PSY.RES9 Data Handling: Descriptive Statistics, Graphs and Levels of Measurement

Total Marks

AQA 7182 · Calculators not allowed · about 60 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Define the three levels of measurement used in psychological data: nominal, ordinal and interval. Give a single-sentence example for each level that is relevant to psychology research.

(Total for Question 1 is 3 marks)

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2 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 2 is 2 marks)

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3 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 3 is 4 marks)

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

(Total for Question 4 is 5 marks)

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5 Calculate the sample standard deviation for the five test scores in Question 4: 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 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)

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8 Sketch a labelled scattergram suitable for showing the relationship between hours of revision (x) and exam score out of 100 (y) for a correlational study of 20 students. In the sketch indicate where you would place axis labels, a title and an appropriate line-of-best-fit.

(Total for Question 8 is 4 marks)

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9 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 9 is 4 marks)

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10 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 10 is 2 marks)

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11 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 11 is 6 marks)

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12 A psychology class records the number of errors made on a memory test by six students: 0, 1, 0, 2, 7, 0. Calculate the mean and median, and explain briefly how an outlier affects the mean more than the median using these data.

(Total for Question 12 is 6 marks)

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13 Explain one strength and one limitation 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 13 is 8 marks)

Mark scheme · PSY.RES9 Data Handling: Descriptive Statistics, Graphs and Levels of Measurement

Question 1

- **B1** nominal: a level of measurement using categories with no order, e.g. participant gender categories or favourite therapy type oe
- **B1** ordinal: ordered categories where the rank matters but intervals are not equal, e.g. Likert scale responses from 1 = strongly disagree to 5 = strongly agree oe
- **B1** interval: numerical scale with equal intervals and no true zero, e.g. temperature in degrees C used in a lab task, or IQ scores treated as interval oe
- **Answer: Nominal: categories with no order, e.g. diagnosis type. Ordinal: ordered categories without equal intervals, e.g. 1 to 5 Likert anxiety rating. Interval: equal-interval numeric scale with no true zero, e.g. temperature in degrees C or IQ score.**

Question 2

- **B1** 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
- **Answer: Nominal. It matters because you cannot compute a mean or standard deviation for nominal data; use mode, counts or percentages instead.**

Question 3

- **M1** correctly calculates the mean: sum all values = 210+245+198+232+245+220+205+238 = 1793 oe
- **A1** mean = 1793 / 8 = 224.125 ms, allow 224.1 ms or 224.13 ms cao
- **M1** orders data to find median: ordered list 198,205,210,220,232,238,245,245; median is average of 4th and 5th values oe
- **A1** median = (220 + 232) / 2 = 226 ms cao; mode = 245 ms (most frequent) cao
- **Answer: Mean = 224.125 ms (224.1 ms). Median = 226 ms. Mode = 245 ms.**

Question 4

- **M1** calculates the range: max 20 minus min 12 = 8 oe
- **A1** range = 8 cao
- **M1** identifies a limitation: range is affected by extreme values/outliers oe
- **A1** 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
- **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 5

- **M1** 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
- **A1** sample variance = 38 / (5-1) = 9.5; sample SD = $\sqrt{9.5}$ = 3.082207... => 3.08 (2 dp) cao
- **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).**

Question 6

- **M1** identifies strength: the mean uses all data points and is sensitive to small differences in scores oe
- **A1** explains consequence: combining mean with SD gives a precise picture of central tendency and spread, useful for comparing groups and calculating further statistics oe
- **M1** identifies limitation: both mean and SD are affected by outliers and non-normal distributions oe
- **A1** 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
- **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

- **B1** 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
- **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

- **M1** sketch shows scatter of points with horizontal x-axis and vertical y-axis oe
- **B1** x-axis labelled 'Hours revision' and y-axis labelled 'Exam score (out of 100)' oe
- **B1** title present, e.g. 'Revision time and exam score' oe
- **B1** line-of-best-fit drawn approximately through the cloud of points, not necessarily connecting extremes, indicating the overall trend oe
- **Answer: Sketch shows a scatter of points, x-axis labelled 'Hours revision', y-axis labelled 'Exam score (out of 100)', title 'Revision time and exam score', and an approximate line-of-best-fit drawn through the points to indicate the trend.**

Question 9

- **M1** 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
- **A1** percentage = 46.666...% => 46.7% to 1 dp cao
- **B1** presents the table or states the total n = 30 cao
- **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 10

- **B1** 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
- **Answer: Median. It is appropriate because it does not assume equal spacing between ranks and is robust to outliers, unlike the mean.**

Question 11

- **M1** orders data: 2,2,3,4,4,4,5 oe
- **A1** median is middle value, 4 cao
- **M1** 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
- **A1** 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
- **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 12

- **M1** calculates mean: sum = 0+1+0+2+7+0 = 10; mean = 10 / 6 = 1.666666... oe
- **A1** mean = 1.67 (2 dp) cao
- **M1** orders data for median: 0,0,0,1,2,7; median is average of 3rd and 4th values = (0 + 1) / 2 oe
- **A1** median = 0.5 cao
- **M1** identifies outlier: 7 is much larger than other scores oe
- **A1** explains effect: the outlier raises the mean from a typical value near 0 to 1.67, while the median remains low at 0.5, showing the mean is more influenced by extreme values oe
- **Answer: Mean = 10/6 = 1.67 (2 dp). Median = 0.5. The value 7 is an outlier that increases the mean substantially while the median, based on the middle ranks, is much less affected, so the mean is more sensitive to extremes.**

Question 13

- **M1** identifies a strength: median and IQR are robust to outliers and skewed distributions oe
- **A1** 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
- **M1** identifies a second strength or expansion: median IQR are appropriate for small samples and ordinal-like distributions within interval data oe
- **A1** 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
- **M1** identifies a limitation: median and IQR discard some information about individual scores, using only ranks and central 50% oe
- **A1** 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
- **M1** identifies a further limitation: some statistical tests and parametric models require means and SDs or assume normality oe
- **A1** 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
- **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.**