separated for a bar chart depending on data type oe **B1**

Answer: Histogram (preferred) or bar chart to show frequency distribution. Label the x-axis with the variable and units, e.g. 'Memory test score (0 to 10)', and label the y-axis 'Frequency' or 'Number of participants'; for a histogram the bars should touch.

Question 8

orders data: 2,2,3,4,4,4,5 oe	**M1**
median is middle value, 4 cao	**A1**
mode is most frequent value, 4 (appears three times) cao	**M1**
identifies that the data are ordinal ranks so mean assumes equal intervals which may not hold oe	**M1**
explains consequence: mean could misrepresent central tendency for ordinal data and be affected by extremes, so median/mode are preferred oe	**A1**
final statement: median = 4, mode = 4, mean less appropriate because interval equality is not guaranteed for ordinal data cao	**A1**

Answer: Ordered data 2,2,3,4,4,4,5. Median = 4. Mode = 4. The mean is less appropriate because these are ordinal ranks and the mean assumes equal intervals between values, which may not be true.

Question 9

identifies a strength: median and IQR are robust to outliers and skewed distributions oe	**M1**
explains consequence: for skewed reaction time data a few slow responses will not distort the median and IQR, so these measures give a better indication of a typical participant and typical spread than mean and SD oe	**A1**
identifies a second strength or expansion: median IQR are appropriate for small samples and ordinal-like distributions within interval data oe	**M1**
explains consequence: they allow meaningful comparisons between groups when assumptions of normality are not met, and they are simple to compute and interpret for practitioners oe	**A1**
identifies a limitation: median and IQR discard some information about individual scores, using only ranks and central 50% oe	**M1**
explains consequence: this can reduce statistical power and conceal details about tails of the distribution, which may be important for understanding variability in reaction times oe	**A1**
identifies a further limitation: some statistical tests and parametric models require means and SDs or assume normality oe	**M1**
explains consequence: using median and IQR may limit options for further parametric analyses unless data are transformed or non-parametric tests are used, so researchers must plan analysis accordingly oe	**A1**

Answer: Strength: median and IQR are robust to outliers and skew, so for skewed reaction time data a few very slow responses will not distort the central value or the measure of spread, giving a better picture of typical performance than mean and SD. They are also simple to compute and suitable for small samples. Limitation: median and IQR ignore some information about individual scores and the tails of the distribution, which can reduce power and hide important variability. Also many parametric analyses require means and SDs, so using median/IQR may restrict further analysis unless non-parametric methods are chosen.

Question 10

states use of sample standard deviation formula (n - 1 in denominator) for a sample rather than population oe	**M1**
computes mean = (12+15+15+18+20) / 5 = 80 / 5 = 16 oe	**M1**
calculates squared deviations: $(12-16)^2=16$, $(15-16)^2=1$, $(15-16)^2=1$, $(18-16)^2=4$, $(20-16)^2=16$; sum = 38 oe	**M1**
sample variance = 38 / (5-1) = 9.5; sample SD = $\sqrt{9.5}$ = 3.082207... => 3.08 (2 dp) cao	**A1**

Answer: Using the sample SD formula (n - 1). Mean = 16. Sum squared deviations = 38. Sample variance = 38/4 = 9.5. Sample standard deviation = $\sqrt{9.5}$ = 3.08 (to 2 dp).